Impact of Distance on Los Angeles Metro Travel Times

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PPD 631 Spring 2024

BACKGROUND

100 years ago, Los Angeles had the world's largest streetcar system.[1] Urban rail was on nearly every major thoroughfare in the urban epicenter, and every town in Southern California was built with the intent of connecting to a larger rail network.

50 years ago, Los Angeles had no streetcar system. Los Angeles had no urban rail system whatsoever. Public transit in Los Angeles had wholly shifted to a motorbus network.

34 years ago, Los Angeles opened the first segment of today's Metro Rail system from Downtown Los Angeles to Long Beach. Today, that system has expanded to four light rail lines, two heavy rail/subway lines, 108 stations, and 109 miles of service.[2]

This network is set to expand even further in the near future. Three extension projects are under construction at this very moment. Three more projects are in environmental review or pre-construction. Seven more projects are in some stage of planning.[3]

For a city which entirely abandoned the idea of passenger rail transit for nearly half a century, the speed by which Los Angeles has committed to ongoing rail projects in recent years is truly impressive. Los Angeles as a region has sustained political will on the subject of public transit expansion for a generation at this point. For all of the agency's faults, the impressive means by which Metro has managed to move mountains should be applauded as a step in the right direction in fully transforming the options by which people have to move across the metropolitan area.

This is not to say that Metro is a wholly good organization, as the agency certainly has its faults and had to make significant compromises along the way. Land acquisition has been tough, and the agency often defaults to corridors with little opposition over actual effectiveness.[4] Land use at stations is often poor. Safe paths to approach a station for locals are seldom considered. The act of walking up to a station and waiting at the platform is often an unpleasant experience, particularly for stations which are in the freeway median or freeway adjacent. Safety and cleanliness are constant concerns across the network, as Metro is notoriously poor in both measures compared to many other metropolitan areas. Metro often has poor right of way access and must slow down or even come to a complete stop in many sections, making it difficult to compete as a means of effective travel. In Los Angeles, more often than not, the cars go slow and the trains go slower.

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[1] Elkind, Ethan: "From Rail to Roads and Back Again: The Rebirth of L.A.'s Public Transit" PBS, 2022 Link
[2] "Metro Facts at a Glance" Los Angeles Metro, 2023 Link
[3] "Long Range Transportation Plan" Los Angeles Metro, 2020 Link
[4] Sharp, Steven: "Metro Considers Updates to its Joint Development Policy" Urbanize Los Angeles, 2021 Link

There are many angles from which to critique Metro as it expands its network and crafts a vision for a multimodal Los Angeles. In this paper, I hope to do a deeper dive into the built infrastructure of Metro and its choice of heavy rail and light rail infrastructure relative to communities served. This is just one of many avenues for critique and critical thinking, but this represents an often overlooked fault of Metro I hope to bring to light as an issue so foundational its faults are present as early as the project is conceived.

ISSUE & ASSUMPTION

Los Angeles has the world's longest light rail line.[5] Hooray!

…but why does Los Angeles have the world's longest light rail line? Why is that not in a Metro area with double or triple the population? Why is that not in a city known for its excellent rail transit, like in Western Europe or East Asia? Why out of every city on planet earth does no city attempt to have as long a line as Los Angeles?

When building passenger rail, most services can be put into three broad categories.

Urban rail, the category belonging to both light rail and heavy rail, is meant for trips from one urban destination to another.[6] Stops are typically put within one mile of one another, which makes all destinations along the whole of the line within a 10 minute walk or less of a station. Because of this, urban rail is designed to accelerate and decelerate quickly while having the ability to dispense hundreds of passengers at stops in a matter of seconds. The goal of this type of rail is to supplement surface street congestion. Importantly, this focus on frequent stops with a lot of coverage means that the service has a low top speed, even in the most technologically advanced locations.

Intercity rail is the exact opposite. This sort of rail is designed to go from the center of one metropolitan area to another. Think of bullet trains going from Tokyo to Osaka or Paris to London - these trains will not stop once every mile, but rather get people from one city to another as fast as possible with little to no stops. This is also true of "low-speed" intercity rail, which will still typically shoot for a top speed above that of any free flowing expressway (typically 80-120mph). The goal is to reach a top speed competitive for longer distances, typically competing somewhere between a long road trip and a short flight for a total duration of 2-4 hours.

