



EiABC

Ethiopian Institute of Architecture,
Building Construction and City Development
የኢትዮጵያ አርክቴክቸር፣ ህንጻ ግንባታ እና ከተማ ልማት ተቋም
Addis Ababa University
አዲስ አበባ ዩኒቨርሲቲ

The Impact of Light Rail Transit on Commercial Property Value: A case of Addis Ababa

A Thesis Submitted to the School of Graduate Studies of Addis Ababa University in partial fulfillment for the requirements of master's degree in urban land and property valuation

By

Moges Wubet Shita

Advisor: Sisay Zenebe

Ethiopian Institute of Architecture, Building Construction, and City Development

Addis Ababa University

October 2018

Addis Ababa, Ethiopia

A Thesis Submitted to Ethiopian Institute of Architecture Building construction and city development to the school of graduates studies of Addis Ababa University in partial fulfillment for the requirements of the degree of masters of Arts in urban land and property valuation.

Title of thesis: The impact of light rail transit on commercial property value: A case of Addis Ababa.

Author: Moges Wubet

October 2018

Approved by Board of Examiners

Sisay Zenebe

Advisor

signature

date

Eyasu Kumera

Internal examiner

signature

date

Gidisa Lachisa

External examiner

signature

date

Dr. Fisseha Wogayehu

Chairperson

signature

date

Declaration

I hereby declare that this MA thesis is my original work and has not been presented for a degree in any other university and all sources of material used for this thesis have been duly acknowledged.

Student's name: Moges Wubet

Signature: _____

Date: _____

Confirmation

This MA Thesis has been submitted for examination with my approval as thesis advisor.

Name: Sisay Zebnebe

Signature: _____

Date: _____

Acknowledgment

First of all, God deserves the first word of thanks for all my achievements. I would like to express my heartfelt thanks and deep gratitude to my advisor Mr. Sisay Zenebe for his tireless commitment and devotion to bring my thesis to this end. Moreover, deep thanks to Mr. Eyasu Kumera for his valuable suggestion.

I would like to extend my sincerest thanks to Mr. Seid Hussen, for his valuable encouragement, suggestion and constructive comment.

Finally, I would like to extend my thanks to all my families who are behind for all my success.

Table of Contents

Acknowledgment	III
List of tables.....	VIII
List of figure	IX
Acronym	X
Abstract.....	XI
Chapter One	1
1. Introduction.....	1
1.1 Background of the Study.....	1
1.2 Statement of the problem	4
1.3 Objective of the Study.....	6
1.3.1 General objective.....	6
1.3.2 Specific objectives	6
1.4 Research Question.....	7
1.5 Significance of the research	7
1.6 Scope of the study	7
1.7 Limitation of the study	7
1.8 Organization of the research	8
1.9 Definitions of terms.....	8
2. Research methodologies	10
2.1 Site selection	10
2.2 Overall flow of the research	14
2.3 Research approach.....	15
2.4 Data type and data collection	15
2.4.1 Data type and data source.....	15

2.4.2 Data Collection Technique	16
2.5 Sample selection and size determination	17
2.6 Techniques of Data Analysis.....	21
2.7 Summary of Methodology with respective objective	23
Chapter Two.....	24
2. Review of Related Literature	24
2.1 The concept of property and real estate	24
2.2 Hedonic pricing	25
2.3 Methods of valuation.....	26
2.4 The three approaches to Valuation.....	28
2.4.1 Sales comparison approach	28
2.4.2 Cost approach	29
2.4.3 Income approach.....	30
2.5 Land rent and location Theory	30
2.6 Determinates of property value	33
2.7 Commercial property and rental price.....	34
2.8 Transportation and property value	35
2.9 LRT and property value	36
2.10 LRT station on property value	37
2.11 Socio-economic and environmental Impact of LRT	38
2.12 Lessons learned from Literature.....	40
Chapter Three.....	42
3. Description of The Study Area	42
3.1 Site description.....	42
3.2 Profile of Addis Ababa.....	43

Chapter Four	45
4. Discussion and Data Analysis.....	45
4.1 Introduction	45
4.2 Effect of LRT station on the commercial property rent	45
4.2.1. Hedonic pricing and multiple linear regression model.....	45
4.2.2 Variable selection and hypothetical relationship to dependent variable	48
4.2.3 Data tabulation and coding	50
4.2.4 The test of multiple linear regression assumptions	51
4.2.5 Descriptive statistics	56
4.2.6 Correlation between variables	57
4.2.7 Regression result	62
4.3. Push and pull effect of LRT station	66
4.3.1 Locational Characteristics of Respondents	67
4.3.2 Tenant displacement and tenant attraction	68
4.3.3 LRT station and business activity.....	70
4.3.4 The effect of Fenced LRT on property value and business	71
4.3.5 Consideration of LRT system during Rent determination.....	72
4.4. Case studies	74
4.5 Socio-economic and environmental impact of LRT	77
4.5.1 General impact of LRT.....	77
4.5.2. The effect of fenced LRT on Occupancy condition of the building.....	80
4.5.3 LRT station as a source of the problem and its effect	81
4.5.4 LRT and LRT station as a problem	82

4.5.5 The effect of problems on property value and business	84
Chapter Five.....	86
5. Conclusion and recommendation.....	86
5.1 Conclusion.....	86
5.2 Recommendation.....	88
References.....	89
Appendices.....	97
Appendix 1-statistical results from SPSS and Stata.....	97
Appendix II, Questionnaire and interview questions	101

List of tables

Table 1: Consecutive distance between Stations	11
Table 2: Feature of East-West corridor LRT stations	13
Table 3: Sample respondents for an in-depth interview.	20
Table 4: Summary of methodology	23
Table 5: Summary of empirical assessment.....	40
Table 6: Variable representation.....	49
Table 7: Normality test result	51
Table 8: Test of multi-collinearity	53
Table 9: Test of Autocorrelation.....	54
Table 10: Test of heteroscedastic.....	55
Table 11: Test of normal distribution of error term	56
Table 12: Descriptive statistic before Log transformation	57
Table 13: Pearson and Spearman correlation coefficients	59
Table 14: The coefficient of linear relationships between Log rent per meter square and distance from LRT	62
Table 15: Regression result.....	63
Table 16: Current location and location preference of respondents	67
Table 17: Tenant displacement	69
Table 18: LRT station sustainability for business.....	70
Table 19: The impact of fenced LRT on business and Property value	71
Table 20: Rent change due to LRT	73
Table 21: Occupancy level of buildings	80
Table 22: LRT station related problems and their impact on property value and business	82

List of figure

Figure 1: Schematic flow of the research	14
Figure 2: Bid rent curve	33
Figure 3: The Layout of Addis Ababa LRT stations	42
Figure 4: The Layout of LRT through sub city.....	43
Figure 5: Locational map of the study area	44
Figure 6: The linear relationship between rent per meter square and distance from LRT station	61
Figure 7: The theoretical relationship between distance and commercial space rent.....	61
Figure 8: Eyoel building St. Michel, Cmc	75
Figure 9: Setit city mall, St. Michael, Cmc.....	76

Acronym

AALRT	Addis Ababa light rail transit
BJ	Bera-Jarque
CBD	Central Business Distribution
CSA	Central Statistical Agency
ETB	Ethiopian Birr
HCB	Hole Concrete Block
Km	kilometer
LRT	light rail transit
M	Meter
MRT	Metro rail transit
R	Correlation coefficient
RICS	Royal institute of chartered surveyors
SPSS	Statistical package for social science
St.	Saint
TOD	Transit Oriented Development
UN	United Nation
UTM	Universal Transverse Mercator
UK	United Kingdom
USA	United States of America

Abstract

The LRT of Addis Ababa is the first of its kind in sub-Saharan Africa. The most part of it is on the surface of the ground and fenced that cuts of main crossings that impede mobility in both pedestrian and car drivers. The impact of LRT station on commercial property value is studied in different countries but not in Ethiopia, consequently, it is found necessary to study in our country context. In this regard the impact of LRT station on commercial space rent, push and pull effect of the stations, and socio-economic and environmental effect is examined in two selected stations. Data were collected using an interview, questionnaire, field observation, and physical measurement. For quantitative analysis, this study has used cross-section data of monthly rent the assumption of multiple linear regressions were tested before the analysis was carried out. The level of occupancy and business activity has been analyzed based on the data collected from respondents. The linear relationship between rent per meter square and distance from LRT station has inverse relation but the statistical test shows that the relationship is insignificant. Although the LRT station has no significant impact on rent per meter Square, commercial buildings near to LRT station is more occupied than buildings far from stations. Therefore a building near to LRT station has more value than buildings far from stations. This is because; the value of the property is a cumulative effect of rental price and occupancy level of the building. Furthermore, LRT station is being a source of problems that is noise, waste, pollution, and traffic congestion, those problems has no impact on commercial property value. These problems come from the situation that LRT has the lack of crossing and the stations serve as pedestrian crossings. To alleviate the problems, the pedestrian crossings should be constructed at the mid-distance between two consecutive stations which lacks pedestrian crossings.

Keywords: Property value, MLR, crossings, Occupancy level, LRT Station, rent

Chapter One

1. Introduction

1.1 Background of the Study

Value can be understood as a probable price or estimated amount which is determined in the competitive market. This price is the result of a transaction between willing and capable parties and the transaction concluded without coercion. Transaction participants are equally and meaningfully informed about the property specific condition and about the prevalent market condition (Fisher, 2004). Values continually change because of changes in general and special accessibility. Planning controls, especially those concerning residential and commercial densities may modify the gradient, and green belts might create local areas of scarcity and so raise values (Balchin, *et al.*, 1995).

Urban rent is determined by profitability, which is highest at the place of maximum accessibility, that is, the central business district. Even if general accessibility begins to reduce when crowding in the center increases to severe levels, values and rents may continue to rise if sites benefit from some form of special accessibility. Within the urban area, large sites may be more valuable than small ones, as economies of scale can be understood even if the site has many uses. Land value gradients vary from city to city, and because of higher incomes and internal and external scale economies. But the rate of fall in value is not the same for every use (Balchin *et al.*, 1995)

As accessibility increases, mobility becomes less costly both on time and money and transport costs decline (Javier *et al.*, 2010). The fact that land value rises when accessibility improves is supported by land rent theory. These theories identify that land rent, a capitalized value of land reflects the accessibility of the land to goods and services. If accessibility is improved by the implementation of new transport infrastructure, these theories predict that the higher accessibility would lead to higher rents and higher rent leads to higher land values. This interaction is described through the concept of accessibility. Accessibility can be defined as the ability to access activities and goods that are in demand. Focusing on the passenger transport accessibility defined as the extent to which land use and transport enable groups of individuals to reach activities or destination by means of a combination of transport modes (Roukouni *et al.*, 2012).

Numerous cities throughout the world are dealing with growing traffic and congestion by building rail transit lines, although many doubters have questioned, whether the lines are cost-effective or not (O'Toole, 2014). However, rail transit has been advertised as an effective way to promote economic development (Ko *et.al*, 2013). Although personal automobiles are convenient and provide travel flexibility, they also cause congestion and accidents, increase energy consumption and emissions, generate sprawl, and exclude low-income and disabled populations. To reduce personal reliance on the automobile and address the social and environmental issues mentioned above, most major European cities have invested in rail systems as an alternate mode of transportation (Yan *et al.*, 2012). The advantages of light rail are reduced pollution, congestion, and energy consumption levels along with more compact economic development. Enhancing economic development around light rail stations was another substantial argument to promote LRT (Kim *et al.*, 2013) and (Mohammad *et al.*, 2013).

The introduction of a rail transit investment brings benefits to the transportation system and to the accessibility of the population to employment, retail, and recreational activities. Rail transit investments also introduce a variety of impacts on the area around the rail alignment. One of the most significant effects of a rail transit project is its impact on property values (Pagliara *et al.*, 2010). Land value in general (and particularly in an urban context) reflects the value of public goods and services available to particular sites. Urban rail transit, in particular, can offer higher land value for the region than other infrastructure (Sun *et al.*, 2017).

Economically, the development should be fairly fast, that is, residential properties near transit stations should appreciate in value. This is because they should capitalize immediately on their new-found accessibility, perhaps even speculatively, before the transportation investment operates. When transit lowers commuting costs property values should rise throughout transit's urban reach. The fundamental assumption for higher property values is that a rail system must reduce commuting costs, either in the form of perceived total transit time or monetary costs (Kim *et al.*, 2013), and (Pan., 2013).

Economic theory suggests that people are willing to pay a premium for access to amenities and these amenities are capitalized into property values (Wang, 2016). Studies suggested that the value of Commercial property near to Light rail transit (LRT) station has to be appreciated (Xu *et al.*, 2016), and (Javier *et al.*, 2010). The willingness to pay for proximity to rail transit reduces

the distance to rail station increase (Ko et al., 2013). A majority of recent empirical studies found that rail stations have positive effects on nearby property values, which is consistent with the standard urban economics theory on the relationship between accessibility and property values. Proximity to rail transit stations can also impose nuisance effects like crime and noise to nearby neighborhoods. The combined effects can be mixed and it becomes a question of which ones dominate (Pan, 2013).

Addis Ababa has two main forms of public transport modes the bus and taxis. The bus includes, Anbesa bus, sheger bus, alliance bus, and Higer buss, on the other, was taxis includes meter taxis which is the new one, blue taxis which is commonly called Lada, and minibus taxis are available in Addis for transportation. Nonetheless, there is increasing the difference between the supply and demand for public transportation. The LRT is introduced to as a solution to balance the supply and demand discrepancies by addressing the congested roads of Addis Ababa, specifically, provide an alternative means of public transport to the city road-based system, Speed up passengers' journey to provide a more environmentally friendly transport option [1].

The light rail transit of Ethiopia, which was inaugurated in September 2015, Addis Ababa is the first urban metro light rail scheme to be built in Sub-Saharan Africa (SSA) excluded.[2]It has two directions, East-west route (Ayat to Torhiloch) and North-south route (Minilik II square to Akaki) [3].

From Yehualaeshet (2012) project report, Addis Ababa LRT has two directions with a total length of 34.25 Kilometer. The East-west direction has 17.35 km and North-south direction has 16.9 Km. the two directions have shared a common distance of 2.7 Km. The most of it is on the ground and fenced. According to the Addis Ababa Light rail office, the North-south direction, the maximum distance between stations is 1.972 km, the minimum distance is 0.435KM, and the average distance between consecutive stations are, 0.773 km. Depend on Andualem and Takele (2018), the distance between each consecutive station in East-West direction the maximum is 2.362 km, the minimum is 0.412 km and the average distance is 0.798 km. It has a total of 39 stations, from which, 32 stations are on the surface, however, and the rest seven are on cave and on the bridge.

1.2 Statement of the problem

According to World Bank data, by 2030 African cities population have grown, as result city boundaries which now expands into the periphery. Due to the spatial growth of the city, for instance, Addis Ababa, Lagos, Nairobi, Accra, Dakar, and Dar Es Salaam are among the cities in which the urban population is inadequately served by the transport system [4].

The population growth of Addis Ababa is a combination of three basic processes: rural-urban migration; natural increase, and reclassification of land from rural to urban categories. This growth combined with the spatial growth of the city increases the mobility of the residents and consequently the demand for public transport in the city (Tilahun, 2014). To alleviate transportation problem Addis Ababa was introduced LRT, and recently introduced meter taxis. However, seeing long lines during rush hours at various bus and taxi stations are still observed and the challenges remain [5].

The Addis light rail transit has become a very popular and common means of transport for all city residents including children and the elderly. Its advantages are, the train does not have to strain during the traffic congestion, low cost for long distance as compared to another mode of the transportation system. At times, there is a push and pull around the public and long queue in order to take a taxi [6]. However, there is also opposition from motorists, taxi-drivers, and business owners, among others. Some peoples of Addis Ababa have mixed feelings. Car owners complain that the rails have cut off key turning points, and some businesses on the wrong side of the tracks are now facing losses because their customers don't want to walk all the way down to the nearest pedestrian crossing [7]. In Addis Ababa he firms with the closest location to crossing points and LRT stations had better performance (Yigzaw et. al.) [8] Regarding the accessibility issue after the construction of the LRT, the firms feel more inconvenience of the parking space, crossing points and pedestrian facility. Pedestrians always choose the most convenient and direct route. They do not want to take much travel time to access services [9].

Planners also argued that the fenced LRT system of Addis Ababa divides the town into four sections. This division has its negative impact on the attractiveness of the city, social and economic activities of the society. It interrupts the social relationship between the opposite sides of the community. The negative impact is not limited only to social issues but it affects the economic relationship of the neighborhood.

LRT may bring certain risk and hazards involving pedestrian and car crossings [10]. Some Car drivers and passengers of cars complained that they waste extra time where stations are the only option to cross the rail line for the pedestrian. They argued that during rush hour, a minimum of twenty minutes are wasted in each station. This might be due to; the pedestrians are crossing through the station to access goods and services from opposite sides of the LRT line. In traffic regulation, the drivers give priority to pedestrians to cross the road; it takes extra time and creates a high level of congestion. This congestion might bring the certain risk for pedestrians as well as at car crossing. At the same time, stations create a high level of congestion, nuisance, and trouble, particularly at the rush hour.

Building owners and tenants argued that stations have push and pull effect in different business and business person. Businesses are pushed from the mid area of between two LRT stations. At the same time, it attracts the tenants from mid-distance area of two consecutive stations and different areas of the city towards the LRT station. However, LRT station creates a node around there, as we go far from stations parallel to the railway line, areas are turned to the dead area and some properties are converted to other function from the previous function and their vacancy is increased. This implies that the value of building near to LRT station and far from LRT station is different. This is due to the fact that fenced LRT system which lacks the adequate pedestrian and car crossings.

Tenants and commercial property owners debated that due to the fenced LRT system, where the LRT station is the only option for crossings, the area around LRT station is most preferable for business as opposed to the mid area. The tenants follow active business areas near to the station, as a result, buildings far from the station, found in the LRT line frontage turned to vacant, it might have has different rent price. Consequently, the LRT of Addis Ababa might have an impact on property value.

Researchers have started to identify transit's benefits for increasing physical activity, reducing traffic congestion, and helping socially-disadvantaged populations become more mobile, but they have spent relatively less time looking at the economic impacts of these systems. Since transit systems concentrate people at particular locations – the stations where everyone boards and exits the train at the same time – we would generally expect the areas around stations to become economically valuable for businesses trying to capitalize on this larger visibility [11]. The impact

extends not only to the business activity but it also affects property value in terms of rent and occupancy condition particularly on commercial property.

