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**Guns and Violence: The Enduring Impact of Crack  
Cocaine Markets on Young Black Males**

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## ABSTRACT

Crack cocaine markets were associated with substantial increases in violence in the U.S. during the 1980s and 1990s. Using cross-city variation in the emergence of these markets, the researchers show that the resulting violence has important long-term implications for understanding current levels of murder rates by age, sex, and race. They estimate that the murder rate of young black males doubled soon after crack's entrance into a city, and that these rates were still 70 percent higher 17 years after crack's arrival. The researchers document the role of increased gun possession as a mechanism for this increase. Following previous work, they show that the fraction of suicides by firearms is a good proxy for gun availability and that this variable among young black males follows a similar trajectory to murder rates. Access to guns by young black males explains their elevated murder rates today compared to older cohorts. The long run effects of this increase in violence are large. The researchers attribute nearly eight percent of the murders in 2000 to the long-run effects of the emergence of crack markets. Elevated murder rates for younger black males continue through to today and can explain approximately one tenth of the gap in life expectancy between black and white males.

## 1. Introduction

Compared to other developed countries, the United States stands alone in its shockingly high murder rate. In 2015, the U.S. murder rate was 5.5 murders per 100,000 people, which is more than three times the rate of France, Canada, and the United Kingdom, and more than five times the rate of Italy, Germany and Spain.<sup>1</sup> Despite being high relative to other developed countries, the U.S. murder rate is actually well below its historical peak. Figure 1 shows the U.S. murder rate since 1968. It has declined markedly since the 1990s, with the 2015 rate 47 percent lower than the rate in 1991.<sup>2</sup>

There are many theories behind this 25-year decline, including the legalization of abortion (Donohue and Levitt, 2001; Levitt, 2004), the rise of personal security (Farrell, 2013; Farrell, Tilley, and Tseloni, 2014), changing demographics of the population (Fox and Piquero, 2003), an improving economy (Gould, Weinberg, and Mustard., 2002), increased imprisonment rates (Levitt, 2004; McCall, Parker, and MacDonald, 2008), changes in policing strategies (Messner et al., 2007), more police (Levitt, 2004), better emergency medicine (Harris et al., 2002), a decline in teen births (Colen, Ramey, and Browning, 2016), and the removal of lead from gasoline (Nevin, 2000 and 2007; Reyes, 2007).

However, this large literature focusing on the aggregate decline mostly fails to discuss the important heterogeneity in the experience of certain subgroups. In particular, young black males in the United States have failed to enjoy a long-run decline similar to other demographic groups, including older black males. Figures 2A-2D contain the murder rates from 1968-2015 by sex (male/female) and race (black/white).<sup>3</sup> Within each graph, we show the murder rates for three age groups: 15-24, 24-34, and those aged 35 and over. Figure 2A shows that there are several important trends in the murder rates for black males. First, from 1968-1984, the oldest and youngest groups of black males had remarkably similar murder rates in both levels and trends. Murder rates for these groups stood at roughly 80 murders per 100,000 people in 1968 and, over the next 16 years, fell by 25 and 32 percent for the younger group and older groups, respectively. Second, the rates diverge sharply after 1984. The murder rate of young black males rose quickly and peaked in 1993 at 164/100,000, before falling to half of this rate by 1999. Between 1999 and 2014, these rates only fell by an additional 11 percent. As a result, in 2015 the murder rate for young black males was 23 percent *higher* than their rate in 1984. In

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<sup>1</sup> Data on murder rates are taken from the World Bank indicators: <https://data.worldbank.org/indicator/VC.IHR.PSRC.P5>.

<sup>2</sup> Murder rates are from Multiple Cause of Death data from the Centers for Disease Control (CDC) Wonder web page <https://wonder.cdc.gov/mcd.html>. Murder is defined using International Classification of Disease (ICD) Versions 8/9 codes E960-E969 from 1968-1998, and ICD-10 codes X85-Y09 in the years 1999-2015.

<sup>3</sup> Hispanic ethnicity is not identified in the Multiple Cause of Death data until 1999. To be consistent over time, we do not use ethnicity in the definition of racial groups.

contrast, over this time period, the murder rate of older black males fell by 54 percent. While black males aged 15-24 and 35+ had similar murder rates in the early 1980s, between 2000 and 2015 the gap in murder rates was consistently around 50 murders per 100,000 people. In recent years, the murder rates for black males aged 15-24 has been more than three times the rate for black males aged 35 and older.

The murder rates for white males are reported in Figure 2B. Note that the range of the y-axis is an order of magnitude lower than for Figure 2A, and that the murder rates of white males aged 15-24 and 35+ started out at around eight murders per 100,000 people (compared to 80/100,000 for black males in these age groups). What is similar is that the white males' relative trends across the age groups are broadly consistent with the patterns for black males. The time-series pattern for younger white males prior to the early 2000s also mimics that for young black males: the murder rate increased by 70 percent from 1984 to 1992, but then declined quickly after that point. Unlike young black males, however, the murder rate decline for young white males continued throughout the 2000s. From 2000-2015, a period where the gap in the murder rates of younger and older black males was constant, the gap between younger and older white males closed meaningfully from five to three murders per 100,000 people.

Taken together, these figures show that focusing on the decline in the national murder rate since the mid-1990s ignores the larger question of what drove the rapid increase and the *persistent elevation* of this rate for young black males compared to what would have happened if this age group continued to follow the trends of white males and older black males. In this paper, we attempt to explain why the murder rates of young black males has followed such a divergent path from the rest of the nation and has coalesced at a level that is substantially higher than most other demographic groups.

The crux of our argument is that the daily experiences of young black males were fundamentally altered by the emergence of violent crack cocaine markets in the United States. We demonstrate that the diffusion of guns both as a part of, and in response to, these violent crack markets permanently changed the young black males' rates of gun possession and their norms around carrying guns. The ramifications of these changes in the prevalence of gun possession among successive cohorts of young black males are felt to this day in the higher murder rates in this community.

Crack cocaine was a technological innovation that allowed sellers to charge a lower price for an inhaled hard drug that caused an immediate but short-lived high (Agar, 2003). Crack was typically sold in single-serving doses for prices as low as \$2 to \$3 – an amount well below the prevailing price-per-high for other hard drugs. These prices opened the cocaine market to a liquidity-constrained customer

base (Caulkins, 1997; Caulkins and Padman, 1993). Crack emerged first in Miami, New York, and Los Angeles around 1982, where retail markets were initially dominated by local gangs of young African American males selling in open-air drug markets. The dependence on a particular location for a place of sale led to violent competition for prime territories. Unlike the contemporary U.S. heroin market, which is driven by cell-phone technology and not geographically based (Quinones, 2015), occupying another organization's open air crack market meant the usurpers gained access to a place-based revenue stream. Unsurprisingly, this led to violent confrontations to both protect and attempt to obtain profitable locations.

Facing growing competition in the initial crack markets and seeking new potential profits, incumbent organizations began to establish markets in new cities. Evans, Garthwaite and Moore (2016) document that the spread of crack markets to the 57 largest cities in the U.S. was driven by potential profits, with the arrival date in a particular city primarily determined by the distance from one of the original three cities and also population size, with closer and larger cities getting crack earlier than further and smaller ones.

As crack emerged in new cities, so too did violence as measured by murder rates. Some of the increase in the murder rate following the emergence of crack markets was the result of disputes about sales locations. This violence was primarily perpetrated with firearms among now heavily-armed dealers. Given only a minority of young black males participated in crack markets, this direct violence is unlikely to explain the large murder rate increase. Blumstein and Cork (1996) and Blumstein (1995) hypothesized that gun possession subsequently diffused throughout the community as individuals not involved in the drug trade sought guns for their own protection. Because the open-air markets were usually established in communities where the drug sellers could more easily blend in, the negative effects of crack markets were highly concentrated in one demographic group: young black males. Using national time trends, Blumstein and Cork (1996) demonstrate that both the youth murder rate and many measures of youth gun possession increased after the mid-1980s. However, they are unable to separate these factors from other potential secular changes over the same time period. We overcome this limitation by exploiting geographic variation in the timing of the emergence of crack markets in cities across the United States.

Figure 3 plots the black male murder rate by age group for the 57 metro areas mentioned above. The x-axis is the years in relation to the arrival of crack. These figures show that the establishment of crack markets is associated with a rapid increase in the murder rate of younger black males. We quantify this graphical analysis using a differences-in-differences model that compares the

time-series pattern of murder rates for younger black males within a city to the rates for older black males. The similar pre-trends in Figure 2A support the use of older black males as a control group. We find the emergence of crack cocaine markets is associated with an increase in the murder rate of young black males that peaks at 129 percent in the decade after these markets first emerge.

The swift increase in murder rates following the emergence of crack markets was soon followed by a marked decline. There are numerous theories for the source of this decline, with many focusing on changes to the market structure for the sale of crack, including a drop in demand for the drug and a movement away from open-air markets. As we document below, while many articles focus on the swift decline in murders in the 1990s, few discuss that young black males' homicide risks remain *persistently elevated* compared to their older counterparts. Using our differences-in-differences model, we estimate that 17 years after crack markets arrived, the murder rates for young black males were 70 percent higher than they would have been had they followed the trends of older black males.

A key unanswered question in the literature and policy community is: given the decline in the systemic violence from crack markets, what drives this persistent gap in murder rates? Building on the Blumstein and Cork (1996) argument about the role that gun diffusion played in the initial increase in the murder rate, we demonstrate that the persistently high murder rate for young black males is due to higher gun possession long after the height of the crack cocaine epidemic.

To demonstrate this point, we document differential changes in gun possession among young black males both during and after the peak of the violence related to crack markets. Unfortunately, there are no consistent data on gun possession rates across geographic areas in the time period in which we are most interested. Therefore, we provide three empirical exercises that support the argument that guns are a mechanism for the persistent increase in murder rates for young black males.

First, we demonstrate that the increase in the murder rate was primarily the result of gun violence committed by black males, rather than simply an increase in violence across the board. While there were many victims of crack-related gun violence, the primary perpetrators were young black males. Although the murder rates of other demographic groups increased as a result of crack, the perpetrator rates for these other groups continued their downward trend even as crack was being introduced. As a result, in the six years after crack markets emerged, the share of all murders attributable to young black males increased by 75 percent. Seventeen years after crack markets emerged, young black males still accounted for a 45 percent greater share of all murders than they had in the years before the arrival of crack markets.

This change in murders could be the result of an increased set of opportunities for violence resulting from the emergence of crack markets. Therefore, we next document the role of Blumstein's hypothesis regarding the diffusion of guns by exploiting a number of proxies for gun access. We first examine the relationship between victims and offenders for gun murders. We focus on murders unlikely to be directly related to the systemic violence of crack markets: those between family members and intimate partners. We find that these murders increase markedly in the years after crack markets and remain elevated over the next sixteen years. This increase is driven entirely by murders involving guns, with no detectable change in the non-gun domestic violence murder rate over this time period. The increase in gun-related domestic violence murders shows that the increased availability of guns changed the technology of settling disputes and hence increased the murder rate.

Finally, we consider changes in the fraction of suicides involving guns, which is a common measure of gun possession (Cook and Ludwig, 2006). To demonstrate the validity of this measure, we show that there is a strong correlation across cities between gun ownership and the fraction of gun-related suicides by adults. Using state-level data between 1993 and 2013, we further show that there is a strong correlation between ten-year *changes* in gun ownership and *changes* in the fraction of suicides involving guns among 15-19 year olds.

For young black males in our 57-city sample, we show that there is a sharp rise in the fraction of suicides using guns after the arrival of crack, indicating a rapid increase in gun access for this group. We next demonstrate a rapid rise in the gun-related suicide and gun-related murder rates for young black males after the arrival of crack, with no change in the corresponding series for murders and suicides not involving guns. The gun-related suicide and gun-related murder rate follow a broadly similar pattern in that, for young black males, their levels remain well above the rates of older black males up to 17 years after the emergence of crack cocaine markets.

We also examine whether this proxy for gun possession can help to explain the persistently high murder rates of young black males that continues until today. To examine persistence in this setting, we split cities into two groups based on whether the emergence of crack cocaine markets was associated with an above- or below-median increase in the fraction of gun-related suicides among young black males. We find that cities with an above-median change in this proxy for gun possession had a larger and far more persistent increase in gun-related murders following the emergence of crack markets than those with a below-median change. Seventeen years after crack markets emerge, the murder rate of young black males in cities that had an above-median increase in our proxy for gun possession was 50

percent higher than those in cities with a below-median increase. There is no such difference for black males aged 35 years or older.

Together, the evidence discussed in detail below demonstrates that the change in murders from crack cocaine markets is not simply the result of an increased proclivity for violence. Instead, it points to a general and persistent increase in gun possession in communities affected by crack markets that changed potentially violent encounters from non-lethal to lethal ones. These effects extend well beyond the peak of the systemic drug violence, which shows how increased gun possession has had long-lasting effects on black males' homicide risks and resulting life expectancy. There is a historic gap between the life expectancy of black and white Americans that is the result of a variety of factors including heart disease, differing prevalence of HIV/AIDS, and exposure to violence. Our estimates suggest that the excess violence from crack markets that continues to this day explains approximately one tenth of the life expectancy gap between white and black males.

## **2. The Emergence of Crack Cocaine Markets and the Violence that Ensued**

In this section, we provide a detailed historical account of the violence generated by the entrance of crack cocaine markets into large cities. The market conditions that brought about the introduction of crack are outlined in section 2.1, where we describe how a new group of cocaine suppliers first brought a glut of powder cocaine to Miami, New York City and Los Angeles. In section 2.2, we describe how retail suppliers developed crack cocaine. In section 2.3, we discuss the spread of these crack cocaine markets across the country. Finally, in Section 2.4, we discuss the nature of violence that occurred in these markets as competing organizations attempt to secure preferential sales locations.

### *2.1 Cocaine in Los Angeles, Miami and New York in the 1970s*

In the early 1970s, much of the cocaine shipped to the U.S. originated in Chile. After the 1973 military coup by Augusto Pinochet in Chile that toppled the administration of Salvador Allende, Pinochet initiated a military crackdown on cocaine smuggling operations. Many smugglers moved to Colombia with the goal of using established marijuana smuggling routes as a way of getting cocaine to the United States.<sup>4</sup> The movement of cocaine trafficking from Chile to Colombia helped foster the development of two major Colombian drug organizations (commonly referred to as cartels): the first based in Medellin and a second in Cali (Chepesiuk, 2003; Gootenberg, 2011 and 2012; Henderson,

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<sup>4</sup> During the 1970s, Colombian smugglers were largely responsible for supplying marijuana into the U.S., with estimates that roughly 70 percent of the world's supply of marijuana came from Colombia at that time (Pardo, 2000; Chepesiuk, 2003).



2012; Tate, 2015). Shipments of cocaine to the U.S. grew rapidly as these organizations realized substantially higher profits from smuggling similar volumes of cocaine than marijuana. As these organizations grew, an informal agreement was struck where the Medellin cartel would primarily control supply into Miami and Los Angeles, while Cali would concentrate its operations in New York (Riding 1988; Woody, 2017). Throughout this period, the Colombian cartels were predominantly wholesale businesses responsible for illegally transporting cocaine into the U.S. and selling it wholesale to local gangs that, in turn, handled retail sales at their own discretion and risk (Kraar, 1988; Lee, 1991).

The influx of powder cocaine led to high rates of gun violence in Los Angeles, Miami and New York as a variety of organizations fought for control of both the wholesale and retail markets. Miami, where the Medellin cartel was in control, found itself in an unprecedented wave of violence as Colombian gangs attempted to oust the incumbent Cuban wholesalers (Treaster, 1989). Miami's overall murder rate quickly escalated from a low of 14.4 murders per 100,000 residents in 1976 to 35.1 murders per 100,000 residents in 1981.<sup>5</sup> A stark indicator of this surge in violence in Miami was that the Dade County medical examiner's office rented a refrigerated truck in 1981 to store additional bodies. In a press conference about this decision, the medical examiner's spokesperson cited the influx of illicit drugs as a source of violence (Jaynes, 1981).

In New York, the Cali cartel's impact on violence was less apparent. Chepesiuk (2003, p.27) notes that some on-the-ground DEA agents had a difficult time convincing their superiors that "...a growing, sophisticated drug trafficking group from Cali, Colombia, was operating in our city, right under our noses." Despite that, the local operations turned many inner city neighborhoods, especially ones with large African American populations, into battle zones. Schorr (1978), Bird (1978) and Fisher (1993) document how the growing presence of the Colombian cocaine trade in the late 1970s transformed the Jackson Heights neighborhood of New York City. Schorr (1978, p. 48) notes that "[o]ver the past three years, in this nice, quiet neighborhood, 27 people have been killed and dozens have been injured.... The violence spreads to surrounding neighborhoods as cops and prosecutors fight a losing battle. Double and triple homicides go unsolved."

Los Angeles also experienced a spike in murders in the 1970s, especially among young black males. This was primarily due to a proliferation of African American gangs. Alonso (2004) notes that the number of known African American gangs increased from 18 to 151 between 1972 and 1982.<sup>6</sup> The two largest gangs during this time were The Crips and The Bloods, which were umbrella organizations

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<sup>5</sup> Author's calculations for murder rate in Miami-Dade County, Florida from the compressed mortality data.

<sup>6</sup> [http://www.streetgangs.com/store/books/gang\\_maps#sthash.U6d4szS2.dpbs](http://www.streetgangs.com/store/books/gang_maps#sthash.U6d4szS2.dpbs)

for many smaller gangs. Alonso (2004, p.669) argues that in the 1970s, "... [with] the proliferation of gangs came an increase of conflict and homicides" and the "gang violence was in the early stages of what would become an epidemic in LA." The violence in LA was less directly related to Colombian cocaine trafficking because many of the gangs primarily turned to selling cocaine and other drugs as a source of income. In 1980, Los Angeles experienced a peak in murders that Alonso (2004) described as "gang violence fueled by drugs."

## *2.2 The Introduction of Crack Cocaine*

The large-scale entrance of the Colombian cocaine cartels into Miami, New York and Los Angeles meant that by the early 1980s, these areas had relatively high cocaine supply leading to falling prices. Despite the downward pressure on prices, many low-income consumers remained priced out of the market – limiting demand to the small number of relatively affluent consumers in each market. Given that Colombian cartels acted primarily as wholesalers, the variety of retail organizations in these markets were free to innovate on both product design and sales processes in an attempt to increase demand.

Many of these organizations saw inhaled cocaine as a potential means of expanding the retail market. At the time, powder cocaine was most frequently ingested intra-nasally. Increasingly, the drug was being smoked through a process known as "freebasing" – a consumption method led to a fast and more intense high as the drug was able to quickly enter the bloodstream via the lungs (Agar, 2003). As a result, inhaled cocaine users often consumer far more powder cocaine than those ingesting the drug intra-nasally. Freebasing cocaine, however, is dangerous and difficult as it involves combining cocaine with a flammable substance and cooking them over an open flame. This danger inherently limited the popularity of this method of consumption.

Crack cocaine was an innovation that provided a safer way to smoke cocaine. It was created replicating a procedure used with coca paste found in South America and the Caribbean (Cooper, 2002). It is made by cooking powder cocaine with baking soda and water, allowing the mixture to cool and harden, and then breaking it up in "rocks." The resulting product can then be relatively easily smoked. This new product has two attractive properties. First, it produced an instant high, and its users could quickly become addicted. Second, an intense high could be produced with a minimal amount of cocaine, meaning that the profit-maximizing per-dose price was a fraction of the price per high for powder cocaine (Witkin, 1991). Describing this new drug, the DEA said: "[i]n some major cities such as New York, Detroit and Philadelphia, one dosage unit of crack could be obtained for as little as \$2.50.

Never before had any form of cocaine been available at such low prices and at such high purity” (U.S. Department of Justice, 1989). This opened up the cocaine market to poor and liquidity-constrained populations that previously had been unable to access these products.

### *2.3 The Structure of Crack Cocaine Markets and how this Leads to Violence*

Crack was first introduced to the market by innovative retail organizations in New York, Miami and Los Angeles, which had a large supply of powder cocaine. It then spread from those cities. On the East Coast, the drug was introduced by Jamaican “posses” that left their home country following a violent election in 1980 (Witkin, 1991). On the West Coast, sales were primarily organized and managed by the two major African-American gangs, The Bloods and The Crips.

The combination of a liquidity-constrained customer base and the short-lived high offered by the product meant many customers purchased multiple times a day (Fagan and Chin, 1989). This required a different sales approach than powder cocaine, which was more often purchased in large quantities that limited the number of illegal transactions and potential for arrest. Powder cocaine sales generally occurred between a dealer and a customer who had a pre-existing business relationship that was at least sufficient to arrange the sales terms and a reasonably private location. In contrast, crack cocaine was sold in small doses, often in open-air drug markets where the dealer and the customer had no pre-existing contact to arrange that particular sale (though may have participated in a similarly anonymous sale at that location before). Describing the market, Drecun and Tow (2014, p. 44) said “[o]n the demand side, crack’s affordability made it a product of choice among poor drug users, who typically could only manage to purchase one dose at a time. Crack users made purchases more frequently than more affluent users of other drugs.”

The lack of preexisting arrangements with buyers meant that geography was a key determinant of a crack dealer’s revenue. As a result, profitable selling locations were obtained and subsequently protected from competitors through violent means – often with guns. Johnson, Golub, and Dunlap (2000, p. 180) describes it in the following manner: “the more-organized crack sellers introduced a variety of violent innovations to control competition and increase their profits. Crew leaders started to hire a ‘protector’ to defend turf and enforce sanctions against operatives. Many of these ‘muscle men’ were perceived as ‘crazy,’ or unpredictably violent, which enhanced their image, instilled fear in others, and increased their worth.”

The violence associated with establishing and defending a market from entry was a key reason for a substantial amount of drug-related violence. For example, Goldstein, Brownstein, and Ryan (1992)

found that the majority (but certainly not all) of drug-related homicides in New York in 1988 were systematic in nature and related to the structure and operation of the drug market. This was different from other illicit drug markets. For example, 44 percent of the crack-related systematic murders were the result of a territorial dispute compared to 22 percent for cocaine and 18 percent for other drugs.<sup>7</sup>

As the profits of these organized crack cocaine markets grew, new organizations emerged to challenge the incumbents – decreasing revenues through price competition and increasing costs via more violence. In addition to violently defending their initial territory, the incumbent retail organizations selling crack expanded to new sales territories where competition was less intense and profits were larger. Describing this phenomenon, Massing (1989) quotes John O’Brien of the Bureau of Alcohol Tobacco and Firearms (ATF): “[t]hey follow the law of supply and demand. When they see that a vial of crack selling for \$5 in New York will get \$15 in Kansas City, they’ll move in.’ New York is their ‘training school,’ O’Brien says, ‘like going to Wharton. They’ll take a guy doing a good job in Harlem and send him to open an office in the Midwest.’”

