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Rental Housing Affordability Analysis Using the Housing and Transport Cost (CHT) Index: The Case of Condominium Neighborhoods in Addis Ababa City, Ethiopia.

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Abstract

Rental housing is a critical housing option, but its measures continue to be debatable. The objective of the paper is to examine the mutual effect of housing and transportation (H+T) monthly expenses on rental housing affordability considering the inner-city, intermediate, and outer-city condominium locations in Addis Ababa, Ethiopia. The combined H+T affordability index, a 45% threshold, and mixed research methodology were all used. GIS analysis, 1152 residents of rental condominiums were randomly chosen and surveyed in three comparable locations. The rental housing affordability was assessed and modeled using one-way ANOVA and multiple regression models.Findings indicate that rental housing affordability is significantly diversified among the three locations. Outer-city and intermediate neighbourhoods are found to be unaffordable, as residents spend over 55% and 48%, respectively, of their monthly income on housing and transport, significantly over the 45% H+T affordability index. Nevertheless, with a 30% H+T index, inner-city neighbourhood is affordable and residents could enjoy better access to various services. Accordingly, distance to the CBD is the most significant factor, and due to their lower proximity to the CBD, outer-city residents and lower-incomers are facing higher financial burdens. So, H+T Affordability analysis provides an up-to-date understanding and will inform urban planning and policymaking to consider innovative options such as location-sensitive housing frameworks and subsidy and rental housing policies. Further researches need to employ at the national and regional levels to discover new perspectives.

Key words: *Housing affordability analysis, Urban transportation, Condominiums, Urbanization, Sustainable city, Urban planning and policy.*

1. Introduction

Rental housing is commonly understood as a property owned by somebody other than the resident owner or by a legal entity for which the resident pays periodic rent to the owner. It is usually governed by an agreement, formal or informal, made between a tenant and a landlord to rent a dwelling to a renter for a defined period at a fixed price. In the urban housing system, rental condominium housing is a critical housing option and can be a financial choice, especially for those who cannot afford to own houses (Peppercorn and Taffin, 2013).

According to Belsky and Drew (2008), rental housing is also a better choice for those who lack the savings to deal with housing-related repairs, have poor credit histories, or are at special risk of disruptions in income. Moreover, rental housing is an important segment of the urban housing supply, and the private rental

housing market has always been an important provider of accommodation for low-income households (Fields and Uffer, 2016; Kellett, Morrissey, and Karuppannan, 2012). Rental housing may also play an important role in establishing a stable housing environment because it can respond more flexibly to changing housing market needs than owner-occupied housing can (Vobeck et al., 2014).

Moreover, more recent studies have begun to address the importance of transportation expenses or costs in housing affordability measurement, particularly in the framework of the geographic location of housing and accessibility to transportation infrastructure. Due to the lack of easily accessible public transportation, households living on the outer fringes of a city tend to own more vehicles than households in the inner city. Though the housing costs of such households are relatively lower compared to inner-city households, they spend a greater portion of household income on transportation as well as experience longer commute times (Guerra and Kirschen, (2016); Isalou et al., (2014); Rodrigue et al., 2017; and Vidyattama et al., 2012).

Transportation costs are one of the considerable proportions of household monthly expenditures. Location affordability is defined by the housing and transportation affordability index as spending less than 45% of income on combined housing and transportation costs (Arigoni, 2011 and Litman, 2013).

The Center for Neighborhood Technology (CNT) in the US is known to have developed a housing and transportation affordability index, known as the H + T Index, in 2006. In a multi-year effort, they expanded the geographical coverage of the H + T Index, improved the model, and developed an online mapping tool for public access (CNT, 2012).

Thus, the index factored in the cost of transportation for the affordability measure at a fine geographic scale. The new index shows that, with the new measure, many areas that were deemed as unaffordable became affordable and many areas located on the urban fringe that were affordable are now unaffordable. With the introduction of the H+T Affordability Index, a number of recent studies have either applied the CNT index or developed similar indices using country or area-specific conditions. Acolin and Green (2017) developed a measure of affordability for the So Paulo metropolitan region that syndicates housing and transportation costs, including opportunity costs associated with commuting time. Their findings showed that the proportion of households spending less than 30% of their income on housing, or 45 percent or more on housing and transportation costs, has been increasing over time.

In another study, Isalou et al. (2012) applied the H+T Affordability Index to analyze housing affordability in Qom, Iran. Their results indicated that households in the suburban area spend more than 57 percent of their monthly income on housing and transportation, significantly more than the 45 percent spent by households in the central district.

In addition, housing affordability remains the most important concern for housing studies and global practice. Inadequate land stock for housing in urban areas and the swift growth of the urban populace cause a constriction of affordable housing supply. This led to a rise in housing values and decreasing affordability, particularly for low-income households. Cities tend towards urban spatial expansion to the periphery, where housing costs tend to be lower but transport costs are often higher (Irandoost, 2011).

Previous studies suggest that incorporating transport expenses or costs into housing affordability calculations can reveal a different pattern of affordability, particularly in less accessible locations. The spatial configuration of housing stress inside and outside the city center areas alters when transport costs are

included in the calculation. Residential areas with higher transport costs, mostly outside of the city center, become less affordable (Guerra and Kirschen, 2016; Isalou et al., 2012; Vidyattama et al., 2013).

A location's affordability level is associated with proximity to employment centres and other urban services and facilities (Mattingly and Morrissey, 2014; Mulliner et al., 2013); tenure (Vidyattama et al., 2012); and a household's choice of transport modes (Kellet et al., 2015).

In the contemporary world, research is highly required to focus on the hottest issues related to urban housing and transportation, particularly in the urban areas of developing countries like Ethiopia where such kinds of literature and studies are lacking.

However, even today, the majority of studies exclusively use housing rental costs as a tool to assess housing affordability with little or no consideration for other household expenses such as transportation costs, location, and neighborhood characteristics. This research, including the one conducted by Aschale (2023), Belete (2019) and Helen (2010), was also studied from the owners' perspective, not from renters' or condo housing perspective, mainly in Addis Ababa city.

As a result, the actual affordability of condo rental housing in the country is still questionable, overlooked, not much known scientifically, and accurate and recent evidence are lacking on this issue. Accordingly, there are critical questions that need research undertakings, such as: What are the determinants or factors affecting the affordability and accessibility of housing in urban areas in this age of rapid urbanization? To what extent will the combined housing and transport costs affect the affordability of rental housing, mainly condominium (or commonly called condo) housing? How does the affordability of urban rental housing vary across various locations and distances from the commercial business district (CBD), such as inner-city, intermediate, and outer-city condo sites? Which locations of condo sites are more affordable and why?

Besides, there is also a heated debate among scholars and researchers regarding the effectiveness of incorporating household transportation expenses with housing expenses in evaluating the location affordability of housing. Accordingly, this study is motivated to find answers to such kinds of questions, issues, and debates by examining an array of multiple variables and the most recent model, i.e., the combined H+T Affordability Index, as a measure of rental housing affordability that tends to have a wider scope. It also used the most up-to-date and comprehensive indicators, such as transportation and housing costs, distance from the CBD and locations within a city, housing typology, car ownership, household income, size, and sex.

The purpose of this study was therefore to realize the link between housing and transport costs or expenses by studying the impact of long-distance commuting or transport costs on housing affordability relative to the respective locations of dwellings in three comparable rental condominium housing sites, which are located in different parts (specifically inner-city, intermediate-city, and outer-city locations) of the city of Addis Ababa, Ethiopia in a comparative analysis manner.

As this is a novel study focused on the hottest urban issues, multi-disciplinary topics of transportation and housing affordability, and using an up-to-date affordability analysis index, the empirical findings can be informative for charting out strategic interventions for urban housing. It can also inform recent developments, trends, new challenges, and opportunities for policymakers in designing innovative pathways to meet the growing housing needs of people. The methodology and findings can also contribute to informing

further research and filling the existing knowledge and literature gaps on the topic. The rest of the article is organized into a range of sections such as: material and methods; results; discussions; and policy implications.

