ISSN: 2247-6172
Review of Applied Socio- Economic Research
(Volume 9, Issue 1/ 2015), pp. 25
URL: http://www.reaser.eu
e-mail: editors@reaser.eu

Did suburbanization cause residential segregation? Evidence from U.S. metropolitan areas

Boishampayan Chatterjee[1 +]

[1]Institute of Management Technology, Ghaziabad, India

Abstract. *Population suburbanization has been long held as a cause for increasing racial residential segregation in US metropolitan areas. This paper hypothesizes that rapid suburbanization between 1960 and 2000 has caused an increase in racial residential segregation in U.S. metropolitan areas. Using the 1947 national interstate highway plan as an instrument for suburbanization and decennial Census data from 1960 to 2000, this paper finds that central city population decline (suburbanization) causes racial residential segregation in a metropolitan area to rise. Estimation results from both long difference and panel regressions are robust to an array of specifications. Had there been no suburbanization between 1960 and 2000, racial residential segregation on average would have declined by about 4 percentage points more than what is observed in the data.*

Keywords: Suburbanization, Residential Segregation, Highways, Metropolitan area

JEL Codes: R11, R23, R40, J1

1. Introduction

This paper tries to establish a link between racial residential segregation and population suburbanization by assessing the extent to which rapid central city population decline (suburbanization) explains the observed pattern of racial residential segregation in US metropolitan areas. The idea is that if the central cities lose population, of which most are affluent whites, then it will keep the metropolitan areas to remain residentially segregated. In particular, the empirical specification in this paper tests the hypothesis that greater central city population decline causes racial residential segregation in a metropolitan statistical area (MSA) to decline slower over time. In other words, population suburbanization raises racial residential segregation.

The vast literature on residential segregation provides evidence of high segregation in the United States from the time when ghettos were born. As blacks migrated to urban areas, ghettos were formed and cities developed vast areas mostly filled with black population. In 1890, the average urban black was living in a neighborhood that was 27 percent black. By 1940, this percentage went up to 43 percent. Between 1940 and 1970, ghettos consolidated and expanded with the peak year of segregation being 1970. In 1970, the average black in US urban areas lived in a neighborhood that was 68 percent black. In 1990 this percentage was 56 (Cutler, Glaeser, and Vigdor, 1999).

On the other hand, population decline in US central cities provides evidence of rapid suburbanization from 1950 onwards. In 1950, 57 percent of MSA residents were located in the central cities. In 1970, the share was 43 percent while in 1990 it was 37 percent (Mieszkowski and Mills, 1993). A recent study by Baum-Snow (2007) showed that between 1950 and 1990, the total population of central cities in the United States declined by 17 percent in spite of population growth of 72 percent for the MSAs.

[+] Assistant Professor, Institute of Management Technology, Ghaziabad. Tel.: +9101203002230; fax: +9101202827895. *E-mail address*: bchatterjee@imt.edu.

ISSN: 2247-6172
Review of Applied Socio- Economic Research
(Volume 9, Issue 1/ 2015), pp. 26
URL: http://www.reaser.eu
e-mail: editors@reaser.eu

Existing literature on segregation argues that residential segregation may rise as neighborhoods expand and people become relatively more mobile. Improvements in the transportation infrastructure encourage suburbanization as people become increasingly able to live in the suburbs and commute to the city to work. If this suburbanization is essentially "White Flight" from the city to the suburbs, then it will cause US metropolis to be more residentially segregated (Boustan, 2010).

Previous studies identify suburbanization as one of the causes for the racially segregated pattern of residential location in US metropolitan areas. In particular, Jackson (1985) emphasizes that federal subsidization and encouragement of suburbanization reinforced racial residential segregation. Massey and Denton (1988) find Hispanic and Asian segregation to be strongly related to suburbanization but Black-Anglo segregation was not. Cutler, Glaeser, and Vigdor (1999) regress the indexes of dissimilarity and isolation on city population and density and find evidence that larger or denser cities have higher levels of segregation.