These new territories were often located in close geographic proximity to existing markets. Describing this pattern, Stephen Higgins of the ATF commented: “When I see some of the places the posses are operating, I can’t find any other explanation than the presence of a nearby Interstate” (Massing, 1989). Crack markets, after being established in coastal cities in the early 1980s, spread inland. By the early 1990s, all major cities in the United States had identifiable crack markets.

Evans, Garthwaite, and Moore (2016) examined the role of various socioeconomic and geographic characteristics in determining when organized crack markets were first established in a city. Their analysis showed that the distance from New York, Miami, and Los Angeles was the most important factor determining the year when crack markets were newly established in a new city. The emergence of crack markets in new cities was unrelated to existing trends in economic conditions.

#### *2.4 Emerging Crack Markets and Widespread Violence*

The arrival of crack markets was associated with a substantial increase in violence. As crack cocaine markets spread across the United States, the murder rates for young black males increased dramatically. Smaller inland cities, which started with lower murder rates for young black males than large coastal cities, experienced murder rate changes that were shocking both in relative and absolute

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<sup>7</sup> The modal reason for cocaine markets was “robbery of a drug dealer” at 29 percent. For the “other drug” markets the modal reason was an “assault to collect a debt” at 27 percent.

terms. Between the 1980s and 1990s, the five cities with the largest changes in the murder rates for young black males were Youngstown, OH, New Orleans, LA, Gary, IN, Shreveport, LA, and Chattanooga, TN. These five cities experienced an average change in the annual murder rate of 380 murders per 100,000 young black males.

Unfortunately, the violence from crack markets was not limited solely to its participants. While organized crack markets were primarily run by young black males, the majority of black males avoided participation in these illicit activities (Fagan and Chin, 1989). Instead, their close proximity to friends and acquaintances involved in the drug trade exposed them to increased risk of violence, a fact that encouraged many to carry guns. Blumstein (1995, p. 30) describes a vicious cycle: “Since the drug markets are pervasive in many inner-city hoods...other young people are likely to arm themselves, primarily for their own protection... This initiates an escalating process: as more guns appear in the community, the incentive for any single individual to arm themselves increases.”

The sentiment is echoed in Kennedy, Piehl, and Braga (1996, p.152), who noted that “...it appears that the urban environment has become so threatening even for youth not involved in the drug trade that many are arming themselves.” They conclude that, as a result, youth violence became “‘decoupled’ from drug and gang activity” (p. 154). Wright, Sheley, and Smith (1992, p.88) surveyed tenth and eleventh graders at the time found that “the desire for protection and the need to arm oneself against enemies were the primary reasons to obtain a gun, easily outpacing all other motivations.”

The history of the development of crack cocaine market effectively creates two broad categories of large American cities. First, there are the cities that serve as the originators of both powder and crack cocaine markets – Miami, New York, and Los Angeles. These cities experienced two distinct shocks to their murder rates (1) their emergence as entry and distribution points for powder cocaine, and (2) the development of the original crack cocaine markets. The second category are other large cities in the United States that eventually had crack markets but did not serve as primary markets for powder cocaine. For these cities, crack is a unique shock to murder rates resulting from competition over the new lucrative markets.

### **3. Murder Rates and the Emergence of Crack Cocaine Markets**

The arrival of crack cocaine markets coincided with a marked escalation in murder rates for young black males. In this section, we exploit variation across large cities in which crack markets were established to examine whether this increase in murders can be attributed to crack cocaine markets. To do so, we need to date when crack cocaine was available in particular cities.

In section 3.1, we summarize an approach from Evans, Garthwaite, and Moore (2016) that produced entry dates for the 57 largest cities, which are cities with at least 800,000 residents in 1980. In section 3.2, we show graphically that the rapid rise of murders of young black males occurs after the arrival of crack in these cities, and continues to be substantially higher than that of older black males. In this section, we also show that there was a much smaller increase in the murder rates of young black females and young white males. In section 3.3, we explain the sources of pre-trends in the data and demonstrate they do not affect our ultimate analysis. Finally, in section 3.4 we present a differences-in-differences specification that uses older age groups as a comparison in order to estimate the magnitude of changes in murder rates induced by the arrival of crack cocaine markets, and in section 3.5 we present the estimates from this model.

### 3.1 *Dating the Arrival of Crack Cocaine Markets*

To understand the role of crack markets in the increased murder rates of young black males, we need a consistent and accurate procedure for dating the entry of these markets into particular geographic areas. We use the dates from our previous paper (Evans, Garthwaite, and Moore, 2016). The approach exploits the fact that, prior to 1982, there were very few deaths in the U.S. with a cocaine-related cause. For example, in the three years from 1979 to 1981, only 30 death certificates in total across the U.S. listed a cocaine-related cause of death. The number of deaths with a cocaine-related cause increased substantially after that period.<sup>8</sup> We attribute this increase to crack cocaine use, which seems reasonable given that the consumption of powder cocaine declined considerably over this period.<sup>9</sup> This approach provides a consistent and nationally-available measure that we apply to every MSA with a 1980 population over 800,000. We define the arrival of crack as the first of two consecutive years where cocaine-related deaths are reported.<sup>10</sup>

These 57 MSAs and the estimated years that crack cocaine markets arrived are listed in Table 1. The crack arrival dates span 1982 to 1994. The three MSAs with the earliest arrival of crack are Los Angeles/Long Beach, Miami and New York, which matches numerous law enforcement and popular

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<sup>8</sup> Deaths related to cocaine use between 1979 and 1981 were 13, 9 and 8 respectively. These same numbers in 1985, 1989 and 1994 were 523, 1075 and 1497, respectively. These are authors' calculations from the public-use versions of the National Center for Health Statistics' (NCHS) Multiple Cause of Death (MCOB) data files.

<sup>9</sup> Authors' calculations from the 1979 National Household Survey on Drug Abuse (NHSDA) indicate that the past-year cocaine use rate was 5.21 percent, which was most likely all powder cocaine use. The same survey for 1992 indicates a past-year use rate for sniffing, swallowing, or injecting cocaine of only 1.95 percent.

<sup>10</sup> Evans, Garthwaite, and Moore (2016) presents a number of robustness checks using other definitions such as two out of three years with an overdose death and found broadly similar dates.

press reports about where crack cocaine first appeared. While it is possible this reflects powder cocaine deaths, none of these MSAs would have met the same test of consecutive cocaine-related deaths in 1980 or 1981.<sup>11</sup> As we noted in our previous work, our dates are generally close to the dates given in newspaper reports and ethnographies for larger cities. Our dates are also broadly similar to the ones generated for a smaller set of cities by Cork (1999) and Grogger and Willis (2000).

### 3.2 *Graphical Analysis: Murder Rates and the Arrival of Crack Cocaine*

In this section, we construct and display murder rates in relation to these crack arrival dates. We construct a consistent set of mortality data using Multiple Cause of Death (MCOB) files (1973-1988) and the restricted-use Compressed Mortality Files (1989-2013), which are constructed from MCOB data. These data provide information on deaths by sex, race, age groups, year, county of occurrence, and underlying cause of death. They represent a census of all deaths in the U.S. The cause-of-death coding is the International Classification of Disease Versions 8 through 10; murders are consistently defined across these classifications. We map the counties to MSAs using consistent geographical definitions that are shown in Appendix Table A1.<sup>12</sup>

We group murders into 12 demographic groups based on sex (male/female), race (black/white) and age (15-24, 24-35, and 35+). Murders of other races are relatively small and omitted from the analysis. We do not use Hispanic ethnicity, as it is not identified in the data before 1999. Murder rates are defined as murders per 100,000 people and annual population estimates are from the National Cancer Institute's Surveillance, Epidemiology, and End Results Program data files.<sup>13</sup>

In Figure 3, we report the murder rates for these demographic groups in relation to the arrival date of crack cocaine markets. The order matches Figure 2, with results for black males (Figure 3A), white males (Figure 3B), black females (Figure 3C), and white females (Figure 3D). We aggregate data across the 57 MSAs based on the year we date the arrival of crack cocaine markets. Year zero is the year of arrival, while the year before is Year -1 and the year after is Year 1. We examine data from eight years prior to the arrival of crack and 17 years after, for a total of 26 years for each city. As the earliest date of crack's arrival is 1982 and the latest is 1994, our data set spans from 1974 through 2011.

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<sup>11</sup> Only the Nassua/Suffolk MSA (NY) consistently reports cocaine-related deaths prior to 1981; it is omitted from the sample. See the online appendix for more details.

<sup>12</sup> Microdata on all deaths with county coding are available from 1973, while CDC Wonder data we use elsewhere are available from 1968.

<sup>13</sup> <https://seer.cancer.gov/popdata/download.html>

Figure 3A shows that crack cocaine markets had little impact on the murder rate of black males aged 35 and older. Their murder rate declined steadily, falling by 64 percent over the 29-year sample period. In contrast, the murder rate of black males aged 15-24 increased by 93 percent from the year crack arrived to seven years afterwards. From this peak, their murder rate declined by almost 50 percent over the subsequent 12 years. This rise and fall leaves the murder rate of black males age 15-24 at the end of the sample period essentially at the same level as at the beginning; over the entire 29 years, the murder rate for this group only fell by seven percent. A similar increase is not seen for black males aged 25-34. The murder rate for this group declined persistently until crack arrives, increased by approximately 15 percent over the next six years, and then declined. We note that there appears to be a slight uptick in murder rates for black males aged 15-24 prior to the arrival of crack. We outline the causes for this in the next section.

The results for white males (Figure 3B) show a similar pattern. There appears to be little impact of crack on the murder rate for those aged 35 and older; their murder rate declines by 37 percent over the sample period. For the 15-24 age group, their murder rate declined until one year after crack arrives but then increased by 71 percent through the peak, which occurs ten years after the arrival of crack markets. Relative to young black males, the impact of crack on murders for young white males takes longer to appear and the relative increase in the murder rates is slightly smaller. Crack markets appear to have little impact on white males aged 25-34.

For black and white females (Figures 3C and 3D, respectively), there appears to be no impact of crack on the murder rates of women aged 35 and older. For black females aged 15-24 and 25-34, murder rates peak about five years after crack markets arrive and then decline steadily after that. The impact of crack on murder for these two black female age groups appears to be temporary, as murder rates converge across all age groups by the end of the sample. For white females, any impact on the younger age groups is small.

### *3.3 Pre-treatment Trends in Murder Rates for Young Black Males*

Figure 3A demonstrates that there was a noticeable increase in the murder rates of young black males after the arrival of crack. However, it also shows that their murder rate started to increase shortly before crack markets arrived in cities. In this section, we show that this trend is driven solely by the three cities at the epicenter of powder cocaine importation: Miami, New York and Los Angeles.

As discussed in section 2, the importation of cocaine by Colombian cartels and heightened gang activity after the mid-1970s led to more violence and murders in Miami, New York and Los Angeles. In



Figure 4A-4C we report the murder rates for black males by age group for these three cities. In Miami, the murder rate for black males aged 15-24 increased by 197 percent during the period from five years before the introduction of crack to one year before it was introduced. Murder rates also increased in the other two age groups over this period, with the murder rates of black males aged 25-34 and 35+ increasing by 161 percent and 95 percent, respectively. Over the same period, the murder rate for black males aged 15-24 in Los Angeles and New York increased by 77 and 30 percent, respectively. Overall, these three cities experienced a surge in murders before crack cocaine that was most likely tied to violence related to the powder cocaine markets. This surge, however, largely recedes by the time crack markets emerge only to rise swiftly again.

To demonstrate the isolated nature of these pre-trends, in Figure 4D we report the same time series for the 54 other MSAs for which we have crack entry dates. In this sample, in the nine years before crack markets arrived, the murder rates of black males aged 15-24, 25-34 and 35+ fell by 23, 32 and 33 percent, respectively. Importantly, the murder rates for this sample show no increase in the years just prior to crack markets emerging.

### *3.4 The Econometric Model*

In this section, we present a simple econometric model to estimate the magnitude of the changes in murder rates of younger individuals after the arrival of crack cocaine markets. We use a difference-in-differences specification in which the murder rate for those aged 35 and older is used to provide the counterfactual trend for the younger individuals' murder rates in the absence of crack. We do this separately for the four sex/race groups. The graphical evidence in Figure 3 suggests that the murder rate for people 35 and older provides a suitable comparison, especially for our primary sample of interest (young black males). Across these older and younger groups, the pre-crack trends are quite similar and the arrival of crack does not alter the rates for these older groups. In the numbers below, we provide a more formal examination of the suitability of this demographic as control group for the murder rate of younger black males.

For a given sex/race group, our observations are at the MSA/year/age-group level. There are many observations with zero murders. Therefore, we use a negative binomial specification that allows us to model both the count nature of the data and potential over-dispersion in the outcome of interest.

Our primary specification is as follows. Let  $y_{it}$  be murder counts for group  $i$  from city  $c$  in year  $t$ . We have two groups: the first is a group that is expected to be impacted by the arrival of crack in a city ( $i=1$ ) and the second will be the murder counts for those aged 35 and older that we will use as a

comparison sample ( $i=2$ ). Given a vector of covariates,  $x_{ict}$ , and the structure of the negative binomial model, the expected value of counts is:

$$(1) \quad E[y_{ict}] = \exp(x_{ict}\beta) / (1 + \delta)$$

where  $\delta$  is the over-dispersion parameter. The model collapses to a Poisson specification if  $\delta=0$ . The structure of the model allows is to easily interpret the parameter  $\beta$  as

$$(2) \quad \partial \ln(E[y_{ict}]) / \partial x_{ict} = \beta$$

which, for small values of  $\beta$  approximates to the percentage change in counts for a one-unit change in  $x$ . In many cases, our estimates for  $\beta$  are quite large, so a more accurate estimate of the percentage change in  $y$  for a one unit change in  $x$ , is  $\exp(\beta) - 1$ .

To specify our particular model, let  $d_i^1$  be a dummy variable that equals one if the data is from Group 1. Define the dummy variable  $yr_s_{ct}^k$  to equal one if in year  $t$ , the observation is within  $k$  years of crack's entrance in city  $c$ . In our model, the expected value of murder counts is defined as:

$$(3) \quad E[y_{ict}] = \exp \left( \ln(pop_{ict}) + \mu_c + \lambda_t + time_t \theta_c + d_i^1 \phi + z_{ct} d_i^1 \pi_1 + z_{ct} (1 - d_i^1) \pi_2 + \sum_{\substack{k=-m \\ k \neq -2, -1}}^l yr_s_{ct}^k d_i^1 \alpha_k \right) / (1 + \delta)$$

where we control for city effects ( $\mu_c$ ), year effects ( $\lambda_t$ ), city-specific calendar time trends ( $time_t \theta_c$ ), and persistent differences in outcomes across groups ( $d_i^1$ ). Our control variables only vary by city and time ( $z_{ct}$ ) and not by age, so we allow the coefficients on these variable to vary by group, which are the vectors  $\pi_1$  and  $\pi_2$ .<sup>14</sup> The parameters of interest are the vector  $a_k$ , and to increase power we group two years together to define  $k$ .

Our reference period is the two years before crack's arrival in a city, so these parameters measure the change in murder counts for Group 1 in period  $k$  in relation to this reference period. In terms of time periods,  $yr_s_{ct}^k$  is defined for  $k=$  (-8 and -7 years before), (-6 and -5 years before), (-4 and -3 years before), (0 and 1 year after), ..., (16 and 17 years after). We control for the log of population in a particular group/city/year cell ( $\ln(pop_{ict})$ ) and force the coefficient to be equal to 1 on this variable.

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<sup>14</sup> We include three variables from the Bureau of Economic Analysis regional data file, all measured at the metro area: the natural log of real per capita income, employment to population ratios, and the natural log of income transfers per capita. The data is original recorded at the county level and we aggregate data up to the metro area using our consistent definitions of metro areas. This data can be found at the web page <https://bea.gov/regional/index.htm>

This restriction makes coefficients on the variables of interest similar analogous to a regression using  $\ln(y_{ict} / pop_{ict})$  as the dependent variable.

Models are estimated by weighting observations by the population in each cell. When calculating the standard errors, we allow for an arbitrary correlation in the errors within the same group using the generalized linear models procedure of Liang and Zeger (1986). To estimate the city, year and city-specific trends, we insert a series of mutually-exclusive dummy variables. As this may generate bias in the form of the incidental-parameters problem, an alternative is to estimate a conditional maximum likelihood count data model (Hausman, Hall, and Griliches., 1984). However, in that model we cannot control for potential correlation in the within-group errors, so we choose to estimate the model with the dummy variables and using the sandwich-type variance/covariance estimator outlined above.<sup>15</sup> We have data on murder counts for 2 groups from 57 cities over a 26-year period producing 2,964 observations in these models.

### 3.5 Results

Figure 5A presents the estimate of the impact crack's entrance on murders of black male aged 15-24 using black males aged 35 plus as the comparison sample. To aid interpretation, we translate the estimates from equation (3) into the percentage change in the murder rate. We see a sharp increase in murder rates after the arrival of crack markets. Even 16 years after crack has arrived, murder rates are positive and statistically significantly different from zero. Murders peak 10 to 11 years after the arrival of crack about 111 percent above the rate for older black males. The coefficient 16-17 years after crack's arrival implies murder rates are still 70 percent higher than the rates for older black men.

The results in this figure suggest a pre-treatment trend in murders, as the coefficients for the dummy variables on the years prior to the arrival of crack are all statistically significant negative numbers. As already noted, we believe this is generated by the violence in the cities of Los Angeles, Miami and New York in the mid- to late-1970s. In panel B, we report results from a model that drops these three cities from the regression and only uses information on the remaining 54 MSAs. The coefficients on the dummies from the post-crack period are almost identical to what we found in Figure 5A, while none of the coefficients for the pre-crack periods are statistically significant.

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<sup>15</sup> Cameron and Trivedi (2005) and Allison and Waterman (2002) note that Poisson models are not subject to the incidental parameters problem but they are to over-dispersion. Cameron and Trivedi suggest then estimating a Poisson model and using a sandwich-type estimate of the variance/covariance matrix. In Appendix Figure A1 we present basic results for black males and white males aged 15-24 and show the models produce essentially the same set of estimates.

In panels B through d in Figure 6, we report results for black males aged 25-34, white males aged 15-24, and white males aged 25-34, respectively. For completeness, we repeat the results for black males aged 15-24 in Figure 6a. In all cases, we use data from all 57 cities and older males with the same race as the comparison sample. Of the coefficients on the 15 pre-crack dummy variables (i.e., three coefficients in each figure), there is a statistically significant coefficient in only one case (-8 and -7 years before for white males aged 15-24). Given this proportion is consistent with chance, there are minimal concerns about pre-treatment trends in these samples. Crack raised murder rates for black males 25-34 about 25 percent about the rate for older black males 10 through 17 years after its arrival. Over the same time frame, murder rates for white males 15-24 are 85 to 123 percent high than older counterparts, while murders for white males 25-34 peak at about 21 percent higher 8-9 years after crack's arrival.

In Figures 6E-6H, we report the results for females with the figures representing blacks aged 15-24, blacks aged 25-34, whites aged 15-24 and whites aged 25-34, respectively. These models are estimated exactly as those in Figures 6A-6D. Of the 20 pre-crack coefficients across the four figures, none are statistically significant. Murders peak anywhere from 8-11 years after crack arrives; the maximum post-crack increases are, respectively, 26, 20, 17 and 11 percent. The rise of crack generated a temporary increase in murders for black females aged 15-24, but the effect is essentially zero 16 or more years after crack's arrival. For the other three groups, there are statistically significant declines of 16, 20 and 14 percent by the end of the sample period. The results suggest that the negative effects of crack were muted and temporary in these groups.

#### **4. What Explains the Persistent Increase in Young Black Male Murder Rates?**

While crack-cocaine markets are associated with a clear increase in the murder rates of young black males, the most intense violence from these markets was relatively short-lived. Within a decade of crack markets emerging, the worst effects were largely receding. Perhaps most striking was the decline in the murder rate of young black males, which fell from a peak of 164 murders per 100,000 residents in 1993 to 84 murders per 100,000 residents just six years later. Murders continued to fall before settling at a rate of approximately 65 murders per 100,000 residents in the 2000s. From that point forward, the rate was stable between 2000 and 2015. While this decline in the murder rate has been broadly celebrated (Sharkey, 2018), Figure 2 shows the young black murder rate is actually higher in 2015 than 1984 and meaningfully higher than the 2015 rate for older black males.

The exact cause of the rapid decline in the mid-1990s is a matter of debate, with many of the proposed factors likely working in concert. First, there is evidence that crack became less popular among younger cohorts of potential hard drug users. Golub and Johnson (1997) report the crack use among arrested juveniles in Washington, DC fell from 39 percent in 1989 to 10 percent in 1996. In Detroit, the rate for a similar population fell from 45 percent in 1987 to five percent in 1996. Over a similar time period, Johnson, Golub, and Dunlap (2000) did not find similar declines for older cohorts who began using hard drugs during the peak of the crack epidemic. These studies suggest a meaningful decrease in the popularity of crack cocaine among potential users that began in the mid-1990s.

As demand for crack fell, the number of suppliers decreased. Purdy (1995, p. 27) discusses this phenomenon and its impact on violence: “The [crack] trade still comprises mostly small operations, each run by fewer than a dozen people, the police say. The difference now is that fewer of these operations exist. ‘On one block you could have three or four major players,’ Mr. Rodriguez said. Five years ago on these blocks you could hardly get down the street, there were so many guys. And there were shootouts all the time because of the competition.”

As the markets for crack matured and property rights over open-air markets became more defined, the demand for violence as a market protection device may have declined. Purdy (1995, pg. 27) notes that “[p]olice officials say those battles – which drew police attention and hurt the drug business – have been quelled to some degree by understandings between dealers about who controls which areas.” Blumstein compared this to the evolution of other instances of organized crime in stating that “as drug markets have matured, just like Mafia markets matured years ago, they have found ways to settle disputes without so much lethal violence” (Associated Press, 1995). A similar comparison to the Mafia was made by New York police lieutenant John Coyne who said, “[i]t’s like the Mafia ... You go back 50 or 60 years and they were killing each other right and left, but you put someone in charge, and they know the rules and they don’t kill each other as much.” (Purdy, 1995, pg. 27)

As crack markets matured, sales also shifted indoors. This appeared to be a response to the increased violence affecting profits, changing police tactics, and changes in sales technology. Bowling (1999, p.540) describes this shift in the following manner: “the streets were dangerous and the violence attracted unwanted attention to senior-level drug suppliers and distributors consolidating business. Consequently, much of the drugs trade move indoors.” In describing the new operations of these markets, Bowling (1999 p. 540) said “rather than have large numbers of people milling about on street corners carrying drugs, intermediaries were now used just to steer clients to an indoor location.”

Similarly, describing the evolution of the market at this time a New York police officer noted, “[i]t’s more secretive and better hidden now ... [i]t was so blatant before” (Purdy, 1995 pg. 27).

