COMMUTING BY PUBLIC TRANSPORTATION TRENDS IN LOS ANGELES COUNTY, 2000 - 2010

INTRODUCTION

Traffic congestion is a major challenge faced by most urban or metropolitan areas around the world. As of January 1, 2007, there were over 6.6 million automobiles, commercial vehicles and motorcycles registered in Los Angeles County according to the California Department of Motor Vehicles (DMV). The major cause of traffic congestion is attributed to the dominance of low-occupancy vehicles among other factors. Federal, State, and Local transportation agencies develop transportation policies and plans to address the traffic congestion problem by improving other means of transportation especially mass transit. Public agencies including the Los Angeles Department of Transportation and the Los Angeles Metropolitan Transportation Association are actively seeking ways to encourage alternatives to low occupancy vehicles towards improved traffic flow, safety, and environmental sustainability. These agencies may very well be on the right track. According to a 2009 American Community Surveys (ACS) report published by the U.S. Census Bureau, over seventy-six percent (three-quarters) of workers in the United States drove alone to work as compared to the five percent who used public transit [ACS, 2009]. The question here is how do these percentages vary with socio economic parameters such as population density and income? Is there a relationship at all? What are the characteristics of the areas which have high commutes by public transportation? Are there any changes in trends over time?

Past studies conducted on commuting trends have used tables and graphs to show the changes in commuting trends with demographics over time. For example, Time to Work - Commuting Times and Modes of Transportation of California Workers, a study by Elisa Barbour showed with tables, the changes in transportation modes in major counties in California. However, in this study, means of commute is compared with demographics using maps to visually show the relationship between means of commute, average income, and population density. The use of maps will show the areas which commute more by public transportation, and make it easier to identify which areas should be targeted for alternative transportation developments based on

the demographics of the area. Additionally, the changing trends in commute (if any) from the year 2000 to 2010 is determined.

Study Questions

In this study, GIS analysis is used to address the following questions:

1. Is there a relationship between mode choice, income, and population density? Are there higher rates of public transit commute in low income areas as shown in past studies? Does density drive public transit i.e. more people, more transit usage?
2. Have there been any changes in means of commuting to work with public transportation over the past 10 years (2000 – 2010)?

Output and Implementation

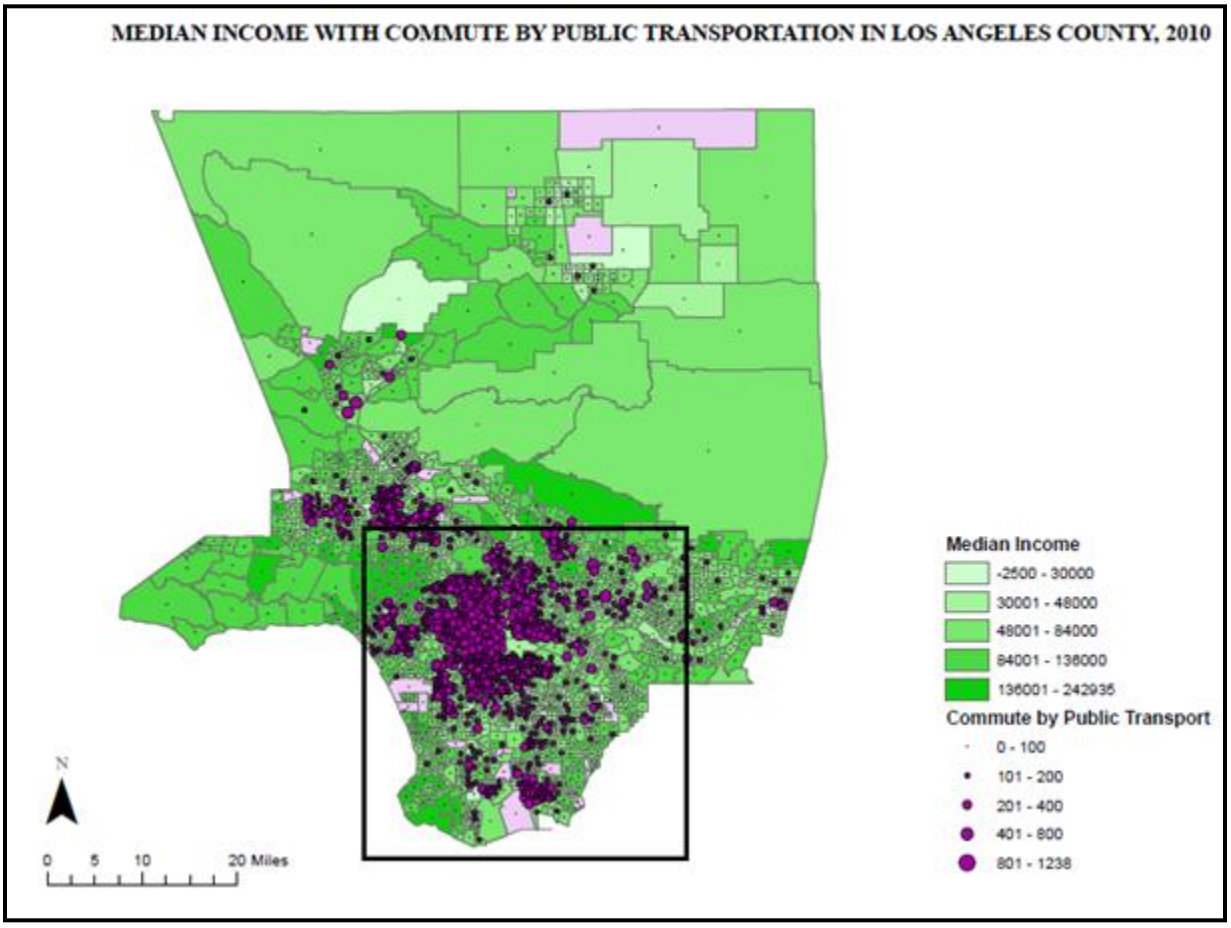
The output of this study will illustrate with maps the relationship, if any, between transport mode and demographics, and the changes over time. The maps produced can be used by City and County Planning Agencies to make timely decisions, and to plan the development of transportation facilities knowing the commuting trends and demographics of the area.

