Balancing Housing Affordability and Transportation Efficiency in the Inland Empire

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ABSTRACT

Housing affordability and transportation efficiency refer to a household’s ability to spend less than 45% of their income on housing and transportation costs combined. Past research indicates there is a high-income disparity, with low-income households allocating a significant portion of their income to housing and transportation costs. Even in areas like the Inland Empire with the lowest housing costs compared to coastal cities, many households are spending more on transportation costs, particularly underserved communities facing car-dependent areas. The goal of this research is to understand the intersection between housing costs and affordability, transportation efficiency, and accessibility in the region. Analyzing the Inland Empire’s unique characteristics and growth trajectory unveils opportunities for innovative urban planning, transit-oriented communities, public-private partnerships, and the integration of emerging technologies to address housing and transportation challenges. The study aims to provide actionable recommendations for policymakers, planners, and stakeholders.

1 INTRODUCTION

Riverside and San Bernardino Counties in Inland Southern California are located 60 miles from Los Angeles and Long Beach ports. Ranking as the thirteenth most populous metro area in the U.S. and the third largest in California, this region also known as the Inland Empire (I.E.) is home to approximately 4.6 million residents as of 2022. Recognized for its remarkable growth, the region has tripled in population since 1990.

Positioned as a logistical powerhouse due to its proximity to major ports and transportation arteries, the I.E. fosters a robust economic ecosystem that attracts businesses seeking strategic advantages in Inland Southern California. A 2022 case study identified the I.E. as the fifth-fastest-growing region in the U.S., the third largest in California, and the twelve most populous metro areas, including Riverside and San Bernardino counties (Celia Lopez Del Rio and Karla Lopez Del Rio, 2022). Projections from the Southern California Association of Governments (SCAG) 2016-2040 Growth Forecast (2012) estimate a future increase of 1.2 million residents by 2040, underscoring the region’s attractiveness and potential for continued expansion.

As the Inland Empire navigates its trajectory toward sustained growth, managing the delicate balance between economic expansion and maintaining a high quality of life for its residents will undoubtedly be a priority. The region's story unfolds as an intricate tapestry of economic prosperity, population dynamics, and geographic advantage, making it a compelling subject for ongoing study and observation in the evolving landscape of Inland Southern California.

This research aims to understand the intersection between housing affordability and transportation efficiency in the I.E., particularly addressing disparities faced by underserved communities. By analyzing the region's unique characteristics and growth trajectory, the study seeks to provide recommendations for policymakers, planners, and stakeholders to foster innovative solutions to ensure a balanced approach to economic expansion and residents' quality of life in Inland Southern California.

2 LITERATURE REVIEW

2.1 Housing

Individuals are drawn to the I.E. for spacious living, lower crime rates, and family-friendly neighborhoods, all coupled with the availability of more affordable housing in contrast to the expensive coastal areas. Significantly, 36% of homes in the I.E. MSA are priced at an average of $534,900, which is considerably "affordable" than the neighboring MSAs. Compared to San Diego-Chula Vista Carlsbad and Los Angeles-Long Beach-Anaheim, the homes are priced at the $500,000 to $749,999 and $750,000 to $999,999 ranges respectively, indicating a remarkably more expensive housing market.

2.2 Geographic Mobility and Location

According to the change of address database from the U.S. Postal Service, from 2018 to 2022, Los Angeles and Orange County experienced an outbound migration of approximately 400,000 residents. In contrast, the Inland Empire, specifically Riverside and San Bernardino gained around 36,000 new residents. This is the third-highest population gain in the nation. Using Census Bureau Data in Geographic Mobility data on Geographic Mobility, the I.E.,the metropolitan area experienced a higher influx of residents in 2022, with 3.3% of residents moving from different counties compared to its neighboring MSAs. The higher rate of migration suggests the region's attractiveness and potentially more favorable living conditions, contributing to its population growth.

