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Does Gentrification Lower Crime: A Look at Granger-Casualty in Washington, D.C.

Abstract

This project looks at the relationship between gentrification and violent crime rates, specifically in Washington, DC. Gentrification is a social phenomenon that involves middle and upper class residents moving into the city center where violent crime had previously acted as a barrier for keeping unwanted demographics out. An increase in demand for housing by the higher income residents drives up the cost of housing which, in turn, forces out the lower income residents. Higher income residents generally have lower crime rates, so the crime rate falls as the lower income residents with higher crime rates move. This, however, is all theory. This study explores whether crime rates fall as a result of these upper income families moving in or if the drop in crime is one more reason the upper income residents want to move.

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Will Lawrence

I. INTRODUCTION

Driving through Washington, D.C. today is noticeably different from twenty years ago. In the 1980s and early 1990s, the crack epidemic took hold of Washington D.C. and in 1991, the murder rate peaked at 479 deaths (NBC4 Washington, 2011). Since then, crime has plummeted and investment in the poverty-stricken areas is on the rise. According to the Federal Bureau of Investigation, from 1995 until 2010, the violent crime rate in Washington, D.C. fell by more than half from 2,661.4 per 100,000 individuals in 1995 to 1,330.2 per 100,000 in 2010 (FBI, 1995, 2011). During that same timeframe, the median housing price (2010 \$) rose three-fold from \$176,000 to \$528,000 (NeighborhoodInfo DC, 2011). These astonishing changes are not a mere coincidence. There is a definite social phenomenon called 'gentrification' occurring in the nation's capital.

This project looks at the relationship between gentrification and violent crime rates, specifically in Washington, DC. Gentrification is a social phenomenon that involves middle and upper class residents moving into the city center where violent crime had previously acted as a barrier for keeping unwanted demographics out. An increase in demand for housing by the higher income residents drives up the cost of housing which, in turn, forces out the lower income residents. Higher income residents generally have lower crime rates, so the crime rate falls as the lower income residents with higher crime rates move. This, however, is all theory. This study explores whether crime rates fall as a result of these upper income families moving in or if the drop in crime is one more reason the upper income residents want to move.

II. THEORY & LITERATURE REVIEW

As gentrification is a pressing phenomenon, large amounts of literature have been devoted to it, and more specifically, its relationship with crime. McDonald

(1986) provides somewhat of a literature review, albeit a dated one, of the competing theories regarding the effects of gentrification. McDonald (1986) characterizes gentrification as "the apparent revitalization of central city private housing markets". An important distinction that must be made in that definition is the existence of a population shift. Simply upgrading the housing supply by long-term residents does not qualify as gentrification. There has to be a movement of middle and upper-class people into what was formerly a predominately lower-class neighborhood.

While it may seem that this 'revitalization' will be a positive influence on neighborhoods, the theory is not so cut-and-dry. In Fairmount, a neighborhood of Philadelphia that previously had strong ethnic bonds, upper class residents with different cultural norms moved in and led to direct conflict escalating into violence with the lower class, long-term residents (McDonald, 1986, p. 167). That being said, this is usually rare because of how strong the ethnic and cultural bonds need to be. A potpourri of different cultures living together simply because of lower housing costs is not enough for this to occur. Rather, it is more in line with the districts of Chinatown and Little Italy in New York City.

McDonald (1986) outlines five potential reasons why crime rates drop with gentrification and four potential reasons why they might rise, along with one reason why it might stay stagnate. The reasons they might drop are as follows: (1) affluent neighborhoods have, on average, less crime than impoverished neighborhoods, (2) revitalization at the hands of the new residents can "pull up" instead of "push out" the former residents, (3) new residents are more cognizant of the crime problem and establish initiatives to combat crime, for example, the neighborhood watch, (4) affluent residents usually have more political influence which leads to more funding devoted to the police department, more stringent stances on crime, etc., and

(5) the displacement of the poor residents can lead to the individuals responsible for committing the crimes to be displaced. Reason five is what gets at the heart of gentrification and is directly related to, if not the cause of, reason one. Reasons two, three, and four are periphery causes of the drop in crime, at least in the context of a model of gentrification.

