Residential Segregation, Socioeconomic Deprivation, and Neighborhood Homicide Victimization

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Abstract

This paper estimates the effects of racial residential segregation and various factors of socioeconomic deprivation on Black and White neighborhood homicide victimization rates in an effort to explain the gap in homicide incidence between the two racial groups. The effects of these variables on neighborhood homicide rates are approximated using socioeconomic data collected from the US Census Bureau at the census tract level in Baltimore, Maryland, from 2010 to 2019, for the non-Hispanic White and Black populations. Racially disaggregated homicide data was obtained from the Baltimore Sun, via the Baltimore Police Department. Examination of 200 Baltimore census tracts provides evidence that various socioeconomic factors are predictors of both White and Black homicide victimization. Additionally, the results suggest that racial residential segregation greatly amplifies the effects of socioeconomic deprivation on Black homicide victimization. This indicates that the gap in racial homicide victimization rates is linked to discriminatory laws and tactics carried out in the United States, as well as the disparities in socioeconomic affluence between Black and White Americans.

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Introduction

In the examination of criminal behavior, a large focus has been placed on social and economic disparities between racial and ethnic groups. The 2014 household poverty and non-fatal victimization report from The Bureau of Justice Statistics (BJS) presents an example which provides an explanation for scholars' interest in analyzing the relationship between socioeconomic deprivation and crime. Impoverished communities had over double the violent victimization rates of high-income neighborhoods from 2008 to 2012, and Black and Hispanic Americans are disproportionately represented in poor neighborhoods, while Whites are disproportionately represented in high-income communities (see Harrell et al. 2014). Research indicates that the over representation of minority groups in neighborhoods of low socioeconomic status is linked with various tactics and acts of discriminatory nature against minority groups, especially against Black Americans. Some of these laws and actions carried out in the US include the enslavement and trade of Black persons; Jim Crow Laws, which were created to segregate and injure the Black population by denying equal access to education, employment, voting rights, housing opportunities, etc.; Gerrymandering; and more (see Yosso et al. 2004, Ronald W. Walters 2012, Highsmith and Erickson 2015). Many scholars argue that the consequences of the Jim Crow era include the large disparity in socioeconomic opportunity and affluence between Black and White Americans.

The present study analyzes homicide rates and various measures of socioeconomic disadvantage for the White and Black populations of Baltimore City, Maryland. These factors are examined because of the large gap in homicide victimization incidence and the large disparity in economic affluence between the two racial groups. According to the FBI's expanded homicide offense characteristics, 51% of homicide victims from 2009 to 2019 were Black, and

44% of homicide victims within the same period were White (The Federal Bureau of Investigation 2009-2019). Black Americans are victimized at alarming rates despite accounting for only about 12%-13% of the United States population during the last decade (United States Census Bureau). This racial homicide differential is commonly attributed to economic and social disadvantage experienced by Black Americans. Studies have continually found a lack of socioeconomic prosperity to be associated with higher incidence of crime. Because of these findings, I hypothesize that a decline in socioeconomic disadvantage and inequality among minority groups will lead to a decline in criminal victimization rates for these marginalized groups, thereby closing the homicide gap between Black and White Americans. Scholars who have studied the homicide gap between racial and ethnic groups have found results that support this theory, most notably, Phillips (2002); and more recently, Ulmer, Harris, and Steffensmeier (2012).

This study aims to extend the body of literature regarding the effects of socioeconomic deprivation and racial residential segregation on crime. I build on prior research by analyzing homicide victimization rates disaggregated by race, White (non-Hispanic) and Black. I examine the effects of various economic and social variables on homicide victimization over a consecutive ten-year period, 2010 to 2019, across 200 Baltimore City census tracts. Examining data over a consecutive period of time allows for the application of a two-way fixed effects analysis, which has not been frequently used at such a local geographic level in prior studies. Research conducted at the census tract level can be used as a proxy to predict neighborhood level estimates of the relationship between crime and disadvantage. Moreover, it allows for a better analysis of residential segregation compared with studies conducted at larger geographic aggregations, such as studies conducted at the metropolitan area level. Analysis of segregation at

such a local level makes it possible to examine the effects of segregation less broadly. With census tract data, I can examine areas with small population size, differing racial composition, and distinct socioeconomic conditions all across the same city. Additionally, evidence suggests that local residential segregation has stronger effects on crime than city-level measures (Krieger et al. 2017). Taking advantage of my ability to measure residential segregation at the neighborhood level, I create interaction terms to determine how the segregation of Black Baltimoreans into socioeconomically deprived areas affects Black homicide victimization. Interaction terms used in this paper estimate the marginal change in homicide victimization when rates of poverty, unemployment, and educational attainment change in a segregated neighborhood. The goal of this analysis is to provide public policy implications that may be used to curb violence, especially in areas where socioeconomic deprivation is widespread among Black Americans.

Results from this study suggest that various factors of socioeconomic deprivation are associated with homicide victimization for both racial groups, however, many of the examined variables are found to be stronger predictors of Black homicide than White. This may be explained by the large gap in socioeconomic affluence between the two racial groups. Furthermore, the findings suggest that segregation amplifies the effects of socioeconomic deprivation on Black homicide victimization.

Literature Review

Racial/Ethnic Segregation:

The United States has a condemnable history regarding racial and ethnic discrimination and segregation dating back to the foundation of the country. Due to these discriminatory beginnings, minorities, most notably Black Americans, were forced into

segregated neighborhoods with high poverty rates and denied access to housing in affluent communities (Massey and Denton 1989 and Massey 1990). Social scientists have posited that there are numerous forms of segregation and have tested them empirically to decide which measures are most useful in statistical analyses (see Massey and Denton 1988; Massey, White, and Phua 1996; and Johnston, Poulson, and Forrest 2007). Massey and Denton (1988) is among the most notable research articles to discuss this issue. Many studies use their proposed measures to estimate the effects of segregation on crime incidence.

