Crime Gun Risk Factors: Buyer, Seller, Firearm, and Transaction Characteristics Associated with Gun Trafficking and Criminal Gun Use

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EXECUTIVE SUMMARY

Controlling gun crime continues to be a difficult challenge for policymakers and practitioners in the United States. With an estimated 258 million guns in private hands and millions more produced each year, there are many sources and means through which offenders can obtain firearms despite legal restrictions on gun purchasing and ownership by convicted felons, juveniles, and other high-risk groups. In order to better understand the workings of illicit gun markets—and particularly the rapid diversion of guns from the retail market into criminal channels—this study utilizes a decade's worth of data on handgun sales in the state of Maryland and subsequent recoveries of those guns by police in order to identify the characteristics of firearms, sellers, buyers, and sales transactions that predict whether a gun is used in crime subsequent to purchase. The study provides some of the most sophisticated evidence to date on crime use risks associated with high-risk buyers, problem gun dealers, preferred crime guns, purchases involving multiple guns, and other suspected trafficking indicators.

The study is based on three sets of analyses: 1) analysis of 235,011 handgun sales in Maryland from 1990 through October 1999 and 7,575 recoveries of those guns reported by police throughout the nation to the federal Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) from 1990 through March 2000; 2) analysis of 71,956 handgun sales in the Baltimore metropolitan area from 1994 through October 1999 and 1,850 recoveries of those guns reported by Baltimore police to ATF from 1994 through March 2000; and 3) analysis of 48,039 handgun sales in the Maryland counties of the Washington, D.C. metropolitan area from 1994 through October 1999 and 529 recoveries of those guns reported by D.C. police to ATF from 1994 through March 2000.

Key Findings

Adjusting for dates of sale, guns sold in Maryland during the 1990s had at least a 4.7% chance of being recovered by police somewhere throughout the nation within 10 years. Handguns sold in the Baltimore area had a 3.2% of being recovered in Baltimore within 5 years, and those sold in the Maryland portion of the D.C. area had a 1.4% chance of being recovered in D.C. within 5 years. Risk factors affecting gun recovery were assessed with multivariate survival analysis and were fairly consistent across the different areas and time periods. Conclusions were also similar whether examining all recoveries or just those guns recovered from someone other than the last registered buyer (which accounted for the majority of recoveries and provide a stronger indicator of trafficking).

Buyer risk factors: Buyers were at higher risk if they were African-American, young, female, living in or close to Baltimore or D.C., or had previously purchased guns that were recovered by police.

- Guns were generally 4 to 5 times more likely to be recovered by police when purchased by African-American buyers and up to 3 times more likely when purchased by buyers from Baltimore City or suburbs close to Baltimore or D.C.

The risk of a gun's recovery dropped by about 10% to 12% with each one-year increase in the buyer's age. Black buyers made nearly two-thirds of the purchases that resulted in a subsequent gun recovery, buyers in their twenties accounted for about half, and buyers from just three counties—Baltimore city, Baltimore County, and Prince George's County—accounted for about three-quarters.

- Female buyers purchased roughly 12% to 16% of guns later used in crime, and buyers linked to prior crime guns accounted for no more than 5%. However, the risk of recovery was up to 57% higher for handguns purchased by female buyers and up to 92% higher for buyers that had previously purchased a gun recovered by police. Although females engage in less gun crime than do males, the findings suggest they are more likely to act as "straw purchasers" who buy on behalf of illegal buyers.

Seller (gun dealer) risk factors: Most crime guns were sold by a relatively small share of dealers located in or close to urban areas.

- Fourteen percent of the dealers in the state sold 92% of the crime guns; 5%, or 31 dealers, sold at least 50 crime guns each and together accounted for about three-quarters of the crime guns.

- Dealers located within 20 miles of Baltimore sold 90% of the Maryland guns recovered in Baltimore; dealers located within 20 miles of D.C. sold 75% of the Maryland guns recovered in D.C. Guns were up to 2.7 times more likely to be recovered when sold by dealers located in or close to these cities.

- Other dealer characteristics—such as time in business, type of establishment, and having a pawnbroker's license—did not predict sales of crime guns as strongly or consistently, though they mattered in some contexts.

Firearm risk factors: Criminal gun users and traffickers seemed to prefer handguns that were semiautomatic, medium to large caliber, easily concealable, and/or cheap.

- Semiautomatic pistols, which generally have larger ammunition capacities than other handguns, were 34% to 56% more likely to be used in crime and accounted for at least three-quarters of the recovered guns. The risk of criminal use was also generally 41% to 91% higher for medium and large caliber handguns, which inflict more lethal wounds, and tended to be highest for medium caliber weapons. Medium to large caliber handguns accounted for 90% or more of the recovered guns; medium caliber guns alone accounted for two-thirds.

- Easily concealable handguns, defined as those having a barrel of 3 inches or less, were 16% to 22% more likely to be used in crime than larger handguns in most analyses and constituted roughly 40% of crime guns (the majority of crime guns had barrels of no more than 4 inches). Cheap handguns, defined as those retailing for $150 or less (and commonly referred to as "Saturday night specials"), were

typically 58% to 98% more likely to be used in crime than more expensive firearms and accounted for upwards of 20% of recovered guns.

Transaction risk factors: the simultaneous or rapid purchase of multiple guns by one individual—commonly known as a "multiple sale"—was a risk factor for gun trafficking.

- Guns sold in multiple sales were up to 64% more likely to be used in crime and accounted for roughly a quarter of recovered guns. Risks associated with multiple sales were greatest when examining the flow of guns from Maryland into D.C. and when examining recoveries from someone who was not the last registered buyer.

Implications for Practice, Policy and Future Research

- There may be substantial opportunity for enforcement action against illicit gun markets, which are often supplied heavily by localized diversions of guns from retail. This may be especially true in states (like Maryland) that have laws regulating private gun sales and prohibiting straw purchasing. Study of the implementation and enforcement of these laws is needed.

- Risk factors like those identified in this study could potentially be used to guide gun trafficking investigations and to develop prevention efforts (such as raising public awareness about the problems of straw purchasing and illegal gun sales) for high-risk actors and areas.

- Regulatory oversight and investigation of licensed gun dealers should emphasize large volume dealers in urban areas and, more generally, dealers with a relatively large percentage of their sales resulting in crime gun recoveries.

- The results provide some support for policies like "Saturday night special" bans and one-gun-a-month laws that regulate particular types of firearms and transactions. This study does not address whether such policies can reduce gun crime, but it shows that particular types of guns and transactions are at higher risk and account for a substantial share of crime guns. At a minimum, it seems that federal reporting requirements for multiple sales are prudent and that law enforcement should emphasize multiple sales and high-risk firearms in trafficking investigations.

- Priorities for future research should include: replicating these results in other locations that have comparable data systems; refining the identification of risk factors, particularly by incorporating elements unavailable for this study such as buyer criminal history, dealer regulatory history, and neighborhood factors; assessing the current state of practice in gun trafficking enforcement; and designing and evaluating risk-based enforcement and prevention interventions to reduce gun trafficking and gun crime.

1. **INTRODUCTION**

Despite the recent drop in gun violence, criminal misuse of firearms continues to be one of America's most serious crime problems. In 2003, there were roughly 11,000 murders with firearms (calculated from Federal Bureau of Investigation 2004:19) and another 367,000 non-fatal violent crimes with guns (Catalano, 2004:10). By some estimates, the total costs of gun violence in the United States – including medical, criminal justice, and other government and private costs – could be as high as $80 billion per year (Cook and Ludwig, 2000).

Further, the recent downturn in gun crime does not appear to have been driven in any large way by a reduction in the availability of guns to offenders. While the number of gun homicides plummeted by 41% from 1993 to 1999, for example, the percentage of homicides committed with guns declined by a modest 6%, from 69.6% to 65.2% (Federal Bureau of Investigation, 1994; 2000). Similarly, the percentage of robberies committed with guns declined by only 6% (from 42.4% to 39.9%) in police statistics and 14% (from 25.1% to 21.5%) in victimization surveys during this same period (Federal Bureau of Investigation, 1994; 2000; Maguire and Pastore, 1995:236; 2001:198). Hence, reducing the availability of guns to criminals remains an important policy concern.

Controlling gun crime is a difficult challenge. With an estimated 258 million guns in private hands in the United States (National Research Council, 2005), there are many sources from which offenders can obtain firearms despite legal restrictions on gun purchasing and ownership by convicted felons, juveniles, and other high-risk groups. However, studies of the types and origins of guns used in crime have revealed potentially promising intervention points for reducing the flow of guns into illicit markets. These intervention points include gun dealers who sell large numbers of guns used in crime, guns that are used in crime soon after purchase, gun makes and models that offenders frequently use, and buyers who purchase multiple guns in a short time span. Nevertheless, these analyses are typically based on the sales histories of guns recovered by police without reference to the types and origins of guns not used in crime. Such studies cannot be used to assess the relative risks of criminal use for different types of guns sold in different types of transactions involving different types of buyers and sellers.

This study utilizes a decade's worth of data on handgun sales in the state of Maryland and subsequent recoveries of those guns by police in order to identify the characteristics of firearms, sellers, buyers, and sales transactions that predict whether a gun is used in crime subsequent to purchase. In so doing, the study provides some of the most sophisticated evidence to date on crime use risks associated with problem gun dealers, preferred crime guns, purchases involving multiple guns, and other suspected trafficking indicators. Practitioners and policymakers might use such evidence to: 1) improve the effectiveness of law enforcement and regulatory efforts to identify dealers, buyers, and networks diverting guns into criminal channels; and 2) inform legislative debates on the efficacy of gun control strategies involving regulation of gun dealers, bans on particular types of firearms, one-gun-a-month laws, and regulation of secondhand gun markets.

2. BACKGROUND: GUN MARKETS AND GUN TRAFFICKING

2.1. Gun Markets and Criminal Gun Acquisition

Firearms are distributed in markets commonly referred to as primary and secondary markets (Cook et al., 1995). Primary markets include transactions by federally-licensed gun dealers who are often referred to as federal firearms licensees (FFLs). Licensed dealers are required to follow federal and state background check procedures to verify the eligibility of purchasers,[1] observe any legally required waiting period prior to making transfers, maintain records of gun acquisitions and dispositions, and report multiple sales (i.e., purchases of more than one handgun by the same buyer within five business days) and losses due to theft to federal authorities.

Secondary markets encompass secondhand gun transactions made by non-licensed individuals.[2] Approximately 30% to 40% of all guns sales occur in the secondhand market (Cook and Ludwig, 1996). Secondary market sellers are prohibited from knowingly transferring guns to ineligible purchasers (e.g., convicted felons and drug abusers). However, secondary transfers are not subject to federal record-keeping and background check requirements, thus making the secondary market largely unregulated and, consequently, a better source of guns for criminal users.[3] In the secondary market, ineligible buyers may obtain guns (through collusion or misrepresentation) from a variety of legitimate and illegitimate gun owners: relatives, friends and other associates; fences and other street dealers; drug dealers and addicts; and persons selling through classified ads or at gun shows (e.g., see Beck et al., 1993; Harlow, 2001; Sheley and Wright, 1993; Wright and Rossi, 1986). Of course, ineligible purchasers may also steal guns; approximately 600,000 guns are stolen each year from private owners, dealers, and common carriers (Cook and Ludwig, 1996:29-30; ATF, 2000a:27-28).

Although secondary market transactions and theft appear to be the predominate sources for the supply of firearms to criminals, the primary market is also important as a proximate or near-proximate source. To begin with, retail dealers serve as the direct source for roughly 11% to 14% of gun offenders (Harlow, 2001; Pierce et al. 2004), most of whom were probably legally eligible buyers when they obtained their firearms.

In addition, many firearms are diverted from the primary market into illicit channels (e.g., see Braga et al., 2002). This diversion occurs in a number of ways (besides theft). Two mechanisms of particular relevance to this study are "straw

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[1] In general, federal law prohibits gun sales to convicted felons, juveniles, fugitives from justice, drug abusers, persons who have been adjudicated as mentally defective or committed to a mental institution, illegal aliens, persons who have been dishonorably discharged from the military, persons who have renounced their citizenship, and persons under a court restraining order pertaining to an intimate partner or child.

[2] Persons who make only occasional sales of firearms from their personal collection are not required to obtain a federal firearms license (ATF, 2000a:11).

[3] Some states require that secondary market participants conduct transactions through licensed dealers or law enforcement authorities (Vernick and Hepburn, 2003). Even in these states, however, it is not clear how well these laws are enforced, a point to which we will return.

purchasing" and unlawful activity by licensed dealers. Straw purchasers are legally eligible gun buyers who purchase guns for illegal users and traffickers or to make illicit sales themselves. Straw purchasers include small-scale actors who make one-time or occasional purchases as well as rings of buyers who traffic large numbers of firearms through systematic, repetitive operations. The full extent of straw purchasing cannot be determined from available data,[4] but it appears to be a fairly common supply mechanism for criminals and juveniles. A survey of juveniles incarcerated in four states, for instance, revealed that a third had asked someone, most commonly a family member or friend, to buy a gun for them at a retail outlet at some point in the past (Sheley and Wright, 1993:6). Another rough indicator is the share of crime guns that are new but that have changed hands at least once. To illustrate, approximately one quarter of guns confiscated by police are less than three years old, and most of these are recovered from persons other than the original buyers (Cook and Braga, 2001:294-295); this implies that many of these guns were diverted from the primary market via straw purchasing and other means.

Straw purchasers move several thousand guns into criminal channels each year based on just those cases known to the federal Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF), the agency responsible for enforcement of federal gun laws. Nearly half of gun trafficking investigations conducted by ATF from July 1996 to December 1998 involved straw purchasers who had diverted an average of 37 guns per case and a total of nearly 26,000 guns (ATF, 2000b: 12-13). Case studies also suggest that larger, repetitive straw purchasing operations and corrupt licensed dealers (discussed below) divert a considerable number of guns to the street markets from which roughly 25% to 40% of offenders obtain firearms and to the interstate flow of guns into areas with strict gun laws and lower levels of gun ownership (ATF, 2000b; Kennedy et al., 1996:174; Wachtel, 1998).[5]

Licensed gun dealers may also facilitate the flow of guns into criminal channels. Some dealers engage in illegal sales (i.e., sales without proper background checks and paperwork), either by selling directly to prohibited users or by colluding with unlicensed street dealers (e.g., see ATF, 2000b; Wachtel, 1998). Licensed dealers involved in such activities have the ability to divert large numbers of firearms into illegal commerce. In federal gun trafficking investigations conducted from July 1996 through December 1998, cases involving corrupt dealers averaged over 350 guns per case and involved more than

[4] In a recent national survey of prison inmates, 14% of gun offenders reported that they obtained the gun used in their conviction offense from a retail outlet, 40% indicated that a family member or friend was the source, 39% cited a "street" or "illegal" source (including theft, drug dealers, and fences), and 7% reported using "other" sources (Harlow, 2001:6). Yet, as noted by others (e.g., Kennedy et al., 1996; Wachtel, 1998), such data tell us nothing about the role of small or large-scale straw purchasers as direct or indirect sources for these offenders. Many of the acquisitions from dealers and from family and friends may have involved straw purchases. And as noted below, some of the guns obtained through street sources may have been originally supplied through straw purchasing.

[5] The estimate that 25% to 40% of offenders obtain guns from street sources is based on surveys of adult and juvenile gun offenders showing the percentages that acquire firearms directly from fences, drug dealers, "street" sources, or the "black market" (Beck et al., 1993:19; Harlow, 2001:6; Sheley and Wright, 1993:6; Wright and Rossi, 1986:183).

40,000 guns in total (ATF, 2000b: 12-13,15). Although the full extent of gun trafficking by licensed dealers is unknown, a reasonable upper bound estimate is perhaps provided by a 1998 ATF study with a national sample of randomly selected dealers which found that 8% of regular dealers and 27% of pawnbrokers had one or more firearms missing from inventory (unpublished ATF data). Further, 1% of the regular dealers and 7% of the pawnbrokers could not account for more than 25 firearms. The latter two figures extrapolate to roughly 1,300 dealers nationwide.[6]

Dealers may also facilitate straw purchasing by suggesting this course of action to prohibited buyers or by turning a blind eye to obvious instances of straw purchasing. These more subtle forms of wrongdoing may be much more widespread among dealers than more blatant forms of trafficking; recent evidence suggests that half of dealers in large cities may be willing to sell handguns to buyers who are purchasing on behalf of someone else (Sorensen and Vittes, 2003).[7]

Whether through straw purchasing, illegal dealer activity, or other means, guns that move quickly into criminal channels (i.e., close to retail diversions) are often highlighted in gun market studies. Analysts and practitioners tend to focus particularly on guns that are recovered within three or four years of purchase (the time that elapses between a gun's purchase and recovery is commonly referred to as "time to crime"). When a gun moves quickly into criminal channels, it is more indicative of a gun that was purchased at retail with criminal intent (reportedly, this is consistent with the experience of ATF investigators).[8] In addition, this segment of the illicit gun market may be more vulnerable to enforcement action; when a gun is relatively new, law enforcement agencies have a better chance of reconstructing its ownership history and identifying persons associated with it.

Further, much of this diversion activity appears to be fairly localized. In most places, the majority of crime guns originate from within the state (e.g., see ATF 2000c). Moreover, national data suggest that nearly half of crime guns are recovered within 25

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[6] As of 2001, there were 63,845 regular gun dealers and 9,199 pawnbrokers licensed to sell guns in the United States (ATF, 2001/2002:E12).

[7] Federal law allows legally-eligible buyers to purchase guns for others when those guns are to be given as gifts. The statistics cited in the text do not correspond to instances of gift-giving.

[8] Estimates of the age of crime guns in relation to estimates of the age of the civilian gun stock also suggest that criminals are more than twice as likely to use newer guns as older ones (Pierce et al., 2003; also see Zimring 1976). This implies that quick diversion of guns from retail outlets is a particularly important component of the illicit gun supply. It also suggests that criminals and traffickers prefer newer firearms.

This study provides more definitive evidence on this issue by tracking representative samples of guns, both those used in crime and those not, from retail sale onward. As discussed below, this study also refines the measurement of time to crime by including records on dealer sales of used guns (time to crime is typically based on the first retail sale, which is not necessarily the most recent sale) and by controlling for extraneous factors likely to be associated with time to crime (e.g., a dealer's time in business or a gun model's production history).

miles of where they were originally purchased (ATF, 2002a: 43-44; Pierce et al., 2004).[9,10]

2.2. Potential Risk Factors for Criminal Gun Use and Trafficking

To improve our understanding of illicit gun markets and primary market diversion, this study examines how the risk of a gun being used in crime subsequent to purchase varies across different types of buyers, sellers, firearms, and sales transactions. The following sections discuss potential risk factors and gun trafficking indicators corresponding to these elements.

2.2.1. Gun Buyers

Buyer characteristics linked to criminal gun use and trafficking are likely to include factors such as criminal history, criminal associates, demographics, area of residence, and perhaps gun purchasing history. A study of California handgun buyers, for instance, revealed that buyers with a misdemeanor conviction that did not disqualify them from buying firearms legally were five times as likely as buyers with no criminal history to commit future offenses involving firearms or violence; those with two or more misdemeanor convictions were more than seven times as likely to commit such offenses (Wintemute et al., 1998a). Similarly, we can expect that buyers from demographic groups and areas at high risk for gun violence (e.g., urban, African-American males in their twenties) are at greater risk of committing subsequent gun offenses (though this has not been examined specifically).

In terms of gun diversion and trafficking, buyers from high-risk groups are probably more likely to have social ties to other high-risk and prohibited gun possessors and to provide guns to such persons through secondhand sales, straw purchases, and other arrangements. Between one-third and one-half of gun offenders obtain their firearms from friends and family members (e.g., see Harlow, 2001; Sheley and Wright, 1993; Wright and Rossi, 1986), and many offenders obtain their guns from local sources (see discussion above). In a multi-site survey of juveniles, for example, one-third of incarcerated juveniles and 18% of inner city students reported having asked someone, most commonly a family member or friend, to buy a gun for them at a store at some point in the past (Sheley and Wright, 1993:6). There is also evidence from national data that crime guns recovered from someone other than the first purchaser have a shorter time to crime if the purchaser was less than 25 years of age, had made a prior purchase(s) of a gun(s) recovered by police, lived in an area with higher levels of gun crime, was a family member or known associate of the final gun possessor, or lived near the possessor or one of the possessor's associates (Pierce et al., 2004).[11]

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[9] Crime guns from out-of-state and distant locations are more common in jurisdictions with more restrictive gun controls (such as New York and Massachusetts), suggesting that interstate trafficking is more prevalent in such jurisdictions.

[10] For extensive reviews of gun markets, see Braga et al. (2002), Cook et al. (1995), Kleck (1999), Koper and Reuter (1996), National Research Council (2005:72-101), and Pierce et al. (2003).

[11] On a related note, a California study suggests that the chance of a retailer's gun sales resulting in crime gun recoveries declines as the age of the retailer's customers increases (Wintemute et al., 2005).

2.2.2. Gun Sellers: Licensed Gun Dealers

A majority of guns recovered by police are initially sold at retail by a minority of gun dealers who tend to be larger volume dealers. In California, for example, about 12% of the dealers who sold handguns from 1996 to 2000 accounted for nearly 82% of all handgun sales in the state and nearly 86% of handgun sales resulting in a gun recovery associated with a violent or firearm-related offense (Wintemute et al., 2005). Likewise, all of the firearms recovered by police throughout the nation and reported to ATF for investigative gun tracing (defined below) during 1998 originated with just 14% of the nation's gun dealers (ATF, 2000a:23).[12] Indeed, a mere 120 dealers nationwide were linked to nearly 55,000 crime guns recovered from 1996 to 2000 and accounted for 15% of all recoveries reported to ATF during that time (Americans for Gun Safety Foundation, 2004). (Eleven of these dealers were located in Maryland, the setting for this study.)

In addition, evidence suggests that gun dealers who are also licensed pawnbrokers are more likely to sell crime guns and commit regulatory or criminal infractions (ATF, 2000a; Pierce et al., 2004; Wintemute et al., 2005). In 1998, for instance, 32% of pawnbrokers were linked to a gun recovered by police, in contrast to only 12% of other dealers (ATF, 2000a:23). In that same year, 45% of pawnbrokers inspected by ATF and 30% of other inspected dealers were found to have one or more violations (ATF, 2000a:30). Further, a California study suggests that pawnbrokers sell crime guns at a rate 26% to 30% higher than that of other dealers even after taking sales volume into account (Wintemute et al., 2005).

The concentration of crime gun sales among a relatively small percentage of dealers, particularly high-volume dealers and pawnbrokers, provides an obvious focus for regulatory and law enforcement efforts. Beyond these factors, however, little is known about the dealers who are most likely to sell crime guns. Other relevant dealer characteristics might include time in business, proximity to high-crime areas, regulatory history, and type of business premises, among others. Comparing the risk that a gun is used in crime subsequent to sale across different groups of dealers defined by such characteristics might refine the identification of problem dealers and help law enforcement and regulatory agencies make more efficient use of their resources.

2.2.3. Firearm Characteristics

Characteristics of handguns that affect their attractiveness to criminals and traffickers are likely to include type (i.e., semiautomatic versus non-semiautomatic), caliber, make, model, and size.[13] Much analysis and debate on this topic has focused in

[12] Note, however, that is figure almost certainly understates the percentage of dealers that sell guns used in crime because not all law enforcement agencies submit information on recovered firearms to ATF (see discussion below).

[13] This discussion focuses on handguns because the data used in this study are based primarily on handgun sales. Moreover, handguns constitute the vast majority of guns used in crime. For example, in a 1996-1997 study of guns confiscated by police and reported to ATF in 17 cities, the percentage that were

particular on inexpensive, low-quality, easily concealable handgun models commonly referred to as "Saturday night specials" (SNS). During the 1960s and 1970s, SNS guns were commonly defined as guns costing $50 or less with a barrel of three inches or less and a small caliber (generally .32 or smaller) (e.g., ATF, 1976; 1977; Brill, 1977). In more contemporary discussions, SNS-type handguns have typically been defined as costing $150 or less with a barrel of no more than three inches and a medium or small caliber (generally 9mm or smaller) (e.g., Wintemute et al., 1998b).[14]

The cheap prices of these guns and the ease with which they may be concealed are thought to make them particularly attractive to criminals and juvenile possessors and, hence, more profitable for traffickers. Since 1968, the federal government has banned the importation of small handguns, defined as semiautomatic pistols with an overall length less than six inches (which generally corresponds to a barrel length of less than three inches—for example, see Warner, 1999) or revolvers with a barrel less than three inches (U.S. Department of the Treasury, 1998: Exhibit 4**).** As of 2003, seven states also restricted sales of domestically manufactured SNS-type guns (Vernick and Hepburn, 2003: 370-371).