As per the knowledge of the researcher, various studies have been conducted related to the light transit and the impacts of Light rail station on the value of the residential and commercial property. In Ethiopia Alebel *et al.* (2017), asserts that value depends on the distance from CBD and accessibility from services but they did not consider the issue of the light transit on property value. Research has not been conducted in relation to this issue in Ethiopia, particularly in Addis Ababa. On the other way Yigizaw *et al.* [12] Studied that Economic benefit and effect of Addis Ababa light rail transit on private business firms, and they only considered from private business perspective. As a result, it has been found so critical to investigate the impact of light rail transit station on the value of commercial properties in Addis Ababa. Furthermore, it has been found necessary have to identify different claims and problems and prove different arguments scientifically.

1.3 Objective of the Study

1.3.1 General objective

This study examines the impact of Light Rail Transit (LRT) stations on the value of commercial properties in Addis Ababa. The impact on value has been measured by the monthly rent of commercial houses and an occupancy level of buildings. It also includes the social and environmental impacts of fenced LRT system.

1.3.2 Specific objectives

Based on the main objective, this research sets specific tasks that may lead to a better understanding of the relationship between LRT station and the value of commercial properties. Specifically, the objectives of this study are to

1. examine the effect of LRT station on commercial property value from a rent perspective
2. assess the push and pull effect of LRT station on tenants and business activity
3. assess existing impacts on the socio-economic and environmental impact of fenced LRT system

1.4 Research Question

In line with the objective of the research, this research has answered the following questions.

1. How much is commercial property rent responded to distance from LRT station?
2. What is the push and pull effect of LRT stations on tenants and business activity?
3. What are the existing problems related to fenced LRT Line and station?

1.5 Significance of the research

Indeed this paper is for the fulfillment of master's degree, the output of this research will give helpful insight for policymakers, municipal leaders, and property owners about the impact of light rail transit on the value commercial properties. Moreover, it will be used for further reference for other researchers who want to study similar problems to save his or her time, money, and energy. And also it uses a premises idea on the related problem to initiate researchers who want to investigate the related issue both on quantitative and quantitative approach. It may open up a new discussion on the issue and the methods. It will also add to the existing scarce literature concerning the impact of Light Rail Transit on the value of commercial properties in developing nations.

1.6 Scope of the study

This has been conducted in Addis Ababa LRT station. It has particularly focused on two selected LRT stations and rental price per meter square of commercial space around the stations was taken. This paper has tried to measure the impact of LRT station on commercial value with respect to distance from the station, both in terms of rent and occupancy level furthermore; it has assessed the impact of fenced LRT system on socio-economic and environmental aspects. By using convincing selection criteria, only two LRT stations namely St. Michael station and Hayyahulet 2 stations have been selected to realize the objective of the study due to lack of time and finance, as described under site selection section of this paper.

1.7 Limitation of the study

This study has been conducted using scientific procedure, however it has some limitation. The limitation includes variable selection; this research could not include the variable building functions which it might have big impact on the model. Because, the functions are very

heterogeneous in the area, the researcher faces complications in data coding for regression. In addition to this, this variable has been not included to remove complications and tediousness in interpretation.

1.8 Organization of the research

This research has five chapters; the first chapter is the introduction and methodology, , the second chapter is related literature review which includes both theoretical and empirical reviews. The third chapter is the description of the study area. The fourth chapter is the analysis and discussion part; in this chapter, the collected data both qualitative and quantitative data has been discussed and analyzed in a qualitative and quantitative way. The final one, chapter five is dealt about the conclusion and recommendation.

The conclusion part of the whole paper particularly the analysis part has been summarized and shows the main findings. In this chapter, relevant recommendations have been suggested based on the main findings of the study

1.9 Definitions of terms

The following terms have been contextually defined to have a common concept through this document. Defining commercial property, rent, the value and rent of the relationship, and LRT station has to be found important since this study has used these terms in various sections of the document.

Commercial property: Commercial property is an income property which is constructed for the intention of generating profit, including office property, hotels, restaurant, and cafes; retail shops (Macgregor, 1998).

Rent: rent is a contract between tenants and building owner to use a commercial space for a specified time, in reward the tenant pays money to secure use right of the commercial space. This amount of money is called the rental price of commercial space. The payment of rent depends on the agreement of the tenant and the owner of the building.

Value versus rent: Rent is one of the sources of income to estimate the market value of the property, the capitalized income indicates the market value of the property, consequently, and as

rent of commercial space increase the value of the building is increased. Market value and rent of property have direct relationships (Macgregor et al., 1998).

Light Rail Transit Station (LRT) station: It is a place where the passengers are boarding and step down from the train.

2. Research methodologies

2.1 Site selection

The East-West corridor of Addis Ababa LRT has been selected because in this corridor there is high mobility of passengers. According to Addis Ababa LRT office, from 11, 3842 passengers 60.44% were from this corridor. Before the site selection was made the researcher sets selection criteria. The relevance of this criteria's is to select the relevant site to meet the desired objective of the research. And it helps to dig out the problems of the fenced LRT system and LRT stations.

These criteria was

1. Location
2. Accessibility of station
3. Type of station
4. Relative number of commercial buildings
5. Relative condition of business movement
6. The absence of crossings between stations
7. Congestion around stations

Location is one of the basic criteria to select stations. Here, one from around the downtown, and the second from around the periphery has been considered to include LRT station impacts in the center of the town and at the periphery. And it is important to include owners and tenants perception. In fact, the station Torhiloch is at the center, and Ayat is the periphery one, Hayaulet 2 and St. Michael station was selected as sample site due to other reasons.

According to Andualem and Takele (2018), stations found in Hayahulet, and Cmc area are among most accessible stations, such as Hayahulet 1, Hayahulet2, Civil service, and St. Michael stations are the most accessible to the population. Since the accessibility increase the area might be active as well as business activity is also might increase. Based on reconnaissance survey of the researcher in this areas there is relatively more commercial buildings and areas are more active than other stations which have a similar feature, like on the surface type of stations.

One of the key criteria is the absence of crossing at the mid-distance between consecutive stations. Due to this, the buildings found around the mid-distance might found their buildings

exposed to high vacancy and low rent as well as tenants' bossiness might affect too. And also the absence of crossings might a cause to other problems such as congestion. Regarding congestion before the site was selected the researcher was mad observation at different stations in the rush hour.

In general, To undertake this study the researcher has been selected two stations based on Station found in different neighborhoods, high accessibility, and its type is on surface, relatively number of commercial properties around station, relatively active business movement around station, the absence of crossing between successive stations, relatively high level of congestion around station was a key criterion to select the sites. By compromising these criteria the researcher was convinced to select Hayahulet 2 station towards Hatahulet 1 station and St. Michael station towards Civil service Station as a sample site.

The table below shows the consecutive distance between Stations in the East-West corridor.

Table 1: Consecutive distance between Stations

Serial number	Name	Distance(M)	Feature
1	Torhiloch-cocacola	720.9	Surface
2	Cocacola-lideta	728.6	Partial(bridge and surface)
3	Lideta-Tegibared	768.4	Bridge
4	Tegbared-Mexico	635.6	Bridge
5	Mexico-Legehar	663.4	Bridge
6	Legahar-stadium	412.1	Bridge
7	Stadium- Stifanos	607.3	Bridge
8	Stifanos-Bambis	590.2	Partial(bridge and surface)
9	Bambis-St. Ureal	699.5	Partial(underground and surface)
10	St. Urael-Hyayhulet2	953.5	Partial(underground and surface)

11	Hayahulet2-Hayahulet1	685.3	Surface
12	Hayahulet1-lemhotel	782.6	Surface
13	Lem Hotel—Megenagna Adebabay	799.2	Partial(underground and surface)
14	Megenagna Adebabay-Gurdshola2	856.3	Partial(underground and surface)
15	Gurd shol2-Gurdshola1	1054.9	Surface
16	Gurdshola1-Manangement institute	970.8	Surface
17	Management institute-Civil service University	724.5	Surface
18	Civil service University-St Michael	845.2	Surface
19	St. micheal-Cmc	849.1	Surface
20	Cmc-Meri	1092.2	Surface
21	Meri-Ayat	2362.9	Surface

Source: Andualem and Takele, (2018) and own observation

Table 2: Feature of East-West corridor LRT stations

Serial number	Station name	Feature	Population Accessibility in 200 m walking distance
1	Torhiloch	Surface	79,918
2	Coca-cola	Surface	108,479
3	Lideta	Bridge	65224
4	Tegbared	Bridge	7993
5	Mexico	Bridge	173,820
6	Legehar	Bridge	9730
7	Stadium	Bridge	23549
8	Stifanos	Bridge	41429
9	Bambise	Surface	39938
10	St. urael	Underground	67552
11	Hayahulet 2	Surface	50865
12	Hayahulet 1	Surface	19625
13	Lem hotel	Surface	16510
14	Megenagna Adebabay	Underground	24479
15	Gurdshola2	Surface	14017
16	Gurdshola1	Surface	41091
17	Management institute	Surface	11153
18	Civil service university	Surface	19668
19	St. Michael	Surface	22873
20	CMC	Surface	21734
21	Meri	Surface	11543
22	Ayat	Surface	20312

Source: Andualem and Takele, (2018) and own observation

Depending on two tables above, the distance between selected stations that is, between Civil Service University and St. Michael is 845.2 meter and between Hayahulet Hulet two towards Hayahulet 1 is 685.3 meter. This distance is close to the average distance of the East-West corridor. The average distance between the stations is 847.74 meter, as well as population accessibility with other key selection criteria; the two sites were selected for this research.

2.2 Overall flow of the research

The general flow of the research is described in the below diagram.

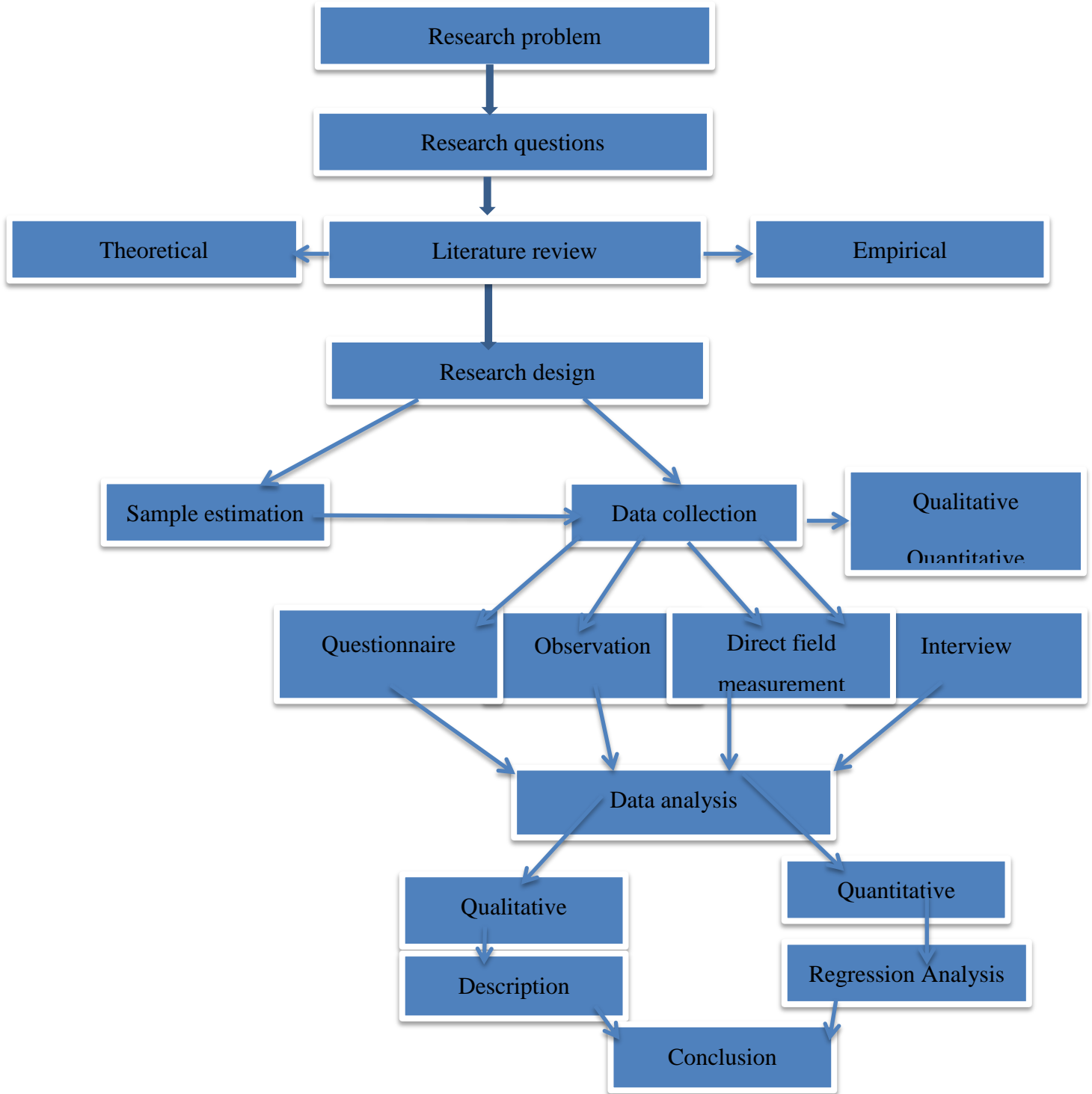


Figure 1: Schematic flow of the research

2.3 Research approach

This research has employed a mixed research approach. Mixed methods research is a research approach which uses a combination of qualitative approach and quantitative approach in the process of getting answers to research questions. The philosophical foundation of choosing this method is the fact that this method enables researchers to collect diversified quantitative data and qualitative data so that they can have a better understanding about the topic under consideration (Creswell, 2014).

The quantitative approach has been used for regressing rental price of the commercial property to infer the relationship of rent and determinate variables and to check statistical significance of LRT station on property rent and analyses other factors which affect the rent value of commercial property. Furthermore, it includes frequency and percentage results from respondent responses. A qualitative approach has been used to include opinions and attitudes of expertise. This approach is very important to explore non quantitative variables and it is very important to check practical significance of variables.

Mainly, the qualitative approach has been employed for analyzing the socio-economic and environmental impact of fenced LRT system due to the absence of pedestrian crossings. The objective of pull and push effect of were described qualitatively by taking case study areas around the LRT system.

2.4 Data type and data collection

2.4.1 Data type and data source

There are different types of data which researchers can use for undertaking the empirical study. These are cross-sectional data, time series data, and pooled data. Cross-sectional data are data on one or more variables collected at a single point in time (Brooks, 2010). Researchers who conducted real estate related research usually use cross-sectional data (Cellmer *et al.*, 2015), and Cebula, 2009). Rent has been used to determine property value (Karytinios, *et al*, 2001) And (Ezebilo, 2017). In this study, cross-sectional data of monthly rent per meter square of each commercial space unit were used to determine the impacts of LRT station on commercial property value combined with occupancy condition of building from owner and tenant perspective.

The researcher has collected both primary and secondary data. Primary data were collected using questionnaires for tenants and an owner; own experience, interview both on face to face and telephone from urban planners, academicians, brokerages, property owners, and managers. The rent data were collected primarily from tenants, owner of building and property managers have been interviewed. In the case of secondary data books, journals and previous research materials, as well as websites, have been used as secondary data. The rent and other characteristics of the commercial space units were collected directly by interviewing tenants or owners or property managers depend on their willingness to give information, field observation, and any necessary measurements that is the distance from LRT station and dimension of the Commercial space unit for area calculation. The rent data were collected from stations which are parallel to the LRT line and it covers commercial properties located from one station to the mid-distance of the next station on both sides.

2.4.2 Data Collection Technique

In this research, the researcher has used different methods of data collection such as observation, interview, and questionnaire both structured and unstructured and direct field measurement. The techniques have used in this research is described as follows,

A. Observation

In this method, data have been collected directly from the field by the researcher and it is a systematic view of the occurrences. In this study, this has mainly been used to collect congestion and traffic-related data around the LRT stations, business movements besides LRT line, the vacancy condition of buildings with respect to LRT stations and the deadness of spaces which are found in mid-distance between two consecutive LRT stations. This data has great importance to investigate the push and pull effect of renters around the LRT Stations. These methods of data collection have been used as a compliment for other methods and more importantly, it has been used for case study analysis.

B. Interview Method

In this case, face to face interview and telephone interview have been employed to collect primary data particularly data on current monthly rent of commercial units from the center, the impact of LRT station on commercial property rents from brokerages and tenants, vacancy and

rent level with respect to LRT station from commercial property owners. The economic, social and environmental impacts of fenced LRT line data was collected through this method from, academicians, and planners. This is very important to understand the issues in depth.

C. Questionnaire Method

This method has been used in this research that leaves the respondent to answer the question on their own. The survey questionnaire includes structured and unstructured questions. The structured questions were prepared to collect responses from the choices given, whereas the unstructured questions were prepared to include the attitude of the respondents and make them express their feelings freely. The prepared questions have been dispatched for tenants and owners close to LRT station, around 100 meters from LRT station and around mid-distance between two stations. This is basically important to know their motivation and attitude towards the advantage of LRT station on their business, occupancy condition of buildings, and the level of noise and pollution. Indirectly it was important to understand the impact of distance from LRT station on property value. From this push and pull effect of LRT station and the impact of fenced LRT was analyzed.

D. Field measurement

This is one of the data collection techniques used for this research, particularly to collect the distance from LRT station and the area of a commercial space data. The distance of commercial unit from LRT station and the dimension of the commercial space if it is unknown were measured by using Meter.

E. photographs

Photographs are one of data collection techniques employed in this paper, particularly, building photographs used as case study and traffic condition near to station was captured during researcher observation for further analysis in supporting with an interview and questionnaire data.

2.5 Sample selection and size determination

Commercial Buildings has been selected purposely in accordance to its distance from LRT station, whereas, to determine the number of rented commercial space units involved in this

study, the judgmental sampling technique was used. The reason to use purposive sampling, it is important to dig out the problems by taking the affected spaces.

In accordance with, Brooks (2010) a sample in excess of around 100 observations is usually considered sufficient for statistical analysis with a test of normality assumption. This is also over satisfied with the central limit theorem, from the site rented commercial spaces units have been selected purposely from the St. Michael station towards civil service station as well as from Hayahulet two towards Hayahulet 1 to represent rented commercial space units in two sites. At the same time buildings found around in this two sites, at frontage line with LRT is considered as a sample frame.

