Spatial Distribution and Impact of Telecommuting

Project Background

According to research conducted by Global Workplace Analytics, based on data collected by the American Community Survey (ACS), revealed that telecommuting population has grown by 11.7% from 2015 to 2016. This figure is greater than the total growth in employee population (0.9%), growth in self-employed population (2.4%) and home-based self-employed population (7.3%). [1] Telecommuting can be defined as the substitution of technology for commuter travel. The ACS assumes that a person who answered “Worked at home” as their primary mode of transportation to work has worked primarily from home at least half-time.

Telecommuting has been recognized for its positive social - better employee flexibility resulting in improved health, better lifestyle and reduced stress levels - and economic – more efficient use of office space resulting in employers saving on resources (lighting, HVAC etc.) spent on employee and the employees saving on the fuel- contribution.

However, from an urban planning perspective telecommuting overall shows counteracting effects. While on one side it appears to substitute the vehicle miles traveled resulting in decreased congestion and fuel saving, on the other hand, it frees up more time for making other non-commute trips. On a larger scale, it contributes decentralization and urban sprawl as people no more feel the need to be located near the place of work, which usually is located near the CBD/ Downtown, where all the other activities – social and leisure- are also located.[2]

Another major concern is about the mode of travel that telecommuting is replacing. As of 2017, according to ACS, the number of people who regularly worked from home (7.9 million) exceeded riders of the public transit system (7.6 million). [3] While telecommuting is not the sole reason for the decline in public transit ridership, it is necessary to understand this impact on taxpayer-funded systems.
This project attempts to enquires the two probable negative impacts – decentralization and substituting use of public transit - of telecommuting on the urban spatial form. This requires the numerical data available to be mapped spatially. The tools offered by GIS enable such multilayered and multidimensional explorations. The geographic constraint set is the city of Los Angeles and the spatial unit of the measure considered are the census tract data sets.

**Decentralization, urban sprawl, and traffic contribution**

To understand the contribution of telecommuters to urban sprawl and traffic we look at where telecommuter live and how many vehicles they own. One of the main reasons that result in relocation and urban sprawl is the relocation of people in search of cheaper housing. Hence, we check if telecommuters are located largely in low median rent areas. The vehicle ownership reflects if telecommuting results in reduced or increased car dependency.

The base shapefile for all the maps was an LA county shapefile which contained the GeoIDs that matched the data files that were retrieved from ACS. However, in order to reduce it to Los Angeles city, I overlapped with another Census Tract District shapefile (I was unable to use this directly as the base file as it did not have GeoIDs). I use the intersect and editor tools to delete all the extra polygons.

**MAP 1:** For this map, I joined the median gross rent data from ACS. I used the graduated colors symbology to map the median rent and graduated symbols to represent the percentage of telecommuting population.

**MAP 2:** The data available by ACS for vehicle ownership by worker was in the form of – number of workers owning 1 car, number of workers owning 2 cars…4 cars for each tract – hence, in order to compile the data so that it could be represented in one layer, total number of cars in a tract was calculated and divided it by the number of workers, to obtain the average number of car owned per tract. This data was represented by graduated colors symbology.
Impact on Public Transit

The impact study of telecommuting on public transit consists of two elements – time and space. The overlapping data of percentage of workers telecommuting against the percentage of workers using public transit is mapped for three years – 2010, 2013, 2016. The temporal dimension is required to check if the use of public transit is reduced in areas with increasing telecommuting. On the other hand, the relationship is also mapped within a spatial constrain – the maximum distance a person will walk to get to a transit station – 1000m.

Map 3: The map represents the change percentage of telecommuters from 2010 to 2016. The graduated colors tool was used to depict the change. I used a color ramp which had two colors (rather than one graduating color) at the extremes as there were also negative values to be depicted. The LA metro Stations are located on the map and have a buffer of 1000m around them representing the ridership catchment area. The geoprocessing tool buffer was used to generate the zones. In order to make the map more readable, transparency was added to the buffer layer (Customize – Effects). The percentages were calculated by first deciphering the percentage of telecommuters for both years – 2010 and 2016 (from ACS) – and then subtracting then using the field calculator in the attribute table.

Map 4: This map represents two attributes. The first represented by the census tract polygons is the change in public transit ridership for work between 2010 and 2016. The graduating color symbology was used. The process to calculate the percentage change was the same as used for calculating the change in telecommuters. This map also overlaps the change in telecommuters information necessary to answer the inquiry made at the beginning of the project. In order to overlap this second layer of information, I used the graduating symbology tool. However, the graduation of the symbol made the map difficult to read the overlapped data. Hence, in the same tool (graduating symbols) the size of the symbol was fixed and the color for each range of data was changed.
Limitations

1. A better criterion to measure the contribution of telecommuters to traffic other than Vehicle ownership would be Vehicle Miles Travelled (VMT). VMT data was unavailable at the census tract level.