On the other hand, decentralized racism and collective action racism (Cutler, Glaeser, and Vigdor, 1999) provide explanation how racial residential segregation may occur because of the individual whites' decision to live with other whites and collective actions taken by the whites to enforce separation from the blacks. Preference to reside among people of like income, education, race and ethnicity induces the affluent middle class to live in the suburbs.

Thus, households willing to move to their preferred location will do so if they get the opportunity to relocate. For instance, in the 1960s, the construction of interstate highway system was considered as one of the major causes of metropolitan suburbanization.

The primary concern that may arise in estimating the effect of suburbanization on residential segregation is because of the problem of reverse causality. As suburbanization may affect residential segregation, people who want to segregate may choose to suburbanize. The main contribution of this paper is to circumvent the problem of reverse causality between residential segregation and suburbanization by using instrumental variables (IV) as an identification strategy. In particular, the 1947 national interstate highway plan is used as an instrument for suburbanization. The motivation for using this instrument comes from the recent study by Baum-Snow (2007), where he has shown that the construction of new limited-access highways has contributed to central city population decline across MSAs in the United States.

Using aggregate data at the MSA level for decennial years from 1960 to 2000, regression equations are estimated for an array of specifications for long difference and panel settings. Given that residential segregation and central city population has fallen during the chosen sample period of this study, this paper finds that greater decline in central city population causes a lesser decline in racial residential segregation in a metropolitan area.

The rest of the paper is organized as follows. Section 2 discusses the relationship between racial residential segregation and suburbanization and why interstate highway qualifies as an instrument. Section 3 discusses the empirical methodology and the data. Section 4 describes the trends in suburbanization and residential segregation. Section 5 presents the results from the long difference and panel regressions. Section 6 concludes.

2. Residential segregation, suburbanization, and highways

Residential segregation on the basis of race can happen when households have direct preference over race or particular neighborhood characteristics that vary by race. For instance, Schelling's (1971) model of "neighborhood tipping" shows how an all-white neighborhood, with residents having different tolerance levels toward black neighbors, starts tipping and culminates into an all-black neighborhood. Again, preference of households for local public goods may lead to residential stratification on the basis of income.

ISSN: 2247-6172
Review of Applied Socio- Economic Research
(Volume 9, Issue 1/ 2015), pp. 27
URL: http://www.reaser.eu
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This 'Tiebout sorting' (Tiebout, 1956) may generate racial residential segregation if race and income are correlated.

With the development of highway construction, many residents of metropolitan areas chose to live outside the central urban area and commute to work by automobile or mass transit. This process of suburbanization is more relevant to the affluent section of the population who can afford to live in the suburbs.

Past studies have observed that between 1950 and 1990, there had been a substantial decline in total population of central cities despite population growth in metropolitan area as a whole (Baum-Snow, 2007), and that mostly urban whites were moving to the suburbs (Boustan, 2010). During 1940-1970, central cities experienced black migration from the rural South, and the urban whites responded to this black influx by relocating to the suburbs.

The goal of this paper is to test the hypothesis that rapid suburbanization during 1960 to 2000 has led US metropolitan areas to be more racially segregated. To address the concern of reverse causality emerging from whites' willingness to move away from blacks thereby causing suburbanization, central city population is instrumented with the number of highways in the 1947 national interstate highway plan. A recent study by Baum-Snow (2007) shows that one new highway passing through the central city reduces its population by about 18 percent.

The identification strategy used in this paper exploits the exogenous variation in the national highway plan, which was designed not to facilitate local commuting but to link faraway places. As a result, some MSAs that are located nearer to other population centers received relatively more interstate highways than others (Baum-Snow, 2007). Thus the rates of suburbanization varied across the metropolitan areas depending upon the number of highways assigned to each metropolitan area. The empirical work in this paper compares the changes in the level of residential segregation across metropolitan areas with different rates of suburbanization. The 1947 national interstate highway plan is purged of any endogeneity because the intention of the plan was not to provide people with highways so that they can suburbanize, and thus, is not correlated with residential segregation. The highway plan thus provides a valid instrument in the sense that the construction of new highways encouraged suburbanization but is not directly correlated with residential segregation in other ways.

