THE WHITE/BLACK EDUCATIONAL GAP, STALLED PROGRESS, AND THE LONG-TERM CONSEQUENCES OF THE EMERGENCE OF CRACK COCAINE MARKETS

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Abstract—We propose the rise of crack cocaine markets as a key explanation for the end to the convergence in black-white educational outcomes in the United States that began in the mid-1980s. After constructing a measure to date the arrival of crack markets in cities and states, we show that the decline in educational outcomes for black males begins with the start of the crack epidemic. We also show that there are higher murder and incarceration rates after the arrival of crack cocaine and that these are predictive of lower black high school completion rates, a result consistent with human capital theory. We estimate that effects related to crack markets can account for approximately 40% to 70% of the fall in black male high school completion rates.

I. Introduction

HISTORICALLY in the United States, there have been persistent differences between high school completion rates and standardized test scores of white and black students.[1] These differences narrowed between the mid-1960s and the mid-1980s as the educational outcomes of black students improved dramatically. Then, for reasons that previous researchers have been unable to explain, this progress stopped. We argue that the introduction and spread of crack cocaine markets in the 1980s and 1990s explains a large fraction of the "stalled progress" in black educational outcomes.

Figure 1 shows the trends for high school completion rates for U.S.-born, non-Hispanic white and black respondents.[2] Figure 1A contains the race-specific high school completion rates for cohorts turning 18 between 1965 and 1997, while figure 1B shows the white-black difference in these rates. Several features of the data are remarkable. First, the gap in completion rates fell by 37% between 1965 and 1986, decreasing from 15.3 to 9.6 percentage points. Second, almost all of the convergence is due to rising black achievement—the completion rates of whites changed little over this period. Third, the convergence ends around 1986, and white-black completion rates diverge until 1997, when the gap was 14.4 percentage points. Fourth, as with the convergence, the divergence is driven almost entirely by black completion rates, which declined by 7.3 percentage points between 1986 and 1997. This wiped out much of the previous progress: the black cohort that turned 18 in 1997 had a completion rate similar to the 1965 black cohort.

There are a number of hypotheses we display the race-specific high school completion rates for males and females in figure 1C and the white-black differences in these rates in figure 1D. There was convergence between the 1965 and 1986 cohorts, as the completion rates of black males and females rose by 5.4 and 7.1 percentage points, respectively. This reversed after 1986, with black males experiencing a greater decline than black females. From 1986 to 1997, completion rates of black males fell by 9.4 percentage points, while the rate for black females declined by roughly 5.1 percentage points. There are a number of hypotheses to explain the black/white convergence in educational outcomes including improved parental education (Cook & Evans, 2000), reduced segregation (Jaynes & Williams, 1989), increased school spending (Boozer, Krueger, & Wolkon, 1992), changes in within-school factors for integrated schools (Cook & Evans, 2000), and better access to health care (Chay, Guryan, & Mazumder, 2009). Less attention has been given to the end of the convergence, and research has not identified why it occurred (Neal, 2006; Magnuson & Waldfogel, 2008).

We examine the emergence of crack markets as an explanation for the stalled progress in black high school completion rates.[3] Crack cocaine was an innovation that allowed cocaine to be cut into much smaller but more potent doses

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[1] For data on the white/black test score gap, see Jencks and Phillips (1998), Neal (2006), and Magnuson and Waldfogel (2008). For data on the high school graduation gap, see Rivkin (1995), Heckman and LaFontaine (2010), and Murnane (2013).

[2] These graduation completion rates are from the 2000 Census Five-Percent Public Use Micro Samples (PUMS) (Ruggles et al., 2010). They are higher than would be obtained from sources such as the October School Enrollment Supplement to the Current Population Survey (CPS) because the PUMS does not distinguish between regular high school graduates and those obtaining a diploma via the GED. Since individuals acquire the GED over time, older cohorts have had more time to acquire it. Neal (2006) found that the GED narrows the white-black gap in high school graduation but does not change the trends, while Heckman and LaFontaine (2010) found that progress in narrowing black-white differences is overstated by the inclusion of the GED. These issues are discussed in detail in Murnane (2013). To note this distinction, we refer throughout the paper to "completion rates" rather than "graduation rates."

[3] Neal (2006) and Fryer et al. (2013) have suggested a potential connection between crack cocaine markets and educational progress, although neither paper empirically examines this relationship.

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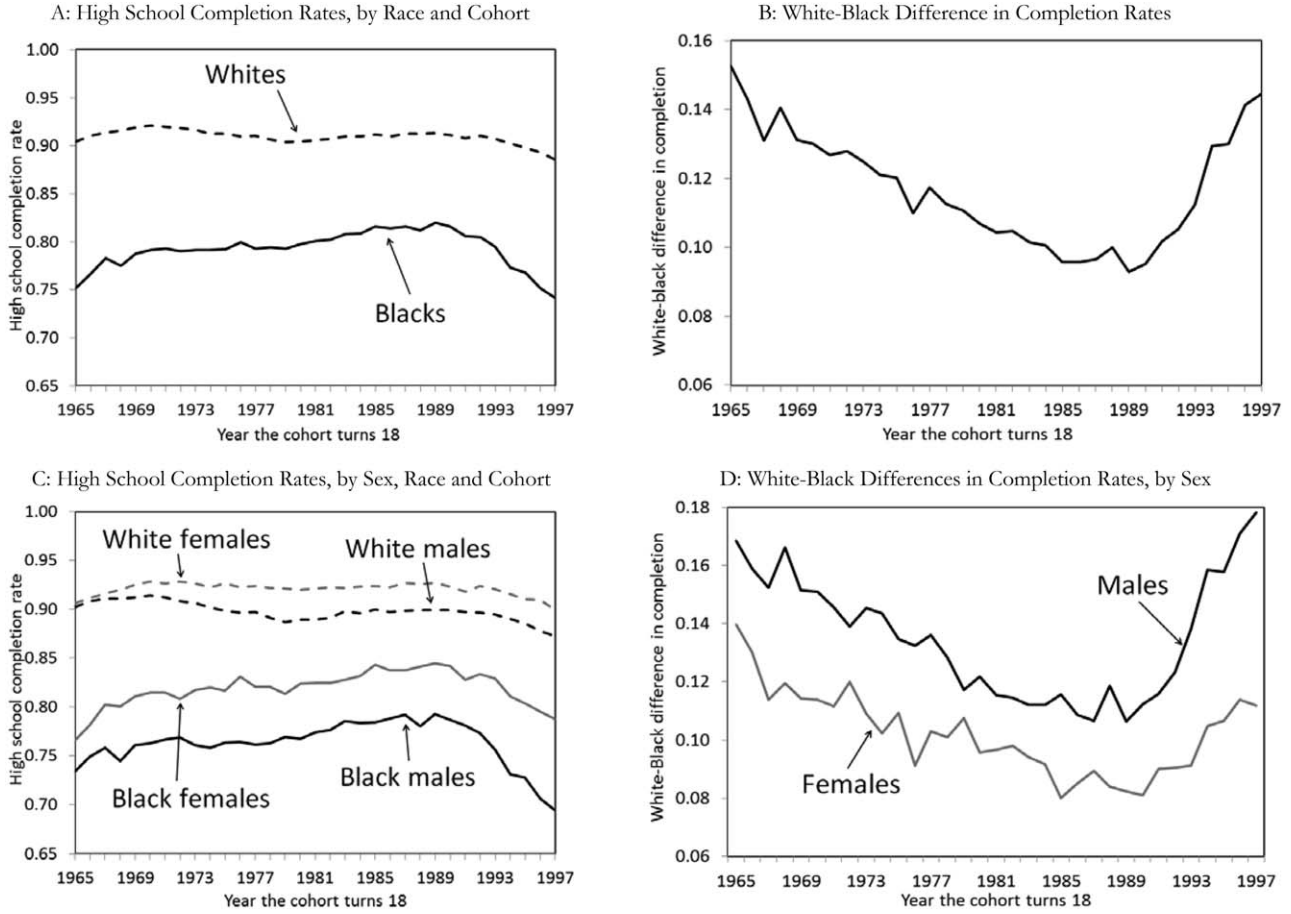
FIGURE 1.—HIGH SCHOOL COMPLETION RATES BY THE YEAR EACH COHORT TURNS AGE 18, BY RACE AND SEX
2000 CENSUS FIVE PERCENT PUBLIC USE MICRO SAMPLE