METHODOLOGY

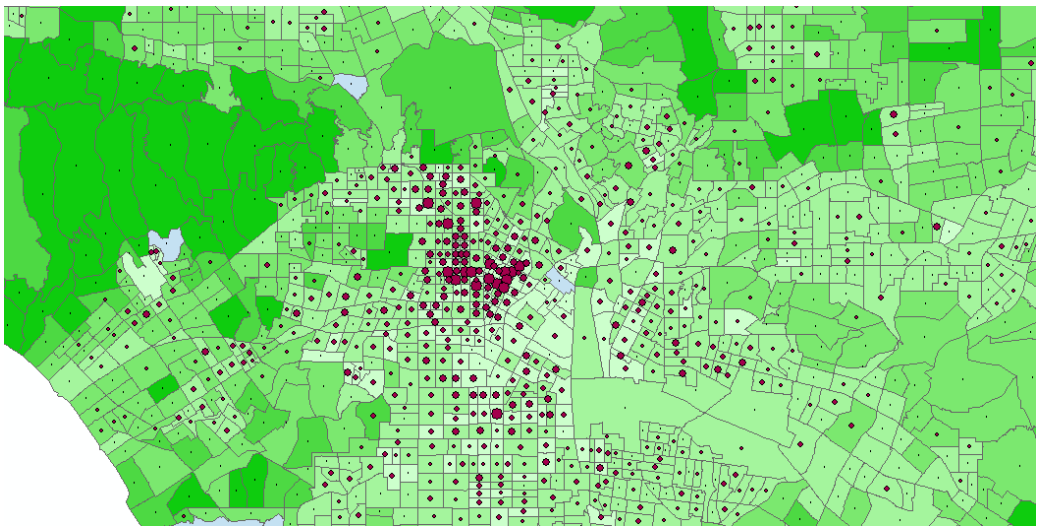
To answer the study questions, it was necessary to obtain a projected Los Angeles county shapefile, and Los Angeles county census tract data on income, means of transportation to work, and population density. All the data was downloaded from the United States Census Bureau website. Average household income data was not available for 2000 and 2010 so the median household income files were downloaded. The data acquisition took quite some time because the vast volume of data available on each topic required going through lists of datasets to finally identify which dataset was most appropriate. The downloaded files included metadata which listed only the heading of each column (or field) and the .csv file which had the actual data. Thus the data was in a ready to use format but the challenge was processing the census tract data to be able to join to the shapefile using ArcGIS 10.1. The shapefile and census tract data were added as layers to a new map. To join the two layers, the attribute table for the census tract was assessed and compared to the census tract data to identity a common field to be used as the JOIN field. The identified JOIN field in the census tract data was then converted

from “number” to “string” to be consistent with the shapefile format. This conversion was done in excel rather than GIS since the excel process was found to be easier and straightforward. Despite this, the join failed several times, till signs such as “_” were deleted. After several failures which mostly resulted in null values in the joined tables, the join was finally successful.