It was difficult to know an exact number of the rented commercial space units in the study area. It is difficult to enumerate all commercial space units, as well as there is no local responsible authority to enumerate and count these specific area commercial space units. When the number of population is unknown samples are estimated as follows, by taking significance confidence level with critical value: the Critical value of 95% confidence level is 1.96. There is statistical formula to determine sample size if the total population is unknown (Cothri, 2004).

Indeed there is a statistical formula, to estimate sample size from the unknown population, however, to use of the formula is difficult to find the standard error and standard deviation, because standard deviation and standard error should be driven from previously related researches.

To compromise, based on the central limit theorem sample size greater than 30 can ensure statistical analysis and sample size 100 is considered sufficient in real estate researches. As a result, this research has used 172 commercial units with appropriate normality tests. This reveals that more than enough samples were taken without using the above formula. These 172 commercial space units have been used for analyzing the effect of LRT on rent per meter square for regression and correlation purpose.

In this research respondent like both property house owners or managers and tenants in the front of the LRT line are assumed to be affected by the LRT system. As a result, the researcher has collected data from them by taking samples. The sample was determined by judgmental sampling technique. It is difficult to use the statistical formula to estimate the sample

respondents because we do not know the number of respondents in the area, but in statistics, the minimum sample is 30 and for a sample size larger than 30 the estimation of the sample would be good (Cothri, 2004). Eyasu and Melaku (2016) was used the same method in their study, the impact of the current land lease law on business and investment expansion.

In this research, 50 tenants and 30 have been involved from owners or property managers in the questionnaire. Taking a small sample is economically advantages and it reduces complications in data analysis. To sum up, samples 172 is commercial property space units to examine the impact of LRT station on commercial space rent in the method of regression and correlation, however, 50 tenants and 30 owners were used to examining and assess the push and pull effect of LRT from occupancy and business perspective.

Furthermore, the researcher has collected the data through in-depth interview taking the following sample in a purposive manner; depending on their experience and exposure to the issue, as indicated in the table below.

Table 3: Sample respondents for an in-depth interview

No.	The idea of the discussion	Composition	Number of participants	Distribution for two stations
1.	The economic impact of LRT system	Property owners, brokerages, and academician, owner/manager	Two, academician, two local brokerages, the property owner/manager and urban planner.	Distribute equally,
2.	The social impact of LRT system	Property owners, academician	Two property owner/owner	Distribute equally
3.	Environmental impact of LRT system and station	urban planners, commercial property owners, academician	Two from commercial property owners/managers, urban planners, Academician	
4.	Impact of LRT station on rent	Brokerage, and commercial property owners/managers	Two brokerage Two property owners.	Distribute equally
5.	The overall impact of LRT system	Academicians from Addis Ababa University, the urban planner	Two academicians and one urban planner	
6.	Compare transportation modalities	Passenger of train	One passenger	

The total samples of house owners, tenants, and different interview respondents participate in this study equally allocated for two stations areas (Cmc St Michael and Hayahulet two),. Commercial property units were taken from each sample LRT station, as sample units, after obtaining the total number of commercial properties in the study area. As indicated previously, 50 tenants were involved in this research and the researcher has collected primary data using a survey questionnaire from 25 sample respondents around St Michael station and the rest 25 from Hayahulet 2.

Here, the selection of building owners (managers) is selected started from station to the mid-distance, even if we did not know the exact number of buildings in the two sites, there are no many buildings to confuse to select to the researcher. Furthermore, buildings are not evenly distributed with respect to LRT station; consequently, data were collected from the station to the mid-distance from two sites. Concerning the tenants from each station, due to the building are not evenly distributed, a questionnaire was dispatched purposely starting from station to the mid-distance from different buildings. Particularly in the areas of close to LRT station, as well as the mid-distance buildings, were considered.

2.6 Techniques of Data Analysis

This study has used quantitative and qualitative data analysis techniques since both qualitative and quantitative data were collected to realize the objective of the study. The data collected through interviews, from open-ended questions, personal observations have been described qualitatively using texts. The data collected through closed-ended questions of survey questionnaire have been analyzed quantitatively using tables, simple frequency, and percentage. Rent per meter square data with respective variable information has been analyzed using multiple linear regression analysis in order to estimate the impact of LRT stations on the rental price per meter square of commercial properties located beside the stations.

In quantitative analysis basically focus on descriptive statistics multiple linear regression analysis, correlation analysis from rent data and, moreover, simple frequency and percentage have been used for analyzing the questioners from tenants and building owners. Qualitative analyses were used for analyzing and describing situations from observation, interviews and unstructured questionnaires. Qualitative data are not expressed in terms of numerical value. In order to analyze the impact of LRT on social, economic and environmental and push and pull effect of the LRT station, the collected data have been described qualitatively.

The analysis techniques are depending on the nature of the data. If the data is quantitative, the techniques should require quantitative analysis and on the other hand, if the data is qualitative the analysis technique should require qualitative techniques.

A. Descriptive statistics

In this research, descriptive statistics were employed such as mean and standard deviation each variable from the collected data. The mean measures the average value of the variables; however standard deviation shows the measure of dispersion from the mean, means that it shows the distribution of data from the mean. Descriptive statistics were basically employed to analyses rent data per month and respective independent variables.

B. Correlation Analyses

The other method of data analysis employed in this research is correlation analysis. Correlation analysis measures the linear association between the dependent and independent variables. The main objective of this technique is to show the linear relationships between rent per meter square and independent variables. It focuses on the direction and strength of relationships.

C. Multiple linear regressions

The multiple linear regression was used to show the quantitative effect of the independent variable over the dependent variable that explained under variable selection section of this document. The rent per meter square is regressed as a function of independent variables, to show independent variable impacts on rent per meter square.

D. Simple frequency and percentage

The collected data from tenants and owners through questionnaire has analyzed in terms of frequency and percentage. The simple statistical tool frequency and the percentage were used to describe the push and pull effect of the LRT station and fenced LRT impacts on property value especially on the occupancy condition of the building.

E. Description

The collected data through observation, interview, unstructured questionnaire, and photographs have described the situation that exists in the area, from the interview and unstructured questionnaire, knowledge, and attitudes of the respondent towards the issue were described. This method of analysis techniques, particularly it was applied to analyses unquantifiable or difficult to show in the quantitative term

F. Case analysis

This method has been used to deeply investigate the phenomenon of push and pull effect of LRT station on tenants, the level of occupancy before and after the introduction of fenced LRT system in nearby and far properties from LRT station. St. Michael LRT station has been taken as case area. observation and interview checklists were prepared in order to collect qualitative data. Property owners and managers close to LRT station and far from LRT station were asked. This technique aimed to dig the problem in depth and to show comparatively. The two cases were analyzed from a different location with respect to LRT station. The one from very close to LRT and the second is far from the station.

2.7 Summary of Methodology with respective objective

To achieve the general objective of the research, the general objective should be breakdowns into specific objectives. Each specific objective might have different methods. Based on the summary of methods, mainly, the specific objectives of this research have been employed in the following data collection technique and data analysis techniques as summarized below.

Table 4: Summary of methodology

Specific Objectives	Methods	
	Data collection techniques	Data Analysis techniques
Effect of LRT station on the commercial property rent	Physical measurement using the meter, correctional rent data from the tenant and the owner	Multiple linear regression analysis
Push and pull effect of LRT station	Interview, questionnaire, and observation and case study	Describing the situation, simple frequency, and percentage
Socio-economic and environmental impact of LRT	Interview, questionnaire, and observation	Describing the situation, simple frequency, and percentage

Chapter Two

2. Review of Related Literature

Introduction

This chapter provides the theoretical and empirical literature reviews. It tries to assess, examining and synthesizing the theoretical and empirical literature from Journals, books, and internet. Basically, the theoretical part emphasizes valuation methods analyses and synthesizes, and determines property value and Land rent and location theory. However, the empirical one mainly emphasizes on LRT station and property value including commercial property value. Furthermore, this chapter includes transportation and house value, LRT and property value, commercial property and rent price

2.1 The concept of property and real estate

Property can be classified as tangible and intangible assets. Tangible properties are an asset which has physical existence for example building and land and the intangible one is an asset which has no physical existence we cannot touch it but it has legal consequence, for example, lease contractual agreements (Hinkel, 2008). “Real estate is property” (Ling and Archer, 2018)

According to (Epley *et al.*, 2005), real estate is composed of land and buildings with a bundle of rights. Real estate has two components; the first one is, land that consists of the physical as well as legal entities on that particular tract of land. Synonymy (Brggeman, *et al.*, 1997) defines the real estate as the real estate is the physical land and its improvement and construction on land and the ownership right associated with real estate. Additionally it has been stated that the rights associated with real estate are real property. However, Ling and Archer (2018) define real estate from a tangible perspective land and improvement attached to the land.

The intangible aspect of real estate is ownership rights (Epley *et al.*, 2005), (Brggeman *et al.*, 1997) and (Hinkel, 2008) and a bundle of rights (Ling and Archer, 2018). However the cumulative result is the same which constitutes the individual right on given property, including the right to sell, the right to lease and rent, the right to shelter, the right to give it away as a gift and the right to disposition

2.2 Hedonic pricing

The hedonic approach is a method of assessing the value of or the pleasure felt from attributes of a good. In contrast to conventional economic valuation, where the value of a good is calculated for the whole of the good, the hedonic approach regards as good as a set of attributes and considers the value of a good as a function of each attribute of that good. The value of the attribute is called an implicit price (a hedonic price) of the attribute. The hedonic approach is defined as a method of finding out the implicit price of the attribute (Hidano, 2002). A good is essentially a bundle of (performance) characteristics (UN *et al.*, 2013). Real state is a composite of a bundle of attributes. This is because the value attached to a property is dependent on many unique bundles of attributes (Abidoye *et al.*, 2017).

The basic assumption of hedonic pricing method is marketed goods in related to its constituent characteristics. The method has become commonly applied to assess variation in housing price in relation to inherent and external attributes. And also effectively value environmental externalities (Ligus *et.al*, 2016). Hedonic pricing becomes a stream of research applies models to study the extent to which characteristics of housing units (e.g., square footage, age, and neighborhood) drive property transaction prices (Hui *et al.*, 2010). The bundle the property may contain attributes of both the structure and the location of the properties. There is no market for characteristics since they cannot be sold separately, so the prices of the characteristics are not independently observed (UN *et al.*, 3013).

In general, hedonic pricing is a method of estimating the implicit price of attributes which cannot be sold in the market separately. According to Shimizu, *et al.* (2015), the hedonic approach is a technique established theoretically. Specifically, it treats a given product's price as a bundle of attributes of the values of the product's various characteristics and estimates the various attribute prices using regression analysis.

The hedonic pricing model is the most leading in capturing its impact on property values. (Ko *et al.*, 2013). Hedonic regression modeling has become the standard methodology for examining price determinants in real estate research (Fuerst, 2007). It explicitly controls for heterogeneity in a given sample. It is a prominent tool in analyzing real estate prices According to this model, the prices of heterogeneous properties are influenced by common market factors and the location and size of the property. Hedonic regression includes much more characteristics (Pol, 2003).

Hedonic price gives a monetary value for every characteristic of the property. Furthermore, hedonic pricing is important to investigate empirically whether proximity benefits related to adjacent commercial activities (Yang et al., 2016).

The conceptual hedonic regression model is expressed as in equation 2 as a function of different characteristics :(Yan, *et al.*, 2012) and (Ko *et al.*, 2013).

$$\hat{y}_i = f(D, H, N) \dots\dots\dots 1$$

Where

\hat{Y}_i is the value of a particular property

D is the distance from LRT station

N is neighborhood characteristics

H is house characteristics

Regression is concerned with describing and evaluating the relationship between a given variable and one or more other variables. More specifically, regression is a try to explain movements in a variable by reference to movements in one or more other variables (Brooks, 2010). Multiple linear regression models are used in real estate price related issue for instance Szczepankowska (2015) used MLR to simulate real estate transactions; Chiarazzo *et al.* (2014) to analyse the effect of environment with log-linear hedonic model to evaluate the logarithm of each property of the real estate value separately based on the log models and establish a linear relationship between each price log property characteristics and Karytinis *et al.* (2001) Use MLR to estimate the determinates of commercial property rental.

In related to LRT impacts it uses log-linear models. Log-linear hedonic model is to evaluate the logarithm of each property of the real estate value separately based on the log models and establish a linear relationship between each price log and property attribute (Lichao, 2015).

2.3 Methods of valuation

As Wyatt (2013) property valuation defied as valuation Property valuation is the process of forming an opinion of value-in-exchange under certain assumptions at the date of valuation and supply and demand of in a particular market. However, market value is debatable; the amount

the subject property would sell for if the owner offered it for sale as of the date of appraisal where the subject was exposed in an open market. Ratterman *et al.* (2014) valuation is an art of judgment that depends on the experience of valuator and relevant statistical data to estimate the present value of the property. The estimated price also depends upon the expected benefit of the property for the owner. Aggarwal *et al.* (2002) and Baum, *et al.* (2011) defines valuation is the art or science of estimating the value of interests in property.

According to (Fischer, 2002), there are two spheres in valuation methods. In the UK sphere, there are five methods and the US sphere categorize into three. There are a lot of books which categorize valuation method into three approaches to income approach, cost approach, and sales comparison or market data approach. For instance, Fischer (2002), Epley, *et al.* (2002), William *et al.* (1997), Ratterman *et al.* (2014) and Jacobus (2010) categories the property valuation methods in three approaches. However, in the UK Sphere valuation system methods are five, it can be included in one of the above three approaches. Fisher (2002) states five valuation approaches in the UK- sphere as follows;

1. The comparison approach
2. The income approach
3. The cost approach
4. The profit approach used in business valuation
5. The residual approach used for development analysis

According to Isaac (2002) there are five approaches in naming but the same in concept with D. Fischer 2002, those are

1. The comparison methods
2. The profit methods
3. The investment methods
4. The residual methods
5. Contractor methods

Within the above sphere and concept, there are a lot of books have written, for instance, Scarrett (2008) and Blackledge (2009) are some of them.

Finally, let as synthesize as profit method, investment methods, residual methods, and discount cash flow methods are included under income approach of valuation; the contractor method of

valuation is under the cost approach to valuation and the sales comparison method is the common one to all spheres. Consequently, it is better to see in three categories of approaches to valuation. Such are,

1. Sales comparison approaches.
2. Income approaches
3. Cost approaches

2.4 The three approaches to Valuation

2.4.1 Sales comparison approach

The basic concept of this property valuation method is that current market data provide the best indication of market value for the property. The appraiser's task is to investigate newly sales in the neighborhood of the subject property. And make some appropriate adjustment of the comparable with respect to subject property to arrive the indicated market value of the subject property Epley, *et al* (2002). The comparison can be defined as 'the act of comparing' and to compare as to examine in order to observe similarities or differences' (Scarrett, 2008). Similarly, Fischer (2002) states in his book as the market comparison approach that estimates the value of the property by comparing recently sold the similar property. Various names are given for these approaches, for instance, market comparison, sales comparison, market adjustment, comparable sales. Furthermore, the comparison method is based on comparisons derived from current market data as evidence to find rental or capital value directly (Blackledge, 2009).

In order to use the sales comparison approach first, it requires finding out the competitive property. As Epley, *et al* (2002) dictates on their book, the selection of comparative properties or competitive properties to use in the sales comparison approach is based on analyses of various aspects of subject property and of the whole profile of properties that have sold in the recent in recent past in local market area. From this heterogeneous group of previously traded properties, the appraiser finds the one that is similar as possible to the subject property in terms of elements of comparison are considered elements of comparison. The following elements of comparison are considered.

1. Real property rights conveyed (fee simple or leasehold)
2. Financing terms (the change of interest rate over time on the mortgage)

3. The condition of sale (the relationship between buyer are arm's length transaction or not)
4. An expenditure made immediately after the purchase (structural maintenance, painting, roofing)
5. Market condition the time of sale expressed in terms of percentage as compared to the date of appraisal)
6. Location (it is from the adjacent otherwise from the neighborhood)
7. Physical characteristics(size, construction quality, and condition) the comparable property should be similar for site-specific characteristics
8. Economic characteristics which consider characteristics that affect the income-producing capacity of the property.
9. Use and zoning
Need have the same zoning classification
10. Nonreality components of value: It is beyond real property itself including fixtures and furniture.

In addition to the above elements of comparison current and forecasted incomes, the return for that particular investment, the strength of the tenant's contract, the lease terms and the tenure of the property. It is therefore appropriate that in seeking to analyses real property transactions involving similar properties to the one to be valued, particular attention should be paid to these features (Scarrett, 2008).

2.4.2 Cost approach

The cost approach is one of the approaches that are used to estimate property provable price (value) of the subject property on the base of the depreciated cost of production factor that has been used in property development and construction. This means it is a valuation method that can be used to determine the value of a property after accrued depreciation is deducted from cost new (Fischer 2002,)It considers that the current market value is based on real estate is composed of two components which are land and improvement. The Appraisers estimates the value of each component separately and gives a dollar value for each component (Epley, *et al.*, 2002), and (Rattermann, *et.al*, 2014). The base of this approach is the cost of the construction of the subject building itself (Isaac, 2002). Sometimes it is called contractor method and it is important when there is no market activity and market transaction (Scarrett, 2008), and (Blackledge, 2009).

Methods of cost approach are; Quantity survey methods Unit in-place methods and Comparative methods (Epley, *et al.*, 2002). But according to Rattermann, *et al.* (2014) it has common procedures such that;

1. Estimate land value
2. Estimate the direct and indirect cost of the improvement
3. Estimate and add entrepreneur profit
4. Subtract depreciation
5. Add land value
6. Indicated value of the improvement

Depreciation is the difference between cost new and the value of improvement at the date of valuation. And can be subdivided into three categories, physical deterioration, functional obsolescence, and external obsolescence (Rattermann *et al.*, 2014) and (Bruegman *et.al.*, 1995).

2.4.3 Income approach

The income approach or investment method is a method of estimating the present value of the rights to future benefits to be derived from the ownership of a specific interest in a specific property under given market conditions. In property valuation, the rights and benefits from a property in terms of rent or resale value will be considered. It considers capitalization of income rent as the indication of the market value of the property. In order to arrive at the estimated value, the appraisers take into account the income and expense of property because the value of property emanates from the net income of subject property (Baum, *et al* 2011). Synonymously, an income property appraisal estimates value for a property that generates income payments to its owner. It is suitable for office and retail space in office buildings, shopping centers, and commercial districts, with the appraising techniques, gross rent multiplier from comparable sales, the direct capitalization technique and yield capitalization (Epley *et al.*, 2002). The yield capitalization technique is sometimes called a discounted cash flow analysis (Fischer, 2002).