The indoor sales locations were also facilitated by changes in technology that allowed for a greater use of phones and beepers as a reliable means of identifying and contacting customers. This meant that indoor sales locations were more profitable than they had been when crack first emerged – a limiting factor that led to the initial development of open air markets. The confluence of emerging technologies and declining demand leading to a more stable and known customer base meant that open air markets were no longer necessary. Describing these factors, Blumstein and Wallman (2006, pg. 332) said: “the open-air curb-service markets were being driven ‘underground,’ with many dealers moving to indoor transactions, a mode of business more feasible with longer-term users ... in recent years this shift has been accompanied by increasing reliance by dealers on technological adjuncts to business, including pre-paid phone cards and disposable cell phones (both resistant to tracing) and even the Internet.” As the market shifted from a place-based sales method to one based on pre-existing retail relationships the benefits of violence declined.

Finally, federal policy outside of the drug market may have decreased access to firearms and/or reduced the flow of guns into the market. One such piece of legislation was the Brady Handgun Violence Prevention Act (i.e. the Brady Act) that required, among other things, a background check for every gun purchased from a licensed gun dealer. The Brady Act became effective on February 28, 1994. The second was the Federal Assault Weapons Ban that was part of the Violent Crime Control and Law Enforcement Act of 1994, which was passed on September 13, 1994. This statute banned the manufacture, transfer or possession of certain semi-automatic weapons and high-capacity ammunition feeding devices for firearms. It is important to note that these statutes did not change the stock of guns, only the flow of new, legal guns into the market.

Time series data provide suggestive evidence that the combination of these two statutes decreased the supply for new weapons. Figure 7 contains firearm statistics from the ATF. From 1986-1994, the number of pistols manufactured increased dramatically. Bartley and Williams (2015) provide additional evidence that this increase in the composite category of pistols is primarily driven by “autoloaders” such as TEC-9s, a type of firearm commonly associated with the drug trade.

In 1994, the first year these two statutes were effective, these patterns reversed as both the number of licensed dealers and the number of pistols manufactured fell precipitously. The number of licensed dealers fell from approximately 250,000 in 1994 to fewer than 70,000 in 2000. Similarly, in

1994 there were approximately two million pistols manufactured; by 2000, that had fallen by more than half. Much of the decline in pistol production was of large-capacity semi-automatics pistols.<sup>16</sup>

The coincident decline of murder rates and open air drug markets suggests that a meaningful fraction of the rapid increase in murder rates in the 1980s was the result of systemic violence related to drug markets. However, even after the prevalence of crack markets declined and the peak of the violence faded, young black males still experienced a markedly higher murder rate than they otherwise would have if they followed their historic trends.

We are interested in the factors driving this *persistent* change in murder rates – a phenomenon that continues to impact successive cohorts of young black males. To better understand the mechanism underlying this persistence, we next examine the role of firearms in the change in the murder rates for young black males. If crack markets changed the stock of guns in the community and the broad norms for gun possession among young black males, the higher prevalence of guns across everyday interactions would increase the equilibrium murder rate long after the systemic violence of crack markets ended.

To identify this potential role of guns, we would ideally document changes in both legal and illicit gun possession by detailed demographic groups over time and across locations. Unfortunately, to our knowledge, no such data exist over the time period in which we are interested.<sup>17</sup> Therefore, we examine three distinct pieces of empirical evidence that support a role for guns as a mechanism in the persistent increase in murder rates for young black males.

First, we consider changes in the young black males' offender rate for murders using guns. If their increased gun possession is responsible for the persistent change in the murder rate then a necessary, but not sufficient, condition is that black males are responsible for the increase in murders. It is not sufficient because an increase could be the result of an increase in systemic drug market-related violence. Therefore, we next present evidence that the increase in guns increased the lethality of disputes, including those that were not directly related to this systemic violence. In particular, we examine changes in lethal instances of domestic violence using murders of family members and

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<sup>16</sup> Ludwig and Cook (2000) exploit the fact that some states had waiting periods for handgun ownership prior to the Brady bill within a difference-in-difference specification and find no effect of the Act on either aggregate suicide or murder rates. They note that their approach does not permit a reliable analysis of how the Act affected guns flowing to secondary markets – which is likely a meaningful source of firearms for crack markets.

<sup>17</sup> Data on aggregate gun sales are available for some time periods. However, we are interested in the extensive margin rate of gun possession and not the intensive accumulation of guns within a household. In addition, many cases of illegal gun possession start with a legal gun sale and therefore even regional data on gun sales does not provide an accurate proxy for illegal gun possession.

intimate partners that involve a gun. An increase in this murder rate would suggest a role for the presence of guns increasing the lethality of arguments that otherwise would have been violent but not fatal. Finally, we show that a proxy for gun ownership, the fraction of suicides using guns, shows a strikingly similar pattern to the gun murder rates for black males 15-24.

#### *4.1 Increases in the Offender Rate for Young Black Males*

If increased gun possession by young black males is driving the murder rate increases documented above, there should also be a corresponding increase in the rate of gun murders committed by young black males. We next turn to data from the FBI's Supplemental Homicide Reports (SHR) to examine this issue.

The SHR is part of the FBI's Uniform Crime Reporting system and participating agencies voluntarily report detailed information about each murder in their jurisdiction. The SHR, available from 1976, reports information about the date, location, method of murder, and demographic information of victims (age, race, sex, and ethnicity). When the offender is known, the SHR reports the same demographic information for the offender as well as the relationship between the offender and victim and circumstances surrounding the murder. The offender information is missing in roughly one-third of cases. Not all agencies report data on a consistent basis to the SHR and, as a result, not all state/year observations are of the same quality. We use a version of the SHR with data from 1976 to 2015 that was compiled by Kaplan (2017) and made available on the Inter-university Consortium for Political and Social Research site.<sup>18</sup> We delete homicides classified as "manslaughter by negligence" and delete all deaths in the data associated with the 9/11 terrorist attacks.<sup>19</sup>

We aggregate the SHR data to the national level to generate comparisons with the MCODE mortality data. Figure 8A shows three measures of murder rates from 1976-2014. The top black line is the murder rate from the compressed mortality data discussed earlier in the paper. The dashed-line below that is the victim murder rate in the SHR, and the grey line at the bottom is the offender rate in the SHR. To get the victimization rate, we aggregate all known deaths in the data and divide by the national population. The SHR victim rate is directly comparable to the MCODE data. The only difference exists when agencies do not report to the SHR so, by construction, the number of homicide victims will be under-reported in the SHR. In contrast, the offender rate is conceptually very different

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<sup>18</sup> <https://www.openicpsr.org/openicpsr/project/100699/version/V1/view>.

<sup>19</sup> This distinction is not necessary in the Multiple Cause of Death data because by 1999, the ICD-10 system had separate codes for assaults leading to a mortality (X85-Y09) and terrorist attacks leading to a homicide (U01).



and not directly comparable. Within the SHR, each incident can have multiple victims and multiple offenders. If two offenders kill one person and both offenders are known, there will be two offenders in the data. The offender rate is typically lower than the victim rate, which is not surprising given the large fraction of observations without a known offender. While there are differences in the levels of murders in the MCOD data, homicide victims in the SHR and homicide offenders in the SHR, the trends across all three series are remarkably similar and suggest that measurement differences are broadly consistent over time.

We next examine the relationship between offender and victimization rates in the SHR for different demographics group for the 57 largest MSAs we have been using. We first delete any data from states in years where the FBI indicates that (population-weighted) agency reporting was less than 50 percent.<sup>20</sup> We then aggregate data to the MSA level using the same county-to-MSA mapping we used for the MCOD data, as MSA definitions can vary over time. The population data used to calculate the murder rates are from the same sources as above.

Figure 8B reports homicide offender and victimization rates for black males aged 15-24 based on the year in which crack markets arrive, along with the same series from the Vital Statistics. These young black males show an increase in both the victimization and offender rates beginning in the year that crack markets emerge. Figure 8C contains similar data for black males aged 24-35. These show a very different pattern where the increase in murders for this group occurs in victimizations and not offender rates. Figure 8D reports results for white males aged 15-24 and these show broadly the same pattern of results for black males of the same ages. Figures 8E and 8F contain the offender and victimization rates for black females, aged 15-24- and 25-34, respectively. The pattern in these is the same as for black males 25-34. There is a noticeable increase in their victimization rate. However, neither group shows any change in its offender rate.

This change in the offender rate can also be seen in the shares of all murders committed by young black males and young white males, which are depicted in Figure 9. Prior to the emergence of crack markets, young black males accounted for a stable 19 percent of all murders. In the six years after crack markets emerge in a city, the share of all murders committed by young black males increased by 14 percentage points – an approximately 75 percent increase. During this period, young black males comprised approximately 1.4 percent of the population yet committed approximately one third of all

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<sup>20</sup> These observations are AL (1999 and 2011 and after), DE (1994 and 1995), DC (1996, 1998-2008, 2011), FL (1988-1991, 1996-2015), IL (1984-1985, 1987), KS (1988, 1993-2000), KY (1987-1988, 1994, 1999-2003), LA (1991), NH (1997), VT (1982-1873), and WI (1998).

murders. Fully 16 years after crack markets emerge, the share of all murders attributable to young black males remained around 45 percent higher than the pre-crack level. A smaller increase in offending occurs for white males – the lower line in the graph -- although not until several years after crack markets emerge. This is consistent with Blumstein’s diffusion hypothesis that other demographic groups arm themselves in response to violence perpetrated by those directly in the crack trade.

#### *4.2 How Guns Changed the Lethality of Violent Interactions*

The change in the offender rate could have been the result of an increase in the number of violent interactions and not an increase in gun possession. In thinking about the potential role for gun possession leading to an increase in the murder rate, it is helpful to consider that every homicide has two necessary conditions: (1) a confrontation that rises to the level of violence; and (2) a method of violence sufficient to end a participant’s life. Factors that increase the frequency of either should increase the murder rate.

The emergence of crack markets could increase both of these factors – which would help explain the very large increase in murders. As discussed above, the open-air nature of these markets and the commodity nature of the product led to physical violence being a primary means of maintaining high prices and profits. In addition, relatively easy access to guns in this period allowed individuals wanting to commit this violence a ready way to do so.<sup>21</sup> While the changes in the offender rate for young black males show that the persistent increase in murders for young black males was caused by their greater use of guns, this does not provide evidence of more gun possession as it could be that crack markets only increased the instances of systemic violence. This would increase the number of violent confrontations and, potentially, the murder rate, even if there was no change in gun possession rates.

If the increase in the murder rate was caused by an increase in gun possession, this should manifest itself in a greater murder rate for circumstances that are unlikely to be directly related to the

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<sup>21</sup> Bartley and Williams (2015) posit that the violence in the mid-1980s is driven not by crack markets but rather by a decrease in prices resulting from a supply shock of “entry level” guns. While we clearly agree guns play a role in the violence, we find it hard to argue that a supply shock is the cause of greater violence. At a minimum, it is hard to understand why simply an increase in the supply of guns would disproportionately increase the murder rates for young black males but not other groups. Instead, we argue that the violence is tied to the emergence of crack markets – as can be seen in our evidence on the timing of murders and the emergence of organized crack markets. The availability of guns in this time could have exacerbated the violent tendencies of crack markets – but this is different from having a causal role. In addition, these authors make no attempt to explain the persistence of murder rates for young black males – a focus on our work in this paper.

systemic violence of crack markets. To examine this issue further, we next turn to data in the SHR that documents the relationship between the offender and murder victim. Specifically, we focus on murders between family members and intimate partners. These relationships are likely less directly affected by systemic violence in drug markets. We estimate our difference-in-difference model for offenders who kill a family member or intimate partner (“domestic relations”), focusing on black male offenders aged 15-24 and using black male offenders aged 35+ as the comparison group. The results of this analysis are presented in Figure 10A. In panel B, we report the same model for black male offenders in the same two age groups where the victims are not family members or intimate partners (“non-domestic relations”).

Prior to the emergence of crack cocaine markets, the estimated coefficients for domestic relations murders are small in magnitude and statistically indistinguishable from zero. However, after the emergence of crack markets this murder rate increases markedly and persistently, so that 16 years after the emergence of crack, the young black males’ rate for murders of family members and intimate partners is 103 percent higher than it would have been had it followed the path of older black males. Panel B contains the results for murders that are more likely to be related to crack markets, and we generate the same general pattern as we saw in Figure 5A.

There could be a concern that factors related to crack markets increase arguments and violence between family members, and that this is driving the results in Figure 10A. To examine this question further, we next examine whether the increase in domestic violence homicides is driven by guns or instead occurs for murders using any type of weapon. Over the period SHR data are available, domestic violence murders are roughly evenly split between those involving a gun and those that do not. Panels A and B of Figure 11 contains the estimates from a difference-in-differences model for offenders that are black males aged 15-24 that kill family and intimate partners, respectively, with a gun (11A) or another weapon (11B). Again, we use black males 35 and up as the comparison sample.

These estimates reveal two important facts. First, there is a clear and persistent increase in young black male gun-related murders among family and intimate partners in the years immediately following the emergence of crack cocaine markets. Fully 16 years after crack markets emerge, the gun murder rate in a situation of domestic violence for young black males remained nearly 150 percent above what it would have been had it followed the rate for older black males. Second, a similar change is not seen for non-gun murders. The estimates for this outcome are far smaller in magnitude, often statistically indistinguishable from zero, and show no persistent increase or pattern over this time period. Panels C and D contain the estimates for the change in gun and non-gun murders for non-

domestic relations for these same age groups of black male offenders. In contrast, both murder rates increase meaningfully and persistently – reflecting a general increase in violence associated with crack markets. Together, these estimates support a role for gun possession in explaining the persistence increase in murder offender rates among young black males. Even murders less likely to be a source of systemic drug market violence show persistent increases after crack markets emerge.

#### *4.3 Gun Suicides as a Proxy for Gun Possession*

A large body of literature in public health has linked access to a gun at home to suicide rates. Gun access plays an important role in suicides because many suicide attempts are impulsive actions and gun suicide attempts have a high likelihood of success (Miller and Hemenway, 2008).<sup>22</sup> Examining this effect, Kellerman et al. (1992) use a case-control design and found that a gun in the home increased the risk of a death by suicide by a factor of five, with the gun/suicide gradient steepest for those aged 24 and under. There is a strong cross-sectional relationship between gun ownership rates and suicides at the state and regional levels in the U.S. (Cook, 1979; Azrael, Cook, and Miller., 2004; Miller, Azrael, and Hemenway, 2002a and 2002b; Kaplan and Geling, 1998), and across countries (Killias, 1993). This research has been hampered by lack of detailed time-series data on gun ownership at more local levels.<sup>23</sup>

Some researchers have used changes in laws surrounding gun ownership to examine the gun availability/suicide link, but the evidence is mixed. Using a panel of states, Edwards et al. (2018) found mandatory delays in handgun purchases reduce suicides. In contrast, Duggan, Hjalmarsson, and Jacob (2011) found that gun shows had no short-term impact on suicide rates in nearby areas. In a panel data set of states, Duggan (2003) found no correlation between gun magazine subscription rates, a proxy for gun ownership rates, and suicides. Using similar data, Lang (2013) found more gun background checks, again a proxy for gun availability, increased gun suicide rates. Leigh and Neill (2010) found that the states that had the most guns sold back to the government as part of an Australian gun buyback policy had the sharpest decline in suicides.

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<sup>22</sup> Estimates suggest that a quarter to 40 percent of suicide attempts occur within five minutes of a person's decision to commit suicide (Simon et al., 2001; Williams, Davidson and Montgomery, 1980). Deisenhammer et al. (2009) put this number at nearly 50 percent of attempts occur within 10 minutes of an initial decision to attempt suicide. Spicer and Miller (2000) estimate that 82.5 percent of suicide attempts with a gun are fatal.

<sup>23</sup> There are a few national surveys that provide data on gun ownership rates over time such as Gallop and the General Social Survey. These samples are however not large enough to generate detailed estimates at lower levels of geography. Some data sets such as the Behavioral Risk Factors Surveillance Survey have periodically asked questions about guns in the home but these questions have only appeared a few times on the surveys and generally not in the time periods before crack markets emerged across the United States.

Despite this mixed evidence, the strength of the suicide/gun availability relationship is thought to be so pronounced that, in much of the literature, the ratio of firearm suicides (FS) divided by total suicides (S) (known as FS/S) is typically used as a proxy for gun availability (Cook, 1979; Kleck and Patterson, 1993; Hemenway and Miller, 2000; Miller, Azrael, and Hemenway, 2002a and 2000b; Cook and Ludwig, 2006).

In Figure 12, we provide some evidence of the validity of gun suicides as a proxy for gun possession that is consistent with the prior literature. In this graph, the horizontal axis measures the fraction of adults in our 57 MSAs in 2001 that live in a home with access to a gun. These data are from the Behavioral Risk Factors Surveillance Survey (BRFSS), which is a nationwide, telephone-based survey of adults aged 18 and older. The survey is conducted in individual states but aggregated to the national level by the Centers for Disease Control.<sup>24</sup> The 2001 BRFSS respondents were asked: “Are there any firearms kept in or around the house?” We aggregate the data from the county-to-MSA level using the same county definitions as above. On the vertical axis, we plot the MSA-level gun FS/S ratio for adults aged 20 and older in the years 2000-2002, which is constructed from the MCODE mortality data. In the scatter plot, the size of each circle is a function of the 2001 population of the MSA. The regression line in the scatter plot is weighted by population. The graph shows a strong positive relationship between these two variables, with a correlation of 0.83.

There could be features of states that lead to both a large cross-sectional relationship between the percentage of households with a gun and the FS/S. In addition, there could be concerns that the relationship between overall gun possession and suicide may not apply to the behavior of younger males. To address these concerns, we exploit changes over time in gun possession and suicide rates among teenagers using data from the Youth Behavioral Risk Factor Surveillance System (YBRFSS). The YBRFSS is a bi-annual survey of students of high school age. Not all states are included in each year. In 1993, respondents were first asked whether they had carried a gun in the previous 30 days.

Using data from 1993-2013, we calculate every available 10-year difference (e.g., 1993-2003, 1995-2005, etc.) in gun carry rates for any state that has one of the 57 largest cities we examine. We plot this value against the contemporaneous change in the gun suicide rate at the state-level value for FS/S for teens aged 15-19, taken from the MCODE data. This analysis effectively controls for time-invariant factors that could be driving both of these outcomes of interest. Figure 13 contains a scatter plot of the

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<sup>24</sup> For more information about BRFSS, please see <https://www.cdc.gov/brfss/index.html>.

ten-year differences in these outcomes for 15-19 years-olds and shows a clear positive relationship between the two differences in these outcomes, with a correlation of 0.6.

Taken together, the evidence in Figures 12 and 13 provide support for the use of FS/S as a proxy for gun possession in our setting. We next examine whether there was a change in the fraction of suicides by firearms coincidental with the arrival of crack in our 57 cities. In Figure 14A, we present the FS/S for black males aged 15-24 and aged 35 and over. For young black males, there is a sharp increase in FS/S from 0.59 the year crack arrives to 0.76 10 years after the arrival. In contrast, for older black males, there is a slight increase in the first few years after crack's arrival, but a slow decline in this number over time. The FS/S started out higher for older black males but, after the arrival of crack, there is a noticeable gap between younger and older black males similar to the gap in murder rates we see for these two groups in Figure 3A. There appears to be some pre-treatment trends in the FS/S, but that is driven again by the cocaine-affected cities of Miami, Los Angeles, and New York City. In Figure 14C, we reproduce Figure 14A but remove the data from these three cities. There is now little pre-treatment trend in the outcome. In Figure 14B, we reproduce the results from 14A for white males. For younger white males, there is a noticeable increase in FS/S starting about 3-4 years after the arrival of crack. This value stays elevated for about another 4-5 years, but declines steadily after that. There is little change in the FS/S number for older white males. These patterns are consistent with an elevated murder rate for young white males that lasts for several years after crack markets emerge.

The evidence in Figure 14A and 14C clearly indicates a rise in gun availability for young black males. We can estimate the rise in gun availability for younger black males relative to those aged 35 and older in our difference-in-differences regression model with FS/S as the outcome of interest. Given that the outcome is a share, we estimate this model by OLS and include the same set of covariates as in the previous negative binomial estimates, excluding the  $\ln(\text{population})$  variable with the coefficient fixed at one. We cluster the standard errors at the MSA level.

Results from this model for males are reported in Figure 15. Figure 15A reports results for black males aged 15-24 and shows that, 8-9 years after crack arrives, the FS/S share has increased by a statistically significant 22.6 percentage points. Even 16-17 years after crack's arrival, the FS/S share is still 16.7 percentage points higher than that for black men 35 and older. The results for black males aged 25-34, reported in Figure 15B, show a later and smaller increase in gun availability. The increase is slowly rising from four percentage points 6-7 years after crack arrives to seven percentage points 12-13 years after. It is only after 16-17 years that the coefficient becomes statistically significant at 11.5 percentage points. In Figures 15C and 15D, we report the results for white males ages 15-24 and 25-34,

respectively. In these cases, FS/S is actually declining relative to the share for males 35 and older. By 8-9 years after crack's arrival, the results are statistically significant and, by the end of the follow-up, the FS/S share has declined by 8.8 and 6.6 percentage points, respectively, for these two age groups. Changing gun availability cannot explain the persistently higher murders among younger white males many years after crack's arrival.

Given the results in Figures 14 and 15 for black males aged 15-24, it is no surprise that we also find rapid changes in gun murder and gun suicide rates coincidental with the entry of crack for this group. Figure 16 shows murder and suicide rates for young males, further split by whether or not they involved a gun. Panel A shows these four time series for black males aged 15-24 at a national level. While the levels are meaningfully different for gun-related suicides and gun-related murders, the trends in the two outcomes are remarkably similar over time. Panel B shows the same time series for white males aged 15-24; the trends in gun-related deaths are not as similar for young white males, although both experience a rise in the late 1980s and early 1990s followed by subsequent declines. Panel C contains the same rates for black males aged 15-24 in relation to the entry of crack cocaine markets for our sample of 57 cities. Prior to the emergence of crack cocaine markets, the rates of gun-related murders and suicides are both flat. In the years immediately following our dates for the arrival of crack cocaine markets, both of these rates swiftly increase, peak, and then decline. Panel D contains the estimates for young white males. For white males, the emergence of crack cocaine markets is associated with a large relative increase in the gun-related murder rate. However, the gun-related suicide rate for young white males does not follow the pattern for gun-related murders.

Similar to our analysis of the murder rate, we next quantify the change in the gun suicide rate for young black males in relation to when crack markets entered their city. In order to control for other events that would have occurred in the absence of the emergence of crack cocaine markets, we again use older black males as the control group. We note that, similar to our previous analysis of murder rates, the trends in gun suicides were remarkably similar for younger and older black males prior to the arrival of crack markets to the United States.

Figure 17 contains the coefficients from our event-study analysis of the change in gun-related suicide rates for black males aged 15-24. For comparison, Panel A shows a sharp increase in gun murders following the emergence of crack markets (previously shown in Figure 5A). Panel B shows the results of a similar analysis using gun-related suicides. These estimates demonstrate a corresponding increase in gun suicides after crack arrives in MSAs. The magnitudes of these estimates are almost the same. Eight years after crack's arrival, the gun murder rate increases by 118 percent while the gun

suicide rate increases by 114 percent. Fourteen years after cracks arrival, gun murder rates are still 70 percent higher, while gun suicide rates are 99 percent higher.