A “test” map was created with the 2010 joined file by adding the file as a map layer twice and using graduated colors for median income field, and graduated symbols for the commute by public transport field. The map showed a concentration of data points in the southern and central parts of the county. This made it difficult to determine what was being portrayed despite adjusting the layer ranges.



A close look at the clustered area as shown below showed workers living in low income areas commute more compared to higher income areas.



Based on the test map and the fact that the northern parts of Los Angeles County are mostly low inhabited areas, the scope of study was narrowed to the southern and central parts of the County including major cities such as Los Angeles, Long Beach, Inglewood, Hollywood, Culver City, Beverly Hills, and Pasadena. Using the "select by rectangle" tool, the areas of interest (indicated in test map) were selected, and the data exported to create a new shapefile under a new geodatabase. It was noted that there was no year 2000 data for some areas in the new shapefile. The census tracts were then joined to the new shapefile using the procedure described above. The layer names were changed, and the ranges adjusted several times till finally, the resulting maps were legible. The maps were exported in a pdf format after a label, scale, title and north arrow were added.

RESULTS AND CONCLUSION

Income and public transportation

It can be seen from the map of median income with commute by public transit that high income areas such as Malibu had low public transportation ridership compared to the lower income areas such as Inglewood in 2000. A similar trend is noticed in 2010 despite the increase in income over the years (probably due to inflation and decrease in the value of money over time). For example, in both 2000 and 2010, areas such as Bel-Air, Pacific Palisades, Brentwood, and Beverly Crest which fell in the highest median income range (100001- 184560 in 2000 and 140001- 242935 in 2010) had public transportation in the lowest range (0-80 in 2000 and 0-90 in 2010). The converse is also true - the highest commutes by public transportation were recorded in the low income areas. This suggests a negative correlation between income and commute by public transportation which is in line with the findings of past studies that the rich use public transportation less compared to the poor. However, it was noted that there were also some low income areas which had low commutes by public transportation which makes the analysis inconclusive.

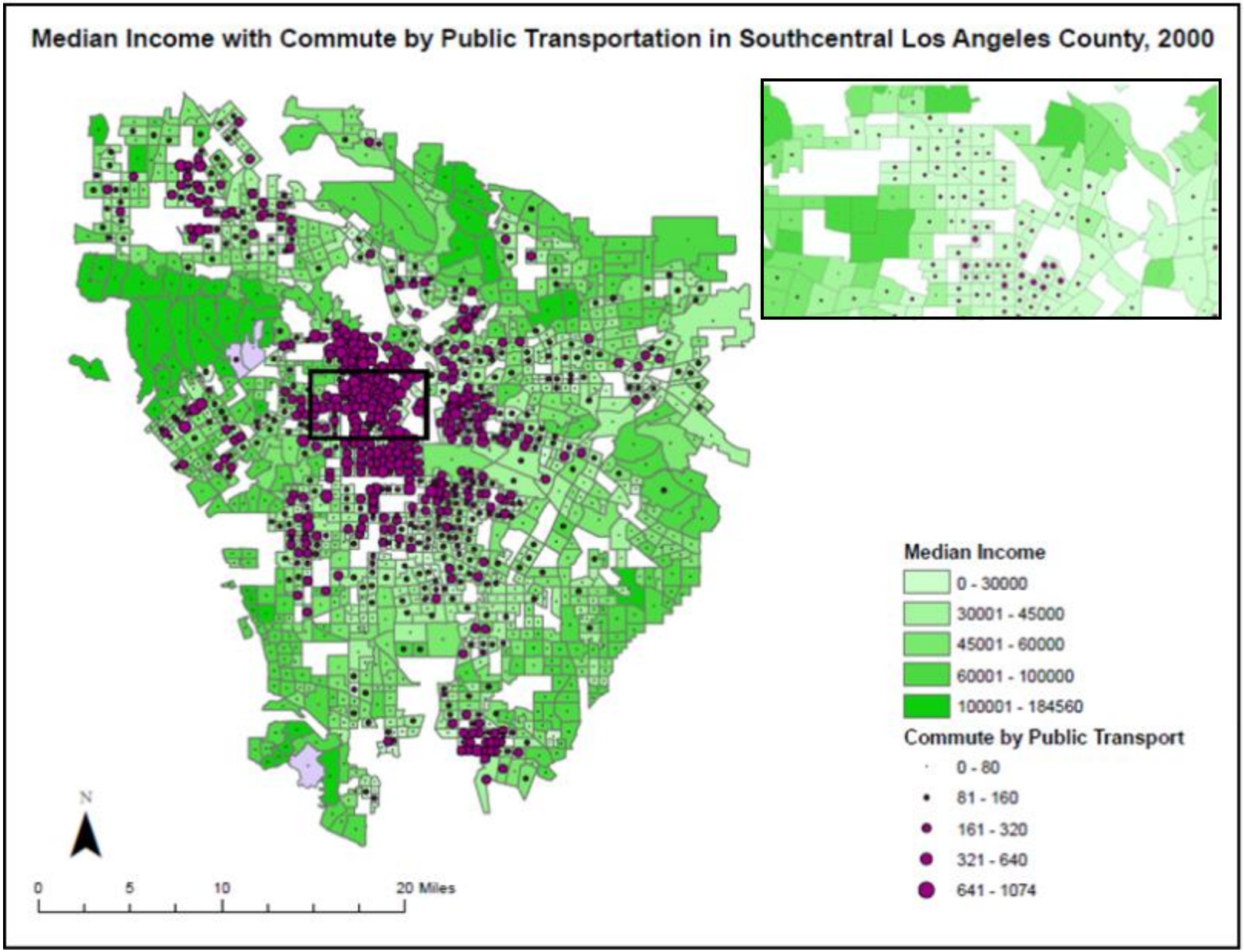
Population density and public transportation