2.5 Land rent and location Theory

The demand for land has been regarded as the primary determinant of land rent and land values while the perceived role of the landowner has been to use the land, or renting to achieve maximum current income (Evans, 2004). Furthermore, the source of demand for land is

expectation or anticipation of profit or utility for any particular purpose. The capital values are derived from the annual rental value; as a result, the highest rental value will have greater capital value (Balchin *et al.*, 1995). Harvey (1996) defines rent as it a periodic payment for the hire of land. Normally, there is competition for land between the different potential users. The rent of land, therefore, as with other factors of production, is determined, in the absence of any government interference, by the interaction of demand and supply. And assume the land is homogenous and full fills competitive market characteristics. And the value from rental price is the rental value of the property (Jacobus, 2010) estimated value of the property is a reflection of property rent (Scarrett, 2008).

The basic theory of land market was set out by the David Ricardo in 1815 in his principle of political economy and taxation. In his principle, it has two elements the quantity of land and the price of land. In this theory, there must be two assumptions the first one is the supply of land is fixed and the land has only one use (Evans, 2004). On the other hand, according to neoclassical view considers the value of land for different uses, means that the rent for commercial land, industrial land, and residential land may not have similar rent even if it locates in the same area. In this theory change in price might be the implication of change in demand or the use of the land (Evans, 2004). For instance, the office has to compete with other uses for land (for residential use, industrial and other uses). To increase the supply of land used for office, the price of land has to try above its next best use, and similarly, the developers compete for each other to acquire the site for development. In these case, the demand curve for land is downward sloping for two reasons, the first one, the higher price of land raise the rent of office and the second one is developers can intensify the scale of any structure built on more highly priced land (Ball, *et al.*, 1998).

The model used by the land economists and geographer, bid rent model shows land users bid for location. The rent of land is increased as we go to the central business district (CBD). Not only is this the model reveals the influence on the way the density of land use determined. (Ling and Archer, 2016,) The location of any activity is determined either by the aspiration to maximize profits in respect of business users of land, or to maximize (or obtain acceptably) utility in the case of residential and other non-business users. The prices and rents of land will fall with increased distance from the central business district through the gradient are rarely smooth.

Wages are higher in the center - local demand for labor being greater than local supply (Balchin, *et al*, 1995).

The price change on the land market is a great challenge in land use planning in line with local policies. This issue is researched over the past few decades and concluded. Economists use recent advances in theory and methods to predict the likely impacts of new and unimplemented policies Joshua *et al.* (Eds), 2014)). Since, land-use planning can make a person poorer or richer, by affecting the value of the rights on his/her land. It can do this both directly by restricting what may be done with that person's land, and indirectly by influencing what others may do with their land, whereby their land has an effect on the value of the first person's land. Those financial consequences for individuals can add up to very great economic consequences for the society (Needham, 2006).

To Sum up, firms maximize their profit when they get high revenue and low cost and they need high revenue but low cost. Nonetheless, there is no single location where this can be achieved in absolute terms. However, there is a trend and practice firms prefer the central location, faraway business districts may be at least as attractive as the central business district in terms of profitability and more attractive than the relatively high-cost and low-revenue locations of the suburban belt in general (Balchin, *et al*, (1995). As shown below the simple bid rent curve, the rent of land increases when close to CBD and vice versa.

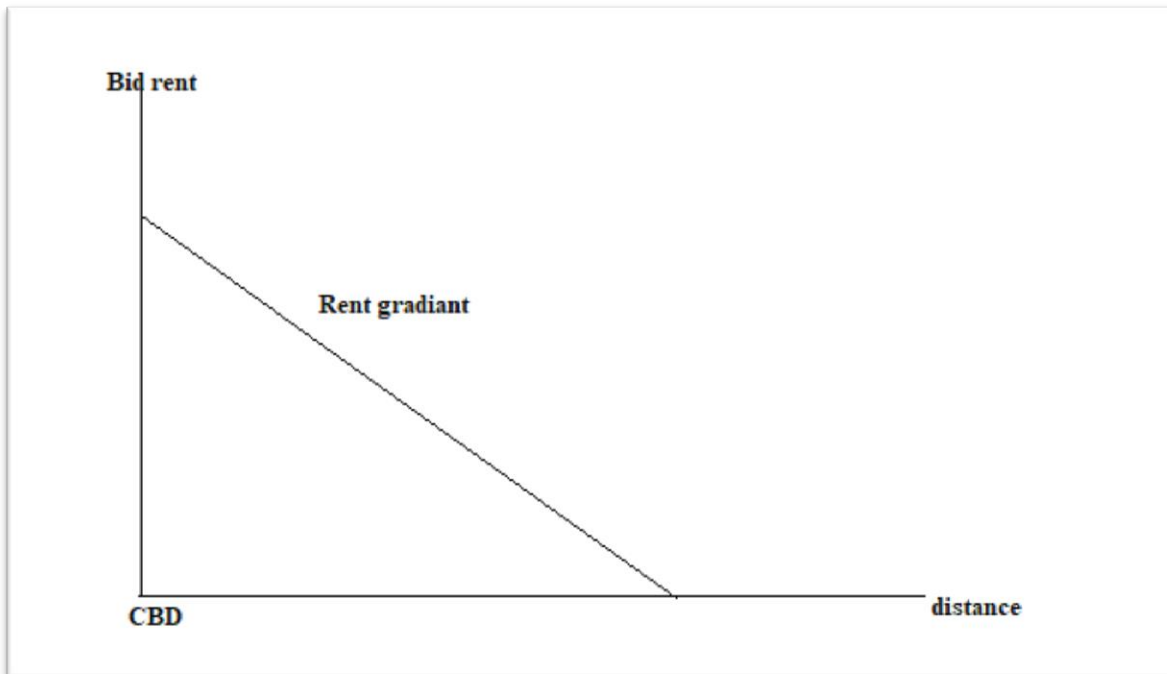


Figure 2: Bid rent curve

2.6 Determinates of property value

Influences on value can be classified as property-specific or market-related. Valuation methods have developed over the years to help the valuer quantify the effect of geographical/spatial, legal and physical influences on value. The wider market factors are less to do with the valuation itself and more to do with context and form part of the rational background that values bring to a valuation including market knowledge and an awareness of the current legislative framework, environmental policy and economic activity (Wyatt, 2013). Market value has determined by the good investigation of property value determinates in both the surrounding and property specific, property value is determined by the age of building, quality of material, design of building which all are characteristics specific properties and the site, the building erected on it and location are other determinates of property value that should be considered in valuation assignment (Scarrett, 2008) in same source value of property is determined by statutory intervention and changes in provisions.

According to Scarlett (2008), location, topography, accessibility, and geology are considered Physical factors that determine property value. Construction materials, the age of buildings, Layout of the building with respect to the site is considered as property specific determinates of

value. However, Epley *et al.* (2002), the value of the property are determined by supply and demand in the market for a particular real property with each particular parcel has its own attribute that determines the value. These determinant attributes are environmental that consists of economic, locational, social, demographic, physical, and government- political environments that affect the property and Site-specific properties include Legal features, Physical feature, Economic and Locational feature.

2.7 Commercial property and rental price

A house is a multidimensional good, which consists of a bundle of attributes that differ in quantity and quality that influence house rental price (Ezebilo, 2017). This can be categorized neighborhood specific and property specific where rent is a source of income used to appraise the market value of the subject property (Epley et al., 2002). This includes physical attributes such as a number of rooms, lot size, and housing type; community attributes such as population and characteristics of the neighborhood; and accessibility to the place of work. People's preferences for these attributes differ, and they often influence the amount of money that consumers would be willing to pay for house rent. House rental price is determined by the price at which a house owner is willing to give out a housing unit to a potential tenant for rent and the price tenant is willing to pay, i.e., equilibrium house rent price, Several factors have been identified that could influence house rent price. These include a shortage in the supply of houses for rent relative to demand, which increases house rental price (Ezebilo, 2017).

Buildings not located on the same parcel as a residence and not used in connection with a residence should be classified as commercial property. An apartment building or other building with four or more family living units is classified as commercial property. Hotels and motels subject to license are classified as commercial property (State of North Dakota, 2011). From the same source, the Rental value can be explained as, is the economic or income value and, under normal conditions, the rental value of the improved property should be reasonably close to the cost or sales comparison value, provided the property is being used properly.

Investors in the commercial property market expect return on their investments in the form of rent Contributors to the early conceptualization of rent theory believed that rent is a differential caused mainly by distance and cost of transportation and attributed differences in rent-earning

capacity of land to differences in location and transport cost (Udoekanem *et al.*, 2014). This causes growth or decline in price depends on transportation cost (Gyourko, 2009).

2.8 Transportation and property value

Transportation is essential for production. It would be just as easy to travel between any two places as between any two other places, and so proximity would have no meaning. People use many different modes of transportation: they walk, run, row, ride bicycles and skateboards, fly airplanes and helicopters; they load packages (Brendan, 2005) including LRT (Randell and Kohtanen, 2012) with the following benefits: Attractiveness, particularly to car users, so encouraging modal shift, Low noise can be specified, Low or zero emissions can be specified leading to improved air quality, Low or zero carbon emissions can be specified to help meet global targets, Light rail can operate safely in pedestrian areas and improve non-car access to such areas and Level entry access speeds operation and meets disability requirements (UK House of Commons Transport Committee, 2005) Cars, buses, and trains are essentially containers for people. The bigger the container, the greater the ratio of volume to surface area, and the more people you can transport (Brendan, 2005).

As accessibility increases, mobility becomes less costly—in time or money—and transport costs decline affirms that mass transport improves accessibility to areas within the transport corridor and increases their relative advantage compared to non-served areas (Raguz, 2010). According to urban rent theory in the urban version, the price of land declines at a decreasing rate with distance from the City Centre, that is the implication of transportation cost (Evans, 2004). Closer locations offer better access but require higher rents; distant locations the reverse (Brendan, 2005) Access improved that would determine the degree of capitalization of property and the propensity to switch mode (Pamungkas *et al.*, 2014). Furthermore, Factor inputs may be equally important in determining location. High levels of accessibility within the central business district are reflected in low transport costs, thus attracting the greatest demand for sites, especially from commercial users. Conversely, low overall accessibility and high transport costs within the suburban areas and the rural-urban fringe will attract a much lower level of demand, especially from commercial users (Balchin, *et al.*, 1995)

To summarize, the value of the property is determined by its location which is accessible or not accessible. The issue of accessibility is directly related to transportation access. Good

transportation facility improves property value. This value drives from a high level of demand for specific space.

2.9 LRT and property value

LRT systems are safer than the motor vehicle-highway system [14]. For instance, in the UK, light rail schemes are presently removing approximately 22 million car trips per year from the roads. The value of avoiding the worsened congestion, greenhouse gas emissions, noise and local air pollution that would have occurred as a result of these car trips has not been specifically identified. Similarly, the pressures on urban land for more road space and parking that have been relieved have not been specifically quantified. There are clear safety benefits associated with trams, which have an excellent safety record. Poor air quality tends to be concentrated in urban centers. Electrically powered light rail vehicles can enhance urban air quality by replacing pollution-generating modes such as car or bus (UK House of Commons transport committee, 2005).

Beyond pollution, urban rail transportation infrastructure became critical given that it provides the essential connection between suburban housing and urban center jobs. In particular, among middle- and low-income groups living in affordable housing, rail transportation became the main affordable travel mode supporting large volumes of mass transit (Xia et al., 2017). Light rail can provide quick and accessible links to jobs, for areas of employment deprivation. It also can provide access for local people in developing community facilities and shopping opportunities, and improve access and mobility for people with disabilities (UK House of Commons transport committee, 2005).

However, the building will have a much more individual effect on the pricing and demand for that asset going forward, and that any premium or reduction in pricing will depend entirely on the individual property's characteristics, market demand, and buyer sentiment. In other words, the effect of sustainability on property value is likely to be very asset specific (RICS, 2010), a number of factors influence the value of the property (e.g. market supply, demand, highest best use, location, condition). However, studies in Edmonton and other cities have shown that more transportation options around a property can increase the value of that property including light rail transit (City of Edmonton, 2012).

2.10 LRT station on property value

A good transit system provides a high level of access to work and other activities for households and to customers and employees for businesses. The monetary value of this access will be reflected in the value of a home or a business (summary of studies, 2001). Crampton (2003) showed that some offices moved out of the city center to the outskirts of the urban area because of lack of expansion and difficulties in reaching the city center by car. However, in most of these cases, accessibility to tram stations becomes a decisive location criterion.

Many researchers have been conducted a lot of research on the impact of LRT stations on property value by different methods. That light rail can have a positive impact on property appreciation rates near urban commuting stations (Kim *et al.*, 2013) particularly on residential property value (Yan *et al.*, 2012) and commercial property is highly affected than the residential value (Ghebreegziabihe *et al.*, 2003).

Randell *et al.* (2012) concluded that the value increment for commercial property is considered to decrease significantly with the distance from light rail stations. This is due to the fact that employees and customers are considered to be less willing to walk distances from stations of more than 400 meters, compared to residents walking to their homes. Ko and Cao (2013) supports the above statement on commercial and property value as Property prices decrease with distance away from LRT stations in the Hiawatha.

Zhong *et al.* (2016) used OLS model to determine the impact of LRT station on property value. However, OLS model reports a no significant property value impact for single-family houses located within a quarter mile of a new transit station, the spatial model confirms that such an impact is significant and the magnitude is also much higher than in the OLS estimation. On the other hand, Pan (2013) concluded that the OLS estimation reveals that the light rail line has positively significant effects on properties located between one-mile and three-mile distance from rail stops while the MLR model only shows insignificant effects of light rail on those properties In Houston LRT system.

Comparing properties located beyond 1600 m from mature line stations and keeping all other variables constant, the values of single-family units within 400–800 m of the stations would be significantly lower. On the contrary, the multi-family housing market seems to have reaped

substantial benefits by being close to these stations. Multi-family houses located within the three distance bands from mature stations (0–400 m, 400–800 m and 800–1600 m) are 27–99% (\$283,090 to \$1,030,410) more valuable than their counterparts located beyond 1600 meter (Zhong et al., 2016). Commercial properties in the inner 0–100 m circle appreciate the most (nearly 16%), while the outer three circles gain less, at circa 8%. The Wuhan MRT#2 transit access premiums present on two levels, with the 0–100 m circle being the core area. Finally, the study suggested that using value capture methodology to collect the incremental fees/taxes of land value could support sustainable urban rail transit development and benefit TOD urban planning policy (China *et al.*, 2016). Commercial properties within 1/4 mile of the station sell or rent 12.2% higher than residential properties in the same distance range. Where the price gap between the railway station zone and the rest is about 4.2% for the average residence, it is about 16.4% of the average commercial property. Note that the reference group for both properties is the set of properties that lay beyond the ¼ mile range from the railway stations. However, on a global effect consideration, the relative impact is reversed. On average, for every 250 m coming closer to the station, the effect of the railway station is 2.3% higher for residential properties compared to commercial properties (Ghebreegziabiher *et al.*, 2007).

2.11 Socio-economic and environmental Impact of LRT

Transit improvements are often encouraged to create more sustainable transportation and land use patterns. Transit service has a tendency to support sustainability in various ways, summarized as in economic, social and environment (Litman *et al.*, 2002). Impact of LRT is different from country to country and even city to city within the same country. (Klau *et al.*, 2004) and in general, facilitates and stimulates development in the city center, development in declining areas, change in the pattern of urban development and shapes the urban development through corridors, and gives a motivation for the construction and new development of houses, offices, and shops (Crampton, 2003).

Light Rail will create jobs and initiate long-term economic development, Building Light Rail will create jobs (Bishop et al., 2015) and produce strong local economic activity, reduce the vacancy level of buildings, appreciate the value of vacant land (Klau, *et al.*, 2004). Proximity to light rail stations increases accessibility to employment for working families (Wayland, 2011).

Crampton (2003) Conclude that on his research Economic Impacts of Urban Rail Transport development the number of shoppers attracted to a town Centre can be increased, sometimes substantially, and there is higher growth in property prices or rents of offices along light rail corridors in comparison to other areas. Similarly Armstrong *et al.* (2005) entails that the introduction of LRT Increase property value for the owner of the office, retail stores, residential buildings and vacant lots. However, the impact of specific types of public transit such as light rail transit Proximity to transit often increases residential property values overall, there can exist a noise effect that declines the values on property that are too close to a rail line or station But the cumulative effect of increased property values along LRT lines may gradually displace poorer populations (Wayland, 2011).

In view of environmentally LRT is eco-friendly, electrically propelled system with no local pollution and low noise and vibrations (Sanghvi *et al.*, 2013). LRT stations can stimulate transit-oriented, mixed-use, walk able centers. Compared with diesel buses automobiles, electric rail creates more attractive urban centers by reducing traffic, air pollution and noise (Litman et al., 2002). Furthermore, reduced energy consumption and air pollution and improved water quality. Indirectly it reduces the vehicular trips that result in the reduction of energy consumption and pollution from fuel (Sound Transit Board, 2007). LRT is quiet, energy-efficient has greater carrying capacity than buses, and it can be powered using renewable energy sources. By taking cars off the road, it reduces air pollution, congestion, and greenhouse gas production (Wayland, 2011).

Some of the newly built light rail lines have managed to increase the overall number of public transport passengers considerably (Crampton, 2003) Accounting for an increasing number of passenger trips, light rail services have contributed to the overall growth in public transit ridership (Armstrong *et al.*, 2005). Reduce reliance on automobiles by improving average citizen's ability to use mass transit to travel through the most congested corridors during rush hours. Mobility and accessibility is a challenge for people who do not own cars or for whom the daily costs of driving are a financial hardship (Sound transit board, 2007). LRT is said to increase the connectivity of riders, particularly when coordinated with bus and other forms of public transit. In some city, for example, Hamilton, LRT connects neighborhoods to more employment, educational, healthcare, recreational and cultural opportunities (Wayland, 2011).

2.12 Lessons learned from Literature

Real estate is the land and its improvement on the land and associated right to real estate is real property. The market value of this real estate or real property is determined by different approaches such as the sales comparison approach, income approach, and cost approach. These approaches used to depend on the nature of the property.