There is substantial evidence that SNS handguns play a prominent role in illicit gun markets and gun violence: they account for a number of the guns most frequently used in crime and having the shortest time to crime (e.g., see ATF, 1995a; 2000c; Wintemute, 1994); they are perhaps three to four times more common among crime guns than among the nation's civilian handgun stock (Wintemute, 1994: 63); and acquisition of SNS-type guns is associated with past and future criminality (Wintemute et al., 1998b; also see Wright et al., 2005). Yet this evidence may be confounded by local patterns of gun buying and gun use. Because SNS guns are inexpensive, they may be more prevalent among the civilian gun stock in poorer areas, such as cities, where gun crime is concentrated. Further, the relatively short time to crime exhibited by some of these guns may reflect the fact that they have been in production for shorter periods of time than guns made by other manufacturers. This study provides more rigorous evidence on the SNS issue by controlling for the location of gun buyers and sellers and by tracking representative samples of SNS and non-SNS handguns from sale onward. As described below, the study also attempts to differentiate between the effects of price and size on criminal gun use.

Besides price and size, handgun type and caliber are additional characteristics that affect the lethality of firearms and possibly their desirability for criminal purposes. With respect to handgun types, semiautomatic pistols generally have larger ammunition capacities than do revolvers, the primary type of non-semiautomatic handgun, and many models permit a somewhat more rapid rate of fire.[15] Whereas revolvers typically hold 5

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handguns had a median value of 76% (ATF, 1997). Further, some studies suggest that handguns are used in 90% or more of gun homicides in urban areas (Hargarten et al., 1996; McGonigal et al., 1993).

[14] Contemporary SNS handguns include models that were made or continue to be made by companies such as David Industries, Lorcin Engineering, Phoenix Arms, Bryco Arms, and Hi-Point (e.g., see Wintemute, 1994).

[15] Revolvers contain ammunition in a rotating cylinder. Each trigger pull rotates the cylinder (to bring the next bullet into alignment with the barrel), cocks the hammer, and fires the weapon. Contemporary

to 6 rounds, semiautomatic pistols commonly hold 5 to 17 rounds (e.g., see Fjestad, 1996; Warner, 1995). Studies suggest that gun attacks involving semiautomatics tend to result in more shots fired, more persons hit, and more wounds inflicted per victim than do attacks with other firearms (Koper, 2004: 83-89; McGonigal et al., 1993; Reedy and Koper, 2003**;** Richmond et al., 2003; Roth and Koper, 1997: Chapter 6).

A handgun's caliber refers to the size of the bullet fired by the gun, measured in inches or millimeters. The ability of firearms with larger calibers to inflict more lethal wounds is well established in medical, forensics, and criminological research (e.g., see DiMaio, 1985; Kleck, 1984; Zimring, 1972).

Semiautomatics and larger caliber handguns (i.e., those larger than .32 caliber) now account for the majority of handguns used in crime (e.g., see ATF, 2000c; Caruso et al., 1999; Koper, 1995; 1997). However, recent increases in criminal use of these weapons have largely followed manufacturing and sales trends in the general civilian handgun market (Diaz, 1999; Dowd et al., 1998; Wintemute, 1996; Zawitz, 1995). Although survey evidence suggests criminal users have some preference for semiautomatics and large caliber handguns (Sheley and Wright, 1993: 4-5; Wright and Rossi, 1986: 162-169), it is not clear from available data that criminal users are actually more likely than other gun buyers to obtain and use semiautomatics or large caliber handguns (e.g., see Wintemute et al., 1998b; but also see Wright et al., 2005). Hence, while trends in the use of these weapons are an important policy concern,[16] it is not clear that gun type and caliber are risk factors for criminal gun use and trafficking. An exception is that buyers of military-style, semiautomatic "assault" pistols—which often have magazines holding more than 20 rounds, design features to facilitate spray fire (such as having a barrel shroud), threaded barrels for attaching silencers, and/or other features useful in military or criminal applications (Koper, 2004)—are more likely to have prior criminal histories and engage in subsequent criminal acts (Wintemute et al., 1998c). However, military-style assault weapons are generally used in no more than 1% to 6% of gun crimes (Koper, 2004).

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revolvers typically require 12 to 15 pounds of pressure on the trigger to fire when they are not manually cocked (DiMaio, 1985: 5). Semiautomatic pistols, in contrast, hold ammunition in a magazine that is inserted into the grip of the gun. Many semiautomatics permit a somewhat more rapid rate of fire than do revolvers because the former have a firing mechanism that automatically loads a new round and cocks the gun for firing after each shot, thus requiring less pressure on the trigger for subsequent shots. (More specifically, "single-action" and "double-action" semiautomatics require manual cocking or a heavier trigger pull, respectively, for the first shot, but require no manual cocking and less trigger pressure for subsequent shots. More recently, gun manufacturers have also developed double-action-only semiautomatics that do not cock themselves automatically after each shot. These guns operate more like revolvers, requiring more pressure on the trigger for each shot [Wintemute, 1996: 1751]).

[16] There have been some legislative attempts to limit crimes with semiautomatic firearms or subsets thereof. Federal legislation passed in 1994 provides penalty enhancements for certain crimes committed with semiautomatic firearms as opposed to other types of firearms, but the effects of this legislation have not been studied. This same legislation also included a ten year ban on semiautomatic assault weapons (i.e., semiautomatics with multiple military-style features) and ammunition magazines holding more than ten rounds. (A few states and cities have similar legislation.) While this legislation was in effect, criminal use of assault weapons (which was rare even before the ban) declined, but there was no reduction in criminal use of semiautomatics equipped with large capacity magazines, primarily because the ban exempted sales and importation of millions of such magazines manufactured before the ban (Koper, 2004).

2.2.4. Transaction Characteristics

With respect to transaction characteristics, this study focuses on the distinction between single and multiple sales. The term "multiple sale" refers to the simultaneous or rapid purchase of multiple guns by one individual. Multiple sales provide an obvious means by which illegal gun traffickers, working alone or with other buyers, can accumulate many firearms in a short period for sale in illegal markets. Accordingly, federal regulations require licensed gun dealers to notify ATF whenever they sell multiple handguns to any one individual within five consecutive business days (ATF, 1995b:59), thereby enabling authorities to monitor these sales for illegal trafficking. In addition, a few states, including South Carolina, Virginia, Maryland, and California, have responded to this problem by enacting one-gun-a-month (OGM) laws that restrict handgun buyers (and sometimes buyers of other designated weapons) to one purchase every thirty days (ATF, 1998; 2003; Vernick and Hepburn, 2003); however, South Carolina recently repealed its OGM law, which was enacted in 1975 (Eichel, 2006).

Although authorities consider multiple sales to a sign of possible gun trafficking (e.g., see ATF, 2000c), there has been very little direct investigation of the link between multiple sales in supplying criminal offenders. Two key questions with implications for the use of multiple sales as a trafficking indicator and for the efficacy of OGM laws are whether guns purchased in multiple sales are more likely than other guns to be used in crime and whether they provide a substantial share of crime guns. Multiple sales are probably fairly common, considering that three-quarters of gun owners possess more than one gun (Cook and Ludwig, 1996: 15).[17] Yet many who purchase guns in multiple sales are likely to be low-risk buyers (e.g., gun collectors), so the risk that guns sold in multiple sales are used in crime is likely to vary across different groups of buyers.

An ATF study that linked multiple sales directly to crime guns found that multiple sales accounted for 22% of a sub-sample of handguns recovered by police in 32 cities (ATF 2000c: 40). Moreover, handguns linked to multiple sales were over twice as common (51%) among handguns with an obliterated serial number, an obvious flag for potential trafficking. Nonetheless, the study was based on only the 5% of recovered handguns (and 4% of all recovered guns) successfully traced to a retail sale that occurred within the prior year,[18] and the link between multiple sales and obliterated serial numbers was not as strong in a later sample (ATF 2002a: 52).[19] And because the study examined only guns used in crime, it provides no basis for comparing the risks that handguns sold

[17] On a related note, Californians who purchased more than one handgun during 1999 (prior to the state's OGM law) accounted for about half of all handgun sales in the state that year (Violence Prevention Research Program, 2002:62).

[18] The full study was based on 49,832 handguns (and 64,637 total guns) reported to ATF by the 32 cities during 1999 (p. 11). The multiple sales analysis was based on 2,378 successfully traced handguns that were sold at retail for the first time in 1999 and recovered that same year (p. 40).

[19] In the later study (based on data from 2000), multiple sales accounted for 20% of all recovered handguns and 27% of recovered handguns with an obliterated serial number. This multiple sale analysis was also based on a small subset of guns both sold and recovered within a one-year period.

in single and multiple sales are used in crime. Information on multiple sales and crime from other sources is fragmentary but suggestive of a link.[20]

2.2.5. Assessing Buyer, Seller, Firearm, and Transaction Characteristics as Risk Factors

As the preceding discussion suggests, prior research has highlighted certain groups of actors, firearms, and sales that are potentially problematic, though evidence on these matters is rather limited. Further, with the exception of a few California studies that have examined the risk of arrest for different types of gun buyers and the risk of recovery for guns sold by different types of dealers (e.g., Wintemute et al., 1998a; 1998b; 2005), this research has usually been based on investigation of the types and origins of guns used in crime without reference to the types and origins of guns not used in crime. For example, numerous studies have examined the percentages of crime guns recovered by police that are of different types as well as the average time between sale and recovery (alternatively, the time to crime) associated with different types of guns. The most sophisticated of these studies, which employed a framework similar to that utilized in this study, examined time to recovery as a function of various buyer, dealer, possessor, and firearm characteristics using multivariate modeling (Pierce et al., 2003; 2004).[21] However, these studies have not been able to assess the risk of criminal gun use across different categories of actors, firearms, and transactions.

Having the ability to make risk assessments for different categories of actors, firearms, and transactions can potentially refine thinking about policy and practice in a number of ways. Such studies have rarely been possible, however, because few jurisdictions maintain—and, consequently, few analysts have access to—the gun sales and registration records that are necessary to make such comparisons.[22] This study assesses risk factors for criminal gun use and trafficking through longitudinal study of the sale and subsequent criminal use of guns sold in Maryland, a state that does maintain such records.

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[20] For example, ATF inspections of Chicago-area gun retailers during the 1970s showed that half of multiple sales involved some form of federal violation in contrast to only 1% of randomly selected transactions (Zimring, 1975:192). A study of guns recovered from persons under the age of 25 in California during 1998 and 1999 revealed that about half of the guns linked to purchasers associated with more than one recovered gun were purchased in multiple sales (Wintemute et al., 2004). Firearms linked to these purchasers accounted for only 6% of crime guns with identified purchasers, but they moved into criminal channels more quickly; the median time from retail sale to recovery was just over two years for these guns but was almost six-and-a-half years for the full sample. In addition, a recent national study found that guns sold by dealers making higher numbers of multiple sales are recovered by police more quickly than guns sold by dealers making fewer multiple sales (Pierce et al., 2003; 2004). The study did not reveal whether guns sold in multiple sales were more likely to be used in crime or whether they moved into criminal channels more quickly, but some findings suggested that multiple sales were correlated weakly to moderately with other gun trafficking indicators. Finally, there are indications that OGM laws reduce the flow (and, presumably, trafficking) of guns from states with lenient gun controls to those with more restrictive gun laws (Weil and Knox, 1996).

[21] See page 67 for further discussion of this study.

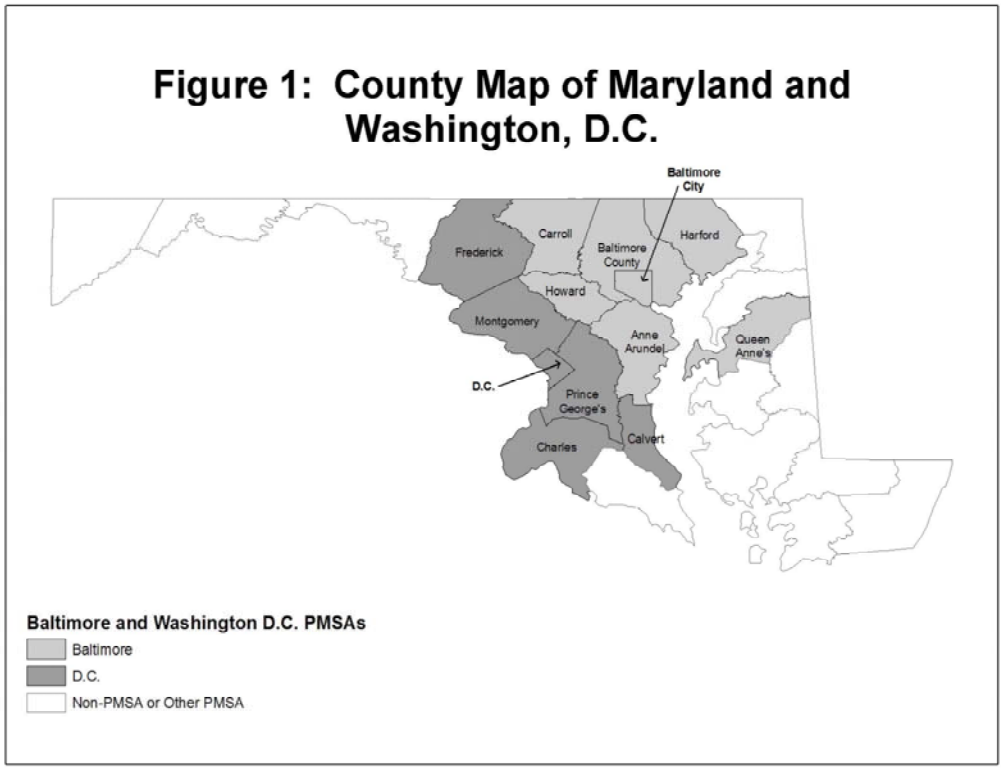
[22] As of 1999, eight states and the District of Columbia maintained centralized gun registration systems (Vernick and Hepburn, 2003: Table 9A-3).

3. STUDY SETTING AND DATA SOURCES

3.1. Study Setting

The state of Maryland had a population of approximately 4.8 million in 1990, which grew to nearly 5.3 million by 2000. Maryland is one of the most densely populated states in the nation, with 87% of its population residing in the metropolitan area of Baltimore, the state's largest city (which has over 650,000 residents), and the suburbs of Washington, D.C., a city of more than 570,000 persons that borders the state (see Figure 1).

Figure 1: County Map of Maryland and Washington, D.C.



Despite relatively stringent gun controls (see discussion below), Maryland had comparatively high rates of violence throughout the 1990s. Maryland's crime rate is driven largely by crime in Baltimore, which had the third highest murder rate among the nation's largest cities in 1998 (Maguire and Pastore, 2000: 288) and, unlike many other big cities, experienced little decline in its homicide rate during the 1990s. Guns are plentiful in Baltimore, where police seize in the neighborhood of 4,000 a year (ATF, 1999a; 2000d; 2002b**)**. Other large, high-crime jurisdictions in the state include Baltimore County, a suburban county surrounding Baltimore city, and Prince George's County, a suburban county bordering Washington, D.C. (see Figure 1). From 1995 to

1999, three-quarters of the violent crimes in Maryland occurred in Baltimore city, Baltimore County, or Prince George's County.

Maryland's proximity to Washington, D.C. (hereafter, D.C.) also has implications for gun markets in the state. Despite having a handgun ban in place since the mid-1970s, D.C. has high levels of gun violence. During the 1990s, police in D.C. recovered 2,000 to 3,000 guns annually (ATF, 1999a; 2000e; Wilber, 2004), and the city's murder rate ranked first or near the top among the nation's largest cities (e.g., see Maguire and Pastore, 1995: 320; 2000: 288; 2001: 301). D.C.'s stringent gun controls, high levels of violence, and proximity make it a likely destination for gun trafficking out of Maryland, from which it gets 20% to 30% of its crime guns (ATF, 1997; 1999a; 2000e; 2002c).

Maryland has licensed handgun dealers and required background checks and a seven-day waiting period for handgun buyers since the 1960s (Vernick and Hepburn, 2003), all of which gave rise to the gun sales database described below. The state also instituted background checks for sales of military-style assault weapons (as defined by state law) in 1989, followed by a later state ban on assault pistols. Since 1990, moreover, the state has prohibited sales of many, though not all, SNS-type handguns. In October 1996, Maryland passed gun legislation that, among other things, limited handgun buyers to one purchase per month, established background check requirements for secondhand sales of handguns, and banned straw purchasing.

3.2. Maryland Gun Sales Data

The Maryland State Police (MSP) maintain a registry of all handgun sales (and assault weapon sales) made by gun dealers in the state. This study is based on 235,011 gun sales made in Maryland from 1990 through October 1999.[23] For each sale, the following data were extracted: characteristics of the firearm (e.g., type, manufacturer, model, serial number); the buyer's identification, demographics, and residence; the identification, location, and other selected characteristics of the dealer; and the date of the sale. From these data, it was possible to measure numerous buyer, seller, gun, and transaction characteristics that are described below.

An important feature of this database is that it is based on the most recent sale of each firearm.[24] Analysis of each firearm's most recent sale has a number of advantages relative to an analysis that is based on a gun's first retail sale, as is typically the case in studies based on ATF gun tracing data (described below): it identifies the most recent

[23] The MSP database contains records of 264,358 completed sales for this period. Eleven percent of these records were omitted from the study due primarily to insufficient information about the firearms (particularly gun make and serial number, which, as described below, were necessary for determining which guns were later recovered by police). Private secondhand sales conducted through licensed gun dealers and the MSP were recorded in the data from October 1996 through October 1999 (more is said about this below).

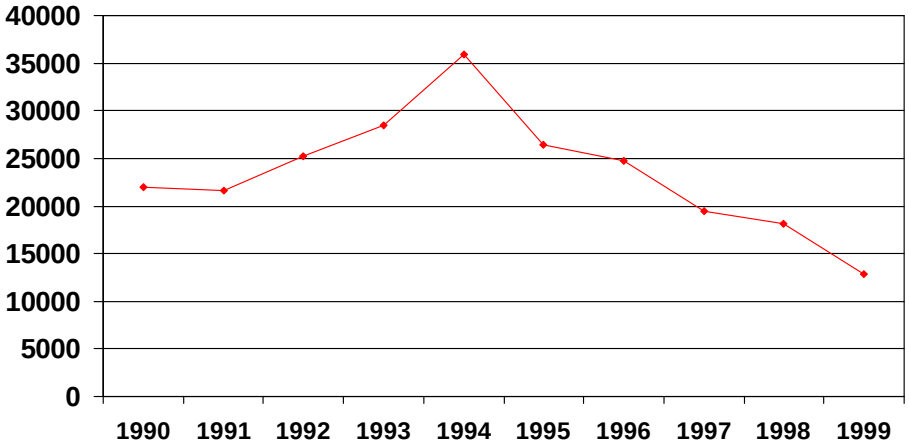
[24] Because the database generally contains only the most recent sale of each firearm, it undercounts the true number of sales to some degree and precludes an examination of each firearm's complete transaction history. However, it also has advantages noted in the text.

buyer and seller associated with each firearm, thus reducing false positives in the identification of buyers and dealers associated with crime guns; it provides a more accurate measurement of time to crime; and, by including a dealer's sales of used guns, it arguably provides a more refined measure of dealer sales volume against which to assess a dealer's sales of crime guns.

3.2.1. Trends and Geographic Patterns in Handgun Sales

As shown in Figure 2, handgun sales in Maryland rose during the early 1990s, increasing from about 22,000 in 1990 to a peak of approximately 36,000 in 1994. Sales then declined during the latter part of the decade, falling to about 18,000 by 1998, the last year for which complete sales data were available.[25]

Figure 2. Handgun Sales in Maryland, 1990-1999



Data for 1999 are based on sales through October.

Eighty-seven percent of handguns were purchased by buyers in the metropolitan areas of Baltimore and D.C. (see Figure 1);[26] nearly two-thirds were purchased by

[25] The increase in sales during the early 1990s was likely due to the increasing crime rates of the early 1990s and to the anticipatory effects of national and local gun legislation that was debated and passed during that time (for example, the federal Brady Act and the federal and state bans on assault weapons). The falling sales of the late 1990s, in contrast, may have been caused by a combination of falling crime rates, saturation of the market following the rising sales of the early 1990s, and Maryland's 1996 Gun Violence Act, which restricted handgun buyers to one purchase per month.

[26] Likewise, approximately 87% of sales were made by dealers in the Baltimore or D.C. PMSAs.

residents of Baltimore city or one of the suburban counties sharing a border with Baltimore city (i.e., Baltimore County and Anne Arundel County) or D.C. (i.e., Prince George's and Montgomery counties) (see Chapter 4). Buyers and sellers were typically located near to one another: 87% of sales involved buyers and sellers from the same PMSA, and 59% involved buyers and sellers from the same county.

3.3. Crime Gun Data

To determine if and when handguns sold in Maryland were subsequently recovered by police, the Maryland sales records were linked to a national database on approximately one million guns recovered by law enforcement agencies and reported to ATF for investigative tracing from 1990 through March 2000. A gun trace is an investigation that tracks the sales history of a gun from its manufacture through its first point of retail sale by a licensed dealer. Upon request, ATF traces guns seized by law enforcement as a service to federal, state, and local authorities. To initiate a trace, law enforcement agencies must provide ATF with detailed information about the firearm, such as make, model, serial number, and caliber.[27]

Although ATF tracing data provide the only available national sample of guns used in crime and otherwise possessed or carried by criminal and high-risk groups, they have limitations for research purposes (e.g., see Cook and Braga, 2001; Kleck, 1999; National Research Council, 2005: 37-40). Guns reported to ATF for tracing represent a subset of guns used in crime, and they may not be representative of all crime guns. To begin with, law enforcement agencies do not seize all guns used in crime, though the guns that they do recover are generally considered to be a reasonably representative sample of crime guns (Brill, 1977; Cook and Braga, 2001). More importantly, gun tracing is voluntary; some law enforcement agencies trace all recovered guns as a matter of policy, while others trace guns only when needed for specific investigations, if at all. These patterns have not been studied systematically but undoubtedly vary widely based on a range of organizational and contextual factors, thus introducing additional bias of an unknown degree into the sample of traced guns.[28]

As of the mid-1990s, it appeared that law enforcement agencies throughout the United States requested traces for about a quarter of gun homicides but only 1% of gun robberies and gun assaults known to police (calculated from ATF, 1995a and Federal Bureau of Investigation, 1995: 13,18,26,29,31,32). However, gun tracing became increasingly common during the 1990s due to a renewed federal emphasis on gun trafficking investigations and dealer regulation, improvements in the tracing process, and

[27] Note that the Maryland data, rather than the ATF trace results, were used to determine if and when the crime guns were sold in Maryland. ATF trace results identify the first retail dealer that sold the gun, who may differ from the Maryland dealer who most recently sold the gun. Also, ATF tracing results are sometimes incomplete due to factors like the failure of dealers to submit their sales records to ATF when they go out of business (e.g., see ATF, 1999a).

[28] Factors influencing tracing practices might include, for instance, the types of firearms confiscated (e.g., see Kleck, 1997:112,141), the availability of state or local gun registration data, knowledge of ATF's tracing capabilities and procedures, the types of investigations being conducted, participation in federal/state/local law enforcement task forces, and the stringency of state and local gun laws.

ATF promotional efforts and special initiatives that greatly increased tracing among state and local police agencies (ATF, 2000a: 19-21; Cook and Braga, 2001). ATF received approximately 200,000 trace requests in 1999 (ATF 2000a: 25), up from 83,359 in 1994 and only 37,181 in 1990 (ATF, 1995a). As part of ATF's Youth Crime Gun Interdiction Initiative (YCGII), 17 major cities have been requesting traces on all confiscated firearms since at least 1996 (ATF, 1997). By 2000 (the end of this study period), the effort had been expanded to 50 cities and metropolitan areas, most of which had successfully implemented comprehensive tracing (see www.atf.gov/firearms/ycgii/2000/index.htm). Further, six states (including Maryland) were instituting or had successfully achieved comprehensive statewide tracing by the end of the 1990s (ATF, 2000c: 51).