Regional rail is somewhat of a middle ground between these two options.[7] Regional rail typically tries to serve all communities of a metropolitan area, ensuring some coverage in urban, suburban, and even exurban communities. Average speeds will exceed those of urban rail, but the train will

[5] Morino, Douglas: "LA Opens Its New Light-Rail Link" The New York Times, 2023 Link
[6] "Glossary & Acronyms" Federal Railroad Administration Link
[7] "Regional Rail Planning" Federal Railroad Administration Link

be designed for semi-frequent stops with more coverage than intercity rail. This is somewhat of a compromise between the two, and the goal would be to be competitive with highway speeds within the confines of a single metropolitan area.

Most cities with heavy investment into rail use a mixture of all three categories. In Paris for example, no metro line exceeds 20 miles in length. Despite this, the city is still able to ensure quality coverage for all citizens. The emphasis of urban rail is on many short lines that go to all neighborhoods within the urban epicenter, whereas regional rail lines with better speeds and less stops go to serve further out communities throughout the entire metropolitan area. This is near universal around the world for major cities.

But not Los Angeles! In Los Angeles, the longest urban rail line, the Metro A Line, is currently 49 miles in length. An ongoing extension project will extend this line to be 61 miles before the Olympics. This is not a record that shows Los Angeles as a city with good transit. This is a record that shows how mismanaged LA's Metro plans have become.

This is not to say that communities along the Metro A Line or other long appendages of the system should not be served by high quality transit. From the Valleys to the South Bay, all communities in the whole of Los Angeles County deserve high quality public transit. However, if the distance is so far that an expressway would be the likely alternative to transit, having a mode share meant for an urban epicenter with frequent stops is not serving the community in an effective manner.

Given this issue, the underlying assumption that acts as the foundation for our analysis will be an expectation to see diminishing returns over longer distances. Based on the idea that urban rail is for short distance trips, we should expect to see uncompetitive travel times for Metro as trips exceed a certain range.

METHODOLOGY

The best means I have to craft my analysis is to build a story-like scenario to understand the concept of diminishing returns over longer distances. A written discussion of the concept is difficult - compared to a problem like safety, where the negative consequences are easily felt and the problem is readily identifiable, this issue of rail type is foundational and harder to conceptualize. This is the primary reason to use ArcGIS; if our assumption is correct, we should expect to see a readily identifiable correlation between distance and efficacy.

The scenario I've crafted is as follows: two office workers are in the epicenter of Downtown Los Angeles for work and commute into downtown on a regular basis. These are perfect riders for Metro, as this represents the location in Los Angeles with the most Metro Rail service. More specifically, the selected location is 7th Street Metro Center, where four metro lines converge and

head in seven varied directions. Our maps will look at every location these riders can get to via Metro Rail without transfer. The metric which will determine the effectiveness of a destination station will be a custom made scale called “Automotive Equivalent Trips (AETs)”. Effectively, this acts as a ratio between the travel time listed on Metro timetables versus the typical travel time on the same route by driving. If the AET value is 0.5, this means the Metro was so quick that the trip by driving would only be halfway complete in the same amount of time; conversely, if the AET value is 2, this means the Metro was so slow that the trip by driving could have been completed twice in the same amount of time.

One worker will leave at 5PM, when evening rush hour is near its very worst conditions. We’ll consider this the “best case” scenario for Metro, as it supplements the worst capacity constraints on some of LA’s most congested freeways. The other worker will leave at midnight, when nearly all freeways are on average in free flowing conditions. We’ll consider this “worst case” scenario for Metro, as it needs to compete with freeways functioning at their very best. Due to the rise of hybrid work for downtown office personnel, we will take traffic times on Wednesdays as this seems to be the most likely day of the week for in-person work.[8]

DATA & SOURCES

Relevant data sources can be broken down into two groups: Metro and Google. Google aggregates traffic data for different times of the week so that typical traffic times can be pulled for any given route. It should be noted that Google will provide both a singular average time and a range of typical times, with the latter showing the delta between traffic times on a given day. This is important as the range given for traffic during rush hour in Los Angeles is fairly high. For example, going from Los Angeles to Pasadena in our rush hour model is given as a wide range of 22 to 50 minutes, whereas the no traffic model is given as just 14 to 20 minutes. Although we will use the singular value given rather than the range, it should be noted that the range of typical traffic times increases fairly substantially during peak hours. This should be significant as it means our “best case” scenario for Metro is more dependent on day to day fluctuations.