The I.E. population growth has coincided with its rise as a global warehousing and logistic hub, and it has become known as a "Trade and Transportation Center Inland Port" (Leitner & Harrison, 2001). Fueled by its extensive freeways, railroads, and port proximity, the region has seen a significant surge in warehouses, leading to challenges for underserved communities, including housing affordability issues, traffic congestion, noise pollution, longer commutes, poor air quality, and the prevalence of low-wage jobs.

2.3 Underserved Communities, Race, and Educational Attainment

For this paper, underserved communities, defined by FEMA, include socioeconomically disadvantaged people, people of color, as well as those of ethnic and national origin minorities, people with limited English proficiency, and others. Significantly, the I.E. is witnessing a transformative demographic shift with 69% of the population identifying as Hispanic/Latino population, 26.3% white, 8.3% Black, 7.2% Asian, and % other (U.S Census Bureau. 2022, July 2). This shift is influenced, in part, by the rising cost of living in coastal areas. In particular the remaining non-Hispanic/Latino population including individuals of diverse racial backgrounds such as white, Black, and others.

The I.E. exhibits distinctive racial demographics, with a majority Hispanic population, emphasizing socioeconomic diversity and challenges. As the coastal regions become less appealing due to high living expenses, the I.E. is drawn to individuals and families who are increasingly turning their attention towards more affordable housing options. In addition, analyzing educational attainment percentages across metropolitan areas underscores disparities, with the I.E. having the lowest rates of higher education attainment, 15.2 % having a Bachelor's degree, and 2.4% with a post-grad degree. While San Diego-Chula Vista-Carlsbad has 26% with a Bachelor's degree and 5.7% post-grad degree, and Los Angeles-Long Beach-Anaheim has 23.9% Bachelor's degree and 4.5% post-grad degree (ACS, 2022).

The educational disparity in the Inland Empire, evident in lower attainment rates, may hinder access to a diverse range of job opportunities, higher income levels, and specialized occupations compared to more educationally advanced regions. This gap can impact career advancement, job stability, and the overall competitiveness of the I.E. workforce regionally and globally.

2.4 Job Desert

The Inland Empire is exposed to the lowest paying jobs in Southern California, predominantly in roles like Office & Admin Support and Food Prep & Serving, offering a wage range of $16 to $22 per hour (U.S. Bureau of Labor Statistics, 2022). However, the Affordable Housing Needs Report for Riverside and San Bernardino Counties indicates that residents require a wage of $34/hour, approximately 2.3 times the state minimum wage, to afford housing costs (Mazella, 2022, as cited by Rio, 2023). This economic disparity emphasizes the stark contrast between job opportunities and the cost of living, underscoring the challenges faced by the I.E. workforce in achieving financial stability and housing security.

The prevalence of lower-paying jobs, compounded by the increasing cost of living, creates a significant disparity between income and housing affordability, impacting not only immediate economic well-being but also the broader social fabric and long-term economic outlook of the region. The limited access to higher-paying, skill-specific occupations hampers career advancement opportunities in the I.E., contributing to a skilled labor shortage and reduced competitiveness in emerging industries.

Geographic location significantly influences access to important destinations like work, schools, and stores, shaping transportation costs. This serves as a focal point for the upcoming section, aiming to pinpoint the intersections between housing affordability and transportation efficiency. A comprehensive literature review of these concepts lays the groundwork for the study's methodology, which includes detailed descriptive statistics and statistical analysis. Lastly, it concludes with an analysis and discussion, bringing together key findings and insights.

2.5 Defining Housing Affordability and Transportation Efficiency

Our analysis centers on the intricate dimensions of housing affordability and transportation costs, often referred to as location-efficiency neighborhoods(Makarewicz 2020). Affordability, as defined as “Affordable housing is that is appropriate for needs of a range of low to moderate income households and priced so that low and moderate income are able to meet their other essential basic living costs (PRWG 2006 in Milligan et al 2007, p26)”. Another perspective by the California Department of Housing and Community Development interprets it as not exceeding 30% of gross household income. Transportation efficiency, per Newmar & Has (2015), involves neighborhoods with the lowest transportation costs, achieved through shorter travel distances and alternative modes. In the I.E., location efficiency plays a crucial role in enhancing residents' quality of life. This is facilitated by a range of transportation options, including Omnitrans, RTA, and Metrolink, which proves especially beneficial for individuals without private vehicles.