Social scientists continue to study the impact of residential segregation on crime rates because the most highly segregated demographic groups in the country commit crimes and are victimized at the highest rates. For example, Shihadeh and Flynn (1996) examines the relationship between Black segregation and Black urban crime rates, particularly robbery rates and homicide rates because they are disproportionately committed by Black Americans. Their findings suggest that increases in two measures of segregation predict higher Black arrest rates. Other studies have resulted in similar findings; Parker and Pruitt (2000) conducted research on the relationship between poverty, concentrated poverty, and White and Black homicide rates. Their results suggest that residential segregation of Black Americans was the strongest predictor of Black homicide arrest rates. Krivo et al. (2009) finds that racial and ethnic segregation of Black and Latino Americans and concentrated disadvantage among Black and Latino Americans are both significant predictors of violent crime.

Building on Massey, White, and Phua (1996), Xie (2010) examines multiple indices of segregation, and her findings suggest that all measures of segregation have strong, positive, and statistically significant effects on the homicide victimization rates for Black and Hispanic

Americans. Feldmeyer (2010) also examines the relationship between Black and Latino segregation and homicide arrests. His findings suggest that the effects racial and ethnic segregation on homicide arrest rates were mediated through measures of socioeconomic disadvantage.

Economic Segregation:

There has been a large body of research conducted to investigate the relationship between economic segregation and crime, especially disaggregated by race. Findings in studies regarding economic segregation tend to have more inconsistencies than studies regarding racial segregation. Lee (2000) points out that prior research has often found that concentrated poverty is predictive of White crime rates but not Black crime rates. Lee takes these inconsistent findings into consideration in his study by including a measure for spatial concentration of poor Black Americans. The results suggest that increases in economic segregation and inequality lead to greater incidence of homicide arrests for the Black and White populations.

Eitle et al. (2006) presented similar findings to Lee (2000). They examined the relationship between economic segregation and racially disaggregated homicide arrest rates using the neighborhood sorting index, which is drawn from Jargowsky (1996). The results from their analysis suggest that economic segregation is a large, statistically significant predictor of Black, White, and total homicide rates.

Alternative research was carried out in Kang (2016); he does not focus on racially disaggregated economic segregation. Instead, he focuses on the differing effects of local economic inequality and across-tract economic inequality. Kang's findings suggest that across-tract inequality leads to insignificant effects on all crime types. However, he finds that measures of concentrated poverty are positively associated with nearly all crime types.

Review of Inequality and Socioeconomic Deprivation and Their Impact on Crime:

Social scientists have been studying the relationship between socioeconomic deprivation and crime for years. Researchers have empirically examined numerous measures of social and economic status to determine the strongest predictors of crime, and although there is a large body of research that points to socioeconomic disadvantage as a determinant of crime, there are slight inconsistencies in results regarding which variables provide the most accurate analyses. Studied determinants of crime range from poverty and income inequality to measures of employment. Labor stratification, unemployment, and the availability of job opportunities have been examined in relation to crime by many social scientists.

Cantor and Land (1985) examines the association of unemployment and crime rates (property and violent crime). They find positive effects for three out of seven examined crime types: robbery, burglary, and larceny. Crutchfield (1989) posits that the relationship between poverty, income inequality, and violent crimes can be partially explained by employment and distribution of workers into primary and secondary labor markets, and that the effects on crime rates from poverty and income inequality are mediated through occupational distribution. Ihlanfeldt (2006) presents empirical results regarding the relationship between job opportunities for young males and three crime indices: violent, property, and taking crimes. Ihlanfeldt's analyses provide evidence that a lack of job opportunities leads to an increase in crime rates for all crime types, except for murder rates.

Bursik and Grasmick (1993) explore the relationship between economic deprivation measures, severe economic deprivation measures, and crime rates, and they find that severe economic deprivation measures have strong and significant effects on crime;

however, the general measures of economic deprivation do not. Krivo and Peterson (1996) studies the relationship between extreme disadvantage and crime basing their measures of low, high, and extreme poverty on William Julius Wilson's book, *The Truly Disadvantaged.* Their analysis of census tracts in Columbus, Ohio presents evidence that increased disadvantage will lead to higher crime rates for both predominantly Black and predominantly White neighborhoods. Hannon (2005) presents results consistent with Krivo and Peterson (1996); results implicate a non-linear relationship between poverty and homicide victimization rates. That is, variation in deprivation is positively associated with variation in homicide even as poverty rates surpass extreme levels.

Parker (2001) assesses the relationship between economic deprivation and Black and White homicide rates disaggregated by offender-victim relationship. Economic deprivation is predicted to have positive, significant effects on total homicide and family homicide for Black persons, and total homicide, acquaintance homicide, family homicide, and stranger homicide for White persons. Jarjoura, Triplett, and Brinker (2002) identify two forms of persistent poverty; both measures of persistent poverty were predicted to increase delinquent behavior. Furthermore, when children are exposed to an impoverished lifestyle, risks of delinquent activity are expected to increase.

Sampson and Groves (1989) examined five sources of social disorganization, including socioeconomic status and family disruption measures, to examine their potential effects on violent and property crime victimization. They find that the effects of various social disorganization factors are mediated through elements of community structure. Warner and Pierce (1993) and Boggess and Hipp (2010) also report on the effects of social disorganization factors, both of which suggest certain that measures of social disorganization influence the

frequency of crime incidence. Hipp (2010) takes into consideration the reciprocal effects of crime on measures of disadvantage. Results from Hipp's analysis imply that concentrated disadvantage increases as neighborhood crime increases, and vice versa. These findings paint a picture of a vicious cycle, where crime repeatedly exacerbates social issues in disadvantaged communities.

Some researchers have taken the examination of deprivation and crime even further by analyzing the degree to which racial/ethnic disparities in socioeconomic factors account for the gaps in racially and ethnically disaggregated crime rates. Phillips (2002) and Ulmer et al. (2012) both examine homicide gaps between White, Black, and Hispanic/Latino Americans. Both studies find that the gaps in criminal occurrence between White Americans and minority groups can be attributed to the racial/ethnic disparities in socioeconomic deprivation. Phillips (2002) examined the homicide gaps using an Oaxaca Decomposition method. Interestingly, the findings indicate that socioeconomic disparities accounted more for the Hispanic-White homicide gap than the Black-White homicide gap. Phillips hypothesizes that this is because Black Americas have been exposed to a deeper history of discrimination and segregation than Hispanic Americans.