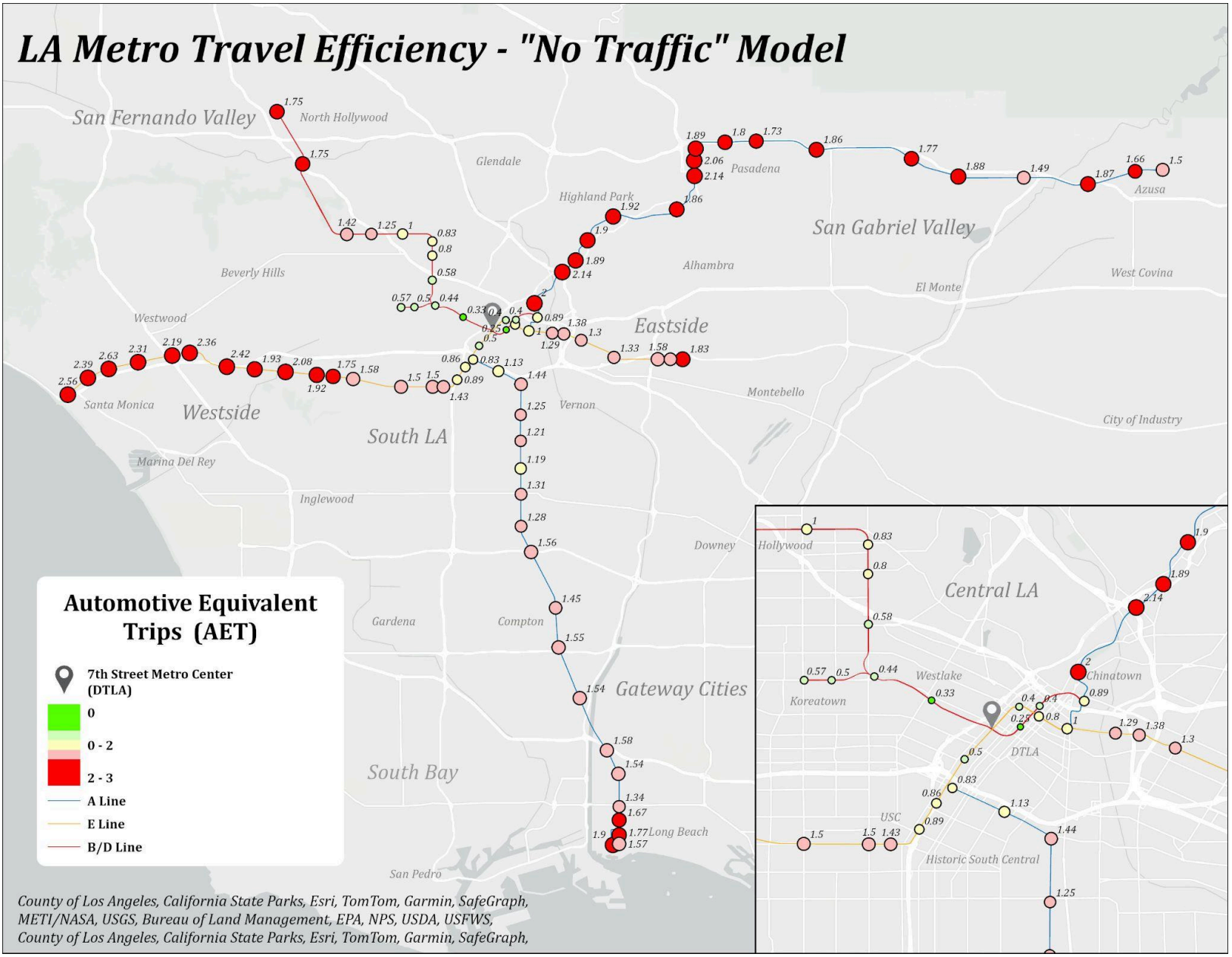
Metro data consists of both timetables and geographic station data. The model is fairly kind to Metro in this regard, as it assumes that Metro is on time on average. While Metro Rail is less likely to be delayed than bus routes that mix with traffic, its delayed trains far outnumber its early trains. While this is an important factor, it will not be included in our model as this represents a related issue of reliability that we’re not attempting to address at this time.