2.6 Intersection between Housing and Transportation

Housing costs, encompassing rent and mortgage, play a pivotal role in affordability, with the general guideline that total housing expenditure should not exceed 30% of household income. Considering transportation costs, the Bureau of Transportation Statistics notes it as the second largest household expenditure, accounting for 15% of average spending. When combined, housing and transportation costs should not surpass 45% of household income.

The U.S. Census Bureau, Housing Inventory Estimate: Owner Occupied Housing Units in the United State reveals the Inland Empire, housing costs stand at 32%, making it relatively more “affordable” than San Diego (33%) and Los Angeles (35%). This seemingly paradoxical affordability may be attributed to the overall surge in house and rent prices throughout the state. Despite the surge, the I.E. maintains affordability, albeit at the cost of households making significant trade-offs, driven by urban sprawl. This leads to homes situated at a greater distance from city centers, resulting in lower housing prices. The compromise for affordable housing frequently involves tolerating extended commutes, as households choose economically priced homes located further from job centers. This decision results in increased transportation expenses, neglecting initial housing savings, primarily due to limited housing options near workplaces.(Litman, 2021; Miller, 2004; California’s High Housing Costs: Causes and Consequences, 2015).

2.7 Longer Commute Times

In the Inland Empire Metropolitan Statistical Area (MSA), the average commute time is 32 minutes, higher than Los Angeles (28 minutes) and San Diego (24 minutes). About 73% of residents in the area drive alone, likely due to limited high-quality job opportunities locally, pushing them to neighboring metropolitan areas. This highlights the intricate connection between housing affordability and transportation efficiency. Such disparities emphasize the impact of housing and job location decisions on commutes, stressing the need for a balanced approach. Extended commutes correlate with increased transportation costs, including higher fuel expenses, frequent vehicle maintenance, and elevated public transportation fares. Prolonged commutes also incur additional costs like parking fees and accelerate vehicle depreciation, affecting resale value. Beyond tangible costs, the intangible factor of time value is crucial, with extended commutes leading to potential lost opportunities for work or other activities. Health costs tied to stress and an inactive lifestyle, along with environmental costs from increased emissions, further compound the overall impact of longer commutes on personal and societal well-being. Individual households navigating extended daily commutes face a complex web of direct and indirect costs.

2.8 Transportation Costs Burden

According to the H+T Affordability Index,(Center for Neighborhood Technology, 2023) transportation costs vary based on neighborhood characteristics. Those in location-efficient neighborhoods experience lower transportation costs, while areas with lower location efficiency, relying heavily on automobiles, incur higher costs. In the I.E., 26% of household income is allocated to transportation costs alone, exceeding the rate observed in San Diego (20%) and Los Angeles (20%). When combined with housing expenses, residents in the I.E. spend a staggering 57% of their income on housing and transportation, further emphasizing the trade-offs made for housing affordability.

Literature indicates that individuals in the low and medium-income groups often face challenges in meeting their household housing demand, highlighting the pivotal connection between income levels and housing struggles. Households with the lowest incomes are by far the most likely to have unaffordable housing costs (Daud et al., 2017; Kimberlin, 2019).

In the I.E., despite housing costs being comparatively lower at 32%, households face challenges like "cost burdens" and trade-offs between housing and transportation expenses, highlighting the unintended consequences of focusing solely on housing costs. The complex interplay of definitions and regional variations underscores the many challenges faced by households, necessitating nuanced policy interventions for diverse community needs in the I.E. and beyond. Understanding the dynamics between housing affordability, commuting times, and spatial expansion is essential for crafting balanced policies that consider accessibility, affordability, and quality of life.

