

Methodological Appendix A

1 Measuring Gentrification

While many have noted the lack of consensus in gentrification research on the outcomes, prevalence, and location of gentrification, only a handful have sought to compare the definitions and measures adopted across the literature to identify gentrifying neighborhoods. Scholars of gentrification use definitions of gentrification that are as varied as the conclusions they ultimately draw. In the following study, we try to account for possible discrepancies resulting from the gentrification definition used by closely replicating four distinct gentrification measures from the literature and comparing their results to assess the degree of overlap or disagreement between the measures.

1.1 Census-based Measures

Many of the most prominent empirical studies traditionally fall back on measuring gentrification through relying on Census data to mark long-term socioeconomic changes at the Census tract level (Vigdor et al., 2002; Freeman, 2005; Ellen and O'Regan, 2011). These studies typically involve a two-step process that first identifies Census-tracts that are eligible to gentrify, and then further identifies those that proceed to actually gentrify within the observation period. Tracts are deemed “gentrifiable” if they fall below some threshold of socioeconomic status at the beginning of the observation period and as “gentrifying” if large, positive changes in socioeconomic status are observed by the end of the observation period. In order to account for the relative nature of gentrification and the variables at hand, many studies measure socioeconomic status of each tract relative to all tracts within its metropolitan area. While the broad operationalization remains largely consistent, the duration of the observation period, the variables used to quantify socioeconomic status, and the thresholds involved in determining a large enough change vary substantially from study to study.

As such, we replicated three distinct Census-based measures of gentrification. Two of the three follow this traditional two-step approach in the literature to identify gentrifying tracts from a subset of tracts considered eligible to gentrify. For all three of these measures, we draw upon the Longitudinal Tract Data Base (LTDB) and the American Community Survey (ACS) five-year estimates from 2012-2016 to observe tract-level socioeconomic changes between 2000 and 2014. The advantage of using the LTDB is that estimates from the 2000 decennial census are provided at 2010 geographies, which allows for a straightforward comparison with the ACS data from more recent years. While some scholars have opted to only include urban tracts in their analysis, we have included both urban and suburban tracts in the top 200 most populous core-based statistical areas (CBSAs).

1.2 Owens Measure

The first of our three Census-based measures replicates the measure of “neighborhood socioeconomic ascent” from Owens’ “Neighborhoods on the Rise: A Typology of Neighborhoods Experiencing Socioeconomic Ascent” which characterizes neighborhoods as “ascending” if they experienced large socioeconomic changes regardless of the initial tract characteristics (Owens, 2012). We replicated Owens’ use of a principle component analysis (PCA)¹ to calculate a socioeconomic status (SES) score for each tract using five distinct variables: median household income, median house value, median gross rent, proportion of residents over 25 years old with at least a four-year college degree, and proportion of the civilian labor force employed in a professional occupation². We then transformed the tract SES scores into percentile rankings within that tract’s CBSA for 2000 and 2014. Using these percentile scores, Census tracts that saw an increase of 10 percentage points or more between 2000 and 2014 were identified as “ascending” tracts. In our analysis, around 15.8% of top 200 CBSA tracts were classified as ascending, which is comparable to the 13.7% of tracts identified in Owens 2012 for the 2000 to 2005-2009 time period which is about seven years shorter than the observation period we used (Owens, 2012). The sample in Owens 2012 included any tract in a Metropolitan Statistical Area (MSA) as defined in 1999 (Owens, 2012).

1.2.1 Typology of Ascending Neighborhoods

We also replicated Owens’ method of identifying the typology of ascending neighborhoods using tract characteristics in 2000. Using 14 additional population and housing variables, we performed an additional PCA and retained the five factors with eigenvalues over one³. These factor scores were then clustered using k-means clustering to classify the ascending tracts into the five categories Owens also identifies for the 2000 time period: minority urban, affluent, diverse urban, upper middle class white suburban, and booming suburbs. The average tract characteristics in 2000 for ascending tracts identified according to cluster is summarized in Table 1.

1.3 Timberlake and Johns-Wolfe Measure

The second census-based measure drew upon the recent study by Timberlake and Johns-Wolfe on gentrifying neighborhoods in Chicago and New York (Timberlake and Johns-Wolfe, 2017). Neighborhood SES scales were constructed using four tract-level variables: percentage of residents not in poverty, percentage over 25 years old with greater than a high school degree, percentage employed in professional or technical occupations, and average family income. Following closely the methods of Timberlake and Johns-Wolfe 2017, we conducted a PCA to construct a combined SES score for each tract in both years and transformed these scores into quintiles within that tract’s CBSA for that year. Any tract in the bottom three quintiles within its CBSA in 2000 was marked as “gentrifiable”. From these, if the tract increased by at least two quintiles by 2014 and did not lose more than 50% of its population, it was further categorized as “gentrifying”.

While Timberlake and Johns-Wolfe 2017 record a gentrifying rate of 16.4% among tracts at risk of gentrifying at the beginning of their observation period (gentrifiable), the rate calculated

¹Robust standardization of all variables were conducted before carrying out the principle component analysis.

²Tracts with missing data for any of these variables were dropped. Our final sample for this measure contained 52,219 tracts from the top 200 CBSAs.

³The number of factors retained align with Owens, 2012 for the 2000 time period

Table 1: Average of 2000 Characteristics for Ascending Neighborhoods by Type

	Affluent	Booming Suburb	Diverse Urban	Minority Urban	Upper Middle Class	White Suburban
% White	76.8	80.9	24.8	21.8	84.0	
% Black	4.9	7.6	10.4	66.8	7.1	
% Latinx	7.1	7.3	53.6	8.5	5.7	
% Asian	10.1	2.8	9.4	1.5	1.9	
% Foreign-Born	15.0	6.6	36.0	7.8	6.1	
Tract Population	3,840.5	5,008.9	4,361.7	3,368.1	3,051.3	
N of Households	1,511.4	1,865.3	1,340.1	1,231.0	1,267.2	
% New Housing	53.7	65.1	37.1	14.7	38.9	
% Residents Under 18	22.9	27.0	30.6	29.8	21.5	
% Residents Under 5	6.0	7.2	8.8	8.0	5.5	
% Fem Headed Households	6.5	10.2	17.4	34.0	10.6	
Poverty Rate	5.1	7.3	21.9	28.4	10.7	
% Urban Tracts	34.7	17.1	55.3	78.1	30.2	
Med HH Income	76,212.9	50,803.2	34,750.5	26,691.7	40,251.7	
Med house value	286,492.2	126,091.7	129,271.5	78,574.2	106,388.3	
Med rent	945.7	572.8	564.2	408.6	485.6	
% BA	52.3	33.6	20.7	21.5	30.8	
% High-status job	54.6	33.6	20.7	21.5	30.8	

among gentrifiable tracts in our sample is 4.22%. A couple of key differences between our sample and Timberlake and Johns-Wolfe 2017 could contribute to this discrepancy. These differences include that their sample only contains urban tracts in the New York and Chicago metro areas while we replicate this measure across all suburban and urban tracts in the top 200 CBSAs. When we restrict our sample to only include urban tracts across the top 200 metro areas, the rate of gentrification increases to 5.82%. When we further restrict to urban tracts in the New York and Chicago metropolitan areas, the rate of classification increases further to 7.57%. Furthermore, while they use a 30-year observation period from 1980 to 2010, we use a 14-year observation period from 2000 to 2014. Regarding their chosen time frame, Timberlake and Johns-Wolfe write “whereas in 2010 16.4% of neighborhoods at risk of gentrifying in 1980 had gentrified, in 1990 this figure was 4.8% and in 2000 it was 9.5%. We believe that this is good evidence that gentrification unfolded over the three decades between 1980 and 2010”.