3. Empirical specification and data

The effect of suburbanization on residential segregation is measured by relating the long run changes in metropolitan area segregation level to the long run changes in central city population. The main advantage of using long difference regressions is that the long run changes of central city population from 1960 to 2000 provide a clear picture of the suburbanization process and the evolution of the residential pattern over a long period.

The empirical specification of the model estimated using long difference regressions is described as follows:

$$\Delta R_i = \alpha_0 + \alpha_1 \Delta S_i + \alpha_2 \Delta D_i + \alpha_3 H_i + \alpha_4 G_i + \alpha_5 I_i + \alpha_6 I_i^2 + \alpha_7 \Delta A_i + \alpha_8 \Delta M_i + \alpha_9 \Delta Y_i + \alpha_{10} \Delta V_i + \upsilon_i \quad (1)$$

where R_i is racial residential segregation measured by the dissimilarity index and S_i denotes constant geography central city population in city i. Thus ΔS_i measures the degree of suburbanization. D_i is a vector of demographic variables, including variables such as MSA population, population density, black and foreign born shares.

ISSN: 2247-6172
Review of Applied Socio- Economic Research
(Volume 9, Issue 1/ 2015), pp. 28
URL: http://www.reaser.eu
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Vector H_i includes variables such as growth potential of industries, historical black migration, 1950 central city area and 1950 MSA population. G_i measures 1962 number of local governments in an MSA.

I control for segregation level in 1960, denoted by I_i, in order to account for the fact that some MSAs had either low or high segregation to begin with. Since dissimilarity index can only vary between 0 and 1, extreme values of the index at the initial period would imply that it would have a unidirectional pattern in its variation thereby inflicting bias on the estimated coefficient of the central city population variable. In addition, I include the square of initial segregation level (I_i^2) to account for any nonlinearity present in the data. Finally, the variables A_i, M_i, Y_i, and V_i measure agricultural employment, manufacturing employment, median family income, and median gross rent in an MSA.

The first stage of the instrumental variable regression is given by

$$\Delta S_i = \delta_0 + \delta_1 PH_i + \delta_2 \Delta D_i + \delta_3 H_i + \delta_4 G_i + \delta_5 I_i + \delta_6 I_i^2 + \delta_7 \Delta A_i + \delta_8 \Delta M_i + \delta_9 \Delta Y_i + \delta_{10} \Delta V_i + \mu_i \quad (2)$$

where PH_i is the number of planned highways in the 1947 national interstate highway plan for MSA *i*. The IV estimates are obtained by replacing ΔS_i in equation (1) with the predicted degree of suburbanization obtained from equation (2).

The identification strategy is to instrument the changes in central city population with rays passing through the central city in the highway plan.[2] Using actual highways poses endogeneity problems because whites may respond to segregation by building more highways to facilitate suburbanization, but the highway plan did not mean to facilitate suburbanization and thus does not have this problem. I use the data from Baum-Snow (2007) on the number of highways in the 1947 national interstate highway plan to instrument central city population.

Racial residential segregation is measured using the index of dissimilarity proposed by Duncan and Duncan (1955). This is a widely used index which measures the extent to which blacks and nonblacks occupy different areas of a city. This measure has been used by Cutler, Glaeser, and Vigdor (1999) and is interpreted as what share of blacks (or whites) would need to change residential areas for the races to be evenly distributed. The value of the dissimilarity index ranges between 0 and 1. The index is calculated at the MSA level and use Census tracts as neighborhoods.

Following Baum-Snow (2007), I use the change in total population of the central city in each metropolitan area for each decennial year from 1960 to 2000 to measure suburbanization. I use the central city population data from 1960 to 1990 created by Baum-Snow (2007) where each metropolitan area is assigned with one central city. Neighborhood Change Database (NCDB) provides decennial census data at the tract level. Tracts in year 2000 that fall within the 1950 central city geography are aggregated to obtain the total constant geography central city population in 2000. The dataset cover altogether 129 MSAs across the United States.