3.3.1. Crime Guns Recovered in Baltimore and Washington, D.C.

Although the developments described above have arguably made tracing data more representative of crime guns in general and enhanced their utility for policy research (e.g., see Cook and Braga, 2001; Pierce et al., 2003; 2004), the variation in gun tracing across places and over time may bias analyses based on national tracing data. Therefore, separate analyses were conducted based on recoveries in Baltimore and D.C., the primary local jurisdictions of interest in this study. Police in these cities traced guns comprehensively from 1994 to 2000 (both department's participated in ATF's YCGII from its inception), thus providing unbiased data on guns recovered by police in these cities over several years.[29] The Baltimore and D.C. analyses are based on guns both sold and recovered after 1993.

The Baltimore and D.C. analyses provide indications as to whether trafficking indicators developed from national tracing data can be validated using more representative samples of crime guns (for a similar approach, see Pierce et al., 2003; 2004). Further, they provide insights into the workings of local gun markets. As noted earlier, local markets provide a large if not predominant share of the criminal supply in most places. Nationally, about half of traced guns are recovered within 25 miles of where they were purchased (ATF, 2002a: 43-44); similarly, recent data suggest that 63% of guns recovered in Baltimore and 44% of those recovered in D.C. are purchased within 25 miles of their purchase locations (ATF, 2002b: 17; 2002c: 17).[30]

Contrasts of the Baltimore and D.C. results also yield insights into differences between interstate and intrastate gun markets. Due to the restrictions on the legal supply of handguns in D.C., it seems likely that trafficking guns from Maryland into D.C. is more profitable than trafficking guns within Maryland. Consequently, trafficking indicators predicting recoveries in Baltimore may differ from those predicting recoveries in D.C.

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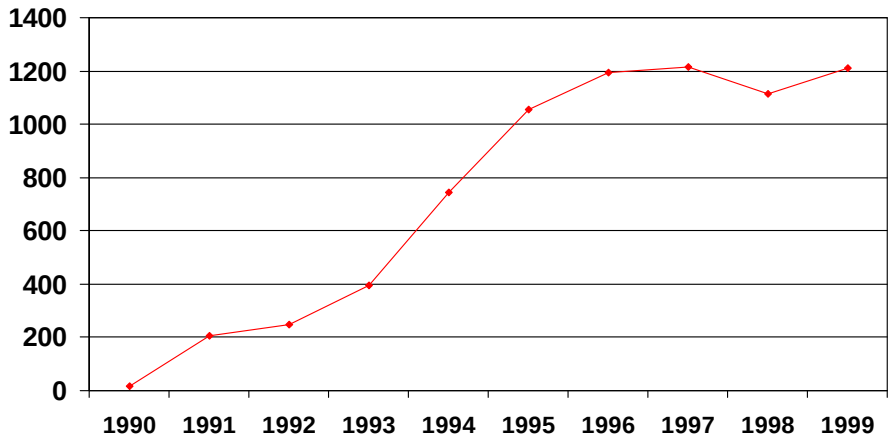
[29] The YCGII did not begin until August of 1996. For this project, however, January of 1994 was designated as the starting point of comprehensive tracing in Baltimore and D.C. This designation was based on patterns in the tracing data and discussions with ATF officials.

[30] Crime guns from out-of-state and distant locations are more common in jurisdictions with more restrictive gun controls (such as New York, Massachusetts, and Washington, D.C.), which is likely due in part to higher levels of interstate gun trafficking in such jurisdictions.

3.3.2. Trends and Patterns in Crime Gun Recoveries

3.3.2.1. Trends. Of the 235,011 handguns sold in Maryland from 1990 through October 1999, 7,575 (3.2%) were recovered by police in criminal investigations and reported to ATF as of March 2000.[31] Recoveries and traces of these guns rose from 16 in 1990 to about 1,200 by 1996 and then remained fairly steady through 1999 (Figure 3). The increase in reported recoveries reflects growth over time in both the sample of guns under study (with each passing year, more guns were in circulation and thus at-risk for criminal use) and the utilization of gun tracing, particularly by police in Baltimore and D.C.

Figure 3. Police Recoveries of Guns Sold in MD, 1990-1999



Based on recoveries by police throughout the nation and reported to ATF, 1990-March 2000.

3.3.2.2. Geographic Patterns. About half (48.5%) of the reported gun recoveries occurred in Baltimore, and 14.4% occurred in D.C. Geographic information for recoveries outside Baltimore and D.C. was limited, but approximately 20% of the recoveries appear to have occurred outside Maryland and D.C.

[31] MSP sales records were linked to the ATF database based on gun make, serial number, and caliber. Matches were not counted as police recoveries if the tracing date was before the date of sale (which suggests that an earlier recovered firearm was released by law enforcement and resold). Also, 294 records were dropped from the analysis due to ambiguous partial matches (for example, cases in which the manufacturer and serial number matched but the caliber did not).

Analysis of recoveries in Baltimore and D.C. revealed strong local patterns of gun diffusion. Approximately 95% of the guns sold in Maryland and recovered in Baltimore originated in the Baltimore PMSA (based on buyer and/or dealer location), and 90% were purchased within 20 miles of Baltimore (based on dealer location). For guns purchased in Maryland and recovered in D.C., 86% to 90% originated in the D.C. PMSA (based on buyer and/or dealer location), and 75% were purchased within 20 miles of D.C. (based on dealer location).[32] Based on these highly localized patterns, the analyses of the Baltimore and D.C. gun markets focus on sales made in each city's PMSA.

3.3.2.3. Crime Types. Two-thirds (66%) of the recovered firearms were associated with weapons offenses (i.e., illegal gun possession and/or carrying). Approximately 16% were recovered during investigations of violent crime (including murder, robbery, aggravated assaults, kidnapping, and sex crimes), and another 13% were seized during drug cases. (The analyses presented throughout this report are based on recoveries for all offense types.)

3.3.2.4. Possessors. Information on the persons from whom the guns were seized was available for 63% of the recoveries. Of these guns, an estimated 19% to 28% were recovered from the most recently registered Maryland purchaser.[33,34] In the local analyses, possessors were identified for 75% of the Baltimore recoveries and 62% of the D.C. recoveries; the purchaser-possessor match rate for cases that had an identified possessor was roughly 19% to 26% in Baltimore and 23% to 25% in D.C.

These match rates are higher than the 11% rate that has been reported in national tracing studies (ATF, 2000c). This is likely due in large part to differences in the data sources. Tracing studies are typically based on information about the first retail purchaser. In contrast, the Maryland sales database used in this study contains information about the most recently registered Maryland purchaser, who may have purchased the gun used from a dealer or from another private gun owner (as of October 1996, Maryland law required private sales of handguns to be conducted through a licensed dealer or the MSP). At any rate, these patterns suggest that illegal gun users are more reliant on the primary gun market than is apparent from other tracing studies, though they could also reflect characteristics unique to Maryland's gun market.[35]

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[32] The analyses for Baltimore and D.C. are based on guns both sold and recovered after 1993.

[33] The ATF crime gun database contained an anonymous possessor identifier based on partial letters from the possessor's first and last names and on the possessor's date of birth and gender. The ranges stated for the purchaser and possessor match rate are based on matches of the name and date of birth at the low end and matches of the name only at the high end.

[34] The age of the possessor was reported for 3,492 of the recoveries (46% of all recoveries). For these cases, 55% of the possessors were 25 or older, 36% were 18 to 24, and 8% were under 17. (The analyses in this report are based on recoveries from persons of all ages.)

[35] Survey studies suggest that as many as 21% of adult gun offenders obtained guns from licensed dealers prior to 1994 (Harlow, 2001: 6; Wright and Rossi, 1986: 183,185). In more recent years, this figure has declined to 14% (Harlow, 2001: 6), due likely to the federal Brady Act, which established a national background check system for purchases from licensed dealers, and reforms of the federal firearms licensing system that have greatly reduced the number of licensed gun dealers (ATF, 2000a; Koper, 2002).

3.3.2.5. Time to Recovery. Time from sale to recovery (the terms "time to recovery" and "time to crime" are used interchangeably throughout this report) averaged 934 days, or about 2.6 years, for the recovered guns (see Chapter 4). About 30% of the crime guns were recovered within a year of sale, and nearly two-thirds (64%) were recovered within three years. [36] Roughly 80% of the guns sold after 1993 that were recovered in Baltimore or D.C. were seized within 3 years of purchase (this figure did not differ appreciably between the cities). Hence, substantial numbers of guns were diverted quickly from the retail sector into criminal channels.

[36] The percentages and averages reported here are not strictly comparable to those in other tracing studies because this analysis is based on guns sold and recovered within a relatively short time period. For example, relatively few guns in the analysis had a follow-up period as long as ten years. In addition, time to recovery was calculated based on each gun's most recent sale in Maryland rather than its first retail sale, which is the point of origin used in other tracing studies. Consequently, the time to crime figures reported here are shorter than those typically found in tracing studies (e.g., ATF 2000c).

4. SALES, RECOVERIES, AND TIME TO RECOVERY BY BUYER, FIREARM, TRANSACTION, AND DEALER CHARACTERISTICS: BIVARIATE, DESCRIPTIVE ANALYSES

This chapter describes the buyer, seller, firearm, and transaction characteristics that were measured and examines sales, recoveries, and time to recovery across different groups of actors, firearms, and transactions. A multivariate analysis assessing the simultaneous influences of these factors on gun recovery is presented in Chapter 5.

4.1. Sales and Recoveries by Buyer Characteristics

4.1.1. Buyer Characteristics Measured

Information available on buyers included age, race, gender, and county of residence. For each purchase, it was also possible to determine the number of guns the buyer had purchased in the past that had been recovered and traced as of that date.

4.1.2. Analysis of All Sales and Recoveries, 1990-2000

Analysis of all sales and recoveries shows that handgun buyers were predominantly male (90.3%), white (81%), and 21 to 49 years of age (77.3%) (Table 1). The vast majority (99%) had not been associated with any prior gun traces at the time of purchase. (Nearly 86% of those linked to any prior traces were linked to only one; the maximum number of prior traces for a buyer was seven.) Compared to the full population of gun buyers, however, those who purchased guns that were later recovered by police were more likely to be female (14.8% for crime gun buyers versus 9.7% for all gun buyers), black (61.7% for crime gun buyers versus 17% for all buyers), in their twenties (49% for crime gun buyers versus 24.6% for all buyers), and to have made prior purchases of crime guns (2.8% for crime gun buyers versus 1% for all buyers).

This is also illustrated in the final column of Table 1, which shows the percentage of sales resulting in recovery for each buyer category. For example, 11.8% of guns purchased by blacks were recovered in contrast to 1.4% of guns purchased by whites and 3.3% of those purchased by persons of other races. Similarly, 8.8% of guns purchased by persons linked to prior traces were later recovered as opposed to only 3.2% of those purchased by other persons. Guns were also significantly more likely to be recovered when purchased by younger persons (6.4% of guns purchased by buyers aged 21 to 29 were recovered compared to about 3% for guns purchased by persons in their thirties and less than 2% for older buyers) and women (4.9% recovered versus 3% for guns purchased by men).

Table 1. Gun Sales and Recoveries by Buyer Characteristics (N=235,011 Gun Sales in Maryland, 1990-October 1999)

Characteristic	Sales (% of All Sales)	Recoveries (% of All Recoveries)	% of Sales Resulting in Recovery
Gender			
Female	22,874 (9.7%)	1,123 (14.8%)	4.9%
Male	212,137 (90.3%)	6,452 (85.2%)	3.0%*
Race			
White	189,710 (81%)	2,720 (35.9%)	1.4%
Black	39,767 (17.0%)	4,675 (61.7%)	11.8%
Other	5,534 (2.4%)	180 (2.4%)	3.3%*
Age Group			
21 to 29	57,898 (24.6%)	3,708 (49.0%)	6.4%
30 to 39	65,107 (27.7%)	2,032 (26.8%)	3.1%
40 to 49	58,758 (25.0%)	1,074 (14.2%)	1.8%
50 to 59	35,278 (15.0%)	462 (6.1%)	1.3%
60+	17,970 (7.7%)	299 (4.0%)	1.7%*
Any Prior Buyer Traces			
No	232,588 (99.0%)	7,363 (97.2%)	3.2%
Yes	2,423 (1.0%)	212 (2.8%)	8.8%*

Recovery figures are based on national police recoveries reported to ATF as of March 2000.
* Differences across groups statistically significant at p<=.01

As shown in Table 2, over half of the recovered guns were purchased by buyers in Baltimore city and Prince George's County, and another 19% were purchased by buyers in suburban Baltimore County. Further, the risk of recovery also varied by the buyer's county of residence. Guns purchased by buyers from Baltimore city and from suburban counties adjacent to Baltimore city and D.C. were at greatest risk. Slightly over 11% of guns purchased by buyers in Baltimore city were recovered, making that jurisdiction the highest-risk area in the state. Over 6% of guns purchased by buyers from Prince George's County were recovered, as were 3.3% of those purchased by Baltimore County buyers. For buyers from other PMSA counties (e.g., Anne Arundel, Charles, Montgomery), the risk of recovery was roughly 1.5% to 2%. For rural counties (e.g., Allegany, Cecil, Washington), recovery rates were typically around 1% or less.

Table 2. Gun Sales and Recoveries by Buyer County (N=235,011 Gun Sales in Maryland, 1990-October 1999)

Buyer County	Sales (% of All Sales)	Recoveries (% of All Recoveries)	% of Sales Resulting in Recovery*
Baltimore PMSA			
Baltimore City	18,359 (7.8%)	2,036 (26.9%)	11.1%
Anne Arundel	25,610 (10.9%)	477 (6.3%)	1.9%
Baltimore County	43,981 (18.7%)	1,451 (19.2%)	3.3%
Carroll	9,709 (4.1%)	125 (1.7%)	1.3%
Harford	11,961 (5.1%)	182 (2.4%)	1.5%
Howard	9,569 (4.1%)	148 (2.0%)	1.6%
Queen Anne	1,512 (0.6%)	18 (0.2%)	1.2%
D.C. PMSA			
Calvert	3,862 (1.64%)	54 (0.7%)	1.4%
Charles	7,043 (3.0%)	125 (1.7%)	1.8%
Frederick	10,047 (4.3%)	78 (1.0%)	0.8%
Montgomery	29,766 (12.7%)	499 (6.6%)	1.7%
Prince George's	33,635 (14.3%)	2,094 (27.6%)	6.2%
Non or Other PMSA			
Allegany	3,037 (1.3%)	15 (0.2%)	0.5%
Caroline	902 (0.4%)	5 (0.1%)	0.6%
Cecil	4,075 (1.7%)	44 (0.6%)	1.1%
Dorchester	1,182 (0.5%)	13 (0.2%)	1.1%
Garrett	1,267 (0.5%)	9 (0.1%)	0.7%
Kent	597 (0.3%)	4 (0.1%)	0.7%
St. Mary's	5,277 (2.3%)	69 (0.9%)	1.1%
Somerset	735 (0.3%)	7 (0.1%)	1.0%
Talbot	1,256 (0.5%)	13 (0.2%)	1.0%
Washington	6,587 (2.8%)	55 (0.7%)	0.8%
Wicomico	3,271 (1.4%)	31 (0.4%)	1.0%
Worcester	1,771 (0.8%)	23 (0.3%)	1.3%

Recovery figures are based on national police recoveries reported to ATF as of March 2000.
* Differences across all counties were statistically significant at p<=.01

In sum, race, age, and area of residence stand out as particularly important factors because buyers in these groups accounted for large and disproportionate shares of sales resulting in a gun recovery. Black buyers made nearly two-thirds of the purchases that resulted in a crime gun recovery, buyers in their twenties accounted for about half, and buyers from just three counties—Baltimore city, Baltimore County, and Prince George's County—accounted for about three-quarters. As described above, guns were also at notably greater risk of being recovered when purchased by buyers in these groups.

There were also significant differences in the time from sale to recovery for guns purchased by different groups of buyers. Those guns that were recovered tended to be recovered more quickly when purchased by females, blacks, younger buyers, and persons linked to prior traces (Table 3). For example, recovered guns had an average time to crime of 553 days (or about 1.5 years) when purchased by a buyer linked to one or more prior traces. Recovered guns purchased by other buyers, in contrast, had an average time to crime of 945 days (or about 2.6 years). Differences in time to recovery were also apparent across counties (Table 4). Guns were recovered most quickly when purchased by buyers from Prince George's County (average = 850 days) and least quickly when purchased by buyers from Talbot County, a non-PMSA rural jurisdiction (average = 1,510 days).

Table 3. Time to Recovery by Buyer Characteristics (N=7,575 Guns Sold in Maryland, 1990-Oct.1999, and Recovered by Police, 1990-March 2000)

Characteristic	Average Time to Recovery
Gender	
Female (N=1,123)	854 days (2.3 years)
Male (N=6,452)	948 days (2.6 years)**
Race	
White (N=2,720)	1,117 days (3.1 years)
Black (N=4,675)	829 days (2.3 years)
Other (N=180)	907 days (2.5 years)**
Age Group	
21 to 29 (N=3,708)	816 days (2.2 years)
30 to 39 (N=2,032)	1,005 days (2.8 years)
40 to 49 (N=1,074)	1,077 days (3.0 years)
50 to 59 (N=462)	1,112 days (3.0 years)
60+ (N=299)	1,131 days (3.1 years)**
Any Prior Buyer Traces	
No (N=7,363)	945 days (2.6 years)
Yes (N=212)	553 days (1.5 years)*

* Differences across groups statistically significant at p<=0.1

** Differences across groups statistically significant at p<=.01

Table 4. Time to Recovery by Buyer County (N=7,575 Guns Sold in Maryland, 1990-Oct.1999, and Recovered by Police, 1990-March 2000)

Buyer County	Average Time to Recovery*
Baltimore PMSA	
Baltimore City (N=2,036)	889 days (2.4 years)
Anne Arundel (N=477)	995 days (2.7 years)
Baltimore County (N=1,451)	959 days (2.6 years)
Carroll (N=125)	1,129 days (3.1 years)
Harford (N=182)	1,074 days (2.9 years)
Howard (N=148)	1,093 days (3.0 years)
Queen Anne (N=18)	1,391 days (3.8 years)
D.C. PMSA	
Calvert (N=54)	1,145 days (3.1 years)
Charles (N=125)	1,076 days (2.9 years)
Frederick (N=78)	1,107 days (3.0 years)
Montgomery (N=499)	993 days (2.7 years)
Prince George's (N=2,094)	850 days (2.3 years)
Non or Other PMSA	
Allegany (N=15)	971 days (2.7 years)
Caroline (N=5)	1,197 days (3.3 years)
Cecil (N=44)	1,082 days (3.0 years)
Dorchester (N=13)	908 days (2.5 years)
Garrett (N=9)	1,474 days (4.0 years)
Kent (N=4)	1,126 days (3.1 years)
St. Mary's (N=69)	1,048 days (2.9 years)
Somerset (N=7)	1,081 days (3.0 years)
Talbot (N=13)	1,510 days (4.1 years)
Washington (N=55)	1,040 days (2.8 years)
Wicomico (N=31)	1,087 days (3.0 years)
Worcester (N=23)	1,434 days (3.9 years)

* Differences across all counties statistically significant at p<=.01

4.1.3. Local Analyses, 1994-2000

Analyses of the local markets in the Baltimore and D.C. areas from 1994 to 2000 revealed very similar findings: in general, guns sold in the Baltimore and D.C. areas were at higher risk of recovery and tended to be recovered more quickly (in Baltimore City and D.C., respectively) when purchased by females, blacks, younger people, persons linked to prior traces, and buyers residing in or close to Baltimore city and D.C. (Tables 5 through 8).

Table 5. Gun Sales and Baltimore Recoveries by Buyer Characteristics (N=71,956 Gun Sales to Buyers in Baltimore PMSA, 1994-Oct. 1999)

Characteristic	Sales (% All Sales to Baltimore PMSA Buyers)	Baltimore City Recoveries (% of Baltimore Recoveries)	% of Sales Resulting in Recovery
Gender			
Female	6,598 (9.2%)	286 (15.5%)	4.3%
Male	65,358 (90.8%)	1,564 (84.5%)	2.4%*
Race			
White	60,080 (83.5%)	611 (33.0%)	1.0%
Black	10,612 (14.8%)	1,223 (66.1%)	11.5%
Other	1,264 (1.8%)	16 (0.9%)	1.3%*
Age Group			
21 to 29	16,085 (22.4%)	909 (49.1%)	5.7%
30 to 39	18,910 (26.3%)	480 (26.0%)	2.5%
40 to 9	18,534 (25.8%)	265 (14.3%)	1.4%
50 to 59	12,119 (16.8%)	116 (6.3%)	1.0%
60+	6,308 (8.8%)	80 (4.3%)	1.3%*
County			
Baltimore City	10,135 (14.1%)	950 (51.4%)	9.4%
Anne Arundel	15,598 (21.7%)	131 (7.1%)	0.8%
Baltimore County	26,717 (37.1%)	641 (34.7%)	2.4%
Carroll	5,685 (7.9%)	31 (1.7%)	0.6%
Harford	7,160 (10.0%)	58 (3.1%)	0.8%
Howard	5,765 (8.0%)	36 (2.0%)	0.6%
Queen Anne	896 (1.3%)	3 (0.2%)	0.3%*
Any Prior Buyer Traces			
No	70,606 (98.1%)	1,756 (94.9%)	2.5%
Yes	1,350 (1.9%)	94 (5.1%)	7.0%*

Recovery figures are based on police recoveries reported to ATF as of March 2000
* Differences across groups statistically significant at p<=.01

Table 6. Time to Recovery in Baltimore by Buyer Characteristics (N=1,850 Guns Sold to Baltimore PMSA Buyers, 1994-Oct. 1999, and Recovered in Baltimore, 1994-March 2000)

Characteristic	Average Time to Recovery
Gender	
Female (N=286)	533 days (1.5 years)
Male (N=1,564)	637 days (1.7 years)**
Race	
White (N=611)	711 days(1.9 years)
Black (N=1,223)	576 days (1.6 years)
Other (N=16)	652 days (1.8 years)**
Age Group	
21 to 29 (N=909)	571 days (1.6 years)
30 to 39 (N=480)	644 days (1.8 years)
40 to 49 (N=265)	696 days (1.9 years)
50 to 59 (N=116)	696 days (1.9 years)
60+ (N=80)	693 days (1.9 years)**
County	
Baltimore City (N=950)	600 days (1.6 years)
Anne Arundel (N=131)	618 days (1.7 years)
Baltimore County (N=641)	645 days (1.8 years)
Carroll (N=31)	657 days (1.8 years)
Harford (N=58)	669 days (1.8 years)
Howard (N=36)	695 days (1.9 years)
Queen Anne (N=3)	391 days (1.1 years)
Any Prior Buyer Traces	
No (N=1,756)	626 days (1.7 years)
Yes (N=94)	531 days (1.5 years)*

*Differences across groups statistically significant at p<=0.1
**Differences across groups statistically significant at p<=.01

Table 7. Gun Sales and D.C. Recoveries by Buyer Characteristics (N=48,039 Gun Sales to D.C. PMSA Buyers, 1994-Oct. 1999)

Characteristic	Sales (% All Sales to D.C. PMSA Buyers)	Recoveries in D.C. (% of D.C. Recoveries)	% of Sales Resulting in Recovery
Gender			
Female	4,398 (9.2%)	63 (11.9%)	1.4%
Male	43,641 (90.8%)	466 (88.1%)	1.1%*
Race			
White	34,204 (71.0%)	79 (14.9%)	0.2%
Black	11,830 (24.6%)	433 (81.9%)	3.7%
Other	2,005 (4.2%)	17 (3.2%)	3.2%*
Age Group			
21 to 29	11,604 (24.2%)	315 (60.0%)	2.7%
30 to 39	13,642 (28.4%)	128 (24.2%)	0.9%
40 to 49	11,646 (24.4%)	52 (9.8%)	0.5%
50 to 59	7,706 (16.0%)	29 (5.5%)	0.4%
60+	3,441 (7.2%)	5 (1.0%)	0.2%*
County			
Calvert	2,166 (4.5%)	3 (0.6%)	0.1%
Charles	4,193 (8.7%)	12 (2.3%)	0.3%
Frederick	5,701 (11.9%)	7 (1.3%)	0.1%
Montgomery	16,897 (35.4%)	61 (11.5%)	0.4%
Prince George's	18,992 (39.5%)	446 (84.3%)	2.4%*
Any Prior Buyer Traces			
No	47,330 (98.5%)	506 (95.7%)	1.1%
Yes	709 (1.5%)	23 (4.4%)	3.2%

Recovery figures are based on police recoveries reported to ATF as of March 2000

* Differences across groups statistically significant at p<=.01

Table 8. Time to Recovery in D.C. by Buyer Characteristics (N=529 Guns Sold to D.C. PMSA Buyers, 1994-Oct. 1999, and Recovered in D.C., 1994-March 2000)

Characteristic	Average Time to Recovery
Gender	
Female (N=63)	615 days (1.7 years)
Male (N=466)	579 days (1.6 years)
Race	
White (N=79)	697 days (1.9 years)
Black (N=433)	571 days (1.6 years)
Other (N=17)	362 days (1.0 years)**
Age Group	
21 to 29 (N=315)	548 days (1.5 years)
30 to 39 (N=128)	598 days (1.6 years)
40 to 49 (N=52)	616 days (1.7 years)
50 to 59 (N=29)	834 days (2.3 years)
60+ (N=5)	614 days (1.7 years)*
County	
Calvert (N=3)	881 days (2.4 years)
Charles (N=12)	634 days (1.7 years)
Frederick (N=7)	774 days (2.1 years)
Montgomery (N=61)	598 days (1.6 years)
Prince George's (N=446)	575 days (1.6 years)
Any Prior Buyer Traces	
No (N=506)	595 days (1.6 years)
Yes (N=23)	321 days (0.9 years)**

* Differences across groups statistically significant at p<=0.1
** Differences across groups statistically significant at p<=.05

4.2. Sales and Recoveries by Firearm Characteristics

4.2.1. Firearm Characteristics Measured

Firearm characteristics available from the sales data included manufacturer, type, caliber, and barrel length. Type categories examined here include semiautomatic pistols, revolvers, derringers, semiautomatic assault weapons (military-style pistols, rifles, and shotguns as defined by federal and/or Maryland law),[37] and other types (voluntarily registered rifles and shotguns and other miscellaneous firearms with unclear type classifications). For analysis, calibers were grouped into small (.22, .25, .32), medium (.380, .38, 9mm), large (.357, .40, .41, 44, .45, 10mm), and missing/other categories.[38] Barrel length measurements were used to classify guns according to their size and thus their ease of concealment. Because the barrel length measurements were imprecise,[39] two classifications were used: guns having barrels of three inches or less and guns having barrels of four inches or less.[40]

Firearm price was not recorded in the MSP data. However, a rough indicator for price and quality was created by flagging handguns made by manufacturers that primarily produced cheap handguns, defined as handguns with a new retail price of $150 or less, during the 1990s.[41] This group included firearms made by Davis Industries, Hi-Point, Phoenix/Raven, and New England Firearms. Although many of these guns are generally considered to be of the SNS type, they were not prohibited by the Maryland SNS law.[42] Eighty-six percent of the cheap handguns as defined here also had short barrels, thus matching the standard definition of an SNS handgun.[43]

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[37] As defined in federal and state laws, assault weapons are semiautomatic firearms that have military-style features such as flash hiders, threaded barrels for attaching silencers and bayonet mounts and that typically come equipped with ammunition magazines holding 20 or more rounds (e.g., see Koper, 2004; Roth and Koper, 1997).