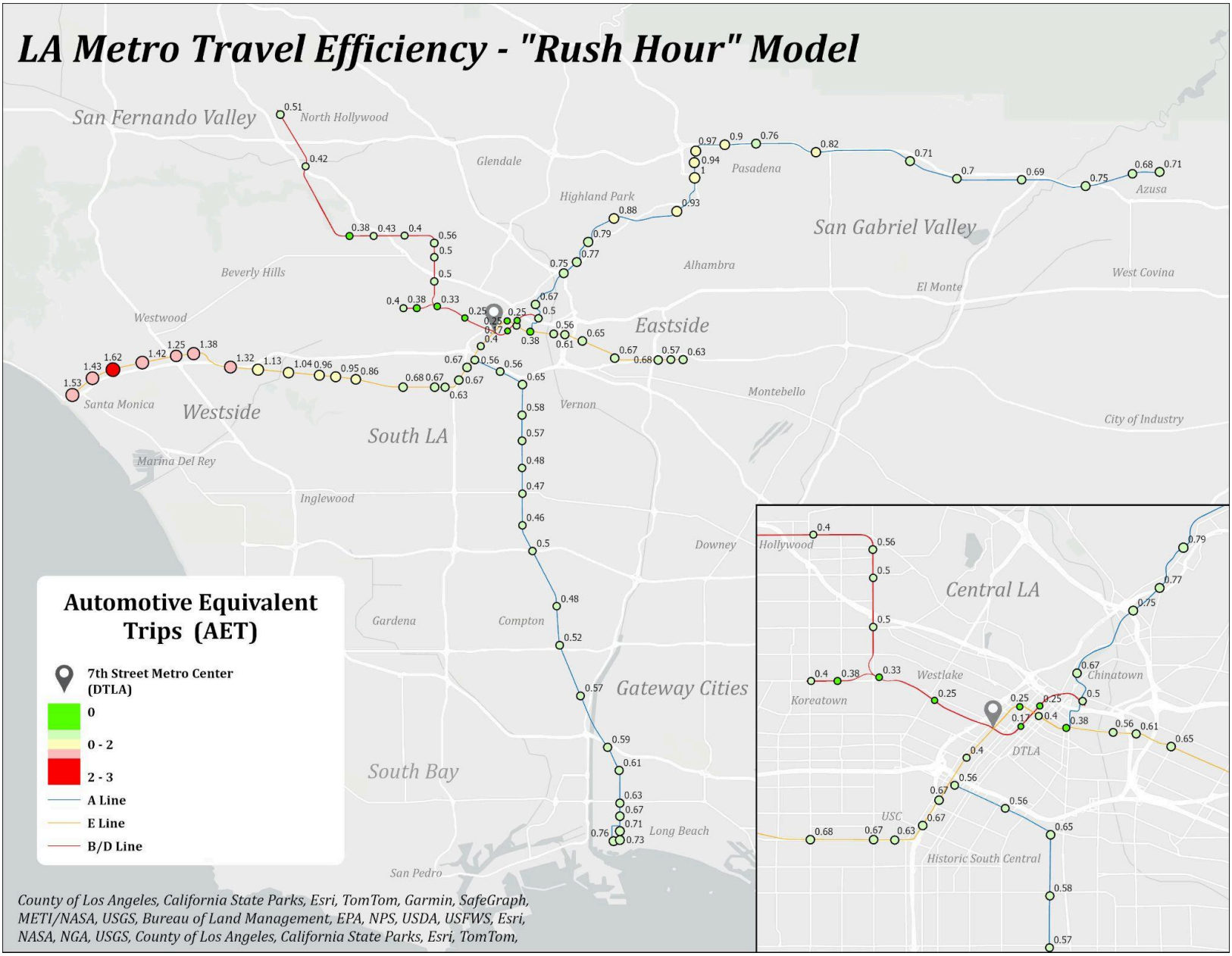
I took Metro Timetables and Google Traffic Data and manually entered them into an excel spreadsheet along with station IDs that could be used to correspond to geographic locations. I then took these values and made formulas for ratios that serve as our AETs for both rush hour

[8] Harter, Jim; Wigert, Ben; Agrawal, Sangetta: “Coordinating Hybrid Work Schedules - 5 Important Findings” Gallup, 2022 Link

and no traffic conditions. I then did a join with Metro's station location data to tie these values to different localities across the system. I then asked ArcGIS to find stations without these AET values via "Select by Attributes" and removed all stations without relevant information. This removed stations along the C and K Lines, neither of which run through Downtown Los Angeles.

GIS MODELS





INTERPRETATION & ANALYSIS

In these maps, I've color coded my scale according to performance. Dark red (AET > 1.6) represents a trip where driving is the significantly faster option, light red (AET = 1.2-1.6) is where driving is somewhat of a better option, yellow (AET = 0.8-1.2) is roughly similar between driving and Metro, light green (AET = 0.4-0.8) is somewhat better by Metro, and dark green (AET < 0.4) is significantly better by Metro. I've chosen a discrete color scale so that each of

these different shades can be described as such. I've also chosen to put station markers on a size scale so that underperforming routes are highlighted to a greater degree.

What resulted in creating this visual aid to the diminishing return concept is both validating and intriguing. Broadly speaking, these maps show how our underlying assumptions are correct, especially in the "No Traffic" model. The no traffic model is so stark that a rough range of effective trips can be drawn around the startpoint. Nevertheless, both models have their own unique traits that are reflective of LA's urban geography and traffic dynamics.