County and City Data Books (CCDB) is the source of all the demographic variables included in the regression. CCDB provides decennial census data aggregated to counties of at least 250,000 inhabitants. County level data on total, black and foreign born population are aggregated to form MSAs using the 1960 standard metropolitan area definition.

The data for the variables included in the vector H_i come from sources such as 1952 CCDB, Bureau of Economic Analysis (BEA), US Department of Commerce, and 1962 Census of Governments. The data on historical black migration are obtained from the Inter-University Consortium for Political and Social Research (ICPSR).

ISSN: 2247-6172
Review of Applied Socio- Economic Research
(Volume 9, Issue 1/ 2015), pp. 29
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Regression equations are estimated at the MSA level for differences between 1960-80, 1960-90 and 1960-2000. OLS and IV regression models are used to estimate equation (1), with the 1947 national interstate highway plan as an instrument for suburbanization in the IV regressions. In estimating equation (1), I also use regional dummies to absorb any variation in segregation across regions. Both OLS and IV regressions for the long-difference model are run with census division fixed effects.

Since metropolitan areas are unique in many ways, using a panel data with metropolitan area fixed effects would control for any time invariant heterogeneity across MSAs. Using an exogenous source of variation in the planned highways as instrument would provide estimates of suburbanization purged of endogeneity arising from potential reverse causality. The full model specification used for panel regressions is as follows:

$$R_{it} = \beta_0 + \beta_1 S_{it} + \beta_2 D_{it} + \beta_3 Y_{it} + \beta_4 V_{it} + \beta_5 A_{it} + \beta_6 M_{it} + \beta_7 W_i + \beta_8 T_t + W_i * S_{it} + \nu_{it} \quad (3)$$

where R_{it} is the measure of residential segregation in metropolitan area *i* at year *t*, D_{it} is a vector of metropolitan area characteristics, which includes metropolitan population, population density, share of black and foreign born population and S_{it} is the share of central city population out of total MSA population. For the instrumental variable regressions, S_{it} is substituted with the predicted central city population share from the first stage. Y_{it}, V_{it}, A_{it} and M_{it} denote median family income, gross median rent, share of agricultural and manufacturing employment in MSA *i* at year *t* respectively. W_i and T_t are regional and year dummies capturing regional and year fixed effects. Regional dummies are interacted with central city population to control for any regional differences in the effect of suburbanization on residential segregation. Both OLS and IV regressions are estimated with MSA fixed effects.

If residential location patterns take longer than ten years to respond fully to the changes in highway infrastructure, then panel estimates without smoothing rays will be biased toward zero due to slow transition to new equilibria. (Baum-Snow, 2007). To construct the instrument for the central city population in a panel setting, I follow Baum-Snow with a minor change. Unlike Baum-Snow (2007), central city population is instrumented with the number of interstate highways in the plan multiplied by the fraction of highway miles completed at time *(t-1)*. This is because highway construction lagged by one period is likely to be more exogenous than highway construction at time *t*. The data on miles of highway completed and opened to traffic for till 1994 were obtained from Baum-Snow (2007). The post 1994 data is obtained from Federal Highway Administration (FHWA) website.[13]

4. Trends in segregation and suburbanization

Table 1. Trends in Residential Segregation, Central City Population, and MSA population

Year	Average Segregation	Total City Population	Total MSA Population	MSA with above average black share		MSA with below average black share	
				Dissimilarity Index	Average City population	Dissimilarity Index	Average City population
1960	0.75	42.99	110.29	0.75	0.57	0.74	0.19
1970	0.75	40.98	127.69	0.77	0.58	0.75	0.15
1980	0.66	36.44	137.68	0.69	0.53	0.64	0.13
1990	0.61	35.73	151.19	0.65	0.49	0.58	0.13
2000	0.56	35.19	208.69	0.61	0.43	0.53	0.17
Percent change	-25.4%	-18.13%	89.22%	-18.6%	-24.5%	-29.3%	-10.5%

ISSN: 2247-6172
Review of Applied Socio- Economic Research
(Volume 9, Issue 1/ 2015), pp. 30
URL: http://www.reaser.eu
e-mail: editors@reaser.eu

Population figures are in million. Black share of population is defined as above (below) average in an MSA if the black share in that MSA at time *t* is greater (lower) than the average black share at time *t*.