On the other hand, McDonald (1986) also gives several reasons why gentrification might not lead to a decrease in crime: (1) when individuals are displaced, they may only be displaced to adjacent blocks or neighborhoods which hardly prevents them from committing crime in their old neighborhood, especially with an influx of attractive targets, (2) if gentrification is drawn out over a long period of time, there will be a very apparent income-gap between residents which suggests an increase in violent crime, (3) gentrification in 'cohesive ethnic neighborhoods' rather than 'disorganized ghetto neighborhoods' may lead to the breakdown of natural order in the communities, (4) gentrification can cause community conflicts which, on some occasions, results in criminal activity, and (5) it may not have any effect at all. Most of these theorized effects occur at the onset of gentrification. As time goes on, it appears that the end-result of a fully gentrified neighborhood will have lower crime rates.

Much research use case-studies to look at individual neighborhoods (McDonald, 1986; O'Sullivan, 2005; Kreager et al, 2011). This paper is different in that it examines the city-wide effect of gentrification. By using data from every neighborhood in a city, regression analysis can be employed to explore the effects of gentrification. Unfortunately, by not focusing on specific neighborhoods, this paper cannot examine the specific reasons gentrification affects crime rates. Instead, it will focus on the gentrification process as it permeates throughout a city.

This paper employs location theory to look at the general effects of gentrification on crime. Location theory states that in a completely un-gentrified city, the city center is high in crime with a low income residential population while the suburbs around the city with low crime rates are populated by higher income people who commute into the city. O'Sullivan's (2005) model of location theory holds that as the cost of travel into the city center goes up and the cost of security in the city center goes down, the higher income people will move into the center of the city to take advantage of the cheap housing and low travel costs. As the higher

income population moves in, they push out the lower income population and the crime rate should fall further due to a variety of factors that McDonald covered previously. The lower income population gets pushed out because while they also value the low travel expenses that are a result of living close to the center of the city, the higher income population is able to outbid the lower income population in order to take advantage of the convenience. The lower income population will be pushed out, starting from the center, to the edges of the city. Once the gentrification process is complete, they will ultimately move elsewhere. Rising travel costs for the upper income population in addition to less crime in the center of the city, based on location theory's explanation of gentrification, will ultimately lead to higher housing costs and a further reduction of crime.

A Granger-causality Test is used in order to examine the relationship between gentrification and crime. A Granger Test attempts to show causality between two variables, although it is closer to an inference than a conclusive finding. The idea behind the Granger Test is that if an independent variable 'X' combined with lags for a dependent variable can give a better estimate of the dependant variable 'Y' than just the lags, X is said to have 'Granger-caused' Y. Specifics of running the test will further be explored in the outline of the empirical model.

The hypothesis states that gentrification will Granger-cause crime rates to go down, at least in Washington, D.C, but crime rates will not Granger-cause gentrification. While location theory holds that both the crime rates are going down as well as travel costs are going up which causes gentrification, this study examines if D.C. is a unique case. Washington, D.C. has the second worst traffic among US cities (Weather.com). Washington D.C. is a high commuter city with the limited upper class neighborhood options concentrated in a very small area. A large population works in Washington D.C. but commutes every day, as evidenced by the fact that the population of Washington D.C. almost doubles during the workday according to the 2000 Census. This study, therefore, has important policy implications for the city of Washington D.C. If gentrification is a socially desirable outcome, it would be beneficial for the government in Washington D.C. to allow travel costs to rise to encourage gentrification. On the other hand, if gentrification is undesirable, it would be more efficient to subsidize travel so that the upper income population stays in the suburbs and does not displace the lower income population in the city.

In the context of this study, it is possible for crime to Granger-cause gentrification just as gentrification Granger-causes crime. If this occurs, this study will be forced to conclude that the two variables are working simultaneously and the causal factors cannot be brought out. If neither gentrification nor crime Granger-cause the other, then the two variables are unrelated.