Other studies have investigated forms of inequality and its effect on crime, positing various theories which suggest that increases in inequality will lead to higher crime rates. Blau and Blau (1982) investigates the hypothesis that violent crime stems from racial socioeconomic inequality. The results from their analyses provide evidence that low socioeconomic status leads to increased rates of violent crime, and that income inequality and racial inequality are positively associated with violent crime. Kelly (2000) presents similar findings; evidence shows that income inequality and educational inequality lead to increases in

violent crime. Hipp (2007) also provides evidence that income inequality is associated with multiple types of violent crime. Unexpectedly, interracial inequality is found to have insignificant effects on all crime types except for murder, which displays an inverse association with interracial inequality. This is contradictory to findings from multiple studies discussed in the present paper.

Data and Methods

Data -

To examine how the disparities in social and economic disadvantage between Black and White Americans affect homicide rates, I gathered socioeconomic data from the United States Census Bureau for the Black population (any ethnic background) and White population (not Hispanic or Latino) in Baltimore, Maryland census tracts; from this point forward, the racial groups of analysis will be referred to as Black and White. A census tract is a geographical area for which the US Census Bureau reports data; it is sometimes used as an areal approximation of the neighborhood level. Analysis at the census tract level provides important implications regarding the occurrence of criminal activity at a micro-geographic level. Baltimore was chosen as the city of analysis for three reasons: (1) There is a large Black population that resides in Baltimore, which has hovered around 60% for the past 10 years; this allows for analysis of a large sample of both demographic groups included in the present analysis (United States Census Bureau). (2) Baltimore has a large number of census tracts that are both racially and economically segregated; economic deprivation and racial residential segregation are two primary variables considered in this analysis. (3) Baltimore City has extremely high murder rates, ranked second among US cities in 2020 (Fieldstadt). Racially disaggregated homicide rates are the dependent variables used in this analysis, which are closely related to murder rates.

Dependent Variables -

The dependent variables are Black and White homicide victimization rates, from 2010 to 2019, at the census tract level. Homicide data was obtained from the Baltimore Sun. The Baltimore Sun's criminal justice reporters receive information about each reported homicide victim from the Baltimore City Police Department. This information includes race, gender, cause of death, location (address and geographic coordinates where the victim was found), and more. From 2010 to 2019, The Baltimore Sun reported 2,309 Black homicide victims, 126 White homicide victims, and 258 homicide victims of unknown race/ethnicity.[1]

After obtaining the homicide data I reverse geocoded each homicide location to its respective census tract.[2] According to the geocoding software, two of the homicide victims were found outside the boundaries of Baltimore City; these homicides were excluded from the analysis (both victims were Black). After I separated each homicide by race and census tract, I created the homicide rates variable by dividing the number of Black homicides by the total tract population and the number of White homicide rates by the total tract population. These numbers were then multiplied by 100,000 to determine the number of homicides per 100,000 persons in each tract.

My method of rate creation warrants a brief discussion. I used the entire tract population as the denominator in my rate formulas instead of each respective race's total tract population to

[1] The Baltimore Police Department slowed race reports of homicide victims to The Sun over the last three years of my analysis. Only 13 homicide victims' racial/ethnic background were reported as unknown from 2010-2016. In 2017, 2018, and 2019 there were 26, 52, and 167 victims of unknown race/ethnicity reported, respectively.

[2] To geocode the homicides, I use three sources. The first source is the US census geocoder, the second is the Federal Financial Institutions Examination Council (FFIEC) geocoding system, and the third is Google Maps. Some of the addresses did not return results in the US census geocoder. In this case, I used the FFIEC location. Some homicide addresses reported different census tract locations depending on the software I used because the homicide address was located close to the border of a census tract. In this scenario, I used Google Maps to pinpoint locations in the direct vicinity of the homicide address to see which side of the border the homicide fell on.

evade skewed results from outliers in the statistical analyses. A large proportion of census tracts in Baltimore City are predominantly Black. For example, in tract 1507.01 (2012) and tract 805 (2017), the White population of these tracts were 6 and 7 residents, respectively. Each of these tracts had a single White homicide victim, if I were to use the White population as the denominator in the creation of the White homicide rate variable, the White homicide rate for tracts 1507.01 (2012) and 805 (2017) would be 16,667 per 100,000 and 14,286 per 100,000, respectively. This is problematic because homicide rates for neighborhoods where a specific racial group is underrepresented will be greatly inflated. The same issue occurs for tracts where the population is predominantly White. There may be one Black homicide victim in a predominantly White neighborhood, and this occurrence would grossly misrepresent the Black homicide occurrence for a given observation. For example, tract 103 (2019) and tract 203 (2016) each had one Black homicide victim. However, the Black population for these tracts were only 39 and 69 residents, respectively. If I were to use the Black population as the denominator instead of the total population, these rates would be 2,564 per 100,000 and 1,449 per 100,000, respectively. For this reason measuring homicide rates using the total tract population as the denominator seems to provide a more accurate depiction of homicide victimization occurrence for each race, whether they are underrepresented in a neighborhood or not.[3]

Independent Variables –

[3] Analyses were also conducted using the homicide rate variable where the population of each respective racial group is the denominator in variable creation. The results for Black models were largely consistent with my primary analyses, but the results reported less statistical significance. The White models were also relatively consistent with the primary analyses; there were many unexpected results and still very little statistical significance in the two-way fixed effects models. The difference between the primary and secondary analyses lies with the coefficients in the White models. The secondary analyses predict very large, statistically insignificant effects for many of the variables on White homicide (In pooled White models there is statistical significance).

The independent variables in the analysis include various measures of socioeconomic status disaggregated by race (White and Black). Data for each variable was collected over a consecutive period of ten years, 2010 to 2019, with the exception of the percent poverty variable and the percent college graduates variable.[4] Independent variables were chosen based on theoretical considerations and findings from prior studies related to the present analysis. Each variable was obtained or created using data from the United States Census Bureau's American Community Survey (ACS).

The independent variables that I employ include four measures of economic status: percentage of the population living in poverty, percentage of the population that is unemployed, percentage of crowded households in a tract, and the percentage of labor force participants in a tract. The independent variables also include four indicators of social structure: percentage of female headed family households in a tract, percentage of the population with a college degree, the percentage of stable residences in a tract, and dummy variables derived from The Index of Concentration at the Extremes (ICE) to measure racial residential segregation. All variables, including the dependent variables, are defined in Table 1 along with the source from which the data was obtained.