1.3.1 Racial Majority

We also replicated the categorization of gentrifying tracts by racial majority at the end of the gentrifying period used in Timberlake and Johns-Wolfe 2017. Gentrifying tracts were further stratified into *gentrifying white*, *gentrifying black*, *gentrifying latinx*, and *gentrifying no majority*.

1.4 Ding et al. Measure

The third census-based measure closely replicated the methods used in “Gentrification and Residential Mobility in Philadelphia” to identify gentrifying neighborhoods in Philadelphia as well as the stage and degree of gentrification occurring (Ding et al., 2016). In this paper, Census tracts that had median incomes that fell below the CBSA-wide median in 2000 were deemed “gentrifiable”. Tracts were further categorized as “gentrifying” if it experienced both an above CBSA-wide median percentage increase in either its median gross rent or median home value as well as an above CBSA-wide median increase in its share of college-educated residents (Ding et al., 2016).

1.4.1 Stages and Pace of Gentrification

Following the methods of Ding et al., we further distinguished between tracts that were previously gentrifying before 2000 by examining tract-level changes from 1980 and 1990 to 2000⁴. Tracts that had gentrified either from 1980-2000 or 1990-2000, were gentrifiable in 2000, and were gentrifying by 2014 were categorized as *continued gentrification*. Tracts that were similarly gentrifying pre-2000 and gentrifiable in 2000 but did not gentrify by 2014 were categorized as *stalled gentrification*. Tracts that were gentrifiable in 2000 but nongentrifying in both 2000 and pre-2000 were considered *never gentrifying*.

Among all tracts that newly begun gentrifying in the 2000-2014 period, we classified them into three categories according to their pace of gentrification: *weak gentrification*, *moderate gentrification*, and *intense gentrification*. The pace of gentrification was determined by the quartiles of median rent prices or home values in 2014. Gentrifying tracts in the top quartile for rent or house value in their CBSA were categorized as *intense gentrification*, while gentrifying tracts in the bottom quartile for both rent and house value were categorized as *weak gentrification*. The remaining gentrifying tracts were classified as *moderate gentrification*.

⁴All estimates for 1980 and 1990 were taken from the LTDB with 2010-standardized tract geographies.

1.5 Price Measure

In addition to the Census-based approaches to measuring gentrification, we include a fourth measure in our analysis which utilizes annual price-to-income ratios as an indicator for the onset of gentrification (Aron-Dine and Bunten, 2019). Capitalizing on the feature of housing prices as a reflection of “both the current composition of the neighborhood as well as expectations of its future change,” the measure relies upon the expectation that housing prices will lead rents and incomes at the onset of gentrification as home buyers and sellers understand and respond to the gentrification process. Using annually available tract-level housing prices and incomes, a percentile ranking for each variable and a resulting gap can be calculated, identifying the first year of incipient gentrification. We replicate this process closely to identify “gentrifiable” and “gentrifying” tracts.

All census-based estimates used in this measure were taken from the 2000 LTDB estimates standardized to 2010 geographies.

1.5.1 Housing Prices: FHFA

Following Aron-Dine and Bunten’s approach, we use annual house price indices (HPI) from the Federal Housing Finance Agency (FHFA) in order to track the changes in housing prices at the tract level for each year in our observation period. Tracts for which no price indices were available were augmented with zip code-level indices also provided by the FHFA⁵. Out of the 72,702 Census tracts in 2010, we had no tract or zip level indices for 2,819 tracts. However, even among tracts with available HPIs, some tract indices begin several years after 2000. Given that the HPIs are grown out based on the median house value of that tract in 2000 (taken from the LTDB estimates), we would not be able to grow out actual housing values for tracts without a valid index in 2000⁶. For these tracts, we impute the HPI in 2000 using the zip-level index between 2000 and the first year for which tract-level data is available and adjust all other years to the new baseline in 2000⁷.

1.5.2 Income: IRS

In order to get yearly income statistics at the tract-level, we started with the Internal Revenue Service (IRS) average household income available annually at the zip code-level. Given that the averages are not robust to outliers, we truncate the values at the 0.5% and 99.5% quantiles and then convert these values to indices similar to the HPIs using 2001 as a baseline year⁸. Using a tract-to-zip crosswalk⁹, we assign yearly income indices at the tract level and then grow these out using the 2000 LTDB estimates of median household income for that tract¹⁰.

⁵Census tracts do not map perfectly to zip codes; some tracts contain several distinct zip codes. We assign one zip code to every tract to build a tract-to-zip crosswalk based on (1) if any FHFA data is available for that zip code, and (2) the percentage of land area covered by that zip code within the tract.

⁶Or 2001, which we believe is a sufficiently benign proxy for 2000.

⁷The states with the highest percentage of missing values among its CBSA tracts are New York (14%), West Virginia (11%), and North Dakota (6.4%). All other states are missing less than 5% of their CBSA tract data.

⁸If we did not truncate the averages, an extreme outlier (e.g. a highly negative number) in the baseline year would skew all other indices of that tract to implausible numbers.

⁹We use the dominant zip code by land area.

¹⁰By converting the IRS statistics into indices at the zip level and then growing them out at the tract level, we allow for variation in the absolute income of tracts with the same zip code even if the relative changes between years are the same.

1.5.3 Price-to-income Gap

After calculating a yearly index for both housing prices and income at the tract level, we convert both of these variables into population-weighted percentile rankings within each tract's CBSA for that year and are able to calculate the gap between housing price and income percentiles for every tract in every year available. Tracts are identified as “gentrifiable” if in the earliest year available, they are in the bottom 60% for both housing prices and income within its CBSA. We further restrict “gentrifiable” tracts to only include those that start with a price-to-income gap of less than 25 percentage points¹¹. Of these tracts, those that see any year in which the housing price percentile leads the income percentile by 25 percentage points or more are further identified as “gentrifying”.