Firstly, not all Metro lines are created equal. The Metro B/D lines to Koreatown and Hollywood/SFV, which are wholly underground and never once interact with at grade crossings, are the faster lines coming out of downtown. By contrast, the Metro A/E lines are significantly slower due to numerous stretches where these lines go slower at grade. As a result, in both models, the B/D lines are shown to be more effective for a longer range than their A/E counterparts.

Similarly, not all freeways are created equal. Some locations have an expressway that is more immediately available whereas others require more surface street travel to effectively complete the trip. Stations in Koreatown are fairly far removed from both the Santa Monica and Hollywood freeways, whereas stations towards Santa Monica are often freeway adjacent.

Finally, not all traffic is created equal. This is an issue which is omnipresent in the "rush hour" model, as some lines seem to flatline on our AET scale outside of a certain range. The reasoning behind this is fairly emblematic of Los Angeles. Recall that urban rail is designed to supplement surface street traffic in urban to urban trips; what this model shows is that the worst congestion on some freeways makes them indistinguishable from typical surface street traffic speeds. Some freeways in Los Angeles on Wednesday at 5PM have average speeds below 20 miles an hour, slower than the slowest Metro line, meaning that these stretches of freeway cannot showcase the diminishing returns concept due to their inability to properly function at freeway speeds. This also explains why the E Line to Santa Monica still performs poorly in the rush hour map, as Westbound traffic on the Santa Monica Freeway is not as bad on average as the Hollywood Freeway, Harbor Freeway, Arroyo Seco Parkway, and other branches leaving Downtown Los Angeles at this time of day.

LIMITATIONS

There are significant ways in which this map fails to address the full context someone might find themselves in when traveling from Downtown Los Angeles to their place of residence. As previously mentioned, any additional calculus that goes into choosing one travel mode over another is not included in this model. For example, if I already own a car, there is a massive sunk cost associated with that purchase relative to the much smaller marginal cost for gasoline each

time a trip is taken. Similarly, if I already have a Metro pass, there is zero additional cost associated with taking an additional trip on Metro. If I don't consider the Metro to be safe or clean I may willingly take a slower, more expensive option to avoid those issues. If I want to read or watch something as I head home I might value my time on Metro more than my time driving. If I want to gain some exercise I may forgo this dichotomy altogether and choose to walk or bike instead. There are many factors beyond just travel times which go into determining the best means of getting around the city.

Even just in regards to travel times, there is a major problem known as the "First/Last Mile" issue. This issue represents how someone can manage to get from each end of their main travel mode from their origin and to their destination. For the Metro user, this is the distance their office and residence have from Metro stations in both downtown and their local community respectively. For the motorist, this is the distance their office has from the place which they're able to park. While price of each mode has not been factored into this model and is a separate issue worthy of its own analysis, the motorist may weigh parking distance to their office relative to price and other factors. This may get even more complicated if the direct trip on a Metro line does not reach the end of the user's trip on public transportation, as transfers are a whole other ballgame consisting of both platform to platform accessibility and frequencies/timetables of multiple branches to make the trip feasible.

CONCLUSION

Without traffic, the Los Angeles Metro is only competitive with driving in the immediate neighborhoods that surround Downtown Los Angeles. With traffic, the dynamics of Los Angeles congestion come to fruition. In some directions, the crush of rush hour is such that the time savings of an expressway over surface streets become difficult to identify, messing with an underlying assumption that freeway speeds would diminish the effectiveness of Metro's urban rail. Nevertheless, regardless of traffic volume, shorter trips on Metro on average perform significantly better than trips further down Metro's appendages. This being said, the means by which the speed of motorists ebbs and flows in LA more so than other metropolitan areas means the competitive nature of the Metro can go further afield than typical ways of thinking would suggest. This interestingly is a showcase not of how Metro is effective but rather how traffic volume makes driving ineffective. From this perspective, at peak times, it is more so that Metro seems effective by comparison.

At present, Metro is able to offer better travel times decently far into the suburbs during peak hours, a rebuke of the initial assumption. That being said, if Metro were to focus on more lines at shorter distances rather than a handful of lines that go far into the suburbs, it is likely they would be competitive with drive times regardless of traffic volume. Although the dynamics of traffic in Los Angeles for most trips make a consistent comparison difficult, it seems short trips on Metro are immune to these fluctuations. There is significant merit to this notion in the no traffic model,

the best showcase of the assumed diminishing returns LA Metro travel times would feel over longer distances.

REFERENCES

Data References

Los Angeles Metro Public GIS Data Link

Los Angeles Metro Timetables Link

Google Maps Traffic Data Link

Other References

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