[4] Data disaggregated by racial group was not available for educational attainment until 2015, and data disaggregated by racial group for poverty rates was not available until 2012.

Table 1: Variable Definitions

Variables	*Definition*	*Source*
Homicide Rate	Homicide victimization rate per 100,000 tract population.	The Baltimore Sun (via Baltimore Police Department)
% Poverty	Percentage of the population living below the poverty threshold.	Census - ACS
% Female Headed Households	Percentage of family households headed by a female with no spouse.	Census - ACS
% Unemployed	Percentage of the population that is unemployed.	Census - ACS
% Labor force Participation	Percentage of the population that is in the labor force.	Census - ACS
% College Graduates	Percentage of the population with at least a bachelor's degree.	Census - ACS
% Stable Residences	Percentage of households that lived in the same residence as last year.	Census - ACS
% Crowded Households	Percentage of households of that have over one resident per room.	Census - ACS
Black Segregation	Dummy variables are derived from the Index of Concentration at the Extremes (ICE) to measure segregation of Black Baltimoreans	Census - ACS

Prior to the statistical analysis, I hypothesized that these variables would affect Black and White homicide in a similar manner, but the effects on Black homicide victimization would be stronger than the effects on White homicide victimization because of the disparities in socioeconomic deprivation between the two racial groups.

I have defined percent poverty as the percentage of the census tract population that lives below the poverty threshold, as defined by the US Census. This variable was chosen based on its use in prior studies. Although some studies' findings are contrary to typical results, high rates of poverty have been empirically associated with high rates of crime in numerous studies.[5]

I defined the female headed household variable as the percentage of female headed family households with no husband present.[6] Similar variables regarding female headship have been used in prior studies as measures of social control or social disruption. Empirical results sometimes suggest that the percentage of female headed households are positively associated with crime rates.[7]

I have defined percent unemployed as the percentage of the census tract population that is not employed but in the labor force, as defined by the US census. Unemployment and job sector/occupation type are often used as measures of economic deprivation and have been found to be a strong predictor of crime.[8]

[5] See Sampson and Groves 1989; Warner and Pierce 1993; Bursik and Grasmick 1993; *Krivo* and Peterson 1996; Parker 2001; Jarjoura, Triplett, and Brinker 2002; Ulmer, Jeffery T., et al 2012.
[6] In 2019, the ACS changed the female headship variable from female headed family household with no husband to female headed family household with no spouse. The estimates were quite consistent across all ten years despite the slight variable adjustment, so all ten years remained in the final data frame.
[7] See Shihadeh and Flynn 1996.
[8] See Ihlanfeldt 2006.

Percent college graduates is defined as the percentage of the tract population that has at least a bachelor's degree; measures of education are commonly employed in studies related to the present paper. Some analyses that I have reviewed have suggested that the percentage of college graduates is inversely associated with crime rates.[9]

Percent labor force participation is the percentage of the census tract population that is represented in the labor force; I have not seen this variable used in any prior studies, however, I felt that it would be necessary to include this variable due to my own theoretical reasoning. It occurred to me that low rates of labor force participation may be positively associated with homicide victimization. The reason for my hypothesis stems from the possibility that more residents of neighborhoods with high crime incidence may rely on criminal activity to earn their income than in areas with low crime incidence. If this is true, it seems likely that labor force participation would be associated with homicide victimization.

I have defined the percent residential stability variable as the percentage of households that are living in the same residence that they lived in the prior year.[10] Similar variables have been used in prior studies regarding the social disorganization theory. The social disorganization theory suggests that a lack of residential stability, sometimes referred to as residential mobility, will lead to higher rates of crime and or delinquency due to a lack of social control. Findings from prior research have been inconsistent with regard to the effects of residential stability on crime.[11]

[9] See Kelly 2000 and Phillips 2002.
[10] In other analyses, the period of residential stability is typically longer than a year. A one-year period was selected due to lack of availability of data over a longer timeframe.
[11] See Sampson and Groves 1989, Warner and Pierce 1993, Hipp 2007, Boggess and Hipp 2010, and Hipp 2010.

Percent crowded households is defined as the percentage of households in each tract with over one resident per bedroom; this variable has not been widely used to my knowledge. However, I have included it in the analysis because crowded households may represent a lack of economic stability. The crowded households variable may represent households inhabited by large families who are unable to afford a more appropriately sized residence.

Finally, the dummy variables derived from the ICE index are used to measure residential segregation of Black Baltimoreans.[12] This index places each tract's segregation rating on a scale from -1 to 1, where -1 is a completely segregated minority group tract, 0 is a perfectly integrated tract, and 1 is a tract comprised of only majority group residents. I created multiple dummy variables, which represent different extents of Black segregation, but I use the two most relevant measures in the final analyses. The first variable defines Black segregation where the ICE Index is less than or equal to -0.50, and the second defines Black segregation where the ICE index is less than or equal to -0.75.[13]

The dummy variables derived from the ICE Index are used in lieu of the frequently used dissimilarity and isolation indices suggested by Massey and Denton. It is worth mentioning that the ICE index is also a proposed method of measuring segregation by Douglas Massey (see Massey, Booth, and Crouter 2001). This index is versatile because it can be used as a measure for various types of concentration, including poverty concentration, racial residential segregation, and economic segregation. One study where the ICE index is employed as a

[12] Formula: $ICE = \frac{Majority\ Group\ Population - Minority\ Group\ Population}{Majority\ Group\ Population + Minority\ Group\ Population}$

[13] For easier interpretation of the ICE Index dummy variables, a neighborhood with an ICE index of -0.50 has a Black to White population ratio of ≈ 3:1. A neighborhood with an ICE index of -0.75 has a Black to White population ratio of ≈ 7:1. The two dummy variables are used in separate models to ensure results are consistent despite differing extents of segregation. Each respective dummy variable considers a neighborhood to be segregated when the Black to White ratio is greater than or equal to the defined ratios above.

measure of racial residential segregation has suggested that segregation is a strong predictor of violent crime. Furthermore, this association was stronger at the census tract level than it was at the city-wide level (Krieger et al 2017).