2 Comparison of Gentrification Measures

2.1 Cross Tabulations

2.1.1 Owens & Timberlake and Johns-Wolfe

The cross-tabulation of the categorization of tracts from the top 200 CBSAs by the Owens and Timberlake Johns-Wolfe (TJW) measures are summarized below in Table 2. The classification rate of the TJW measure as gentrifying is much lower (2.3%) than the rate of classification as ascending by the Owens measure (15.8%). As such, we can see that a vast majority of tracts identified as gentrifying by the TJW measure is also considered as an ascending neighborhood by the Owens measure (98%) while only 14.6% of ascending tracts are also considered gentrifying by the TJW measure. Looking at the cross-tabulation of Owens ascending tracts by TJW gentrification classification summarized in Table 3, we can see that this discrepancy is due, in part, to that many affluent and booming suburb ascending neighborhoods are more likely to fail the initial “gentrifiable” restriction of the TJW measure, and are thus not identified as having begun gentrifying by 2014. A comparison of the bivariate relationship between Owens ascending tracts and TJW gentrifying tracts yields a phi coefficient of 0.35 ($N = 52,219$)¹².

2.1.2 Owens & Ding et al.

The cross-tabulation of the categorization of tracts by the Owens measure and the Ding et al. (DHD) measure are is summarized in Table 4. We can see that the DHD measure classifies tracts as gentrifying at a higher rate (23.4%) than the Owens measure classifies tracts as ascending (15.8%). While a majority of ascending tracts are also identified as gentrifying by the DHD measure (58%), a substantial proportion are considered not gentrifiable (36.1%). Looking at all DHD gentrifying tracts, about 60% were classified as not ascending by the Owens measure. A comparison of the bivariate relationship between Owens ascending tracts and DHD gentrifying tracts also yields a phi coefficient of 0.35 ($N = 52,219$).

2.1.3 Owens & Price

The cross-tabulation of the categorization of tracts by the Price measure with that of the Owens measure is summarized in Table 5. Looking at the overall rate of classification as ascending or gen-

¹¹This step excludes tracts that theoretically began gentrifying before our observation period from our sample.

¹²“Phi coefficients have a similar interpretation to Pearson correlation coefficients but are used to assess bivariate relationships when at least one variable is categorical”(Barton, 2016).

Table 2: Cross Tabulation of Owens and Timberlake Johns-Wolfe Measures

	<i>Timberlake Johns-Wolfe:</i>			
	gentrifiable	gentrifying	not gentrifiable	<i>Row Total:</i>
ascending	5,336	1,203	1,703	8,242
<i>% of row</i>	64.7	14.6	20.7	15.8
<i>% of column</i>	17.7	98	8.2	
<i>Owens:</i>				
not ascending	24,853	24	19,100	43,977
<i>% of row</i>	56.5	0.1	43.4	84.2
<i>% of column</i>	82.3	2	91.8	
<i>Column Total:</i>	30,189	1,227	20,803	52,219
	57.8	2.3	39.8	

Table 3: Cross Tabulation of Timberlake Johns-Wolfe Classification and Owens Ascending Tracts

	<i>Timberlake Johns-Wolfe:</i>			
	gentrifiable	gentrifying	not gentrifiable	<i>Row Total:</i>
Affluent	115	32	305	452
<i>% of row</i>	25.4	7.1	67.5	5.5
<i>% of column</i>	2.2	2.7	17.9	
Booming Suburb	1,287	136	659	2,082
<i>% of row</i>	61.8	6.5	31.7	25.3
<i>% of column</i>	24.1	11.3	38.7	
<i>Owens:</i>				
Diverse Urban	1,004	257	47	1,308
<i>% of row</i>	76.8	19.6	3.6	15.9
<i>% of column</i>	18.8	21.4	2.8	
Minority Urban	900	267	17	1,184
<i>% of row</i>	76	22.6	1.4	14.4
<i>% of column</i>	16.9	22.2	1	
Upper Middle-Class Suburb	2,030	511	675	3,216
<i>% of row</i>	63.1	15.9	21	39
<i>% of column</i>	38	42.5	39.6	
<i>Column Total:</i>	5,336	1,203	1,703	8,242
	64.7	14.6	20.7	

Table 4: Cross Tabulation of Owens and Ding et al. Measures

	<i>Ding et al.:</i>			
	gentrifiable	gentrifying	not gentrifiable	<i>Row Total:</i>
ascending	485	4,780	2,977	8,242
<i>% of row</i>	5.9	58	36.1	15.8
<i>% of column</i>	3.5	39.2	11.4	
<i>Owens:</i>				
not ascending	13,451	7,426	23,100	43,977
<i>% of row</i>	30.6	16.9	52.5	84.2
<i>% of column</i>	96.5	60.8	88.6	
<i>Column Total:</i>	13,936	12,206	26,077	52,219
	26.7	23.4	49.9	

trifying, the Owens rate (15.2%) is much higher than the Price classification rate (5.6%). However, unlike with the TJW measure, a much larger proportion of Price-gentrifying tracts are classified as not ascending by the Owens measure (72.4%) than are classified as ascending (23.6%). While the Owens-ascending tracts overlap with the Price-gentrifying tracts at a rate slightly higher (8.6%) than the baseline (5.6%), a vast majority of ascending tracts overlap with the tracts identified as either not gentrifiable or gentrifiable and non-gentrifying by the Price measure. This seeming lack of overlap between the two measures is reflected in a small phi coefficient yielded of 0.06 ($N = 50,096$).

Table 5: Cross Tabulation of Owens and Price Measures

	<i>Price:</i>			
	gentrifiable	gentrifying	not gentrifiable	<i>Row Total:</i>
ascending	3,580	659	3,382	7,621
<i>% of row</i>	47	8.6	44.4	15.2
<i>% of column</i>	17.1	23.6	12.8	
<i>Owens:</i>				
not ascending	17,375	2,137	22,963	42,475
<i>% of row</i>	40.9	5	54.1	84.8
<i>% of column</i>	82.9	76.4	87.2	
<i>Column Total:</i>	20,955	2,796	26,345	50,096
	41.8	5.6	52.6	

2.1.4 Timberlake and Johns-Wolfe & Ding et al.

The cross-tabulation of the Timberlake and Johns-Wolfe measure with the Ding et al. measure is summarized in Table 6. Given the disparity in classification rate (TJW: 2.4%, DHD: 23.2%), it is unsurprising that the majority of TJW-gentrifying tracts are also classified as gentrifying by the DHD measure (80.5%). Yet, a non-trivial proportion of the TJW-gentrifying tracts are classified as not gentrifiable by the DHD measure (15.6%). A comparison of the bivariate relationship between TJW-gentrifying tracts and DHD-gentrifying tracts yields a phi coefficient of 0.21 ($N = 53,945$).