[38] These categorizations were based on convention in the firearms literature (e.g., Wintemute et al., 1998b) and are rooted in assessments of the power of different calibers as computed by measures like kinetic energy or relative stopping power (e.g., see DiMaio, 1985: 140; Warner, 1995: 223; Wintemute, 1996: 1751).

[39] For example, a barrel of three-and-a-half inches might have been coded as three inches, four inches, or anything in between.

[40] The three inch criterion has been used commonly by ATF and other analysts to define "Saturday night specials" (SNS), a group of handguns thought to be particularly attractive for criminal purposes due in part to the ease with which they can be concealed (see Chapter 2). The three inch criterion is also factored into federal regulations limiting the importation of handguns into the United States (see Chapter 2).

[41] Note that it was not possible to reliably identify firearms that were likely to sell for $150 or less in used condition.

[42] See Fennell (1992) for a discussion of the drafting and implementation of Maryland's SNS law.

[43] In preliminary analysis, a proxy SNS indicator was also tested that reflected guns having both a price of $150 or less and a barrel of no more than three inches. This indicator largely overlapped with the cheap gun indicator, but the latter was a stronger predictor of recovery. The statistical models described in the next chapter performed somewhat better when using separate indicators for firearm size and price as opposed to using just the SNS indicator. Moreover, use of separate price and size indicators provides some sense of the comparative importance of these firearm features to criminal users and traffickers.

4.2.2. Analysis of All Sales and Recoveries, 1990-2000

For the full sample, the most frequently recovered guns were semiautomatic pistols (74.5%), medium caliber handguns (67.6%), and handguns with barrels of four inches or less (70%) (Table 9). Low priced handguns accounted for nearly a fifth (19.3%) of the recovered guns. Handguns made by Davis Industries were the most frequently recovered gun make, accounting for 15.3% of recoveries (Table 10). Other frequently recovered gun makes included Sturm Ruger (13.9% of recoveries) and Smith and Wesson (12.4% of recoveries).

Taking sales volume into account, the firearms most likely be recovered (i.e., those with the greatest percentage of sales resulting in recovery) were semiautomatic pistols (3.9% recovered) and assault weapons (3.2% recovered), medium caliber guns (4.7% recovered), short-barreled guns (4.6% of those with barrels of three inches or less were recovered as were 4.1% of those with barrels of four inches or less), and lower priced guns (10.4% recovered). The most dramatic differential was that for price; 10.4% of guns made by cheap gun manufacturers were recovered by police in contrast to 2.8% of other guns. Among gun makes, Davis Industries firearms had the highest probability of recovery (11.5%). Other makes with a relatively high probability of recovery were AEI (8.8%), Star (5.9%), and Rossi (5.7%).

Time to crime for recovered firearms generally revealed similar firearm risk factors (Tables 11 and 12). Average recovery times tended to be somewhat faster for pistols, medium and large caliber handguns, smaller handguns, and cheaper firearms. Results were more mixed for gun manufacturers, but Davis Industries' handguns had the fastest time to crime.

Table 9. Gun Sales and Recoveries by Firearm Characteristics (N=235,011 Gun Sales in Maryland, 1990-Oct. 1999)

Characteristic	Sales (% of All Sales)	Recoveries (% of All Recoveries)	% of Sales Resulting in Recovery
Gun Type			
Semiautomatic	143,130 (60.9%)	5,640 (74.5%)	3.9%
Revolver	81,259 (34.6%)	1,683 (22.2%)	2.1%
Derringer	1,624 (0.7%)	2 (0.03%)	0.12%
Assault Weapon	6,509 (2.8%)	205 (2.7%)	3.2%
Other	2,489 (1.1%)	45 (0.6%)	1.8%*
Caliber			
Small	41,401 (17.6%)	776 (10.2%)	1.9%
Medium	110,070 (46.8%)	5,120 (67.6%)	4.7%
Large	77,263 (32.9%)	1,650 (21.8%)	2.1%
Misc.	6,277 (2.7%)	29 (0.4%)	0.5%*
Size			
Barrel <= 3”	62,699 (26.7%)	2,901 (38.3%)	4.6%
Barrel >3”	172,312 (73.3%)	4,674 (61.7%)	2.7%*
Barrel <=4”	129,360 (55.0%)	5,302 (70.0%)	4.1%
Barrel > 4”	105,651 (45.0%)	2,273 (30.0%)	2.2%*
Price (Quality)			
Price <=$150	14,024 (6.0%)	1,460 (19.3%)	10.4%
Price > $150	220,987 (94.0%)	6,115 (80.7%)	2.8%*

Recovery figures are based on national police recoveries reported to ATF as of March 2000

* Differences across groups statistically significant at p<=.01

Table 10. Gun Sales and Recoveries by Firearm Manufacturer (N= N=235,011 Gun Sales in Maryland, 1990-Oct. 1999)

Manufacturer	Sales (% All Sales)	Recoveries (% of All Recoveries)	% of Sales Resulting in Recovery *
Amadeo Rossi	6,847 (2.9%)	390 (5.2%)	5.7%
Beretta	19,289 (8.2%)	476 (6.3%)	2.5%
Bersa	2,812 (1.2%)	248 (3.3%)	8.8%
Browning	5,650 (2.4%)	56 (0.7%)	1.0%
Colt	20,298 (8.6%)	268 (3.5%)	1.3%
Davis Industries	10,111 (4.3%)	1,160 (15.3%)	11.5%
Glock	14,412 (6.1%)	639 (8.4%)	4.4%
Sig Sauer	7,634 (3.3%)	97 (1.3%)	1.3%
Smith & Wesson	42,002 (17.9%)	939 (12.4%)	2.2%
Star	3,004 (1.3%)	177 (2.3%)	5.9%
Sturm Ruger	40,174 (17.0%)	1,055 (13.9%)	2.6%
Tauras	23,364 (9.9%)	765 (10.1%)	3.3%
Other	39,414 (16.8%)	1,305 (17.2%)	3.3%

Recovery figures are based on national police recoveries reported to ATF as of March 2000
Listed manufacturers ranked in the top 10 for sales and/or recoveries
* Differences across groups statistically significant at p<=.01

Table 11. Time to Recovery by Firearm Characteristics (N=7,575 Guns Sold in Maryland, 1990-Oct. 1999, and Recovered by Police, 1990-March 2000)

Characteristic	Average Time to Recovery
Gun Type	
Semiautomatic (N=5,640)	865 days (2.4 years)
Revolver (N=1,683)	1,154 days (3.2 years)
Derringer (N=2)	402 days (1.1 years)
Assault Weapon (N=205)	981 days (2.7 years)
Other (N=45)	1,149 days (3.1 years)*
Caliber	
Small (N=776)	1,067 days (2.9 years)
Medium (N=5,120)	909 days (2.5 years)
Large (N=1,650)	944 days (2.6 years)
Misc. (N=29)	1,148 days (3.1 years)*
Size	
Barrel <= 3" (N=2,901)	916 days (2.5 years)
Barrel >3" (N=4,674)	945 days (2.6 years)
Barrel <=4" (N=5,302)	902 days (2.5 years)
Barrel > 4" (N=2,273)	1008 days (2.8 years)*
Price (Quality)	
Price <=$150 (N=1,460)	751 days (2.1 years)
Price > $150 (N=6,115)	978 days (2.7 years)*

* Differences across groups statistically significant at p<=.01

Table 12. Time to Recovery by Firearm Manufacturer (N=7,575 Guns Sold in Maryland, 1990-Oct. 1999, and Recovered by Police, 1990-March 2000)

Manufacturer	Average Time to Recovery *
Amadeo Rossi (N=390)	946 days (2.6 years)
Beretta (N=476)	1,032 days (2.8 years)
Bersa (N=248)	973 days (2.7 years)
Browning (N=56)	1,202 days (3.3 years)
Colt (N=268)	1,143 days (3.1 years)
Davis Industries (N=1,160)	784 days (2.1 years)
Glock (N=639)	932 days (2.6 years)
Sig Sauer (N=97)	974 days (2.7 years)
Smith & Wesson (N=939)	1,015 days (2.8 years)
Star (N=177)	955 days (2.6 years)
Sturm Ruger (N=1,055)	923 days (2.5 years)
Tauras (N=765)	1,042 days (2.9 years)
Other (N=1,305)	849 days (2.3 years)

Listed manufacturers ranked in the top 10 for sales and/or recoveries

* Differences across groups statistically significant at p<0.01

4.2.3. Local Analyses, 1994-2000

Similar patterns were found in the local analyses for the Baltimore and D.C. areas (Tables 13 through 20). In brief, handguns were most likely to be recovered and generally had shorter recovery times if they were semiautomatic, medium caliber, short-barreled, and/or inexpensive (though the relationships between gun characteristics and recovery time were not as strong in the D.C. analysis). Handguns in these categories accounted for large or otherwise disproportionate shares of crime guns. Gun makes that had the highest risk of recovery in the local analyses included Davis Industries, Hi-Point, AEI, Rossi, Phoenix/Raven, and Star. In some cases, these makes were also among the most frequently recovered guns or among those with faster recovery times. Most notably, guns made by Davis Industries were the most frequently recovered and among the fastest in recovery time in both the Baltimore and D.C. analyses.

Table 13. Gun Sales and Baltimore Recoveries by Firearm Characteristics (N=71,956 Gun Sales to Buyers in Baltimore PMSA, 1994-Oct. 1999)

Characteristic		Sales (% All Sales to Baltimore PMSA Buyers)	Recoveries in Baltimore City (% of Baltimore Recoveries)	% of Sales Resulting in Recovery
Gun Type				
	Semiautomatic	46,684 (64.9%)	1,476 (79.8%)	3.2%
	Revolver	22,926 (31.9%)	345 (18.7%)	1.5%
	Derringer	402 (0.6%)	0 (0.0%)	0.0%
	Assault Weapon	1,451 (2.0%)	21 (1.1%)	1.5%
	Other	493 (0.7%)	8 (0.4%)	1.6%*
Caliber				
	Small	12,499 (17.4%)	188 (10.2%)	1.5%
	Medium	32,275 (44.9%)	1,232 (66.6%)	3.8%
	Large	25,555 (35.5%)	423 (22.9%)	1.7%
	Misc.	1,627 (2.3%)	7 (0.4%)	0.4%*
Size				
	Barrel <= 3”	19,604 (27.2%)	749 (40.5%)	3.8%
	Barrel >3”	52,352 (72.8%)	1,101 (59.5%)	2.1%*
	Barrel <=4”	41,803 (58.1%)	1,366 (73.8%)	3.3%
	Barrel > 4”	30,153 (41.9%)	484 (26.2%)	1.6%*
Price (Quality)				
	Price <=$150	4,883 (6.8%)	473 (25.6%)	10.0%
	Price > $150	67,073 (93.2%)	1,377 (74.4%)	2.1%*

Recovery figures based on police recoveries reported to ATF as of March 2000
* Differences across groups statistically significant at p<=.01

Table 14. Gun Sales and Baltimore Recoveries by Firearm Manufacturer (N=71,956 Gun Sales to Buyers in Baltimore PMSA, 1994-Oct. 1999)

Manufacturer	Sales (% All Sales to Baltimore PMSA Buyers)	Recoveries in Baltimore City (% of Baltimore Recoveries)	% of Sales Resulting in Recovery *
Amadeo Rossi	2,075 (2.9%)	105 (5.7%)	5.1%
Beretta	5,560 (7.7%)	97 (5.2%)	1.7%
Bersa	1,107 (1.6%)	78 (4.2%)	7.1%
Colt	6,203 (8.6%)	47 (2.5%)	0.8%
Davis Industries	2,951 (4.1%)	348 (18.8%)	11.8%
Glock	5,233 (7.3%)	146 (7.9%)	2.8%
Hi Point	493 (0.7%)	67 (3.6%)	13.6%
Makarov	1,626 (2.3%)	0 (0.0%)	0.0%
Phoenix Arms	1,262 (1.8%)	54 (2.9%)	4.3%
Sig Sauer	2,998 (4.2%)	15 (0.8%)	0.5%
Smith & Wesson	11,612 (16.1%)	181 (9.8%)	1.6%
Sturm Ruger	11,566 (16.1%)	265 (14.3%)	2.3%
Tauras	7,425 (10.3%)	187 (10.1%)	2.5%
Other	11,845 (16.5%)	260 (14.1%)	2.2%

Recovery figures are based on police recoveries reported to ATF as of March 2000
Listed manufacturers ranked in the top 10 for sales and/or recoveries
* Differences across groups statistically significant at p<=.01

Table 15. Time to Recovery in Baltimore by Firearm Characteristics (N=1,850 Guns Sold to Baltimore PMSA Buyers, 1994-Oct. 1999, and Recovered in Baltimore, 1994-March 2000)

Characteristic	Average Time to Recovery
Gun Type	
Semiautomatic (N=1,476)	600 days (1.6 years)
Revolver (N=345)	699 days (1.9 years)
Assault Weapon (N=21)	934 days (2.6 years)
Other (N=8)	298 days (0.8 years)*
Caliber	
Small (N=188)	660 days (1.8 years)
Medium (N=1,232)	605 days (1.7 years)
Large (423)	651 days (1.8 years)
Misc. (N=7)	690 days (1.9 years)
Size	
Barrel <= 3” (N=749)	608 days (1.7 years)
Barrel >3” (N=1,101)	630 days (1.7 years)
Barrel <=4” (N=1,366)	595 days (1.6 years)
Barrel > 4” (N=484)	697 (1.9 years)*
Price (Quality)	
Price <=$150 (N=473)	568 days (1.6 years)
Price > $150 (N=1,377)	639 days (1.8 years)*

* Differences across groups statistically significant at p<=.01

Table 16. Time to Recovery in Baltimore by Firearm Manufacturer (N=1,850 Guns Sold to Baltimore PMSA Buyers, 1994-Oct. 1999, and Recovered in Baltimore, 1994-March 2000)

Manufacturer	Average Time to Recovery
Amadeo Rossi (N=105)	660 days (1.8 years)
Beretta (N=97)	628 days (1.7 years)
Bersa (N=78)	662 days (1.8 years)
Colt (N=47)	683 days (1.9 years)
Davis Industries (N=348)	564 days (1.5 years)
Glock (N=146)	599 days (1.6 years)
Hi Point (N=67)	585 days (1.6 years)
Phoenix Arms (N=54)	559 days (1.5 years)
Sig Sauer (N=15)	721 days (2.0 years)
Smith & Wesson (N=181)	632 days (1.7 years)
Sturm Ruger (N=265)	648 days (1.8 years)
Tauras (N=187)	647 days (1.8 years)
Other (N=260)	632 days (1.7 years)

Listed manufacturers ranked in the top 10 for sales and/or recoveries

Table 17. Gun Sales and D.C. Recoveries by Firearm Characteristics (N=48,039 Gun Sales to Buyers in D.C. PMSA, 1994-Oct. 1999)

Characteristic	(% of All Sales to DC PMSA Buyers)	Recoveries in DC (% of DC Recoveries)	% of Sales Resulting in Recovery
Gun Type			
Semiautomatic	31,108 (64.8%)	440 (83.2%)	1.4%
Revolver	15,326 (31.9%)	77 (14.6%)	0.5%
Derringer	264 (0.6%)	0 (0.0%)	0.0%
Assault Weapon	923 (1.9%)	11 (2.1%)	1.2%
Other	418 (0.9%)	1 (0.2%)	0.2%*
Caliber			
Small	7,260 (15.1%)	37 (6.7%)	0.5%
Medium	22,763 (47.4%)	375 (70.9%)	1.6%
Large	16,828 (35.0%)	116 (21.9%)	0.7%
Misc.	1,188 (2.5%)	1 (0.2%)	0.1%*
Size			
Barrel <= 3”	13,050 (27.2%)	197(37,2%)	1.5%
Barrel >3”	34,989 (72.8%)	332 (62.8%)	1.0%*
Barrel <=4”	28,329 (59.0%)	389 (73.5%)	1.4%
Barrel > 4”	19,710 (41.0%)	140 (26.5%)	0.7%*
Price (Quality)			
Price <=$150	2,898 (6.0%)	134 (25.3%)	4.6%
Price > $150	45,141 (94.0%)	395 (74.7%)	0.9%*

Recovery figures are based on police recoveries reported to ATF as of March 2000

* Differences across groups statistically significant at p<=.01

Table 18. Gun Sales and D.C. Recoveries by Firearm Manufacturer (N=48,039 Gun Sales to Buyers in D.C. PMSA, 1994-Oct. 1999)

Manufacturer	Sales (% All Sales to DC PMSA Buyers)	Recoveries in DC (% of DC Recoveries)	% of Sales Resulting in Recovery*
Amadeo Rossi	1,750 (3.6%)	27 (5.1%)	1.5%
Astra	585 (1.2%)	22 (4.2%)	0.5%
Beretta	4,563 (9.5%)	22 (4.2%)	0.5%
Colt	3,894 (8.1%)	9 (1.7%)	0.2%
Davis Industries	1,902 (4.0%)	86 (16.3%)	4.5%
Glock	3,001 (6.3%)	32 (6.1%)	1.1%
Heckler and Koch	1,181 (2.5%)	11 (2.1%)	0.9%
Hi Point	399 (0.8%)	39 (7.4%)	9.8%
Sig Sauer	2,027 (4.2%)	7 (1.3%)	0.4%
Smith & Wesson	9,162 (19.1%)	81 (15.3%)	0.9%
Star	634 (1.3%)	17 (3.2%)	2.7%
Sturm Ruger	7,725 (16.1%)	82 (15.5%)	1.1%
Tauras	3,883 (8.1%)	28 (5.3%)	0.7%
Other	7,333 (15.3%)	66 (12.5%)	0.9%

Listed manufacturers ranked in the top 10 for sales and/or recoveries
* Differences across groups statistically significant at p<=.01

Table 19. Time to Recovery in D.C. by Firearm Characteristics (N=529 Guns Sold to D.C. PMSA Buyers, 1994-Oct. 1999, and Recovered in D.C., 1994-March 2000)

Characteristic	Average Time to Recovery
Gun Type	
Semiautomatic (N=440)	559 days (1.5 years)
Revolver (N=77)	735 days (2.0 years)
Assault Weapon (N=11)	517 days (1.4 years)
Other (N=1)	282 days (0.8 years)*
Caliber	
Small (N=37)	602 days (1.6 years)
Medium (N=375)	578 days (1.6 years)
Large (N=116)	589 days (1.6 years)
Misc. (N=1)	984 days (2.7 years)
Size	
Barrel <= 3” (N=197)	595 days (1.6 years)
Barrel >3” (N=332)	577 days (1.6 years)
Barrel <=4” (N=389)	583 days (1.6 years)
Barrel > 4” (N=140)	584 days (1.6 years)
Price (Quality)	
Price <=$150 (N=134)	565 days (1.5 years)
Price > $150 (N=395)	590 days (1.6 years)

* Differences across groups statistically significant at p<=.05

Table 20. Time to Recovery in D.C. by Firearm Manufacturer (N=589 Guns Sold to D.C. PMSA Buyers, 1994-Oct. 1999, and Recovered in D.C., 1994-March 2000)

Manufacturer	Average Time to Recovery*
Amadeo Rossi (N=27)	788 days (2.2 years)
Astra (N=22)	566 days (1.6 years)
Beretta (N=22)	589 days (1.6 years)
Colt (N=9)	680 days (1.9 years)
Davis Industries (N=86)	594 days (1.6 years)
Glock (N=32)	453 days (1.2 years)
Heckler and Koch (N=11)	524 days (1.4 years)
Hi Point (N=39)	557 days (1.5 years)
Sig Sauer (N=7)	908 days (2.5 years)
Smith & Wesson (N=81)	518 days (1.4 years)
Star (N=17)	529 days (1.4 years)
Sturm Ruger (N=82)	548 days (1.5 years)
Tauras (N=28)	601 days (1.6 years)
Other (N=66)	660 days (1.8 years)

Listed manufacturers ranked in the top 10 for sales and/or recoveries
* Differences across groups statistically significant at p<=.01

4.3. Sales and Recoveries by Transaction Characteristics

4.3.1. Transaction Characteristics Measured

The discussion of transaction characteristics focuses primarily on the distinction between single and multiple sales. For the descriptive analysis examined here, two definitions of a multiple sale were employed. The "federal definition" refers to the purchase of two or more handguns by the same individual from the same gun dealer within five consecutive business days. Federal regulations require licensed gun dealers to report such transactions to the ATF, thereby enabling ATF to monitor these sales for illegal gun trafficking (ATF, 1995b: 59). Multiple sales were also examined using a broader "state definition" that corresponds to the purchase of two or more handguns by the same person from any gun dealer(s) within a 30-day period.[44] This definition is consistent with the logic of one-gun-a-month (OGM) laws, such as that in Maryland, and it captures the activities of buyers who may have spread multiple buys over several dealers and/or days to avoid federal reporting requirements. Nonetheless, during the period prior to Maryland's OGM law (a period of particular interest for reasons discussed below), 82% of the guns purchased in multiple sales under the state definition were also purchased in transactions that met the federal definition of a multiple sale, in almost all cases involving same-day, same-dealer purchases.[45]

[44] More specifically, a purchase was counted as a multiple sale if the buyer made any other purchases on the same day, during the prior 30 days, or during the subsequent 30 days.
[45] Federally-defined multiple sales were approximated based on purchases from the same dealer within any five consecutive calendar days.