Similar to the murder rate, the increase in gun-related suicides remains persistently high. Fully 16 years after the emergence of crack cocaine markets, the suicide rate for young black males is 77 percent higher than it would have been had it followed the trend for older black males. As we mentioned above, these full sample results are potentially contaminated by some pre-treatment trends in violence associated with the cocaine wars in Los Angeles, Miami and New York. In Panels C and D, we show the gun-related murders and gun-related suicides results without including these three cities. The suicide results are similar using this sample of 54 MSAs.

#### *4.4 Differences in Persistence of Young Black Male Murder Rate Increases*

The evidence above shows a meaningful increase in gun suicides in cities in the years following the emergence of crack cocaine markets. The change in gun suicides is also strongly correlated with the gun murder rate. Given the evidence of the correlation between gun suicides rates and gun possession, this provides evidence that the increase in guns in the community led to the large increase in murder rates for young black males.

To further understand the role of the increased prevalence of guns in the *persistently* increased murder rate for young black males, we next examine the change in murder rates for groups of cities based on the change in the suicide rate. If gun suicides are a proxy for increased gun possession in the community, and these guns are responsible for a larger change in the murder rate, then cities which experience the largest changes in gun suicide rates as a result of the emergence of crack markets should have a different time path and persistence in their murder rates compared to other cities.

To examine this point, Figure 18A contains the murder rate for black males aged 15-24 in relation to when crack cocaine markets entered their city. Cities are grouped based on the change in the trough-to-peak of their FS/S ratio over the eight years before and the 17 years after crack markets emerged. The black line represents cities which had a change in this ratio over this time period that was above the median for all of the cities in our sample.<sup>25</sup>

Given the correlation between this ratio and gun possession, these above-median cities are those that likely had a greater inflow of guns following the emergence of crack cocaine markets.

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<sup>25</sup> The cities with below-median changes in FS/S are: Salt Lake City, Charlotte, Orange County, Columbus, Albany, Portland, Denver, Orlando, Grand Rapids, New Haven, Atlanta, Oklahoma City, Louisville, St. Louis, Greensboro, Ft. Lauderdale, Phoenix, Cleveland, Bergen, Birmingham, Tampa, New York, Nashville, Los Angeles, San Antonio, Cincinnati, Miami, San Diego and Baltimore.



Accordingly, the graphical evidence in Figure 18 shows that the cities which appeared to receive more guns also had a greater and far more persistent increase in the murder rate for younger black males. This difference was not present prior to the emergence of crack cocaine markets where these cities both had broadly similar murder rates.<sup>26</sup> Eight years after crack markets emerged, the above-median cities had a murder rate that was nearly 40 percent greater than the below-median cities. Fully 17 years after crack markets emerge, the above-median cities had a rate that was approximately 50 percent greater than the below-median cities. The growth in the gap between the cities in later years is driven by a declining murder rate in the cities below the median, while the cities above the median remain at a roughly constant murder rate of 130 per 100,000 residents in this demographic group.

Panel B of Figure 18 contains similar data for black males aged 35 and older, where cities are grouped in the same categories as Panel A. In contrast to the murder rates for young black males, there is no persistent difference between the murder rates for these groups. Eight years after crack markets emerge, the above-median cities have a murder rate that is only six percent higher than the below-median cities, and 17 years after crack arrives the murder rate is 16 percent higher.

## 5. Conclusion

The evidence above demonstrates a clear relationship between the spread of crack markets and a sharp increase in the murder rate of young black males. The combined evidence of a sustained increase in gun suicide rates, an increase in the share of all murders attributed to young black male offenders, and the widespread increase in murder rates across relationship types provide evidence of firearms as the mechanism driving the persistently higher murder rate for young black males. The increased likelihood that young black males would have access to firearms changed the fundamental lethality of altercations within this group. As a result, even though violence directly related to organized crack markets has largely receded, the negative effects of these markets on young black males continues to this day.

Given the demonstrated role of guns in the increased violence of crack markets, it is perhaps not surprising that murder rates remain elevated long after the market-related violence of crack markets has subsided. Guns are durable goods that remain in the geographic area long after their direct use in crack markets has passed. In addition, it is possible that the widespread prevalence of firearms and

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<sup>26</sup> Similar to the evidence discussed earlier, there is a slight pre-trend for the below median suicide cities which reflects the fact that New York, Miami, and Los Angeles are in this group and had an increase in murders in the years before crack cocaine driven by their role in powder cocaine distribution. Appendix Figure A18 shows these results for a sample excluding these cities.

increased rates of gun possession during the height of the crack markets and changed cultural norms regarding the routine carrying and possession of firearms. Consistent with both of these channels, we find that the cities with the largest change in our proxy for gun possession by young black males also had larger and more persistent increases in the young black male murder rate.

The magnitude of this long-lasting effect is substantial. Our evidence suggests that, even 16 years after the emergence of crack markets, the murder rate for young black males is 70 percent greater than it otherwise would have been. In the year 2010, this amounts to nearly 970 additional murders, or approximately 6 percent of all murders in that year. The relative impact on young black males is even greater. The excess deaths from the emergence of crack cocaine markets account for 40 percent of all murders for 15-24-year-old black males. If we consider the leading causes of death in 2010, these excess murders would be the third leading cause of death for 15-24-year-old black males trailing only other homicide and accidents (unintentional injuries). Similarly, increased suicides from the greater prevalence of guns account for nearly one quarter of young black male suicides in 2010. If separately categorized, these suicides would be the sixth leading cause of death for these young black males.

The additional exposure to violence stemming from the emergence of crack cocaine markets has had a meaningful impact on the longevity of black males in the United States. Due to a variety of factors, there is a persistent and historical gap in the life expectancy of whites and blacks in America. For example, in 2014 this gap was a historic low of 3.4 years. This life expectancy gap is driven by a variety of factors, including large differences in cardiovascular mortality and differential exposure to both AIDS and violence. As such, it varies along with these factors. Perhaps unsurprisingly given the evidence above, white-black differences in male life expectancy increased sharply between the 1980s and early 1990s, and then gradually declined since (Harper et al., 2007; Harper, Rushani, and Kaufman, 2012).

To understand the magnitude of the impact of crack markets in these changes, we use our difference-in-differences estimates to construct counterfactual murder and suicide rates that would have occurred in the absence of the emergence of crack cocaine markets in our 57 city sample. Using these counterfactual rates, we calculate the differences in life expectancy at 15 years of age across the four sex and race groups.<sup>27</sup> For black males, the reduction in life expectancy is largest in 1993, i.e. the peak of the increase in crack related murders, when it is 0.61 years. It is still 0.31 years in 2005, and 0.27 in 2012.

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<sup>27</sup> We calculate life expectancy from age 15 using age-group-specific mortality rates from the MCODE data. We calculate life expectancies based on mortality rates for specific years rather than for birth cohorts, and also apply other standard life table methods (e.g., Harper et al., 2007).

The effect is markedly smaller for other race and sex groups. For white males, the maximum reduction is 0.08 years in 1994; it is 0.03 in 2012. The maximum reduction is 0.03 years for black females and 0.003 years for white females; both occur in 1993.

To place these numbers into perspective, consider the impact of these increased murders relative to other factors contributing to the black-white life expectancy gap. For example, our estimates suggest that crack-related violence explains nearly all of the increase in the life expectancy gap related to homicides between 1983 and 2003. In fact, it suggests the homicide-related portion of the gap would have shrunk by one third between 1983 and 2003 if crack markets had never emerged. Finally, it has about one third to one half of the impact on the male life expectancy gap of cardiovascular disease and AIDS, which were two key causes of death driving the overall gap in white-black life expectancy over this period.

Our estimates suggest that the emergence of crack cocaine markets has fundamentally impacted the lives of successive cohorts of black males. The increased presence of guns in these communities continues to contribute to shockingly high murder rates. We find that even today, nearly 25 years after the peak of the systemic violence in retail crack market, crack-related violence and suicide may explain approximately one tenth of the gap in life expectancy between white and black males.

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Figure 1  
National Murder Rate, 1968-2015, NCHS Compressed Mortality Data

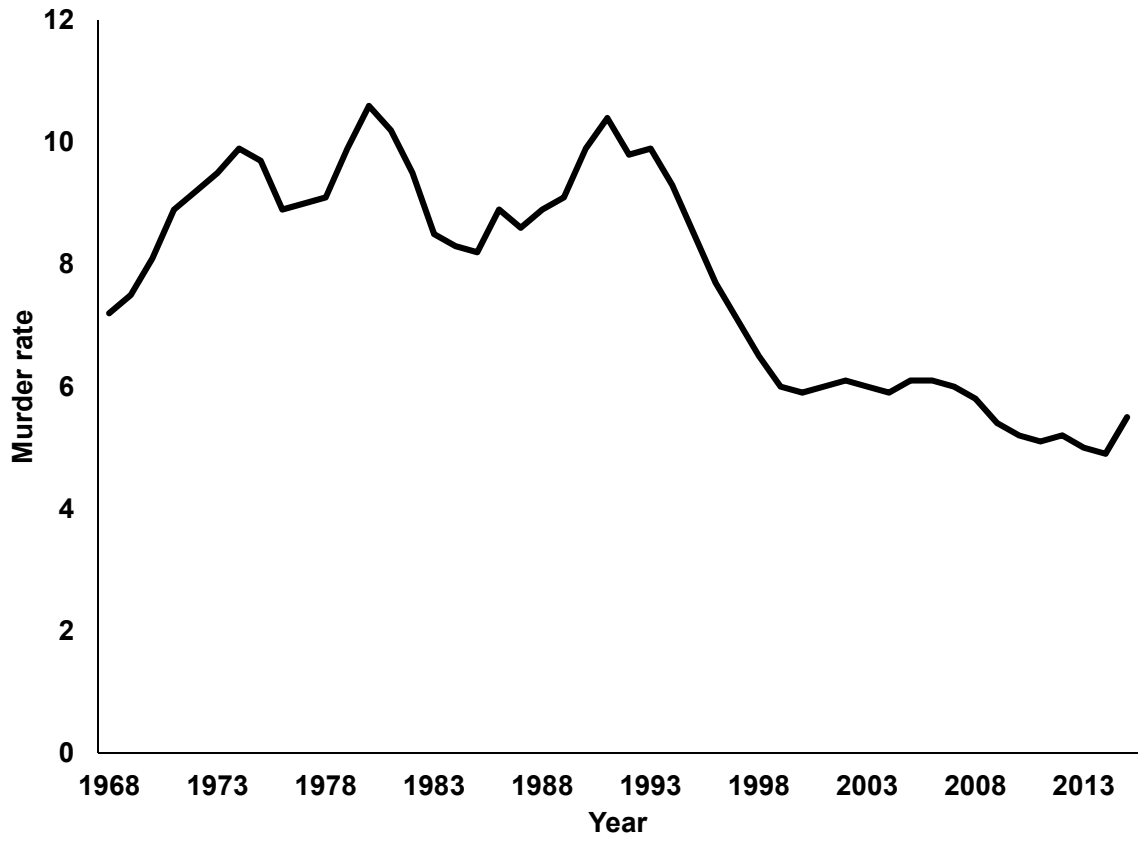


Figure 2  
National Murder Rates 1968-2015, By Race, Age and Sex, Multiple Cause of Death Data

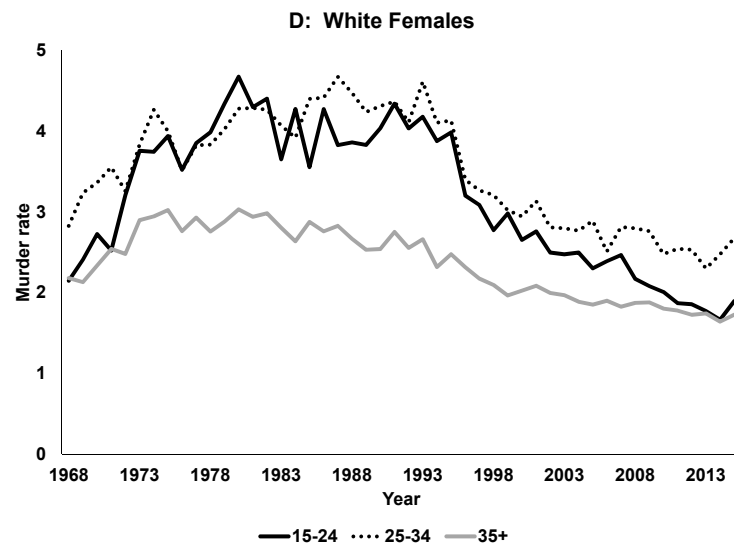
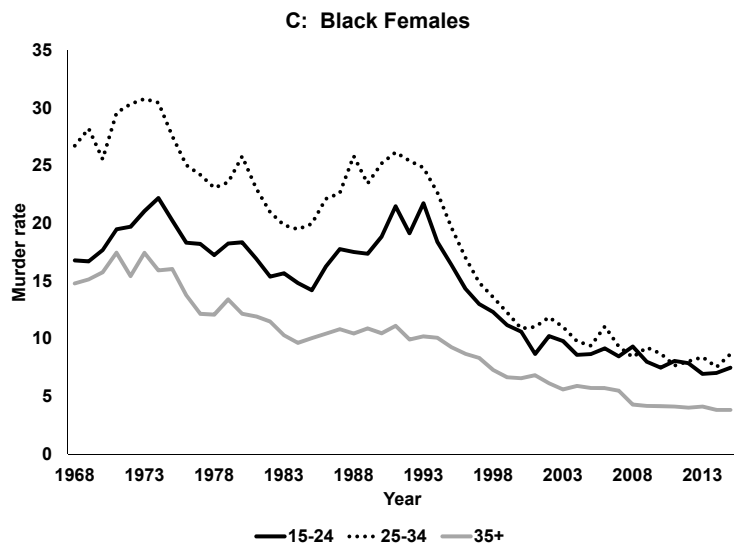
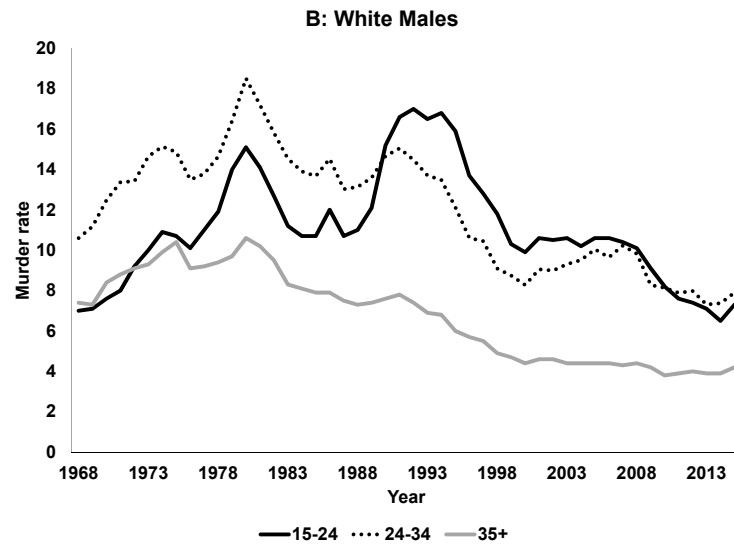
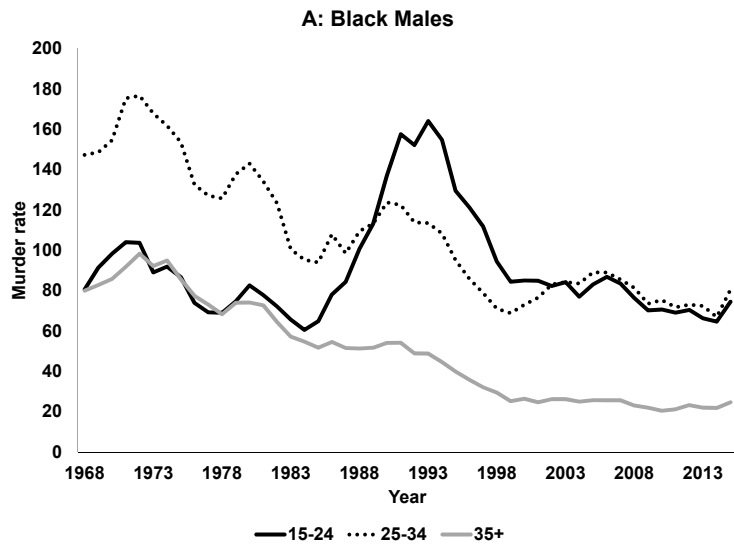


Figure 3

Murder Rates for 57 Large Metro Areas in Relation to Arrival of Crack Markets, By Race, Age and Sex, Multiple Cause of Death Data

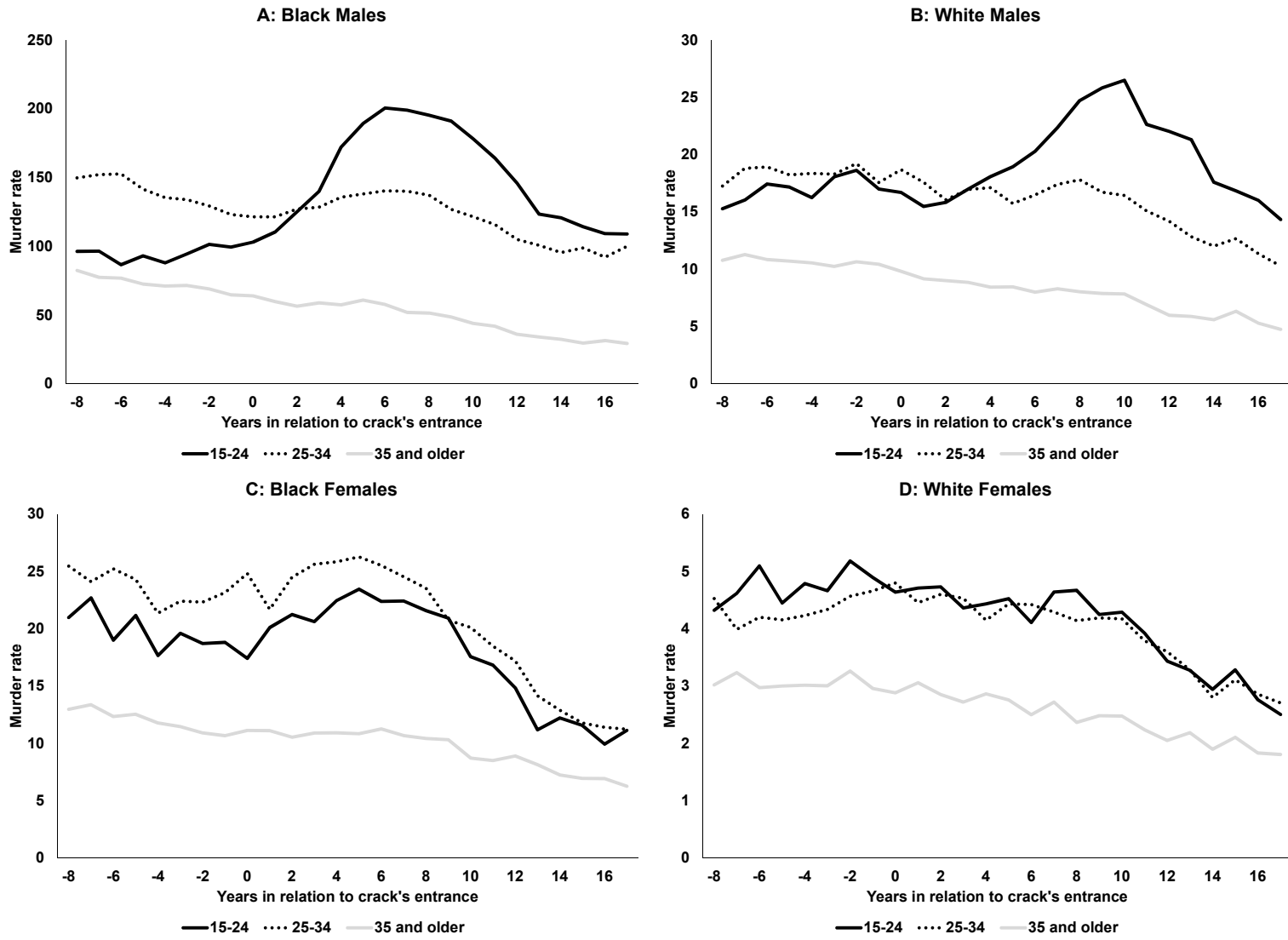


Figure 4  
 Murder Rates for Specific Cities in Relation to Crack's Entrance, Black Males, Multiple Cause of Death Data