2. Materials and Methods

2.1 Study Areas

The study was spatially delimited to the city of Addis Ababa, the capital city of Ethiopia, which is characterized by rapid urbanization and growing demand for housing and transport demand. It is also a city where the most extensive condominium housing investments have been made in the country in the last two decades. As it is indicated in Figure 1, in line with the research objectives, three comparable condo sites were selected based on their location and distance from the city core or commercial business district (CBD) of the city, representing inner city, intermediate and outer city neighbourhood sites. The first one is the "Lideta" condominium housing site, which is located in the inner-city or within 10 km of the CBD, the next is "Gerji" from condo sites with an intermediate location or between 10-20 km, and the last one is "Tulu Dimtu", among sites which are located in the outer-city or peripheral areas, over 20 km from the city's core.

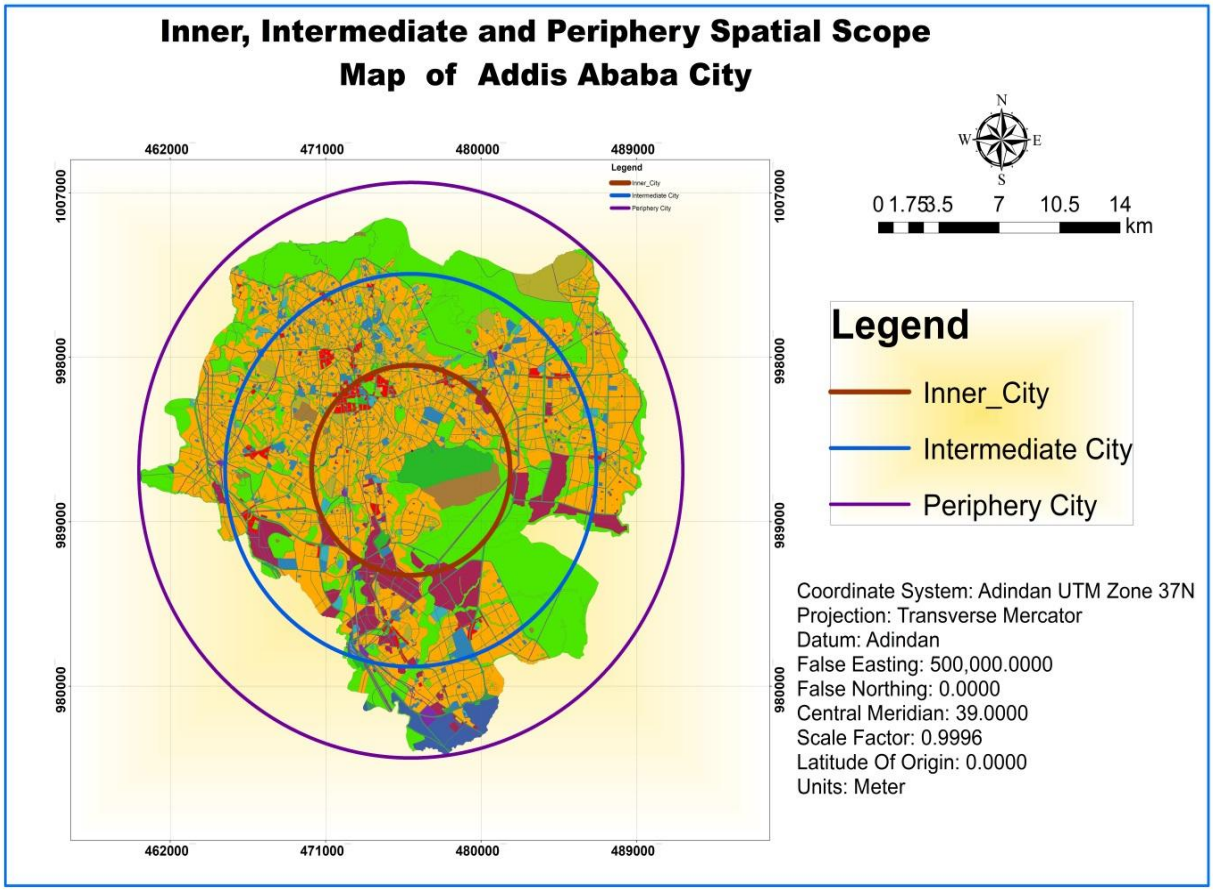

Figure 1.Inner, Intermediate and Outer city Condo Sites of Addis Ababa City
Source: Developed by the Researchers, 2023

To analyze the location rental affordability of condo sites in Addis Ababa city, these three condo locations were purposefully selected using GIS analyses considering their relative distance difference from the CBD of the city around the piazza area. This could help to

enhance the representativeness of residential neighborhoods and renter households from the inner, intermediate, and outer city locations and the suitability of the three sites for this kind of research. The category of the condo housing program named the 20/80 housing scheme was the target housing type of the research on the three sites. The Lideta condo site was recently opened in 2009 and is one of the inner-city redevelopment condominium housing projects in the city. Among the condo sites located at intermediate locations, Gerji is selected under the same 20/80 housing scheme. From the outer-city or peripheral locations, the Tulu Dimtu condominium neighbourhood was chosen as a study area. It is also one of the recently (2012) developed and furthest condominium housing neighborhoods from the city center. It shares the same housing scheme with both Lideta and Gerji, which is helpful for this particular comparative research (Sascha, 2016 and Yewoineshet, 2007). This could help to find an actual, comprehensive, and accurate understanding of the affordability of various housing and residential neighbourhoods from the perspective of condo renter households at the city level.

2.2 Research Design

In line with the pragmatism research paradigm, the mixed research approach that integrates both qualitative and quantitative methods was an ideal technique to conduct this research and provide empirical and more conclusive evidence using various approaches than a single research approach would. As the research questions require quantitative and qualitative evidence as well as objective measurements and subjective interpretations, a sequential mixed approach was suitable to obtain different but complementary data on the topic. First, a quantitative approach, mainly a close-ended questionnaire survey, was employed, and then a qualitative approach, mainly structured interview or discussion, was followed with the selected cases or key informants.

A quantitative research method was selected since it typically explores the first and second research questions of the study (i.e., the variability of housing and transportation cost indexes and the impacts of the determinant explanatory variables on the housing location affordability) using the H+T cost affordability index. As a result, primary data were collected using a cross-sectional survey design and close-ended questionnaires that were carefully designed and structured to provide the researchers with numerical data via one-time data collection procedures. One of the basic primary data sets includes the proportion of transportation and housing expenses of condo renter households from their monthly income as well as data related to the demographic, socio-economic, and travel behaviour of participants. A total of 1152 questionnaire surveys were conducted on the condo renter households that meet certain practical criteria at the three condo sites, considering their willingness to participate and availability at the survey time. In addition to the responses obtained from the surveyed condo renter households, the researchers themselves conducted three travel time experiments and travel cost tests on each condo site to record statistical data and conduct informal interviews with passengers by making an actual journey during the selected comparable off-peak hour, morning, and afternoon peak hours. These transportation surveys could help to make a more valid and reliable evaluation and comparison of the three condo sites on the basis of transportation expenses, travel time, and distance, while keeping other factors constant. It could help the data be analyzed statistically and yield a result that can be generalized to selected informants. Structured interviews, on the other hand, were used to delve deeply into understanding, feelings, opinions, practices, meanings, characteristics, and descriptions of the fundamental issues. This qualitative method enabled the research to provide a thorough and illustrated explanation of the lived experiences

of condo renter households, housing and transport experts, and urban planners in relation to the overall nature, variability, and heterogeneity of the location rental housing affordability of various condo sites and bottlenecks of affordable housing development. Moreover, explanatory research design was also used to explain the variability of location affordability among condo renters as well as how and why the determinant factors affect and predict the level of location rental affordability of condo sites using the H+T affordability index.

2.3 Sampling Method

The target population of the study were condo renter households from inner-city, intermediate, and outer-city households who make trade-offs by spending more on housing located close to jobs and other facilities in the inner city for the Lideta and those choosing more affordable housing in the intermediate and fringe areas with higher commuting costs for the case of the Gerji and Tulu Dimtu sites, respectively.