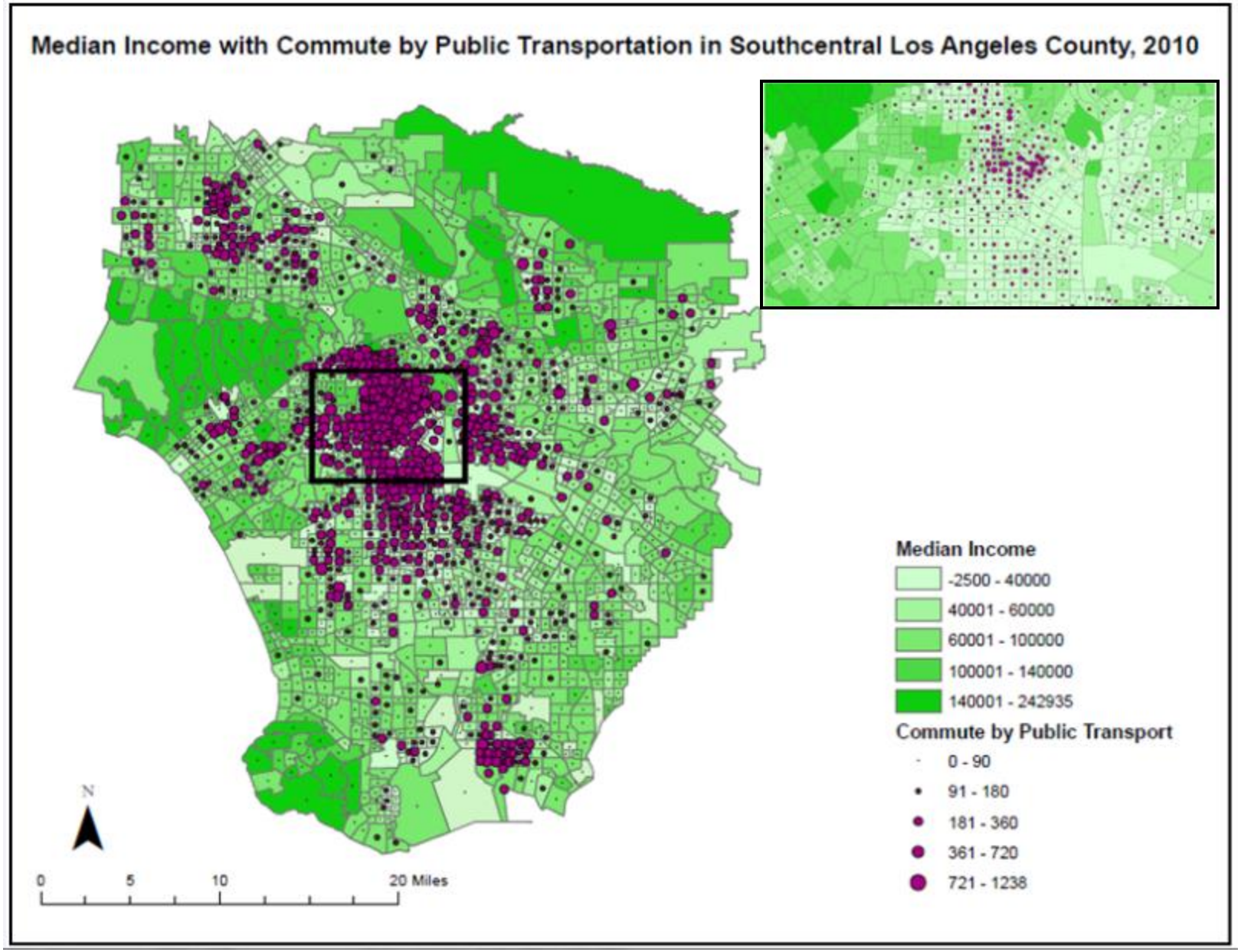
Contrary to the income with public transportation scenario, high population density areas (7201-10909 in 2000 and 6801-9344 in 2010) showed high commutes by public transportation and vice versa. The areas which showed the highest commutes by public transportation were mostly dense areas. This suggests that there could be some truth in the statement “density drives public transportation.”However, there were also dense areas which did not have high commutes by public transportation which suggests that this may not always be the case. It could be that the dense areas which had low commutes by public transportation were also rich areas. In furtherance of that, if density really drives public transportation, shouldn’t Los Angeles County (the densest county in the country) record the highest levels of commute by public transportation? It is also noted that overall, the number of commutes by public transportation increased between 2000 and 2010 whereas population density marginally decreased (or increased in some areas). In El Monte, for example the median income remained at about the