In rent theory, the value of the property closer to CBD has greater value than property found at the periphery. Investors in the commercial property market expect a return on their investments in the form of rent. Contributors to the early conceptualization of rent theory believed that rent is a differential caused mainly by distance and cost of transportation and attributed differences in the rent-earning capacity of land to differences in location and transport cost. This causes growth or decline in price depends on transportation cost.

LRT is one of mass transportation mechanism and it is suitable than another mode of transportation. Theoretically, property near to LRT station improves property value and LRT station too. But the impact is different in different type of property and method or models of determinations. The empirical evidence is summarized as follows,

Table 5: Summary of empirical assessment

Author and year	Title	Methods	Result
(Mohammad <i>et al.</i> ,2013)	A meta-analysis of the impact of rail projects on land and property values	Meta-analysis Regression based approach	Commercial land/properties tend to exhibit significantly higher value changes compared to residential land/properties: by over 24%-3%)
(Ko <i>et al.</i> ,2013)	The Impact of Hiawatha Light Rail on Commercial and Industrial Property Values in Minneapolis	Hedonic pricing	for station areas generated a continuous price function that suggests property prices decrease with distance away from LRT stations since the line became operational, but the proximity to major interactions do not significantly add values for properties nearby
(Pan, 2015)	The impacts of an urban light rail system on residential property	hedonic pricing employed in OLS linear regression	Aggregate result is a positive impact on residential property, but on very close to LRT station properties LRT system has a negative

	values: A case study of the Houston Memorial transit line	model (MLR)	impact
(Yan, et al., 2012)	The impact of a new light rail system on single-family property values in Charlotte, North Carolina	-hedonic pricing model (multiple linear regression) use logarithmic distance Log transformation of the sales price	Positively correlated the price of single-family houses near to LRT station
(Ghebreegziabiher <i>et.al.</i> ,2007)	The Impact of Railway Stations on Residential and Commercial Property Value: A Meta-analysis	Meta-analyses(differences in study findings) using a hedonic regression model	On average, commercial properties within 1/4 mile of the station sell or rent 12.2% higher than residential properties in the same distance range. Where the price gap between the railway station zone and the rest is about 4.2% for the average residence, it is about 16.4% for the average commercial property
(Hartenian et al., 2015)	Rail Trails and Property Values: Is There an Association?	Use log price Multiple linear regression analysis	Our analysis found that homes within one-half mile of a well-established rail trail in Northampton, Massachusetts tended to appreciate more (or retain a higher value) during the period from 1998–2014 than homes farther than one-half mile away from the original 1984 trail.
Xu (<i>et al.</i> , 2016)	The impact of urban rail transit on commercial property value: New Evidence from Wuhan, China	Use log price no other variables The integration of Multiple linear regression and special autoregression	LRT has appositives impact on commercial property value this the study found that commercial properties in the inner 0-100m circle appreciate the most (nearly 16%), while the outer three circles gain less, at circa 8%

Chapter Three

3. Description of The Study Area

This section provides general understanding and short insight of study area about, location, population, employment condition and mode of transportation.

3.1 Site description

Addis Ababa is the capital of both Ethiopia and Africa. It is the first urban LRT system in sub-Saharan countries. It has characterized by poor transportation system and high population growth.

To explain more about stations, the layout and consecutive distance between them the two figures and the table are hereunder

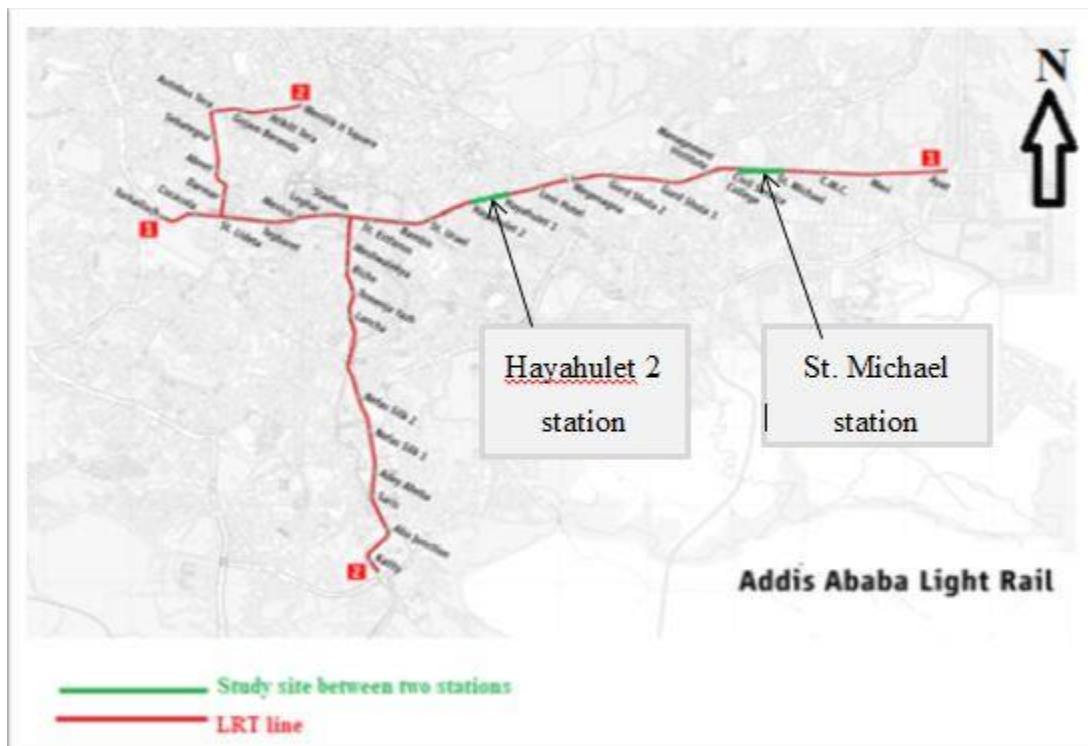


Figure 3: The Layout of Addis Ababa LRT stations [15]

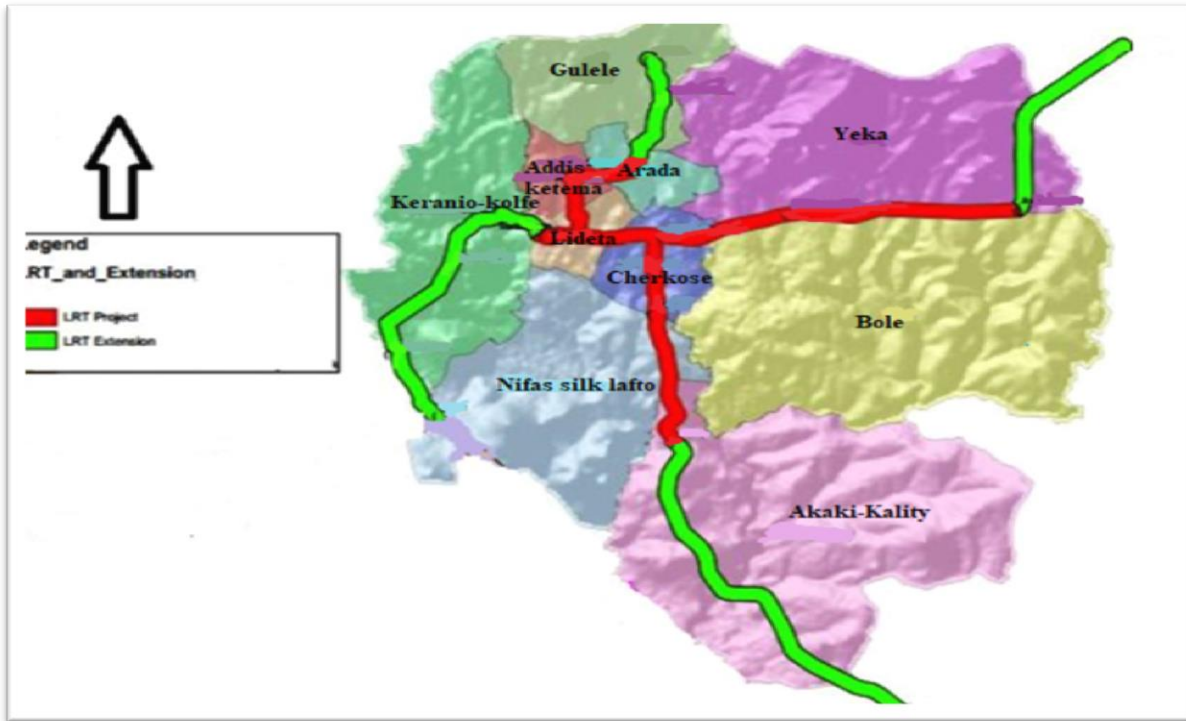


Figure 4: The Layout of LRT through sub city

Source: Yehualashet Jemere, (2012)

As shown in figure 3, the East-west corridor, starts from Ayat through, CMC, Megenagna, stadium, Hayahulet and Mexico square that ends at Torhiloch , at the second route which is North to south is, starts from Kality, Saris, Gotera, stadium, Mexico square, Lideta, Autobis Tera that ends at Paisa.

3.2 Profile of Addis Ababa

Addis Ababa was established in the late 19th and in comparison to other capital cities, it is relatively young. Addis Ababa has evolved in the nineteenth century from small rural settlement up to the 1950s into a vibrant modern metropolis today. Much of this urban transformation began during the period of Imperial Rule but accelerated in the post-1991 era (UN-habitat, 2017). It is known that Addis Ababa is located in Ethiopia and it is both the capital of Ethiopia and Africa union. The absolute location of Addis Ababa, GPS coordinate that is latitude and longitude is (9.005401, 38.763611) respectively which is equivalent to UTM Easting and UTM Northing (474,017.86, 995,457.69) respectively. The elevation of the city is 2,356 meters [16].

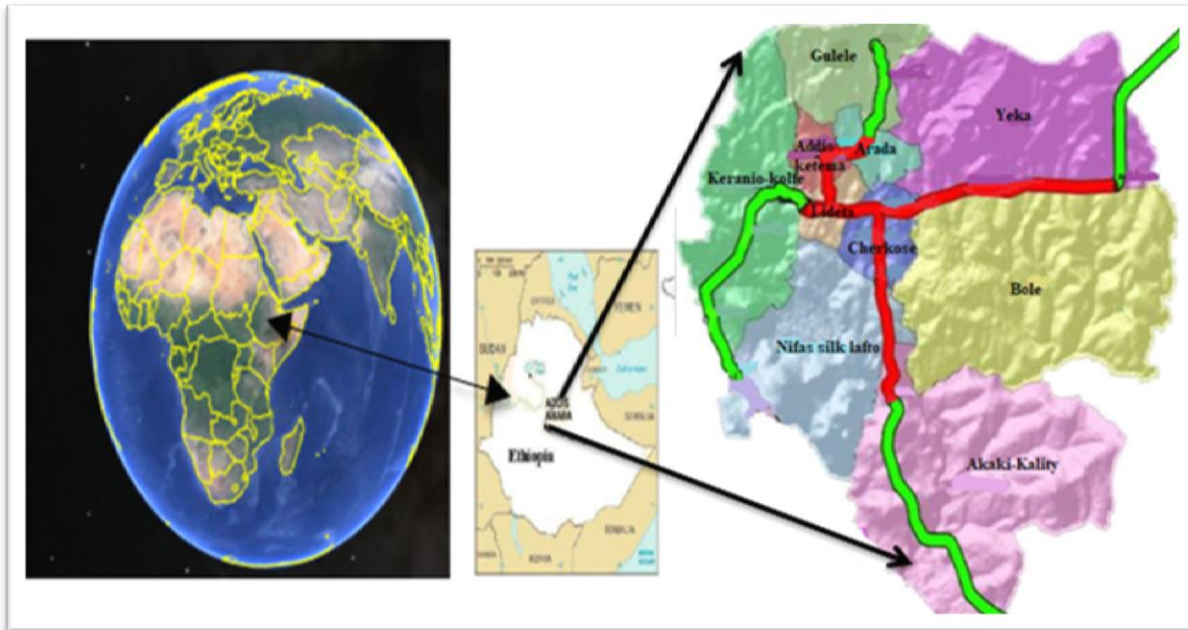


Figure 5: Locational map of the study area [17]

Administratively, Addis Ababa has ten sub-cities which are divided into three categories inner city as central business distribution, transitional and periphery. The Administrative structure of Addis Ababa is Sub city-Woreda-Sub Woreda- Village. According to the 2007 census total population was 3,384,569 with yearly growth. According to UN-habitat2017, the population growth is estimated in 2016 is 4.6 million with 3.8 growth rate.

This population growth, rapid urbanization, unemployment, and poverty will put further and continued challenges and pressure on the city administration to provide efficient and affordable basic services and housing in sufficient quantities. Further, it is a challenge to meet transportation demand.

In short, the description of study area section can be summarized as, Addis Ababa is found in both high spatial and population growth, and residents are under high poverty due to this reason, the demand of affordable public transportation is increasing from time to time. As a result, one of the objectives of introducing LRT in Addis Ababa is to alleviate transportation problem.

Chapter Four

4. Discussion and Data Analysis

4.1 Introduction

This chapter provides the analysis of data collected, in the study area, regarding the effects of LRT station on commercial property value quantitatively from a rent perspective. It considers the distance from the LRT station and rent price. The rental price per meter square is the dependent variable. The dependent variable is regressed over different explained variables. As it is noted in the methodology part of this paper, correlation and multiple linear regression analyses are used. Moreover, the frequency and percentage are used to explain the response of respondents quantitatively. It also qualitatively discusses push and pulls effect of LRT station as well as the social, economic and environmental impacts of the fenced LRT system.

The researcher has used excel, SPSS and Stata for data tabulation, editing, testing and for data analyses but it depends on conditions.

4.2 Effect of LRT station on the commercial property rent

The effects of LRT station on commercial property value is analyzed quantitatively from monthly rent perspective using MLR and correlation analysis. It considers the distance from the LRT station and rent price. The rental price per meter square is the dependent variable and it is regressed over the explained variable. To examine these effect 172 commercial space units were involved. As it is noted in the methodology part of this paper, correlation and multiple linear regression analyses are used hereunder.

4.2.1. Hedonic pricing and multiple linear regression model

This section provides the conceptual model of hedonic pricing and the regression analysis. The concept of hedonic pricing is applied in the regression analysis for this research. After the conceptual or theoretical model, the selected variable for this research is explained and framed in line with the conceptual model. Afterward, the quantity and estimation are described in the analysis and discussion section.

This paper has used the semi-log model. The log rent of commercial house price per square variable relationship is linear and additive and then let us allows all possible influences of the rental price that can be observed by the researcher and then decomposes the rent prices into things which affect the rental price per square meter. Such are physical, environmental characteristics, economic activity and so on. The regression an analysis has been carried out based on considering the following variables. Rent per meter square which is the dependent variable, total rent, the total area of commercial space unit, type of building, distance from LRT, number of rooms per commercial space unit, availability of water, availability of toilet, the location of the commercial building and floor level of the commercial space unit are independent variables.

This research has employed hedonic regression analysis to examine the impact of Addis Ababa light rail station. It focuses on property specific characteristics such as the distance of the property from LRT station, the number of rooms, and other dummy variables.

The rental price per square meter has been indicated by the following model

$$\text{LnRp} = \beta_0 + \beta_1 X_i + \epsilon_i \dots \dots \dots 2$$

Rp is the dimension of $i \times 1$, β is the dimension of $K \times 1$ vector of unknown parameters, X is the dimension of $i \times K$ vector of explanatory variables, and ϵ is the dimension of $i \times 1$ vector of random error term .where LnRp is log transformed rent per meter square, k is a number of explanatory/independent variable, βX_i indicates the independent variables, and ϵ_i the residuals, and i represents the number of observation.

$$\begin{pmatrix} R_1 \\ \cdot \\ \cdot \\ \cdot \\ R_i \end{pmatrix} = \begin{pmatrix} \beta \\ \beta_1 \\ \cdot \\ \cdot \\ \cdot \\ \beta_n \end{pmatrix} X \begin{pmatrix} X_1 \\ \cdot \\ \cdot \\ \cdot \\ X_i \end{pmatrix} + \epsilon \dots \dots \dots 3$$

Where β minimum rental price as well as it is the rental price if other explanatory variables become zero, which means β is the intercept of the graph. And the coefficients have been determined by using the least square principle from the function.

Rental price can be expressed as the function of independent variables

$$RP = f (Tr_j, TA_j, DLRT_j, FL_j, NR_j, AT_j, AW_j, L_j, TB_j) \dots \dots \dots 4$$

Where,

$$\text{And here we write our model as } R_p = \beta + Tr + \sum_{i=1}^K X_i + \epsilon_i \dots \dots \dots 5$$

Where $\beta + \sum_{i=1}^K X_i$ is an explanatory variable that affects the rental price and

ϵ_i Is the residual of which the difference between the true value in observation and the value estimated in the regression value sometimes called stochastic element.

$$\text{We can write fully as } R_p = \beta + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X \dots \dots \dots \beta_n X_n + \epsilon$$

The predicted value of rent in regression can be written as,

$$\hat{R}_p = \hat{\beta} + \hat{\beta}_1 X_1 + \hat{\beta}_2 X_2 + \hat{\beta}_3 X_3 + \hat{\beta}_4 X \dots \dots \dots \hat{\beta}_n X_n + \epsilon \dots \dots \dots 6$$

Where X represents the independent variables

Finally, after the rent per meter square and total rent of commercial space is transformed the conceptual model of this research was,

$$\begin{aligned} \ln R_p = & \beta + \beta_1 \ln Tr + \beta_2 DLRT + \beta_3 L + \beta_4 AT + \beta_5 WT + \beta_6 FL + \beta_7 NR + \beta_8 TB + \beta_9 A \\ & + \epsilon \dots \dots \dots 7 \end{aligned}$$

Where, the variables are represented as,

- Log-transformed monthly rent per meter square (LnRp)
- Distance from LRT (DLRT)
- Area of the commercial space unit (A)
- Type of building (TB),
- A number of the room (NR),
- Availability of toilet (AT),
- Availability of water (AW)
- Location (L),
- Floor Level (FL),
- Log-transformed total rent (LnTr)

After describing the model the next issue is interpretation. The model can be interpreted as depending on the nature of the model and variable relationships, according to Cornell university stat news, (2012) interpretation of the model can be seen as follows,

- I. If the dependent variable is log transformed and the independent is not log transformed, the relationship between dependent and independent variable can be expressed as; an increase in one unit of the independent variable would cause β_1 percentage change in a dependent variable. Where β_1 represents the coefficient of the independent variable.
- II. If the independent variable is log transformed and the dependent is not, the relationship can be interpreted as, $\beta_1 * \left(\frac{101}{100}\right)$ changes in an explained variable, where β_1 the coefficient of the log is transformed variable.
- III. If both dependent and independent variables are log-transformed, the relationship between dependent and independent variable can be interpreted as one percent change in an independent variable would result $((1.01)^{\beta_1} - 1) * 100$ percentage change in an explained variable, where the β_1 is the coefficient of log-transformed independent variables.