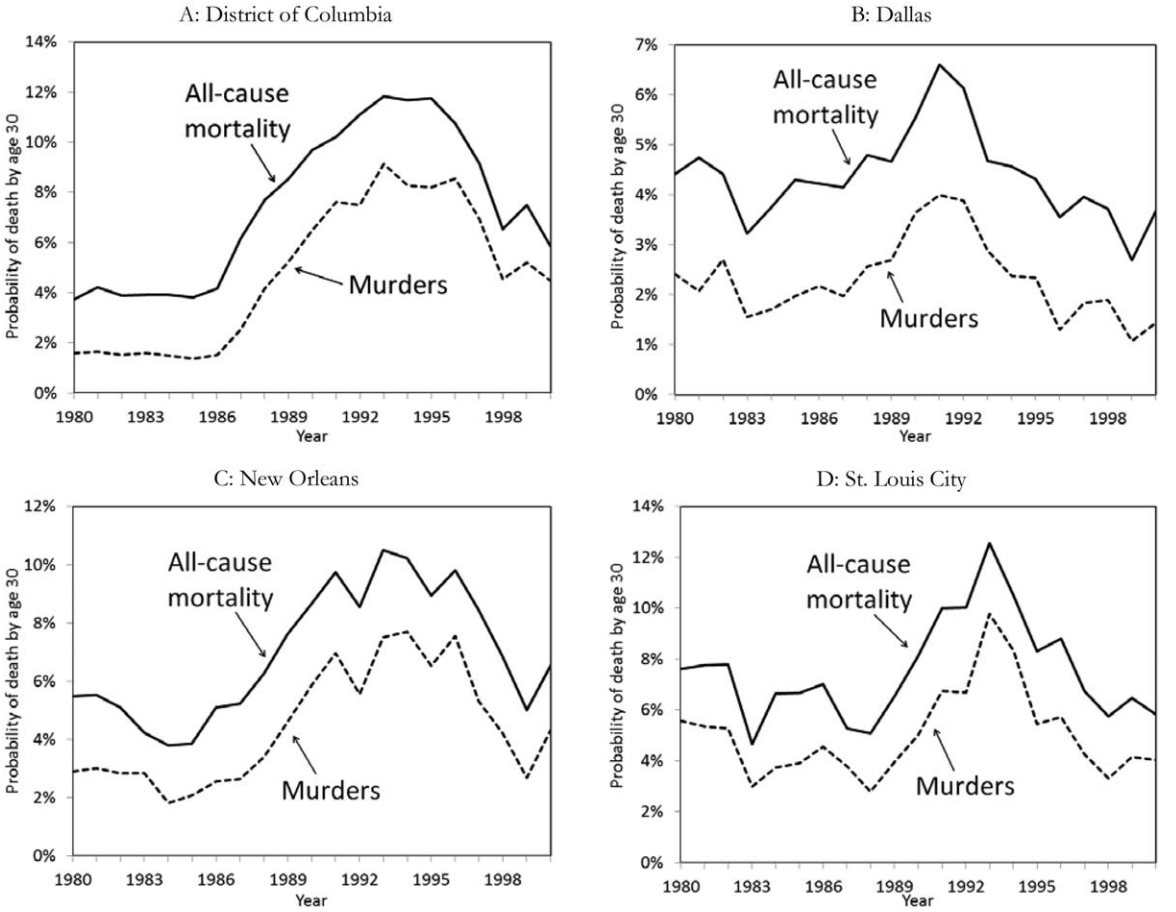
that simultaneously cut the price of cocaine, expanded the potential market size, and increased profits from drug dealing. The drug first appeared in Miami, New York, and Los Angeles around 1982, and then spread across the nation over the next decade. Dealers initially operated through crack houses, then moved to open-air sales, where violence was used to both establish and protect local monopolies (Fagan & Chin, 1989; Reuter et al., 1990). The violence associated with the open-air markets spilled into the community and affected people not part of the drug trade. The negative effects of crack markets were particularly devastating for young black males. As we outline below, the murder rate of young black males doubled after the emergence of crack cocaine, and their incarceration rate tripled. Ethnographic accounts and surveys indicate that inner-city children were well aware of the changes in violence, with large fractions reporting they had observed murders or had seen a dead body.

Standard theoretical models of optimal schooling predict that individual investments in human capital should decrease with lower life expectancy (Becker, 1964; Ben-Porath, 1967; Hazan, 2009; Hansen & Lonstrup, 2012), and some empirical studies have confirmed this prediction (Fortson, 2011; Oster, Shoulson, & Dorsey, 2013; Jayachandran & Lleras-Muney, 2009). To demonstrate the large changes experienced by young black men, consider how their risk of dying changed between the 1980s and 1990s. Suppose that 15-year-old males estimate their chance of dying before age 30 by examining the contemporaneous, age-specific mortality rates of older individuals living in the same city and who share the same sex and race. For example, a black male aged 15 years in the District of Columbia (DC) uses the annual death rates of each cohort of older black males in DC to judge his cumulative risk of dying.[4] Figure 2 shows this calculation from 1980 to 2000 for black males in DC, Dallas, New Orleans, and Saint Louis, respectively.[5] In 1980, a 15-year-old black male in DC making this calculation would have estimated his risk of dying before age 30 to be 4%, which is already several times higher than for other 15-year-olds in DC. This increases sharply after 1985, so that by 1993, the cumulative perceived risk of death by age 30 is 12%. It declines to 6% by

[4] The expected mortality rate by age 30 is the sum of the contemporaneous mortality rates at age 15 , age 16 (conditional on living to 16), age 17 (conditional on living to 17), and so on, up to and including those aged 29 years.

[5] The mortality data come from the National Center for Health Statistics' (NCHS) Multiple Cause of Death (MCOD) data; population data are from the Census.

FIGURE 2.—EXPECTATIONS OF DEATH BY AGE 30 FOR A BLACK MALE AT AGE 15, BASED ON CONTEMPORANEOUS AGE-SPECIFIC MORTALITY RATES



Each panel shows the cumulative rate of death between the ages of 15 and 30 based on the contemporaneous age-specific mortality rates of black males living in the same city. Deaths are from the Multiple Cause of Death data files.

2000. In Dallas, New Orleans, and St. Louis, cities in different parts of the United States, 15-year-old black males' risk of death by age 30 increased by between 3.5 and 8 percentage points over the same period. For comparison, these changes in perceived mortality risks are broadly similar to the mortality changes resulting from the AIDS epidemic in South Africa (Chicoine, 2012). In contrast, the changes in the equivalent mortality calculation for white males, white females, and black females over this period were generally less than 1 percentage point in these cities.

In the next section, we provide an account of the rise of crack cocaine markets and use cocaine-related deaths in the Multiple Cause of Death (MCOD) data, which were rare before the introduction of crack cocaine but prevalent afterward, to date the arrival of crack cocaine markets in 57 large cities and 41 states. Our dates correspond well with other published estimates.

In section III, we consider whether there is a reduced-form relationship between the emergence of crack cocaine markets in a metropolitan area or state and the high school completion rates of blacks. We use data from the 2000 Five-Percent Census Public Use Micro Samples (PUMS) to document the magnitude of this effect. Our results indicate that the completion rate for black males fell by about 0.3 percentage points per year after crack was introduced in a local area.

The primary threat to our hypothesis is the existence of another shock to the economic or educational opportunities of young black males that occurs at the same time as the arrival of crack cocaine markets. This does not appear to be the case. For example, the economic decay in the Midwest associated with the decline in manufacturing over this period cannot explain our results. As we demonstrate, crack spread to the South and West at the same time, and these areas were growing much faster than the Rust Belt. In addition, we show that our results are robust to the inclusion of a variety of time-varying socioeconomic factors.

In section IV, we investigate potential mechanisms underlying the decrease in educational attainment. The arrival of crack markets resulted in sharp increases in the murder rates of a reference group of black males, and we show that a higher murder rate among an older reference group lowers the probability of males graduating high school. We also find that a higher prison entry rate for young black males is associated with lower high school completion rates. In a regression containing measures of murder and prison entry, both are independently predictive of changes in black male high school completion rates. We also con-

sider other mechanisms, such as how crack cocaine markets affected families and neighborhoods and whether drug dealing changed the incentives to stay in school. The evidence suggests that these were not primary channels through which crack markets affected the educational outcomes of young black males, although they could have contributed to the overall impact of crack cocaine. Depending on the underlying assumption, we estimate that the arrival of crack cocaine markets can account for 36% to 73% of the decrease in black male completion rates between the mid-1980 and mid-1990s. In section V, we note some limitations to our analysis. We conclude in section VI.

II. Crack Cocaine Markets in the United States

Crack cocaine was introduced to the United States from the Caribbean around 1981, first in Miami and soon after in Los Angeles and New York. The drug is made by cooking powder cocaine with baking soda and water and then letting it cool and harden. Crack is easier to produce than other types of smokable cocaine and generates a more intense high than snorted cocaine (Agar, 2003). Crack cocaine is reported to yield a high lasting 20 minutes, followed by a sharp crash and an intense drive to get high again (Fagan & Chin, 1989). The drug proved to be popular with new users of cocaine, who could buy a "hit" of crack for as little as $5 (Witkin, 1991). Selling it could be highly profitable, with police estimating that a $5,000 investment in powder cocaine could yield $125,000 in crack sales (U.S. GAO, 1989).

A. The Spread of Crack Cocaine Markets

Retail crack cocaine markets spread across the United States over the course of the 1980s and early 1990s. The emergence of organized crack markets in cities was primarily driven by the decisions of loosely organized national trafficking groups, such as the Jamaican posses based in New York and Miami and the Bloods and the Crips street gangs of Los Angeles (Witkin, 1991). Traffickers initially looked for large cities that were easily accessible from their powder cocaine distribution hub, so proximity to the three original cities where the drug emerged was a critical determinant of when crack markets emerged in a particular city or state (Agar, 2003). As we demonstrate below, crack markets were more likely to enter larger cities and cities closer to LA, Miami, and New York first, but few places were immune from crack. The U.S. Department of Justice (1989) and Massing (1989) document many instances of crack markets in small towns.

Initially, crack was sold in crack houses, which also offered a place to use the drug (Mieczkowski, 1992). As crack became popular, dealers established markets on street corners, and many small and decentralized organizations started to sell crack (Massing, 1989). Dealers used violence to establish and protect their turf (Fagan & Chin, 1989). Intensifying competition in the initial cities prompted the national organization to move into new areas where they could continue to sell crack at marked-up prices (Massing, 1989). Witkin (1991, p. 52) said, "America was caught in a pincer movement; Los Angeles street gangs moved east and Jamaican posses move west from the East Coast, and between them . . . introduced much of the rest of the country to crack."