Table 2: Summary Statistics

Variables/Data	*Black*					*White*				
	Mean	**SD**	**Med**	**Min**	**Max**	**Mean**	**SD**	**Med**	**Min**	**Max**
Homicide Rate Per 100,000 Population	42.50	61.20	19.70	0.00	487.00	2.19	10.00	0.00	0.00	140.00
% Living in Poverty	27.90	16.50	26.00	0.00	100.00	23.70	24.80	15.00	0.00	100.00
% Female Headed Households	29.80	15.80	31.00	0.00	100.00	10.40	16.70	5.00	0.00	100.00
% Unemployed	15.40	10.40	14.00	0.00	75.00	8.20	14.40	4.00	0.00	100.00
% Labor force Participation	60.40	15.00	60.00	0.00	100.00	59.50	24.80	65.00	0.00	100.00
% College Graduates	19.40	16.70	15.00	0.00	100.00	40.20	28.80	40.00	0.00	100.00
% Stable Residency	82.30	13.90	85.00	0.00	100.00	75.90	24.30	82.00	0.00	100.00
% Crowded Households	2.20	4.00	1.00	0.00	54.00	1.70	5.10	0.00	0.00	63.00
ICE Index	-0.33	0.69	-0.65	-1.00	1.00	-0.33	0.69	-0.65	-1.00	1.00
Tract Population	3100	1370	2860	0	7440	3100	1370	2860	0	7440
% Black	63.40	34.10	78.00	0.00	100.00	63.40	34.10	78.00	0.00	100.00

Review of Baltimore's Socioeconomic Disparities -

Summary statistics are displayed in Table 2. These descriptive statistics show the disparity in socioeconomic status between the two racial groups. In nearly every measure of socioeconomic status examined, Black Baltimoreans appear to suffer from greater disadvantage. Focusing primarily on the medians of each observation, we see some of the largest differences between Black and White Baltimoreans in poverty rates, unemployment rates, rates of single female headship, and college graduation rates. Interpretations of these four variables used in prior studies are commonly linked to higher rates of crime, and in these statistics, we see that association front and center. The median percentage of Black poverty is 26% compared to 15% for Whites, the median Black unemployment rate is 14% compared to 4% for Whites, the median Black college graduation rate is 15% compared to 40% for Whites, and the median rate of female headship for Black Baltimoreans is 31% compared to 5% for Whites.

As presented in Table 2, along with the socioeconomic disadvantage, the median Black homicide rate is nearly 20 per 100,000 residents, while the median White homicide rate is 0 per 100,000 residents. My hypothesis is that these disparities in socioeconomic disadvantage explain a large portion of the disparity in homicide rates; that is, measures of socioeconomic deprivation will be strongly associated with homicide victimization, especially in the Black models.

Methods -

This analysis incorporates a dual-model approach; each statistical method is employed for two separate, race-specific models (Black and non-Hispanic White). The statistical methods that I use to estimate the results include pooled ordinary least squares (OLS) regression models

and two-way fixed effects OLS models. The two-way fixed effects models are incorporated to compliment my use of panel data. With ten years of data across 200 census tracts, the two-way fixed effects models are used to control for differences across tracts that are stable over time (group-specific fixed effects) and differences over time that are stable across census tracts (time-specific fixed effects).[14] Three interaction terms are included in the Black models to examine how Black segregation can amplify the effects of the three variables of greatest interest on Black homicide victimization rates. The three interaction terms include a segregation dummy variable paired with each of the following continuous variables: percent poverty, percent unemployed, and percent college graduates. In preliminary analyses, these three variables appeared to be the strongest predictors of Black homicide rates, so pairing them in the interaction terms with the Black segregation dummy variables allows me to obtain an estimate that describes how each variable of interest affects homicide in areas where racial residential segregation is prevalent.

The interaction terms are only present in the Black models because the interaction of Black segregation with various White socioeconomic characteristics would not provide relevant estimates. Two segregation dummy variables were chosen for the analyses, primarily to ensure that the results were consistent despite defining the cut off for racial residential segregation in multiple ways. As mentioned previously, the two dummy variables that most strongly reflect racial residential segregation were selected for the final analyses; recall that the first dummy variable defines a segregated neighborhood as a census tract where the ICE rating is -0.50 or

[14] The two-way fixed effects analyses incorporate a dummy variable for each census tract and a dummy variable for each year to control for the group-specific and time-specific fixed effects. My analyses include dummy variables for each census tract, but some of the years are excluded in the fixed effects analyses due to missing data from 2010-2015.

below, and the second dummy variable defines a segregated neighborhood as a census tract with an ICE rating of -0.75 or below.

Models –

As mentioned previously, the models used in this analysis include pooled OLS regression models and two-way fixed effects OLS regression models, which both include interaction terms.

Pooled Models:

$$\hat{Y}_{it} = \beta_0 + \beta_1 X_{1it} + \beta_2 X_{2it} \ldots + \beta_n X_{nit} \ldots + \beta_n (X_{nit} \times D_{it}) \ldots + u_{it}$$

The pooled regression treats each observation as independent, where i represents each group (census tract) and t represents each time period (year). $\hat{Y}_{it}$ represents the predicted value of the dependent variable based on the effects of each respective independent variable. β_0 represents the constant, the estimate of the dependent variable when all independent variables are equal to 0, the y-intercept for the OLS regression. $\beta_1, \beta_2,$ and β_n represent the coefficient estimate for each respective independent variable, $X_{1it}, X_{2it,}$ and X_{nit}, holding all other variables constant. $\beta_n (X_{nit} \times D_{it})$ represents the interaction term of a continuous variable, X_{nit}, and a dummy variable, D_{it}, where β_n is the estimated marginal effect on the dependent variable, ceteris paribus.[15] u represents the error term, any omitted variables that may influence the dependent variable.

Two-way Fixed Effects Models:

$$\hat{Y}_{it} = \beta_1 X_{1it} + \beta_2 X_{2it} \ldots + \beta_n X_{nit} \ldots + \beta_n (X_{it} \times D_{it}) \ldots + \alpha_i + \theta_t + \nu_{it}$$

[15] Ceteris Paribus: With other conditions remaining the same.