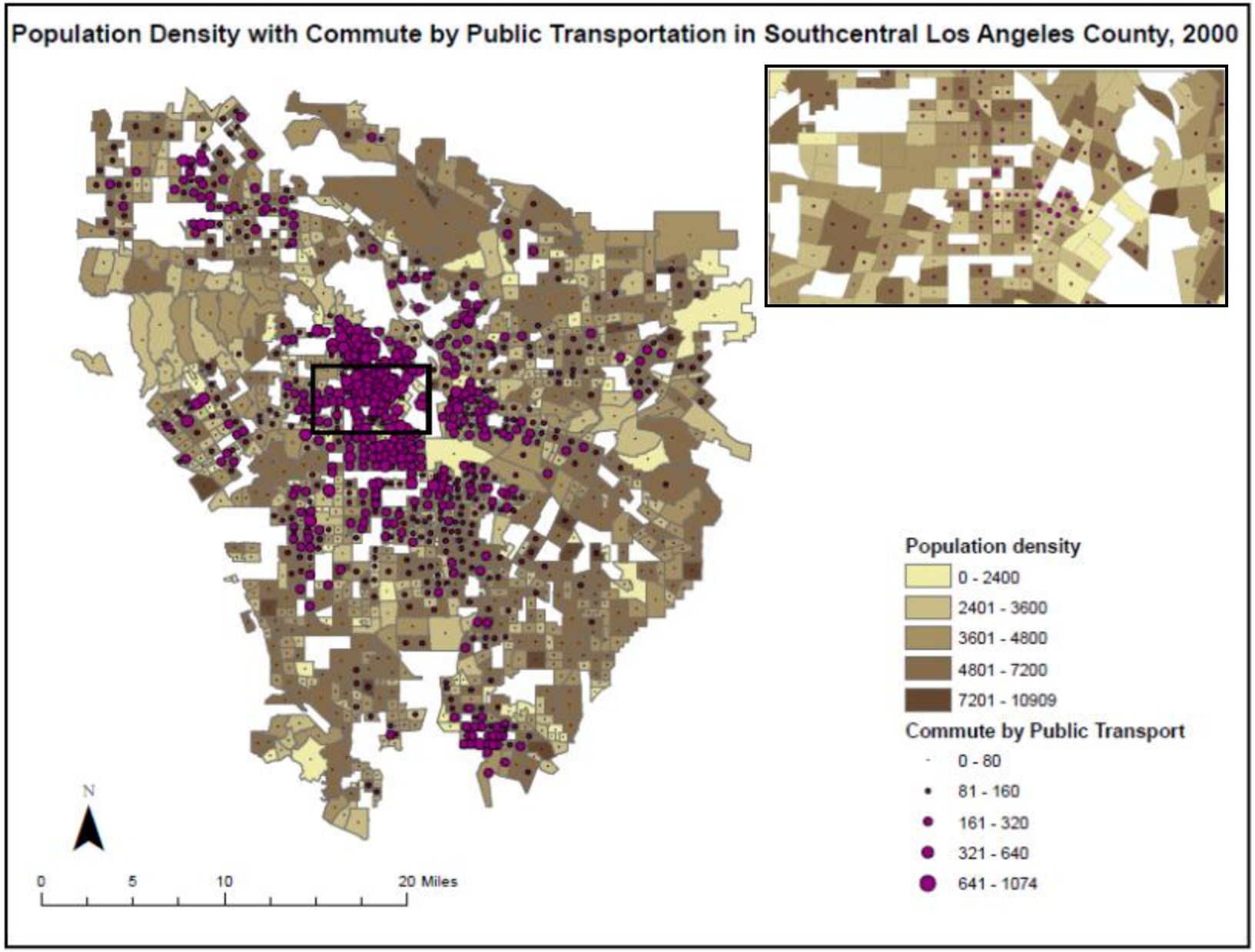
same level in 2000 and 2010, but commute by public transportation increased whereas population density remained at the highest level in both 2000 and 2010.