In this paper, the case I and III has been applied in the analysis and discussion part.

4.2.2 Variable selection and hypothetical relationship to dependent variable

The general types of data are discrete, dummy and continuous. Continuous variables are expressed in both integer and decimal level, discrete data is in integer sense and dummy variables are qualitative variables that are usually expressed in terms of 0 or 1 value. The variables used in this study have been selected based on the observation of the researcher and the easy accessibility and collection of their data. There are many variables which affect the value of the house including the rent but it was very difficult to get numerical data. The variables and their respective nature are shown on below table.

Table 6: Variable representation

Serial number	Variable	Type	Representation on this paper	Remark
1	Rent per m ²	Continuous	RP	Dependent
2	Total rent	Continuous	TR	Independent
3	The total area of house unit	Continuous	TA	Independent
4	Type of building	Dummy	TB	Independent
5	Distance from LRT station	Continuous	DLRT	Independent
6	Number of room	Discrete	NR	Independent
7	Availability of toilet	Dummy	AT	Independent
8	Availability of water	Dummy	AW	Independent
9	Location	Dummy	L	Independent
10	Floor Level	Discrete	FL	Independent

Source: own survey, 2018

Describing the hypothetical relationship between the dependent and the independent variable is important premises to test the impact of independent variables on dependent variables. Based on this, the independent variable, distance from LRT station has a significant impact on the rental price per meter square. Many studies suggested as the distance from LRT station increase, the rental price per meter square will be decreased. The independent variable area of commercial space has a significant impact on the rental price per meter square. As the area increase, the rent per meter square is getting decreased. The independent variable, total rent has a significant impact on rent per meter square. The total rent also has a significant impact on rent per meter square, if the total rent increased, the rent per meter getting decreased.

The discrete variables, the number of rooms has a significant impact on commercial space rent. As the number of rooms increases it might increase the total rent, as a result as the rooms increase the rental price getting decreased. The independent variable the floor level has a significant impact on rental price. As the floor level increase the rental value might be decreased.

The dummy variables, the location has a significant impact on the rental price of commercial space. The commercial unit found around station Hayahulet 2 has more rental price than commercial space units found in around station St. Michael. Because urban planner suggests that, commercial space found in the center of the city is expensive than the periphery. The independent variable, the type of building has a significant impact on commercial space rent. Multistory buildings might have more value than detached buildings. The availability of water has a significant impact on commercial space rent. A building which has water might have more value than buildings which lack water. Regarding the availability of toilet has significant impact on commercial space rent.

4.2.3 Data tabulation and coding

Before starting any work of data analysis the variable was coded and tabulated in order to make it ready for further analysis. The dependent variable, collected data of commercial space rent per month is covered rent per meter square. The variables are coded depending on their nature, as follows, the continuous variables (rent per meter square, total rent, the area of commercial space unit, and distance from LRT station) value is recorded as the value gained from the field directly, however, the discrete and dummy variables are coded as follows,

- Type of building (TB) is represented as 0 if the building is a single story and 1 if it is multistory.
- A number of the room (NR), represented starting from (1, 2 ...n), where n represents the number of room. This implies that 1 is given for commercial space which has one room only and so on.
- Availability of toilet (AT) is coded as 0 for commercial space which lacks toilet and 1 for which has a toilet.
- Availability of water (AW) is coded as 0 for commercial space which lacks water and 1 for which has water.
- Location (L), is coded as a commercial space found in CMC is coded as 0, whereas found in Hayahulet is coded as 1.
- Floor Level (FL), is coded as starting from (0, 1, 2...n) for ground, (G+1, G+2...G+n) respectively. Where n is a number of floors and G represents ground.

4.2.4 The test of multiple linear regression assumptions

Before running the regression analysis, it is necessary to check whether the assumptions are satisfied or not. As a result, different tests were conducted. The following tests have been conducted: a test of normality, a test of heteroscedasticity, a test of multicollinearity, a test of autocorrelation, and a test of the normality of disturbance. The details are described hereunder as follows.

A. Normality test and Transformation of data

In multiple linear regressions, the relationship between the dependent and independent variables must be linear. The first task was testing the normality of the collected rent per meter square data. The Shapiro-Wilk test has been used for normality testing.

Null hypothesis: The data is not normal

Alternative hypothesis: data is normal

After the data test has been run by using Stata statistical software, the result is given as,

Table 7: Normality test result

Shapiro-Wilk W test for normal data					
Variable	Obs	W	V	z	Prob>z
RentperMet ²	172	0.89955	13.148	5.882	0.00000

. swilk Logrentpermetersquare

Shapiro-Wilk W test for normal data					
Variable	Obs	W	V	z	Prob>z
Logrentper ²	172	0.99406	0.777	-0.576	0.71769

Source: Own survey

The normality of the data can be identified by the significance of the normality test based on p-value; p-value less than 5% is significant in 5% alpha levels.

According to the above table(7), the first test was made before transforming the data, the result, p-value is less than significance level 5%, and therefore, there is not enough evidence to reject the null hypothesis. According to the test the data was found to be not normal.

If the data is not normal, the data has to be transformed to change from non-normality to normality. Furthermore, data transformation is very useful and practical to control the outlier effect and heteroscedasticity and to maintain the linear relationship between the dependent and independent variable. Log transforms are particularly appropriate if the variance increases with the mean (Brooks, 2010). After log transformation, the data was tested again as shown in the above table; the p-value shows that 72% this shows that the null hypothesis which is the data is not normal should be rejected. On the contrary, the alternative hypothesis should be accepted. Based on the test result after log transformation, the data is found to be normal.

B. Test of multicollinearity

Multi-collinearity occurs when there is the relationship between the independent variables. This problem affects the estimation of coefficients. However, it does not affect the R-squared. To estimate the correct coefficients variable the problem of multicollinearity should test and solved (Brooks, 2010). There are other different methods of testing multi-collinearity; VIF (variance inflation factor) has been employed in this study.

Variable which has less VIF value is less collinear with other variable. In this methods of test $VIF > 10$, indicates that there is a problem of multicollinearity [18]. However, according to the test result in the table below (8), non of variables has VIF value above 10. VIF is around 5 and below 5 which better as VIF below 5. As a result it can be concluded that for this data, there is no linear relationship between independent variables.

Table 8: Test of multi-collinearity

Model	Collinearity Statistics	
	Tolerance	VIF
(Constant)		
Area	0.282	3.547
Distance from LRT station	0.848	1.179
Building Type	0.497	2.011
Floor Level	0.606	1.650
Number of room	0.340	2.942
Availability of Water	0.193	5.176
Availability of toilet	0.194	5.165
Location	0.849	1.178
Log total rent	0.432	2.315

Source: own survey

C. Test of autocorrelation

Multiple linear regression analysis requires that there is little or no autocorrelation in the data. Autocorrelation occurs when the residuals are not independent of each other. In other word $E(e, e-1)$ should independent, when the autocorrelation occurs the two consecutive residuals ($e-1$) depends on the (e) (Brooks, 2010).

In this research to detect the presence autocorrelation Durbin-Watson test was conducted with the null hypothesis residuals are not linearly autocorrelated. For this research sample, rent data was not very large and Durbin-Watson test was found to be suitable

In Durbin Watson test the residuals are regressed over independent variables. The Durban Watson value lies between 0 and 4, however, d-value is near to 2 indicates the absence of autocorrelation.

Table 9: Test of Autocorrelation

Model	R	R Square	Adjusted R Square	Std. error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.00	.000	-.056	.34766	.000	.000	9	162	1.000	1.851
a. Predictors: (Constant), Area, Location, Availability of toilet, Distance from LRT station, Floor Level, Building Type, Log total rent, Number of room, Availability of Water b. Dependent Variable: Squared residuals										

Source: own survey

In this regard, the Durbin-Watson value is the data employed in this study is 1.851 which is very close to 2 and therefore, there is less problem of autocorrelation, implies the data meets the requirement of multiple linear regression in the case of autocorrelation.

D. Test of heteroscedasticity

The other assumption the multiple linear regression analysis makes is homoscedasticity. The homoscedasticity assumption dictates that variance of the error term must have a constant variance for unbiased estimation in linear regression. That is $var(e_i) = \sigma^2$. the scatter plot is a good way to check whether homoscedasticity (that is the error terms along the regression line are equal) is given. However, scatter plot may depend on the subjectivity of the researcher. As a result, the Breusch-Pagan test was used with the hypothesis that the error variance is all equal and the alternative hypothesis is that error variance is not equal. The Breusch-pagan test is depends on the goodness fit measure of error term regression.

$$\varepsilon^2 = \delta_0 + \delta_1 X_1 + \delta_2 X_2 \dots + \delta_n X_n + e \dots \dots \dots 10$$

Where ε^2 is the predicted value of the residual from the regression, (X1, X2...Xn) are the independent variables $\delta_0, \delta_1 \dots \delta_n$ are error estimators and ‘e’ is the residuals of the error term. In this test the, Lagrange multiplier is calculated as

Here the predicted variable is residual square, and the independent variables are the distance from LRT station, location, and area, type of buildings, floor level, availability of water, and

availability of toilet, total rent, and number of rooms. These independent variables are regressed over independent variable as shown the table below. To identify the presence of heteroscedasticity problem, it depends on the significance of the model from squared residuals as dependent variables.

The null hypothesis: The error term is heteroscedastic

The alternative hypothesis: The error term homoscedastic

According to the table (10) below shows, the significance value of the model 1 implies that the null hypothesis error term is heteroscedastic is insignificant, that should be rejected. In the other hand, the alternative hypothesis error term homoscedastic should be accepted. Therefore the variance of the error term is homoscedastic.

Table 10: Test of heteroscedastic

Source	SS	df	MS	Number of obs =	172
Model	0	9	0	F(9, 162) =	0.00
Residual	19.5800848	162	.120864721	Prob > F =	1.0000
Total	19.5800848	171	.11450342	R-squared =	0.0000
				Adj R-squared =	-0.0556
				Root MSE =	.34766

myResiduals	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Area	4.09e-11	.0013109	0.00	1.000	-.0025886 .0025886
DistancefrmLRT	-1.59e-12	.0002765	-0.00	1.000	-.0005459 .0005459
BuildingType	-2.57e-10	.0758109	-0.00	1.000	-.149705 .149705
FloorLevel	7.13e-10	.0275528	0.00	1.000	-.0544089 .0544089
No_ofrooms	-1.00e-09	.0525705	-0.00	1.000	-.1038119 .1038119
Water	-1.56e-09	.1392808	-0.00	1.000	-.27504 .27504
Toilet	1.91e-09	.1380719	0.00	1.000	-.2726527 .2726528
Location	-4.74e-10	.0611243	-0.00	1.000	-.1207031 .1207031
LogTotalrent	-1.93e-09	.052874	-0.00	1.000	-.1044112 .1044112
_cons	1.74e-08	.4752575	0.00	1.000	-.9384985 .9384986

Source: own survey

E. The disturbances are normally distributed

The error term should be normally distributed. For this test BJ (Bera and Jarque) test is employed. The concept of this test is from the coefficient of skewness and kurtosis from the error (Chris Brooks 2010). In this case,

The null hypothesis: The error term is not normally distributed

Alternative hypothesis: The error is normally distributed

As shown in the table (11) below, using a 5% significance level the test statistic result is greater than 5%, which is 5.81%. Therefore, the null hypothesis is insignificant, that should be rejected on the other hand the alternative hypothesis, the error term is normally distributed should be accepted. Therefore, the data meets the assumption of which the disturbance is normally distributed.

Table 11: Test of normal distribution of error term

```
. sktest myResiduals
```

Skewness/Kurtosis tests for Normality					
Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	joint Prob>chi2
myResiduals	172	0.0715	0.1086	5.69	0.0581

To sum up, every test that is necessary for this linear regression analysis has been conducted and shows there is no the problem of multicollinearity, heteroscedasticity, autocorrelation, as well as the error term, are equally distributed.

4.2.5 Descriptive statistics

The variables used in this description is monthly rent per meter square, total rent, the area of commercial space, distance from LRT station, building type, floor level, number of room, availability of water and toilet.

The table below (table 12) shows the result of descriptive statistics of data collected from for 172 observations. It presents the mean, standard deviation, minimum and maximum values of the sample commercial property units of each attribute of the rent. The finding indicates that there is a big difference between maximum and minimum rent per meter square, that is indeed the commercial space are not very similar. According to the academicians, this is due to, The difference in physical, environmental, economic and location characteristics of commercial space reveals in terms of rent price.

Besides this, it has been found that some owners have a fixed rental price for their building and some others fix the rental price through negotiation carried out in between the owner and the tenant. This implies that the rent amount is depending on the ability of the tenant and the owner. It might not depend on characteristics of the building; the local brokerage has a big impact on price determination of commercial space, sometimes price from the owner and from the brokerage for the same property is different. Brokerages have a tendency to increase the rental price for commercial space than the owner.

Table 12: Descriptive statistic before Log transformation

Variables	Sample size	Mean	St. deviation	Median
Rent per meter square	172	507.64	248.83	487.5
Total rent	172	12090.41	17217.28	7500
Area	172	29.55	38.2	15
Distance from LRT station	172	164.33	104.39	121
Building Type	172	0.56	0.5	1
Floor Level	172	0.74	1.24	0
Number of room	172	1.38	0.867	1
Availability of Water	172	0.75	0.434	1
Availability of toilet	172	0.74	0.438	1

Source: own, field Survey, 2018

4.2.6 Correlation between variables

To test the association between the dependent and independent variable Pearson correlation was employed to contentious variables and spearman correlation coefficient has used to test the correlation between dependent and independent discrete and dummy variables. The correlation coefficient (r) is a measure of the linear relationship between two variables X and Y , giving a value between $+1$ and -1 inclusive, where 1 is a total positive correlation, 0 is no correlation, and -1 is a negative correlation. The strength of the correlation is not dependent on the direction or

the sign. A positive correlation coefficient indicates that an increase in the first variable would correspond to an increase in the second, implying a direct relationship

This analysis is vital to understand the linear association between the rental price per meter square and the distance from LRT station. Where the rental price per meter square is the dependent variable and the distance from LRT station is independent variables. The result will be between -1 and +1. If the sign is negative the relationship is an inverse relationship. And the correlation coefficient approaches 1, the relation is direct and strong but, if -1 the relation is inverse and strong. If the coefficient approaches zero in both directions the relationship is weak. In this analyses method, the relationship between rent per square meter of commercial property and the distance from LRT station and rent per square meter and area of the unit has been tested.

The correlation analysis shows the linear association between the two variables. The linear association of dependent variable (log rent per meter square) with itself and other independent variables is shown in the below table (13).

Table 13: Pearson and Spearman correlation coefficients

Variables	Log Rent Per meter square	Log total rent	Location	Availability of toilet	Availability of Water	Number of room	Floor Level	Building Type	Distance from LRT station	Area
Log Rent Per meter square	1.00									
Log total rent	-0.12	1.00								
Location	0.013	0.009	1.00							
Availability of toilet	-0.148	-0.03	-0.13	1.00						
Availability of Water	-0.13	0.05	-0.15	0.89	1.00					
Number of room	-0.50	0.60	-0.03	0.08	0.11	1.00				
Floor Level	-0.39	0.25	-0.17	0.30	0.31	0.35	1.00			
Building Type	-0.30	0.20	-0.32	0.59	0.60	0.27	0.54	1.00		
Distance from LRT station	-0.04	-0.08	-0.13	-0.25	-0.22	-0.10	-0.05	-0.06	1.00	
Area	-0.5	0.75	-0.01	0.09	0.10	0.67	0.37	0.314	-0.01	1.00

Source: own survey 2018

The above table (13) shows that the Pearson and Spearman correlation coefficients depend on the nature of the variables. The Pearson coefficient is suitable for continuous and metrics variable relationships, however, the Spearman correlation coefficient is suitable for nominal, ordinal and categorical variables.

Depending on the correlation analysis result, the direction of the relationship between total rent, area, availability of toilet and water, Number of room, floor level, building type distance from LRT station and area have a negative relationship with rent per meter square. The location variable is the only one that has a positive linear relationship to rent per meter square.

The relationships of the dependent variable of rent per meter square and the independent variables such as distance from LRT station, area, floor level, number of rooms, and total rent are confirmed with the hypothetical relationship. However, the correlation result of the availability of water, availability of toilet and type of building with dependent variable is contrary to the hypothetical relationships.

The table (13) above shows the person and Spearman correlation coefficient near to zero and below 0.5 and - it indicates that no variable has a strong relationship with rent per meter square. Concerning the relationship between rent per meter square and distance from LRT station ($r = -0.04$), the negative sign reveals that the relationship is inverse and the magnitude 0.04 indicates that the relationship between two variable is weak. The change in distance from LRT station has no significant response to the rent value of commercial spaces. Javier F. (2010) pointed out that distances to LRT1 and land values show a strong negative relationship, an inverse correlation in urban residential land manila, however, the correlation for commercial land is slightly weak.

According to Spearman correlation coefficient, the surprising thing is that a rent per meter square and the availability of toilet has inverse relationships. In addition to this, the relationship is very weak that is (-0.148). The relationship between the rent per meter square and availability of water is negative with a very weak relationship that is (-0.13). However, practically anyone has a choice building which has water and toilet with equal desirability to other competent buildings. But in this case, the tenants did not consider the availability of water and toilet rather they give more concern about suitability for business to attract customers easily. The other reason is mostly single-story buildings (both metal and HCB) has no water and toilet and it has a comparable rent value with a multistory building which has water and toilet.