The potential for violence from competition within organized retail crack markets was exacerbated by both the customers buying crack and the open-air sales locations. Low-income buyers would often purchase one hit at a time, which generated many transactions and more opportunities for violence than existing drug markets did. This violence was primarily perpetrated with firearms (Blumstein, 1995). It resulted in the diffusion of guns for self-defense, even among those not dealing drugs, and this further increased violence in areas with crack markets. As a result, there were large increases in the black male homicide rate that extended well beyond crack cocaine users and distributors (Blumstein, 1995).

B. Identifying the Arrival of Crack Cocaine

Our work requires a measure of when organized crack markets first emerged in particular cities and states. Despite numerous ethnographic accounts of crack markets, there are few existing options that cover a large number of cities or states. Our approach is to use cocaine-related deaths to estimate when crack markets emerged. Few deaths in the United States had a cocaine-related cause prior to the introduction of crack, with reported cocaine-related deaths numbering thirteen in 1979, nine in 1980, and eight in 1981.[6] The number of cocaine-related deaths increased dramatically thereafter, with 67 deaths in 1985, 523 in 1989, 1,075 in 1994, and 1,497 in 1998. Given that the consumption of powder cocaine did not change substantially over this period, it seems reasonable to attribute this increase to the use of crack cocaine (Boggess & Bound, 1997). While the cocaine-mortality relationship is not direct enough to use death records to measure the intensity of crack cocaine use (Derlet & Albertson, 1989), cocaine-related deaths provide a consistent and nationally available measure that indicates the presence of crack markets in an area. We create mortality counts from 1980 to 1998 for every Metropolitan Statistical Area (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.[7]

[6] Tabulations are from the public-use versions of the MCOD files. They contain a unique record of each death in the United States, including information about each decedent's age, race, gender, place of residence, and cause of death. The public-use files are provided by the National Bureau of Economic Research: http://www.nber.org/data/vital-statistics-mortality-data-multiple-cause-of-death.html. Deaths in the United States between 1979 and 1998 are coded according to the 9th Revision of the International Classification of Diseases system (ICD-9) system. The relevant ICD-9 codes are 304.2 (Cocaine dependence) and 305.6 (Cocaine abuse).

[7] Appendix table A1 contains more information on alternative dating methodologies. All of these alternatives produce broadly similar results to our measure.

These MSAs and the estimated years that crack cocaine markets arrived are listed in table A1 in the online appendix. The crack arrival dates span 1982 to 1994. The three MSAs with the earliest arrival of crack are Los Angeles, Miami, and New York, which matches reports on where crack cocaine first appeared. While it is possible this reflects powder cocaine deaths, none of these MSAs met the same test of consecutive cocaine-related deaths in 1980 or 1981.[8] Our dates are generally within a year of the earliest dates given in newspaper reports and ethnographies for larger cities. They are also similar to the ones generated for a smaller set of cities by Grogger and Willis (2000) and Cork (1999). Grogger and Willis surveyed police chiefs in 25 cities in 1991 about when they first became aware of the existence of crack. They also used data on 22 cities from the Drug Abuse Warning Network (DAWN), a surveillance system that monitors drug-related visits to hospital emergency departments, to identify when there is an increase in reports of smoking cocaine. The correlation coefficient between our measure and the police survey dates is 0.43; between our measure and the DAWN measure, it is 0.37. These correlations are higher than the correlation across their two sets of dates, which is 0.32. Cork used murder and drug arrests to calculate crack's arrival, and our dates have a correlation coefficient of greater than 0.3 for each of these measures.

We adopt a similar approach for dating the arrival of crack cocaine in 41 states (including DC). The crack arrival dates, presented in appendix table A2, are again based on cocaine-related deaths in two consecutive years.[9] The earliest dates are 1981 for California and 1982 for Florida and New York. The state-level dates are more compressed, with all 41 states having crack cocaine by 1988. Again, these dates are roughly in accord with other evidence of the arrival of crack markets.

C. *Factors Affecting the Spread of Crack Markets*

Many observers and law enforcement officials have emphasized the importance of proximity to the major cocaine distribution hubs of New York, Miami, and Los Angeles in the development of organized crack cocaine markets (Massing, 1989; Agar, 2003). If true, the spread of crack cocaine should be related to proximity to these three places rather than existing social and economic trends that may separately influence educational outcomes. We examine this using a Weibull duration model, with the dependent variable equal to the number of years after 1980 that crack cocaine is estimated to arrive. In addition to the minimum distance to Los Angeles, Miami, and New York, we include the natural log of population, percentage white, percentage black, and the percentage of blacks who are in poverty, unemployed, high school dropouts, and high school graduates, and have some college education. Using Census data for the fifty largest cities, we estimate a model based on 1980 values and another model using the changes between 1970 and 1980. We also estimate a model using within-decade changes in MSA-level economic data from the ES-202 system.

Hazard rates and 95% confidence intervals for the model using 1980 data are presented in column 1 of appendix table A8a. Only log 1980 population and the minimum distance to New York, Miami, and Los Angeles have a statistically significant relationship to the length of time it takes for crack markets to emerge in a city. Larger cities and cities closer to the distribution hubs are more likely to get crack markets earlier. The model based on changes in covariates between 1970 and 1980, shown in column 2 of appendix table A8a, displays similar results.

We also examine whether trends in local economic characteristics are related to the arrival of crack cocaine market. The results in appendix table A8b show that changes in the employment-to-population ratio, average transfers per capita, and average wages between 1980 and 1984 (the years immediately prior to crack arriving in most large MSAs) also do not predict the arrival date of crack cocaine markets. Taken together, these results suggest that the spread of crack markets was not related to differences in or changes in the levels of economic characteristics of MSAs.

III. Crack Cocaine Markets and High School Completion Rates

If organized and violent crack cocaine markets are responsible for the stalled progress in closing the black-white education gap, then their emergence in each MSA or state should be followed by worsening black educational outcomes. We investigate this using data from the 2000 Census Five-Percent PUMS and exploit the differential timing in the arrival of crack markets. While we would like to know where each individual lived during high school, we instead know the person's MSA and state of residence in 2000 and state of birth. However, we demonstrate that state of residence and state of birth produce similar estimates, suggesting that migration concerns are not having a strong impact on the results.

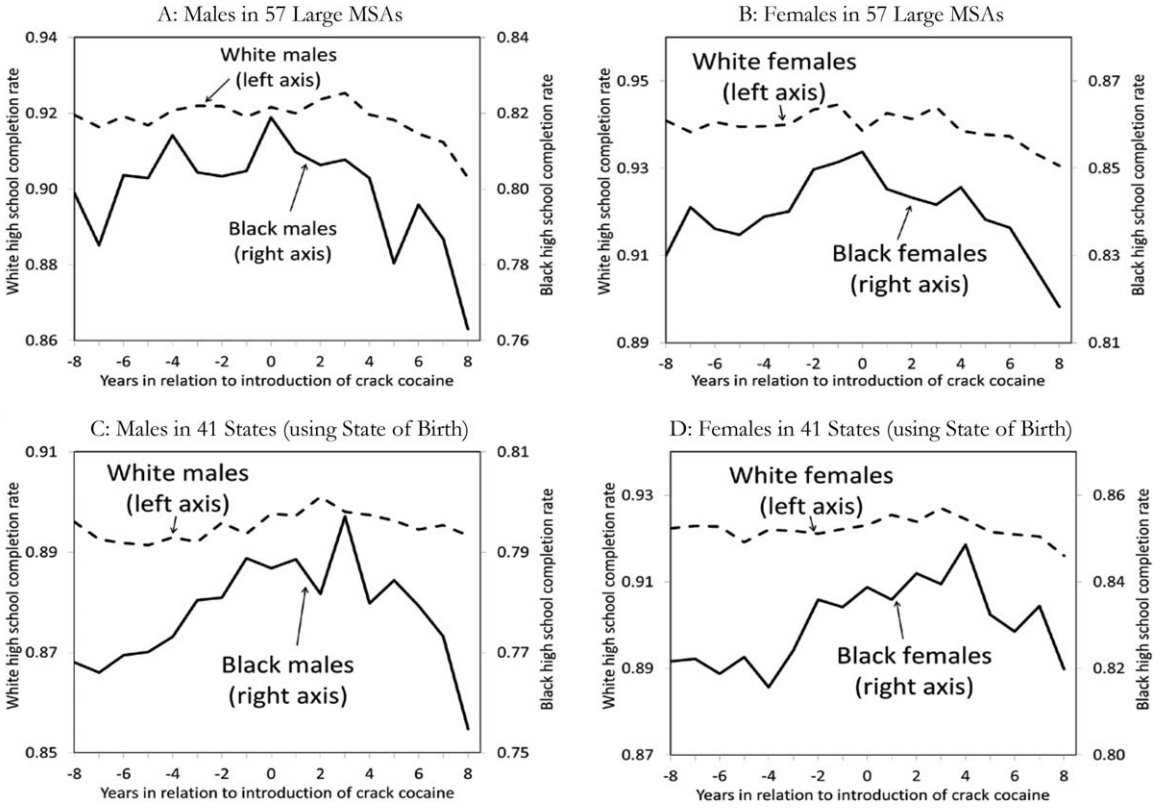
Each sample contains U.S.-born, black and white non-Hispanic respondents who turned 18 between the years 1975 and 1998. We start with individuals who were residing in the 57 MSAs for which we can establish the date of the arrival of crack cocaine markets. Among the respondents in this sample in 2000, 80% resided in the MSA that they lived in five years previously.[10] Our second and third samples are based on the 41 states with larger black populations. The

[8] Only the Nassau/Suffolk MSA (New York) consistently reports cocaine-related deaths prior to 1981; it is omitted from the sample. See the online appendix for more details.