Separate analyses are also presented for guns purchased before and after Maryland's Gun Violence Act of 1996 (GVA). As discussed earlier, this law generally prohibits gun buyers in Maryland from purchasing more than one handgun (or assault weapon) within any 30-day period. Exceptions were made, however, for gun collectors registered with MSP and for some other special circumstances (e.g., a bulk purchase from an estate sale). For this reason, one may expect that multiple sales made after the GVA were lower risk transactions than those made before the GVA.

In addition, the GVA specifically forbids straw purchasing and requires that secondhand sales of handguns be conducted through licensed gun dealers or the MSP so that background checks may be conducted on prospective buyers. These provisions may have discouraged straw purchasing and other secondhand sales to prohibited buyers. If so, guns sold in single sales after the GVA may have been at lower risk of criminal use than guns sold in single sales before the GVA.

4.3.2. Analysis of All Sales and Recoveries, 1990-2000

Prior to the GVA, 22.3% of sales met the federal definition of a multiple sale and 27.4% met the state definition of a multiple sale (Table 21). After the GVA, these respective percentages dropped to 10.1% and 14.3%. Depending on how multiple sales were defined, 22% to 25% of all pre-GVA guns that were recovered originated from multiple sales.

For pre-GVA sales, the risk of recovery was essentially equal between federally-defined multiple sales and other sales (3.5% and 3.6%, respectively). Using the state definition, pre-GVA multiple sales were at lower risk of recovery (3.3%) than were other pre-GVA sales (3.7%). As will be shown in subsequent sections, however, this pattern changes when factors such as buyer demographics are taken into account (also see Koper, 2005). Further, using both the federal and state definitions of a multiple sale, recovery time was shorter for pre-GVA multiple sales than for pre-GVA single sales, which provides some indication that multiple sales may have been associated with gun trafficking (Table 22). Using the federal definition, for example, recovered guns sold in a pre-GVA multiple sale had an average recovery time of 915 days, while the average for recovered guns sold in single sales was 1,076 days.

As expected, guns sold in multiple sales after the GVA, defined with either the federal or state multiple sales criteria, were at lower risk of recovery than were guns sold in post-GVA single sales (Table 21). However, differences in time to crime were not apparent between these groups (Table 22).

Finally, informal comparisons between pre- and post-GVA sales (these comparisons were not tested for statistical significance) would seem to provide some indications that the GVA may have reduced the flow of guns to criminals through both single and multiple sales. To illustrate, 3.5% of federally-defined pre-GVA multiple sales were recovered in contrast to only 1.1% of those made after the GVA. Likewise, the percentage of federally-defined single sales that were recovered dropped from 3.6%

for pre-GVA sales to 1.1% for post-GVA sales (Table 21). However, these differences may simply be due to the fact that post-GVA sales, which took place from October 1996 onward, had shorter potential follow-up times than did pre-GVA sales.[46] (This is also the reason for the large differences in time to recovery for pre- and post-GVA sales shown in Table 22.) The multivariate analysis in Chapter 5 compensates for this problem by controlling for each gun's period at-risk.[47]

Table 21. Gun Sales and Recoveries by Transaction Characteristics (N=235,011 Gun Sales in Maryland, 1990-Oct. 1999)

Characteristic	Sales (% of All Sales)	Recoveries (% of All Recoveries)	% of Sales Resulting in Recovery
Pre-GVA Multiple Sale (State Definition)			
No	130,883 (72.6%)	4,850 (75.1%)	3.7%
Yes	49,361 (27.4%)	1,612 (24.9%)	3.3%*
Post-GVA Multiple Sale (State Definition)			
No	46,935 (85.7%)	1,032 (92.7%)	2.2%
Yes	7,832 (14.3%)	81 (7.3%)	1.0%*
Pre-GVA Multiple Sale (Federal Definition)			
No	139,970 (77.7%)	5,041 (78.0%)	3.6%
Yes	40,274 (22.3%)	1,421 (22.0%)	3.5%
Post-GVA Multiple Sale (Federal Definition)			
No	49,216 (89.9%)	1,053 (94.6%)	2.1%
Yes	5,551 (10.1%)	60 (5.4%)	1.1%*

Recovery figures are based on national police recoveries reported to ATF as of March 2000
Pre-GVA sales include sales from January 1990 through September 1996. Post-GVA sales include sales from October 1996 through October 1999.
* Differences across groups statistically significant at p<=.01

[46] In other words, the time from sale until the end of the study period was shorter for guns sold after the GVA. For the purposes of this study, therefore, guns sold after the GVA were at-risk of criminal use for shorter periods of time.

[47] The MSP sales database used in this study did not distinguish between retail and secondhand sales that were conducted through licensed dealers during the post-GVA period. This precludes general comparisons of primary and secondary market sales. However, the database did have records on over 1,100 secondhand sales that were conducted through the MSP. Overall, guns sold in these transactions had a lower probability of recovery than did other post-GVA sales (0.4% versus 2.1%). For the purposes of this study, the MSP sale designation is treated as a dealer characteristic rather than a transaction characteristic.

Table 22. Time to Recovery by Transaction Characteristics (N=7,575 Guns Sold in Maryland, 1990-Oct. 1999, and Recovered by Police, 1990-March 2000)

Characteristic	Average Time to Recovery
Pre-GVA Multiple Sale (State Definition)	
No (N=4,850)	1,072 days (2.9 years)
Yes (N=1,612)	946 days (2.6 years)*
Post-GVA Multiple Sale (State Definition)	
No (N=1,032)	319 days (0.9 years)
Yes (N=81)	298 days (0.8 years)
Pre-GVA Multiple Sale (Federal Definition)	
No (N=5,041)	1,076 days (2.9 years)
Yes (N=1,421)	915 days (2.5 years)*
Post-GVA Multiple Sale (Federal Definition)	
No (N=1,053)	318 days (0.9 years)
Yes (N=60)	301 days (0.8 years)

Pre-GVA sales include sales from January 1990 through September 1996. Post-GVA sales include sales from October 1996 through October 1999.

* Differences across groups statistically significant at p<=.01

4.3.3. Local Analyses, 1994-2000

For guns sold in the Baltimore area, pre-GVA multiple sales had a lower risk of recovery in Baltimore than did pre-GVA single sales (Table 23). However, the former had shorter recovery times when they were recovered (Table 24). For guns sold in the D.C. area, in contrast, there were no pronounced differences in the likelihood of recovery or time to recovery between pre-GVA single and multiple sales (Tables 25 and 26). In both sets of local analyses, guns sold after the GVA had lower chances of recovery and shorter recovery times, whether comparing single or multiple sales. However, comparisons between pre- and post-GVA sales should be regarded cautiously for the reasons discussed above.

Table 23. Gun Sales and Baltimore Recoveries by Transaction Characteristics (N=71,956 Guns Sales to Baltimore PMSA Buyers, 1994-Oct. 1999)

Characteristic	Sales (% All Sales to Baltimore PMSA Buyers)	Recoveries in Baltimore City (% of Baltimore Recoveries)	% of Sales Resulting in Recovery
Pre-GVA Multiple Sale (State Definition)			
No	30,336 (68.5%)	1,016 (74.9%)	3.4%
Yes	13,961 (31.5%)	341 (25.1%)	2.4%*
Post-GVA Multiple Sale (State Definition)			
No	23,704 (85.7%)	459 (93.1%)	1.9%
Yes	3,955 (14.3%)	34 (6.9%)	0.9%*
Pre-GVA Multiple Sale (Federal Definition)			
No	32,994 (74.5%)	1,058 (78.0%)	3.2%
Yes	11,303 (25.5%)	299 (22.0%)	2.7%*
Post-GVA Multiple Sale (Federal Definition)			
No	24,951 (90.2%)	470 (95.3%)	1.9%
Yes	2,708 (9.8%)	23 (4.7%)	0.9%*

Recovery figures are based on police recoveries reported to ATF as of March 2000.
Pre-GVA sales include sales from January 1994 through September 1996. Post-GVA sales include sales from October 1996 through October 1999.
* Differences across groups statistically significant at p<=.01

Table 24. Time to Recovery in Baltimore by Transaction Characteristics (N=1,850 Guns Sold to Baltimore PMSA Buyers, 1994-Oct. 1999, and Recovered in Baltimore, 1994-March 2000)

Characteristic	Average Time to Recovery
Pre-GVA Multiple Sale (State Definition)	
No (N=1,016)	752 days (2.1 years)
Yes (N=341)	670 days (1.8 years)*
Post-GVA Multiple Sale (State Definition)	
No (N=459)	321 days (0.9 years)
Yes (N=34)	266 days (0.7 years)
Pre-GVA Multiple Sale (Federal Definition)	
No (N=1,058)	757 days (2.1 years)
Yes (N=299)	641 days (1.8 years)**
Post-GVA Multiple Sale (Federal Definition)	
No (N=470)	320 days (0.9 years)
Yes (N=23)	260 days (0.7 years)

Pre-GVA sales include sales from January 1990 through September 1996. Post-GVA sales include sales from October 1996 through October 1999.
*Differences across groups statistically significant at p<=.05
**Differences across groups statistically significant at p<=.01

Table 25. Gun Sales and D.C. Recoveries by Transaction Characteristics (N=48,039 Gun Sales to Buyers in D.C. PMSA, 1994-Oct. 1999)

Characteristic	Sales (% of All Sales)	Recoveries in DC (% of DC Recoveries)	% of Sales Resulting in Recovery
Pre-GVA Multiple Sale (State Definition)			
No	19,645 (69.6%)	298 (71.1%)	1.5%
Yes	8,563 (30.4%)	121 (28.9%)	1.4%
Post-GVA Multiple Sale (State Definition)			
No	16,606 (83.7%)	103 (93.6%)	0.6%
Yes	3,225 (166.3%)	7 (6.4%)	0.2%**
Pre-GVA Multiple Sale (Federal Definition)			
No	21,059 (74.7%)	306 (73.0%)	1.5%
Yes	7,149 (25.3%)	113 (27.0%)	1.6%
Post-GVA Multiple Sale (Federal Definition)			
No	17,461 (88.1%)	104 (94.6%)	0.6%
Yes	2,370 (12.0%)	6 (5.5%)	0.3%*

Recovery figures are based on police recoveries reported to ATF as of March 2000.
Pre-GVA sales include sales from January 1994 through September 1996. Post-GVA sales include sales from October 1996 through October 1999.
* Differences between groups statistically significant at p<=.05
** Differences between groups statistically significant at p<=.01

Table 26. Time to Recovery in D.C. by Transaction Characteristics (N=529 Guns Sold to D.C. PMSA Buyers, 1994-Oct. 1994, and Recovered in D.C., 1994-March 2000)

Characteristic	Average Time to Recovery
Pre-GVA Multiple Sale (State Definition)	
No (N=298)	661 days (1.8 years)
Yes (N=121)	667 days (1.8 years)
Post-GVA Multiple Sale (State Definition)	
No (N=103)	275 days (0.8 years)
Yes (N=7)	363 days (1.0 years)
Pre-GVA Multiple Sale (Federal Definition)	
No (N=306)	658 days (1.8 years)
Yes (N=113)	675 days (1.8 years)
Post-GVA Multiple Sale (Federal Definition)	
No (N=104)	273 days (0.7 years)
Yes (N=6)	412 days (1.1 years)

Pre-GVA sales include sales from January 1994 through September 1996. Post-GVA sales include sales from October 1996 through October 1999.

4.4. Sales and Recoveries by Dealer Characteristics

4.4.1. Dealer Characteristics Measured

Dealer information available from the MSP gun sales data included the name, location, and phone number of the gun dealer that made each sale, as well as information about the ownership of that business. In addition, project staff utilized ATF records to identify all pawnbrokers that operated as gun dealers in Maryland during the study period.[48] These sources were used to classify gun dealers in terms of type (regular dealer versus pawnbroker), years in business, size (as measured by sales volume), and proximity to Baltimore city and D.C.

Table 27 provides descriptive statistics on the full population of 629 dealers that were active between 1990 and 1999. **(**For this portion of the analysis, the firearms sales data were aggregated at the dealer level; hence, the units of observation are dealers rather than sales.) As will be discussed in further detail below, dealers sold an average of 374 guns during the study period and were linked to an average of 12 crime guns. Pawnbrokers accounted for approximately 7% of the dealers. Twenty-one percent of the dealers were located within 20 miles of Baltimore city (including those within the city), and 11% were located within 20 miles of D.C. On average, dealers were active for five years of the study period.

Table 27. Characteristics of Handgun Dealers (N=629 Dealers Active in Maryland, 1990-Oct. 1999)

Sales	Average=374, median=39
Recoveries	Average=12, median=0
Pawnshop	7%
Location (relative to cities)	34% in Baltimore PMSA (21% within 20 miles of Baltimore city) 23% in D.C. PMSA (11% within 20 miles of D.C.)
Years Active	Average = 5 years
Storefront	66%
"Gun Store"	63%
Multiple locations	10%

Recovery figures are based on national police recoveries reported to ATF as of March 2000

A few other potential dealer risk factors that were derived from the data require further explanation. First, each dealer was classified as having a storefront or residential location, approximated by whether the business and business owner's addresses were the same. By this criterion, two-thirds of the Maryland dealers were storefront dealers. At different points during the 1990s, the percentage of gun dealers nationwide that operated

[48] Electronic listings of federally-licensed gun dealers can be obtained from ATF via Basics Information Systems in Wheaton, Maryland.

from residential rather than commercial premises varied from 74% in 1992 (ATF, 1993) to 56% in 1998 (ATF, 2000a: 16). Due to resource constraints, ATF tended to focus its resources on larger, storefront dealers, thereby increasing opportunities for residential dealers to operate without regard to legal requirements for paperwork, background checks, waiting periods, and the like. Research in a few locations suggests that residential dealers can be important players in the illegal firearms market. A 1989-1990 ATF study of crime guns recovered in Detroit, for example, found that one-third of the dealers linked to 5 or more guns confiscated by police were residential dealers and that 6 of the 10 dealers most frequently linked to crime guns were residential dealers (Violence Policy Center, 1992: 78-82; also see Wachtel, 1998). Other evidence, however, suggests that residential dealers during this time were largely hobbyists who made few sales and were less likely to be linked to crime guns than larger storefront dealers (ATF, 1993; Koper, 2002).

A related characteristic is whether the dealer operated from a business normally associated with firearms, measured by whether the name of the business included terms like "guns", "firearms", "sporting goods", and the like. In 1998, most dealers operating out of commercial premises nationwide were located in businesses such as auto parts stores, funeral homes, and other businesses not normally associated with firearms (ATF, 2000a: 16). As with residential dealers, these less obvious gun dealers could be at greater or lesser risk of selling crime guns than more obvious, and typically larger, gun stores. Nearly two-thirds (63%) of the Maryland dealers had names clearly suggesting a business associated with firearms or sporting goods.

Finally, dealers were classified as having a single location or multiple locations; dealers were coded as the latter if they appeared to have the same name, owner, or phone number as any other dealer(s). This was done to approximate retail chain dealers and assess whether their management and/or visibility put them at differential risk of selling crime guns.[49] Ten percent of the Maryland dealers were thus categorized as multiple location businesses.

4.4.2. Analysis of All Sales and Recoveries, 1990-2000

The average number of sales per dealer was 374, and the median was 39 (note that these are not annual figures) (Table 27). As shown in Table 28, sales volume varied substantially among dealers; dealers ranking in the bottom 10% on sales volume sold 3 or fewer guns each for the entire period, while dealers in the top 10% sold over 900 per dealer.

The average number of crime guns linked to each dealer during the study period was 12, but most dealers (55%) were not linked to any crime guns (thus the median value was zero) (Table 28). The 63 dealers ranking in the top ten percent on the number of

[49] Unfortunately, the number of each dealer's prospective buyers whose purchases were denied because of a background check was not available. Other research has shown this to be a predictor of the number of crime guns with which a dealer is associated (Wintemute et al., 2005).

recoveries were each linked to 14 or more recovered guns and together sold over 90% of all recovered guns. (In large part, these were also the dealers that sold the most guns.)

Table 28. Distribution of Gun Sales and Recoveries among Dealers (N=629 Dealers Active in Maryland, 1990-Oct. 1999)

	Sales	Recoveries	Recoveries per Sale
10th percentile	3	0	0
25th percentile	11	0	0
Median	39	0	0
75th percentile	203	3	0.02
90th percentile	922	14	0.04
Maximum	10,498	827	0.33

Recovery figures are based on national police recoveries reported to ATF as of March 2000

The final column of Table 28 shows that recoveries per sale ranged from zero to 0.33 (or, 33%). For dealers ranking in the 90th percentile or higher, roughly 4% or more of their sales resulted in police recoveries. Some of the dealers with the largest ratios of recoveries to sales were small dealers who made very few sales and were linked to few recoveries; for example, the maximum ratio value of 0.33 was attributable to two dealers who each had three sales resulting in one recovery. Perhaps more importantly, there was notable variation in the recovery to sale ratio among dealers linked to large numbers of gun recoveries. Among the ten dealers who sold the most crime guns, for instance, the recovery per sale figure ranged from 0.022 to 0.191 (in percentage terms, from 2.2% to 19.1%). This demonstrates that there is substantial variation in risk levels among dealers connected to the most crime guns, a factor that may be useful to law enforcement and regulatory agencies responsible for regulation of gun dealers.

Table 29 provides further illustration of the distribution of crime gun sales among dealers. Forty-five percent of the dealers sold at least one gun that was recovered by police during the study period. However, just 5%—31 dealers—sold at least 50 crime guns each and accounted for more than three-quarters of all crime gun sales.

Table 29. Distribution of Gun Recoveries among Dealers (N=629 Dealers Active in Maryland, 1990-Oct. 1999)

Sales of Recovered Guns	Percentage (and Number) of Dealers	Percentage of Recoveries
1 or more	45% (284)	100%
5 or more	22% (138)	96%
10 or more	14% (88)	92%
25 or more	7% (44)	84%
50 or more	5% (31)	78%

Recovery figures are based on national police recoveries reported to ATF as of March 2000

Table 30 and Table 31 contrast sale and recovery figures for different categories of dealers. Referring to the last two columns of these tables, the dealers who were most likely to have sold crime guns and who had the highest percentages of sales resulting in recovery were pawnbrokers, older dealers (particularly those that had been operating for more than 2 or 3 years), high volume dealers, dealers close to Baltimore or D.C., storefront dealers, gun shops, and multiple location businesses. For example, 80% of pawnbrokers had sold at least one recovered firearm, whereas only 42.8% of regular dealers had sold any crime guns. On average, 3.9% of pawnbrokers' sales resulted in recovery in contrast to 1.4% of sales made by other dealers.

Some of these risk factors were also evident in the time to recovery analysis (Tables 32 and 33). Time to recovery was generally shorter for guns sold by pawnbrokers, dealers close to urban areas (though these differences were not statistically significant), storefront dealers, gun shops, and dealers with multiple locations.

4.4.3. Local Analyses, 1994-2000

The local analyses focus on the comparisons of sales, recoveries, and time to recovery across dealer categories (see tables 34 through 41). As in the full analysis, dealers in the Baltimore and D.C. areas were more likely to have sold crime guns and to have a higher percentage of their sales recovered if they were: pawnbrokers; older, larger, storefront, or multiple location dealers; gun shops; or dealers located in or close to high crime areas. However, time to recovery patterns were more mixed. (Since the number of dealers involved in some of these analyses was very small, statistical significance tests are not emphasized.)

Table 30. Gun Sales and Recoveries by Dealer Characteristics (N=629 Dealers Active in Maryland, 1990-Oct. 1999)

Characteristic	Sales (avg.)	Recoveries (avg.)	% With Recoveries	% of Sales Recovered (avg.)
Dealer Type				
Pawnbroker (N=40)	593	25	80.0%	3.9%
Other dealer (N=589)	359	11	42.8%**	1.4%**
Years in Business				
0-1 yr (N=74)	5	0	2.7%	0.6%
1-2 yrs (N=107)	36	1	21.5%	1.1%
2-3 yrs (N=65)	66	1	38.5%	1.3%
3-4 yrs (N=71)	185	4	56.3%	1.5%
4-5 yrs (N=62)	201	4	53.2%	2.1%
5-6 yrs (N=51)	492	22	60.8%	2.6%
6-7 yrs (N=34)	289	5	55.9%	1.7%
7-8 yrs (N=26)	309	6	53.9%	2.0%
8-9 yrs (N=27)	350	6	59.3%	0.9%
9-10 yrs (N=42)	224	5	52.4%	1.5%
10+yrs (N=70)	1,988	73	84.3%**	2.4%*
Dealer Size (sales volume)				
<= 25th percentile (N=155)	6	0	7.1%	1.2%
26th-50th percentile (N=160)	28	0	18.8%	0.8%
51st-75th percentile (N=157)	98	1	56.1%	1.6%
>75th percentile (N=157)	1,365	46	98.7%**	2.6%**
Distance to Baltimore				
<=10 miles (N=75)	823	43	65.3%	3.0%
11-20 miles (N=59)	507	14	52.5%	1.3%
>20 miles (N=495)	290	7	41.2%**	1.3%**
Distance to DC				
<=10 miles (N=30)	647	45	60.0%	3.7%
11-20 miles (N=42)	479	18	35.7%	1.6%
>20 miles (N=557)	351	10	45.1%	1.4%**

Recovery figures are based on national police recoveries reported to ATF as of March 2000

* Differences statistically significant at p<=.05

** Differences statistically significant at p<=.01

Table 31. Gun Sales and Recoveries by Dealer Characteristics (N=629 Dealers Active in Maryland, 1990-Oct. 1999)

Characteristic	Sales (avg.)	Recoveries (avg.)	% With Recoveries	% of Sales Recovered (avg.)
"Storefront" (N=415)	519	18	54.2%	1.7%
"Home-based" (N=214)	91	1	27.8%**	1.2%*
"Gun" store (N=449)	480	16	53.9%	1.9%
Other business (N=180)	108	2	23.3%**	0.7%**
Multiple locations (N=64)	663	25	75.0%	2.8%
Single location (N=565)	341	11	41.8%**	1.4%**

Recovery figures are based on national police recoveries reported to ATF as of March 2000
* Differences statistically significant at p<=.05
** Differences statistically significant at p<=.01

Table 32. Time to Recovery by Gun Dealer Characteristics (N=284 Dealers That Sold Guns Recovered by Police, 1990-March 2000)

Characteristic	Average Time to Recovery
Dealer Type	
Pawnbroker (N=32)	715 days (2.0 years)
Other dealer (N=252)	1,144 days (3.1 years)*
Years in Business	
0-1 yr (N=2)	864 days (2.4 years)
1-2 yrs (N=23)	1,344 days (3.7 years)
2-3 yrs (N=25)	904 days (2.5 years)
3-4 yrs (N=40)	1,059 days (2.9 years)
4-5 yrs (N=33)	1,143 days (3.1 years)
5-6 yrs (N=31)	1,035 days (2.8 years)
6-7 yrs (N=19)	1,123 days (3.1 years)
7-8 yrs (N=14)	1,246 days (3.4 years)
8-9 yrs (N=16)	1,118 days (3.1 years)
9-10 yrs (N=22)	1,100 days (3.0 years)
10+yrs (N=59)	1,067 days (2.9 years)
Dealer Size (sales volume)	
<= 25th percentile (N=11)	1,425 days (3.9 years)
26th-50th percentile (N=30)	1,022 days (2.8 years)
51st-75th percentile (N=88)	1,159 days (3.2 years)
>75th percentile (N=155)	1,051 days (2.9 years)
Distance to Baltimore	
<=10 miles (N=49)	1,023 days (2.8 years)
11-20 miles (N=31)	1,005 days (2.8 years)
>20 miles (N=204)	1,127 days (3.1 years)
Distance to DC	
<=10 miles (N=18)	842 days (2.3 years)
11-20 miles (N=15)	1,111 days (3.0 years)
>20 miles (N=251)	1,113 days (3.0 years)

* Differences between groups statistically significant at p<=.01

Table 33. Time to Recovery by Gun Dealer Characteristics (N=284 That Sold Guns Recovered by Police, 1990-March 2000)

Characteristic	Average Time to Recovery
"Storefront" (N=225)	1,042 days (2.9 years)
"Home-based" (N=59)	1,302 days (3.6 years)*
"Gun" store (N=242)	1,056 days (2.9 years)
Other business (N=42)	1,329 days (3.6 years)**
Multiple locations (N=48)	898 days (2.5 years)
Single location (N=236)	1,136 days (3.1 years)*

* Differences between groups statistically significant at p<=.05
** Differences between groups statistically significant at p<=.01