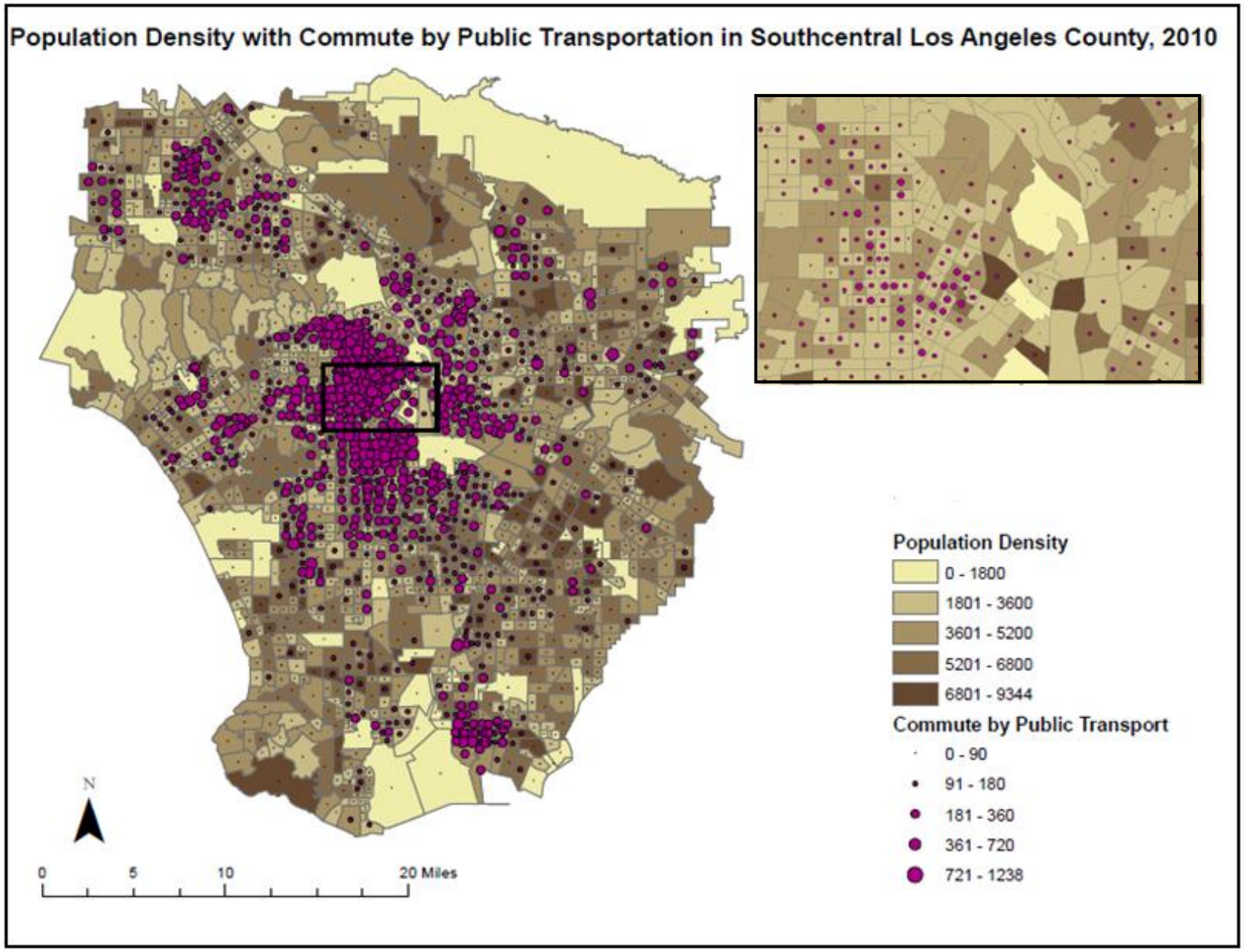
In conclusion, most areas which were high income in 2000 and had low commute by public transport were still high income in 2010 with low commute by public transport. Comparing the median income maps to population density maps for both years, it is interesting to note that most of the high income areas are larger in terms of area, but have lower population densities and low commutes by public transport. The maps suggest a negative correlation between income and commute by public transportation but a positive correlation between density and commute by public transportation. For example, Echo Park, El Monte, and East Compton have low median incomes, high population densities, and high commutes by public transport. This however could be as a result of a good public transportation system within these neighborhoods.