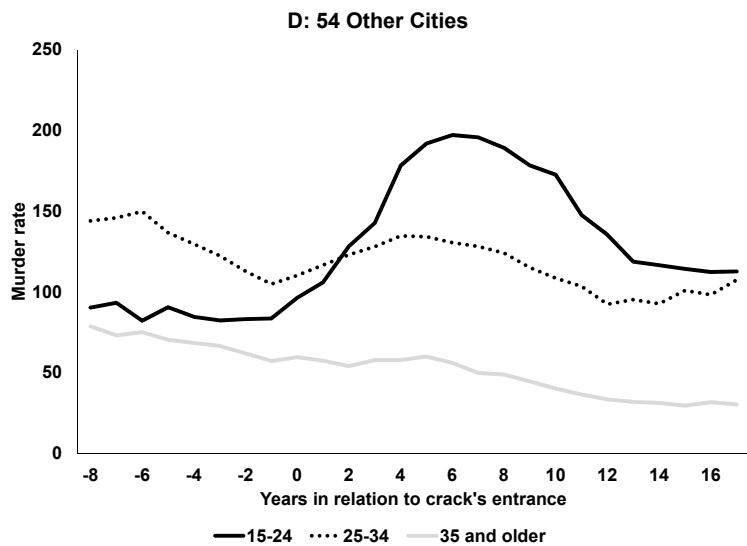
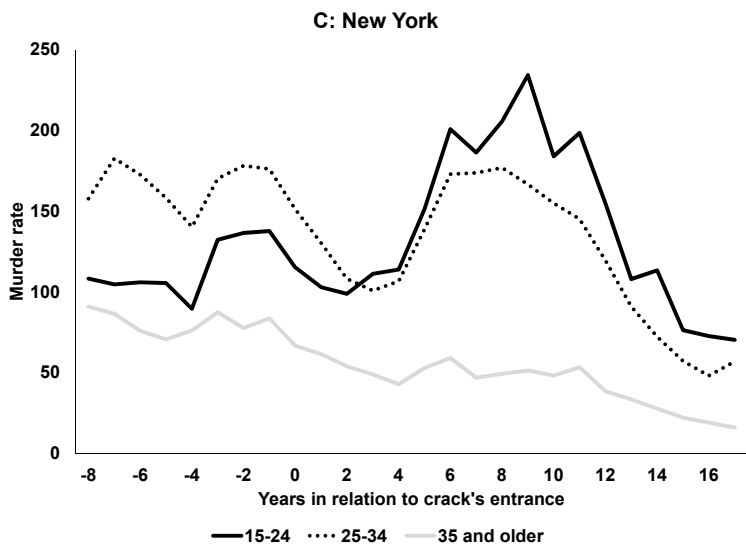
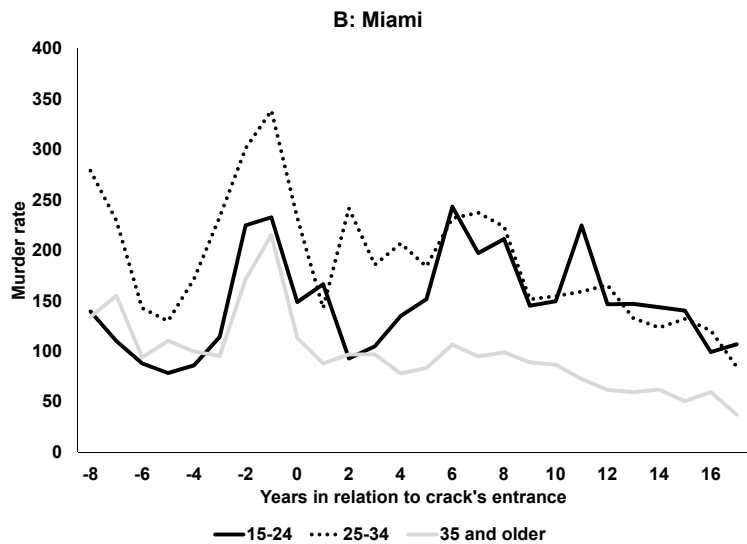
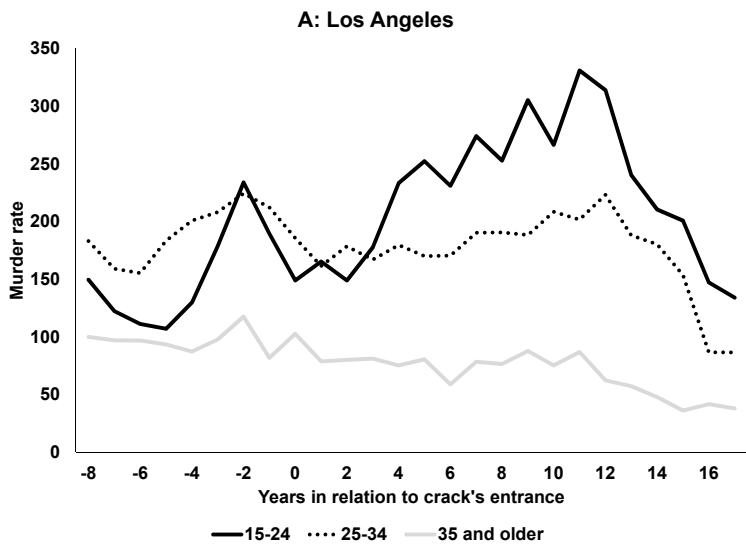


Figure 5

Estimates of the Impact on Crack's Entrance on Murder Rates of Black Males 15-24, Implied Percent Change and 95% Confidence Intervals

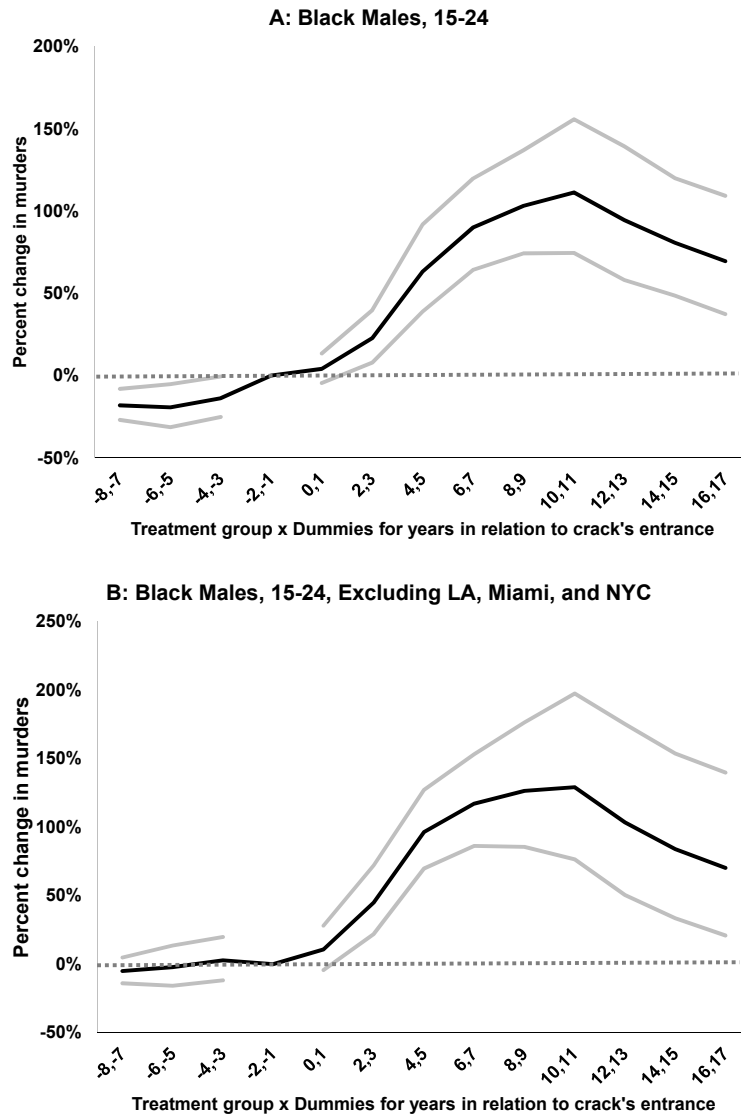


Figure 6  
 Negative Binomial Estimates of the Impact on Crack's Entrance on Murder Rates for Males by Race and Age,  
 57 City Sample, Implied Percentage Changes and 95% Confidence Intervals

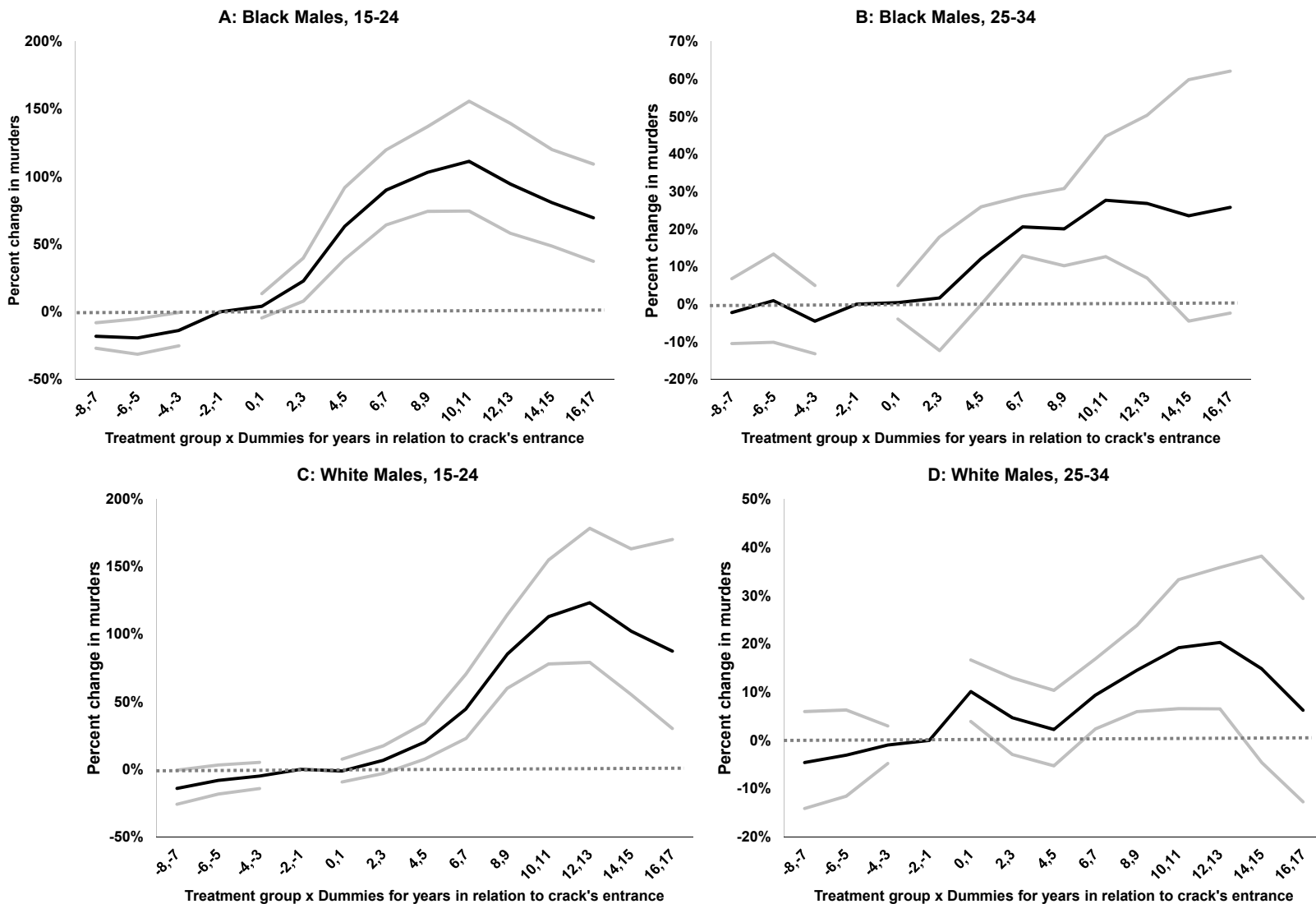


Figure 6 (continued)  
 Negative Binomial Estimates of the Impact on Crack's Entrance on Murder Rates for Females by Race and Age,  
 57 City Sample, Implied Percentage Changes and 95% Confidence Intervals

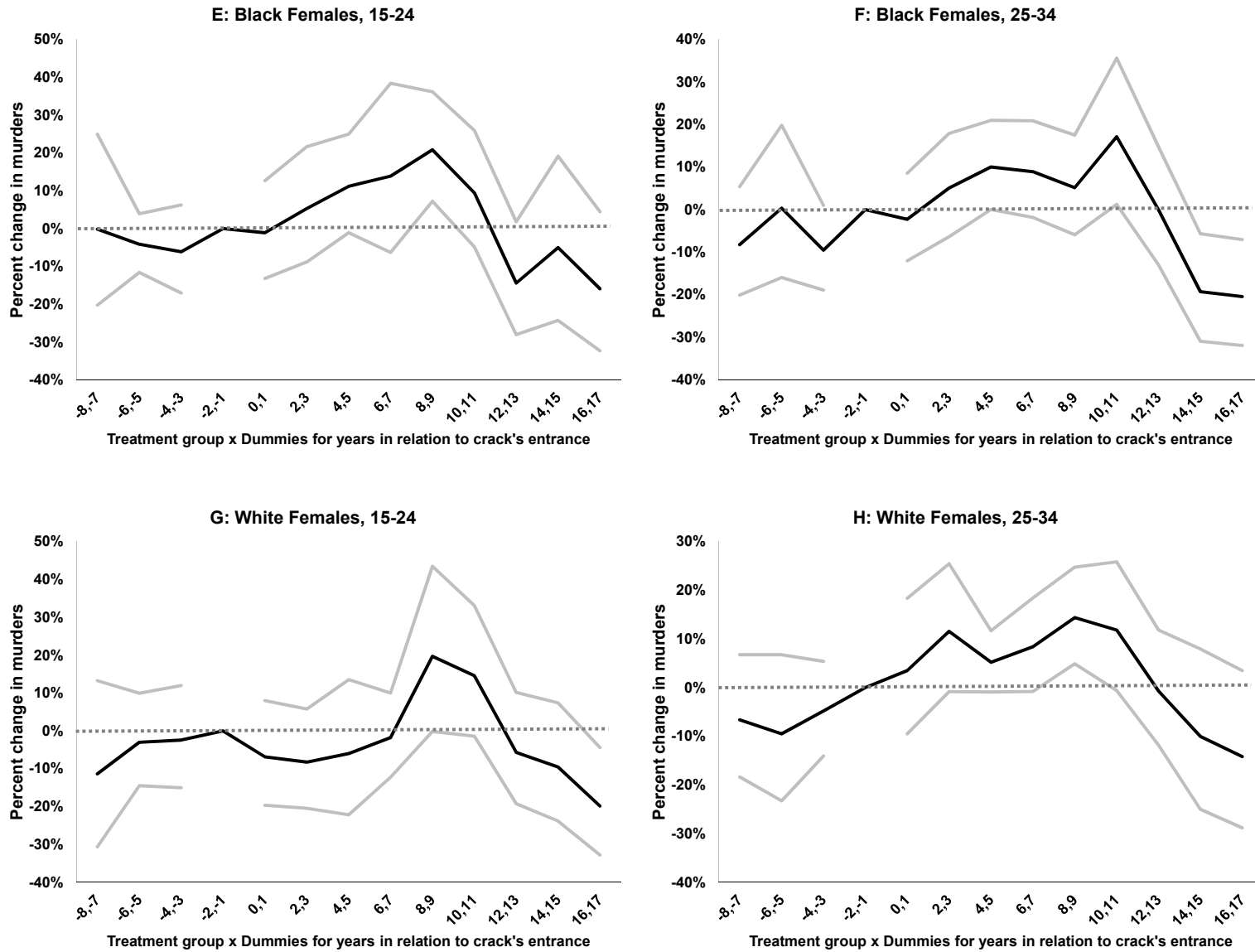




Figure 7  
 Number of Guns Manufactured and Gun Dealers Licensed by Bureau of Alcohol, Tobacco and Firearms

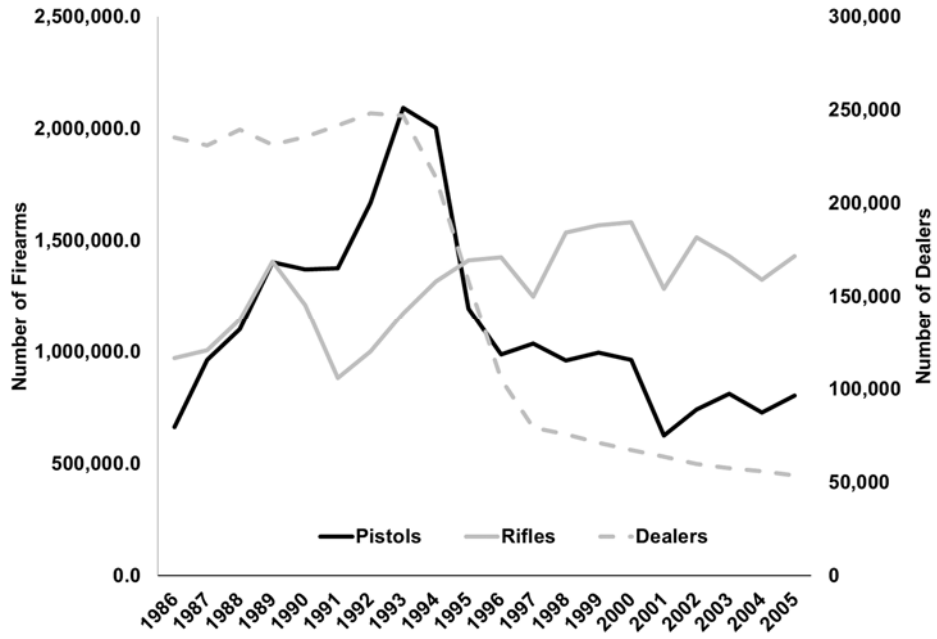


Figure 8  
 Murder Rate, Victimization Rate, and Offender Rate in Relation to Crack's Entrance,  
 Multiple Cause of Death Data and Supplemental Homicide Reports

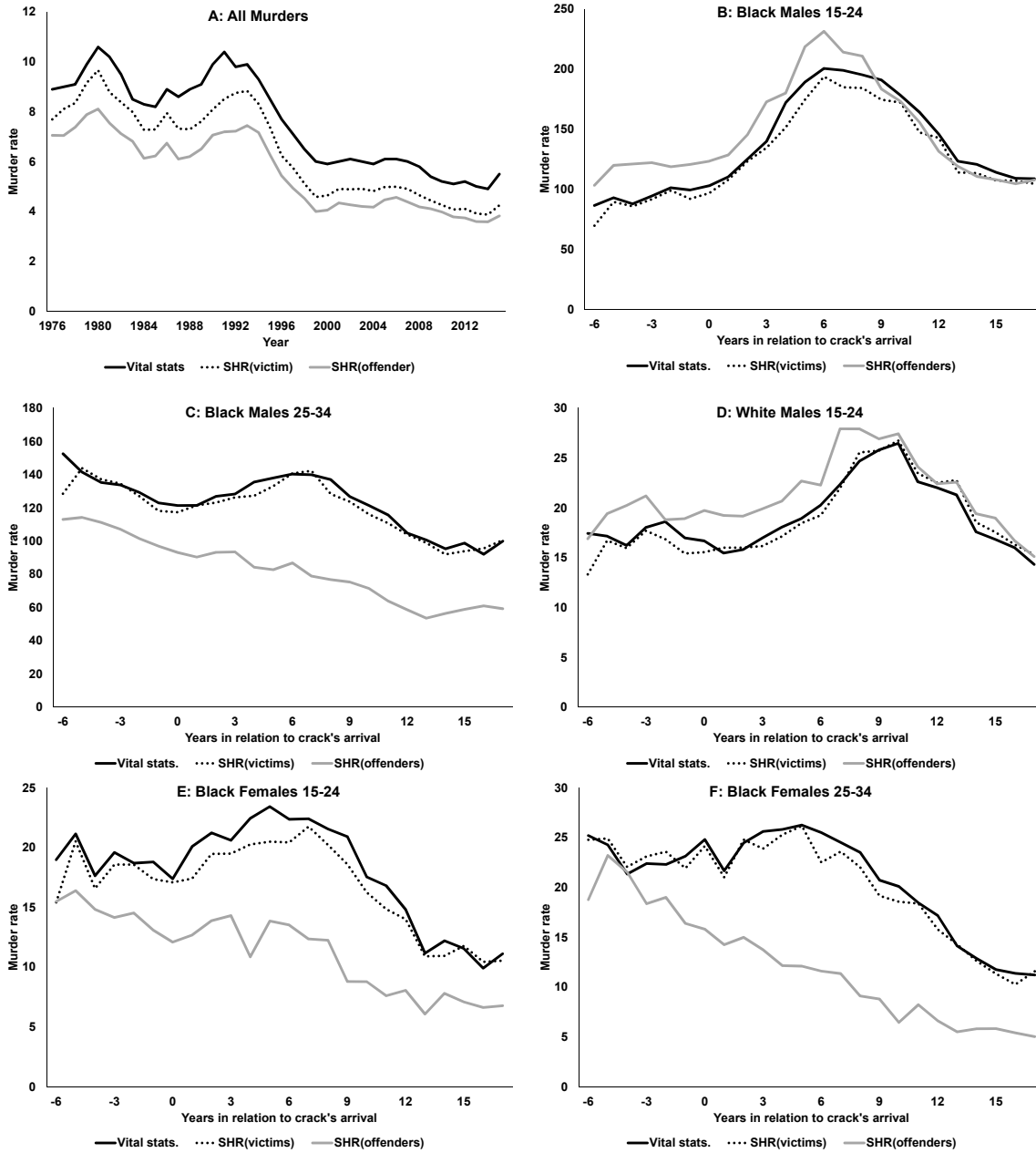


Figure 9  
Share of Murders Attributable to Young Black and White Males in Relation to Crack's Entrance, Supplemental Homicide Reports

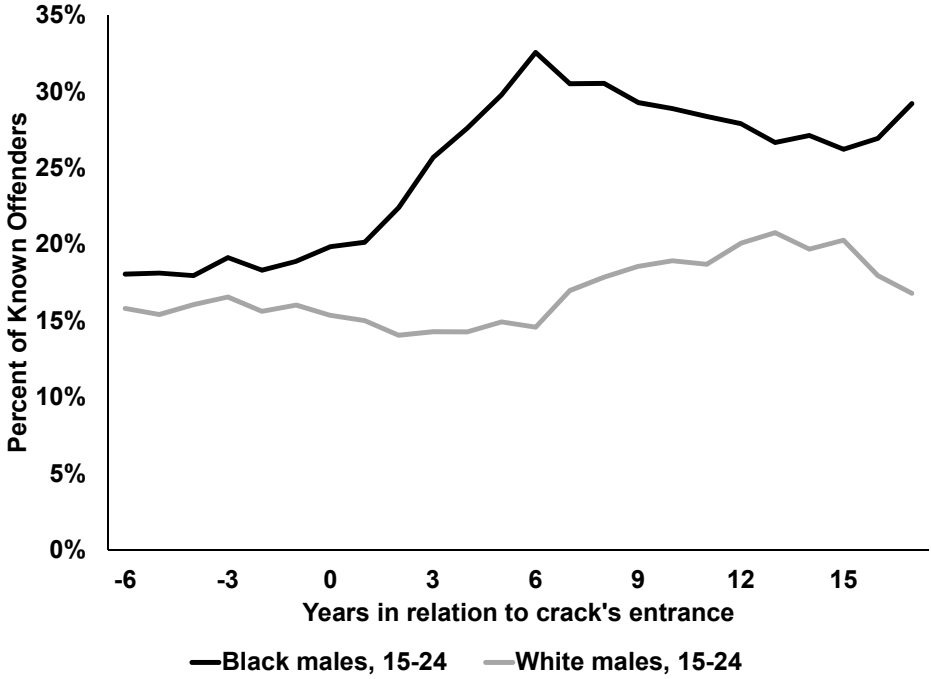


Figure 10  
 Negative Binomial Estimates of the Impact on Crack's Entrance on Murder Rates,  
 Implied Percentage Changes and 95% Confidence Intervals,  
 Murders by Black Males Ages 15-24 by Relationship to Victim