III. DATA

This study uses data directly from the Metropolitan Police Department's (MPD) Research and Analysis Branch. Washington D.C. has several different divisions including quadrants (NW, SE, etc.), wards (1-8), police districts (1-7), and police service areas (PSAs) (within each police district). Quadrants, police districts, and wards are all too large areas to approximate the effect of individual neighborhoods. Another problem is there are not enough data points to get significant results. Even with wards, 8 wards and 6 years (2004-2010) only yield 48 observations. Because of the Granger-causality Test, lagging variables take even more observations away. Therefore, this study uses PSAs, both to combat a small sample size and to attempt to get at neighborhood differences. Ideally, this study would examine data going back to 1995, or when the crack epidemic of the late 1980s and early 1990s was winding down. Unfortunately, MPD was not comfortable releasing data prior to 2004 due to reporting and geographic inconsistencies. In order to get the prior data, a FOIA request is necessary, which leads to a natural continuation of this research. Going back to only 2004 will yield a large enough sample size to conduct a regression analysis, but it is unlikely to show as strong of a correlation between crime and gentrification. Because gentrification is a process, only six years might not be enough to show the process happening.

This study also uses data from a website called NeighborhoodInfoDC.com which is a source that pulls together data from a variety of sources including the DC Department of Human Services and the D.C. Office of Tax and Revenue's Real Property Tax Administration's real property database. From this website, the average property values as well as Temporary Assistance for Needy Families (TANF) for each individual PSA will be used. Property values are used as a proxy for one side of gentrification: the upper class residents moving in. TANF will be used as a proxy for the other side of gentrification: the lower classes moving out. TANF is a means-tested government subsidy so the more individuals receiving TANF implies that there is a higher population of poor people. If gentrification is occurring,

an increase in housing prices, accompanied with a fall in individuals receiving TANF, will show that crime rates are falling.

In 2004, Washington, D.C. redrew the lines for the Police Service Areas. Unfortunately, the data from the Metropolitan Police Department were coded for the post-2004 PSAs while the data from NeighborhoodInfoDC.com were coded for the pre-2004 PSAs. While this certainly detracts from the credibility of the data, it does not completely undermine the study. The police districts have not changed. So while the districts may have been slightly different, the neighborhoods still have much overlap. The biggest issue is that in the redistricting, two new PSAs were created. Because this study cannot accurately redistribute the crime data from the new PSAs to the old ones, those data points have been omitted. Due to the same overall police districts and the two omitted PSAs, there should not be significant errors in the analysis.

Due to the limited scope of this project, the effect of traffic will not be examined. While it is an important effect with regards to location theory, the other half of the location theory still warrants a treatment. An increase in housing prices implies that there is a higher demand for houses in neighborhoods with high crime rates, which accounts for the gentrification. In addition, looking at the effects of gentrification (the smaller number of lower income people proxied by the TANF measure) can also be fruitful. A continuation of this paper would incorporate traffic and attempt to show that traffic Granger-causes gentrification, although the exact method for conducting that test is not overtly apparent.

IV. EMPIRICAL MODEL

The empirical model in this paper follows the Granger-causality Test. Two separate Granger-causality tests will be run: one with housing as the independent variable and the other with TANF as the independent variable. To begin, an Ordinary Least Squares (OLS) regression is run to see the correlation between the dependent variable (crime) and the independent variables (housing or poverty), as well as a variable for lagged crime. The number of violent crimes related to the city-wide mean will be CRIME. HOUSE is the median house price for the individual PSA. TANF is the number of individuals receiving the subsidy as related to the city-wide mean. This takes the following form:

$$\text{CRIME} = \beta_0 + \beta_1 \text{HOUSE} + \beta_2 \text{CRIME}_{t-1}$$

Next, the variable 'HOUSE' is removed yielding the following equation:

$$\text{CRIME} = \beta_0 + \beta_1 \text{CRIME}_{t-1}$$

Finally, a Wald test is done between the two regressions. The first equation with housing included is the unrestricted model. The second model with the HOUSE variable omitted is the restricted model. An F-test is then run to determine if the omission of HOUSE had a statistically significant effect on the prediction of CRIME. The F-statistic is as follows:

$$F = \frac{(\text{ESS}_R - \text{ESS}_U) / (\text{DF}_R - \text{DF}_U)}{\text{ESS}_U / \text{DF}_U}$$