[9] In the three most populous states of California, New York, and Texas, we use more than two deaths two years in a row. Ten states with small black populations are omitted because they do not have enough observations to analyze education outcomes. Appendix table A2 lists the arrival dates for states using a variety of measures.

[10] A concern may be that families move to get away from crack-related violence. Cullen and Levitt (1999) find migration in response to crime, but families tend to move to areas within the same MSA.

FIGURE 3.—HIGH SCHOOL COMPLETION RATES BY THE YEAR EACH COHORT TURNS AGE 18 AND WHEN CRACK COCAINE ARRIVED, BY RACE AND SEX, 2000 CENSUS FIVE-PERCENT PUMS



second sample contains current residents of those states, and the third contains respondents born in them. In addition to addressing migration concerns, a benefit of these state samples is that they allow us to include individuals living outside metropolitan areas. As noted above, crack cocaine markets were operating in many nonmetropolitan areas over this time period.

The nature of the relationship between crack cocaine markets and high school completion rates is shown in figure 3, where we report average completion rates for black and white males and females based on the year crack markets arrived in MSAs. Respondents in the 2000 PUMS are placed into cohorts based on when they turned age 18. Zero on the horizontal axis is the year crack cocaine markets arrived in each MSA, so if crack arrived in an MSA in 1986, the high school completion rate is for the respondents who turned 18 in 1986. Figure 3A shows that differences in male completion rates narrowed before crack cocaine arrived, in line with the literature on convergence. The black male high school completion rate starts to fall two years after crack markets emerge. In figure 3B, we see a similar precrack increase in completion rates for black females, with a far less pronounced drop after the arrival of crack markets. Figures 3C and 3D contain similar completion rates using the PUMS sample based on state of birth.

We use a regression to put a magnitude on the changes shown in figure 3. The model must be specified in a way that captures a number of key time series features in the data, such as the convergence in high school completion rates prior to the arrival of crack and the possible divergence in outcomes after the local arrival of crack. Since there are persistent differences in outcomes across geographic regions, races, and cohorts, the model must also control for these dimensions of the data. To capture these characteristics, we use the following specification:

$$y_{icg} = \mu_c + \lambda_g + Black_{icg}\eta_1 + Black_{icg} \times PreTrend_{cg}\beta_1 + Black_{icg} \times YearsAfterCrack_{cg}\beta_2 + \varepsilon_{icg}, \quad (1)$$

where y_{icg} is an indicator equal to 1 if person i from cohort c and geographic area g completed high school and 0 otherwise. A complete set of fixed effects for each birth-year cohort is represented by μ_c, geographic-specific fixed effects are given by λ_g, $Black_{icg}$ is an indicator equal to 1 if the respondent is black and 0 otherwise, and ε_{icg} is an idiosyncratic error term that allows for arbitrary correlation in errors within a geographic area. Estimates are weighted using PUMS person weights.

The variable $PreTrend_{cg}$ measures trends in high school completion before the arrival of crack cocaine. It equals 1 for the cohort that turns 18 in 1973, two for the 1974 cohort, and so on, until the year that crack arrives in a geographic area, after which it is held constant. For example, we estimate that crack arrives in Los Angeles, Miami, and New

TABLE 1.—LINEAR PROBABILITY ESTIMATES OF HIGH SCHOOL COMPLETION, COHORTS TURNING 18, 1973–1998

Covariates	57 MSAs (1)	41 States	
		Residents (2)	Place of Birth (3)
A. Males			
(1) Black × Pre-Crack Time Trend	0.0023***	0.0039***	0.0037***
	(0.0008)	(0.0010)	(0.0007)
(2) Black × (Years after Crack ≥ 0)	−0.0030**	−0.0032***	−0.0040***
	(0.0012)	(0.0008)	(0.0008)
P-value of test (1) = (2)	<0.01	<0.01	<0.01
R^2	0.030	0.027	0.027
Observations	679,067	1,562,331	1,564,393
Average black high school completion, year before crack	0.805	0.786	0.789
B. Females			
(1) Black × Pre-Crack Time Trend	0.0013**	0.0022***	0.0019***
	(0.0006)	(0.0007)	(0.0004)
(2) Black × (Years after crack ≥ 0)	−0.0019*	−0.0007	−0.0011*
	(0.0011)	(0.0008)	(0.0006)
P-value of test (1) = (2)	0.05	0.02	<0.01
R^2	0.027	0.021	0.021
Observations	713,912	1,617,164	1,618,387
Average black high school completion, year before crack	0.851	0.836	0.834

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$. Standard errors allow for arbitrary correlation in errors within state or MSA. Data are from the 2000 Five-Percent PUMS. See text for more details.

York in 1982, so $PreTrend_{cg}$ is equal to 10 for residents in those MSAs for all years after 1982. The coefficient β_1 from the interaction of this variable and the black indicator $Black_{icg}$ measures the convergence in white-black completion rates across cohorts prior to the arrival of crack markets, so we expect this coefficient to be positive.

There is a second trend variable, $YearsAfterCrack_{cg}$, which also varies by cohort and location. It equals 0 in all years prior to the arrival of crack, then 1 in the year after crack arrives, 2 the next year, and so on. The coefficient β_2 from the interaction of this trend variable and the race indicator $Black_{icg}$ measures the trend in white-black completion rates after the arrival of crack markets.[11] Since crack markets emerge at different times in each MSA, the cohort effects control for age-specific secular changes in outcomes.

To better understand the role of the trend variables and the effect of crack markets on educational attainment, consider a variable $Trend_{cg}$ that equals 1 for the oldest cohort, 2 for the second, and so on. Notice that, by design, $Trend_{cg} = PreTrend_{cg} + YearsAfterCrack_{cg}$. If the arrival of crack had no race-specific impact on the time series of high school completion rates, then β_1 (the precrack trend) will equal β_2 (the postcrack trend). The effect of crack markets is given by the relative magnitudes of β_1 and β_2: a finding that β_2 is smaller and statistically different from β_1 is evidence that the emergence of crack cocaine markets decreased black educational outcomes relative to whites.

Our identifying assumption is that the arrival of crack markets is uncorrelated with location-specific progress in completion rates. The validity of this assumption is supported by the lack of a relationship between crack market arrival and the level or trends of socioeconomic characteristics. In this setting, with multiple events and spatial and temporal variation in the timing of these events, equation (1) can be characterized as a difference-in-differences model where—although every location in the sample is ultimately treated by crack—the variation compares the trends in black-white completion in locations where crack arrived early to places where it arrived later.

The first column of table 1 contains the key coefficients from equation (1) using the MSA sample. Panel A contains the estimates for males. For each year prior to the arrival of crack, the percentage of black males completing high school increased by 0.23 percentage points relative to white males (p-value < 0.01). The estimated coefficient on $Black_{icg} \times YearsAfterCrack_{cg}$ suggests that after crack arrives, black males had a relative decline in high school completion of 0.3 percentage points per year (p-value < 0.05). The p-value for the equality of these coefficients is less than 0.01. Panel B contains similar estimates for females. While black female completion rates showed progress compared to whites before crack's arrival, the estimated impact of crack on high school completion is roughly 40% smaller than the male estimate and only statistically significant at a p-value of 0.10. The p-value on the test of equality for the pre- and postcrack trends for females is 0.05.

The second and third columns of panel A contain equivalent estimates using the state-of-birth and state-of-residence samples. The coefficients across both samples are remarkably similar, suggesting that selective migration is not a

[11] Because crack enters cities at different times, larger values of $YearsAfterCrack_{cg}$ will combine two effects. One is the long-term impact of crack, and the other is the changing composition of cities. We have at most eight years of postcrack completion rates for all areas, and therefore we delete observations for cohorts if they are nine or more years after the arrival of crack in their MSA. Appendix table A3 contains estimates from a specification that does not delete these observations from later years. The results are qualitatively similar.

large source of bias in our estimates. The estimated annual decrease in black male completion rates after the arrival of crack is 0.32 percentage points for the state-of-residence sample and 0.4 percentage points for the state-of-birth sample. The postcrack decline in high school achievement for females is again smaller than for males, but the test of the equality of the precrack and postcrack coefficients is statistically significant at a p-value of 0.05.

The precrack trends in the results in table 1 remain positive because the convergence in black-white high school completion rates was not geographically uniform. Chay et al. (2009) showed this convergence occurred predominantly in the South. When we reestimate the regressions without southern MSAs, none of the coefficients on the precrack trend variables are large in magnitude or statistically significant at the 5% level. However, the estimated annual decrease in completion rates after the emergence of crack cocaine markets remains similar in magnitude to the main estimate and is statistically significant at the 5% level for all three male samples and for the MSA and state-of-birth female samples.[12]

We conduct several additional exercises to assess the robustness of these results. First, there could be concerns that our estimates reflect changes in socioeconomic conditions contemporaneous with the arrival of crack markets. We address this by estimating a specification of equation (1) that includes covariates that vary by state, race, and year, such as the educational status of mothers, the percentage of children without a father present in the home, median family income, and the state unemployment rate. These covariates are generally available starting in 1978 when the Current Population Survey started to identify all states in the sample. We also include race-specific measures of the school environment, including current expenditures per student, the racial fraction in schools, and the within-district Gini coefficient in family income.[13] The results from this specification are available in appendix table A5. The inclusion of covariates decreases the magnitude of the male pretrend estimate for males by approximately 30%. This is consistent with Cook and Evans (2000), who found that school and demographic factors can explain 25% of the convergence in test scores. The estimated impact of crack arrival on black male completion rates is still a statistically significant -0.2 percentage points per annum, and the p-value on the test of equality with the precrack trend is less than 0.01. For females, the estimate on the postcrack trend after including covariates falls to -0.0002 (0.0007) and the p-value on the test of equality between the pre- and postcrack trend coefficients is 0.07.