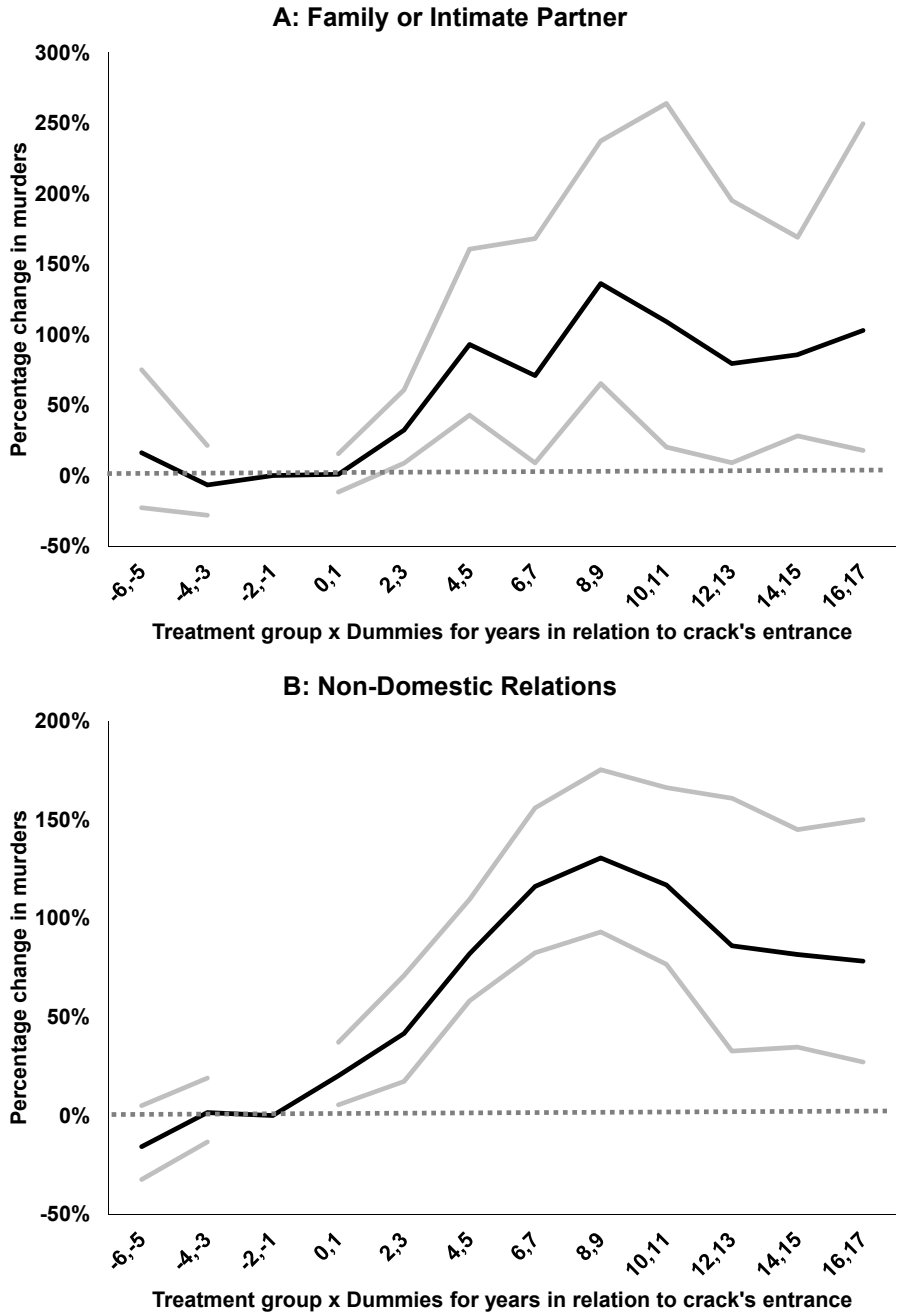


Figure 11

Negative Binomial Estimates of the Impact on Murder Rates, Implied Percentage Changes and 95% Confidence Intervals, Murders by Black Males Ages 15-24 by Weapon and Relationship to Victim

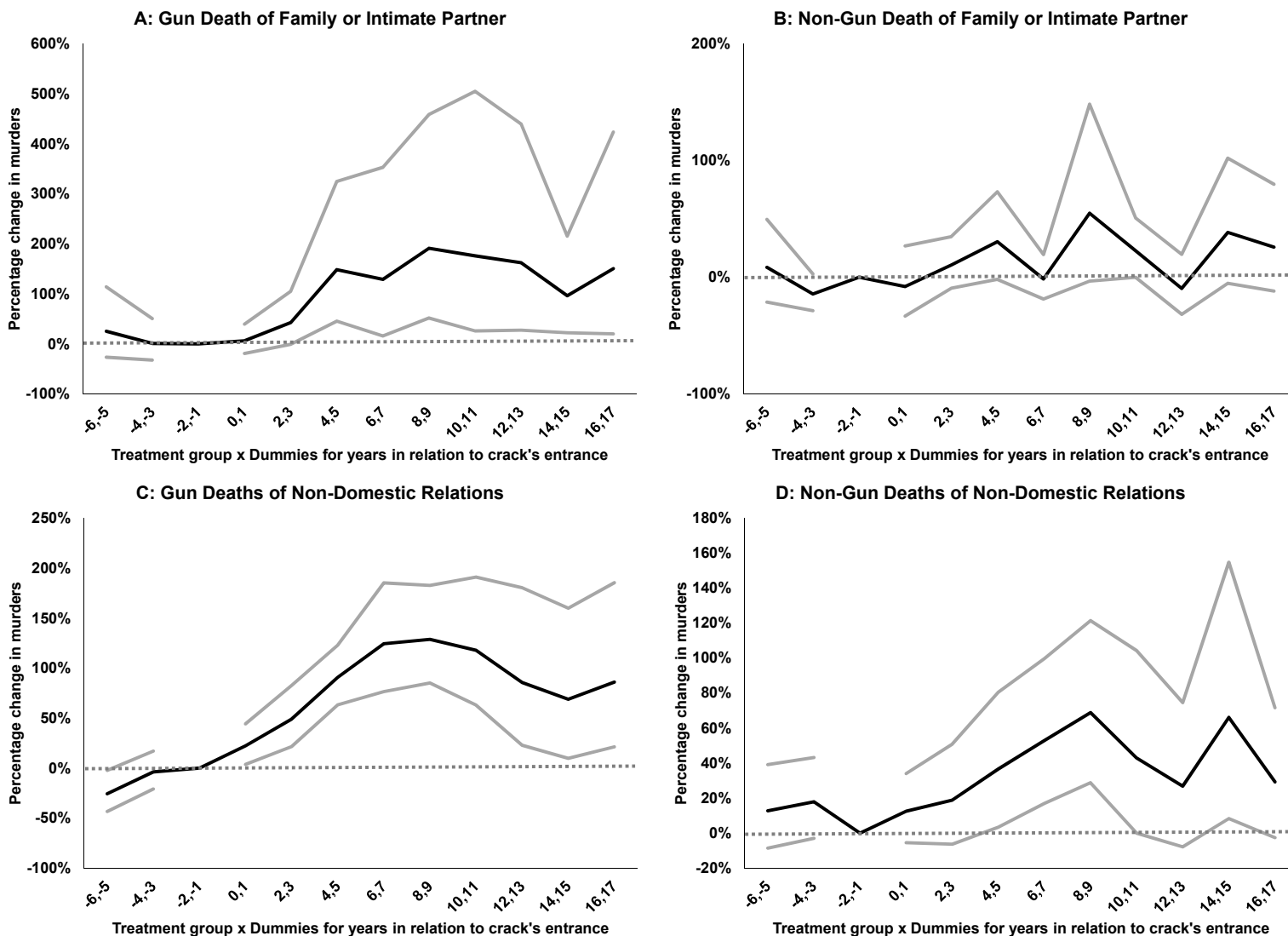


Figure 12

Percent of Respondents with a Gun in the Home (Behavioral Risk Factor Surveillance System Data, 2001) and the Fraction of Suicides by Gun (Multiple Cause of Death Data, 2000-2002)

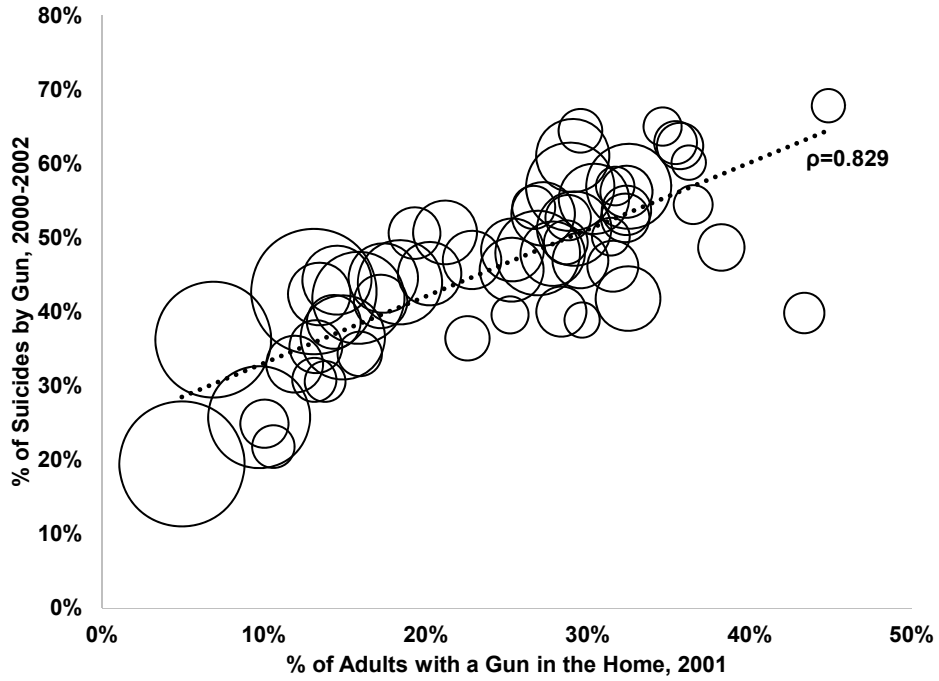


Figure 13

10-Year Change in Gun Carry Rates among Youths 15-18 (Youth BRFSS) and the 10-Year Change in the Fraction of Suicides by Gun for Youths 15-19 (Multiple Cause of Death Data)

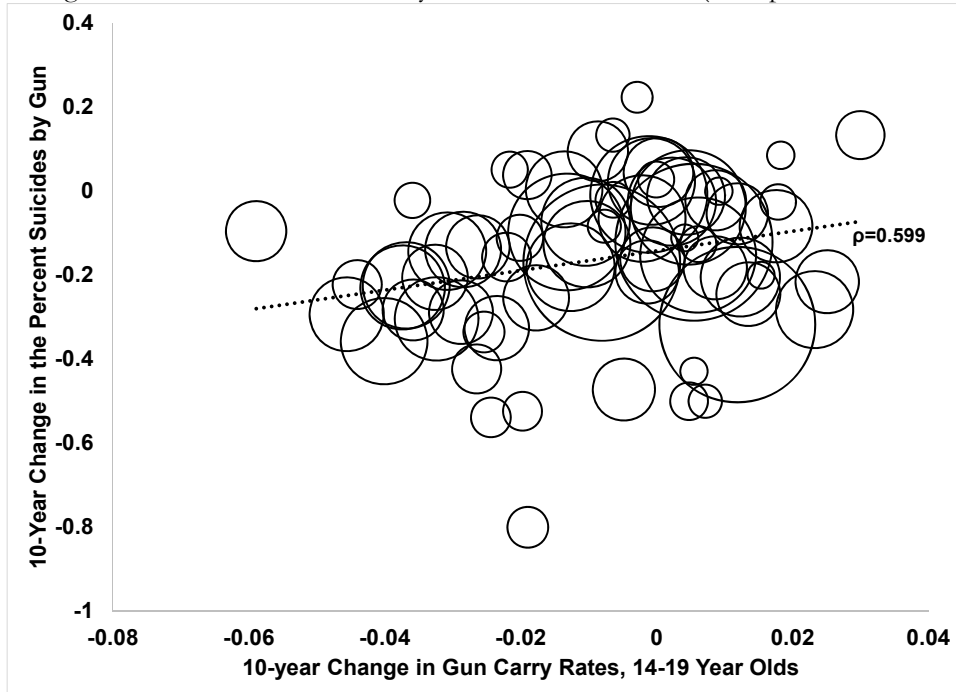


Figure 14  
 Fraction of Suicides by Guns in Relation to Crack's Entrance, 57 Large Metro Areas

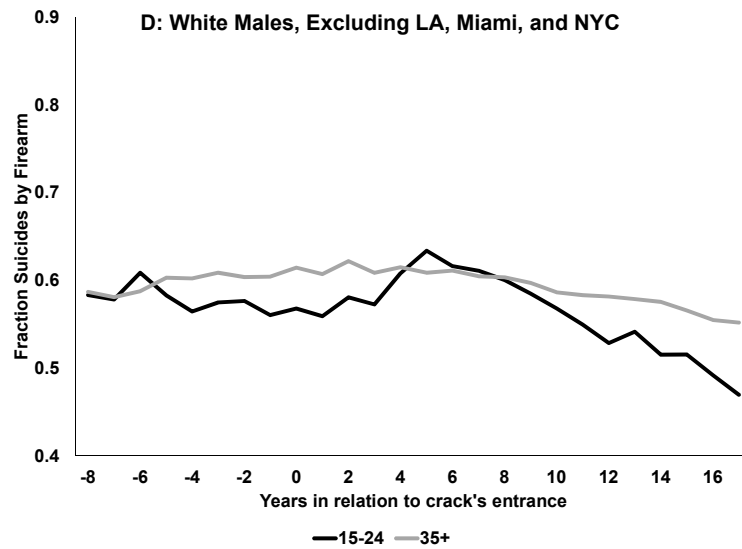
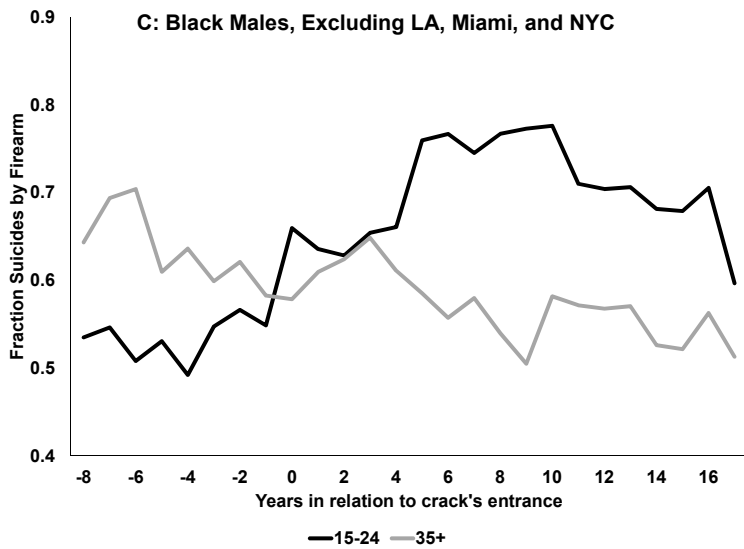
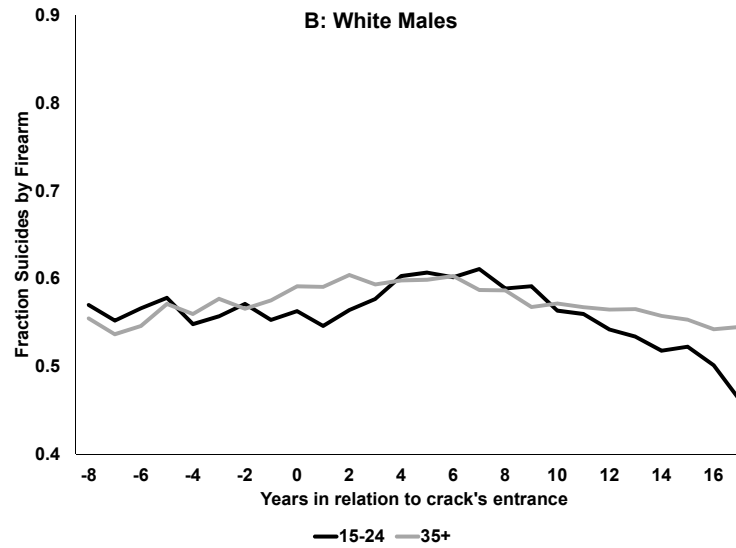
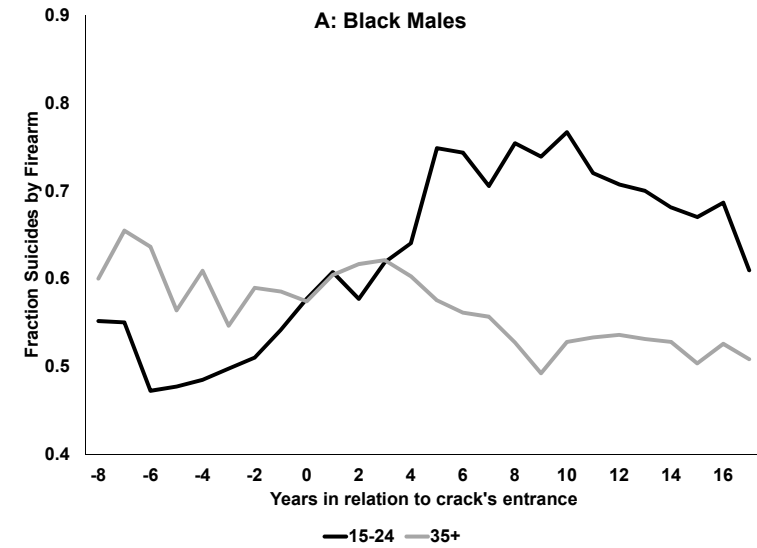


Figure 15  
 OLS Estimates of Fraction Suicides by Firearm, 57 Large Metro Areas  
 Parameter Estimates and 95% Confidence Intervals, Males

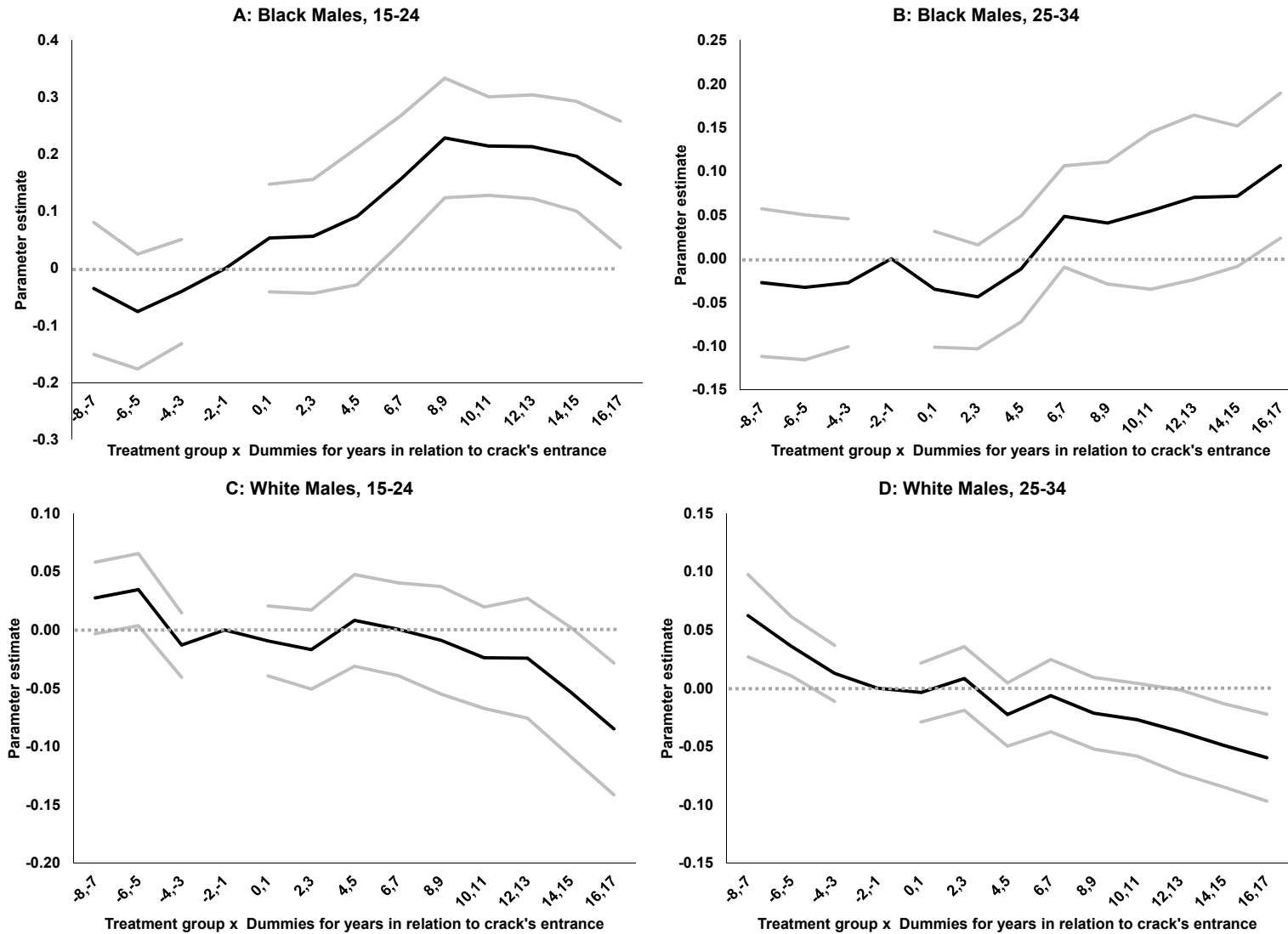




Figure 16  
 Gun and Non-Gun Murder and Suicide Rates, Males 15-24, By Race

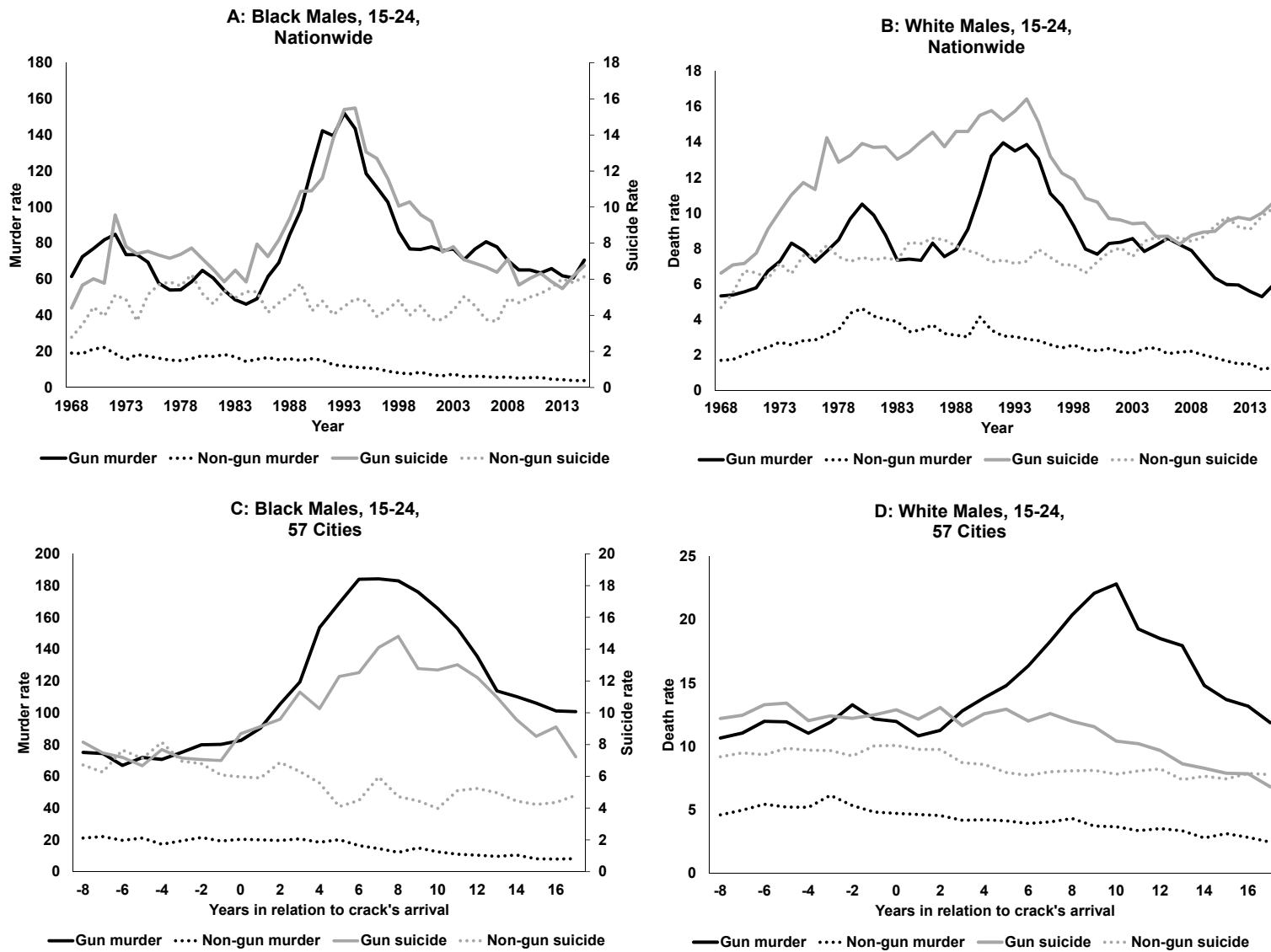


Figure 17

Negative Binomial Estimates of the Impact on Crack's Entrance on Gun Murder and Gun Suicide Rates, Males 15-24 by Race, Implied Percentage Changes and 95% Confidence Intervals