Table 6: Cross Tabulation of Timberlake Johns-Wolfe and Ding et al. Measures

		<i>Timberlake and Johns-Wolfe:</i>			
		gentrifiable	gentrifying	not gentrifiable	Row Total:
gentrifiable	gentrifiable	13,038	51	1,362	14,451
	% of row	90.2	0.4	9.4	26.8
	% of column	42.1	4	6.3	
<i>Ding et al.:</i>	gentrifying	10,814	1,034	680	12,528
	% of row	86.3	8.3	5.4	23.2
	% of column	34.9	80.5	3.1	
not gentrifiable	gentrifiable	7,150	200	19,616	26,966
	% of row	26.5	0.7	72.7	50
	% of column	23.1	15.6	90.6	
<i>Column Total:</i>		31,002	1,285	21,658	53,945
		57.5	2.4	40.1	

2.1.5 Timberlake and Johns-Wolfe & Price

The cross-tabulation of the Timberlake Johns-Wolfe and Price measure is summarized in Table 7. Both measures have relatively low classification rates and a low proportion of tracts are classified as gentrifying by both measures (155 tracts). The vast majority of the Price-gentrifying tracts are classified as gentrifiable only by the TJW measure (87.1%) while only 5.4% are classified as gentrifying. Among the TJW-gentrifying tracts, just 13.9% are also classified as gentrifying by the Price measure. A comparison of the bivariate relationship between the two measures yields a phi coefficient of 0.05 ($N = 51,563$).

2.1.6 Ding et al. & Price

The cross-tabulation of the DHD and Price measures are summarized in Table 8. The Price appears to have slightly more overlap with the DHD measure than with the TJW or Owens measure. A plurality of the Price-gentrifying tracts were also classified by the DHD measure as gentrifying (48.5%). However, a majority of the DHD-gentrifying tracts were classified as gentrifiable only by

Table 7: Cross Tabulation of Timberlake Johns-Wolfe and Price Measures

		<i>Timberlake and Johns-Wolfe:</i>			
		gentrifiable	gentrifying	not gentrifiable	<i>Row Total:</i>
	gentrifiable	19,463	492	1,409	21,364
	% of row	91.1	2.3	6.6	41.4
	% of column	67.2	44	6.6	
<i>Price:</i>	gentrifying	2,486	155	212	2,853
	% of row	87.1	5.4	7.4	5.5
	% of column	8.6	13.9	1	
	not gentrifiable	7,019	471	19,856	27,346
	% of row	25.7	1.7	72.6	53
	% of column	24.2	42.1	92.5	
<i>Column Total:</i>		28,968	1,118	21,477	51,563
		56.2	2.2	41.7	

the Price measure (68.9%). This could, in part, be a function of the much higher classification rate of the DHD measure than the Price measure (21.6% and 5.5% respectively). A comparison of the bivariate relationship between the two measures yields a phi coefficient of 0.16 ($N = 52,174$).

Table 8: Cross Tabulation of Ding et al. and Price Measures

		<i>Ding et al.:</i>			
		gentrifiable	gentrifying	not gentrifiable	<i>Row Total:</i>
	gentrifiable	9,981	7,771	3,795	21,547
	% of row	46.3	36.1	17.6	41.3
	% of column	72.7	68.9	14	
<i>Price:</i>	gentrifying	1,370	1,393	109	2,872
	% of row	47.7	48.5	3.8	5.5
	% of column	10	12.4	0.4	
	not gentrifiable	2,385	2,111	23,259	27,755
	% of row	8.6	7.6	83.8	53.2
	% of column	17.4	19.7	85.6	
<i>Column Total:</i>		13,736	11,275	27,163	52,174
		26.3	21.6	52.1	

2.2 Mapping the Measures

To illustrate how the measures interact spatially in a single metropolitan area, we map the broad categorization of tracts in the Chicago-Naperville-Elgin CBSA for each measure. The broad gentrification categories for the Owens and TJW measures are displayed in Figures 1 and 2 respectively, while those for the DHD and Price measures are displayed in Figures 3 and 4.

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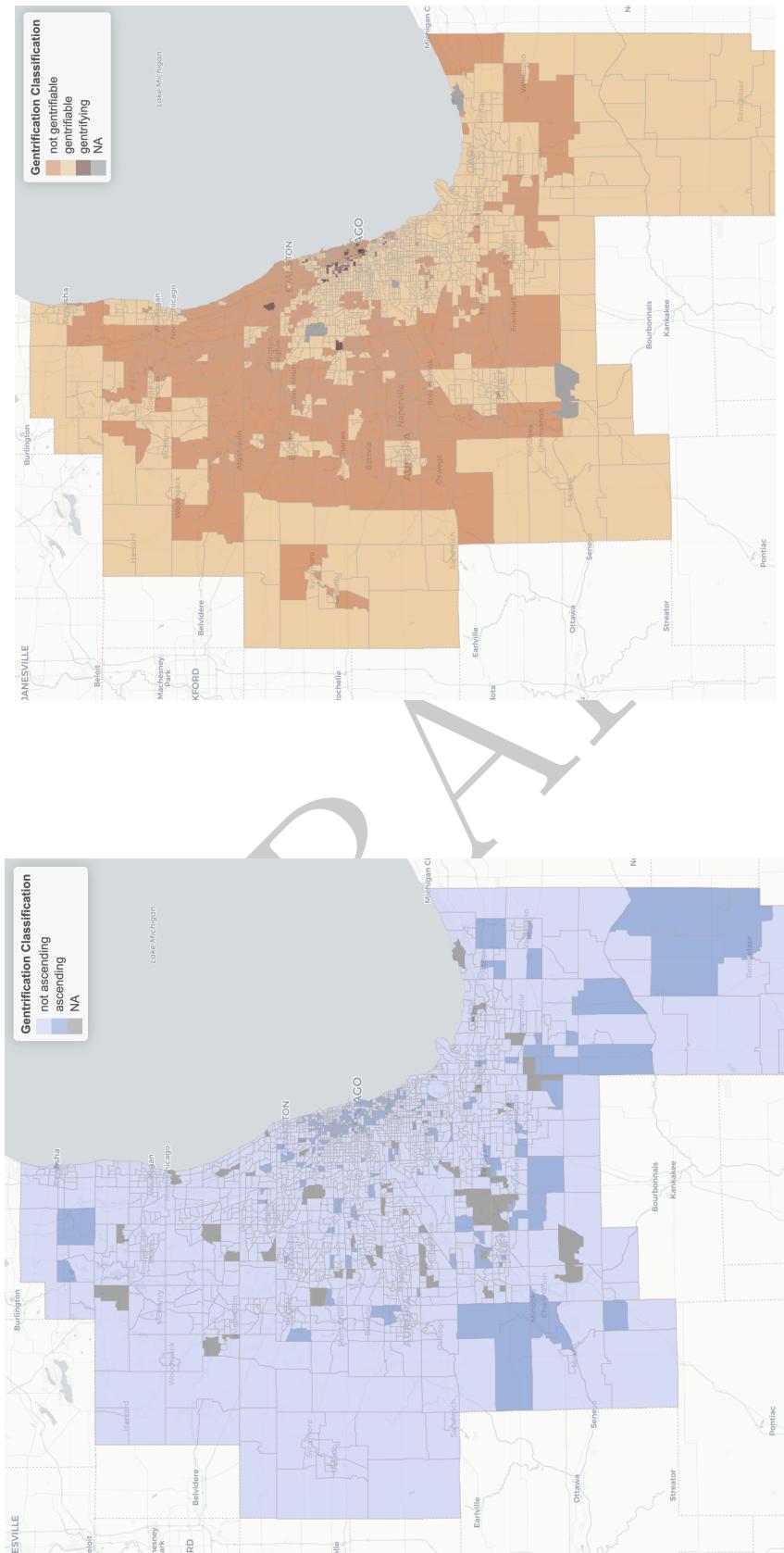