Table 1 provides an overview of the trends in black-nonblack residential segregation, central city population, and MSA population. From Table 1 it can be seen that there has been a substantial population movement from the central city to the suburbs, with the central city population falling by 18 percent and MSA population rising by 89 percent between 1960 and 2000. One noticeable fact in Table 1 is that central city population dropped marginally during the 1990-2000 period while there has been a considerable increase in MSA population in that time period. This trend in central city population indicates that MSAs on average were not experiencing much suburbanization in the post 1990 period.

Residential segregation was at its peak in the 1970 with the value of the dissimilarity index being .752. From 1970 onwards, segregation fell persistently with the value of dissimilarity index dropping down to .56 in 2000. This decline in segregation level can be attributed to rising income and education level of blacks with a change in attitude of the blacks toward living in a ghetto (Massey and Denton, 1987).

Table 1 also shows the average segregation level and the central city population according to the proportion of black population in MSAs. MSAs with above average and below average black share of population had almost the same average level of segregation in 1960. For the later years, MSAs with above average black share of population have higher segregation than MSAs with below average black share.

Central city population declined consistently from 1970 onwards for the MSAs with above average black share. As for the MSAs with below average black share, average central city population had a downward trend till 1980 but had risen by about 30 percent between 1990 and 2000. MSAs with higher black share experienced greater black in-migration than MSAs with comparatively lesser black population. Suburbanization happened at a faster rate in those MSAs as whites responded to the influx of black population.

The main observation from Table 1 is that the level of the dissimilarity index has persistently fallen between 1960 and 2000. Again, central cities had a substantial population loss during the same time period. However, the key is whether the reduction in residential segregation is smaller where suburbanization is faster. This paper attempts to test the hypothesis that cities that experienced greater suburbanization had a slower decline in racial residential segregation.

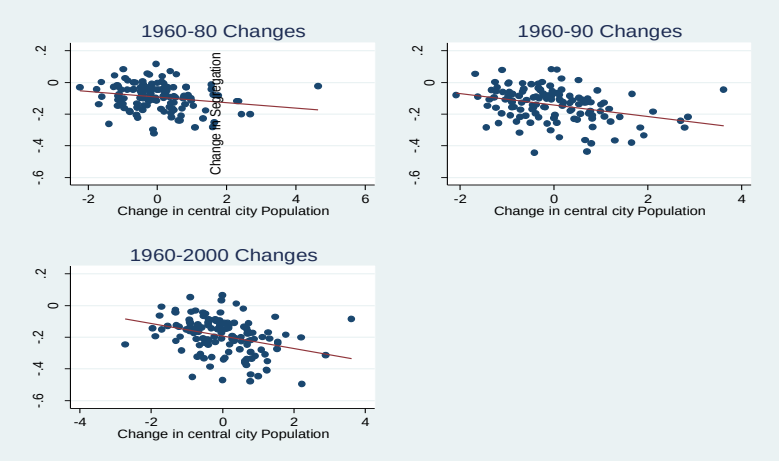

Fig. 1: Suburbanization and Change in Racial Residential Segregation

ISSN: 2247-6172
Review of Applied Socio- Economic Research
(Volume 9, Issue 1/ 2015), pp. 31
URL: http://www.reaser.eu
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Figure 1 gives a graphical exposition of the relationship between the change in residential segregation and the change in central city population between 1960-80, 1960-90 and 1960-2000. Higher negative values for the change in central city population implies greater decline in central city population, meaning more suburbanization. Similar explanation holds for the change in residential segregation as well. Suburbanization and change in residential segregation has a negative relation for all the three long run changes. Greater central city population loss is associated with lesser decline in residential segregation.

5. Results

This section presents the OLS and IV regression results from the long difference and panel regressions corresponding to the equations (1), and (3).