For the purpose of questionnaire surveys, a total sample size of 1152 sample respondents was estimated using a scientific formula with a 95% confidence level and considering the renter household population of each condo site location, namely "Lideta," "Gerji", and "Tulu Dimtu."

For this research, the sampling techniques that were used to select the three condo sites at various distances from the CBD as case studies and recruit key interview informants (KIIs) were largely purposive, with an additional utilization of convenience sampling techniques. The purposive sampling was employed mainly to locate households who often make trade-offs between housing and transportation costs in the selected case study areas as well as by considering easy accessibility and geographical proximity to the researchers.

Once the three relevant condo sites were identified, those 1152 participants of questionnaire surveys, i.e., especially those condo renters who make trade-offs between housing and transportation costs, who possess certain characteristics were selected and asked to refer others with similar characteristics using stratified sampling. To increase the representativeness of respondents of basic backgrounds, the target population was categorized into three condo sites with a proportional quota based on their size in households. In each condo site, additional classifications were made considering the representation of certain characteristics or selection criteria such as sex, employment status, housing typologies of the condominium houses (studio, one-bedroom, two-bedroom, and three-bedroom), and car ownership. Accordingly, the study also applied simple random sampling to members of the target population that met the aforementioned selection criteria as well as certain practical criteria, such as willingness to participate, availability at survey time, and easy accessibility. In this case, questionnaires were distributed to condo renter households that make trade-offs between housing and transportation costs, possess certain characteristics, and meet criteria.

In addition, a total of 18 KIIs, including 5 informants from the condo renter households of each condo site and 3 other informants from urban planning, housing, and transportation experts, were purposefully chosen as qualitative data sources. This research selected elements based on hypotheses about the population of interest, known as selection criteria, as well as the principles of representativeness and randomness to minimize sample selection bias.

2.4 Data Analysis

Initially, GIS analysis was used to determine and map out the three condo sites and their locations based on their relative distance in kilometers from the city core or CBD. It was also applied to analyze the levels of proximity of each residential condo site to the place of

employment, basic services, and the travel routes of the condo renter households residing in each condo site in Addis Ababa city, such as Lideta, Gerji, and Tulu Dimtu.

Both quantitative and qualitative data analysis were used to answer the research questions. After data were encoded and processed using relevant tools, such as the statistical package for social sciences (SPSS) version 24 and EXCEL, statistical or quantitative data analysis tools were used.Instead of the traditional housing affordability measure, an up-to-date analysis tool, i.e., the combined H+T affordability index, was used to analyze the location housing affordability of each condo site. To this end, the proportion of transportation and housing expenses of condo renter households from their monthly income were estimated and a threshold level of 45%was used as a standard measure of location housing affordability.

Among the quantitative data analysis tools, descriptive statistics such as mean, percentage, and frequency were used to describe the demographic, socio-economic, and travel behavior of study participants. Besides, independent-samples T-test and One-Way ANOVA tests were run to analyze and compare the variability and heterogeneity of the mean combined H + T cost index and housing location affordability among condo renter households based on three or more independent groups, such as the condo renter households in the three comparable condo sites located in the inner-city, intermediate, and outer-city; studio, 1–room, 2–room, and 3-bed–room owner households; and employment status.

Model specification

A comparative and impact analysis approach was used to analyze the location rental affordability of the three condo sites using a model such as the H+T affordability index. This aided in analyzing and comparing the variability of housing location affordability among the three condo locations, as well as the significant factors influencing housing location affordability based on renter households' socioeconomic and demographic backgrounds and travel characteristics, such as household size, income, sexes, employment status, car ownership, housing typology, proximity to and distance from the condo location, and so on.

Considering the basic commonality of underlying housing affordability measures and indicators verified by the literature, for example, Hulchanski (1995) and Nepal, Tanton, & Harding (2010), the current study used the combined H+T affordability approach to create a threshold line for residential rental housing location affordability. This approach states that housing location affordability is the ratio between what households pay for their housing and transportation, and affordable rental housing should cost only a certain percentage (usually below 45%) of a household's monthly income, considering other confounding variables such as quality of dwellings are constant. A household that spends less than or equal to 45% of their monthly income (i.e., 30% for housing plus 15% for transportation) is considered affordable, while households that spend more than 45% of their monthly income are considered unaffordable (Ndubueze, 2007 & 2009; Rodrigue et al., 2017).

In the current study, housing costs were conceptualized and operationalized as the monthly expenses of the households (HH) for their dwelling accommodation. It includes rent for renters (HH's monthly condo rental cost) and "owner equivalent rent" for owners (HH's monthly condo mortgage payment). Besides, transportation costs encompass the monthly household expenses on daily travel for various purposes, including work, education, and shopping, mainly using private vehicles and public transportation modes. With regard to the second specific objective, i.e., to analyze and estimate the impacts of the most significant factors (the independent/predictor variables include age, sex, distance of condo site location from the city core/CBD, employment status, car ownership, housing typology, household size,

and income) that affect and predict location affordability (i.e., dependent/outcome variable), step-wise regression and multiple regression models were used. To regress and specify rental housing affordability, the following model was used:

$$\mathbf{Y = \beta 01 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 \ldots\ldots + e}$$

Where, Y is the dependent variable i.e., rental housing affordability; X_1, X_2, X_3....are the independent/predictor variables and β_1,β_2, β_3....are the slope or regression coefficient of each predictor variable

Finally, thematic and narrative analysis were employed to analyze qualitative data as it was helpful to make a detailed assessment of the overall housing location affordability based on the implications and impacts faced and felt by condo renter households.

3. Findings

3.1 The rental condo resident households' characteristics and how they vary in terms of their CHT cost affordability

Among the objectives of this research, one was intended to understand how residential housing location and other demographic and socio-economic factors can affect the affordability of housing. The descriptive statistics in Table 1 show the characteristics of condo renter households on the basis of selected variables such as distance to the city center or CBD, employment status, family size, household (HH) income in ETB, sex, and car ownership and housing typology.

Table **1.** Descriptive Statistics for characteristics of participants based on the selected variables

Variables		Frequency	Percent	Variable Type	Mean	N (Valid)
Sex	Male	773	67.3	Predictor	1.33	1130
	Female	376	32.7			
Employment status	None/unemployed	156	13.6	Predictor	2.69	1130
	Government employee	237	20.6			
	Private sector employee	580	50.4			
	Self-employed	164	14.2			
	Religious institute employee	14	1.2			
Car ownership	Yes	45	3.9	Predictor	1.96	1130
	No	1101	96.1			
Housing typology				Predictor	2.71	1130
Household income (in ETB)				Predictor	7948	1130
Family size				Predictor	3.89	1130
Distance to city center/CBD in km				Predictor	12.59	1130
The combined (or H+T) affordability index (in %) of three condo sites				Dependent	44.77	1130

N.B: On Jan. 2023, US Dollar to Ethiopian Birr average exchange rate was 1USD=51 ETB
Source: Field Survey, 2023

Accordingly, 67 percent and 33 percent of the participants were male and female, respectively. In terms of employment, 14, 21, 50, 14, and 1% were unemployed, government employees, private sector employees, self-employed, and religious institution employees, respectively. Besides, 4% and 96% of the participants replied that they had a private car and hadn't. The average household income, family size, distance to the city core/CBD, and the combined H+T cost affordability index were estimated to be 7948 ETB, 3.84 or 4 family members, 12.59 kilometres, and 44.7 percent, respectively. All these variables were used as predictor variables that are expected to impact the outcome variable, i.e., the combined

H+T cost affordability index. Hence, one of the primary reasons for examining these variables was to make a comparative CHT affordability index analysis on the situation of residential housing location affordability using the selected variables. In this case, the residence location was held constant.

As indicated in Figure 2, the proximity of each residential condo site to the place of employment or work significantly varies due to their distance from the CBD. The inner-city condo site, i.e., Lideta, has the highest level of proximity due to its shortest distance from the CBD, followed by the Gerji condo site, which is situated in the intermediate location. On the other hand, the Tulu Dimtu condo site, which is located in the fringe area, is characterized by a low level of proximity to work places due to its longest distance from the CBD.