As a related robustness check, we add race-specific cohort effects to equation (1) to control for contemporaneous race-specific changes. Although doing this absorbs most of the variation in the dependent variable, we can still identify a statistically significant change in male high school completion following the arrival of crack cocaine markets in states.[14] In combination, these results suggest that the male estimates in table 1 are not primarily due to contemporaneous changes in socioeconomic and school-level characteristics.

Second, we examine the uniqueness of the informational content in the dates. Given the pronounced trends in figure 1, it is possible that any dates we use for the arrival of crack would generate a negative coefficient on the $Black_{icg} \times YearsAfterCrack_{cg}$. We address this using a permutation test where we allow the arrival date of crack markets to vary randomly across an interval of four years before and after the date used in our main results. If our results are simply the result of the aggregate trends, then any set of randomly drawn dates over this time period should produce similar estimates. However, if our estimates reflect changes resulting from crack markets emerging in the years we identify, the reduced-form estimate from our dates should be larger in magnitude than one from a set of random dates. Estimating equation (1) using 2,000 sets of randomly drawn dates, we find that the estimate using our dates in the first column of appendix table A1 is at the 5th percentile of all estimates. If we allow the dates to randomly vary over an eight-year window before and after our main date, our reduced-form estimate is at one-half of the 1st percentile of all estimates. (More information about this test is provided in section VI of the online appendix.)

Third, we assess the robustness of our findings to using the alternative crack arrival dates. Column 1 of appendix table A6 shows the main results, while columns 2 to 4 contain estimates using three alternate sets of dates that are also based on cocaine-related deaths (described in appendix table A1). The results remain similar. Columns 5 and 6 contain estimates using the two sets of dates in Cork (1999), while columns 7 and 8 contain estimates for the two sets of dates in Grogger and Willis (2000). The p-value on the hypothesis that there is a different pre- and postcrack trend is 0.07 or less for these estimates except when using the

[12] Appendix table A4 contains these estimates, as well as estimates for the fifteen-state southern samples (which are based on the southern and border state sample used by Chay et al. 2009, consisting of Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia, and West Virginia). There are statistically significant precrack positive trends in five of the six southern samples. In each case for the southern samples, the p-value on the test of equality for the pre- and postcrack trends is less than 0.01.

[13] The variables are calculated from the data in Cook and Evans (2010), a panel data set of unified school districts from 1970/1980/1990/2000. We obtain race-specific state-level averages by aggregating data from the district to the state level using the number of whites and blacks in the district as the weight. We interpolate data between Census dates.

[14] The difficulty is that this specification absorbs nearly all of the variation in the *YearsAfterCrack* variable. For example, in the 57 MSA sample, the R^2 from a regression with race-specific cohort fixed effects is 0.994, compared to 0.030 in the original specification. It is therefore not surprising that adding the race-specific cohort effects to the reduced-form model results in an imprecise estimate of the effect of crack markets for the MSA sample. For the larger state-of-birth sample, the coefficient on $Black_{icg} \times YearsAfterCrack_{cg}$ increases to 0.0072 (0.0077) and importantly remains statistically different from the pretrend at a p-value of 0.05.

police chief survey, where the standard errors are too large to detect a difference in the pre- and postcrack trends.

A related measure is provided by Fryer et al. (2013), who constructed a time-varying index of crack severity in 144 cities and in states.[15] This index is composed of factors such as homicides, cocaine arrests, cocaine-related emergency department measures, cocaine seizures, and newspaper articles discussing crack cocaine. As a further specification check, we estimate the relationship between the high school completion of blacks and the Fryer et al. index in our MSA sample. To use this measure of intensity, we use the MSA-specific index value for the year each cohort turned 18 and interact it with the black identifier. We include fixed effects for cohorts, MSA, and race. The estimated coefficient (standard error) on the interaction term between whether an individual is black and the Fryer et al. measure of intensity is −0.0091 (0.0029) for males and −0.0038 (0.0026) for females. From 1983 to 1993, the Fryer et al. index increased by 1.85 points, suggesting that crack index values were associated with a 2 percentage point decrease in black male completion rates. Given the different structure of this index and the limited relevance of some index components to a local geographic area, we view this as complementary evidence of a meaningful relationship between crack cocaine markets and the high school completion of black males.

IV. Potential Mechanisms Driving the Effect of Crack Markets on Educational Attainment

The reduced-form results above show that high school completion rates for black male students declined quickly after crack markets were established in major cities. In order to understand potential mechanisms underlying this stalled progress, in this section we consider potential pathways through which crack markets may have altered outcomes. While we particularly focus on murder and incarceration rates as key crack-related outcomes that standard human capital investment models suggest should affect the investment in schooling, we also consider alternative mechanisms.

A. The Rapid Rise in the Murder Rate

Murders provide a consistent measure through which we can investigate what changes were occurring when crack cocaine markets were introduced.[16] While we focus on murder, there is evidence that related outcomes like assaults and gunshot wounds during this period moved in line with murder rates (Boggess & Bound, 1997; Fryer et al., 2013).

The aggregate annual murder rate was reasonably stable between 1980 and 1995, at between 8 to 10 deaths per 100,000 residents. However, there are enormous differences across age groups. Figure 4A shows the murder rates for four age groups: less than 15 years, 15 to 24 years, 25 to 39 years, and 40 years and older. What is most striking is the large increase among those aged 15 to 24, whose murder rate increases by 94% from 1985 to 1993. Their homicide rate is lower than the 25–39 age group at the beginning of the period, but by 1993 it is 50% higher than the 25–39 age group and several times higher than the rates for other age groups.

To understand who in the 15–24 age group accounts for these changes, figure 4B shows the homicide rates of black males, black females, white females, and white females in this age group. Note that because the black male homicide rate is much higher than the other groups, it is measured on the right vertical axis while the other three groups reference the left. Starting in the middle of the 1980s, there is a large increase in the homicide rate for black males aged 15 to 24 years. Per 100,000 population, their rate increased from 66 in 1985 to 166 in 1993, an increase of 150%. Per 100,000 population, the homicide rates of white males over the same period increased from 11 to 17 and black females increased from 14 to 22. After peaking around 1993, the homicide rates for black males, white males, and black females declined by 42% to 51% by 2000. In contrast, the homicide rate for white females is low and stable throughout the sample period.

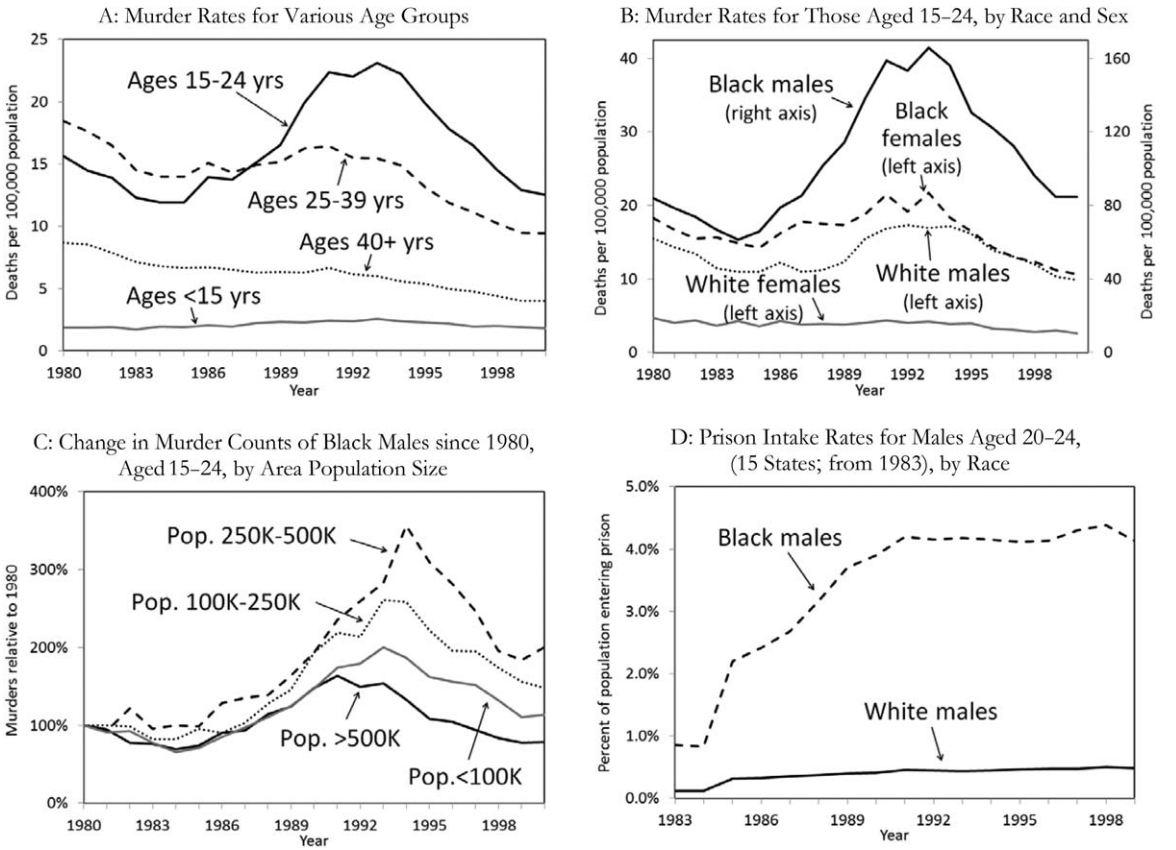
An analysis of both absolute and relative changes in murder rates shows these changes were geographically widespread. Of the 100 MSAs with the largest black population, between the 1980s and 1990s, the five cities with the largest absolute change in the murder rate of black males aged 15 to 24 years were Youngstown, Ohio; New Orleans, Louisiana; Gary, Indiana; Shreveport, Louisiana; and Chattanooga, Tennessee. Each city experienced an absolute increase in its annual murder rate of over 300 per 100,000 residents in this demographic group. Further supporting the widespread impact of crack markets, figure 4C shows the relative changes since 1980 in the murder rate of black males aged 15 to 24 years for different city sizes.[17] The largest increase was in cities with 250,000 to 500,000 residents, followed by cities with 100,000 to 250,000 residents. The smallest relative increase in murders was for cities with more than 500,000 residents. These results are consistent with the hypothesis that competition for territory between national criminal enterprises in the middle of the country led to the worst crack-related violence in midsized cities (Massing, 1989; Witkin, 1991).