Long Difference Regression Results

Results in Table 2 show that the change in residential segregation is negatively associated with the change in central city population decline. In fact, significant IV estimates for the change in central city population suggest that suburbanization causes metropolitan areas to be more residentially segregated. For the 1960-80 long difference IV regression, a one standard deviation increase in suburbanization causes residential segregation to rise by 5.2 percentage points. For 1960-90 and 1960-00, the effect is about 4.7 and 3.6 percentage points respectively.

The first stage F-statistic ranging between 11.17 and 19.37 provides evidence that the 1947 national interstate highway plan is a strong predictor of the change in central city population.

The causal estimates of the effect of suburbanization on residential segregation are strong and significant, especially for the 1960-80 and 1960-90 long difference regressions. US metropolitan areas experienced considerable loss in central city population between 1960 and 1990. Average segregation level also declined during that period. An implication of the results obtained from the IV regressions in the long difference model is that the MSAs in which central cities experienced greater suburbanization had a significantly lesser fall in racial residential segregation.

Among the other independent variables, higher black share of population has a significant negative association with racial residential segregation in all the long difference regressions. This result might be attributed to rising income and education level of blacks with a change in attitude of the blacks toward living in a ghetto. The other two variables strongly related to segregation are the central city area and the central city population density. We can see that segregation is higher in larger and denser cities, a result similar to the one obtained by Cutler, Glaeser, and Vigdor (1999).

The first thing noticeable from Table 2 is that the longer the difference between the two years, the smaller is the absolute magnitudes of the IV estimates. This finding may indicate that the changes in residential segregation and central city population has been the most during the 1960-1990 time period and the process of suburbanization petered out in the post 1990 period. Average residential segregation consistently dropped during this period, which might be attributed to amendments in antidiscriminatory policies and changes in attitude of the nonblacks toward the blacks.

Secondly, the absolute magnitudes of the OLS estimates are bigger, the longer the difference between the two years. Longer the time people get, the more they can respond to segregation by suburbanizing. In that case, the bias arising from reverse causality will be bigger the longer is the period of the difference between the two years.

ISSN: 2247-6172
Review of Applied Socio- Economic Research
(Volume 9, Issue 1/ 2015), pp. 32
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	1960-80		1960-90		1960-2000	
	OLS	IV	OLS	IV	OLS	IV
Change in log CC population	-0.011	-0.052*	-0.021**	-0.047**	-0.025**	-0.036
	(0.007)	(0.027)	(0.009)	(0.021)	(0.011)	(0.023)
Change in log MSA population	-0.013	0.035	0.077**	0.095***	0.029**	0.031***
	(0.050)	(0.056)	(0.038)	(0.027)	(0.013)	(0.011)
Change in CC population density	0.020*	0.042***	0.021	0.039*	0.034**	0.042**
	(0.011)	(0.013)	(0.018)	(0.021)	(0.015)	(0.018)
Change in black share of population	-0.063***	-0.071***	-0.061***	-0.068***	-0.033**	-0.035**
	(0.022)	(0.025)	(0.017)	(0.015)	(0.015)	(0.014)
Change in foreign born share	-0.012	0.0054	-0.044**	-0.032*	-0.031**	-0.028**
	(0.009)	(0.011)	(0.017)	(0.019)	(0.013)	(0.012)
1950 CC area	0.065***	0.081***	0.056**	0.063***	0.051*	0.0545***
	(0.017)	(0.018)	(0.022)	(0.018)	(0.027)	(0.020)
Change in median family income	0.161	0.191	-0.214	-0.180	-0.210**	-0.198***
	(0.146)	(0.155)	(0.156)	(0.142)	(0.089)	(0.077)
Change in median gross rent	0.075	0.100	0.069	0.035	0.178	0.172*
	(0.118)	(0.123)	(0.103)	(0.102)	(0.108)	(0.095)
Change in percent manufacturing employment	0.069	0.090	0.036	0.036	-0.036	-0.049
	(0.094)	(0.075)	(0.058)	(0.051)	(0.043)	(0.039)
Change in percent agriculture employment	0.018	0.011	0.057*	0.051	0.079**	0.068
	(0.031)	(0.028)	(0.029)	(0.031)	(0.036)	(0.043)
Reject null of no endogeneity at 5% level	Yes	Yes	Yes	Yes	Yes	Yes
First stage F-stat		14.09		11.17		19.37
R^2	0.628	0.529	0.749	0.730	0.754	0.750
N	124	124	123	123	124	124
Census division fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 2. 1960-80, 1960-90, and 1960-00 long difference regressions