The two-way fixed effects regression controls for group fixed effects, α_i, which account for time-invariant differences across groups; and time fixed effects, θ_t, which account for group invariant differences over time. Like the pooled regression, $\hat{Y}_{it}$ represents the estimate for the dependent variable based on effects from the independent variables. Similarly, $\beta_1, \beta_{2,}$ and β_n represent the coefficients/estimated effects from each respective independent variable $X_{1it}, X_{2it,}$ and X_{nit}, holding all other variables constant. $\beta_n(X_{nit} \times D_{it})$ represents the interaction term of a continuous variable, X_{nit}, and a dummy variable, D_{it}, where β_n is the estimated marginal effect on the dependent variable, ceteris paribus. Finally, ν_{it} represents all remaining random errors that are unaccounted for.

Results

Pooled OLS Analysis –

First, I examine the pooled regression models in Table 3. Black Model 1 and White Model 1 include the segregation dummy variable where segregation is defined as a tract with an ICE rating at or below -0.50, this dummy variable is also included in three interaction terms for the Black model with the following continuous variables: percent poverty, percent unemployed, and percent college graduates. Black Model 2 and White Model 2 follow the same guidelines as the first pooled OLS models, but the dummy variable defines segregation where a tract has an ICE rating at or below -0.75. The interaction terms with Black segregation are only estimated in the Black models, as discussed earlier.

Table 3: Pooled OLS Models (Model 1: ICE ≤ -0.50 | Model 2: ICE ≤ -0.75)

VARIABLES	BLACK: POOLED OLS 1	WHITE: POOLED OLS 1	BLACK: POOLED OLS 2	WHITE: POOLED OLS 2
CONSTANT	40.875 *	0.647	40.693	0.343
	(20.628)	(3.345)	(20.764)	(3.358)
% POVERTY	15.278	2.580	21.751	2.229
	(18.221)	(2.341)	(17.518)	(2.335)
% FEMALE HEADED HOUSEHOLDS	18.034	-1.007	36.029 *	-1.132
	(16.184)	(2.719)	(16.185)	(2.723)
% UNEMPLOYED	43.317	-1.104	60.567 *	-0.630
	(28.073)	(3.341)	(27.397)	(3.338)
% LABORFORCE PARTICIPATION	-24.889	1.120	-30.204 *	1.280
	(15.100)	(2.437)	(15.168)	(2.438)
% COLLEGE GRADUATES	-27.983	-2.106	-33.501 *	-2.137
	(16.002)	(1.775)	(15.782)	(1.811)
% STABLE RESIDENCES	-12.485	3.652	-11.670	3.526
	(17.023)	(2.839)	(17.181)	(2.848)
% CROWDED HOUSEHOLDS	50.275	4.104	52.048	3.437
	(57.334)	(6.611)	(58.137)	(6.644)
BLACK SEGREGATION	35.497 *	-2.449 **	25.606	-2.118 *
	(14.480)	(0.841)	(16.248)	(0.880)
BLACK SEGREGATION & POVERTY	27.610		24.558	
	(29.697)		(31.812)	
BLACK SEGREGATION & UNEMPLOYMENT	190.877 ***		187.547 ***	
	(49.886)		(54.410)	
BLACK SEGREGATION & COLLEGE GRADUATES	-248.093 ***		-208.652 ***	
	(45.419)		(54.885)	
N	988	898	988	898
R-SQUARED	0.317	0.013	0.298	0.010
*** P < 0.001; ** P < 0.01; * P < 0.05.				

Similar results are obtained from Models 1 and 2, for both Black and White models, in Table 3. Looking at the Black models first, we see that two of the three interaction terms are strong predictors of homicide in both models, and they are statistically significant in both models as well. Model 1 suggests, for segregated neighborhoods, that a one percentage point increase in percent unemployed will lead to an increase of about 191 homicides per 100,000. Similarly, Model 2 suggests that a one percentage point increase in percent unemployed, in a segregated neighborhood, will lead to an increase of about 188 homicides per 100,000. We also see, for segregated neighborhoods, that a one percentage point increase in percent college graduates predicts a deduction of roughly 248 homicides per 100,000 in Model 1, and a decrease of about 209 homicides per 100,000 in Model 2. Additionally, the interaction of percent poverty and segregation predicts an increase in homicide victimization of 28 per 100,000 in Model 1, and an increase of 25 per 100,000 in Model 2; these estimates are not statistically significant.

For both Black models, all continuous variables and the segregation dummy variables are predicted to affect the Black homicide victimization rate in the same manner. However, Model 2 presents more estimates that are statistically significant. Both models predict that increases in percent poverty, percent female headed households, percent unemployed, and percent crowded households will lead to increases in homicide victimization. Additionally, they predict that homicide victimization will be higher in segregated Black neighborhoods than in neighborhoods that are not segregated. Furthermore, both Black models predict that increases in percent labor force participation, percent college graduates, and percent stable residency will decrease the Black homicide victimization rate. In Model 1, the only statistically significant independent variable, excluding interaction terms, is the segregation dummy variable. In Model 2, along with the two interaction terms discussed, percent female headed households, percent unemployed,

percent labor force participation, and percent college graduates are all statistically significant estimates. Each of these variables' predicted effects on homicide are consistent with my hypothesis, and with hypotheses and results from much of the prior literature related to the present analysis.

For both White pooled models, increases in percent poverty, percent labor force participation, percent stable residency, and percent crowded households are predicted to increase the homicide victimization rate. Additionally, increases in the following independent variables are predicted to decrease homicide victimization: percent female headed households, percent unemployed, percent college graduates, and Black segregation. Some of the results from the White pooled models do not reflect the expectations from my hypothesis. I was expecting the White socioeconomic variables to affect White homicide rates in a similar manner to those that the Black models predicted.

It is unexpected that increases in White unemployment are associated with lower White homicide rates. However, it is noteworthy to mention that the estimates for all independent variables predict very slight effects on White homicide. For example, the largest predicted effects on homicide reside with the percent crowded households variable in Model 1 and the percent stable residency variable in Model 2. The predicted effect on homicide victimization is roughly 4 per 100,000 for both variables. Furthermore, only one independent variable has a statistically significant effect, and that variable is Black segregation. This statistically significant estimate does have theoretical backing. The vast majority of murder victims are killed by a member of their own race, which means in a highly segregated Black neighborhood, theoretically, there should be less White homicide victims due to a lack of White residents in a given segregated tract. According to the FBI Uniform Crime Reporting (UCR) data, from 2014,

2017, and 2018, between 80% and 82% of White murder victims were killed by a White offender, and between 88% and 90% of Black murder victims were killed by a Black offender (Uniform Crime Reporting Program).