3 METHODOLOGY

3.1 Data source

The data utilized in this study for housing burden and demographic information were sourced from CalEnviroScreen 4.0, which specifically incorporates the use of the Caltrans Equity Index (EQI). Developed by the California Department of Transportation (Caltrans 2023) in response to acknowledging disparities in benefits and negative impacts associated with the state's transportation system, the EQI is designed to address inequalities in transportation decision-making, policy, and planning, particularly in underserved populations. This tool undergoes continuous development with input from public and internal discussions covering indicators, thresholds, and geographics. In addition, this study benefits from the current beta version, emphasizing the unique focus on transportation-related equity issues in the assessment of housing burden and demographic data.

The data pertaining to transportation accessibility was acquired from the California Department of Transportation EQI. It provides a comprehensive methodology designed to identify California communities disproportionately burdened by multiple sources of pollution. It also offers an interactive online tool for filtering and visualizing data.

3.2 Creation of the Disadvantaged Index

The Disadvantaged Index was constructed to reflect various socio-economic and demographic factors that contribute to the vulnerability of a population. The index was formulated by combining several normalized variables using Z-scores. from the CalEnviroScreen 4.0 dataset. These included median household income, percentage of the population identified as white, and education levels. To account for challenges faced by non-English speaking populations, linguistic isolation was subtracted. Similarly, to capture economic stressors, the poverty rate and unemployment rate were also subtracted. The resulting index is a composite score where a higher value indicates a greater level of disadvantage.

3.3 Creation of the Housing Burden Index

The Housing Burden Index was directly adopted from the CalEnviroScreen 4.0 dataset, where it is defined as the percentage of a household's income spent on housing costs. This single-variable index is normalized using Z-scores. reflects the economic pressure on households related to housing expenses, with higher values indicating greater financial strain.

3.4 Transportation Accessibility Index

Transportation accessibility data from the Caltrans EQI were normalized using min-max scaling to create the Transportation Accessibility Index. This scaling transformed the data to a fixed range of 0 to 1, allowing for a comparative analysis across different regions. The index aggregates normalized values for auto and multimodal access to work and nonwork activities.

3.5 Multiple Linear Regression Analysis

A multiple linear regression analysis was employed to elucidate the relationships between the indices. The Disadvantaged Index was used as the dependent variable, while the Housing Burden and Transportation Accessibility Indices served as independent variables. Prior to the regression analysis, all variables were checked for multicollinearity and standardized when necessary to facilitate interpretation. The regression output included coefficients for each predictor, the model's R-squared and Adjusted R-squared values, F-statistics, p-values, and the Residual Standard Error, which provided insight into the model's explanatory power and the significance of each index in predicting disadvantage within populations.

$$\begin{aligned} \mathit{Disadvantaged\ Index} &= B_o + B_2 X\ \mathit{Housing\ Burden\ Index} \\ &+ B_2 X\ \mathit{Transportation\ Accessibility\ Index} + E \end{aligned}$$

B_o: Intercept, B_1: Coefficients for Housing Burden Index, B_2: Coefficients for Transportation Accessibility Index

Index, E: Error team

4 RESULTS

4.1 Disadvantaged Index

In Figure 1, we examine the Disadvantage Index Map. This visualization aims to illustrate the distribution of underserved populations in the Inland Empire. The resulting disadvantaged index Figure 1 categorizes the data into three levels—low, moderate, and high. ArcGIS Pro was utilized to visualize disadvantaged communities at the census tract level.