ISSN: 2247-6172
Review of Applied Socio- Economic Research
(Volume 9, Issue 1/ 2015), pp. 33
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* p<0.10, ** p<0.05, *** p<0.01

Table 3. Average change in residential segregation: actual versus predicted

	1960-80		1960-90		1960-2000	
	(1) Actual	(2) Predicted	(3) Actual	(4) Predicted	(5) Actual	(6) Predicted
Average change in dissimilarity index	-0.092	-0.128	-0.142	-0.194	-0.193	-0.231

Predicted average change in dissimilarity index is obtained by estimating the long difference regressions assuming no suburbanization.

Table 3 presents the actual and the predicted changes in racial residential segregation for 1960-80, 1960-90, and 1960-2000 long run changes. The figures in columns 1, 3, and 5 are the actual changes in the dissimilarity index as observed in the data. Columns 2, 4, and 6 show the changes in the dissimilarity index as predicted by the long difference model, assuming the rate of suburbanization to be zero for all the cities in the sample. Table 3 shows that on average, the decline in residential segregation would have been greater had there been no suburbanization. For 1960-80 long run change, the average decline in dissimilarity index would have been 3.6 percentage points more in absence of suburbanization. For 1960-90 and 1960-2000, it is by 5.2 and 3.8 percentage points respectively. Thus between 1960 and 2000, suburbanization has weakened the decline in racial residential segregation on average in US metropolitan areas.

Panel Regression Results

Table 4 presents the results from panel regressions for decennial years from 1960 to 2000 as specified in equation (3).

The first two columns in Table 4 include the demographic variables, regional dummies and year dummies (not shown in the table) as controls in addition to the central city population variable. The last two columns report OLS and IV regressions adding further controls. Central city population is negatively associated with racial residential segregation and is statistically significant for all the specifications. For OLS(3), one standard deviation decline in the share of central city population is associated with a 8 percentage points rise in residential segregation.

For the panel IV regressions, the instrument is measured as the number of interstate highways in the 1947 highway plan times the fraction of highway mileage running through the central city of MSA *i* in year *t-1*. The instrument performs well in predicting central city population with F-statistics ranging from 14.75 to 17.96

ISSN: 2247-6172
Review of Applied Socio- Economic Research
(Volume 9, Issue 1/ 2015), pp. 34
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Table 4. Panel OLS and IV regressions with share of central city population as the dependent variable

	OLS1	IV1	OLS2	IV2	OLS3	IV3
Share of CC population	-0.0723**	-0.114*	-0.0866**	-0.100*	-0.0842*	-0.0960*
	(0.0341)	(0.0620)	(0.0428)	(0.0592)	(0.0443)	(0.0522)
Log MSA population	-0.0502	-0.125**	-0.0545	-0.122**	-0.154**	-0.0631
	(0.0511)	(0.0587)	(0.0552)	(0.0591)	(0.0682)	(0.0478)
Log population density	-0.0300	-0.0120	-0.0234	-0.0110	-0.0145	-0.0302***
	(0.0179)	(0.0146)	(0.0172)	(0.0121)	(0.0163)	(0.0109)
Log black share	0.0151	0.0480*	0.0142	0.0499*	-0.0153	-0.00507
	(0.0227)	(0.0250)	(0.0222)	(0.0269)	(0.0215)	(0.0118)
Log foreign born share	-0.0170	-0.00859	-0.0226*	-0.0173**	-0.00496	-0.00474
	(0.0125)	(0.00867)	(0.0124)	(0.00745)	(0.0196)	(0.00834)
Log median income			0.0940	0.0769*	0.0353	0.0113
			(0.0644)	(0.0412)	(0.0546)	(0.0254)
Log median rent			0.0171	0.0597	0.126	0.138***
			(0.105)	(0.0614)	(0.0922)	(0.0451)
Share of manufacturing employment			-0.00504	-0.00711	-0.00787	-0.00538
			(0.0594)	(0.0384)	(0.0584)	(0.0330)
Share of agriculture employment			0.290	0.0504	0.110	0.240
			(0.191)	(0.217)	(0.186)	(0.190)
Endogeneity		Yes		Yes		Yes
First stage F-stat		15.86		17.96		14.75
R2	0.652	0.539	0.678	0.550	0.725	0.557
N	645	645	641	641	641	641