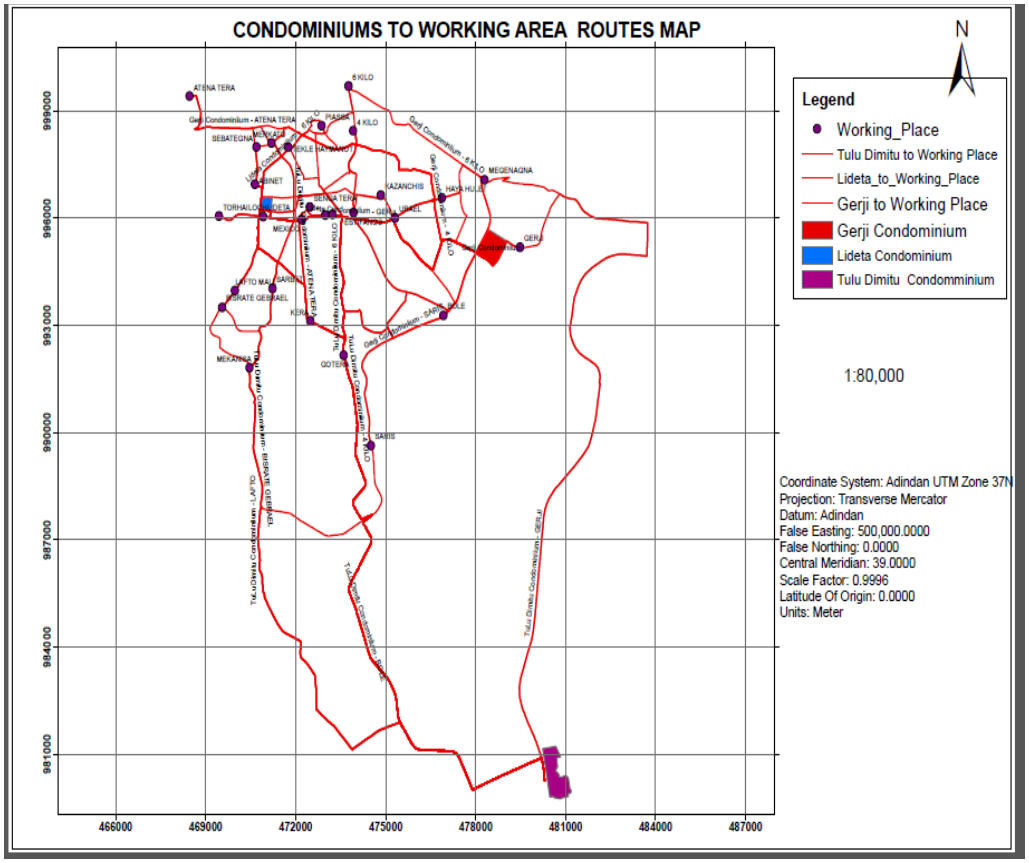

Figure 2. Proximity of working area to Lideta, Gerji and Tulu Dimtu condo sites Source: GIS data developed by the Researchers, 2023

This variability in proximity of each condo site to the place of work influences a range of travel costs and economic and social outcomes, from local fiscal health to the employment prospects of residents, particularly low-income and minority workers like certain condominium dwellers.

3.1.1 Analysis of the Combined Housing and Transportation (CHT) Affordability Index

The combined H+T cost affordability index provides an estimate of the typical cost of housing and transportation in these two different condominium neighbourhoods and compares this estimate to a household's or typical household's income. This index, which

was developed by CNT (2012), considers a neighborhood affordable if a given household would spend 45% or less of its income on housing and transportation costs. This number accounts for an existing rule of thumb that households should spend 30% or less of their income on housing, and adds another 15% for transportation costs. Therefore, the equation below is used to calculate the selected condo renter households' H+T cost affordability index.

Table 2. Condo renter households' combined H+T cost affordability index

H+T Affordability index in %	Tulu Dimtu Condo Site		Lideta Condo Site		Gerji Condo Site		Total	
	N	%	N	%	N	%	N	%
12.00	-	-	26	7	-	-	26	2
14.00	-	-	12	3	-	-	12	1
17.00	-	-	12	3	-	-	12	1
18.00	-	-	26	7	-	-	26	2
19.00	-	-	26	7	-	-	26	2
21.00	-	-	26	7	-	-	26	2
28.00	-	-	12	3	-	-	12	1
29.00	-	-	26	7	-	-	26	2
31.00	-	-	12	3	-	-	12	1
33.00	-	-	26	7	-	-	26	2
34.00	-	-	30	8	-	-	30	2
37.00	-	-	12	3	-	-	12	1
38.00	-	-	12	3	12	3	24	2
39.00	-	-	12	3	25	7	37	3
40.00	-	-	12	3	25	7	37	3
41.00	-	-	12	3	12	3	24	2
42.00	-	-	12	3	12	3	24	2
44.00	-	-	12	3	25	7	37	3
45.00	-	-	66	17	25	7	91	10
46.00	64	16	-	-	63	16	127	15
47.00	61	14	-	-	25	7	86	7
48.00	12	3	-	-	12	3	24	2
50.00	25	7	-	-	12	3	37	3
51.00	25	7	-	-	25	7	50	4
52.00	12	3	-	-	12	3	24	2
54.00	12	3	-	-	12	3	24	2
55.00	25	7	-	-	12	3	37	3
56.00	25	7	-	-	25	7	50	4
60.00	25	7	-	-	25	7	50	4
61.00	25	7	-	-	25	7	50	4
64.00	12	3	-	-	-	-	12	1
66.00	12	3	-	-	-	-	12	1
69.00	25	7	-	-	-	-	25	2
77.00	12	3	-	-	-	-	12	1
79.00	12	3	-	-	-	-	12	1
Total	384	100	384	100	384	100	1152	100

Source: Field Survey, 2023

$$H{+}T\,Index\ (\%) = \frac{Housing\,Costs + Transportation\,Costs}{Income}$$

To account for the effect of transport costs on housing affordability in relation to the residential location, this research paper calculated the combined housing and transport

affordability using the index equation described above. For the statistical analysis, four input variables were used: monthly average household income; proportion of monthly housing cost; proportion of monthly transportation costs such as private vehicle transport expenses (fuel cost, parking, and maintenance cost); and the household's public transportation expenses.

Therefore, based on the questionnaire survey results indicated in Table 2, of the surveyed 384 households in the inner-city "Lideta" condo residential neighborhood, the entire households spent an equivalent to or less than 45% of the combined housing and transportation costs. Hence, according to the questionnaire analysis, this particular inner-city located condo neighborhood is deemed affordable since the selected 384 households spent 45% or less of their monthly income on housing and transportation costs.

In addition, based on the survey results, of 384 households in the "Gerji" condo neighborhood, the entire households spent from 38–60% of the combined housing and transportation costs. Hence, according to the H+T Index analysis, this particular intermediate city-located condo neighborhood was deemed the average affordability index based on Table 2. On the other hand, when it comes to the fringe area located in the "Tulu Dimtu" residential neighborhood, the selected 384 households' H+T Affordability Index showed that all of the households spend more than 45%. That is, the analysis of this research showed that even though housing affordability in an area was predominantly 30% or less of the total household income, when combined with transport costs, the combined H+T burden rose above 45% (see Table 2). And this was because of the lack of integration of the newly developed mass condominium housing with the existing urban fabric of the city. And/or the fringe area dwellers of Addis Ababa, such as the Tulu Dimtu condo neighborhood, are faced with high monthly transportation costs and long commute times emanating from the absence of mixed land use, which has a direct effect on the household's housing affordability as it is combined with the housing cost.

As a result, households in the outskirts spent more on transportation and less on housing, but when the two variables (housing and transportation expenses) were combined, they negatively affected and continued to affect their overall housing affordability, and the opposite was true for households in the inner-city "Lideta" and the intermediate city "Gerji" condominium sites, respectively.