Figure 2: Gentrification by TJW Measure for Tracts in the Chicago-Naperville-Elgin Metropolitan Area

Figure 1: Gentrification by Owens Measure for Tracts in the Chicago-Naperville-Elgin Metropolitan Area

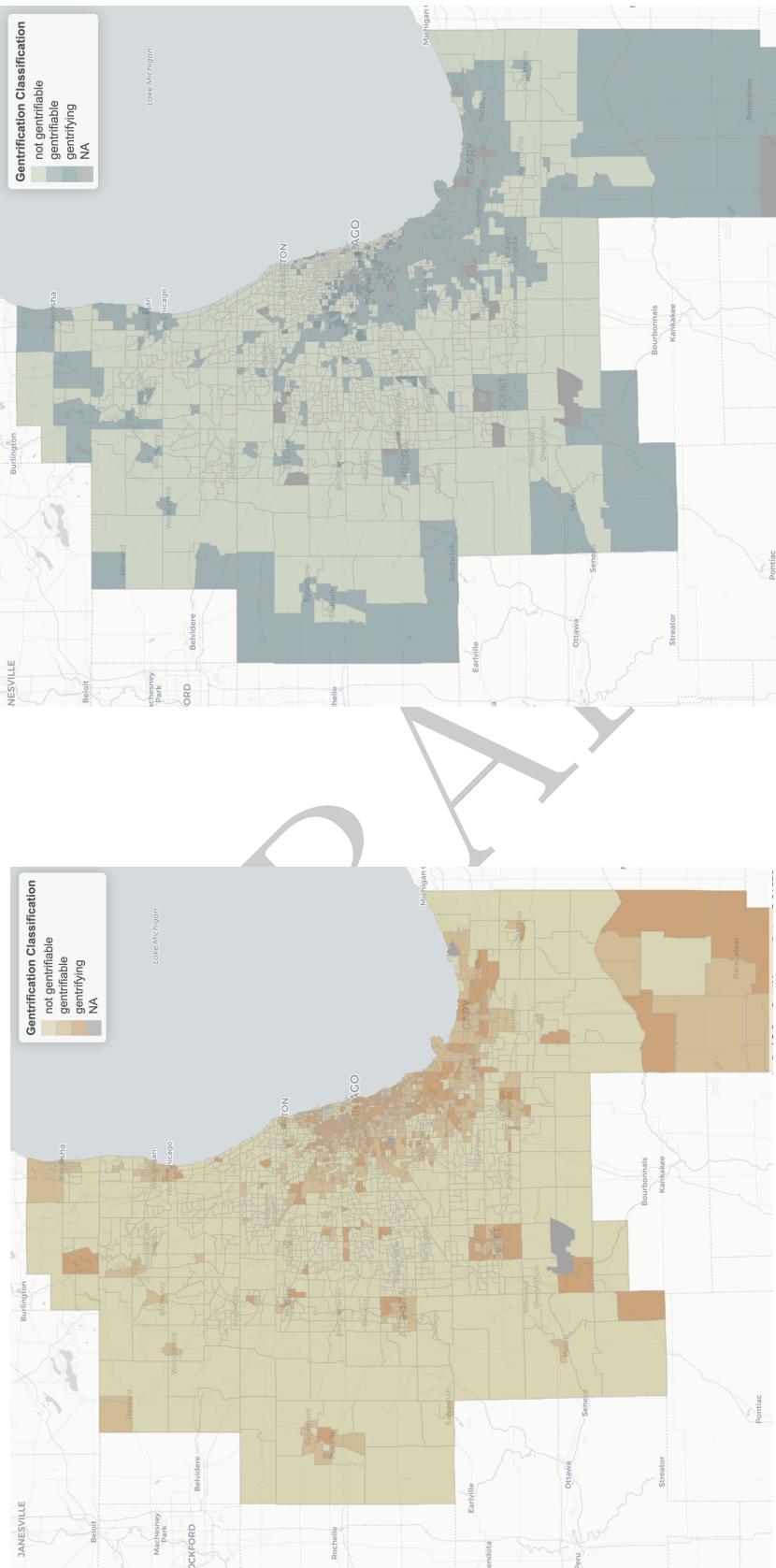


Figure 3: Gentrification by DHD Measure for Tracts in the Chicago-Naperville-Elgin Metropolitan Area

Figure 4: Gentrification by Price Measure for Tracts in the Chicago-Naperville-Elgin Metropolitan Area

Even looking at the broad categorization of the tracts by the different measures, a substantial amount of heterogeneity is evident. While the Price and TJW gentrifying tracts seem to cluster mostly in the urban center of Chicago, the ascending and gentrifying tracts identified by the Owens and DHD measure are more spread out between both urban and suburban spaces. A breakdown of the place type of gentrifying tracts identified by each measure is summarized in Table 9.

Table 9: Comparison of Urban-Suburban Variable by Gentrifying Measure)

		Gentrifying/Arcending				
	Full Sample	<i>Any Measure</i>	<i>Owens</i>	<i>TJW</i>	<i>DHD</i>	<i>Price</i>
Urban	19,652 35.9%	8,102 46.2%	3,338 40.5%	753 58.6%	6,695 53.0%	1,728 60.2%
Suburban	35,020 64.1%	9,432 53.8%	4,904 59.5%	532 41.4%	5,926 47.0%	1,144 39.8%

To get a more detailed sense of the heterogeneity between the measures, we also map the types of gentrifying tracts according to the sub-categories each measure affords, focusing on the urban center of the Chicago-Naperville-Elgin CBSA. These are displayed in Figures 5, 6, and 7 for the Owens, TJW and DHD measures respectively.

2.3 Discrepancies Between Measures

Broadly, among all tracts identified as gentrifying or ascending by at least one of the four measures, the mean number of measures which identify that tract as gentrifying/ascending is 1.43. About 66.4% of tracts are identified by just one of the four measures while just 0.8% are identified by all four measures as gentrifying or ascending. If we look at the gentrifiable variable (for the TJW, DHD and Price measures), the average tract considered gentrifiable by at least one measure is identified by 2.37 measures as gentrifiable (median = 3). This differing agreement rate for the gentrifiable and gentrifying variables could be driven, in part, by the difference in classification rate for each variable by the measures. For example, while the TJW and Price measures have very low rates of classifying a tract as gentrifying (2.4% and 5.5% respectively), both measures have relatively much higher rates of classifying tracts as gentrifiable (59.9% and 46.8% respectively). If we were to calculate the variance across all relevant measures for the gentrifiable and gentrifying/ascending variables, across all tracts in our sample there is an average variance of 0.0838 for the gentrifiable measure and 0.0878 for the gentrifying/ascending measure. At the CBSA-level, the CBSA with the highest average variance in the gentrifiable variable is the San Luis Obispo-Paso Robles-Arroyo Grande, CA Metro area (0.157 average variance) while Fayetteville, NC yielded the highest average variance in the gentrifying/ascending variable (0.133 average variance)¹³.