Controls not shown: Year dummies. Regional Dummies, regional dummies and suburbanization interaction

* p<0.10, ** p<0.05, *** p<0.01

Causal estimates of the central city population variable have the expected negative sign and are statistically significant at conventional levels for all the three specifications. For the baseline specification (IV1), a one standard deviation decline in the share of central city population causes metropolitan area residential segregation to rise by 11 percentage points. Again, regressions including manufacturing and agricultural employment as additional controls produce qualitatively similar coefficient estimates of the central city population variable, confirming that the estimates are not picking up any correlation between the

ISSN: 2247-6172
Review of Applied Socio- Economic Research
(Volume 9, Issue 1/ 2015), pp. 35
URL: http://www.reaser.eu
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1947 highway plan and future employment growth. As it can be seen from regression IV3, a one standard deviation decline in the share of central city population causes metropolitan area residential segregation to rise by 10 percentage points. Thus suburbanization over time has led the metropolitan areas to be more residentially segregated.

Among the other variables, dissimilarity index is strongly negatively associated with MSA population. If differences in income across race contribute to racial residential segregation, then this segregation may fall because of an increase in MSA population if a significant portion of this population increase is better educated and higher income blacks. Median single family gross rent and median income is positively related to segregation. Higher rental prices may be a result of housing supply constraint due to various residential land regulations. As Rothwell (2009) finds, restrictive measures such as maximum density zoning have a strong negative effect on metropolitan housing growth. Regulatory regimes like this limit the supply of new housing and facilitate construction toward larger and more expensive homes inaccessible to minorities, thereby causing racial residential segregation (Massey and Rothwell 2009).

The absolute magnitudes of the OLS estimates for the central city population variable are always smaller than that of the IV estimates for both the long difference and panel regressions. This might happen due to the measurement errors arising from incorrectly measuring the suburbanization and residential segregation variables. The process of suburbanization may be more relevant to a particular section of the central city. In that case, the effect of suburbanization on racial residential segregation would be better captured by measuring suburbanization and segregation at smaller neighborhood levels instead of the entire central city.

6. Conclusion

This paper tests the hypothesis that population movement from the central cities of MSAs in the United States between 1960 and 2000 have caused the MSAs to be more residentially segregated. This process of suburbanization consisted of mostly the nonblacks, who moved to the suburbs, and the central cities remained predominantly inhabited by the blacks. This population movement thus resulted in greater black-nonblack residential segregation.

Previous research viewed suburbanization as one of the factors that explain the observed segregated residential pattern in the United States. This paper contributes to the existing literature by identifying the direction of causality between suburbanization and racial residential segregation.

Using the 1947 national highway plan as an instrument for suburbanization and decennial census data from 1960 to 2000 in long difference and panel settings, this paper finds significant evidence that central city depopulation in fact caused metropolitan areas to be more residentially segregated. Estimation results from the 1960-80, 1960-90 long difference regressions and panel regressions yield significant negative coefficients for the suburbanization variable. A one standard deviation more decline in the central city population from 1960 to 2000 lessens the decline in dissimilarity index by 4 percentage points.

This paper finds that suburbanization has decelerated the fall in racial residential segregation on average in US metropolitan areas between 1960 and 2000. Had there been no suburbanization, black-nonblack residential segregation on average would have declined by .231 points, which is about 4 percentage points more than what is observed in the data.

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ISSN: 2247-6172
Review of Applied Socio- Economic Research
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