Table 3. The Variability of Combined Housing & Transportation (CHT) Affordability Index (in %) among the three Condo Sites using One Way ANOVA test

ANOVA

Combined housing & transportation Affordability Index (in %) of three Condo Site

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	118942.043	2	59471.022	704.834	.000
Within Groups	96947.943	1149	84.376		
Total	215889.986	1151			

Multiple Comparisons

(I) The three condo sites	(J) The three condo sites	Std. Error	Sig.	95% Confidence Interval

		Mean Difference (I-J)			95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
CHT index of Tulu Dimtu Site	CHT index of Lideta Site	24.13*	.663	.000	22.58	25.69
	CHT index of Gerji Site	6.79*	.663	.000	5.24	8.35
CHT index of Lideta Site	CHT index of Tulu Dimtu Site	-24.13*	.663	.000	-25.69	-22.58
	CHT index of Gerji Site	-17.34*	.663	.000	-18.90	-15.79
CHT index of Gerji Site	CHT index of Tulu Dimtu Site	-6.79*	.663	.000	-8.35	-5.24
	CHT index of Lideta Site	17.34*	.663	.000	15.79	18.90

*. The mean difference is significant at the 0.05 level.

Dependent Variable: Combined housing & transport Affordability Index (in %) of three Condo Site

Descriptives

Combined housing & transportation Affordability Index (in %) of three Condo Site

	N	Mean	Std. Deviation	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Min	Max
CHT index of Tulu Dimtu Site	384	55.05	9.2	54.1	55.9	46	79
CHT index of Lideta Site	384	30.92	11.0	29.8	32.0	12	45
CHT index of Gerji Site	384	48.26	6.7	47.5	48.9	38	61
Total	1152	44.75	13.6	43.9	45.5	12	79

Source: Field Survey, 2023

Considering the proportion of average housing and transportation expenditure of condo renter households from their monthly income, a One-Way ANOVA test was run to analyze the statistical significance of mean differences among the three condo sites (i.e., Tulu Dimtu, Lideta, and Gerji sites) in their level of combined housing and transportation affordability index (in %). As indicated by the ANOVA statistical analysis results in Table 3, the null hypothesis is not accepted and a statistically significant difference is found among the three condo sites in their level of combined housing and transportation affordability index, at sig. 0.000 (or approximately 0.01). The statistical outcome of the Post Hoc analysis for multiple comparisons shows a statistically significant mean difference among each condo site, at sig. 0.000 (or approximately 0.01). Accordingly, the largest mean difference in the CHT affordability index is seen between Lideta and Tulu Dimtu condo sites (about 24.133% of the CHT affordability index). The next largest mean difference (about 17.341% of the CHT affordability index) is between Lideta and Gerji condo sites. The smallest mean difference is between Gerji and Tulu Dimtu sites, with a 6.7% CHT affordability index.

From the descriptive statistics in Table 3, we can also understand that the Tulu Dimtu condo site accounts for the largest mean CHT affordability index (i.e., 55%), which is far beyond the widely accepted standard of 45%. This means that the location (i.e., outer-city location) of this residential condo site is not affordable for the renter households. On the other hand, the Lideta condo site (inner-city location) is found to be the most affordable residential site because of its smallest mean CHT affordability index, i.e., 30.9%, which is significantly below 45%, the widely accepted standard or threshold level. In the case of the Gerji condo site (the intermediate-city location), the mean CHT affordability index is 48%. Though slightly larger than the standard,

it is found to be an unaffordable residential location. Thus, from this evidence, we can understand that inner-city condo sites are more affordable than the intermediate city and outer-city condo sites, considering both transportation and housing monthly costs.

Similar to the findings of questionnaire surveys, the analysis of statistical data obtained from the researchers' travel time experiments and travel cost tests reveals that the travel cost, time, and distance for the three condo sites are hugely varied. The Lideta and Tulu Dimtu condo sites account for the smallest and highest amounts of travel cost, time and distance, respectively, keeping other factors constant. On the other hand, for the Gerji condo site, the amounts of travel cost, time, and distance were found to be smaller and larger than the Tulu Dimtu and Lideta sites, respectively.

In addition to the statistical analysis, personal interviews were conducted with 18 key informants in the study areas, and the researchers tried to present certain questions that they thought were suitable for the analysis. The issues and questions raised for all of the 18 informants, especially those who participated in the formal interviews, were related to: the location of the participant's residence; the impact of transport costs on their housing affordability; the management of transportation and housing costs in accordance with their income; the variability of housing affordability in the city; their views towards overcoming both transport and housing costs; and what they expected from the concerned bodies, mainly government, as solutions. Finally, the researchers organized and summarized the informants' opinions in accordance with each condo site and the issues.

In the case of the inner-city Lideta condo neighborhood, all five individuals residing in the area and the three experts who were involved in the interview believed that this particular neighborhood location has an ease of access to the services and activities, including shops, healthcare, schools, suitable jobs, etc., that the residents demand.

The researchers raised the question regarding participant's opinion towards the impact of their transport costs on the level of their housing affordability and asked them to share their thoughts by comparing their neighborhood location with the fringe area located in the condo neighborhood, which is one of the research areas that the study worked on, and their opinions are summarized as follows.

"In comparison to outer-city residents, as a result of the shorter and walking distances from their inner-city neighborhood, they can easily access numerous service facilities and areas (locally named as" Lideta "," "Piassa", "Merkato", "4 kilo "," "Mexico area ", etc.) and almost all of the participants' work places are located within a range of less than 1 km and 5 km, with only one individual traveling a distance of about 10 km to his respective work place."

So, according to the participants' opinions, the transportation cost has less impact on their housing affordability. Regarding how they manage both household costs, that is the transport cost and housing cost, in accordance with their average monthly income, almost all the participants (7 out of 8) who live in the neighborhood as condo renters said that it is the monthly housing cost that is high in this neighborhood, not the transportation cost, because the location of the neighborhood and short trip distances allow them to use non-motorized transportation modes, for example, walking while they travel to the nearby service areas. They stated that in order to balance the pressure of CHT costs, they occasionally reduce some household expenditures, such as avoiding the purchase of certain expensive properties, such as household furniture and appliances, and reducing entertainment-related activities.

They also forwarded their reflections regarding the question that the researchers had raised regarding the solutions that they expected from the concerned bodies, such as the government, on how to manage the combined housing and transport costs, and they had talked about several points, but the researchers summarized and organized them in the following meaningful ways. They pointed out that:

"*Housing of various types, in sufficient supply, and at varying levels of affordability should be well integrated into the fabric of this mass housing neighborhood community's design in a feasible and effective manner so that the growing demand of the residents would be met and urban sustainability in terms of economy, environment, and social aspects would be achieved."*

Five interviews were conducted, representing each case study of the intermediate-located Gerji and periphery-located Tulu Dimtu condo neighborhoods, plus the three experts commonly representing all the condo sites. The researchers have raised issues regarding their particular current location of residence to forward their opinions, and all of the 10 participants and the experts think that the overall rental housing expenditure greatly depends on the respective housing neighborhood location as well as proximity to work places and services.

The views regarding the affordability of intermediate-located condo sites were found to be mixed. Two of the experts and two of the five informants chosen from this site believed that the location affordability of intermediate-city condo sites is somewhat better and worse than that of outer-city and inner-city condo sites, respectively. However, the rest of the informants (i.e., one expert and three condo renters) replied that residing in this intermediate-city located condo site has no difference with those outer-city located condo sites.

Almost all of the interviewees assumed that most people, including urban planners, transportation and housing experts, decision or policy-making authorities and other concerned bodies, believed that houses located on the urban outskirts or in low-density areas, such as the Tulu Dimtu condo neighborhood, were more affordable. However, these interviewees have clearly expressed that they suffer from less accessibility to their places of employment, various urban amenities, and destinations, with higher travel expenses, longer travel times, and distances.

Based on their various forwarded opinions, the researcher summarized the raised issue regarding the impact of transportation costs on their housing affordability as follows: the participant's lower housing price in their outer fringe area located condo neighborhood is often offset by their household's high monthly transportation cost, which in turn affects their level of affordability in a negative manner. Since this condo site is located on the urban fringe, it is more likely to rely on the use of motorized transportation, mainly public transportation and private vehicles, than walking.