Two-way Fixed Effects Analysis –

Table 4 displays the results from the two-way fixed effects regression analyses. I took the same steps running the fixed effects analyses as I did for the pooled regression analyses. Black Model 1 and White Model 1 include the segregation dummy variable where segregation is defined as a tract with an ICE rating at or below -0.50, this dummy variable is also included in three interaction terms for the Black model. Black Model 2 and White Model 2 follow the same guidelines as the first fixed effects models, but the dummy variable defines segregation where a tract has an ICE rating at or below -0.75.

Table 4: Two-way Fixed Effects (Model 1: ICE ≤ -0.50 | Model 2: ICE ≤ -0.75)

VARIABLES	BLACK: FIXED EFFECTS OLS 1	WHITE: FIXED EFFECTS OLS 1	BLACK: FIXED EFFECTS OLS 2	WHITE: FIXED EFFECTS OLS 2
% POVERTY	-25.110	5.749	-13.924	5.994
	(32.070)	(4.802)	(31.656)	(4.811)
% FEMALE HEADED HOUSEHOLDS	29.304	-0.129	29.311	-0.258
	(30.641)	(4.705)	(30.561)	(4.714)
% UNEMPLOYED	14.097	-2.434	10.980	-2.670
	(41.610)	(5.181)	(41.042)	(5.189)
% LABORFORCE PARTICIPATION	-2.820	2.157	-3.928	2.271
	(30.412)	(5.200)	(30.374)	(5.224)
% COLLEGE GRADUATES	-0.870	5.576	4.842	5.380
	(27.354)	(5.064)	(27.129)	(5.075)
% STABLE RESIDENCES	-4.784	7.794	-4.992	8.029
	(31.938)	(5.927)	(31.888)	(5.942)
% CROWDED HOUSEHOLDS	47.093	-43.267 *	49.291	-40.347 *
	(100.384)	(18.027)	(100.225)	(17.978)
BLACK SEGREGATION	-27.401	-4.782	-31.463	0.687
	(28.294)	(3.092)	(31.789)	(3.847)
BLACK SEGREGATION & POVERTY	28.957		-16.141	
	(57.353)		(68.194)	
BLACK SEGREGATION & UNEMPLOYMENT	191.692 **		230.382**	
	(70.418)		(76.649)	
BLACK SEGREGATION & COLLEGE GRADUATES	-16.592		-102.501	
	(97.426)		(101.158)	
N	988	898	988	898
R-SQUARED	0.021	0.018	0.024	0.015
*** P < 0.001; ** P < 0.01; * P < 0.05.				

Looking at the Black fixed effects models first, we see that the results are mostly consistent despite the use of different extents of segregation in each model. We also see some consistencies between the two-way fixed effects models and the pooled regression models with regard to the expected effects for the primary variables of interest, the interaction terms. However, many of the estimates became statistically insignificant after controlling for group and time specific fixed effects. In both Black models, the only statistically significant predictor of Black homicide is the interaction of segregation and unemployment. Both models not only predict statistically significant effects with this interaction, but also a large increase in homicide rates when unemployment increases in segregated neighborhoods. Model 1 predicts a marginal increase of over 190 homicides per 100,000, and Model 2 predicts a marginal increase of over 230 homicides per 100,000.

Each model also predicts that the interaction of segregation and percent college graduates has an inverse association with Black homicide, as expected. However, Model 2 predicts a much larger effect for this interaction term than Model 1. Neither of these predictors is statistically significant, but it is interesting to note that the definition of segregation in Model 2 is stricter than it is in Model 1. So, it seems when residential segregation increases to a further extent, educational attainment may have a stronger association with violence. Interestingly, the poverty and segregation interaction terms have different expected effects when the defined cutoff for a segregated tract differs. Again, these predictors are not statistically significant, but we see an inverse effect from the poverty and segregation interaction in Model 2, and a positive association in Model 1.

Some more surprising results come from the variables of interest when regressed outside of their respective interaction terms. In both models, percent poverty, percent college graduates,

and segregation exhibit unexpected results. It seems possible, however, that this unexpected outcome may be caused by a mediation of these variables through their respective interaction terms. As mentioned earlier, the interaction terms are the strongest predictors of homicide, and the unemployment interaction is statistically significant in both models. As expected, percent crowded households and percent female headed households also remain relatively strong predictors of homicide, however, they remain statistically insignificant in both fixed effects models, as they were in the pooled regression models. Increases in labor force participation rate and percent stable residences also yield consistent results in all models, but they are weak predictors compared to other variables in the fixed effects models, and they are statistically insignificant.

The White fixed effects models present a plethora of surprising results, most notably a strong, statistically significant, inverse association between White homicide rates and percent crowded households. The estimated marginal effect in both White models is a decrease of over 40 homicides per 100,000. This variable was incorporated as a measure of social and economic instability, yet it is associated with a decline in violence. This finding contradicts my hypothesis, and it is inconsistent with the crowded household measure in each of the Black models and both White pooled models. Additionally, the percent unemployment, percent stable residences, percent labor force participation, and percent college graduate variables yield unexpected estimates. However, each of these estimates are relatively small and statistically insignificant predictors of homicide. Unlike in the White pooled models, the expected effects of Black segregation on White homicide are statistically insignificant in both fixed effects models. White Model 1 predicts the same inverse effect on White homicide that we saw in both pooled models, but Model 2 shows inconsistency. Model 2 predicts a small, positive association between Black

segregation and White homicide rates; the marginal effect of Black segregation on White homicide is only estimated to increase the homicide rate by about 0.7 per 100,000.