Where ESS is the Error Sum of Squares for the respective restricted and unrestricted models and DF is the Degrees of Freedom for the respective restricted and unrestricted models. If the F-test is significant, then it can be said that HOUSE 'Granger-caused' CRIME.

The test then needs to be run again to determine if CRIME 'Granger-causes' HOUSE. It will look exactly the same as the first Granger-causality Test except the initial setup will look as follows:

$$\text{HOUSE} = \beta_0 + \beta_1 \text{CRIME} + \beta_2 \text{HOUSE}_{t-1}$$

$$\text{HOUSE} = \beta_0 + \beta_1 \text{HOUSE}_{t-1}$$

The F-test is then run to determine if CRIME 'Granger-caused' HOUSE. The hypothesis is HOUSE will 'Granger-cause' CRIME to fall but CRIME will have no effect on HOUSE in terms of Granger-causality. This is in accordance with the location theory as previously articulated.

The previous test is then run again with the variable TANF in place of the variable HOUSE. Equations 1 to 5 are followed and the methodology is exactly the same.

V. RESULTS

In order to simplify the Granger-causality Tests, only one variable at a time is introduced. This results in two separate Granger Tests, one for housing prices and the other for TANF. These two tests get at both sides of the gentrification process: the former is a proxy for the upper income residents moving in and the latter is a proxy for the lower income residents moving out.

To start, two regressions are run: the first regression is HOUSE on CRIME and the second regression is TANF on CRIME. This is done to check both the coefficients and the signs. As a Granger Test only examines Granger-causality, the coefficients and signs are irrelevant. Table 1 shows the first regression with HOUSE is significant at the .01 level, has the correct sign, and a coefficient of -.287. Table 2 shows the second regression with TANF also is significant at the .01 level, has the correct sign, and a coefficient of .150. The reason for running the two regressions separately was that the variables have high multicollinearity. Since both housing prices and TANF numbers are directly related (lower income residents have lower housing prices), including both HOUSE and TANF in the same regression with crime is not productive.

Table 3 shows the first Granger Test examined, CRIME and HOUSE. As previously explained, HOUSE and CRIME_{t-1} are regressed on CRIME in the unrestricted model. Then, CRIME_{t-1} is regressed on CRIME in the restricted model. The resulting F-value comparing the restricted and the unrestricted models is 39.94 which is statistically significant at the .01 level. Next, CRIME and HOUSE_{t-1} are regressed on HOUSE. Then, CRIME is taken out and HOUSE_{t-1} is regressed on HOUSE. The resulting F-value is 102.68, which is also statistically significant at the .01 level. From these results, HOUSE Granger-causes CRIME and CRIME Granger-causes HOUSE.

Table 4 shows the second Granger Test which repeats the above test, this time examining the relationship between TANF and CRIME. The unrestricted model involves regressing TANF and CRIME_{t-1} on CRIME while the restricted model excludes TANF and only has a regression of CRIME_{t-1} on CRIME. The resulting F-value was 36.6, which is statistically significant at the .01 level. The process is then reversed with CRIME and TANF_{t-1} having a regression on TANF in the unrestricted model. CRIME is then excluded from the restricted model and the resulting F-value was 6.3, which due to the high sample size is significant at the .01 level. From this, it can be shown that TANF Granger-causes CRIME and CRIME Granger-causes TANF.

VI. CONCLUSIONS

From the results, the effects of gentrification can clearly be seen. The individual regressions show that an increase in housing price and a decrease in the number of poor people will each lead to a decrease in crime. That being said, the goal of this project is not to merely

note the existence of gentrification. Rather, it is to show a potential causal relationship between the proxies for gentrification and the effects of the gentrification.