Table 34. Gun Sales and Baltimore Recoveries by Gun Dealer Characteristics (N=214 Dealers Active in the Baltimore PMSA, 1994-Oct. 1999)

Characteristic	Sales (avg.)	Recoveries (avg.)	% With Recoveries	% of Sales Recovered (avg.)
Dealer Type				
Pawnbroker (N=23)	598	19	60.9%	2.7%
Other dealer (N=191)	314	7	39.3%**	1.2%
Years in Business				
0-1 yr (N=15)	5	0	0%	0%
1-2 yrs (N=29)	13	0	13.8%	0.9%
2-3 yrs (N=21)	73	1	28.6%	0.9%
3-4 yrs (N=19)	222	3	57.9%	0.9%
4-5 yrs (N=23)	99	2	21.7%	0.9%
5-6 yrs (N=28)	546	15	67.9%	2.8%
6-7 yrs (N=10)	169	2	50.0%	1.4%
7-8 yrs (N=12)	258	4	50.0%	1.3%
8-9 yrs (N=11)	238	1	45.5%	0.5%
9-10 yrs (N=16)	219	3	37.5%	1.9%
10+yrs (N=30)	1303	40	73.3%**	2.0%*
Dealer Size				
<= 25th percentile (N=54)	5	0	7.4%	0.8%
26th-50th percentile (N=53)	26	0	17.0%	0.9%
51st-75th percentile (N=54)	133	1	48.2%	1.3%
>75th percentile (N=53)	1,225	33	94.3%***	2.4%**
Distance to Baltimore				
<=10 miles (N=62)	559	22	54.8%	2.3%
11-20 miles (N=47)	441	8	51.1%	1.3%
>20 miles (N=105)	174	1	29.5%***	0.8%***

Recovery figures are based on police recoveries reported to ATF as of March 2000

* Differences across groups statistically significant at p<=.1

** Differences across groups statistically significant at p<=.05

*** Differences across groups statistically significant at p<=.01

Table 35. Gun Sales and Baltimore Recoveries by Gun Dealer Characteristics (N=214 Dealers Active in the Baltimore PMSA, 1994-Oct. 1999)

Characteristic	Sales (avg.)	Recoveries (avg.)	% With Recoveries	% of Sales Recovered (avg.)
"Storefront" (N=157)	435	12	50.3%	1.6%
Non-storefront (N=57)	95	0	17.5%**	0.6%**
"Gun" store (N=156)	440	12	51.3%	1.7%
Other business (N=58)	87	1	15.5%**	0.4%**
Multiple locations (N=23)	725	26	73.9%	3.4%
Single location (N=191)	299	7	37.7%**	1.1%*

Recovery figures are based on police recoveries reported to ATF as of March 2000
* Differences between groups statistically significant at p<=.05
** Differences between groups statistically significant at p<=.01

Table 36. Time to Recovery by Gun Dealer Characteristics (N=89 Baltimore PMSA Dealers That Sold Guns Recovered in Baltimore, 1994-March 2000)

Characteristic	Average Time to Recovery
Dealer Type	
Pawnbroker (N=14)	727 days (2.0 years)
Other dealer (N=75)	667 (1.8 years)
Years in Business	
0-1 yr (N=15)	N/A
1-2 yrs (N=4)	638 days (1.7 years)
2-3 yrs (N=6)	512 days (1.4 years)
3-4 yrs (N=11)	592 days (1.6 years)
4-5 yrs (N=5)	417 days (1.1 years)
5-6 yrs (N=19)	761 days (2.1 years)
6-7 yrs (N=5)	805 days (2.2 years)
7-8 yrs (N=6)	934 days (2.6 years)
8-9 yrs (N=5)	806 days (2.2 years)
9-10 yrs (N=6)	612 days (1.7 years)
10-11 yrs (N=22)	646 days (1.8 years)
Dealer Size	
<= 25th percentile (N=4)	374 days (1.0 years)
26th-50th percentile (N=9)	557 days (1.5 years)
51st-75th percentile (N=26)	866 days (2.4 years)
>75th percentile (N=50)	624 days (1.7 years)*
Distance to Baltimore	
<=10 miles (N=34)	683 days (1.9 years)
11-20 miles (N=24)	612 days (1.7 years)
>20 miles (N=31)	720 days (2.0 years)

* Differences statistically significant at p<=.05

Table 37. Time to Recovery by Gun Dealer Characteristics (N=89 Baltimore PMSA Dealers That Sold Guns Recovered in Baltimore, 1994-March 2000)

Characteristic	Time to Recovery (avg.)
"Storefront" (N=79)	689 days (1.9 years)
Non-storefront (N=10)	580 days (1.6 years)
"Gun" store (N=80)	648 days (1.8 years)
Other business (N=9)	935 days (2.6 years)
Multiple locations (N=17)	603 days (1.7 years)
Single location (N=72)	694 days (1.9 years)

Table 38. Gun Sales and D.C. Recoveries by Gun Dealer Characteristics (N=144 Dealers Active in the D.C. PMSA, 1994-Oct. 1999)

Characteristic	Sales (avg.)	Recoveries (avg.)	% With Recoveries	% of Sales Recovered (avg.)
Dealer Type				
Pawnbroker (N=10)	106	3	40.0%	2.1%
Other dealer (N=134)	327	4	17.2%*	0.2%
Years in Business				
0-1 yr (N=10)	8	0	0%	0%
1-2 yrs (N=21)	22	0	4.8%	0.3%
2-3 yrs (N=14)	75	0	14.3%	0.1%
3-4 yrs (N=15)	66	0	6.7%	0.0%
4-5 yrs (N=14)	260	1	14.3%	0.7%
5-6 yrs (N=9)	134	5	22.2%	0.8%
6-7 yrs (N=12)	124	1	8.3%	0.2%
7-8 yrs (N=8)	268	2	25.0%	0.4%
8-9 yrs (N=10)	255	1	20.0%	0.1%
9-10 yrs (N=11)	65	1	9.1%	0.3%
10+yrs (N=20)	1,531	20	65.0%**	0.7%
Dealer Size (sales volume)				
<= 25th percentile (N=36)	4	0	0%	0%
26th-50th percentile (N=36)	20	0	0%	0%
51st-75th percentile (N=36)	66	0	11.1%	0.5%
>75th percentile (N=36)	1,158	14	63.9%**	0.8%**
Distance to DC				
<=10 miles (N=25)	451	11	28.0%	1.1%
11-20 miles (N=33)	333	5	18.2%	0.3%
>20 miles (N=86)	264	1	16.3%	0.1%**

Recovery figures are based on police recoveries reported to ATF as of March 2000
* Differences across all groups statistically significant at p<=.1
** Differences across all groups statistically significant at p<=.01

Table 39. Gun Sales and D.C. Recoveries by Gun Dealer Characteristics (N=144 Dealers Active in the D.C. PMSA, 1994-Oct. 1999)

Characteristic	Sales (avg.)	Recoveries (avg.)	% With Recoveries	% of Sales Recovered (avg.)
"Storefront" (N=99)	440	5	25.3%	0.5%
Non-storefront (N=45)	31	0	4.4%**	0.0%**
"Gun" store (N=104)	380	5	23.1%	0.5%
Other business (N=40)	135	1	7.5%*	0.0%**
Multiple locations (N=19)	558	4	36.8%	0.5%
Single location (N=125)	275	3	16.0%*	0.3%

Recovery figures are based on police recoveries reported to ATF as of March 2000
* Differences between groups statistically significant at p<=.05
** Differences between groups statistically significant at p<=.01

Table 40. Time to D.C. Recovery by Gun Dealer Characteristics (N=27 D.C. PMSA Dealers That Sold Guns Recovered in D.C., 1994-March 2000)

Characteristic	Average Time to Recovery
Dealer Type	
Pawnbroker (N=4)	443 days (1.2 years)
Other dealer (N=23)	706 days (1.9 years)
Years in Business	
0-1 yr (N=0)	N/A
1-2 yrs (N=1)	268 days
2-3 yrs (N=2)	396 days
3-4 yrs (N=1)	565 days
4-5 yrs (N=2)	375 days
5-6 yrs (N=2)	1,147 days
6-7 yrs (N=2)	989 days
7-8 yrs (N=2)	655 days
8-9 yrs (N=2)	1,000 days
9-10 yrs (N=1)	712 days
10+ yrs (N=13)	641 days
Dealer Size	
<= 25th percentile (N=0)	N/A
26th-50th percentile (N=0)	N/A
51st-75th percentile (N=4)	684 days (1.9 years)
>75th percentile (N=23)	664 days (1.8 years)
Distance to DC	
<=10 miles (N=7)	504 days (1.4 years)
11-20 miles (N=6)	605 days (1.7 years)
>20 miles (N=14)	775 days (2.1 years)

Table 41. Time to D.C. Recovery by Gun Dealer Characteristics (N=27 D.C. PMSA Dealers That Sold Guns Recovered in D.C., 1994-March 2000)

Characteristic	Average Time to Recovery
"Storefront" (N=25)	675 days (1.8 years)
Non-storefront (N=2)	568 days (1.6 years)
"Gun" store (N=24)	676 days (1.9 years)
Other business (N=3)	594 days (1.6 years)
Multiple locations (N=7)	541 days (1.5 years)
Single location (N=20)	712 days (2.0 years)

5. ASSESSING CRIME GUN RISK FACTORS WITH UNIVARIATE AND MULTIVARIATE SURVIVAL ANALYSES

This chapter examines the relationships between hypothesized risk factors and gun recovery more rigorously using methods of survival analysis, a group of statistical techniques for analyzing the occurrence and timing of events (Allison, 1995). These methods were used to analyze the time from each handgun's sale in Maryland until its recovery by police or the end of the study period (March 2000), whichever came first. In the latter case, an observation was censored, meaning that we know only that the gun was not recovered—i.e., that it "survived"—during the time that elapsed between its sale and the end of the study period. Survival analysis techniques were developed specifically for the study of censored data. These methods allow us to control for the time during which each firearm was observed to be at-risk of criminal use and to assess the simultaneous influence of buyer, dealer, firearm, and transaction characteristics on the likelihood and timing of firearm recovery.

5.1. Probability of Police Recovery: Univariate Survival Analyses

5.1.1. Analysis of All Sales and Recoveries, 1990-2000

Table 42 shows the probability that handguns purchased in Maryland were recovered anywhere and reported to ATF within selected follow-up periods. These estimates are based on the life table method of survival analysis.[50] They differ from the recovery percentages presented in Chapter 4 because the life table estimates adjust for censoring and thus account for differences in follow-up time for guns sold at different points during the study period.

Overall, handguns sold in Maryland had a 1% chance of being recovered by police within one year of sale, a 3.2% chance of recovery within five years, and a 4.7% chance recovery within 10 years. We can expect therefore that roughly 5% of the guns sold in Maryland during the study period were recovered by police somewhere in the nation within 10 years. These are only minimum estimates of recovery, however,

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[50] In the life table method, the analyst groups the event times into intervals of a chosen length – in this application, one year – and calculates S_t, which is the probability that the case "survived" (i.e., did not experience the event of interest) to the start of interval t. For each interval, the value of S_t is based on the probabilities of events occurring in prior intervals. For example, the probability of surviving to the third interval or beyond would be the product of $(1-q_1)(1-q_2)$, where q_1 and q_2 represent the probabilities of events occurring during intervals 1 and 2, respectively. For a given interval, the probability of an event (conditional on survival to the start of the interval) is denoted as $q = d / (n – m/2)$, where d equals the number of events occurring during the interval, n refers to the sample at risk at the start of the interval (i.e., the number of cases that haven't experienced an event or been censored by the start of the interval), and m is the number of cases censored during the interval (Teachman, 1983:270). For further discussion of the life table method, see Allison (1995) and Teachman (1983).

The values presented in Table 42 are based on $1-S_t$. To illustrate, the probability that a handgun survived (i.e., was not recovered by police) to the start of year 2 was 0.9901. Conversely, the probability that the gun was recovered by the start of year 2 was 1-0.9901, or about .01**,** which is presented in Table 42 as the probability that the gun was recovered within 1 year.

because they are based on only those guns that police reported to ATF for tracing. (As discussed earlier, gun tracing is voluntary.)

Table 42. Likelihood of Gun Recovery within Selected Periods (N=235,011 Guns Sold in Maryland, 1990-Oct. 1999)

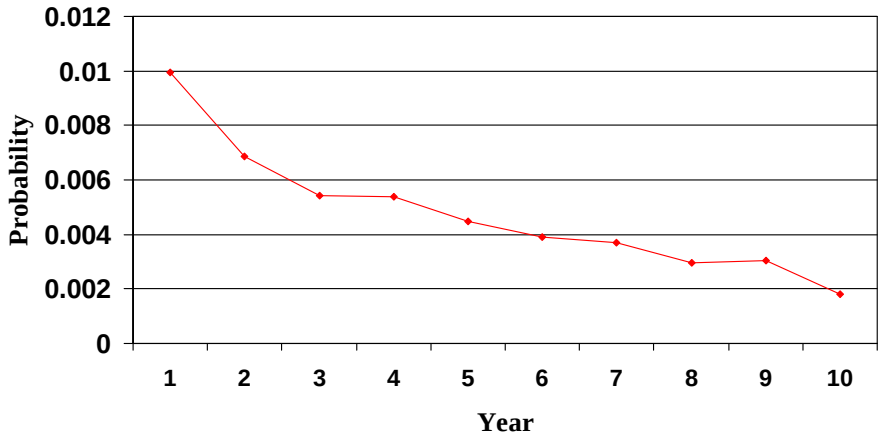
Follow-Up Time	Probability of Recovery (Cumulative)
1 year	1.0%
2 years	1.7%
3 years	2.2%
4 years	2.7%
5 years	3.2%
6 years	3.6%
7 years	3.9%
8 years	4.2%
9 years	4.5%
10 years	4.7%

Life table estimates
Recovery estimates are based on national police recoveries reported to ATF as of March 2000

Figure 4 shows the probability that a gun was recovered within a particular year, given that the gun had not been recovered by the start of that year. For the full sample of sales and recoveries, guns had a 1% chance of being recovered within a year of being sold. Given that a gun was not recovered within its first year of circulation, it had an approximately 0.6% chance of recovery during its second year, and so on.[51] This graph reveals that guns were at greatest risk of criminal use soon after sale – in other words, when they were new. This lends support to the "new guns" hypothesis (Zimring, 1976; also see Pierce et al., 2003), which states that criminals make disproportionate use of newer firearms, and it helps demonstrate the importance of retail market diversion in supplying illegal gun markets. It also suggests that criminals and traffickers prefer newer firearms.

[51] These are not estimates of the hazard rate (a survival analysis statistic to be discussed later), but they are roughly comparable (the hazard rate follows the same general pattern shown in Figure 4).

Figure 4. Probability of Recovery By Year of Follow-Up



Based on recoveries by police throughout the nation and reported to ATF, 1990-March 2000

5.1.2. Local Analyses, 1994-2000

Turning to the local analyses, guns sold after 1993 to buyers in the Baltimore PMSA had a 3.2% chance of being recovered by police in Baltimore within 5 years (Table 43). Guns sold after 1993 to buyers in the Maryland suburbs of D.C. had a 1.4% chance of recovery in D.C. within 5 years (Table 44). (The local analyses focus on recovery probabilities up to five years because most of the guns had less than six years of potential follow-up time.) As in the national analysis, guns were at greatest risk of recovery in the first year after sale, and this risk declined over time (graph not shown).

Table 43. Likelihood of Baltimore Gun Recovery within Selected Periods (N=71,956 Guns Sold to Baltimore PMSA Buyers, 1994-Oct. 1999)

Follow-Up Time	Probability of Recovery (Cumulative)
1 year	1.1%
2 years	1.8%
3 years	2.3%
4 years	2.8%
5 years	3.2%

Life table estimates
Recovery estimates are based on police recoveries reported to ATF as of March 2000

Table 44. Likelihood of D.C. Gun Recovery within Selected Periods (N=48,039

Follow-Up Time	Probability of Recovery (Cumulative)
1 year	0.5%
2 years	0.8%
3 years	1.0%
4 years	1.2%
5 years	1.4%

Life table estimates
Recovery estimates are based on police recoveries reported to ATF as of March 2000

5.2. Assessing the Simultaneous Influences of Buyer, Firearm, Transaction, and Dealer Characteristics on Gun Recovery: Multivariate Survival Analyses

Having examined the overall probability of gun recovery, we now consider how that probability was influenced by the characteristics of buyers, sellers, firearms, and transactions. The bivariate analyses in Chapter 4 revealed numerous factors that were related to gun recovery. However, these factors may be related in various ways that affect their utility as crime gun and trafficking indicators. For example, cheap handguns were at higher risk of recovery by police in the bivariate analyses. Yet if cheap handguns were more likely to be purchased in areas of lower income and higher crime, then accounting for the buyer's area of residence might eliminate or reduce the apparent relationship between cheap handguns and criminal gun use.

To provide a contrasting example, multiple sales did not appear to be a strong risk factor in Chapter 4. However, multiple sales were associated with other factors like buyer demographics that could have obscured the relationship between multiple sales and gun recovery. Older gun buyers and white gun buyers, for instance, were more likely to purchase guns in multiple sales, but the guns they purchased were less likely to be used in crime. Indeed, an earlier study conducted with some of the data examined here revealed that multiple sales were a risk factor for criminal gun use after controlling for the buyer's demographics and area of residence (Koper, 2005).

Therefore, to provide a more rigorous assessment of potential crime gun risk factors, a series of multivariate survival models were estimated to test the simultaneous influence of buyer, seller, firearm, and transaction characteristics on the likelihood of gun recovery.[52]

5.2.1. Methodological Approach

The following variables were selected for the survival models based on the results of the analyses in Chapter 4, preliminary modeling, and other considerations such as sample sizes and policy relevance.

> *Buyer characteristics:* gender; race (categorized as white, black, and other or as white and non-white); age measured in years (the square of the buyer's age was also included to examine whether the age effect changed over the life span—that is, to test for a non-linear effect); whether the buyer had been linked to any prior gun recoveries as of the sale date (coded as yes/no); and county of residence.
>
> *Firearm characteristics*: gun type, classified as semiautomatic versus others (semiautomatics included regular semiautomatic pistols and semiautomatic assault weapons); small, medium, or large caliber; small size, approximated by

[52] This study utilizes methods similar to those used by Pierce et al. (2003; 2004), who employed survival analysis to ascertain the association between time to recovery and various characteristics of buyers, sellers, possessors, and firearms. Direct comparisons between this study and the work of Pierce et al. are complicated, however, by a number of considerations. The Pierce et al. work was a time to crime study based on national and local samples of recovered firearms (the researchers employed survival analysis because some recovery times could only be measured as a lower bound). This study, in contrast, is a risk assessment analysis that compares guns recovered by police to guns not recovered by police in order to determine which guns are most likely to be used in crime. Further, the variables available for analysis differed substantially between the studies. Focusing on variables most comparable to those used in this study, the Pierce et al. analysis suggested that guns reached criminal users more quickly when sold by pawnbrokers, dealers that sold higher numbers of recovered guns, and dealers that made higher numbers of multiple sales; when purchased by younger buyers, buyers linked to prior firearm recoveries, and buyers from high-crime areas (as approximated by the number of crime guns traced to the buyer's zip code); and when the firearm was a semiautomatic pistol. (Other key findings from that study (cited in Chapter 2) showed that guns had shorter recovery times when sold by dealers selling older guns and by dealers with higher numbers of prospective buyers that failed a background check; when sold in states having less stringent gun purchasing laws; when the purchaser and eventual possessor of the gun were closer in age and geographic proximity; when the purchaser and eventual possessor of the gun were family members or known associates; and when final possessor was younger.) Finally, Pierce et al. utilized a stepwise modeling procedure in which dealer variables were entered into the model before other variable groups (thus forcing dealer variables to take precedence over others) based on the argument that dealer characteristics are temporally antecedent to other factors in the trafficking process. Although the causal ordering issue is arguably uncertain (e.g., honest dealers may unknowingly sell to straw purchasers), the stepwise approach was also consistent with Pierce et al.'s emphasis on the development of gun trafficking indicators for use by law enforcement—particularly ATF, which is responsible for regulation of gun dealers. Because the current study has a broader emphasis on a variety of policy issues besides dealer regulation and gun trafficking investigation (e.g., regulation of multiple sales, regulation of SNS-type firearms, and regulation of secondhand sales)—and because of uncertainty regarding the causal ordering of suspected risk factors—stepwise modeling is not used here. This study also controls for dependence between guns sold by the same dealer.

whether the gun had a barrel of three inches or less; and low quality/cheap gun, based on whether the gun was made by a manufacturer specializing in guns priced at $150 or less.[53]

Transaction characteristics: an indicator for multiple sales as defined by federal regulations (i.e., the purchase of multiple handguns by the same person from the same dealer within a five day span);[54] an indicator for sales made after Maryland's Gun Violence Act of 1996 (GVA); and an indicator for multiple sales made after the GVA (i.e., an interaction term between the multiple sale and GVA indicators).

Dealer characteristics: dealer type, classified as regular or pawnbroker; the number of years the dealer had been in business as of the sale date; the number of prior sales made by the dealer that had resulted in a gun recovery as of the sale date; the dealer's proximity to Baltimore and/or Washington, D.C.; the dealer's size as measured by sales volume during the year in which the sale was made;[55] and separate indicators for storefront dealers, gun shop/sporting goods stores, and retail chain dealers.

The simultaneous effects of these factors on gun recovery were assessed using Cox proportional hazards models. These models provide estimates of how the selected characteristics affected a gun's "hazard rate", which essentially represents the risk that the event of interest—in this case, a recovery—occurred at a given point in time, conditional on the event not having occurred prior to that point.[56] In addition to the variables listed above, the models also included the year of sale. This was done to control for each gun's potential follow-up period (i.e., its time at-risk) as well as for temporal trends in crime and gun tracing that may have influenced the results. The

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[53] Preliminary modeling indicated that the variability in gun recovery can be explained as well by a gun's manufacturer as it can be by the characteristics discussed above. However, the firearm characteristics used in the models discussed in the text represent the characteristics that explain why certain gun makes are at greater risk of criminal use, and they are more directly relevant to policymaking.

[54] Preliminary modeling suggested that guns sold in federally-defined multiple sales (see the definition above) were at somewhat higher risk of recovery than were guns sold in sales meeting the broader state definition of a multiple sale (i.e., the purchase of multiple handguns by one individual from any dealer(s) within a 30-day period).

[55] Other things being equal, we can expect that dealers who sold more guns were linked to higher numbers of gun recoveries (see Chapter 4 and Wintemute et al., 2005). Because this analysis focuses on the risk that each firearm was used in crime (as opposed to the number of guns traced back to a dealer), sales volume is largely factored out. Nonetheless, dealer size was included in the models to determine whether larger dealerships—which were presumably more well-known and accessible—were at greater or lesser risk for selling crime guns than were smaller dealerships, which may have catered to a different class of customers.

[56] The Cox proportional hazards model is often expressed as: $h_i(t) = \lambda_0(t)\exp(B_1x_{i1}+\ldots+B_kx_{ik})$, where $h_i(t)$ represents the hazard for subject i at time t, $\lambda_0(t)$ represents a baseline hazard function (which can be regarded as the hazard function for a subject whose covariates all have values of zero), x_{i1} through x_{ik} represent a set of fixed covariates, and B_1 through B_k represent the effects of those covariates (these effects are then exponentiated) (Allison, 1995: 113-114). The model assumes that the ratio of the hazards for any two subjects remains constant over time (i.e., that they remain proportional to one another) but makes no assumption about the distribution, or shape, of the baseline hazard rate.

models were estimated with robust standard errors **(**Lin and Wei, 1989**)** that were also adjusted for dependence between guns sold by the same dealer.[57]

5.2.2. Model for All Sales and Recoveries, 1990-2000

Table 45 presents the results of models based on all sales and recoveries. The effect of each indicator is presented as a hazard ratio, which shows the indicator's multiplicative impact on the hazard rate of recovery. If the ratio is greater than one, it indicates that the characteristic in question increased the hazard; a ratio less than one shows that the characteristic reduced the hazard. If the buyer was male, for example, the hazard was reduced by a factor of 0.819 (second column of Table 45). This effect can also be expressed in percentage terms by subtracting one from the hazard ratio and multiplying the difference by 100. Thus, the hazard of recovery was reduced by (0.819-1)*100 = 18.1% when the buyer was male (in other words, the hazard was 18.1% lower for males than for females). Ninety-five percent confidence intervals are also presented showing a likely range for each estimated hazard ratio (coefficients that were statistically significant at the 5% level are listed in bold).