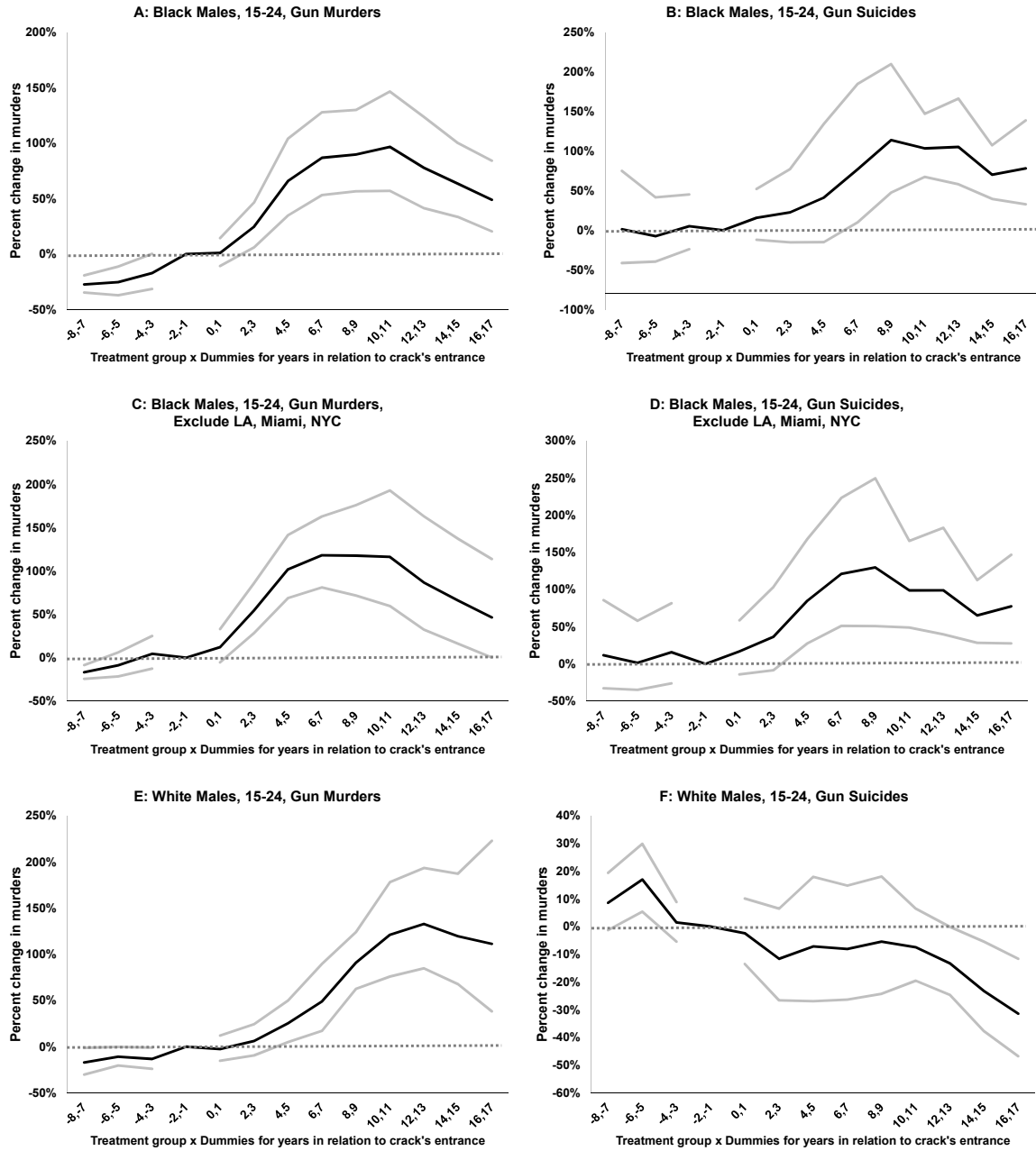


Figure 18  
 Black Male Murder Rates by Age and Cities Change in Firearm Suicide/Suicide Ratio

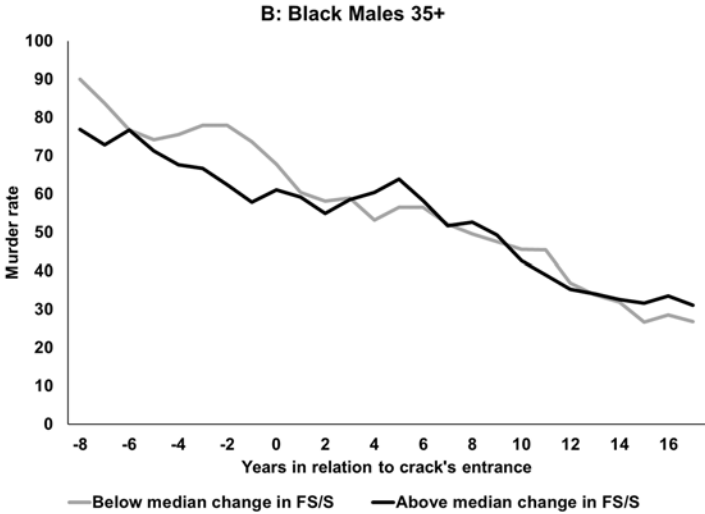
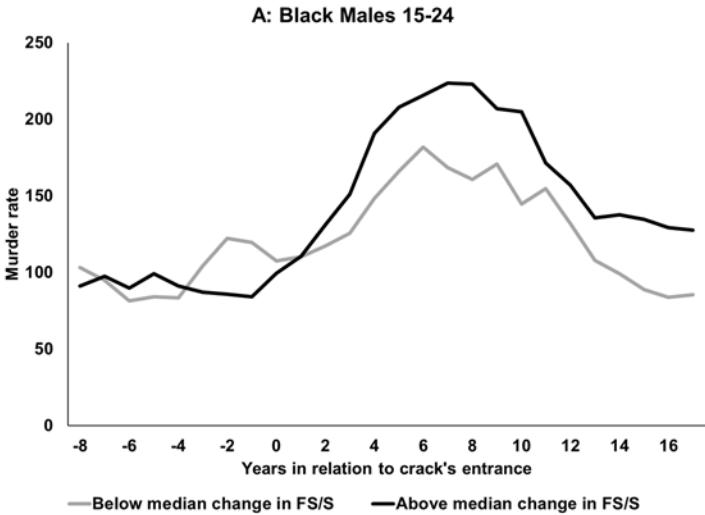


Table 1  
 Year Crack Arrives in the 57 Largest Metropolitan Statistical Areas  
 Based on Cocaine-related Deaths in Two Consecutive Years, 1981-1998

Year	Metropolitan Statistical Area
1982	Los Angeles/Long Beach; Miami; New York
1983	Atlanta; Riverside/San Bernadino; San Francisco/Oakland
1984	Ft. Lauderdale; San Jose; Seattle/Bellevue/Everett; Tampa/St. Petersburg/Clearwater
1985	Albany/Schenectady/Troy; Dallas/Fort Worth/Arlington; Detroit; Kansas City; Philadelphia; Washington, DC
1986	Boston; Chicago; Cleveland; Indianapolis; Memphis; Minneapolis/St. Paul; Monmouth-Ocean, NJ; Newhaven/Bridgeport; New Orleans; Newark, NJ; Orange Co. CA; Sacramento
1987	Cincinnati; Greensboro/Winston Salem/High Point; Milwaukee/Waukesha Norfolk/VA Beach/Newport News; Providence
1988	Buffalo/Niagara Falls; Denver; Hartford, CT; Houston; Louisville; Nashville; Oklahoma City; Orlando; Phoenix/Mesa; Pittsburgh; Portland, OR/Vancouver, WA; Rochester; Salt Lake City/Ogden; San Diego
1989	Baltimore; Birmingham; Charlotte, NC/Gastonia, NC/Rock Hill, SC; Grand Rapids/Muskegon/Holland, MI; St. Louis, MO
1991	Bergen/Passaic; Dayton/Springfield; Middlesex/Somerset/Hunterdon, NJ
1992	Columbus
1994	San Antonio

Note: The Nassua/Suffolk MSA is omitted because cocaine-related deaths were present in multiple years prior to 1981. The size of the MSA is based on 1980 population.

Appendix Table A1  
Mapping of Counties into Metro Areas

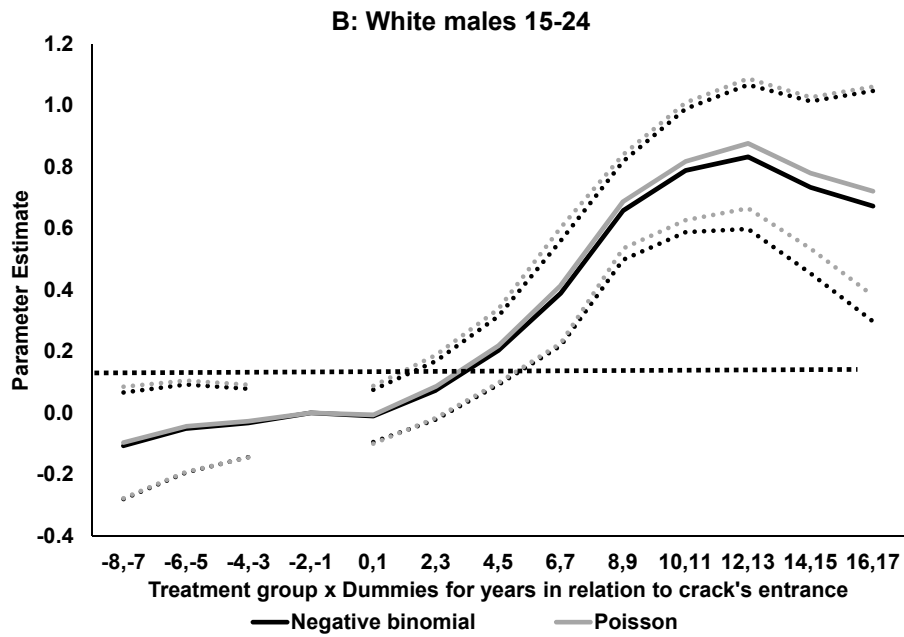
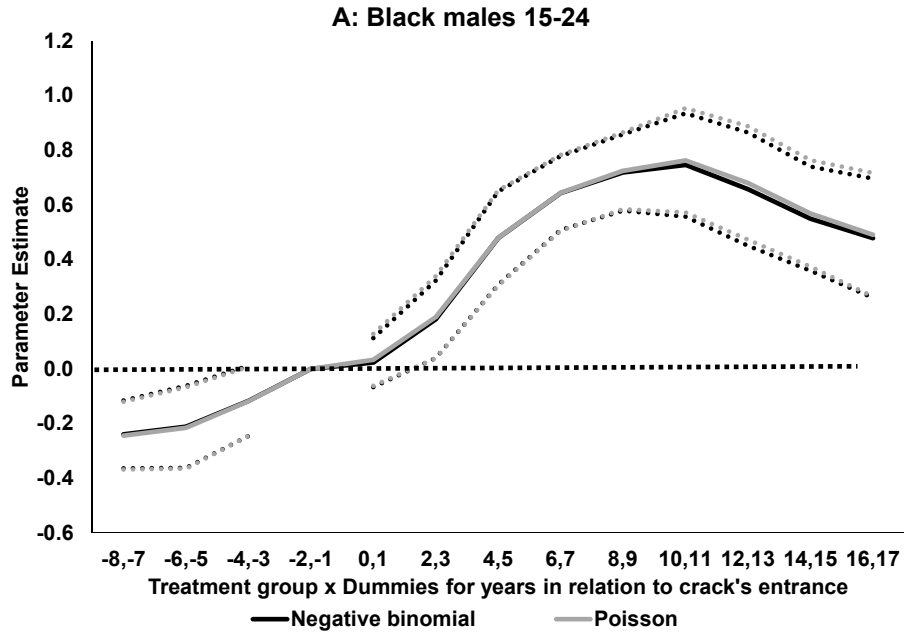
Metro area	MSA code	County name (FIPS code)
Albany-Schenectady-Troy, NY	160	Albany (26001), Saratoga (36091), Rensselaer (36083), Schenectady (36093), Schoharie (36095)
Atlanta, GA	520	Dougherty (13095), Lee (13177), Clayton (13063), Cobb (13067), DeKalb (13089), Fulton (13121), Gwinett (13135)
Baltimore, MD	720	Anne Arundel (24003), Baltimore (24005), Harford (24025), Howard (24027), Baltimore City (24510)
Bergen-Passaic, NJ	875	Bergen (34003), Passaic (34031)
Birmingham, AL	1000	Jefferson (1073)
Boston-Worcester-Lawrence- Lowell-Brockton	1123	Bristol (25005), Essex (25009), Middlesex (25017), Norfolk (25021), Plymouth (25023), Suffolk (25025), Worcester (25027), Hillsborough (33011), Rockingham (33015), Strafford (33017)
Buffalo-Niagara Falls, NY	1280	Erie (36029), Niagara (36063)
Dayton-Springfield, OH	2000	Clark (39023), Greene (39057), Montgomery (39113)
Greensboro- Winston-Salem-High Point, NC	3120	Davidson (37057), Forsyth (37067), Guilford (37081)
Charlotte-Gastonia-Rock Hill, NC- SC	1520	Gaston (37071), Mecklenburg (37119), York (45091)
Chicago, IL	1600	Cook (17031), DuPage (17043), Kane (17089), Lake (17097), McHenry (17111), Will (17197)
Cincinnati, OH-KY-IN	1640	Kenton (21117), Clermont (39025), Hamilton (39061)
Cleveland-Lorain-Elyria, OH	1680	Cuyahoga (39035), Lake (39085), Lorain (39093), Medina (39103)
Columbus, OH	1840	Franklin (39049), Licking (39089)
Dallas, TX	1920	Collin (48085), Dallas (48113), Denton (48121)
Dayton-Springfield, OH	2000	Clark (39023), Green (39057), Montgomery (39113)
Denver, CO	2080	Adams* (8001), Arapahoe (8005), Denver (8031), Jefferson* (8059)
Detroit, MI	2160	Macomb (26099), Monroe (26115), Oakland (26125), St. Clair (26147), Wayne (26163)
Ft. Lauderdale, FL	2680	Broward (12011)
Grand Rapids-Muskegon-Holland, MI	3000	Kent (26081), Muskegon (26121), Ottawa (26139)
Hartford, CT	3283	Hartford (9003), Middlesex (9007), Tolland (9013)
Houston, TX	3360	Fort Bend (48157), Harris (48201), Montgomery (48339)
Indianapolis, IN	3480	Boone (18011), Hamilton (18057), Hancock (18059), Hendricks (18063), Johnson (18081), Madison (18095), Marion (18097), Morgan (18109), Shelby (18145)
Kansas City, MO-KS	3760	Johnson (20091), Wyandotte (20209), Clay (29047), Jackson (29095)
Los Angeles-Long Beach, CA	4480	Los Angeles (6037)
Orange County, CA	5945	Orange (6059)
Louisville, KY-IN	4520	Jefferson (21111)
Memphis, TN-AR-MS	4920	Shelby (47157)
Miami, FL	5000	Miami-Dade (12086)

Appendix Table A1 (Continued)

Metro area	MSA code	County name (FIPS code)
Milwaukee-Waukesha, WI	5080	Milwaukee (55079), Ozaukee (55089), Washington (55131), Waukesha (55133)
Minneapolis-St. Paul, MN-WI	5120	Anoka (27003), Dakota (27037), Hennepin (27053), Ramsey (27123), Washington (27163)
Monmouth-Ocean, NJ	5190	Monmouth (34025), Ocean (34029)
Nashville, TN	5360	Cheatham (47021), Davidson (47037), Dickson (47043), Rutherford (47149), Sumner (47165), Williamson (47187), Wilson (47189)
New Haven-Bridgeport, CT	5483	New Haven (9009), Fairfield (9001)
New Orleans, LA	5560	Jefferson (22051), Orleans (22071), St. Tammany (22103)
New York, NY	5600	Bronx (36005), Kings (36047), New York (36061), Queens (36081), Richmond (36085), Rockland (36087), Westchester (36119)
Newark, NJ	5640	Essex (34013), Morris (34027), Sussex (34037), Union (34039)
Norfolk-Virginia Beach-Newport News, VA-NC	5720	Chesapeake City (51550), Hampton City (51650), Newport News City (51700), Norfolk City (51710), Portsmouth City (51740), Virginia Beach City (51810)
Oklahoma City, OK	5880	Cleveland (40027), Oklahoma (40109)
Orlando, FL	5960	Lake (12069), Orange (12095), Seminole (12117)
Philadelphia, PA-NJ	6160	Burlington (34005), Camden (34007), Gloucester (34015), Bucks (42017), Chester (42029), Delaware (42045), Montgomery (42091), Philadelphia (42101)
Phoenix-Mesa, AZ	6200	Maricopa (4013)
Pittsburgh, PA	6280	Allegheny (42003), Beaver (42007), Butler (42019), Fayette (42019), Washington (42125), Westmoreland (42129)
Providence, RI	6483	Bristol (44001), Kent (44003), Providence (44007), Washington (44009)
Portland-Vancouver, OR-WA	6440	Clackamas (41005), Multnomah (41051), Washington (41067), Clark (53011)
Riverside-San Bernardino, CA	6780	Riverside (6065), San Bernardino (6071)
Rochester, NY	6840	Monroe (36055)
Sacramento, CA	6920	Placer (6061), Sacramento (6067)
Salt Lake City-Ogden, UT	7160	Davis (49011), Salt Lake (49035), Weber (49057)
San Antonio, TX	7240	Bexar (48029)
San Diego, CA	7320	San Diego (6073)
San Francisco, CA	7360	Marin (6041), San Francisco (6075), San Mateo (6081), Santa Clara (6085)
San Jose, CA	7400	Santa Clara (6085)
Seattle-Bellevue-Everett, WA	7600	King (53033), Snohomish (53061)
St. Louis MO-IL	7040	Madison (17119), St. Clair (17163), Jefferson (29099), St. Charles (29183), St. Louis (29189), St. Louis City (29510)
Tampa-St. Petersburg-Clearwater, FL	8280	Hillsborough (12057), Pasco (12101), Pinellas (12103)
Washington DC-MD-VA-WV	8840	District of Columbia (11001), Fredrik (24021), Montgomery (24031), Prince George's (24033), Arlington (51013), Alexandria City (51510)

Appendix Figure A1

Comparison of Negative Binomial and Poisson Estimates of the Impact on Crack's Entrance on Murder Rates, Parameter Estimates and 95% Confidence Intervals, Males 15-24 by Race



## Appendix Figures A6, A8, A10, A11, A15 and A18

Over the next few pages, we reproduce some of the key graphs from the paper for the 54 city sample that excludes the three ports of entry for cocaine into the United States: Los Angeles, Miami and New York. As we note in the text, the shift in supply of cocaine to the Medellin and Cali cartels in the mid to late 1970s brought an initial wave of violence to these three cities. As a result, we observe rising murder rates prior to the arrival of crack in the aggregate data. As we have demonstrated, these trends are driven solely by these cities and when they are excluded from the analysis, these pre-treatment trends mostly vanish. The exclusion of these three cities from our analysis does not change the basics of the story. In the figures below, A6 replicates the results from Figure 6, Figure A8 replicates the results from Figure 8, etc.