Now, let it be run the correlation between Log rent per meter square and distance from LRT station, graphically

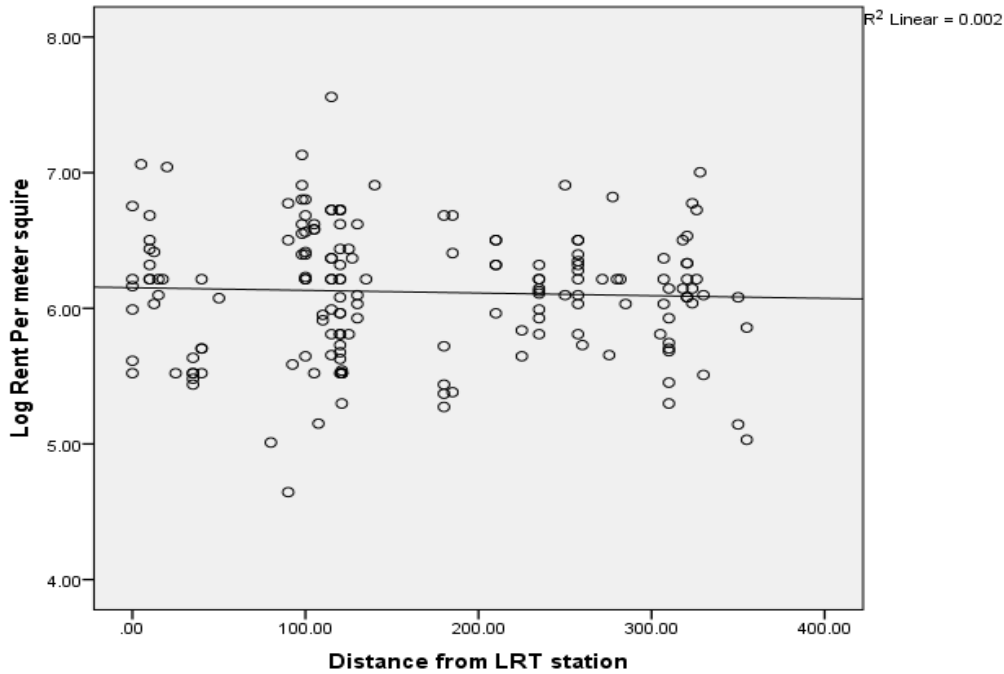


Figure 6: The linear relationship between rent per meter square and distance from LRT station
 As figure 6 shows, the line of relationship is very flat, but according to Pearson correlation coefficient, the slope is still downward sloping which is indeed as theoretical.

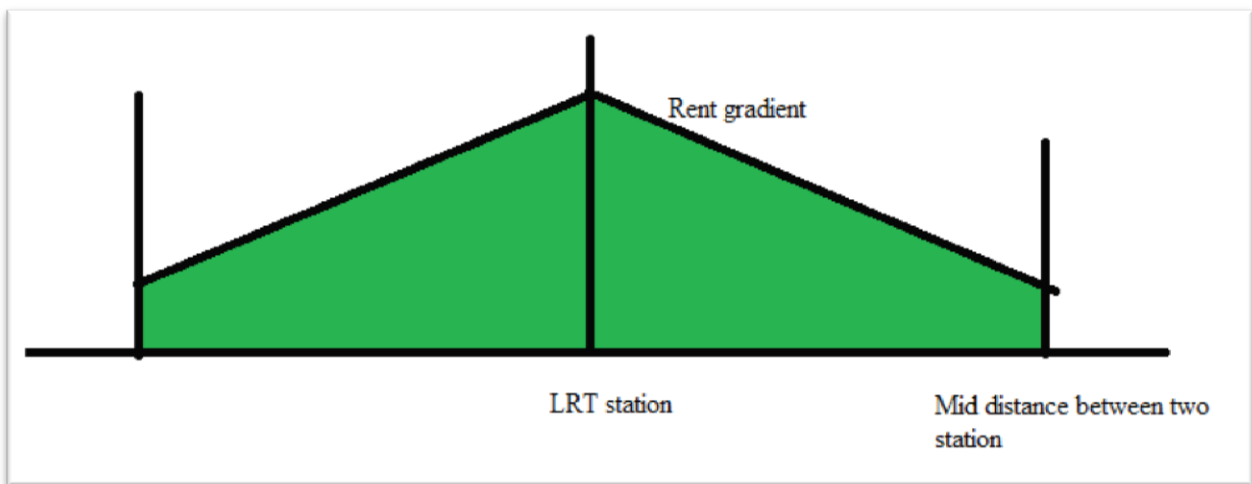


Figure 7: The theoretical relationship between distance and commercial space rent

Theoretically, as demonstrated in figure 7, the rental price near to LRT is expensive as a result the correlation coefficient is strong and negative as for why, if the distance between the commercial space and LRT station increase the rent for commercial space is decreased, this

implies that the relationship is inverse between two variables. However, the relationship has been found still inverse; the two variables have not significant linear relationship shown in table (14) below.

Table 14: The coefficient of linear relationships between Log rent per meter square and distance from LRT

		Log Rent Per meter square	Distance from LRT station
Log Rent Per meter square	Pearson Correlation	1	-0.04
	Sig. (2-tailed)		0.57
	N	172	172
Distance from LRT station	Pearson Correlation	-0.04	1
	Sig. (2-tailed)	0.57	
	N	172	172

Source: own survey, 2018

4.2.7 Regression result

In the previous section, the conceptual model was described, which the empirical model emanates as well as this conceptual model was tried to substantiate with previous studies. Variables which involved in this regression analysis were represented and the data was tabulated, edited, and coded. Moreover, the assumptions of linear regression were diagnosed Based on that, the data is found in the good performance of multiple linear regressions.

The equation of the regression analysis which is semi-logarithmic function described as a combination of variables as,

$$\text{LnRp} = \beta_0 + \beta_1 \text{LnTr} + \beta_2 \text{DLRT} + \beta_3 \text{A} + \beta_4 \text{FL} + \beta_5 \text{BT} + \beta_6 \text{NR} + \beta_7 \text{AW} + \beta_8 \text{AT} + \epsilon \dots (13)$$

Where

LnRP- is log rent per meter square

LnTr- is log total rent

DLRT- is the distance from LRT station

A- is an area of the commercial space unit.

FL- is the floor level of the commercial space unit

BT- is the building type

NR- is number of room per commercial space unit

AT- is the availability of toilet the

AW- is the availability of water

ε = is error term sometimes called residuals

Table 15: Regression result

Source	SS	df	MS	Number of obs	=	172
Model	19.0449483	9	2.11610537	F(9, 162)	=	17.51
Residual	19.5800849	162	.120864722	Prob > F	=	0.0000
Total	38.6250332	171	.225877387	R-squared	=	0.4931
				Adj R-squared	=	0.4649
				Root MSE	=	.34766

Logrentperme~e	Coef.	Std. Err.	t	P> t	Beta
Area	-.0082907	.0013109	-6.32	0.000	-.6663143
DistancefrmLRT	-.0002148	.0002765	-0.78	0.438	-.0471947
BuildingType	-.1661243	.0758109	-2.19	0.030	-.1738405
FloorLevel	-.0748035	.0275528	-2.71	0.007	-.1950984
No_ofrooms	-.11032	.0525705	-2.10	0.037	-.2013566
Water	.0738349	.1392808	0.53	0.597	.0674671
Toilet	-.0101411	.1380719	-0.07	0.942	-.0093372
Location	-.0609888	.0611243	-1.00	0.320	-.0605812
LogTotalrent	.3605755	.052874	6.82	0.000	.5803689
_cons	3.436981	.4752575	7.23	0.000	.

Source: own survey

The above table (15) shows that the coefficient of variables and respective significance status with a 95% confidence level. The variable natural logarithm of total rent, number of room, floor level, building type and area of a commercial space are statistically significant. Nonetheless, distance from LRT station, location, availability of toilet and water is found to be insignificant. Indicates the insignificant variable has not an impact on commercial property space rent per meter square.

As a number of the room increases the rent per meter square is decreased this why in commercial space to have more rooms it require large space. The larger space also requires more amount of money that reduces the tenant's willingness to pay more per meter square. Additionally except some service which requires larger space most tenants of commercial space prefer one room to reduce the total amount of rent. The other variable which is significant is the area too. The Area has a negative impact on the natural logarithmic of rent per meter square. This is the same as to a number of rooms. As the area increases the total rent is increased as a result of reducing the total rent the tenants prefer small area.

The floor level of the building also has a negative impact on commercial space rent. The ground level of the building is more preferable than the above satire. Related to this building type also has a negative consequence on the natural logarithmic rent of commercial space. According to the regression result, the rental price of a single story (either metal or HCB) commercial building is greater than multistory buildings. On the other hand, according to the survey, most of the single-story buildings lack toilet and water on the other hand almost all multistory buildings have water and toilet. But the availability of water and toilet has not any impact on commercial space rent. This reveals that tenants are more worry about their business than their safety and might be irrational about the availability of water and toilet.

As compared to the hypothetical relationships, the significant variables, area, floor level, building type, number of rooms and log total rent has a significant impact on rent per meter square. Even if, the building type has a significant impact the result is contrary to the hypothetical relationships because in the study area most multistory building better has a better facility than single-story buildings.

The independent variables, distance from LRT station, the availability of water, the availability of toilet and location has an insignificant impact on rent per meter square. The result is the contrary to hypothetical premises.

As explained in the above table, The variable the location, availability of water and toilet, distance from LRT station are insignificant based on a 5% significance level measured as P-value.

Finally, the regression equation is

$$\text{LnRp} = 3.4370 + 0.3606\text{LnTr} - 0.0002\text{DLRT} - 0.0083\text{A} - 0.0748\text{FL} - 0.1661\text{BT} + \\ -0.1103\text{NR} + 0.07383\text{AW} - 0.0101\text{AT} - 0.06011\text{L} + \varepsilon \dots\dots\dots (14)$$

As described in the hedonic pricing and regression model section of this chapter, for better understanding the model should be interpreted quantitatively. For all interpretation technique for this research, the dependent variable rent per meter square and the independent variable total rent are log-transformed variables, but not others. The effect of every independent variable on rent per meter square has percentage change. The constant 3.437 is the intercept of the graph, that shows the log rent per meter square where all independent variables getting zero. However, in practice, if the area of space is zero it cannot be taking about rent per meter square.

One percent change of total rent would result $((1.01)^{0.361} - 1) * 100 = 0.36\%$, in this regard, the coefficient is less than one implies that the rate of change between two variables is not equal in every change. For example, if the independent variable growth by ten percent, the percentage change in rent per meter square is 3.5%, it can't be multiplied directly by the same unit of growth. If it grows in the same unit the change is 3.6%. It can be generalized as if the total rent is going much; the tenant would refrain from paying more money for per meter square. This condition can be generalized as economies of scale, that you pay more total rent; you get low rent per meter square.

Another independent variable which is not log transformed is interpreted as one unit change in the independent variable would result, β percentage changes, where β is the coefficient of independent variables. Based on this One-meter change in distance from LRT station would Cause 0.0002% change in rent per meter square. If the distance increase one meter the rent per meter square will be reduced by 0.0002%. One meter square increment of commercial space

would be the cause of rent per meter square reduction by 0.0083%. One floor level increment would reduce rent per meter square by 0.0748%. Regarding the building type, commercial spaces found in multistory buildings are less than buildings found in single-story buildings by 0.1661%. If the commercial space adds one extra room the rent per meter square will be reduced by 0.1103%. The availability of water in the building will add 0.07383% in rental price per meter square, however, the availability of toilet reduce rent per meter square by 0.0101%. When we look the location variable, if the location of commercial space is found in Hayahulet2 station, the rent per meter square will be reduced by 0.0601% on the contrary commercial space found in St. Michael is greater than commercial spaces found in Hayahulet 2 station by 0.0601%.

The goodness of fit statistics/ coefficient of determination is an important statistical measure of how the regression model fits the data and how the independent variables explain the dependent variable. Furthermore, it shows how the regression functions close to the regression line in all data points. R-squared is the most common statistical measure of Goodness. The best measure of goodness fit test is adjusted R square which incorporates the degree of freedom when there is an additional variable.

The above regression result table contained both R-squared and adjusted R-squared. However, the best statistical measure for decision making is adjusted R-squared rather than R-square. The rise of R-squared is important means that the independent variable is explaining the dependent variable more than which the adjusted R-squared is low. The amount of the range is the same as R-squared. For this model, the coefficient of determination adjusted R-squared which is the power of the independent variables to explain the dependent variable is 46.49%. The rest of the rent per meter square is explained by other characteristics beyond researcher observation but the property might have.

4.3. Push and pull effect of LRT station

This section primarily tries to explain and describe qualitative data that have been collected by in-depth interview, questionnaire, and observation. It focuses on the push and pulls effect of LRT station from a tenant perspective and from an owner perspective. As noted in the methodology part of this research, 50 tenants and 30 building owners or managers were involved in the questionnaire. The table below shows that the current location of respondents with respect to LRT station and there location preference with respect to LRT station.

4.3.1 Locational Characteristics of Respondents

They are located between two successive stations in Cmc which is between St. Michael and civil service university stations and in Hayahulet which is between Hayahulet 1 and Hayahulet 2. Locational characteristics of respondent are classified into three as; between 0 meters to 75 meters, between 76 meters and 150 meter, and between 151 meter and mid-distance between two consecutive stations.

Before classifying these scales of distances, the observation was made by the researcher, which considers the business activity of that area and the occupancy condition of buildings. But this classification technique is conducted in a subjective manner. For the purpose of better understanding and simplicity of the analysis, the researcher represents the scales as follows. The first scale is represented as the area close to LRT station, the second scale is represented as around 100 meters and the third scale is represented as around the mid-distance between stations. The respondents were asked about their locational preference with respect to LRT station and their answer is summarized in below the table as follows,

Table 16: Current location and location preference of respondents

location with respect to LRT station	Owner		Tenants	
	Frequency	Percentage	Frequency	Percentage
Close to LRT station	13	43.33%	25	50%
Around 100 meter	7	23.33%	14	28%
At mid distance between station	10	33.33%	11	22%
Total	30	100%	50	100%
Location choice				
Close to LRT station	25	83.33%	46	92%
Around 100 meter	4	13.33%	3	6%
At Mid distance between station	1	3.33%	1	2%
Total	30	100%	50	100%

Source: own survey, 2018

As shown on the table (16), above from the owner side 43.33%, 23.33%, and 33.33 % are located close to LRT station, around 100 meter and at the mid-distance between two stations respectively, however, their locational preference is 83.33%, 13.33%, 3.33% are close to LRT station, around 100 meters and at the mid-distance between station are their locational preference. From a tenant perspective, the respondents constitute 50%, 28%, and 22% are located close to LRT station, around 100 meters and around the mid-distance between two consecutive stations respectively. Despite the fact that, more tenants are far from LRT station, this location is not their best preference. According to the data collected from tenant respondents, 92% of tenants are preferred near to LRT station.

The very reason is that owners and tenants preference near to LRT station is the accessibility issue. The commercial building near to LRT station is easy to access for customers as well as the area near to LRT station is very active than at the mid-distance area particularly in the absence of crossing other than LRT station. As a result, tenants want to rent around the LRT station for their business. At the same time, the vacancy condition of the building is decreased near to LRT stations.

From the point of respondent locational preference, it can be concluded that the distance from LRT station and business activity and property occupancy is inversely related. To make briefing, buildings near to LRT station is more occupied than the building far from LRT station. And building near to LRT station is more suitable than buildings found far from LRT station. Therefore building close to LRT station has more value than buildings found far from LRT station concerning in terms of the occupancy condition

4.3.2 Tenant displacement and tenant attraction

The building owners were asked whether there is tenant displacement or not. As well as the tenants were asked their willingness to stay in their current commercial space. The statistical result is summarized in the table below as follows,

Table 17: Tenant displacement

Question	Owner				Tenant			
	Yes		NO		Yes		No	
Location of respondent	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Is there tenant displacement? And Are you willing to stay?								
Very close to LRT station	1	3.33%	12	40%	21	42%	4	8%
Around 100 meter	6	20%	1	3.33%	9	10%	5	18%
Around the mid-distance between two station	10	33.33%			3	6%	8	16%
Total	17	56.67%	13	43.33	29	58%	21	42%

Source: own survey, 2018

As noted in table (17) above, from the owner perspective 55.67% have said there is tenant displacement from their building. However from 55.67 %, 20% and 33.33% are far from LRT station. Buildings which serve as hotel and bedroom are not willing to stay near to LRT station due to noise. On the tenant side, 42% are not willing to stay in their current space from the total of 42%, 34 % are far from LRT station. However 58% are willing to stay in their current commercial space, most tenants were found near to LRT station. Cumulatively, tenants far from LRT station are not willing to stay on current space on the other hand tenants near to LRT station are willing to stay in current commercial space.

A building far from LRT station has recorded high level of tenants' displacement; however, buildings near to LRT station has a low level of tenant displacement. The tenants are displaced from mid-distance area of between two consecutive stations to area of around LRT station. The big reason for tenant displacing to LRT station is finding suitable are for their business. Due to fenced LRT system, the business around the mid area of between to station is highly harmed.

4.3.3 LRT station and business activity

Both 30 owners' and 50 tenants have asked their perception of whether Commercial building near to LRT station is more suitable for business than buildings far from LRT station. The following table shows that their believes as follows

Table 18: LRT station sustainability for business

Near to LRT is more suitable for business	Strongly agree		Agree		I don't agree		I have no idea	
	Frequency	Percent age	Frequency	Perce ntage	Freque ncy	Percent age	Frequen cy	Percenta ge
Owner	22	73.33%	6	20%	0	0	2	6.67%
Tenants	37	74%	8	16%	1	2%	4	8%
Total	59	73.75%	14	17.5%	1	1.25%	6	7.5%

Source: own survey, 2018

The table (18), above provides information concerning the relationship between business activity and LRT station. According to the survey table, 73.75% of respondent believe that commercial space near LRT station is very suitable. And 17.5 % of respondents are agreed on the suitability of the LRT location area for business; however, 1.25% and 7.5% do not agree and have no idea respectively.

According to the survey table and from the interview, the LRT location area is very active. As a result, it is very suitable for the most business activity. As one goes from LRT station to the mid area between two stations business activities is getting decreased. Business activity is one of the reasons that tenants prefer to rent near to LRT station, the very reason for this is the absence of pedestrian cross between two stations. In support of this, Yigzaw *et al.* [19] concluded that the firms with the closest location to crossing points and LRT stations had better performance. And regarding the accessibility issue after the construction of the LRT, the firms feel more inconvenience of the parking space, crossing points and pedestrian facility.

According to the planner, LRT station creates a node and central business distribution (CBD). In this area, there is a high concentration of population, economic concentration and transportation breaks. Bus and taxi station are also near to LRT station because LRT station is the only option for a pedestrian to access the opposite side goods services. Consequently, business is attracted to

the LRT station from far area of LRT station, commercial spaces near to LRT station is become fully occupied and the building far from the station becomes vacant.