[15] Among the 57 MSAs in our reduced-form analysis, 52 are included in the Fryer et al. (2013) index.

[16] Homicides are taken from the public use versions of the National Center for Health Statistics' Multiple Cause of Death (MCOD) data files. These files contain a unique record of each death in the United States, including information about each decedent's age, race, gender, place of residence, and cause of death. The public use files are provided by the National Bureau of Economic Research: http://www.nber.org/data/vital-statistics-mortality-data-multiple-cause-of-death.html. Population data are Census data compiled by Cancer SEER.

[17] We examine the relative change because the MCOD files have a city size identifier but not enough information to create population counts (and therefore death rates).

FIGURE 4—MURDER RATES AND PRISON INTAKE RATES, MULTIPLE CAUSE OF DEATH AND NATIONAL CORRECTIONS REPORTING PROGRAM DATA, 1980–2000



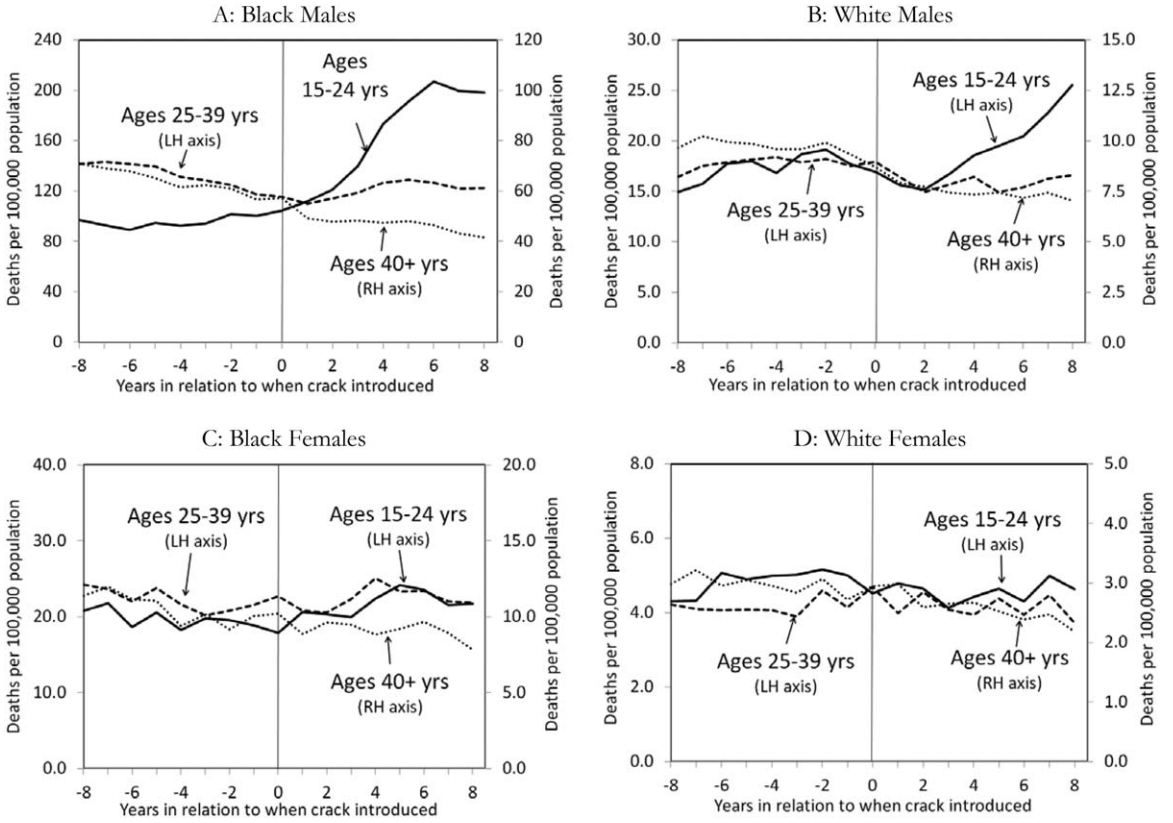
Surveys suggest that school-aged children were keenly aware of this violence. A 1992 study of inner-city children aged 7 to 19 years in Birmingham, Alabama, found that 43% had witnessed a homicide or a body after a homicide (Morganthau, 1992). Schubiner, Scott, & Tzelepis (1993) found that among black youths in Detroit aged 14 to 23, 42% had witnessed a shooting and 22% had seen someone killed. Among inner-city Baltimore residents aged 12 to 24, 42% had seen a shooting, 25% a stabbing, and 23% a murder (Gladstein, Rusonis, & Heald, 1992). A parental survey in a New Orleans housing project found that 71% of children had reported seeing a weapon used, and 39% had seen dead bodies (Osofsky et al., 1993).

To focus on the role of crack markets in the increase in murder rates, figure 5 depicts the murder rates of different age and demographic groups for the eight years before and nine years after the arrival of crack markets in the 57 MSAs for which we have arrival dates. Figure 5A shows the rates for black males aged 15 to 24 years, 25 to 39 years, and 40 years and older. The 15 to 24 age group murder rate is initially flat and then rises considerably after the arrival of crack markets. Six years after the arrival of crack, the murder rate for this age group is twice what it was the year before the arrival of crack. Black males aged 25 to 39 experienced a 12% increase after crack arrival, while there is no change in the trend for black males aged 40 and older.

Figure 5B displays the murder rates of white males for the same three age groups. The 15–24-year-old murder rate increases three years after crack arrives in MSAs and by 51% eight years after crack arrives. It is important to note that the peak murder rate for this group was approximately one-eighth the rate of their black counterparts. Murder rates for white males aged 25 years and older are unchanged by the introduction of crack. Murder rates for black females are in figure 5C. The murder rate for black females aged 15 to 24 increases three years after crack arrives in MSAs and is 51% higher eight years after crack arrives. The rates for black females aged 15 to 24 and 25 to 39 had small increases after crack arrives, although they are not affected to the same degree as black males. The rates for white females are in figure 5D, all age groups of white females are unaffected by the emergence of crack markets.

If the perceived risk of murder and violence after the arrival of crack is a mechanism through which crack markets affect black males' educational attainment, their school completion should be correlated with the murder rates of a reference group of older black males. As a measure of perceived mortality risk, for each individual we calculate the average murder rates of those aged 20 to 24 years during the years an individual was between 16 and 18 years old. These rates are specific to location, sex, and race. For example, a black male in Denver is assigned the average murder

FIGURE 5—MURDER RATES BEFORE AND AFTER THE INTRODUCTION OF CRACK MARKETS IN 57 LARGE MSAs, BY RACE AND SEX, MULTIPLE CAUSE OF DEATH DATA, 1973–2000



rate of black males aged 20 to 24 in Denver in the years he was 16, 17, and 18.[18] Murder rates can be generated for smaller cities, increasing the coverage beyond the 57 large MSAs used above.

Table 2 contains the estimates from a model that regresses high school completion rates on the average murder rates of the reference group during high school, plus the controls described below. The sample for these regressions is similar to that in table 1 in that it includes native-born white and black non-Hispanics who turned 18 between 1975 and 1998. Given the disparities in murder rates by gender, we estimate models separately by sex. The top panel of table 2 contains estimates for males, and the bottom panel shows the results for females. We use four different samples. In column 1, we generate estimates for the 57 MSAs that match the cities used in the reduced-form analysis. In column 2, we expand this to include all 176 MSAs that we can define consistently in the MCOD data and match to the PUMS. Column 3 contains estimates using state of residence for the 41 states with the largest black populations, while column 4 uses the state-of-birth sample. In all models, we include a race dummy plus cohort and geographic area fixed effects. For each model, we use PUMS sample weight, report the coefficient on the murder rate ($\times$ 1,000), and report standard errors clustered within the geographic areas.

The estimates for the 57 largest MSAs suggest that as murder rates for the reference group increase, there is a statistically significant decline in high school completion rates. The results in column 2 for the sample of 176 MSAs are quite similar. Columns 3 and 4 show the results for the samples based on state of residence and birth. These samples produce larger coefficients on the race-specific murder rate, which is perhaps not surprising given that the average change in murder rates over the 1980s and early 1990s is larger in these samples.