A group of outlier tracts of interest might be tracts that were considered gentrifying by one measure but not gentrifiable by another. Among all tracts that were considered gentrifying or

¹³The number of tracts in these CBSAs are 53 and 77 respectively

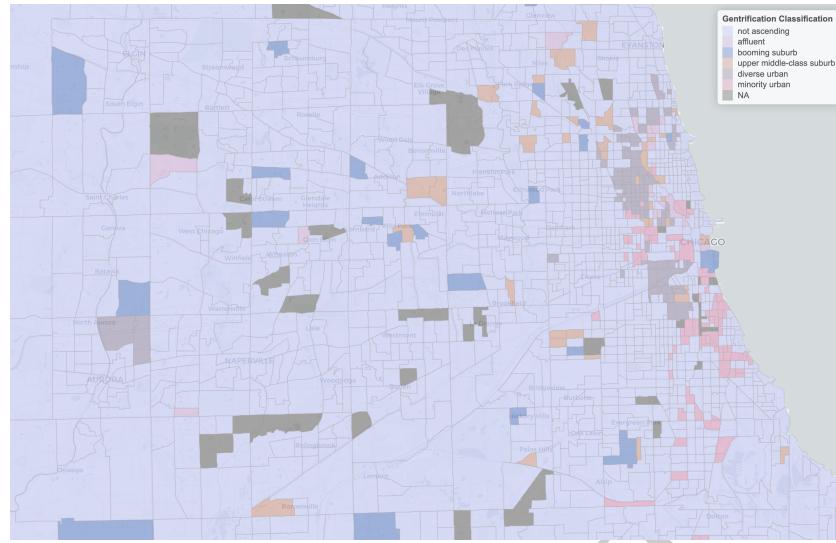


Figure 5: Gentrification by Owens Measure with Cluster Type

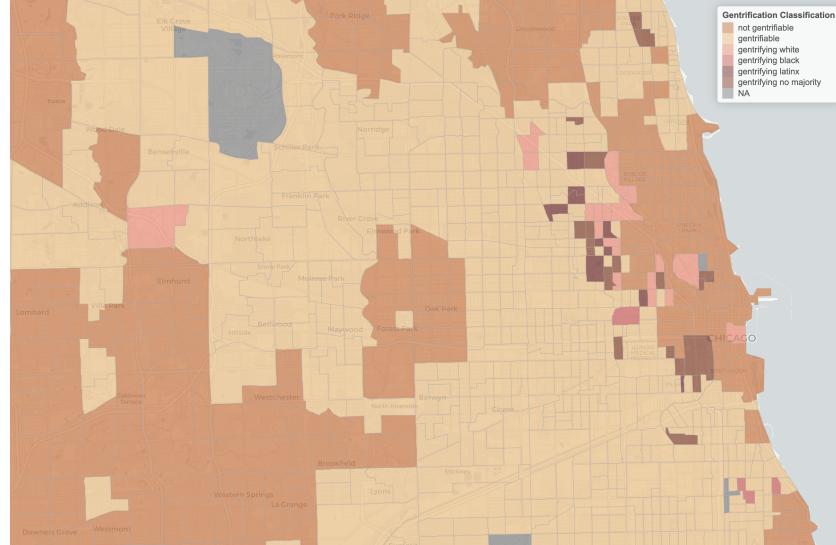


Figure 6: Gentrification by TJW Measure with Race Majorities

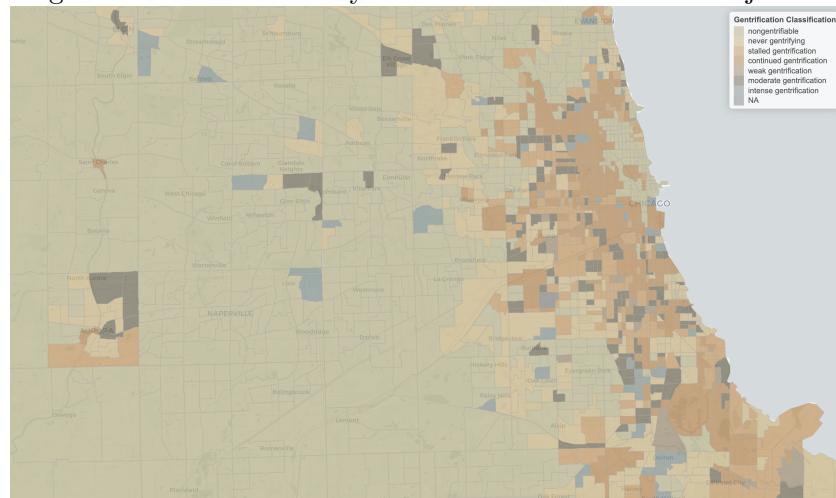


Figure 7: Gentrification by DHD Measure with Gentrifying Type

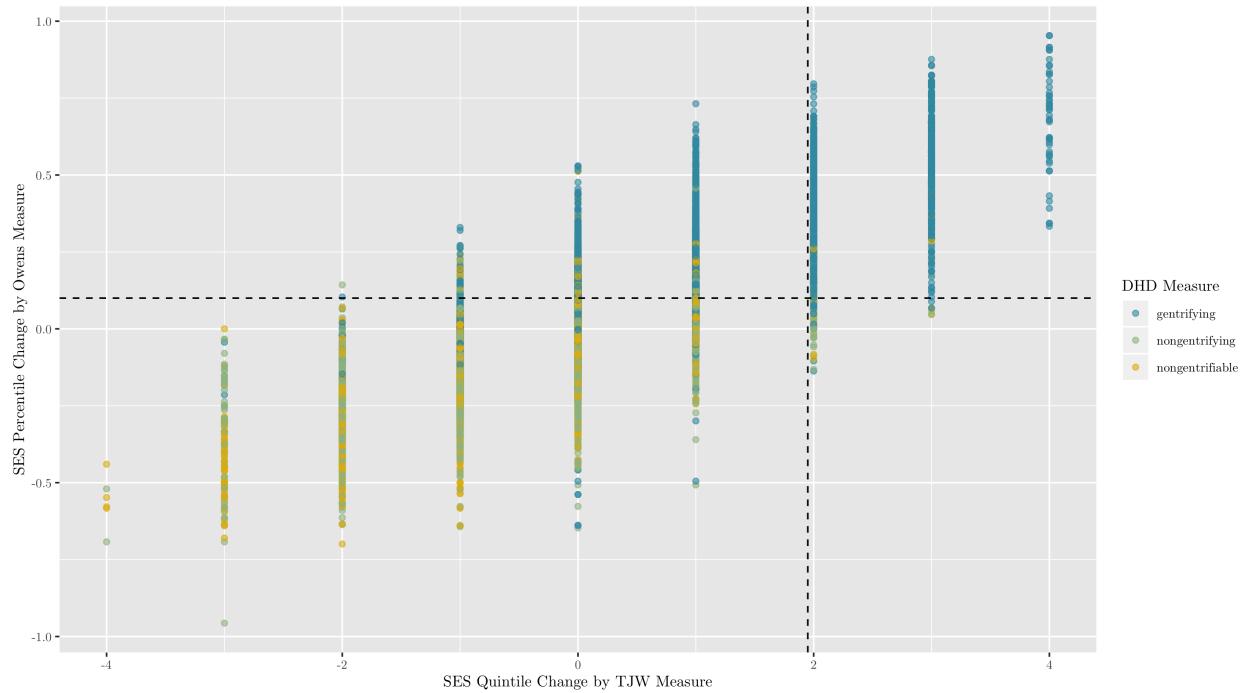


Figure 8: SES Change by Owens Measure Against TJW Measure Stratified by DHD Classification

ascending by at least one of the four measures, 35.3% were considered not gentrifiable by at least one of the three measures that classifies tracts as such. If we were to exclude the Owens ascending tracts, 21.7% of gentrifying tracts are considered not gentrifiable by at least one other measure. The CBSAs with the highest proportion of gentrifying tracts that fall in this category are College Station-Bryan, TX (57.1%); Greeley, CO(56.2%); and Fargo, ND-MN (54.5%)¹⁴.

If we look at Figure 8, we see quite a lot of harmony between the DHD measure and the changes in SES according to the Owens measures. A large majority of the tracts that fall above the Owens threshold for ascending neighborhoods are also classified as gentrifying by the DHD measure while many of the tracts considered non-gentrifying or not gentrifiable fall below the 10 p.p. threshold. Given that the Owens measure does not exclude tracts from being classified as ascending or not based on initial tract characteristics while the DHD measure does, it is unsurprising that a few DHD non-gentrifiable tracts are above the Owens threshold. However, most of the non-gentrifiable tracts are not ascending according to the Owens measure.