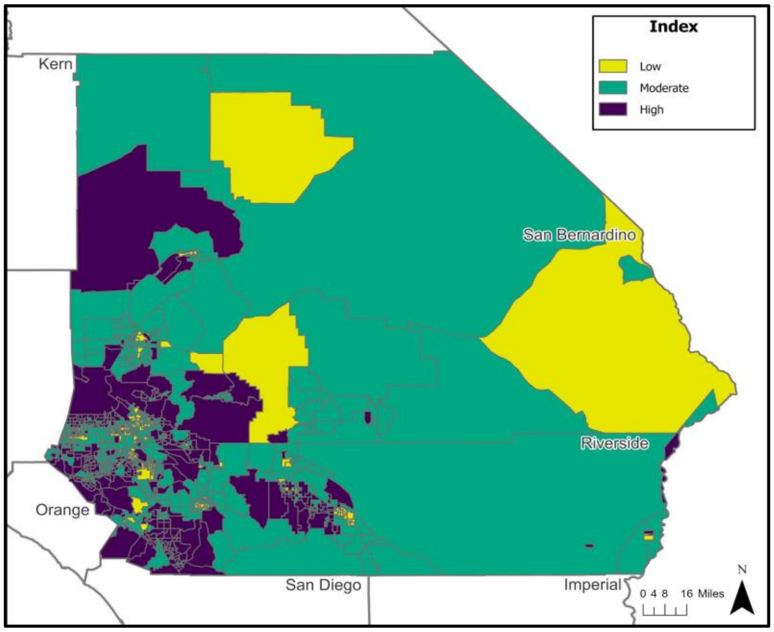

Figure 1: Socioeconomic Disparities in I.E.: Disadvantage Index Figure

In Figure 1, the Disadvantage Index Figure 1 explores socioeconomic disparities in the I.E. Purple signifies a higher concentration of disadvantaged communities, green represents moderate disadvantage, and yellow indicates the lowest disadvantaged population.

4.2 Housing Burden Index

Figure 3 examined in this study pertains to the transportation accessibility score. Similar to the previously discussed datasets, these figures were transformed into an index for enhanced clarity and comparative analysis. Just like the previous two maps, we utilized the ArcGIS Pro program to visualize Transportation Accessibility at the census tract level.

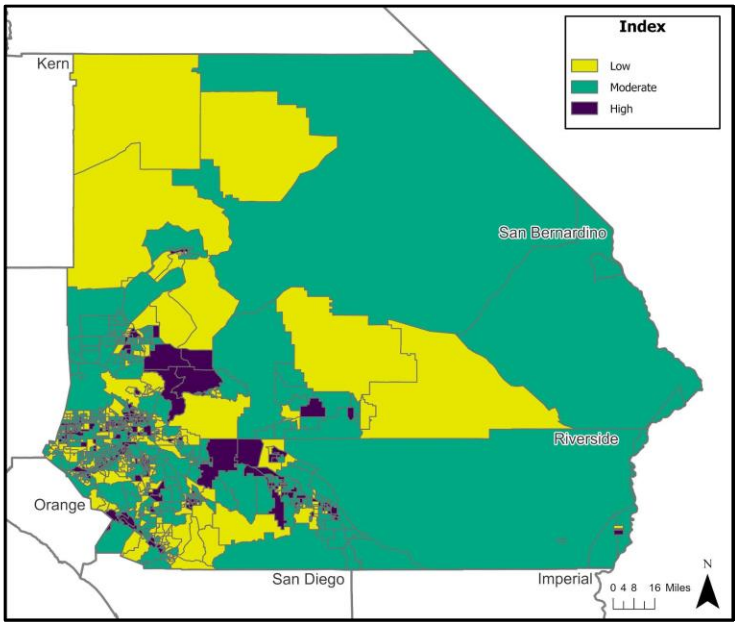

Figure 2: Housing Burden Index Visualization

In the Housing Burden Index Figure 2, the housing burden index ranges from the yellow area indicating the least burden, progressing to darker colors as the housing burden index increases. Green areas represent a moderate burden, while purple darker-shaded census tracts reflect the highest housing burden index.

4.3 Transportation Accessibility Index

Figure 3 examined in this study pertains to the transportation accessibility score. Similar to the previously discussed datasets, these figures were transformed into an index for enhanced clarity and comparative analysis. Just like the previous two maps, we utilized the ArcGIS Pro program to visualize Transportation Accessibility at the census tract level.