To provide another illustration, the race indicators show the impact of black and white buyers relative to buyers of other races (the latter serve as the omitted reference category for the race variables). The hazard ratio for black buyers indicates that the hazard of recovery was 2.4 times higher when the buyer was black than when the buyer was of another non-white race. Alternatively, we can say that hazard of recovery was increased by (2.408-1)*100 = 140.8% for guns purchased by black buyers. For guns purchased by white buyers, on the other hand, the hazard was reduced by a factor of 0.6, which amounts to a decrease of 40% relative to guns bought by other non-black buyers.

[57] Estimation was done using procedure PHREG in SAS software, version 9.1.3.

Table 45. Effects of Buyer, Firearm, Transaction, and Dealer Characteristics on Risk of Police Recovery: Cox Proportional Hazards Model Estimates (N=235,011 Gun Sales in Maryland, 1990-1999)

	Hazard Ratios and 95% Confidence Intervals	
	All Recoveries	**Recovery From Possessor Who Was Not Buyer**
Buyer Characteristics:		
Male	**0.819** (0.750 – 0.894)	**0.664** (0.598-0.737)
Black	**2.408** (2.056-2.820)	**2.625** (2.044-3.370)
White	**0.601** (0.502-0.719)	**0.751** (0.586-0.961)
Age	**0.891** (0.876-0.906)	**0.903** (0.884-0.922)
Age sq.	**1.001** (1.001-1.001)	**1.001** (1.001-1.001)
Prior crime gun	**1.599** (1.404-1.820)	**1.700** (1.422-2.032)
Anne Arunel Co.	**1.379** (1.138-1.670)	**1.670** (1.267-2.200)
Balt. City	**2.647** (2.185-3.231)	**3.354** (2.547-4.417)
Balt. Co.	**1.793** (1.495-2.152)	**2.395** (1.836-3.125)
Calvert Co.	1.083 (0.858-1.368)	1.168 (0.725-1.884)
Carroll Co.	**1.386** (1.090-1.762)	**1.742** (1.227-2.475)
Charles Co.	**1.481** (1.128-1.943)	**1.567** (1.055-2.328)
Fredrick Co.	0.834 (0.573-1.215)	1.216 (0.739-2.003)
Hartford Co.	1.263* (0.982-1.626)	**1.727** (1.255-2.377)
Howard Co.	1.198 (0.942-1.525)	**1.654** (1.191-2.297)
Montgomery Co.	**1.316** (1.089-1.592)	1.284* (0.974-1.693)
Prince George's Co.	**1.946** (1.620-2.339)	**1.902** (1.430-2.528)
Queen Anne Co.	1.251 (0.779-2.009)	**1.909** (1.007-3.621)
Firearm Characteristics:		
Semiautomatic	**1.383** (1.301-1.471)	**1.466** (1.349-1.595)
Medium caliber	**1.632** (1.484-1.796)	**1.859** (1.612-2.144)
Large caliber	**1.500** (1.338-1.681)	**1.784** (1.523-2.091)
Barrel<=3"	**1.189** (1.101-1.284)	**1.174** (1.064-1.295)
Cheap gun	**1.627** (1.428-1.854)	**2.005** (1.710-2.351)

	Hazard Ratios and 95% Confidence Intervals	
	All Recoveries	**Recovery From Possessor Who Was Not Buyer**
Transaction Characteristics:		
Multiple sale	**1.160**	**1.232**
	(1.061-1.268)	(1.117-1.359)
Post-GVA	1.141	1.060
	(0.891-1.461)	(0.776-1.447)
Post-GVA multiple sale	**0.627**	0.759
	(0.433-0.907)	(0.479-1.203)
Dealer Characteristics:		
Pawnbroker	1.012	1.139
	(0.812-1.263)	(0.917-1.416)
Years in business	0.977	0.969
	(0.942-1.013)	(0.930-1.010)
Prior crime guns	**1.001**	**1.001**
	(1.001-1.002)	(1.001-1.002)
Storefront	**1.256**	1.173
	(1.042-1.514)	(0.915-1.503)
Multiple locations	1.069	1.047
	(0.919-1.243)	(0.894-1.226)
Gun/sporting store	1.184	1.154
	(0.961-1.460)	(0.898-1.482)
Sales for year	1.000	**0.9999**
	(1.000-1.000)	(1.000-1.000)
<=5 miles from city	**2.077**	**2.035**
	(1.544-2.792)	(1.542-2.686)
6-10 miles from city	**1.494**	**1.569**
	(1.317-1.696)	(1.349-1.825)
11-15 miles from city	**1.290**	**1.416**
	(1.104-1.507)	(1.172-1.712)
16-20 miles from city	**1.165**	**1.171**
	(1.012-1.340)	(1.022-1.343)

Coefficients in bold were statistically significant at p<=.05. Coefficients denoted by (*) were statistically significant at p<=.10. Estimates are based on separate analyses of: 1) all 7,575 police recoveries reported by police throughout the nation to ATF as of March 2000; and 2) 3,305 cases in which the possessor was not the last registered buyer. Buyer county effects are interpreted relative to buyers outside the Baltimore and D.C. PMSAs. Indicators for year of sale are not shown. Models were estimated with robust standard errors adjusted for dealer-level clustering.

Turning to other buyer characteristics, the risk of recovery declined with the buyer's age (by about 11% per year of age) up until roughly age 58, at which point the effect leveled off;[58] hence, younger buyers were higher risk purchasers. In addition, the hazard of recovery was about 60% higher for guns purchased by persons who were linked to prior gun recoveries.

[58] This inflection point is calculated as b1 / (-2 * b2), where b1 is the coefficient for age and b2 is the coefficient for age-squared. (Both coefficients were used in their original metrics rather than as hazard ratios.)

With respect to geographical patterns, the model includes indicators for buyers in each of the counties in the Baltimore and D.C. PMSAs. These buyer county effects are interpreted relative to buyers in counties outside the Baltimore and D.C. metropolitan areas. Guns purchased by Baltimore city residents, for instance, were nearly 2.7 times as likely to be recovered as were guns purchased by buyers from rural areas. Buyers from several other suburban counties around Baltimore and D.C. were also at higher risk, with effects ranging from about 32% for Montgomery County buyers to about 95% for buyers from Prince George's County.

In terms of firearm characteristics, semiautomatics, medium and large caliber handguns, small (i.e., short-barreled) handguns, and cheap handguns were all at greater risk of recovery. The strongest effects were for medium caliber and cheap handguns. The hazard for medium caliber handguns was about 63% higher than that for small caliber handguns (the omitted reference group for the caliber categories). Likewise, the hazard for cheap handguns was about 63% higher than that for better quality firearms.

To interpret the transaction characteristics, note that: the multiple sales variable represents multiple sales made prior to the GVA; the GVA variable represents single sales made after the GVA; and the multiple sale-GVA term represents multiple sales made after the GVA (i.e., an interaction of the multiple sale and GVA terms). The results show that multiple sales made prior to the GVA were 16% more likely to be recovered than were pre-GVA single sales. However, multiple sales made after the GVA—which restricted multiple sales primarily to registered collectors—had a reduced likelihood of recovery (see the multiple sales-GVA term). Single sales made after the GVA, in contrast, were no more or less likely to be recovered by police than were those made before the GVA.

Finally, a few gun dealer characteristics were also related to the likelihood of gun recovery. Most notably, guns sold by dealers located in or near Baltimore or Washington, D.C. were more likely to be used in crime. Guns sold by dealers operating within 5 miles of either city were over twice as likely to be recovered as were guns sold by dealers operating further than 20 miles from both cities (the latter group constitutes the omitted reference group for the set of indicators representing a dealer's distance from the cities). This risk declined as a dealer's distance from both cities increased; the hazard for guns sold by dealers within 16 to 20 miles of either city, for instance, was only 16.5% higher than that for guns sold by dealers more than 20 miles from either city.[59] In addition, guns were at higher risk when sold by storefront dealers and dealers linked to prior gun recoveries. The latter effect amounted to an increase of 0.1% per prior recovery; the hazard thus increased by 10% for every 100 crime guns the dealer had sold.[60]

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[59] Preliminary modeling indicated that dealers operating 21 to 25 miles from either city were not at elevated risk relative to dealers farther from the cities.

[60] Because the number of recoveries reported to ATF was especially low prior to 1994, an additional model was estimated based on all sales made after 1994 and all recoveries of those guns. The post-1993 model generally produced effect sizes and inferences very similar to those reported in the text for all sales and recoveries from 1990 onward.

As discussed in Chapter 3, guns were recovered from the most recently registered purchaser in 12% to 18% of the recoveries and from someone else in 45% to 51% of the recoveries. In 37%, it was unclear whether the purchaser and final possessor were the same. Since a recovery from someone other than the last lawful purchaser is a better indicator of gun trafficking, an additional model was estimated predicting the 3,305 cases in which a gun was clearly recovered from someone other than the most recent buyer.[61] In general, the inferences from this model (third column of Table 45) were similar to those of the main model, and effects became larger for a number of risk factors. The most notable differences were that significant buyer county effects emerged for Harford, Howard, and Queen Anne's counties, while the Montgomery County indicator became statistically insignificant. In addition, the gun dealer storefront indicator was not a significant risk factor and the largest volume dealers were at a slightly reduced risk. These patterns could point to potential refinements in trafficking indicators—for example, some noteworthy trafficking operations may originate from places farther removed from cities—but these results should be viewed very cautiously because they may have been biased by the substantial percentage of cases with missing information about possessors.

5.2.3. Local Analyses, 1994-2000

Next, we examine how buyer, seller, firearm, and transaction characteristics influenced the likelihood that guns sold in the Baltimore and D.C. PMSA areas were later recovered by police in Baltimore and D.C., respectively.[62] Results for Baltimore area sales and Baltimore city recoveries are presented in Table 46, while the results for D.C. area sales and D.C. recoveries are shown in Table 47.[63]

5.2.3.1. Baltimore Area Sales and Baltimore City Recoveries

For the main Baltimore model (second column of Table 46), the buyer's race and area of residence stood out as leading predictors of recovery in Baltimore city. Guns purchased by black buyers were over four times more likely to be recovered in Baltimore than were guns purchased by buyers of other races. (Based on sample sizes, white buyers and buyers of other races were combined and contrasted against black buyers in the local models). In addition, guns were more than three times as likely to be recovered in Baltimore when sold to Baltimore city residents (the geographical indicators for the buyer's residence are interpreted relative to Anne Arundel County). Buyers were also at higher risk if they were female, young, linked to prior gun recoveries, and/or living in suburban Baltimore County.

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[61] This is based on the most stringent definition of a purchaser and possessor match (see Chapter 3). Other recoveries were treated as censored cases as of the date of recovery. This is known as a "competing risks" model (Allison, 1995).

[62] The local models are competing risks models (Allison, 1995) in which recoveries outside the location of interest are treated as cases that were censored at the time of recovery. Thus, the Baltimore model treats recoveries outside Baltimore as censored cases, and the D.C. model treats recoveries outside D.C. as censored cases.

[63] In the local models, Baltimore and D.C. area sales were defined based on the buyer's area of residence.

As in the national analysis, firearm characteristics predicting recovery included semiautomatic type, medium to large caliber, a short barrel (i.e., small size), and low price. Medium caliber and low price were again the strongest predictors among the firearm characteristics, increasing the likelihood of recovery by 56% to 57% each.

Transaction characteristics were not significant predictors of recovery in Baltimore. Guns sold in multiple sales prior to the GVA were no more likely than other guns to be recovered in Baltimore, though an important qualification to this finding is discussed below. There is some indication that risk levels were lower for guns sold in multiple sales after the GVA, but this effect was statistically insignificant and may have therefore been due to chance. There also appears to have been no general effect from the GVA.

Among the dealer characteristics, proximity to Baltimore stood out as the most powerful predictor. Sales made by dealers in or within 5 miles of the city were about 2.6 times as likely to be recovered as were guns sold by dealers located more than 20 miles from the city (the omitted reference group for the dealer location variables). Risk levels were also substantially elevated for other dealers operating within 20 miles of the city.

In addition, prior sales of crime guns and sales volume had small but statistically significant effects. Guns had slightly elevated risk levels when sold by dealers associated with prior crime guns (10% for every 100 prior crime guns) and slightly reduced risk levels when sold by larger volume dealers (3% for every 100 annual sales). Guns sold by gun shops and retail chain dealers had elevated hazards that nearly reached conventional levels of statistical significance.

As for the national analysis, a separate model was estimated predicting just those cases in which a gun was recovered from someone other than the most recently registered purchaser (third column of Table 46). The inferences from this model were very similar to those from the preceding model. One notable difference, however, was that multiple sales were a significant risk factor (increasing the hazard of recovery by nearly 23%) when focusing specifically on recoveries from persons other than the last buyer. In addition, the hazard was lower in this model for guns sold by dealers who had been in business for a longer time (by about 6% per year in operation). Other notes of interest are that effects became stronger for female buyers and for cheap, semiautomatic, and medium to large caliber firearms while becoming somewhat weaker for race of the buyer, short-barreled guns, and buyer and dealer locations.

Table 46. Effects of Buyer, Firearm, Transaction, and Dealer Characteristics on Risk of Police Recovery in Baltimore: Cox Proportional Hazards Model Estimates (N=71,956 Gun Sales to Buyers in the Baltimore PMSA, 1994-Oct. 1999)

	Hazard Ratios and 95% Confidence Intervals	
	All Recoveries	**Recovery From Possessor Who Was Not Buyer**
Buyer Characteristics:		
Male	**0.800**	**0.637**
	(0.720 – 0.890)	(0.538-0.755)
Black	**4.259**	**3.919**
	(3.651-4.967	(3.403-4.512)
Age	**0.895**	**0.910**
	(0.876-0.913)	(0.880-0.941)
Age sq.	**1.001**	**1.001**
	(1.001-1.001)	(1.000-1.001)
Prior crime gun	**1.627**	**1.640**
	(1.330-1.992)	(1.329-2.024)
Balt. City	**3.211**	**2.715**
	(2.511-4.105)	(2.092-3.523)
Balt. Co.	**1.885**	**1.743**
	(1.531-2.321)	(1.382-2.197)
Carroll Co.	1.081	1.007
	(0.687-1.702)	(0.668-1.517)
Hartford Co.	1.160	1.138
	(0.795-1.693)	(0.853-1.517)
Howard Co.	0.851	0.968
	(0.567-1.276)	(0.576-1.629)
Queen Anne Co.	0.604	0.329
	(0.158-2.314)	(0.056-1.926)
Firearm Characteristics:		
Semiautomatic	**1.341**	**1.562**
	(1.177-1.528)	(1.274-1.916)
Medium caliber	**1.561**	**1.728**
	(1.300-1.875)	(1.390-2.148)
Large caliber	**1.408**	**1.722**
	(1.139-1.740)	(1.350-2.197)
Barrel <=3”	**1.223**	**1.164**
	(1.090-1.373)	(1.005-1.348)
Cheap gun	**1.577**	**1.970**
	(1.259-1.975)	(1.537-2.525)
Transaction Characteristics:		
Multiple sale	1.094	**1.227**
	(0.918-1.305)	(1.008-1.495)
Post-GVA	1.087	1.105
	(0.691-1.708)	(0.735-1.661)
Post-GVA multiple sale	0.699	0.818
	(0.435-1.125)	(0.467-1.432)
Dealer Characteristics:		
Pawnbroker	1.038	0.848
	(0.742-1.452)	(0.630-1.142)
Years in business	0.974	**0.941**
	(0.922-1.029)	(0.892-0.992)
Prior crime guns	**1.001**	**1.001**
	(1.001-1.002)	(1.000-1.002)
Storefront	1.449	1.604
	(0.871-2.411)	(0.837-3.071)

Dealer Characteristics (continued)	Hazard Ratios and 95% Confidence Intervals All Recoveries	 Recovery From Possessor Who Was Not Buyer
Multiple locations	1.224* (0.975-1.537)	1.257* (0.989-1.598)
Gun/sporting store	1.600* (0.948-2.700)	1.662* (0.970-2.849)
Sales for year	**0.9997** (1.000-1.000)	**0.9997** (1.000-1.000)
<=5 miles from Baltimore	**2.599** (1.672-4.041)	**2.712** (1.750-4.203)
6-10 miles from Baltimore	**1.991** (1.461-2.711)	**1.916** (1.406-2.612)
11-15 miles from Baltimore	**1.924** (1.357-2.729)	**1.752** (1.219-2.517)
16-20 miles from Baltimore	**1.515** (1.107-2.075)	**1.391** (1.009-1.917)

Coefficients in bold were statistically significant at p<=.05. Coefficients denoted by (*) were statistically significant at p<=.10. Estimates are based on separate analyses of: 1) all 1,850 police recoveries reported by police to ATF as of March 2000; and 2) 967 cases in which the possessor was not the last registered buyer. Buyer county effects are interpreted relative to buyers in Anne Arundel County. Indicators for year of sale are not shown. Models were estimated with robust standard errors adjusted for dealer-level clustering.

5.2.3.2. D.C. Area Sales and D.C. Recoveries

Among buyer characteristics, race and area of residence again stood out as leading predictors in the main model of D.C. area sales and D.C. recoveries (second column of Table 47). Guns purchased by black buyers were more than five times as likely to be recovered in D.C. as were guns purchased by buyers of other races. Further, guns were about three times as likely to be recovered in D.C. when sold to residents of Prince George's County (the county indicators are interpreted relative to Frederick County). Guns were also at higher risk when purchased by young buyers and buyers linked to prior gun recoveries.

Firearm characteristics predicting recovery in D.C. included semiautomatic type, medium to large caliber, and low price. These effects ranged from a 42.8% increase in risk for semiautomatics to a 90.8% increase in risk for cheap guns. Barrel length, in contrast, was not a significant risk factor.

Guns purchased in multiple sales were at higher risk of recovery in D.C., and the magnitude of this effect (a 38.8% increase in the hazard) was larger than that in the national analysis. This is consistent with the notion that multiple sales are an important mechanism for the trafficking of guns from jurisdictions with more lenient gun controls to those with more stringent gun controls. Multiple sales made after the GVA had lower risk levels, a finding which is suggestive but which was not statistically significant and

may therefore have been due to chance. There was no clear effect from the GVA on single sales.

Turning to dealer characteristics, guns sold by pawnbrokers were more than twice as likely to be recovered in D.C. as were those sold by regular dealers. Proximity to D.C. was another important factor. Relative to dealers operating more than 20 miles from D.C., risk levels were nearly 2.5 times higher for dealers within 10 miles of the city and about 1.7 times higher for dealers located 11-15 miles from the city. Other dealer characteristics did not emerge as clear risk factors, although larger volume dealers may have had slightly elevated risk levels.[64]

Finally, a model predicting cases in which a gun was recovered from someone other than the last buyer generally yielded the same inferences as did the main D.C. model (third column of Table 47). However, females were at significantly higher risk of buying crime guns in this model, and effects became larger for prior crime gun purchases, buyers from Prince George's County, medium and large caliber handguns, multiple sales, and pawnbrokers. Two predictors that were significant in the main model, semiautomatic weapon type and purchase from a dealer located within 11 to 15 miles of D.C., were not significant predictors in the alternative model. Effects for the buyer's race and the dealer's proximity to D.C. were diminished somewhat.

[64] This analysis and discussion has focused on recoveries in D.C. because D.C. traced guns comprehensively during this period and because contrasts of these results with those of the Baltimore models provide some insights into differences between intrastate and interstate gun trafficking patterns. However, 65% of the guns that were sold in the Maryland suburbs of D.C. and recovered by police were recovered outside D.C., typically in Maryland jurisdictions near to D.C. A model predicting recoveries outside D.C. produced some results that differed from those of the D.C. recovery model: most notably, the race effect was greatly diminished, though still statistically significant; buyer county effects were not limited to just Prince George's County; multiple sales were not a significant risk factor; and dealers were at greater risk if they were linked to prior sales of crime guns and were located farther from D.C.. These results suggest there are differences between intrastate and interstate gun diffusion patterns in the D.C. area, but they could be biased by variation in tracing practices among Maryland law enforcement agencies.

Table 47. Effects of Buyer, Firearm, Transaction, and Dealer Characteristics on Risk of Police Recovery in Washington, D.C.: Cox Proportional Hazards Model Estimates (N=48,039 Gun Sales to Maryland Buyers in the D.C. PMSA, 1994-Oct. 1999)

	Hazard Ratios and 95% Confidence Intervals	
	All Recoveries	**Recovery From Possessor Who Was Not Buyer**
Buyer Characteristics:		
Male	1.007	**0.671**
	(0.778-1.302)	(0.462-0.973)
Black	**5.202**	**4.572**
	(3.688-7.336)	(2.790-7.493)
Age	**0.878**	**0.861**
	(0.841-0.917)	(0.807-0.920)
Age sq.	**1.001**	**1.001**
	(1.000-1.001)	(1.000-1.002)
Prior crime gun	**1.365**	**1.922**
	(1.063-1.754)	(1.155-3.199)
Calvert Co.	0.623	0.514
	(0.102-3.804)	(0.069-3.802)
Charles Co.	1.489	1.210
	(0.615-3.603)	(0.286-5.123)
Montgomery Co.	1.484	1.816
	(0.673-3.270)	(0.553-5.964)
Prince George's Co.	**3.170**	**3.644**
	(1.389-7.237)	(1.042-12.741)
Firearm Characteristics:		
Semiautomatic	**1.428**	1.265
	(1.077-1.895)	(0.849-1.886)
Medium caliber	**1.450**	**2.349**
	(1.019-2.064)	(1.433-3.850)
Large caliber	**1.511**	**1.909**
	(1.107-2.063)	(1.187-3.070)
Barrel <=3"	1.053	1.060
	(0.799-1.387)	(0.735-1.529)
Cheap gun	**1.908**	**1.865**
	(1.556-2.338)	(1.378-2.525)
Transaction Characteristics:		
Multiple sale	**1.388**	**1.641**
	(1.108-1.739)	(1.234-2.182)
Post-GVA	0.883	0.608
	(0.585-1.334)	(0.141-2.614)
Post-GVA multiple sale	0.496*	0.570
	(0.240-1.025)	(0.247-1.318)
Dealer Characteristics:		
Pawnbroker	**2.252**	**3.229**
	(1.476-3.436)	(1.841-5.665)
Years in business	1.033	1.048
	(0.946-1.129)	(0.930-1.182)
Prior crime guns	1.000	1.000
	(0.999-1.000)	(0.999-1.002)
Storefront	0.690	0.617
	(0.342-1.390)	(0.245-1.554)
Multiple locations	1.001	1.251
	(0.799-1.254)	(0.917-1.706)

Dealer Characteristics (continued)	Hazard Ratios and 95% Confidence Intervals All Recoveries	 Recovery From Possessor Who Was Not Buyer
Gun/sporting store	0.954 (0.704-1.294)	0.718* (0.492-1.049)
Sales for year	1.0003* (1.000-1.001)	1.000 (1.000-1.001)
<=10 miles from D.C.	**2.448** (1.816-3.301)	**1.890** (1.242-2.878)
11-15 miles from D.C	**1.661** (1.147-2.403)	1.386 (0.795-2.416)
16-20 miles from D.C.	1.291 (0.935-1.784)	1.491 (0.848-2.620)

Coefficients in bold were statistically significant at p<=.05. Coefficients denoted by (*) were statistically significant at p<=.10. Estimates are based on separate analyses of: 1) all 529 police recoveries reported by police to ATF as of March 2000; and 2) 233 cases in which the possessor was not the last registered buyer. Buyer county effects are interpreted relative to buyers in Frederick County. Indicators for year of sale are not shown. Models were estimated with robust standard errors adjusted for dealer-level clustering.

5.2.4. Summary of Multivariate Survival Analyses

In sum, the national and local survival models reveal numerous factors that were associated with criminal use and trafficking of guns sold in Maryland during the 1990s. Buyers tended to be at higher risk if they were black, young, female, living in or close to cities, and had previously purchased guns that were recovered by police. Criminal gun users seemed to have preferences for handguns that were semiautomatic, medium to large caliber, short-barreled, and cheap. Guns sold in multiple sales were more likely to be used in crime, particularly outside the state. After accounting for these buyer, firearm, and transaction characteristics, most gun dealer characteristics did not predict gun recovery as strongly or consistently. However, dealers operating in or near cities were at substantially higher risk. Overall, the strongest predictors tended to the buyer's race, the buyer's area of residence, and the dealer's location. The effects of key predictors are graphically illustrated in figures 5 and 6 using the estimates from the Baltimore analyses.[65]

[65] The Baltimore results are perhaps the most informative because they are based on comprehensive gun recovery data and because guns sold in Maryland were more likely to be recovered in Baltimore than in D.C.