Relatively less harmony exists between the DHD measure and the TJW measure. Even though few tracts that are above the TJW threshold for gentrifying tracts are not also gentrifying by the DHD measure, many of the tracts that fall below are considered gentrifying by the DHD measure and the Owens measure. If we look at some of these tracts that were considered gentrifying by the DHD measure and ascending by the Owens measure but stayed in the same SES quartile according to the TJW measure,

To further examine the discrepancy in the gentrifiable exclusion variable between the different

¹⁴The total number of tracts in these CBSAs are 52, 76, and 46 respectively.



Figure 9: Initial TJW Measure SES Percentile Against Initial Median Income Percentile

variables, we plot the distribution of points based on their initial (2000) SES rankings according to the TJW measure and their initial (2000) median income as CBSA-specific percentile rankings. This is displayed in Figure 9 where the dashed lines indicate the threshold for the “gentrifiable” variable for the respective measures. Given that household income was one of the variables included in the PCA used to calculate SES rankings by the TJW measure, the strong relationship between the two is unsurprising. Many tracts that fall just above the threshold for the DHD measure are considered gentrifiable by the TJW measure and vice versa.

2.3.1 Gentrifying/Ascending

We also compare the differences in thresholds for the gentrifying/ascending variable. In Figure 10, we plot the change in SES percentile rankings by the Owens measure against the change in SES quintiles by the TJW measure. Many tracts that fall below the threshold of a two-quintile gain to be classified as gentrifying by the TJW measure fall above the Owens threshold and are classified as ascending. Conversely, given the low classification rate of the TJW measure, only a handful of