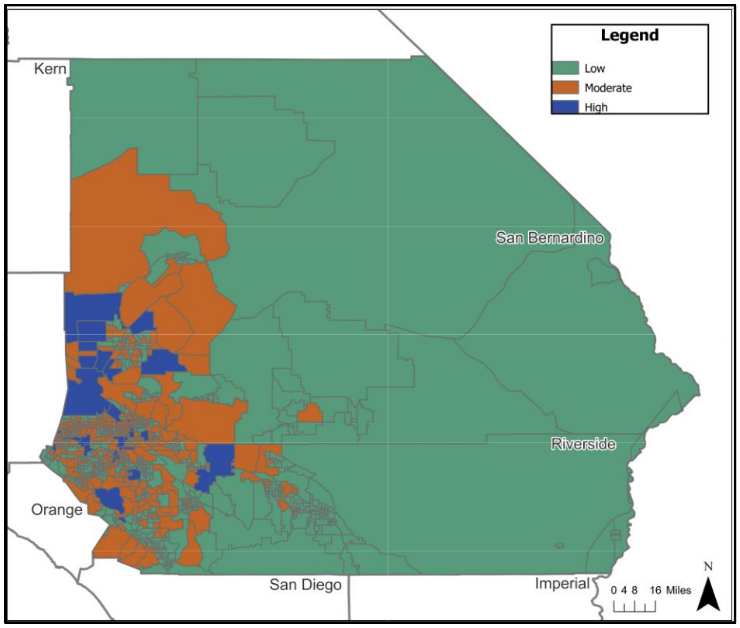

Figure 3: Transportation Accessibility Scores

In this Figure 3, let's explore the transportation accessibility score. Figure 3 uses blue for high scores, orange for moderate, and green for low. Blue areas show the best accessibility, consistent with our study's blue regions consistently having superior scores. Examining the southern and western parts of the I.E. reveals significant progress in transportation and infrastructure. This lower progress is influenced by the unique characteristics of these sparsely populated desert areas, where the transportation challenges are primarily associated with the presence of extensive highways rather than dense local infrastructure.

4.4 Regression Results

Table 1 represents descriptive statistics for three different indices: Index 1 (Disadvantaged - DAI), Index 2 (Housing Burden Index - HBI), and Index 3 (Transportation Accessibility Index - TAI). Each index has been measured across a sample of 984 observations. These stats provide insights into the central tendency, variability, and distribution of each index within the dataset.

Table 1: Social Indicators Table: Disadvantaged, Housing Burden, and Transportation Accessibility Indices Statistics

Statistics	Index 1 (Disadvantaged)	Index 2 (Housing Burden)	Index 3 (Transportation Accessibility)
Count	984	984	984
Mean	$2.31\times10{-}16$	$1.30\times10{-}16$	-0.454
Standard Deviation	2.679	1.001	0.327
Minimum	-13.802	-1.782	-0.007
25%	-1.419	-0.688	0.242
50% (Median)	0.142	0.000	0.380
75%	1.785	0.653	0.583
Maximum	6.943	3.677	3.427
Tolerance	—	0.994	0.994

The dataset of 984 observations reveals that the Disadvantaged Index centers around zero with a broad spread, ranging from -13.802 to 6.943, and a median of 0.142. The Housing Burden Index, also centered around zero, shows less variability (standard deviation of 1.001) with a range from -1.782 to 3.677, a median of 0.000. Meanwhile, the Transportation Accessibility Index, with a mean of -0.454 and tighter spread (standard deviation of 0.327), ranges from -0.007 to 3.427, with a median of 0.380. The Tolerance values for Housing Burden and Transportation Accessibility Indices are 0.994, indicating a specified acceptable range.

Model Fit

Table 2 presents the model fit statistics for three different regressions involving the Disadvantage Index, Housing Burden Index, and Transportation Accessibility Index. The Model fit is evaluated through several metrics.

Table 2: Regression Model Fit Statistics

Model Fit	R^2	Adjusted R^2	F-Statistic	p-value	Residual Standard Error	df	N
Regression	0.734	0.732	245.67	<0.001	2.189	2	984

The model fit is the Disadvantage Index, Housing Burden Index, and Transportation Accessibility Index. As the Disadvantage Index increases, the Housing Burden and Transportation Accessibility Indices are also observed to rise. The R^2 value signifies that for every one-point increase in the Disadvantage Index, 73% of the data related to the Housing Burden and Transportation Accessibility Indices will correspondingly increase or decrease. The p-value is also important in determining the statistical significance of these R2 values; a p-value of <0.001, implies that the regression analysis R2 is indeed statistically significant.