Figure A6  
 Negative Binomial Estimates of the Impact on Crack's Entrance on Murder Rates, 54 Large City Sample  
 Implied Percentage Changes and 95% Confidence Intervals, Males by Race and Age

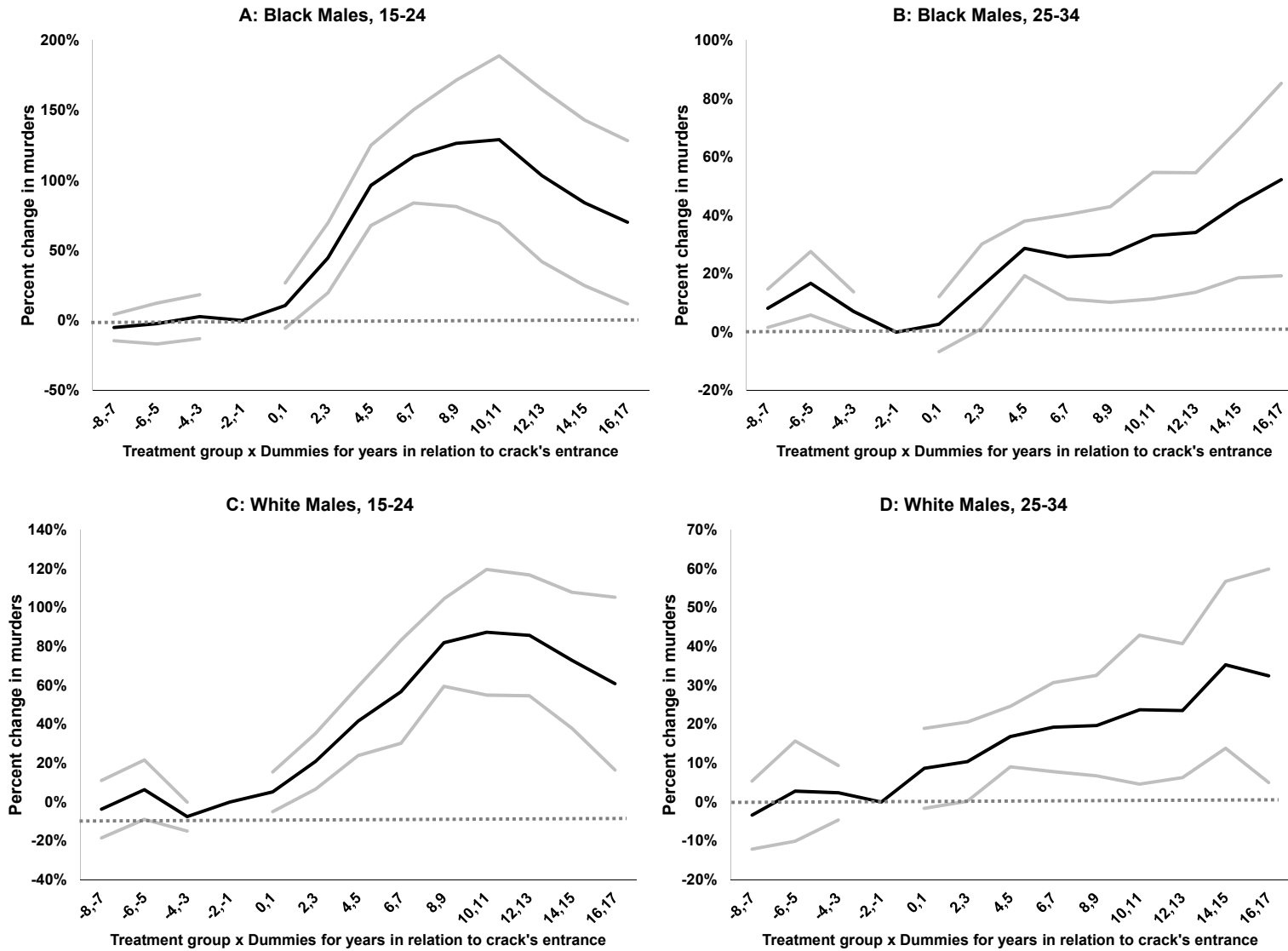


Figure A6 (continued)  
 Negative Binomial Estimates of the Impact on Crack's Entrance on Murder Rates, 54 Large City Sample  
 Implied Percent Changes and 95% Confidence Intervals, Males by Race and Age

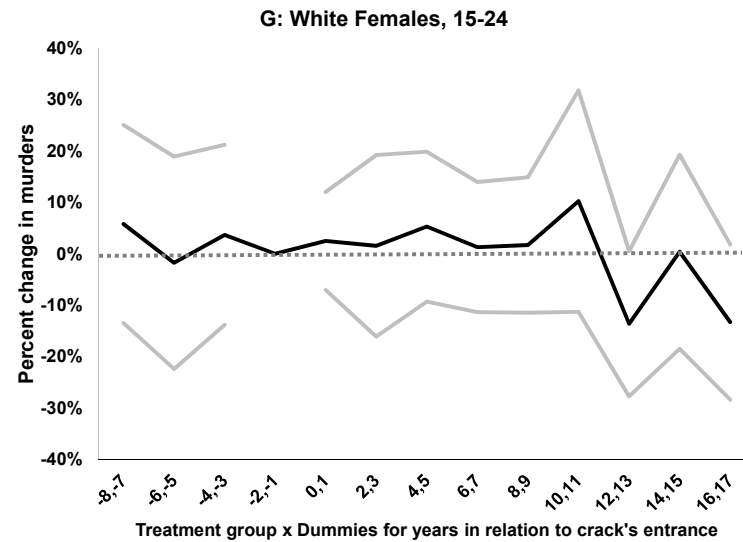
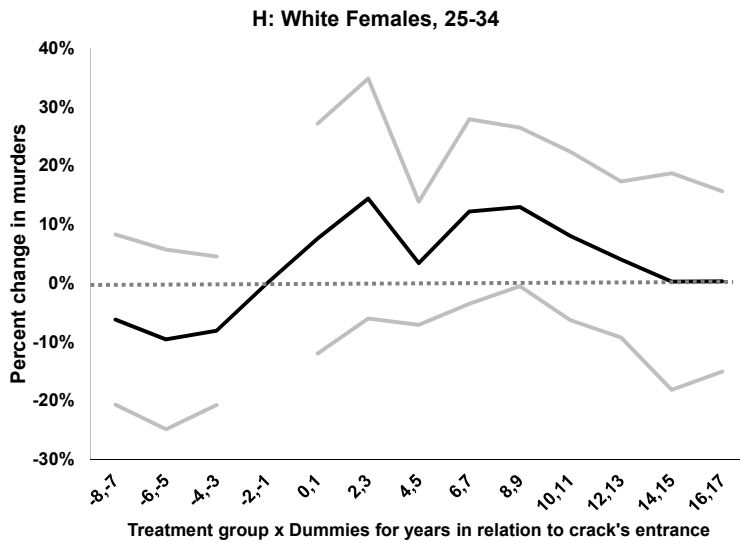
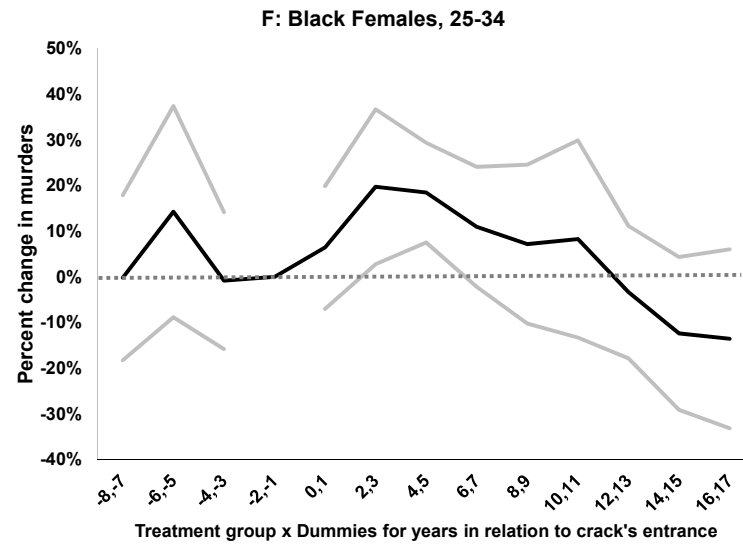
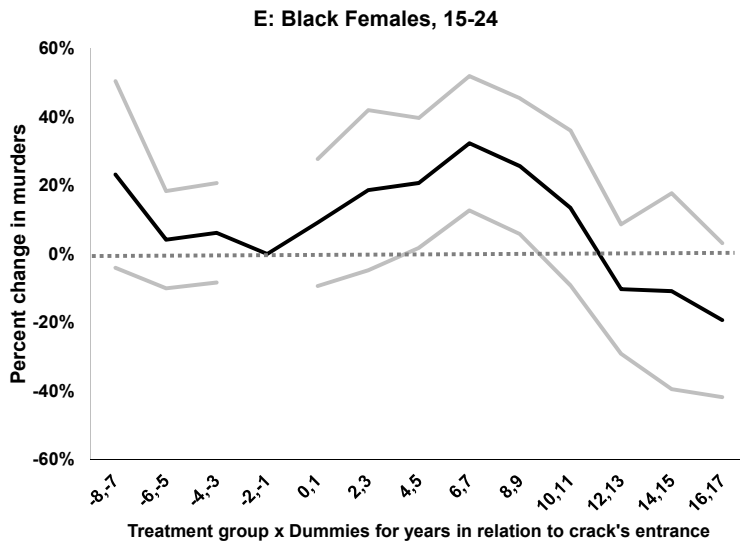


Figure A8

Murder Rate, Victimization Rate, and Offender Rate in Relation to Crack's Entrance, Multiple Cause of Death Data and Supplemental Homicide Reports, 54 City Sample

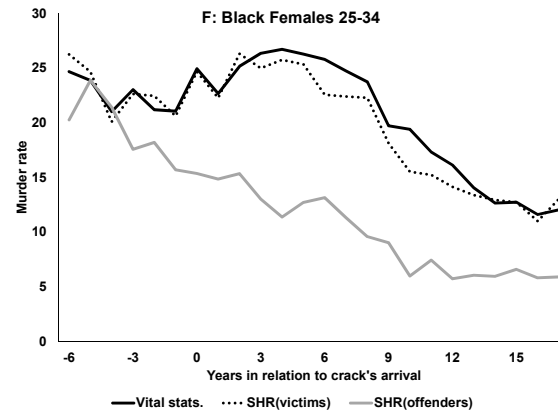
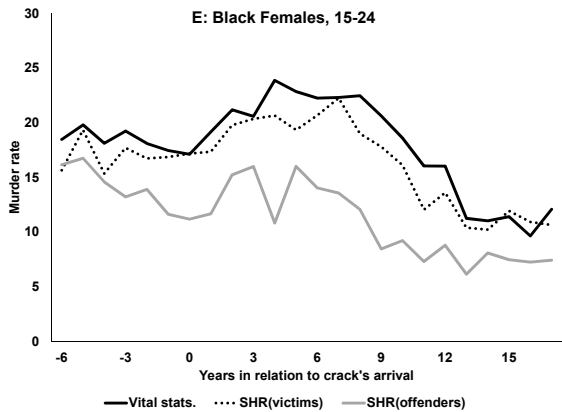
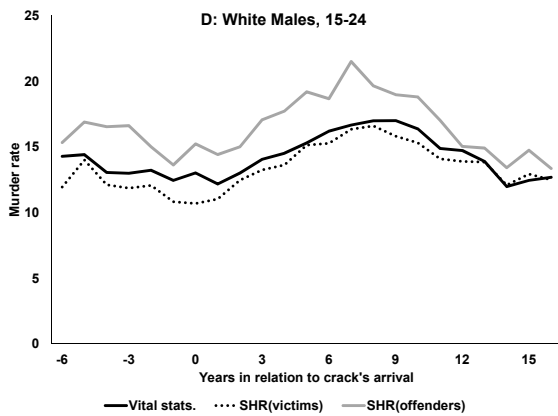
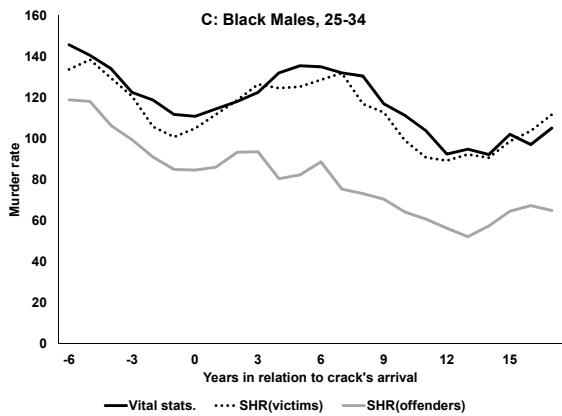
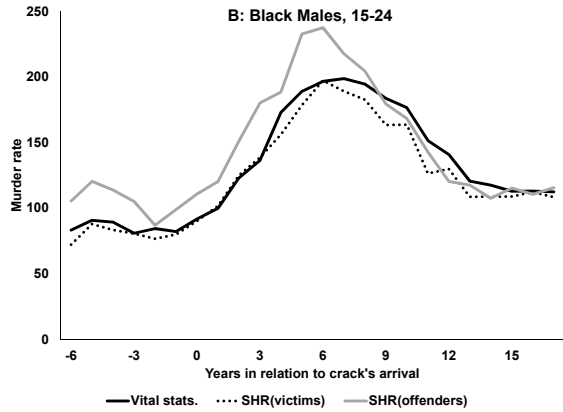


Figure A10

Negative Binomial Estimates of the Impact on Crack's Entrance on Murder Rates, 54 City Sample  
 Implied Percentage Changes and 95% Confidence Intervals, Murders by Black Males Ages 15-24 by Relationship  
 to Victim

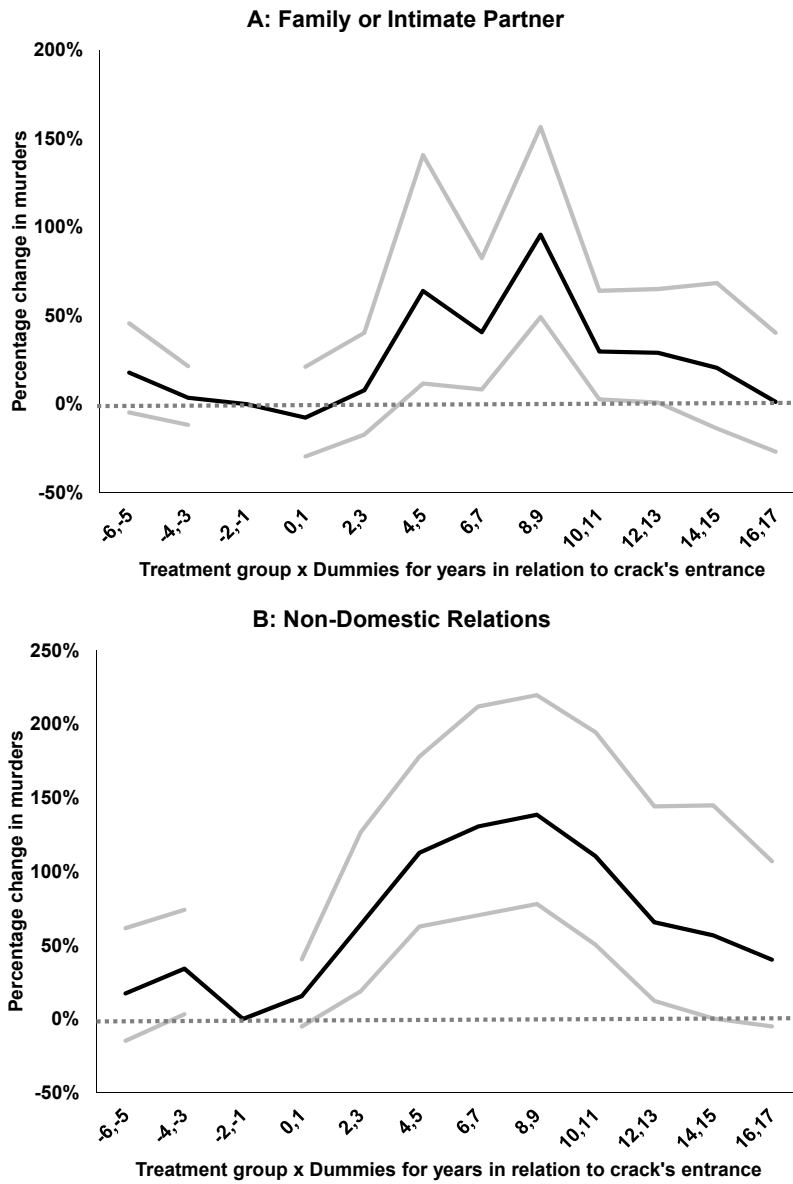


Figure A11

Negative Binomial Estimates of the Impact on Crack's Entrance on Murder Rates, 54 City Sample  
 Implied Percentage Changes and 95% Confidence Intervals, Murders by Black Males Ages 15-24 by Weapon and Relationship to Victim

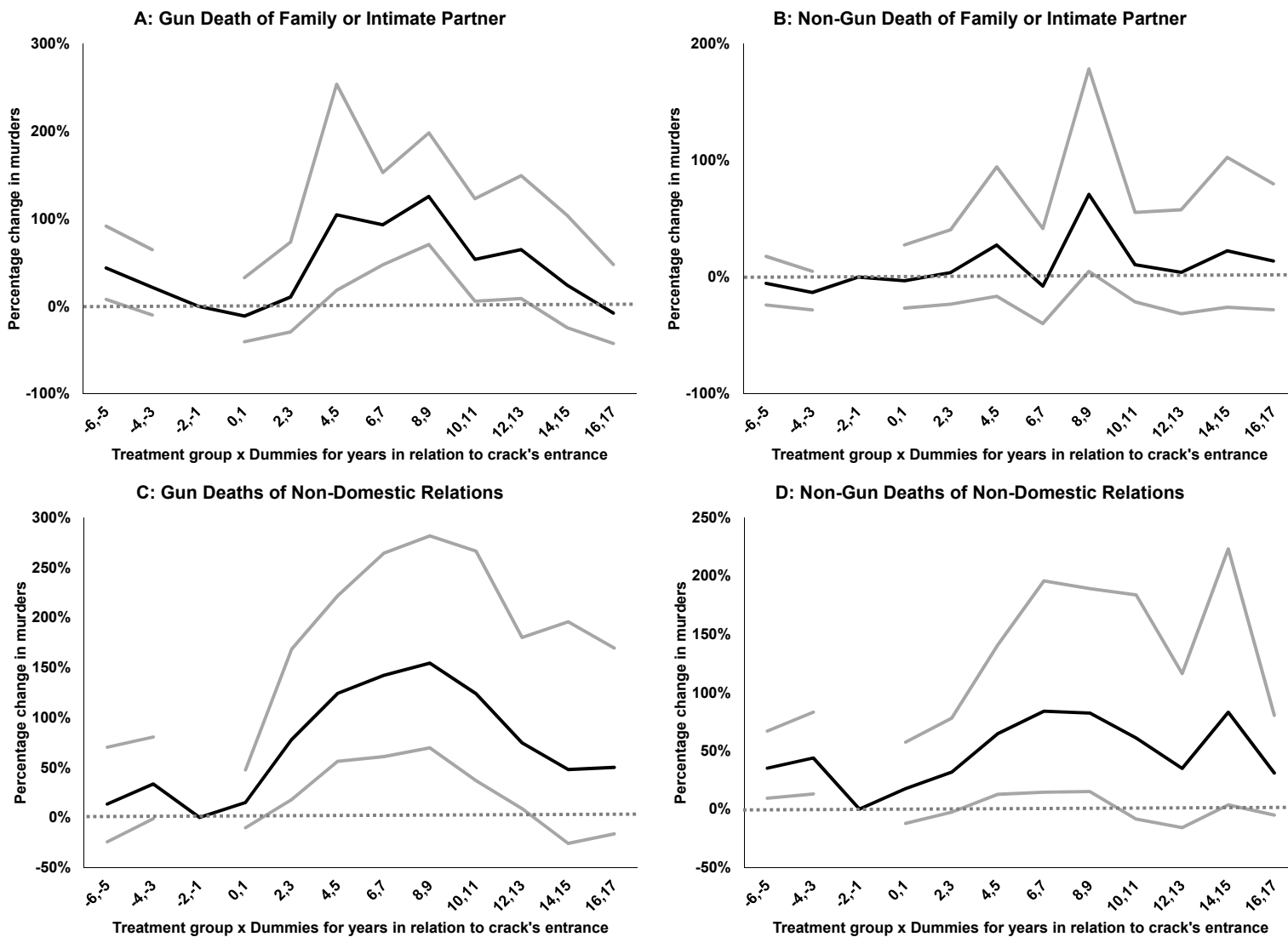


Figure A15  
 OLS Estimates of Fraction Suicides by Firearm, 54 Large Metro Areas  
 Parameter Estimates and 95% Confidence Intervals, Males

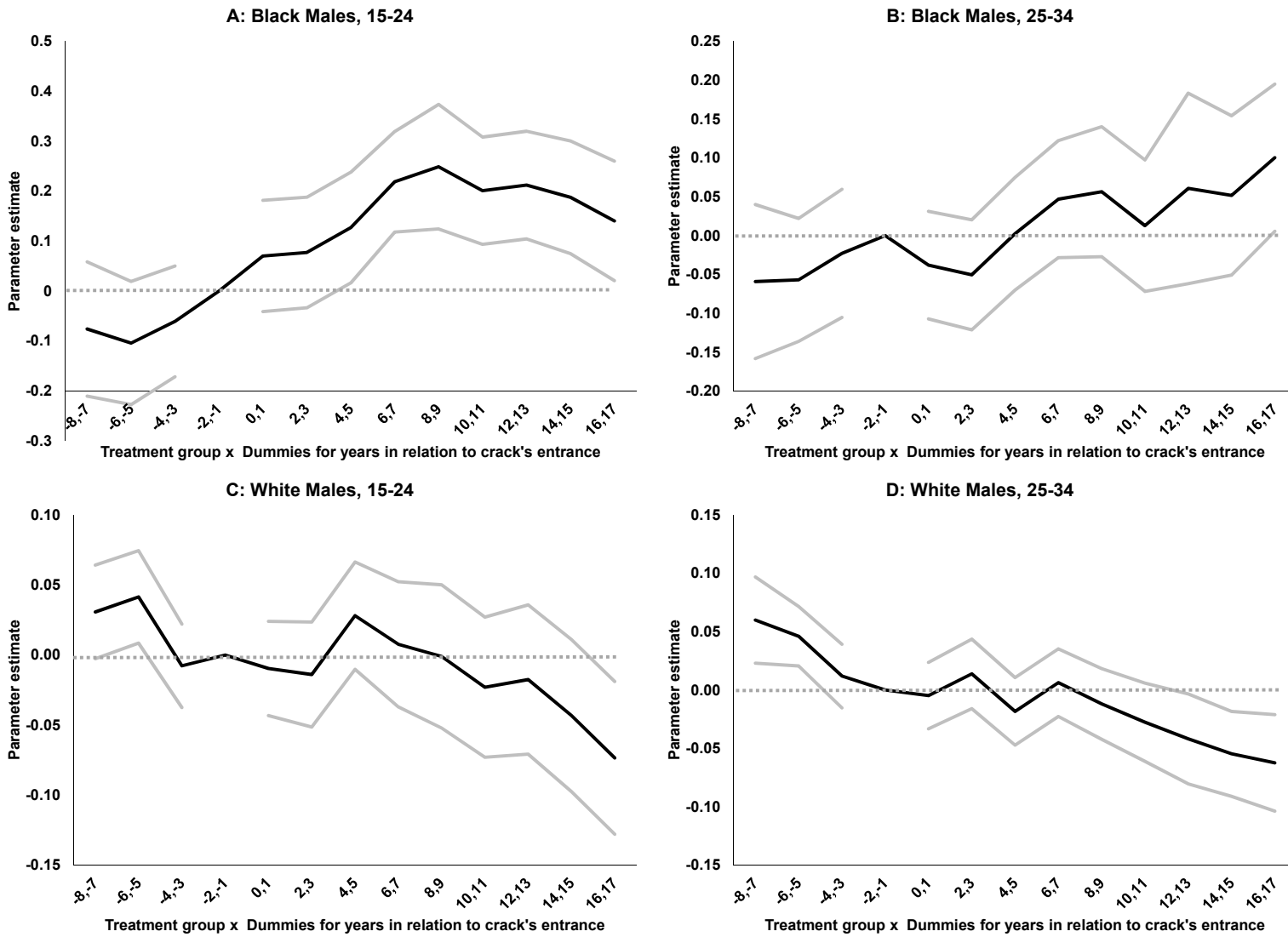


Figure A18  
 Black Male Murder Rates by Age and Cities Change in Firearm Suicide/Suicide Ratio, 54 City Sample