2. The buffer that is considered around the transit station is the air distance. The actual walkable distance from/to the station that would define the actual catchment area for the station would require an in-depth study of walking/biking routes around the stations.

3. The project has been restricted to impact study majorly around rail transit. While I was able to map the bus stations (Exploratory Map 5), the buffer area covered the entire region. The ACS does not provide information about distribution between public transits, which I think in this case would make a difference. As telecommuters are said to locate themselves further from the workplace, they might be contributing to rail ridership more than bus transit.

4. Some data for few census tracts were missing in the ACS data, which reflected as zero in the attribute table and got represented in the lowest graduation. This I found was misrepresenting the situation.

5. In the project, I have used GIS to map numerical data spatially and represent it. However, I am aware that GIS offers tools to analyze the spatial representation of data and extract numerical results. For example, extracting the number of tracts falling in the buffer zone and analyzing numerically the increase in telecommuting versus a decrease in transit ridership over time in those census tracts. I would like to further the project in that direction after learning more about those tools.

Conclusion

In Map 1 it can be observed that it is opposite of what is predicted. This may because of the demography of low median rent tracts – like lower education bracket – an average telecommuter has a bachelor’s degree according to the Global Workplace Analytics research. (Explorative map 1, reflects this possibility)
In Map 2, it can be observed in the map that tracts with the highest population of telecommuters do own more cars. This could also be the result of those tracts having higher median income. An average telecommuter earns more than $58,000 annual salary (Exploration Map 2, explains the high ownership of cars in relation to median income). Furthermore, it can be seen that tracts with medium population telecommuting do own a lesser number of cars comparatively. However, as we can see in Map 3, these tracts are close to transit stops and this might be the reason for lower car ownership.

In Map 3 it can be seen that telecommuting has majorly increased along the transit corridor in central and east LA, however has reduced in west LA. The number of tracts with decreasing telecommuting however (yellow polygons)seem to be closer to transit corridors than the rest of the surroundings.

Map 4 in part supports the theory proposed at the beginning of the project. While there is no certain decrease in use of public transit due to increasing telecommuters, it can be said that the two are inversely proportional. That is, census tracts that have higher rate of increase in telecommuters have lost public transit ridership and vice versa.

Overall, the exploration gives mixed responses, there is no definite answer. A more numeric based analysis is required to be done. However, the concentration of telecommuters as of today seems to be more based on the demography of the tract rather than its location in the urban form. The exploratory maps were made as a part of the process to understanding who the telecommuters are. While they define their location, the impact of telecommuters on the urban form seems to be unclear. This uncertainty could be due to a lack of specific data about telecommuters and their travel behavior (past and present) as well as their minority proportion with respect to private car owners. Nevertheless, with its rising proportion, more detailed numeric as well as spatial studies are necessary.
Map 1: Median Gross Rent and Percentage of working population Telecommuting; Los Angeles Census Tracts, 2016.
Map 2: Average Number of Vehicles owned per worker and Percentage of working population Telecommuting; Los Angeles Census Tracts, 2016.
NOTE: An map showing the zoomed in portion around the transit corridor is attached at the end of the project as an Exploratory map (No.3)
NOTE: An map showing the zoomed in portion around the transit corridor is attached at the end of the project as an Exploratory map (No.4)
Data Sources

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<td>Commute Time by Census Tract (2016)</td>
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<td>Average Number of Vehicle owned by working population by Census Tract (2016)</td>
<td>Excel</td>
<td>American FactFinder Number Of Workers In Household By Vehicles Available ACS_16_5YR_B08203</td>
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All the maps contain a Light Gray Canvas Base map to better understand the surrounding geographies and neighborhoods.
References


Exploratory Map 2

Percentage of Working Population Telecommuting
- 0% - 3.3%
- 3.4% - 7.5%
- 7.6% - 15%
- 15.1% - 30%

Median Household Income
- $0.00 - $25,000.00
- $25,001 - $50,000.00
- $50,001 - $75,000.00
- $75,000.01 - $225,000.28

(ESRI, HERE, Garmin, & OpenStreetMap contributors, and the GIS User Community)
Change In Percentage Workers Telecommuting from 2010 to 2016
Exploratory Map 4

Change in Telecommuting v/s Public Transit between 2010 and 2016
Exploratory Map 5: Representation of telecommuting along bus routes.