Figure 5. Effects of Buyer, Dealer, and Firearm Characteristics on Baltimore Gun Recovery

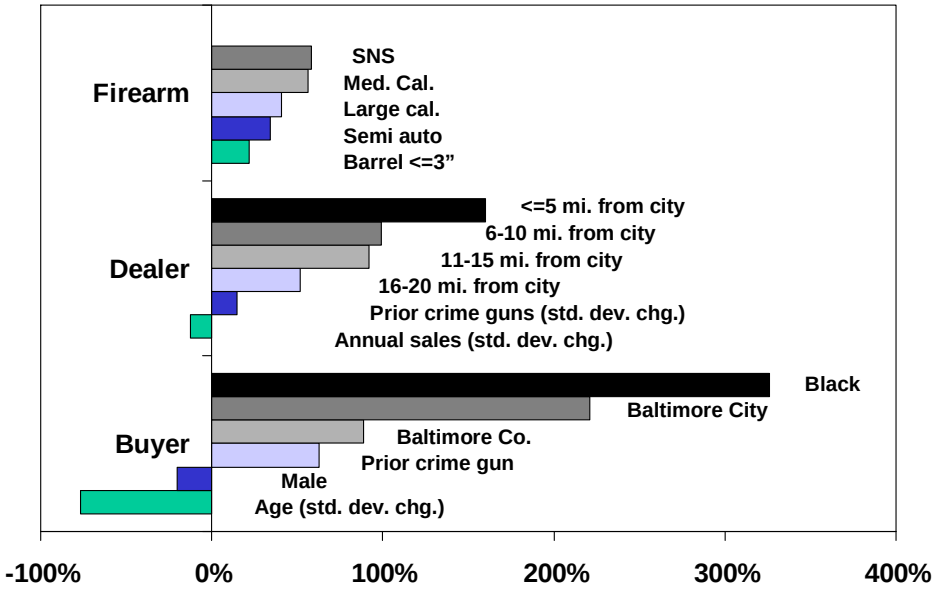
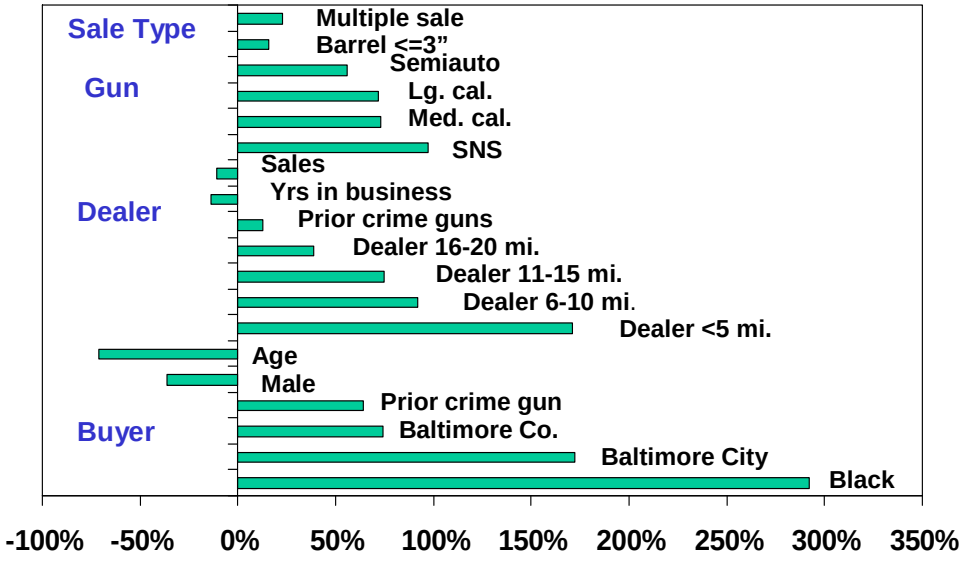


Figure 6. Effects of Buyer, Seller, Firearm, and Transaction Characteristics on Baltimore Gun Recovery (Buyer not Possessor)



To provide some further sense of how these factors were related to criminal gun use and trafficking, the models' results can also be used to estimate the probability that particular gun transactions would have resulted in a crime gun recovery within a given timeframe (Allison, 1995: 165-173). The examples presented here are based on the local models since those models were estimated with comprehensive gun recovery data. Consider, for example, a cheap handgun purchased by a black resident of Baltimore City from a gun dealer within five miles of the city. Holding other factors (i.e., other buyer, firearm, transaction, and dealer characteristics) at their average values for the Baltimore PMSA, the Baltimore model implies a 21% chance that this firearm would have been recovered by Baltimore police within 5 years. If the buyer had also made a prior purchase of a gun used in crime, this probability would have risen to 32%. These recovery probabilities are 6 to 9 times higher than the overall 5-year recovery probability of 3.4% for all gun purchases in the Baltimore PMSA (estimated from the life table analysis—see Table 43).

Turning to the D.C. area, a cheap gun purchased by a black resident of Prince George's County from a dealer within 10 miles of D.C. had a 7% chance of being recovered in D.C. within 5 years, holding other factors at their average values for the D.C. area. If the gun was also purchased in a multiple sale prior to the GVA, this probability would have risen to 10%. In contrast, the overall probability of a D.C. area sale resulting in a D.C. recovery within 5 years was only 1.4% (see the life table analysis in Table 44).[66]

[66] Alternatively, one could compute life table estimates for the groups highlighted in the text. Life table estimates of gun recovery for these groups are actually higher than the model-based estimates discussed in the text, most likely because the former reflect the influence of other variables (for example, the age composition of a group) that were held at their means for the model-based predictions.

6. DISCUSSION AND CONCLUSIONS

6.1. Summary of Findings

This study has revealed several characteristics of buyers, sellers, firearms, and sales transactions that were associated with criminal use and trafficking of guns sold in Maryland during the 1990s. Identified risk factors were generally consistent across analyses that examined all guns sold in Maryland and all recoveries of those guns by police throughout the nation; guns sold in the Baltimore PMSA and recoveries of those guns in Baltimore City; and guns sold in the Maryland counties of the Washington, D.C. PMSA and recovered in D.C.

In terms of buyer characteristics, guns were more likely to be recovered by police when the buyers were black (and, to a lesser extent, of other non-white races), young, female, or living in or close to Baltimore or D.C. (the major cities in and around Maryland). Buyers were also at greater risk if they had previously purchased guns that were recovered by police. The strongest effects were those associated with the buyer's race and county of residence. Guns purchased by black buyers were four to five times as likely to be recovered by police as those purchased by white buyers, and guns purchased by buyers from Baltimore City or from counties adjacent to Baltimore or D.C. were up to three times more likely to be recovered than were guns purchased by buyers who resided farther from these cities. Recovery risk also dropped by about 10% to 12% for each one-year increase in the buyer's age. Overall, black buyers made nearly two-thirds of the purchases that resulted in a gun recovery, buyers in their twenties accounted for about half, and buyers from just three counties—Baltimore city, Baltimore County, and Prince George's County—accounted for about three-quarters.

Although female buyers purchased only 12% to 16% of guns later used in crime, guns purchased by females were up to 57% more likely to be used in crime. This suggests that female buyers are more likely than male buyers to act as straw purchasers who buy on behalf of illegal buyers and traffickers. Finally, if the buyer was linked to a prior crime gun recovery—arguably a clear indication of a potentially problematic buyer—the gun was up to 92% more likely to be recovered, though these buyers accounted for no more than 5% of the recovered guns.

Turning to gun dealers, a relatively small share of dealers located in or close to urban areas accounted for most sales of crime guns. Fourteen percent of the dealers in the state sold over 90% of the identified crime guns, and just 5% sold about three-quarters.

Dealers who were most likely to have sold crime guns and who had the highest percentages of sales resulting in recovery were pawnbrokers, older dealers, high volume dealers, dealers close to Baltimore or D.C., storefront dealers, gun shops, and multiple location businesses. However, after accounting for buyer, firearm, and transaction characteristics (in multivariate survival analyses), the dealer's distance to a city (Baltimore or D.C.) was the primary characteristic of importance; guns sold by dealers

located in Baltimore or located close to either Baltimore or D.C. were up to 2.7 times more likely to be recovered than guns sold by dealers farther from these cities. Dealers located within 20 miles of Baltimore sold 90% of the Maryland guns recovered in Baltimore, while dealers located within 20 miles of D.C. sold 75% of the Maryland guns recovered in D.C. Other dealer characteristics were not strong or consistent predictors of gun recovery. This suggests that the risk of a dealer selling crime guns is strongly linked to the dealer's location, clientele and wares, a pattern that has also emerged from other research (Wintemute et al., 2005).

Criminal gun users and traffickers seemed to have preferences for handguns that were semiautomatic, medium to large caliber, short-barreled, and cheap. Each of these characteristics generally raised the likelihood of police recovery by 20% to 98%, though the strongest risk factors tended to be low price and medium caliber. Semiautomatic pistols and medium to large caliber handguns constituted the vast majority of crime guns. Easily concealable handguns (those with a barrel of 3 inches or less) accounted for roughly 40% of crime guns, and low-priced, SNS-type handguns accounted for upwards of 25%.

Guns were also up to 64% more likely to be recovered when they were sold in multiple sales, which accounted for about a quarter of crime guns. This was most apparent when examining recoveries in D.C., which reinforces the view that multiple sales are an important mechanism for the trafficking of guns from jurisdictions with more lenient gun controls into those with more stringent controls. However, guns sold in multiple sales also had an elevated risk of being recovered within the state from someone other than the last registered buyer. Furthermore, there was a consistent tendency (albeit not usually a statistically significant one) for guns sold in multiple sales to be at lower risk after the passage of Maryland's Gun Violence Act of 1996, which restricted multiple sales primarily to registered collectors.

The findings summarized above are based primarily on the results of multivariate survival modeling. However, many of the risk factors identified through survival modeling were also apparent from simple cross-tabulations of sales and recoveries with the characteristics of interest. A practical implication of this is that law enforcement analysts with access to sales and recovery data should be able to identify many risk factors reliably using simple analytical techniques.[67, 68]

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[67] As highlighted throughout the report, high-risk categories of actors, firearms, and transactions often accounted for substantial portions of the recovered guns. In the local analyses, for example, the majority of crime guns were semiautomatic, medium caliber, and relatively concealable (most had barrels of four inches or less). In addition, the most common make was Davis Industries, a manufacturer of cheap guns. Hence, the types of guns used most frequently in crime also tended to be the types at highest risk of being used in crime. More generally, this suggests that gun recovery data provide good indicators of problematic groups, firearms, and transactions. This is a subtle point, but it is a potentially important and fortuitous finding given that researchers and law enforcement do not have access to gun registration records in most states and therefore cannot conduct the sorts of risk assessments undertaken for this study. Besides Maryland, the only states with centralized gun registration records are California, Connecticut, Hawaii, Massachusetts, Michigan, New Jersey, and New York (Vernick and Hepburn, 2003).

[68] Because factors associated with a shorter recovery time are often considered to be promising trafficking indicators when risk analyses cannot be performed (e.g., see Pierce et al., 2003; 2004), a series of auxiliary

Other findings of note include the strong local character of illegal gun markets and the extent to which illegal gun users obtain guns through the primary market. Overwhelming majorities of the guns recovered in Baltimore and D.C. originated from those cities' respective metropolitan areas. Further, as many as a quarter of the crime guns may have been recovered from their last legally-registered purchaser.

6.2. Study Limitations

This study is based on sales as reported by primary market (i.e., retail) gun dealers. It cannot address sales in the secondary market prior to October 1996, unregistered secondary market sales that took place after October 1996, or covert sales made by corrupt dealers in the primary market. Further, the study is based on crime guns that could be matched to sales records based on make and serial number. If purchasers with criminal intent are more likely to obliterate serial numbers, then these results may understate the importance of some suspected trafficking indicators.[69]

Potentially important factors that could not be examined in this study might include, among others, the buyer's prior criminal history (i.e., arrests and misdemeanor convictions that do disqualify a person from buying firearms) (Wintemute et al., 1998a) and known associations with criminal actors (Pierce et al., 2004), the percentage of a dealer's prospective buyers whose sales were denied because they failed a background check (Pierce et al., 2004; Wintemute et al., 2005), criminal activity in the buyer's immediate neighborhood (Pierce et al., 2004), prior regulatory violations by the gun dealer, and features of a dealer's location besides proximity to high-crime areas (such as location along a major thoroughfare). Police practices, including the emphasis placed on seizing guns and the people and places that were the focus of enforcement efforts, may be another relevant factor. Finally, the recovery of a gun by law enforcement is not necessarily indicative of criminality on the part of the former buyer or seller. (Other limitations to the data were discussed earlier.)

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models (not shown) were estimated in which the recovery time of each recovered firearm was regressed on the buyer, seller, firearm, and transaction characteristics. (The estimates were computed using generalized estimating equations that allowed for dependence between guns sold by the same dealer. Guns that were not recovered were not included in these analyses). Relative to the risk models presented in the text, the results of the recovery time models were more variable between the national and local analyses and between analyses using all recoveries and those using just recoveries from someone other than the last registered buyer. Further validation of time to recovery as a trafficking indicator may therefore be warranted. Nonetheless, there was some tendency across the models for recovery time to be shorter for guns purchased by buyers who were female, young, non-white, and/or associated with prior gun recoveries; high-risk handguns (semiautomatics, cheap guns, etc.); guns sold in multiple sales; and guns sold by dealers located in or very close to Baltimore or D.C. Hence, some commonly suspected trafficking indicators, including purchase of prior crime guns, purchase of guns in multiple sales, and purchase of cheap guns, tended to be associated with short recovery times as expected. These results must be interpreted with great caution, however, due to the highly truncated recovery times of the guns in this study (as described in Chapter 3, most of the recovered guns were seized within three years of purchase).

[69] For example, some ATF research suggests that crime guns are more likely to have an obliterated serial number if they are semiautomatic or were purchased in a multiple sale (ATF, 2000c, pp.38-40).

We must also be cautious about generalizing these findings to other states and perhaps to other time periods. The state of Maryland licensed handgun dealers, required a waiting period on handgun sales, and banned many cheap handguns throughout the full study period. For portions of this period, the state also regulated private sales and restricted multiple sales. These laws may have discouraged gun trafficking in the state, especially large-scale, repetitive trafficking. On the other hand, it is not particularly difficult to buy a gun from a dealer in Maryland – one need only pass a background check and wait a week – and the state's proximity to a major city with a handgun ban (D.C.) may have provided an incentive for trafficking. In other jurisdictions, risk factors for intrastate and/or interstate trafficking may differ.

6.3. Implications for Policy and Practice

6.3.1. Implications for Enforcement and Prevention

Notwithstanding the caveats noted above, the study's results help to illuminate the workings of illegal gun markets and have a number of implications for gun policy and enforcement. One implication is that law enforcement should place greater emphasis on local gun markets and networks. Although high percentages of illegal gun possessors obtain guns from family, friends, and street sources rather than directly from retail outlets, this study suggests that those social networks are often supplied heavily by local diversions of guns from the primary retail market. Patterns in the Baltimore area illustrate this well. Over 60% of Baltimore's crime guns originate from within the state (ATF, 2002b), and those in-state guns come almost entirely from the Baltimore metropolitan area. Many of these guns move into criminal channels rapidly; as shown by this study, nearly 1,900 guns that were purchased legally in the Baltimore area between January 1994 and October 1999 were recovered by police in Baltimore as of March 2000. Buyers whose guns are most likely to be used in crime are often geographically proximate and demographically similar to those who are at greatest risk for involvement in gun violence. The fact that many crime guns originate locally and are relatively new should facilitate law enforcement efforts to identify dealers and other persons associated with criminal gun diversion. Further, the proximity and likely familiarity of many buyers and sellers would seem to present additional enforcement leverage; it seems reasonable to conclude that many persons who provide crime guns know the legal status of those to whom they sell, give, loan, or trade guns.

Accordingly, there may be substantial potential for enforcement action against illegal gun markets, particularly in jurisdictions like Maryland that regulate secondary market gun transfers and that explicitly prohibit straw purchasing.[70] Nevertheless, we know little about how secondary market laws are used in practice, a point to which we return below.

Risk factor assessment might also be used to guide enforcement and prevention efforts in various ways. Recovered crime guns associated with higher numbers of

[70] If, for example, a gun that is legally registered to person A is recovered from person B, then there is the potential for criminal investigation of both persons A and B.

identified risk factors, for instance, may have greater potential for investigation in gun trafficking cases.[71] In terms of prevention, policing agencies might consider distributing notices to all handguns buyers or more specifically to handgun buyers in high-risk areas, urging them to secure their firearms against theft (and perhaps offering trigger locks or other anti-theft devices) and reminding them of applicable laws and penalties regarding straw purchasing and secondhand transfers. Such information could be distributed at the point of sale or, perhaps to greater effect, by mailings from state or local authorities.[72] More aggressive action, such as personal contact by law enforcement, may be prudent and justifiable for certain categories of high-risk buyers, including people who have been linked to prior gun recoveries, persons who have purchased high-risk guns (e.g., cheap guns) in multiple sales, buyers with prior criminal histories (i.e., arrests and misdemeanor convictions), known associates of gang members or drug dealers, and others. Also, prevention programs that try to steer high-risk persons like teens and young adults away from gun violence might incorporate elements dealing with straw purchasing and other forms of gun trafficking.

The overriding point is that more emphasis could be placed on reactive and proactive strategies that address the diversion of guns from the primary market and into criminal channels. Such efforts could be informed by further study and consideration of crime gun risk factors like those illuminated by this study.

Another issue that warrants discussion here is the role of race in the findings and its attendant implications. The strong race effects found in this study may raise concern that law enforcement will target non-white (and especially black) gun buyers in trafficking investigations. This study has attempted to identify a number of risk factors that operate independently of race and that are appropriate foci for law enforcement attention (e.g., links to prior crime guns and purchase of guns in multiple sales). Having said this, attempts to disrupt gun distribution networks in high-crime areas may often have disproportionate impacts on minority gun buyers, even when guided by factors that are intended to be race-neutral, and this issue will need to be addressed by law enforcement and community members. More broadly, these results suggest that there is an urgent need to raise awareness about the problems of straw purchasing and illegal gun sales (as well as gun theft), particularly in minority communities located in or close to high-crime areas, and to address these problems using both enforcement and prevention strategies.

6.3.2. Implications for Regulation of Gun Dealers

Retail gun dealers provide an obvious focus for law enforcement and regulatory action to reduce gun crime for a number of reasons: they are regulated by federal law and in some cases, by state and local laws; they serve as the initial points of distribution for the dissemination of guns into the population; and sales of guns used in crime tend to

[71] Alternatively, investigators may choose to focus on outlier cases that don't fit typical patterns (e.g., city crime guns with short recovery times that originate from farther suburbs or rural areas).

[72] A similar strategy is currently being tested with gun buyers in high-crime areas of Los Angeles (Tita and Ridgeway, 2006).

be concentrated among a relatively small percentage (and number) of gun dealers. Although much of the variability in dealers' sales of crime guns may stem from sales volume, location, clientele, and types of products sold, careful monitoring of dealers with large numbers or percentages of sales resulting in crime gun recoveries should arguably be a priority for law enforcement insofar as it facilitates: 1) identification of dealers who facilitate straw purchases or engage in other unlawful activities; 2) identification of dealers that are unknowingly frequented by straw purchasers; and 3) improved cooperation between law enforcement and dealers in thwarting illegal firearms commerce.

Having said this, emphasis should be given to the monitoring of large volume dealers in urban areas and, more generally, to dealers with a relatively large percentage of their sales resulting in crime gun recoveries. Identifying the latter group of dealers can be done most readily in jurisdictions like Maryland that maintain centralized gun registration records. Yet even in locations without such record systems, authorities could collect information about dealer sales volume in the course of periodic inspections and license renewals that are required for licensed gun dealers. This information could then be used as a benchmark against which to assess sales of crime guns by individual dealers and by different groups of dealers.

6.3.3. Implications for Gun Control Policies

As discussed above, gun registration and regulation of secondhand sales may have the potential, if properly used, to substantially disrupt illicit gun markets. Having said this, there is no evidence that Maryland's secondary market and straw purchasing laws have been effective—guns purchased after implementation of those laws in late 1996 were no less likely to be used in crime than were guns sold earlier. A caveat, however, is that this study is based on data from only the first few years that these policies were in effect. Moreover, this investigation has not examined efforts or problems associated with the implementation of the laws.

The results also provide some support for restrictions on particular types of firearms and transactions, most notably SNS handguns and multiple sales, and other policies to discourage crimes with certain types of weapons (e.g., federal sentence enhancements for crimes committed with semiautomatics). Whether these sorts of policies can reduce gun crime is a complex issue; one must consider, for example, the possible substitution of other types of firearms and supply sources for those that are restricted (National Research Council, 2005: 72-101; for further discussion of the impacts of Maryland's SNS law, see Koper, 2005: 770-772; Vernick et al., 1999; Webster et al., 2002). In the case of SNS bans, policymakers must also consider the discriminatory impact such laws may have on lawful gun buyers of low income (Cook, 1981). Nevertheless, this study shows that particular types of guns and transactions are at higher risk, and that they account for a substantial share of crime guns. At a minimum, the findings suggest that reporting requirements for multiple sales are prudent and that law enforcement should emphasize multiple sales and particular types of firearms in trafficking investigations.

6.4. Research Recommendations

To conclude, this study has identified a number of risk factors associated with criminal use or trafficking of guns purchased from retail outlets. This research complements other recent efforts to develop improved indicators of gun trafficking (Pierce et al., 2003; 2004; Wintemute et al., 2005). But unlike most prior studies of crime guns, this study used longitudinal analysis of the sale and subsequent criminal use of representative samples of handguns sold at retail, thus permitting a more refined assessment of the risks that different types of guns purchased in different types of transactions involving different types of buyers and sellers are used in crime.

Replication of these results in other jurisdictions that maintain similar data systems would help show which of these results can be generalized to other locations and which are perhaps more idiosyncratic to gun markets in and around Maryland. It is also likely that the development of trafficking indicators from these sorts of data can be improved. Techniques such as data mining might be used, for instance, to further assess combinations of risk factors that are highly predictive of gun recovery or to examine particular types of recoveries—such as those associated with violent crimes or juvenile crimes—that have high policy relevance but that are rarer. In addition, future research efforts might incorporate other useful data elements that could not be examined here, including the buyer's criminal history, the dealer's regulatory history, and characteristics of the buyer and/or dealer's neighborhood.

Other forms of basic research on illicit gun markets might also help clarify the mechanisms that relate the risk factors identified here to criminal gun use. To what extent, for instance, is the relationship between gun recovery and the buyer's race or area of residence due to risk of theft as opposed to straw purchasing (or other forms of trafficking) or social diffusion through secondhand sales? Studies of these issues could include end-to-end tracing studies (in which guns are traced through every retail and secondary sale prior to recovery), studies of gun trafficking investigations, interviews with convicted gun traffickers and other gun offenders, and ethnographic research on illegal gun acquisition. (In the process, such investigations could also provide further evidence on the validity of time to crime as a trafficking indicator.)

Finally, there is a need for research on enforcement efforts directed at illegal gun markets. As noted above, this study suggests there may be substantial potential for attacking these markets, particularly in jurisdictions like Maryland that have laws regulating the secondary market. However, there has been virtually no research on the use of these laws in Maryland or elsewhere. The fragmentary evidence that is available suggests there are no systematic attempts to enforce them (e.g., Cook et al., 1995; Jacobs, 2002). In general, there is a dire need for research on how workable these laws are, how well enforced they are, and how they might be better utilized.

In addition to assessing the current state of practice in gun trafficking enforcement, researchers and practitioners should also collaborate in the design and

evaluation of experimental interventions to disrupt illicit gun markets. Such interventions might focus on guns used in particularly serious crimes, guns recovered from juveniles or other groups of high interest, and/or guns recovered in high-crime neighborhoods.

This study has provided one step in the identification of risk factors for criminal gun use and trafficking. This study and future research along the lines discussed above could potentially be used to improve the effectiveness and fairness of law enforcement and regulatory efforts to identify networks diverting guns into criminal channels and to inform debates on the efficacy of various gun control policies, including OGM laws, regulation of gun dealers, gun bans, and others.

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