Furthermore, all of the informants believed that there was a serious lack of public transportation infrastructure and service provisions, mainly during the morning and afternoon peak hours. Their reliance on the use of various motorized transportation options generally resulted in greater travel costs, time, and distance relative to the inner-city condo site residents. According to the informants' view, in this particular outer-city condo neighborhood, the monthly household cost of transportation was probably estimated as the second or third highest type of average household expenditure, next to rental housing and food expenditures.

The findings also revealed that, due to the unaffordability of housing and transportation markets, residents of outer-city condos and middle- and lower-income households bear a far greater socioeconomic and financial burden than others.

The other fascinating thing that researchers faced during the interviews with the informants of the three condo sites was the contradictory views and assumptions that arose between residents of inner-city and outer-city locations when transportation costs are combined and excluded with housing costs as well as market rent value of condo houses relative to private-rent houses in the same location. The former assumed that affordable housing was an essential element of a caring, modern, and prosperous community launched by government housing development programs, and others assumed it was an intrusion that brought unwelcome change like high transportation costs, particularly for those relocated residents who were originally residing in the inner-city areas.

All of the interviews conducted with the selected condo renter households and experts showed that considering CHT Affordability Analysis is more significant for the current and future sustainable affordable housing development than considering the rental housing expenses only. Almost all of them also believe that location, or distance from places of employment and basic services in the city core, is a significant factor in the affordability of housing in condo sites.

They could also verify that the role of location or distance from the city core is applicable not only to rental condo houses but also to private rental houses. The results of these interviews show that the monthly market rent values of private rental houses are somewhat lower, compared to the monthly market rent values of condo houses in similar locations. Although the monthly rental housing cost is lower than that of private rental houses, because owners or renters are constantly living together with the rented in the same compound or at the neighboring dwelling, the level of freedom and quality of dwellings for rented households is far lower than that of residing in rental condominium houses. Thus, they usually make compromises and prefer renting condos to the somewhat cheaper private rental houses. As a result, the variation and heterogeneity level of housing location affordability is obvious and greater among the condo sites, namely Lideta, Gerji, and Tulu Dimtu.

Finally, the authors have understood the basic issues they believed regarding the differing and incompatible impacts that exist between transportation and housing planning. This means the programs, policies, planning, and maybe regulatory issues that determined how both transportation and housing would function were the product of a lack of strategic, integrated, and coordinated institutional, policy, planning, and legislative frameworks as well as separately functioning departments and offices in the city and country at large. Housing and transportation projects and provisions are typically led from the top down, with little involvement from actors and fewer people-centric planning elements; in particular, urban housing and transportation are frequently governed by different standards and requirements.

3.2 The significant factors that affect and predict the location's housing affordability levels with new measurement of (H+T) expenditure

As indicated in Table 4, stepwise regression was used to make a selection of potential explanatory variables to be used in the final multiple regression model. Based on the statistical outcomes of the modal summary of the stepwise regression analysis, out of the seven explanatory variables, all are found to be good predictors of the dependent variable (CHT affordability index), except housing typology.

In descending order of their statistical significance levels, the potential explanatory variables are: distance to city center/CBD, employment status, family size, household (HH) income, sex, and car ownership, respectively.

Table 4. Multiple Regression Analyses Outputs

Model Summary

Model	Variables entered	R	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	Distance to city center	.668[a]	.446	10.220	.447	910.092	.000
2	Employment status	.759[b]	.575	8.947	.130	344.972	.000
3	Family size	.774[c]	.598	8.704	.023	64.702	.000
4	Household income	.780[d]	.607	8.606	.009	26.767	.000
5	Sex	.783[e]	.612	8.552	.005	15.378	.000
6	Car ownership	.785[f]	.614	8.527	.003	7.457	.006

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	131332.711	7	18761.816	258.120	.000[b]
	Residual	81554.005	1122	72.686		
	Total	212886.716	1129			

a. Dependent Variable: Combined housing & transportation Affordability Index (in %) of three Condo Site

b. Predictors: (Constant), Car Ownership, Distance to city center, Housing Typology , Sex, Family Size, Employment Status, Household Income

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		Sig.
		B	Std. Error	Beta	t	
1	(Constant)	28.390	3.228		8.794	.000
	Housing typology	.700	.581	.045	1.204	.229
	Employment status	-5.847	.556	-.392	-10.515	.000
	Sex	2.825	.834	.097	3.389	.001
	Household income	-.001	.000	-.319	-5.504	.000
	Family size	4.114	.405	.300	10.156	.000
	Distance to city center	1.018	.041	.689	24.719	.000
	Car ownership	3.395	1.453	.048	2.337	.020

a. Dependent Variable: Combined housing & transportation Affordability Index (in %) of three Condo Site

N.B: On Jan. 2023, US Dollar to Ethiopian Birr average exchange rate was 1USD=51 ETB

Source: Field Survey, 2023

Accordingly, regarding the strength of the relationship between the model and the dependent variable, for the first model (i.e., distance to the city center/CBD), the R square and adjusted R square are 66.8% and 44.6%, respectively, which are quite large and significant. And when the remaining five variables are added, the R square and adjusted R square are 78.5% and 61.4%, which are also extremely large. These large values indicate a strong casual relationship between the model and the dependent variable. This means 78.5% or 61.4% of the changes seen in the dependent variable are because of the effects of these explanatory variables.

In the outcomes of ANOVA analysis in multiple regressions, there is a statistically significant finding that tells us the overall

model is a significant predictor of the outcome variable at a P-value of 0.0001, or approximately 0.01 and F = 258.120. There is a good fit for a model to estimate and predict the impact of explanatory variables on the outcome variable.

Finally, the regression coefficient results show that, with the exception of housing typology (which has a P-value of.229), each of the six variables has a statistically significant impact on the outcome variable. Those independent variables which are correlated to the dependent variable and have a statistically significant p-value less than 0.05 alpha values are focused on and discussed based on the model output interpretation. The findings of the multiple regression model reveal that the explanatory variables such as distance to city center/CBD, employment status, family size, HH income, sex, and car ownership were significant predictors of CHT affordability.

For example, for the unstandardized coefficient or slope for the first significant explanatory variable (i.e., distance to the city center/CBD), a positive casual link is found with the CHT affordability index at B = 1.018. Thus, as the distance of a condo site to the city core/CBD increases by 1 km from the city center, the CHT affordability index also increases by 1.018%, given the other independent variables in the model are kept constant. This means that as the distance of a condo site from the CBD increases, the probability of it being an unaffordable site (having an affordability index of over 45%) increases because when the CHT index (combined costs in percent) increases, it decreases housing affordability.

It is important to bear in mind that an increase in the CHT affordability index (in percent) shows a decline in actual housing affordability. The larger the CHT index, the lower the housing affordability, and vice versa. For any condo site to be affordable in housing, the CHT index should be lower and essentially below 45%.

In Table 4, the findings for employment status, a negative casual link is found with the CHT affordability index at B = -5.847. This means a one-unit increase in the independent variable of employment status (i.e., the change from non-employed to employed status) is associated with a decrease of 5.847% in the CHT affordability index. Accordingly, housing affordability increases for the respondents with "employed status" compared to the non-employed respondents.

For family size, a positive casual link is found with the CHT affordability index at B = 4.114. A family size increase by 1 person is associated with an increase in the CHT affordability index by 4.1%. This means that when household size increases, there is a decline in housing affordability because of an increase in the monthly expense of both housing and transportation. Unlike households with a large family size, households with a lower family size have lower housing and transportation monthly expenses.

For household (HH) income, a negative casual link is found with the CHT affordability index at B = -.001. This means a one unit change (i.e., by 1ETB or 0.01 USD) in the household income is related to a decrease in the CHT affordability index by 0.001%. When income increases by 1 ETB or 0.01 USD, housing affordability increases by 0.001%. The affordability of housing is found to be higher for households with a higher monthly income compared to households with a lower monthly income.

On the other hand, for explanatory variables such as sex and car ownership, a positive casual link is found with the CHT affordability index at B = 2.82 and B = 3.39, respectively. This means, for a change in sex and car ownership status of the respondents, there is an increase in the CHT affordability index by 2.82% and 3.39% respectively. As a result, findings show that respondents of male sex and having no private car are more likely to have affordable housing than their counterparts.