Conclusion:

The objective of this paper was to examine homicide victimization occurrence among Black and White Americans and explain why Black homicide victimization rates tend to be higher than White homicide victimization rates. Prior studies on this topic have typically associated the racial homicide gap with the socioeconomic disparities between different racial groups. To analyze this relationship, I used panel data gathered at the census tract level of Baltimore, Maryland from 2010 to 2019. Keeping the findings and theories from previous studies in mind, I selected various socioeconomic measures believed to influence crime, and I estimated the effects that these socioeconomic variables have on racially disaggregated homicide victimization rates. The statistical analyses include the use of two-way OLS fixed effects models, which incorporate interaction terms to measure the combined effects of Black segregation and socioeconomic disadvantage.

The results from the statistical analyses mostly line up with my hypotheses and the findings from prior studies. That is, various socioeconomic measures are found to be predictors of both White and Black homicide incidence. For the Black models, the strongest predictors of homicide victimization are two interaction terms, Black segregation and unemployment (statistically significant) and Black segregation and educational attainment. These results suggest that, in racially segregated neighborhoods, increases in unemployment and decreases in educational attainment will lead to increases in Black homicide victimization rates.

For the White models, there were inconsistencies with prior studies' findings, yet some results followed the expectations that I presented in my hypotheses. Although percent crowded households is predicted to have a strong, statistically significant inverse relationship with White homicide victimization, we also see that percent poverty is a relatively strong predictor of White homicide victimization, which was expected.

The findings also suggest that measures of socioeconomic deprivation tended to be much stronger predictors of Black homicide victimization than White homicide victimization. It appears that the expected effects are stronger in the Black models due to the disparities in socioeconomic affluence between the two racial groups. As the data shows, socioeconomic deprivation is far more prominent for Black Americans than it is for White Americans, particularly in rates of unemployment, poverty, and educational attainment.

The findings from this study not only suggest that the racial homicide gap can be attributed racial socioeconomic disparities, but they suggest further that the homicide gap can be attributed to the segregation of Black Americans into disadvantaged neighborhoods. Considering the American history of slavery and racially discriminatory laws, which segregated Black Americans into impoverished neighborhoods and barred them from obtaining employment opportunities, housing opportunities, equal access to education, and more, my findings also suggest that the racial homicide gap is linked with the aforementioned systemic abuse of the Black population in the United States. Policy implications from this study call for action to be taken to reduce the prevalence of racial segregation as well as the disparities in socioeconomic deprivation between racial groups. According to my findings, policies that address these issues will help prevent violent victimization, especially in marginalized communities.

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Appendix:

Table 5: Pooled Models (Rate Denominator = Respective Racial Group Population)

VARIABLES	BLACK: POOLED OLS 3	WHITE: POOLED OLS 3	BLACK: POOLED OLS 4	WHITE: POOLED OLS 4
CONSTANT	79.395	-427.317 **	77.310	-454.263 **
	(48.452)	(153.119)	(48.362)	(153.149)
% POVERTY	90.990*	36.819	100.854 *	40.215
	(42.800)	(107.184)	(40.803)	(106.513)
% FEMALE HEADED HOUSEHOLDS	18.746	-60.581	38.758	-56.380
	(38.013)	(124.491)	(37.697)	(124.185)
% UNEMPLOYED	-27.705	31.457	2.526	45.726
	(65.940)	(152.953)	(63.812)	(152.247)
% LABORFORCE PARTICIPATION	54.421	105.565	50.365	105.557
	(35.468)	(111.554)	(35.328)	(111.218)
% COLLEGE GRADUATES	63.226	178.740 *	57.648	209.759 *
	(37.586)	(81.273)	(36.758)	(82.582)
% STABLE RESIDENCES	-113.374 **	322.218 *	-115.869 **	337.801 **
	(39.985)	(129.985)	(40.017)	(129.888)
% CROWDED HOUSEHOLDS	-43.181	24.414	-41.206	86.226
	(134.672)	(302.657)	(135.409)	(303.017)
BLACK SEGREGATION	29.278	112.395 **	20.814	141.894 ***
	(34.011)	(38.494)	(37.844)	(40.133)
BLACK SEGREGATION & POVERTY	0.511		-2.726	
	(69.755)		(74.094)	
BLACK SEGREGATION & UNEMPLOYMENT	282.620 *		256.641 *	
	(117.177)		(126.730)	
BLACK SEGREGATION & COLLEGE GRADUATES	-334.711 **		-290.972 *	
	(106.685)		(127.836)	
N	988	898	988	898
R-SQUARED	0.065	0.020	0.055	0.024
*** P < 0.001; ** P < 0.01; * P < 0.05.				

Table 6: Two-way Fixed Effects (Rate Denominator = Respective Racial Group Population)

VARIABLES	BLACK: FIXED EFFECTS OLS 3	WHITE: FIXED EFFECTS OLS 3	BLACK: FIXED EFFECTS OLS 4	WHITE: FIXED EFFECTS OLS 4
% POVERTY	18.359	312.447	31.399	315.031
	(77.885)	(228.775)	(76.944)	(228.810)
% FEMALE HEADED HOUSEHOLDS	90.266	28.802	90.683	30.616
	(74.415)	(224.169)	(74.282)	(224.180)
% UNEMPLOYED	12.155	-99.187	12.484	-97.025
	(101.053)	(246.804)	(99.758)	(246.752)
% LABORFORCE PARTICIPATION	-2.299	264.399	-3.463	270.340
	(73.859)	(247.717)	(73.828)	(248.415)
% COLLEGE GRADUATES	65.421	639.833 **	74.843	643.391 **
	(66.432)	(241.234)	(65.940)	(241.373)
% STABLE RESIDENCES	-28.468	202.461	-29.802	197.872
	(77.566)	(282.365)	(77.508)	(282.584)
% CROWDED HOUSEHOLDS	41.239	-353.967	44.890	-343.940
	(243.795)	(858.805)	(243.611)	(854.966)
BLACK SEGREGATION	-29.825	-0.311	-25.538	57.521
	(68.715)	(147.328)	(77.267)	(182.969)
BLACK SEGREGATION & POVERTY	8.939		-52.755	
	(139.289)		(165.755)	
BLACK SEGREGATION & UNEMPLOYMENT	201.318		235.001	
	(171.017)		(186.304)	
BLACK SEGREGATION & COLLEGE GRADUATES	-18.056		-150.878	
	(236.611)		(245.878)	
N	988	898	988	898
R-SQUARED	0.007	0.016	0.008	0.016
*** P < 0.001; ** P < 0.01; * P < 0.05.				