These models are robust to the inclusion of race-specific cohort fixed effects. For example, adding them reduces the coefficient (standard error) on the murder rate in the 57 MSA sample from -0.183 (0.053) to -0.149 (0.056) and in the 176 MSA sample from -0.171 (0.039) to -0.131

[18] The use of the murder rates of the 20–24 age group avoids a potential mechanical correlation between educational outcomes and homicides. The murder rate is calculated when the teens are 16 to 18 years of age, but the regression models contain only people who are alive at the time of the Census. If those less likely to graduate high school are more likely to die from gun violence after the arrival of crack, then an area with a high murder rate will have simultaneously a higher numerator in the murder rate and a smaller denominator in the high school graduation rate, producing a mechanical negative correlation between the variables. Using the murder rates from older cohorts may still be subject to an omitted variables bias, but this mechanical linkage is lessened by using data from the older cohorts.

TABLE 2.—OLS ESTIMATES OF IMPACT OF MURDER RATES ON HIGH SCHOOL COMPLETION, COHORTS TURNING 18, 1975–1998

Covariates	57 MSA (1)	176 MSA (2)	41 States: State of Residence (3)	41 States: State of Birth (4)
A. Males				
Sex/race-specific murder rate	−0.183***	−0.171***	−0.317***	−0.245***
in high school (× 1,000)	(0.053)	(0.039)	(0.080)	(0.080)
R^2	0.035	0.035	0.030	0.030
Observations	704,988	1,025,361	1,720,256	1,719,950
B. Females				
Sex/race-specific murder rate	−0.019	−0.046	−0.128	−0.020
in high school (× 1,000)	(0.206)	(0.112)	(0.278)	(0.262)
R^2	0.030	0.029	0.022	0.022
Observations	740,661	1,070,704	1,769,373	1,767,901

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$. Standard errors are in parentheses and allow for arbitrary correlation in errors within a state/MSA. High school completion data are from the 2000 Five-Percent PUMS, and murder rates are calculated using the MCOD data files. All models include race, cohort, and geographic area fixed effects.

(0.041). The estimates remain quantitatively large and statistically significant at demanding levels.

For females, in all specifications the coefficient on the race-specific murder rates is small. Coefficients are about one-tenth the size of the coefficient for males and statistically insignificant. This is not surprising given the small relative change in murder rates for females.

B. Increased Incarceration of Black Males

Changes in the probability of incarceration would further limit the expected benefits from human capital investments. The number of federal and state prisoners more than doubled from 1980 to 1996, driven by a nine-fold increase in incarceration for drug offenses (Blumstein & Beck, 1999). To examine state-based differences in the probability of incarceration by age and race, we construct a prison intake measure from restricted-use data provided by the U.S. Bureau of Justice Statistics National Corrections Reporting Program (NCRP) from 1983 to 1999. The NCRP tracks the entry and exit from prisons and includes basic demographic information and in what state the sentence was imposed. The NCRP data do not report previous incarcerations for those entering prison, so we are not able to identify first-time incarcerations. We instead calculate the percentage of each group that enters prison in a year. There is inconsistent participation in the NCRP by states over time. Although 36 of our 41 states participate in any year, only 15 provide data for each year from 1983 to 1999.[19] The limited sample and the lack of data prior to 1983 mean there are few intake data prior to the arrival of crack markets.

Despite these limitations, the NCRP data provide insight into the general increase in imprisonment in the 1980s and the race-specific differences in this change across states and over time. Figure 4D shows the prison intake rate for males aged 20 to 24 from 1983 to 1999 for the fifteen states reporting data in each year. In 1983, the fraction of black and white males entering prison was 0.86% and 0.12%, respectively. Over the next sixteen years, the prison intake rate for black males increased by 3.3 percentage points, compared to 0.3 percentage points for white males. As a result, by 1999 the original 0.7 percentage point racial gap in incarceration rates grew to 3.6 percentage points.[20] It is important to note that none of these figures includes jails, which generally hold around 40% as many people as state and federal prisons (Caulkins & Chandler, 2006). It is also important to note that the quality of the data does vary across the states, as noted most recently by Neal and Rick (2014). We address this data quality issue below.

The increase in the prison intake rate is likely driven by both a change in criminal activity and a shift in federal policy that results in part from the emergence of crack cocaine. In the 1980s, Congress passed two major pieces of federal legislation in an attempt to address the rising violence related to drug markets. The Anti-Drug Abuse Act of 1986 created a set of mandatory minimums for drug offenses. Two years later, the Omnibus Anti-Drug Abuse Act of 1988 created much harsher penalties for the possession of crack cocaine compared to powder cocaine. In addition, this law applied stringent penalties to all conspirators in a criminal organization, greatly increasing the probability of lengthy federal incarceration for low-level participants in the drug trade. Mascharka (2001, p. 941) said that "this measure—designed to catch drug kingpins, who rarely have large quantities of drugs in their possession—has been criticized for being more routinely used against low-level drug dealers, look-outs, and peripheral conspirators such as the girlfriends of drug dealers." The broad application of mandatory minimum sentences in this period increased the risk of incarceration far beyond high-level dealers and traffickers.

[19] Fifteen states participated in each year (Alabama, California, Colorado, Illinois, Kentucky, Maryland, Michigan, Minnesota, Mississippi, Missouri, Nebraska, Oregon, Tennessee, West Virginia, and Wisconsin). An additional two states that reported every year, New Hampshire and North Dakota, are not in our 41-state sample.

[20] While the absolute rates of change here are much larger for black versus white males, the difference in the relative rates is not as stark. However, to the extent that young black males are changing their human capital investment decisions in response to the risk of incarceration, their decisions should be driven by absolute rather than relative changes in this outcome.

TABLE 3.—OLS ESTIMATES OF THE IMPACT OF MURDER AND PRISON ENTRY ON MALE HIGH SCHOOL COMPLETION, BASED ON THE SEPARATE IMPACTS OF MURDER AND PRISON, COHORTS THAT TURNED 18, 1983–1998

	(1)	(2)	(3)
Race-specific murder rate during high school (× 1,000)	−0.451***		−0.323***
	(0.103)		(0.079)
	[−0.047]		[−0.034]
Race-specific prison intake rate (× 1,000)		−1.788***	−1.039**
		(0.494)	(0.360)
		[−0.059]	[−0.035]
R^2	0.031	0.031	0.031

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$. Standard errors are in parentheses and allow for arbitrary correlation in errors within a state. The brackets show the estimated total effect on black completion rates from the changes in murder and incarceration rates from 1983 to 1993 (e.g., −0.047 in the first column represents a 4.7 percentage point decrease in completion). High school completion data are from the 2000 Five-Percent PUMS, murder rates are calculated using the MCOD data files, and prison entry is from the NCRP data files. All models include a dummy variable for race and a complete set of cohort and state fixed effects. The sample is the fifteen states reporting every year and contains 405,507 observations.

In addition to the large national increase in incarceration, there was substantial variation across states. In 1984, the state-level prison intake rates for black males aged 20 to 24 ranged from 0 to 1.4%. A decade later, this range was 0.3% to 6.9%. This variation is useful for identifying an effect of incarceration risk on educational attainment. While there could be a concern that the variation is due to state policies, to the degree that these policy changes are a response to crack cocaine, they should still be considered an effect of the emergence of these markets. For example, many states passed mandatory minimum statutes intended to deter and control crack markets.

We analyze the impact of incarceration on black male high school completion using the state-of-birth 2000 PUMS sample.[21] Table 3 shows the estimates from a sample containing the 15 states that are both reporting NCRP data each year and among the 41 states with the largest black populations.[22] Column 1 shows the results from the regression used to produce the results in table 2. While this estimate is approximately twice the magnitude of the corresponding results in table 2, the estimated coefficient of interest is not statistically different at the 5% level from the other 26 states not reporting NCRP data every year. To put the estimates in perspective, the brackets below these estimates contain the total estimated effect on black high school completion rate using the change in the relevant black murder rates from 1983 to 1993. They suggest that rising murder rates can explain a 4.7 percentage point drop in the completion rate of black males.

Column 2 of table 3 contains estimates from a regression of male high school completion rates on the race-specific NCRP prison intake rate of 20- to 24-year-olds when a respondent turned 18.[23] The main specification includes state, cohort, and race fixed effects. Results are similar if we include a full set of race-specific cohort fixed effects. Results suggest that the changes in intake rates from 1983 to 1993 are responsible for a 6 percentage point decline in black male completion rates.

In order to determine the independent impacts of murder and prison rates, column 3 contains the estimates from a specification with both the murder rate and prison intake rate included as independent variables. Both of these factors are independently predictive of changes in the high school completion rate. The marginal effects for black males suggest that the combined impact of these factors is a decline in male high school completion rates of 6 to 7 percentage points, with a roughly similar impact from the two variables. This suggests that the changes in murder and incarceration experienced by younger black males were important channels through which the emergence of crack markets had a negative impact on their high school completion.

C. The Effect on Black Families and Neighborhoods

The crack cocaine epidemic was a dramatic event that had a profound effect on families and neighborhoods. A *Los Angeles Times* reporter that covered the South Central Los Angeles area for twenty years notes that "crack steered fathers to jail, lured mothers into the streets and left children to raise themselves in neighborhoods bristling with despair and anger. Their families and communities were left scorched and in many cases, still smoldering" (Banks, 2010).

Many factors are predictive of high school completion rates, including family structure, parents' education, family income, and school spending. For any of these factors to explain the sharp decline in black male high school completion rates that began in the 1980s, it must be the case that the variable moved massively against black families relative to their white counterparts and differentially affected males compared to females. The nine chapters in Magnuson and Waldfogel (2008) considered many likely explanations for the stalled progress among blacks in test scores (e.g., changing income levels and inequality, school inputs, changes in family structure). Their conclusion was that few moved adversely enough against black students compared to their white counterparts to explain the stalled progress. Neal (2006) examined similar factors as possible explanations but found no strong connection. Berends and Penaloza (2008) showed that among children in school from 1972 to 2004, parental education increased for black children relative to white children, indicating this input cannot explain the differential trends we detect.