4. Discussions

4.1 The rental condo residents' characteristics and how they vary in terms of their CHT cost affordability

There is an extensive body of literature that uses both the classical and modern measures of housing affordability to indicate that the financial burden and affordability of housing are significantly diversified and heterogeneous, typically across areas of geographic space and location in urban areas. Guerra and Kirschen (2016), Isalou et al. (2014), and Vidyattama et al. (2012) showed the spatial configuration of housing in which residential areas with higher transportation costs, mostly outside of the city center, become less affordable. Kellett, Morrissey, and Karuppannan (2012) also revealed the impact of location on housing affordability.

Public transit in urban areas has different transport price rates, and the affordability of travel costs is determined by considering the proportion of monthly household travel expenditure which is expected to be below 15 percent to be considered more affordable (Rodrigue et al., 2017).

A household that spends less than or equal to 45% of their monthly income (i.e., 30% for housing plus 15% for transportation) is considered affordable, while households that spend more than 45% of their monthly income are considered unaffordable (Hulchanski, 1995; Nepal, Tanton, & Harding, 2010; and Ndubueze, 2009).

Litman (2006) showed the inter-urban and intra-urban variation in CHT expenditure as a percentage of income. Besides, a neighborhood exhibiting high housing prices may simply be suggestive of more positive attributes relative to other areas.

According to surveys conducted in several African cities, households spend 8-15 percent of their total monthly expenditure on transportation. On the contrary, certain extremely low-income community groups in many developing-country cities may spend more than 30% of their monthly income on similar public transportation travel (Paul & John, 2014).

According to Stone (2006), a household could spend less than 30% of its income on housing that is structurally unsafe, inadequate for the needs of its inhabitants, or poorly located in relation to work. Therefore, higher housing expenditure in proportion to income should not therefore be unquestionably equated with being unwelcoming to household interests.

More central locations tend to offer better accessibility and lower transportation costs, but higher housing costs (Irandoost, 2011). The findings of the current study are dominantly consistent with the findings of previous studies. It emphasized the importance of considering and applying CHT Affordability analysis for current and future sustainable affordable housing developments, as well as transportation-related flaws such as location and distance in housing affordability measures, particularly in terms of housing and transportation geography. In this study, three residential condominium sites with different spatial locations or distances were studied, and the location or distance of the condo housing site relative to the city core/CBD has once again proved to be a fundamental factor explaining the affordability of residential neighbourhoods.

The dichotomy between what is affordable and unaffordable housing proximity is typically delineated in this study by a 45 percent monthly income threshold. This deems the index as it gives an estimate of the cost of housing and transportation in different condo neighborhoods and compares this estimate to a monthly household's income. Accordingly, evidence revealed that the inner-city or within

10 km of the "Lideta" condo site This particular condo neighborhood exhibits high housing affordability and is simply found to be suggestive of more positive attributes relative to other condo areas of the city.

Previous literature, including Gibbons and Machin (2005), assures us that transportation expenses rise with increased distance from employment clusters and that this has various impacts on housing costs. In addition, Kellett, Morrissey, and Karuppannan (2012) also showed that the addition of transport expenses changes the location of unaffordable areas, with peripheral neighborhoods being particularly prominent and new unaffordable housing locations. Thus, the findings of the current study are consistent. For example, the average monthly housing cost for selected households residing in the inner-city Lideta residential condominium was close to 10,000 ETB. Residents in the outlying Tulu Dimtu residential neighborhood pay 4000 ETB (or 78 USD) for their housing. Although the inner-city Lideta condominium residential neighborhood housing costs were somewhat higher, this was more than offset by the much higher transportation costs in the peripheral Tulu Dimtu condominium residential neighborhood households.

According to the findings of the combined H+T cost affordability index analyses, the outer-city located "Tulu Dimtu" condo site with over 20km distance from the CBD is found to be the most affordable (31% H+T affordability index, i.e., below 45% relative to monthly income) and non-affordable (55 H+T affordability index, i.e., over 45% relative to monthly income) residential neighbourhoods.

Having a 48% H+T affordability index, the intermediate-city located "Gerji" condo site (between 10-20km distances from the CBD) is also found to be a non-affordable residential housing location. This is because of the condo site's relatively longer distance from the CBD, the lack of easily accessible public transport and other amenities, and the associated higher transportation expenses to access jobs and services in these outlying areas. This recognizes that households often make trade-offs between housing and transportation costs when selecting to reside in inner-city or outer-city locations.

Housing affordability indicators, according to Currie and Senbergs (2007) and Stone (2006), can provide an expressive measure of the financial burden faced by the most vulnerable communities, such as middle- and lower-income families. Similarly, the current study's findings demonstrated that the housing affordability indicators used in this study can provide an expressive measure of the socioeconomic and financial burden faced primarily by residents of outlying or inaccessible rental condo sites, as well as middle- and lower-income households, as a result of the non-affordability market value of housing and transportation.

In addition to the cost of rental condo dwellings, household transportation expenses for both private and public transportation modes also play a role in determining the housing location's affordability. Therefore, this study showed that the variable location includes not only the geography or environment of the residential house in the classical sense but also the proximity to the places of employment, the presence and accessibility of services, motor transport, and walking accessibility. As expected, we found that the spatial location effect is strongest for the variability or heterogeneity of rental residential housing affordability in urban areas, and the most important factors are directly related to the dwelling location, distance from the city core, and housing and transportation costs in combination.

As per the evidence found in our research, services within walking distance of the residential dwellings are significant due to their relationships with the enhanced housing affordability, particularly in the inner-city

located sites, and the accessibility of the condo houses is thus a relevant factor. The inclusion of a combination of accessibility indicators such as transportation and other socio-economic amenities complements the discussion on residential rental housing affordability. Specific types of transportation accessibility that are related to residential housing affordability include not only the simple availability of public transportation services but also a quality public transportation service, non-motorized transportation (walking and bicycling) facilities, and multimodal transport hubs that could accommodate the needs of all condo sites. Therefore, rental condo housing affordability among these three condo sites in Addis Ababa city is extremely diversified and heterogeneous.

4.2 The significant factors that affect and predict the housing location affordability

According to Amenyah & Fletcher (2013) and Ding & Knaap (2002), there are various factors determining the location affordability of residential rental houses, and housing location affordability levels are the outcomes of factors such as proximity to jobs and commercial establishments; access to environmental amenities; taxes and public services; and the residents' income level.

In line with the findings of past studies, the detailed CHT Index and regression model analysis of the current study showed that monthly transportation and housing costs as well as housing location affordability vary between and within the three residential condo areas of Addis Ababa, the city, depending on their respective condo neighborhood characteristics and other factors. Among these factors, location or distance to the city core/CBD is proved to the most significant one affecting and predicting the housing location affordability, holding all other factors constant. Employment status, family size, household (HH) income level, sex, and car ownership were also found to be the other significant factors, respectively.

With regard to distance to the city core/CBD, evidence shows that it has a positive correlation with location affordability. This means it positively affects the outcome variable or affordability index of residential housing, and then as distance from the city core increases, the corresponding housing and transportation affordability index level also increases.

However, it is thus important to bear in mind that, according to the combined H+T cost index analysis, a higher H+T index (i.e., over 45%) is associated with lower housing affordability, whereas a lower H+T index (i.e., below 45%) means higher housing affordability. An increase in the CHT affordability index (in percent) shows a decline in actual housing affordability. The larger the CHT index, the lower the housing affordability, and vice versa. For any condo site to be affordable in housing, the CHT index should be lower and essentially below 45%.

Condo sites with a shorter distance from the CBD are more affordable and accessible housing locations than those condo sites with a longer distance. For example, the inner-city condo(i.e., Lideta site) dwellers who were living in location-efficient neighborhoods within 10 km of the CBD and which were mixed-use or with convenient access to jobs and services such as transportation and amenities, tended to have lower housing and transportation cost indexes. Those who live in the intermediate area of Gerji condominiums, a fringe area located in the Tulu Dimtu-condominium residential neighborhood, on the other hand, tend to pay higher housing and transportation costs. Thus, here, the largest reason for the affordability of the Lideta condo site and the unaffordability of the Tulu Dimtu condo site is their relative proximity, location, and distance from the CBD, where transportation and other socio-economic services are easily accessible.