The two Granger Tests yielded the same result: both examined variables Granger-caused the other. This essentially means that the variables influence each other, preventing any causal conclusions from being drawn. While there is no one way Granger-causality, these results still allow some inferences to be made.

It is worth looking at the TANF Granger Test a little more closely. The F-statistic for the first half of the Granger Test to determine if TANF Granger-causes CRIME was 36.6, which is statistically significant at the .01 level. The F-statistic for the second half of the test was merely 6.3, but is also statistically significant at the .01 level due to the large sample size. Because the F-test is designed to examine the difference between two regressions, the large difference in magnitude between the two F-statistics may lead one to believe that there is a difference. While conclusions cannot be drawn given that they are both statistically significant, it appears that TANF may Granger-cause CRIME to a higher degree than CRIME Granger-causes TANF.

One possible reason why no conclusive Granger-causality results were drawn is that the data only went back to 2005. Because the Metropolitan Police Department did not grant access to earlier data, the entire process of gentrification could not be examined. One important aspect of gentrification on a city-wide level is that it is an ongoing process. In Washington, D.C., the process started in the early 1990s with the end of the crack epidemic. Without including almost a decade's worth of data, it is hardly a surprise that the results are not exactly what are expected. Once the entire gentrification process is contained in the data, the results might be more in line with what is hypothesized.

Even without Granger-causality one way or the other, this study still has merit. In short, it served as a confirmation of one side of location theory. A fall in crime rates does lead to the occurrence of gentrification. While the traffic side has not been accounted for, it is an area for additional research. Washington, D.C., at least according to the results in this study, is simply another example of location theory at work.

Unfortunately, without any Granger-causality to build from (aside from the weak inference with the TANF results), it is not as easy to make policy

implications. That being said, this information can be useful for city planning. If gentrification is a desired outcome, governments should allow traffic costs to rise (assuming the traffic side of location theory still holds) as well as combating crime in the inner-city. This brings up an entirely new debate, however, about whether or not gentrification is, in fact, desired. There is a difference between pushing lower income people out and pulling them up into a better social standing. It appears that gentrification is guilty of the former, although this area deserves more research. If this is the case, it is difficult to see gentrification as anything more than a geographic redistribution of the indigent; a hardly desirable outcome when it comes to social justice.

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VIII.APPENDIX

Table 1: Preliminary Housing Regression			
Vairable	Explanation	Coefficient	Significance
Dependent Variable			
CRIME	Number of crimes in a given year		
Independent Variable			
HOUSE	Median house sale for a given year	-.287	-.2900(***)
Adjusted R ²	.030	Sample Size	243

Table 2: Preliminary Temporary Assistance for Needy Families Regression			
Variable	Explanation	Coefficient	Significance
Dependent Variable			
CRIME	Number of total crimes in a given year		
Independent Variable			
TANF	Number of individuals receiving Temporary Assistance for Needy Families	.150	6.627(***)
Adjusted R ²	.143	Sample Size	257

Table 3: HOUSE Granger Test		
Variable	Unrestricted	Restricted
HOUSE	-.009 (-.396)	
CRIMEt-1	.974 (64.971)***	.975 (71.994)***
Error Sum of Squares	1632386	1953531
Sample Size	206	257
F-Statistic	39.94***	
CRIME	-.012 (-1.346)	
HOUSEt-1	.966 (64.014)***	.959 (58.928)***
Error Sum of Squares	598383	907136
Sample Size	201	207
F-Statistic	102.68***	

Table 4: TANF Granger Test

Variable	Unrestricted	Restricted
TANF	.013 (2.230)**	
CRIME _{t-1}	.964 (64.240)***	.975 (71.994)***
Error Sum of Squares	1673740	1953531
Sample Size	220	257
F-Statistic	36.6***	
CRIME	-.043 (-2.460)**	
TANF _{t-1}	.999 (144.045)***	.993 (160.756)***
Error Sum of Squares	2071699	2132402
Sample Size	215	224
F-Statistic	6.3***	