Although crack was undoubtedly devastating for many families, the data show that family characteristics typically predictive of high school completion did not move appreciably for black families when compared to white families over the period of analysis. In appendix table A9, we pro-

[21] Similar results are obtained using state of current residence.

[22] Neal and Rick (2014) note that there are many errors in the NCRP data. Appendix A6 shows that if we limit our sample to the states with fewer errors, we obtain qualitatively similar results.

[23] Because we have so few years of data on prison entry rates, we only use the prison entry rate the year a cohort turned 18 instead of the three-year moving average we used for mortality rates.

vide descriptive information about changes in family characteristics and economic conditions of black and white families with children aged 0 to 18 from the 1980 to 1990. This table lists a variety of variables, including poverty rates, a measure of welfare receipt, indicators of family structure, the returns to education, unemployment rates, and school district spending. At best, the table shows mixed evidence of deteriorating conditions for black families over our sample period. While families with young black children had a higher poverty rate and a lower fraction of families with a birth father present, many other outcomes of black families are improving—for example, a lower fraction of families on food stamps, higher fraction of families where the birth mother is present, higher rates of return to education, lower unemployment rates, and more school spending. Moreover, the relative changes for blacks compared to whites are modest, suggesting that these factors are unlikely to explain the sharp and large change in black male high school completion.

Just as important, any change in factors common to both males and females would have to incorporate an explanation of why black males were disproportionately affected. In addition, any deterioration in the family or school environment brought about by crack would likely decrease educational attainment for black males at all ages. However, this is not the case. Some evidence on this point can be found in patterns from the National Assessments in Educational Performance Long-Term Trend (NAEP-LTT) standardized test scores. These math and reading tests have been given at ages 9, 13, and 17 every two to five years since the early 1970s, and the tests have not changed over this period. In appendix figures A1A and A1B, we present the percentage differences in white and black scaled scores by age for reading and math, respectively.[24] The filled year markers represent the years in which NAEP tests were administered. Among 17-year-olds, the reading scores of whites were 22% higher than of blacks in 1971. This gap fell to 7% in 1988 and then rose to 11% by 2004. For this same age group, the gap in math test scores halved from 14% to 7% between 1978 and 1990 and then rose to 10% by 2004.[25] The trends for 13-year-old reading and math scores are similar, with white and black test scores converging until the late 1980s and diverging after. The trends for 9-year-olds are different, however, with the gap generally decreasing throughout the period. This is particularly evident for math scores. The lack of a similar impact in scores for younger and older black males suggests that common factors such as families or schools are not primary drivers of stalled progress.

[24] Data for these figures are taken from the National Center for Education Statistics website.

[25] Only those attending school are tested, so the 17-year-old sample is missing individuals who have dropped out of high school. The decreasing high school graduation rates of blacks relative to whites in the 1990s should remove black students aged 17 of below-average ability and bias the results away from finding a widening test score gap.

D. The Potential for Other Pathways to Explain Changing Black Male High School Completion Rates

Two additional mechanisms are worth considering. First, it is possible that educational attainment is affected by race-based differences in the use of crack cocaine. This does not appear to be the answer, as crack use by individuals under the age of 18 was low (Johnston, O'Malley, & Backman, 1991, found that in 1980, 1.2% of high school seniors reported crack cocaine use in the past year) and school-age blacks used crack at rates similar to whites (the National Household Survey of Drug Abuse in 1995 found the lifetime crack use for 16- to 17-years-olds was 5.1% for whites compared to 4.2% for blacks). Of course, crack use was more problematic among older black males, and that may have changed younger black males' expectations about the future and their expectations about the return to schooling.

Second, another possible pathway through which the rise of crack markets could affect education attainment is through participation in the drug trade. Detailed information about the income-generating effects of crack cocaine markets is not available, but there are studies of the returns to drug dealing helpful for understanding its likely influence in this setting. These suggest that crack dealing was predominantly a part-time activity that did not conflict with formal employment or high school attendance. Johnson, Dunlap, and Tourigny (2000) observed 300 participants in crack markets in New York and found most used it as a sporadic way to earn income. Levitt and Venkatesh (2000) reported that members of a Chicago crack-selling gang most commonly worked four times a week for four hours each time, that the pay was low, and that many also held legitimate jobs. Reuter et al. (1990) examined arrest records in DC between 1987 and 1989 and found the employment rates of individuals arrested for drug selling were similar to those arrested for nondrug offenses. In a follow-up survey, they found that individuals working more intensively in the formal labor market were more active in selling crack and that their income from dealing drugs was limited. Even if dealing did not prevent school completion, drug dealing could have consequences by increasing the risk of homicide mortality or arrest (or both). For example, Reuter et al. (1990) found that among adolescents in DC, half thought that dealing drugs for a year would lead to serious injury or death, while 38% felt it would lead to an arrest. At the aggregate level, these consequences should be measured through the analysis of the mortality and incarceration rates.

V. Limitations

Although we have marshaled a number of high-quality data sets to test our hypothesis, our work is hampered by some inherent data limitations. First, we would like a measure of crack cocaine use that is distinct from powder cocaine. However, it was not until the late 1980s that any data collections started to make that distinction, and by that

time, the presence of crack cocaine was widespread (Agar, 2003). Second, in order to merge the MCOD mortality and Census data sets together, we had to aggregate murder rates to at least the MSA level. It would be useful to have more detailed geographic data on murder rates to exploit within-city and across-race variation in exposure to violence. Second, a key assumption we make is that teens were aware of the rise in mortality and the expected decline in life expectancy identified in figure 4. Some qualitative studies suggest that black male teens during this time expected to die much sooner (Anderson, 1994). Ample survey data also indicated that a high fraction of black youths witnessed gun violence, but no systematic surveys identify how this changed self-reports of life expectancy. In addition, we have no data at the city or within-city level that would allow us to exploit geographic differences in these expectations. Third, our prison intake data from the NCRP did not start until 1983, giving us few precrack years in incarceration rates. In addition, the key outcome we would like to have is the lifetime chance of an incarceration, but no data are available. Finally, while we have very good data on an important educational outcome, high school graduation, it would be useful to have be able to consider the effect of crack markets on a broader set of educational outcomes. Unfortunately, data sets like the NAEP-LTT are not representative at the state level. NAEP has started to generate test results that are representative at the state level, but the first data from these surveys were in 1990, well after crack markets were started in most cities.

Another limitation of our analysis is the difficulty in explaining black males' educational attainment in more recent years. By the late 1990s and early 2000s, murders associated with crack markets had subsided. Law enforcement accounts suggest that this was the result of crack turning into a stable drug market where property rights were relatively well established. However, there was not a return to convergence in the educational attainment of black students. In figure A2, we use the 2009–2011 American Community Survey to document the white-black high school completion gap in recent years. Panel A contains the high school completion rate for black males by the year they turn 18. As would be expected, prior to 1997, these data show a generally similar pattern to the trends in the 2000 PUMS data shown in figure 1.

After 1997, the pace of the decline in completion rates for cohorts turning 18 years old was much slower. From 1987 to 1997, black male high school completion rates fell by 0.4 percentage points per year. In the next five years, the rate, fell only by 0.06 percentage points per year, a total decline of 0.3 percentage points over the five-year period. While this was not a return to the historical growth throughout the 1970s, it certainly was a clear break from the declining trend during the height of the crack epidemic. The failure to return to convergence may be due to at least two factors. First, despite a general belief that this marked an end of the crack epidemic beginning in the mid-1990s, it is important to note that the decline in mortality risk was not matched by a similar decrease in the prison intake rate. In the late 1990s, over 4% of black males aged 20 to 24 entered a federal or state prison each year. Over this time period, the rate for similarly aged white males never exceeded 0.5% a year. Given that this represents the flow of young black males into prison, it demonstrates a large and continued disruption in the lives of black males throughout our sample. Recall that morality and incarceration risks are of roughly equal importance in explaining the decline in educational attainment during the peak of crack market activity. The number of federal and state prisoners declined in 2010, the first decrease since 1972 (Guerino, Harrison, & Sabol, 2012). It will take some time to see whether such declines lead to further convergence in black-white educational outcomes. Second, the lack of a rebound in completion rates for black males could be a sign of a new equilibrium resulting from factors such as decreased intergenerational transfers in education from parents, siblings, or other relatives. Further research is necessary to determine the factors underlying the current trends in black educational attainment.

VI. Conclusion

We provide evidence that the stalled progress in blacks' high school completion, especially by black males, resulted from the emergence of organized crack cocaine markets. These markets had three primary impacts: an increased murder rate, an increased prospect of incarceration, and an increased opportunity for employment outside the formal sector. These factors disproportionately affected black males. Each of these factors lowers the potential return from an investment in human capital, and therefore our estimates of reduced schooling provide suggestive evidence of individuals investing in education as outlined in Becker (1964) and Ben-Porath (1967).

From 1965 to 1985, the percentage of black males who received a high school diploma increased by an average of approximately 0.3 percentage points per year. Our results show that the introduction of crack cocaine reversed this progress. Over the period of greatest postcrack decline in black high school completion rates, 1986 to 1996, there was an approximately 8 percentage point decrease in the percentage of black males with a high school diploma. We provide evidence that changes in murder and incarceration rates serve as mechanisms through which crack markets affect educational attainment. Depending on assumptions about the continuation of the historical convergence, the change in murder and incarcerations risks explains between 37% and 73% of the decline in educational achievement among black males between 1986 and 1996.

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