Similarly, the significant determinant factors such as family size, car ownership status, and sex are also found to be positively correlated with the combined H+T cost index. This means they positively affect the outcome variable H+T affordability index of residential housing. When household size increases, there is a decline in housing affordability because of an increase in the monthly expense of both housing and transportation. Unlike households with a large family size, households with a lower family size have lower housing and transportation monthly expenses. Condo housing is more affordable for households with a smaller number of family members, and this is mainly because of the relatively lower monthly housing and transportation costs than households with larger family members. As a result, the study has reasonable grounds to conclude that residential rental condo housing is more affordable for men and those without a private car than for women.

On the other hand, the multiple regression model analysis confirmed that the significant determinant factors such as household (HH) income level and employment status are found to be negatively correlated with the outcome variable, i.e., the combined H+T cost index. This factor could negatively affect the combined H+T affordability index of residential housing, and thus a one-unit incremental change in the household income (i.e., by 1ETB or 0.01 USD) and employment status (i.e., the change from non-employed to employed status) resulted in the decline of the CHT affordability index. This is due to the fact that when a household's employment opportunities and income increase, the capability to cover transportation and housing costs is improved. These findings are consistent with the findings of recent studies such as CNT (2012), Mulliner & Maliene (2011), and Sascha (2016), which found that the likelihood of rental housing affordability varies significantly with the change in household income. The findings are also consistent with those of Haas et al. (2006), who discovered that increasing household income and full-time employment increase average household earnings and improve housing affordability. As per the statistical evidence, it is possible to understand that residential rental condo housing is more affordable for households that are employed and with a higher monthly income, compared to non-employed and lower-income households.

A somewhat unexpected result of the regression model is the absence of correlation and a statistically significant effect in determining affordability of the combined H+T cost affordability index for the housing typology (i.e., the number of rooms in condo houses), a variable selected as one of the predictor variables. This means that the increase or decrease in the number of rooms in condo houses does not actually affect the level of condo housing affordability. This particular finding is inconsistent with other studies such as CNT (2012), which shows that the likelihood of rent affordability decreases as the number of rooms increases from a single-sized unit to many rooms.

Additionally, the qualitative evidence also revealed the negative impact of the market value on the private rental houses in similar locations to condo rental houses. Households prefer the relatively expensive condo rental houses to the private rental houses, which lack the required housing quality and freedom. This particular finding is also inconsistent with previous studies such as Aschale (2023), which confirms that the probability of affording residential house rent increases as households live in private rental houses compared to households living in condominiums. Possibly, a trend that can be observed for condo dwellings is that they are more attractive to rented households because of the availability of freedom from the renter or owner, and standard kitchen and bathroom are well provided. With this finding, it is possible to conclude the market rent value of condominium houses is

more affordable than the market rent value of private-rent houses in similar locations.

Based on "distance to the city core/CBD", which is the most significant predictor variable of housing affordability, it is the Lideta condo residential neighborhood (i.e., the inner-city location), where comparatively, there is an extent to which the condo resident households have access to essential facilities (i.e., work places, schools, hospitals, etc.) that characterize their daily lives. This significant indicator is also assessed by the amount of travel time and travel cost spent between these facilities. This consideration of housing accessibility comes from the spatially fixed attribute of housing, which is the location of one of the research study areas (Lideta condo neighborhood) is in the inner-city where there is an accumulation of essential service facilities and proximity of places of employment to the households, compared to the fringe-located condo neighborhood (such as Tulu Dimtu condo neighborhood).

Moreover, the other research study area taken for the comparative investigation was the outer-city located Tulu Dimtu condo residential neighborhood. Based on the survey evidence, monthly housing costs tend to be lowest in this particular condo site since it is located at the periphery of the city. Yet this same area was likely to lack employment opportunities, amenities, and non-auto transport options, all of which contribute to higher transport costs.

Therefore, as described above, housing costs in neighborhoods with close proximity to jobs, the ability to walk or bike to shopping districts, and the availability of transit and non-motorized transportation options may be higher, but high housing costs are likely to be offset by lower transportation costs in the case of the Lideta condo neighborhood. While housing may be least expensive in peripheral condo areas (such as Tulu Dimtu) and the intermediate-city located condo areas (such as Gerji residential condo housing) of the city of Addis Ababa, higher reliance on various motorized transportation modes (for example, autos, public transportation like city-buses, midi-buses, and mini-buses) is likely to make transportation costs much higher compared to more central condo areas with higher housing costs.

5. Conclusions

The main objectives of the research were to investigate how the location of a housing neighborhood can affect the affordability of housing by comparing the periphery-located Tulu Dimtu condominium housing neighborhood with that of the inner-city located Lideta and Gergi; to perceive the impact of a household's transportation cost on housing affordability when it is combined with the housing cost; and to understand and verify the importance of considering both housing and transportation/commuting costs of the rental condo dwellers relative to their monthly income. This research illustrates that the application of the combined housing and transportation affordability index to evaluate and understand the housing location affordability of rental condominium residential neighborhoods located in various areas of a city is more feasible and significant compared to the traditional affordability measures.

According to the evidence of the study, rental condo housing affordability is considerably varied among the inner-city, intermediate-city, and outer-city located condo neighbourhoods of the city of Addis Ababa. More specifically, inner-city condo neighbourhoods are more affordable than outer-city and intermediately located neighbourhoods, owing to the location factor and variation in proximity to the CBD or city core, where most services and amenities are concentrated in the city. Spatial location is the most important and meaningful reason for the variability and heterogeneity of rental housing affordability. Because of the shorter distance and better proximity advantages than the other two condo sites in the fringe locations, resident

households could get easy access to and benefit from employment destinations, transportation services including walking, and other amenities. On the other hand, the resident households, mainly those with lower incomes, residing in the unaffordable or remotely located outer-city condo neighbourhoods are suffering and facing higher financial and socio-economic burdens due to their longer distance from the CBD and transportation problems.

Therefore, it is possible to conclude that location and distance to the CBD or to employment and service centers are the fundamental determinants of rental housing affordability in urban areas. Using housing costs alone in the housing affordability analysis cannot produce realistic and meaningful outputs for decision and policy makers unless other factors such as transportation accessibility and affordability are taken into account. However, the IHDP in Addis Ababa city did not fully consider the location, transportation, and other related issues while developing the mass housing condominium projects, especially those housing projects developed in the fringe areas of Addis Ababa like the Tulu Dimtu condominium sites. The combined H+T affordability index is a unique, integrated, and holistic approach to addressing urban housing and poverty problems.

This up-to-date model and measure of housing affordability, i.e., the combined H+T affordability index, could help to study and identify the truly affordable and unaffordable urban residential housing locations. The findings can be used as reliable inputs and new considerations for the efforts of integrated housing (IHDP) and sustainable development programs. As a result, the IHDP projects can reasonably target to supply housing and related transport services to those unaffordable, inaccessible, and underserved locations. It can thus help housing and transportation affordability analyses and decision-making in the cities of developing countries.

Accordingly, this study makes its own contribution to the existing body of knowledge and debates on the use of housing affordability measures, mainly between advocators of the classical housing cost to income ratio versus the combined H+T affordability index. It is important to note that, in many cases, the authors have concluded and agreed with those advocators of the combined H+T affordability index. Properly addressing the problems of existing rental condo housing is essential to maintain its sustainability and affordability benefits. To this end, the authors have suggested solutions such as location-sensitive, pro-poor and subsidy-based housing policies; rental housing and informal broker systems; integrating transport accessibility and improving public transportation and active transport modes such as biking and walking; and maintaining appropriate land use and population densities. Furthermore, through integrated and comprehensive urban planning, they should promote mixed-use neighborhoods and multiple CBDs, as well as business, social, and leisure centers across the city. Future research can be conducted focusing on a wider scope through a greater number of condo sites and variables.

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