Equation

$$DAI = \boldsymbol{-0.159} + \boldsymbol{1.551}\,HBI - \boldsymbol{0.351}\,TAI$$

Coefficient for HBI (1.551): This value indicates that as the Housing Burden Index increases by one unit, the Disadvantaged Area Index is expected to decrease by 1.551 units, assuming the Transportation Accessibility Index (TAI) is held constant. This suggests a positive relationship between the housing burden and the level of disadvantage —indicating that as the housing burden increases, it might actually increase the level of disadvantage in an area.

Coefficient for TAI (-0.351): This value indicates that as the Transportation Accessibility Index increases by one unit, the Disadvantaged Area Index is expected to decrease by 0.351 units, assuming the Housing Burden Index (HBI) is held constant. This suggests a negative relationship between transportation accessibility and the level of disadvantage — implying that better accessibility is associated with less disadvantage.

5 ANALYSIS AND DISCUSSION

5.1 Regression analysis

Table 3 provides a regression analysis that evaluates the impact of predictors on the dependent variable. The intercept, starting at -0.159 (std. error= 0.120), is statistically significant (p<0.001). The predictor HBI shows a positive effect, with an estimate of 1.551 (Std.error=0.070) and a substantial standardized beta of 0.579 (P<0.001). On the other hand, TAI has a negative estimate of -0.351 (std.error=0.014) and a standardized beta of -0.043, both statistically significant (p<0.001). The confidence intervals for all estimates are provided, and T-statistics reinforce the significance of these findings.

Table 3: Regression Coefficients

Predictors	Estimates	std. Error	Standardized Beta	std. standardized Beta	CI Lower Bound	CI Upper Bound	T-Statistic	p-value
(Intercept)	-0.159	0.120	NaN	0.120	-0.394	0.076	-11.332	<0.001
HBI	1.551	0.070	0.579	0.070	-1.689	-1.414	22.166	<0.001
TAI	-0.351	0.014	-0.043	0.214	-0.069	0.772	-11.639	<0.001

After confirming the statistical significance of the model fit, we proceed to examine the estimates. These estimates play a crucial role in formulating the equation to determine coefficients. The Beta values are as follows: Beta Zero is -0.159, Beta One is 1.551, and Beta Two is -0.351.

6 CONCLUSION

Underserved populations in the I.E. face disproportionate challenges in housing and transportation policies, with geographic disparities exacerbating these issues. Housing development away from job centers not only strains residents financially but also hinder access to crucial opportunities, perpetuating cycles of poverty. Contrary to the belief that well-intentioned development in the Inland Empire will inherently alleviate housing burdens, there is a risk that such efforts may inadvertently exacerbate existing inequalities. This underscores the unintended consequences of policies that overlook the connections between affordable housing and transportation accessibility in evolving developments.

To address this, a nuanced approach is essential, considering immediate housing needs and broader economic and social dynamics. Policymakers must prioritize affordable housing alongside transportation development, recognizing their intricate connection. Community engagement should be central to decision-making, ensuring the voices of affected populations shape policies. A comprehensive strategy must include safeguards against gentrification, and implementation measures to protect existing residents while fostering inclusive development. Adopting a holistic and inclusive approach is crucial for the Inland Empire to navigate housing and transportation challenges, striving for a more equitable and sustainable future.

7 RECOMMENDATION

As a recommendation, we believe that policymakers should collaborate on a comprehensive and inclusive approach, recognizing the dynamic connection between housing and transportation, particularly for disadvantaged communities that are considered marginalized. Prioritizing affordability and involving communities in the decision-making processes can contribute to creating a more equitable and sustainable future. Emphasizing long-term considerations, particularly the benefits of home ownership, and ongoing research will enhance the understanding and resolution of housing and transportation disparities within the Inland Empire.

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