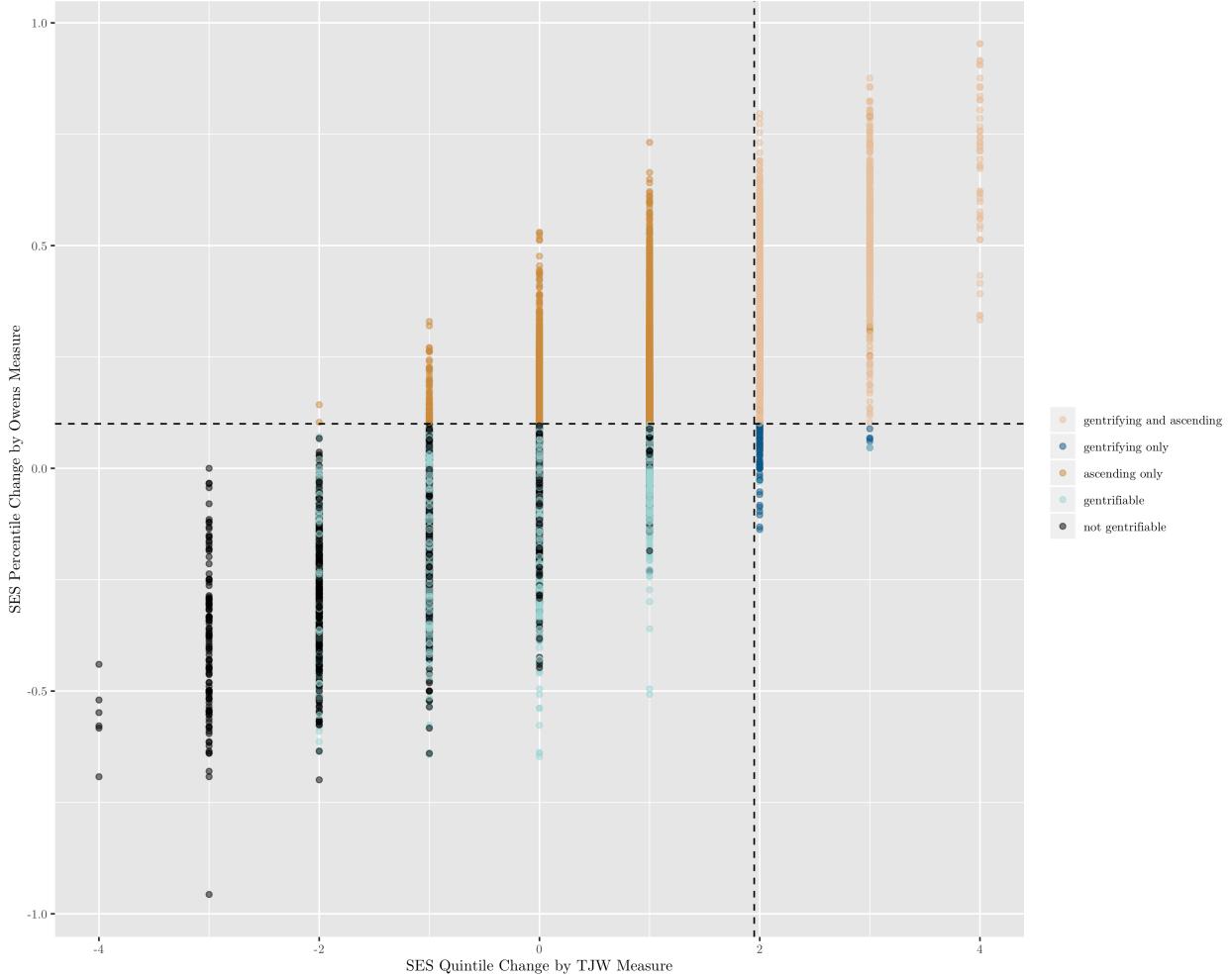


Figure 10: Owens SES Percentile Change Against TJW SES Quintile Change

tracts that fall short of the Owens threshold are considered gentrifying by the TJW measure.

While all three census-based measures rely upon measuring some form of socioeconomic change at the census tract level over the 14 year period, the price measure departs from the others in both theory and construction. Unsurprisingly, the measure with the least amount of overlap with the other measures is the price measure. In order to take a closer look at the relationship between Price categorization and socioeconomic status (SES) at the census tract level, we compare the changes in CBSA percentile rankings in SES as measured by the Owens measure with the categorization of the Price measure. The density plots of SES change over time stratified by the Price measure's categorization are displayed in Figure 11.

From the Figure we can see that Price-gentrifying tracts have a slight positive tail with some tracts falling above the +10 p.p. threshold that would be considered “ascending” under the Owens specifications. While the shape suggests that larger SES changes according to the Owens’ PCA method are slightly more probable among Price-gentrifying tracts, a large majority of Price-

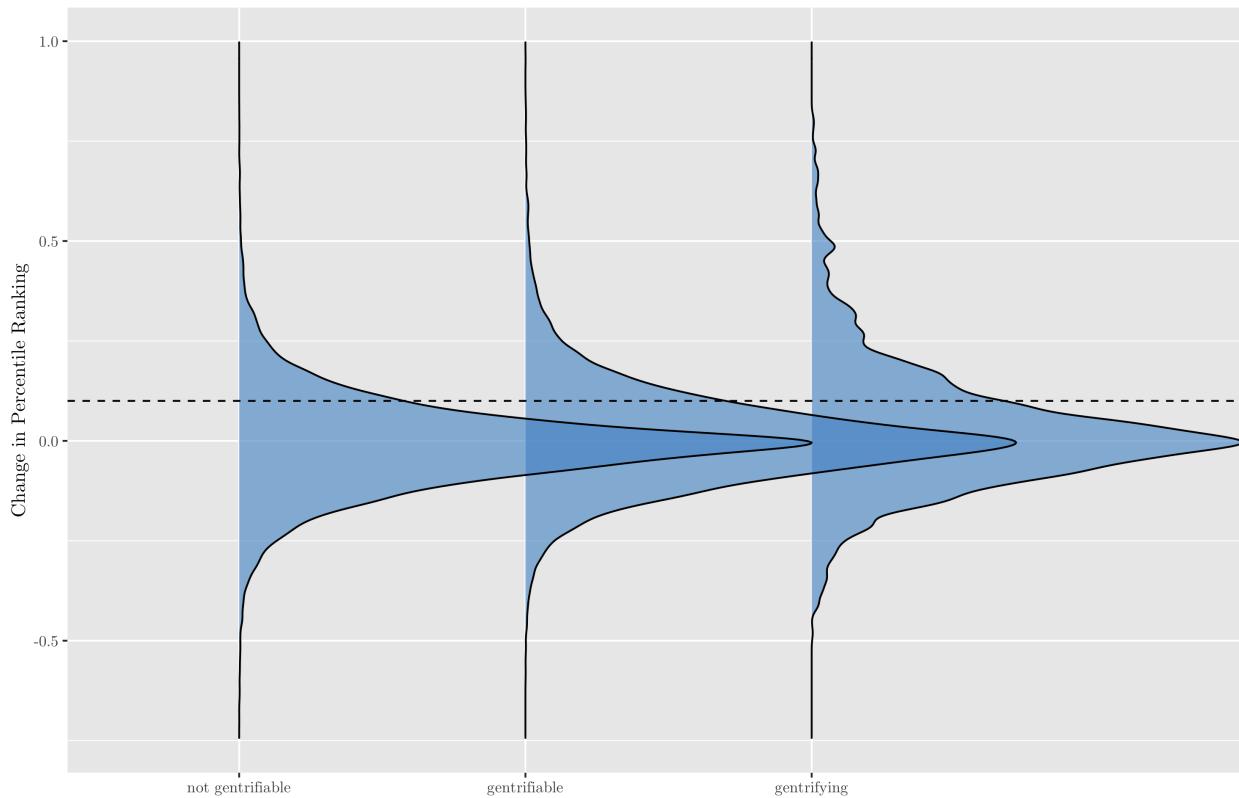


Figure 11: Change in SES Percentile Rank by Price Measure Classification

gentrifying tracts do not exhibit large SES increases in step with the other census-based measures.

2.4 CBSA-level Discrepancies

2.4.1 Discussion on Discrepancies

Since gentrification is largely understood to be a long-term process of neighborhood change, one way of thinking about the discrepancies between the Price measure and the census-based measures could be the stage of gentrification they identify. Since theoretically the Price measure is designed to identify incipient gentrification while the census-based measures rely on measuring the total change accumulated over a fourteen-year period, we might expect the timing of the Price measure to implicate if a tract's demographic changes as a result of gentrification are picked up by a Census-based measure. However, when we examine the first years in which a price-to-income ratio is identified for gentrifying tracts by the Price measure alone, there is no immediate indication that they are any more recent than the years identified for tracts considered gentrifying by both the Price and a census-based measure¹⁵. Additionally, we could also conceive of a tract having the expectations to gentrify (and thus identified by the Price measure at a relatively early year), undergo some of the demographic changes expected to accompany the process of gentrification, but in the later years leading up to 2014 experience disinvestment which would ultimately mask it from either of the census-based measures. While there appears to be quite a substantial amount of divergence between these measures of gentrification, previous similar comparisons of gentrification measures reveal large discrepancies on where and how much gentrification occurs, even only between census data-reliant measures (Barton, 2016; Drew, 2018; Martin, nd). When we further take into account the distinctions in stage and perhaps even type of gentrification the Price and Census-based measures theoretically identify, the divergence we observe in the tracts identified by the different measures is largely within reasonable expectations, even if certain extreme cases remain unaccounted for.

¹⁵A one-sided t-test yielded a t statistic of -0.48 and a p-value of 0.685.

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