Overall, the maps suggest a relationship between income, population density, and public transportation. However, there is not enough evidence to draw a definite conclusion.


Median Income with Commute by Public Transportation in Southcentral Los Angeles County, 2000
Median Income
0 - 30000
30001 - 45000
45001 - 60000
60001 - 100000
100001 - 184560
Commute by Public Transport
0 - 80
81 - 160
161 - 320
321 - 640
641 - 1074
N
0
5
10
20 Miles


Median Income with Commute by Public Transportation in Southcentral Los Angeles County, 2010
Median Income
-2500 - 40000
40001 - 60000
60001 - 100000
100001 - 140000
140001 - 242935
Commute by Public Transport
0 - 90
91 - 180
181 - 360
361 - 720
721 - 1238
N
0
5
10
20 Miles


Population Density with Commute by Public Transportation in Southcentral Los Angeles County, 2000
Population density
0 - 2400
2401 - 3600
3601 - 4800
4801 - 7200
7201 - 10909
Commute by Public Transport
0 - 80
81 - 160
161 - 320
321 - 640
641 - 1074
N
0
5
10
20 Miles


Population Density with Commute by Public Transportation in Southcentral Los Angeles County, 2010
Population Density
0 - 1800
1801 - 3600
3601 - 5200
5201 - 6800
6801 - 9344
Commute by Public Transport
0 - 90
91 - 180
181 - 360
361 - 720
721 - 1238
N
0
5
10
20 Miles

LIMITATIONS OF DATA AND FUTURE WORK

In this work, median household income is used to establish the relationship between income and commute by public transportation. However, it may be more accurate to use average income for this analysis. Also, the population density data is based on the number of people in the census tract area irrespective of age whereas the commute to work by public transport is based on people aged 16 and above. This affects the accuracy of the analysis because areas with high numbers of residents under the age of 16 are still regarded as "dense" areas which should not be the case in the context of this study. Ideally, the number of people over the age of 16 years should have been used to even the scale for a more accurate analysis.

Another limitation faced was the differences in shapefiles between 2000 and 2010 which made the comparison challenging. Additionally, despite the reduced scope from the entire Los Angeles County to a few selected areas, the dot density map was still clustered with data points making it difficult to see clearly the changes over time. Examples are the Pasadena and Glendale areas – the census tracts for these areas are very small divisions. Future work on this subject should therefore focus on the city level to provide a more clear analysis and comparison.

Given more time, it would have been interesting to investigate how commute by public transportation compares with other means of commute, and with income and population density. For example, do the rich commute more by single-occupancy vehicles? Which areas commute by bicycles more? Are there other factors (such as distance to work) that influence commute choice other than income and density?

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