4.3.4 The effect of Fenced LRT on property value and business

Commercial space near to LRT station is very suitable for business activity than other space far from LRT station. As result, tenants are attracted to the LRT station area to get space for their business. As the interest of tenants to rent a commercial property near to the LRT station increase, the occupancy condition of buildings increases. As a result, the value of the property near to LRT station is increased. Here it has been noted that rent per meter square has no significant difference. The value difference comes from the occupancy difference not at the rental price. The fenced LRT has harmed the occupancy level of building around particularly, buildings found at the mid-distance between two stations as well as the business too. The owners and the tenants were asked to express their agreement on the negative effect of fenced LRT on their property value and business. The respondent's evaluation the owner and the tenants are summarized as follows.

Table 19: The impact of fenced LRT on business and Property value

Location	Strongly agree		Agree		I don't agree		I have no idea	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Close to LRT station	3	3.75%	5	6.25%	25	31.25%	3	3.75%
Around 100 meter from LRT station	21	26.25%						
At mid-distance between two station	21	26.25%						
Total	45	56.25%	5	6.25%	25	31.25%	3	3.75%

Source: own survey, 2018

As shown in table (19), above 56.25%, 6.25%, 31.25%, and 3% are said that strongly agree, agree, they do not agree and have no idea respectively. This indicates that most of the respondents other than close to LRT station strongly agree that their vacancy of the buildings, as well as the tenant's business, are highly harmed by the fenced LRT. However, most respondents near LRT station did not agree about the negative effect of LRT station or they didn't know

since they are not affected by the fence. Near to LRT stations, buildings vacancy condition is very low and the business activity is very active and vice versa.

This finding shows that commercial property near to LRT stations has more value than commercial property far from LRT stations. This finding also substantiates with the conclusion of (Ko and Cao 2013) supports the above statement on commercial property value as Property prices decrease with distance away from LRT stations in the Hiawatha.

The fenced LRT interrupts free movement between two opposite side of the roads. For example, let us consider two buildings found at the mid-distance of LRT station but in opposite direction. To access one of the buildings starting from the other building it requires walking distance which is proportional at the distance between two stations.

The fenced LRT station has a negative impact particularly for buildings found between two consecutive stations. Around this, areas are turned into inactive and dead as well as business activities are very low as compared to areas around LRT station. Due to the fact that tenants preferred very accessible and suitable area for their business, the tenants leave the buildings which are found in this inactive area. This is in agreement with the conclusion of (A. Randell et al., 2012), concluded that the value increment for commercial property is considered to decrease significantly with the distance from light rail stations. This is due to the fact that employees and customers are considered to be less willing to walk more distances from stations.

4.3.5 Consideration of LRT system during Rent determination

According to hedonic pricing theory, value or rental price of a house is the composition of different characteristics such as it might be house specific or physical and neighborhood characteristics of the location. For example house, specific characteristics include the age of the building, quality of construction materials, the design of building etc. On the other hand neighborhoods, characteristics include security, waste disposal areas, economic bases etc. The physical characteristics of location basically focus on infrastructure development of the location that includes the availability of water, electricity, and transport mechanisms.

LRT is one of the transportation modalities in Addis Ababa. Its station, particularly in the absence of crossing, LRT station is serving as a center for business activity. When tenants want to occupy commercial space, the location of commercial space with respect to LRT station is a

key criterion. Not only the tenant but also the owner prefer near to LRT station. This is due to, however, in quantitative analysis section particularly in regression result of this paper, there is no rental price advantage for owners due to the location of their building with respect to LRT station, and indeed they got occupancy advantage. Occupancy level of the building near to LRT station is greater than buildings far from LRT station.

According to local brokerages owners and tenants, in general, due to many factors rents of commercial space have been increasing. In order to understand LRT system is one factor of rent increment or not, owners and tenants were asked the change of rent due to LRT station and how distance from LRT station is considered during rent determination. This question is basically employed to know the attitude and understanding of owner and tenants towards LRT.

The respondent's answer to this question is summarized as follows,

Table 20: Rent change due to LRT

Rent change due to LRT	Increased		Decreased		No change	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Ownerr	0	0%	1	3.33%	29	96.67%
Tenants	11	22%	8	16%	31	62%
Total	11	13.75%	9	11.25%	60	75%

Source: own survey, 2018

As indicated in the table above (20), LRT station consideration is described as 13.75%, 11.25% and 75% are increased, decreased and not changed respectively.

Surprisingly all respondents who say increased are all tenants. According to the survey conducted from 80 respondents, 11.25% has said that the rental price is decreased due to the fenced LRT station. This indicates that owners have taken a solution by reducing some amount of money from rental price which is found around LRT station. From an owner perspective, 96.67% has no change in rent due to LRT including LRT station. In addition to this, 62% of tenants witnessed that there is no price change due to LRT. Cumulatively, 75% of respondents assure that there is no rental price change currently due to LRT. It can be understood that most of the respondents did not consider LRT and LRT station during rent determination.

In the previous locational characteristics of the respondent, indicates that most tenants were preferred near to LRT station, nonetheless, this section reveals that there is no rental price change due to LRT station. This is why, according to owners whose building is found at the mid-distance of two consecutive stations, they took rental price reduction as a mitigating strategy to increase the occupancy level of their building, and it was not an effective solution. They argued that most tenants come to there if there is no free commercial space around LRT station. As a result, they persuaded to maintain the rental price relatively equal to buildings found near to LRT station. If they maintain price reduction as a solution they would be doubly punished, high vacancy and low rent price. In support of these, tenants were not motivated for a rental price reduction, because the rental price has no a significant difference as compared to their business. However, if there is no free commercial space around LRT station they persuaded to find commercial spaces far from LRT station. So now, most of tenants and owners did not consider LRT station during rental price determination.

However, LRT station is a key criterion for location selection for both owners and tenants. Most of the tenants and owners don't consider the station during rent determination. But the negative and positive effect of LRT station is manifested as occupancy level and business activity, not in a rental price change.

4.4. Case studies

The two comparative case studies were undertaken based on two building descriptions with respect to LRT station. The LRT stations are the only means to access goods and services from the opposite side. These two cases have given a deep insight into the impact of fenced LRT line on commercial buildings particularly the level of occupancy and the level of vacancy and the turnover of tenants. Vacancy and occupancy level for a commercial building is a direct measure of property value. Furthermore, a commercial space tenant follows the business. As a result, buildings near to suitable areas for business are a tendency to be more occupied than that building found unsuitable areas. These two cases, Eyoel building is found near to LRT station and Setit city mall far from LRT station shows the impact of fenced LRT and station on the occupancy level of building and business activity of the area.

Case 1: Eyoel buildings



Eyoel is found in Addis Ababa at CMC area particularly near to St. Michael church. With respect to LRT station, it is located very close to St. Michael LRT station. It was constructed before the commencement of LRT. It is a five-story building that has a total of 45 rooms, used for office, banks, clinic and beauty salon. At the time of the investigation, this building was 100% occupied.

Figure 8: Eyoel building St. Michel, Cmc

According to the manager, the tenants are stable means that there is a low turnover of tenants. , Tenants from other buildings located in the mid area of two stations are asking for renting rooms in this building. However, the building is fully occupied and they could not get space for them. Tenants are stable and there is no price increment due to the fact that the building is located near to the LRT station. Rental price is different on each floor of the building. The price of rooms found on the ground floor is higher than those rooms found on the upstairs. The price of rent decreases from the ground to the upstairs.

The full occupancy of this building is due to the situation that tenants are attracted to this building because this building is found very close to LRT station because of two reasons

1. Tenants prefer to do business near to LRT station since LRT station is the only option to cross LRT line; as a result, customers are not happy to go far into the mid area of the station.
2. The area near to LRT is active than the mid area of two stations as why stations are the area of boarding and alighting area for the passenger.

Generally, this building is benefited from LRT station; it decreases vacancy level and turnover of tenants. However, there is a noise near to LRT station, for this building, it has no impact on rental price and occupancy level of the building.



Case 2: Setit city mall

Setit City mall is found in Addis Ababa at Cmc area particularly near to St. Michael church. With respect to LRT station, it is located the mid-distance between St. Michael LRT station and civil service university station. It was constructed before the commencement of LRT. It is a six-story building that has a total of 60 rooms. From 60 rooms only 39 rooms are occupied in percentage it is 65 percent of the total room. But 21 rooms are vacant; in terms of a percent, it takes 35 percent are vacant. Setit City mall is used for office, furniture shops, and retail shops.

Figure 9: Setit city mall, St. Michael, Cmc

According to the manager, in this building, during the investigation of these data, five tenants were applied to leave these building. This implies that there is a high level of vacancy and high level of tenant turnover in this building as compared to buildings near to LRT station. The manager added that, even reducing the rent is not a solution to hold the tenants. Tenants need active areas for those business and they prefer more accessible and suitable areas for their customers. As result, tenants are pushed to near to LRT station buildings for their business and work. The basic consequence for this problem is the absence of crossings between two LRT station, means that the fenced LRT line has a negative impact on commercial property particularly, and buildings far from LRT station.

Depend on the manager, the tenant is unstable they tried for a few months and they leave the building. Before the construction of LRT, there are few vacant rooms and fewer turnovers, as a consequence of the absence of pedestrian cross now, the vacancy and turnover of tenants are increased from time to time. On the other hand the tenants said that their business is harmed. They believe that the reduction of their business is due to their location, that far from LRT station and the absence of crossings.

In general, the absence of crossings on LRT lines and the distance of the location of buildings from LRT stations have their own impacts on occupancy/vacancy level and tenant turnover. Vacancy level and tenant turnover of a building increase as the distance of a building away from

the LRT station increases. Similarly, the absence of nearby crossings on LRT lines increases vacancy level and tenant turnover of those buildings located far away from the LRT stations.

From the above two cases: There is no rental price change due to the position of building with respect to LRT station. The Eyoel building near to LRT station is fully occupied, tenants are a stable and very low turnover of tenants and Setit city mall is more vacant and tenants are unstable there is more turnover. According to the managers of the building, this not only the distance from LRT station rather the big impact comes from the absence of crossing between stations. As discussed in the previous section, rent has not statistically significant with respect to LRT station. As a result, the building near to LRT station might have a higher value than the building far from LRT station even if it has found in the same neighborhood.

4.5 Socio-economic and environmental impact of LRT

This section provides the socio-economic and environmental impact of Addis Ababa LRT station in connection with total LRT system. This part of the analysis is qualitative. It depends on the data from the interview, questionnaire questions and personal observation of the LRT system. This section includes, first introduce the general socio-economic and environmental impact of LRT and the second one is tried to assess the socio-economic and environmental impact of LRT station related to commercial property rent.

4.5.1 General impact of LRT

A. socio-economic impact of LRT

Even though LRT is the source of criticism, question related to quality and efficiency of infrastructure, central government to repay the loan under agreed terms and dangerous in crossing which are the stations are on the surface (Clelie Nallet, 2018), according to the LRT official, it is affordable for the low-income people as compared to another type of transportation modalities. Particularly for long distance, and passengers who work at the center of the city who commutes from around Ayat and Akaki-Kaliti. The passenger adds that it is not only the issue of money but also it saves time at the peak hour. During peak hour there is high traffic congestion, as a result, it is usually difficult to get transport services by taxi and bus at this time compared to taxi and bus a train is relatively preferable.

Based on AALRT office data, one of the economic advantages of AALRT is that it creates a contract and permanent work opportunity. Currently, under AALRT office there are 656 permanent staffs, with gender composition males are 524 and females are 132. In terms of contract work opportunity, there are 600 workers, which of this 306 are males and 294 are females. Furthermore, there are 14 daily labor workers. Totally, the AALRT creates work opportunity for 1270 peoples. Beyond to economical implication, according to passenger, and planner Addis Ababa LRT used to strengthen social relationships between the center of the city and the periphery one this is why the passengers have preferred that less cost as well as less boarding and dropping. However, from commercial property owner and commercial space tenant perspective, it highly affects the social and economic relationships between the opposite side residents. In addition to this, according to AALRT office, it is a source of income for the government, it generates an average of 339, 409 Ethiopian ETB per day.

According to planner and academician, the big issue of LRT in socio-economic implication is mobility and accessibility. In Addis Ababa, mobility and accessibility are a challenge for many peoples particularly people who do not have own cars. The introduction of LRT system from the center particularly from Torhilo to Ayat and from Piassa and Akaki Kaliti create good opportunities for workers to commute to their jobs to the center and the find affordable house in rent at the periphery. In general low transport, cost creates good accessibility for workers and help to rent an affordable residential house. For low-income people, low transportation cost and low rent of the house is an important issue.

According to the owner of commercial properties, areas between two consecutive LRT stations which have no pedestrian cross between them, active commercial areas become inactive and idle. Furthermore, in related to the absence of pedestrian cross, LRT is a source of congestion in LRT station why because LRT station is serving as a pedestrian cross. Based on the researcher observation, traffic congestion becomes the source of pollution and at the same time economical waste in terms of fuel price. Anyone can observe that more and more cars are waiting to move in both two sides of the LRT line at different LRT stations in Addis Ababa. For instance, stations such as, St. Micheal, Hayahulet one, HayaHulet 2, Gurdishola 1, Leme hotel are an example of which this problem is observed in East-West corridor.

The local brokerages said that the introduction of Addis Ababa LRT, increase new real estate development including commercial and residential buildings. Real estate development has been increased after the commencement of the LRT system. Real estate developers are attracted to develop real estate at the periphery which the LRT line touches practically Ayat and Akaki-Kaliti. Particularly Ayat area is going rapidly in real estate development in connection with LRT line. The academicians added that the presence of LRT increases the value of land and property. After the introduction of LRT, the sale of the property has increased in residential and commercial buildings. But it requires detail study because property value is increased due to many reasons.

The planner said that the introduction of LRT in Addis Ababa causes to change the character of the location. It makes noisy near to LRT station and dead between two consecutive stations and Cause for tenant displacement and changing of building function.

B. Environmental impact

On one side, according to Addis Ababa light rail official, Addis Ababa light rail is compared to another type of transportation modality, it has a high capacity to travel more passengers per one trip. This capability reduces the trip of other modalities including buses and minibus taxis. This is the very important side of the LRT system to reduce carbon emission and more economical in saving fuel consumption. It is environmentally friendly as it is the electric system. No omission of carbon dioxide into the air it has a great contribution to environmental safety. According to the academician, however, because of the lack of pedestrian cross sometimes LRT station is the only option to access the opposite side of roads and services. Additionally, the problem of Addis Ababa LRT station is lack of integration with other road system and transportation modalities.

On the other side, according to the planner, the system creates congestion that induce more emission of carbon dioxide from cars consume a large amount of fuel it has environmental pollution and economic implication. More fuel takes more amount of money. The more time –to wait for the pass-more amount of fuel-more toxic substances emission into the air and that influence the quality of the environment this case might increase the greenhouse effect. And the planner adds that light rail can be aesthetically pleasing and give a strong positive image of the city. Nonetheless, Addis Ababa light rail is not more attractive and it divides the city in two four section.

AALRT is a source of accidents, for instance according to AALRT office, 286 incidents were occurred and recorded related to the whole LRT system. From 286 incidents, 82 incidents were a car crash with the fence and the colon of the railway.

Case from passenger

One of the passengers was asked, about his transportation preference. During the investigation, he was a student in Ethiopian Institute of architecture building construction and city development (EiABC) Addis Ababa University. He came from Ayat area, which is the end station of the East-West route of LRT. Most of the time he has used the train rather than taxi and bus, because of two reasons. The first reason is, in terms of cost, if he uses the train he pays 6 ETB, however, if he uses the taxi, he pays more than 13 ETB. The second reason is in terms of time if he uses the train, it takes 45 minutes, however, if he uses the taxi it takes around 2:00 hour. Consequently, he decides that using train is more important than other transportation modalities in terms of cost and time.

4.5.2. The effect of fenced LRT on Occupancy condition of the building

In this regard, to know the effect of fenced LRT and LRT station on occupancy and vacancy condition of buildings 30 owners were asked for their building occupancy condition comparing with before and after the introduction of LRT. The owners of buildings were asked how the occupancy level of the building is going on. The following table below shows respondents response.

Table 21: Occupancy level of buildings

Location	Occupancy condition					
	Increased		Decreased		No change	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Very close to LRT station	13	43.33%	0		0	
Around 100 meter	0	0%	7	23.33%	0	
Around mid-distance	0	0%	10	33.33%	0	
Total	13	43.33%	17	56.67%	0	

Source: own survey, 2018

As shown in the table (21) above 43.33% and 56.67% occupancy level of the building is increased and decreased respectively. In all buildings near to LRT station, occupancy level is increased, and some of these are fully occupied. At the same time, the occupancy level of all buildings far from LRT stations decreased. No building is at constant occupancy level.

This occupancy condition of buildings implies that it has two edges in the occupancy level of building due to LRT station. The first edge is the building near to LRT station which is highly occupied and low vacancy level, however, the second edge buildings far from LRT station particularly at mid area of between two stations there is a high level of vacancy. Although most owners do not adjust the rental price of commercial space due to LRT, there is high occupancy difference between buildings which is found near to LRT station and far from LRT station. This indicates that in the income approach to valuation principle there would be value difference between buildings due to fenced LRT at the same time as LRT station is the only option for a pedestrian cross.

4.5.3 LRT station as a source of the problem and its effect

LRT station has a cause for several problems such as noise, congestion, pollution; waste and rubbery. In Addis Ababa fenced LRT system the absence of car crossing and pedestrian crossing is the considered as a major problem for free movement of between the opposite sides of the LRT. 30 property owners' /managers/ and 50 tenants were asked their observation on problems around LRT station and their consideration as a problem. As the same time owners were asked the impact of that problem on their house value in terms of rent and occupancy level. And tenants were asked the impact of those problems on their business. The following table below shows respondents consideration as a problem and its impact on their property value and business.

Table 22: LRT station related problems and their impact on property value and business

Problems	Consideration as problem				Status of impact on property value and business					
	Yes		No		Positive		Negative		No impact	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Robbery and security problem	17	21.25%	63	78.75%			1	1.25%	79	98.25%
Noise	55	68.75%	25	31.25%			0	0%	80	100%
Traffic congestion	78	97.5%	2	2.5%			23	28.75%	67	71.25%
Interruption of relationships	78	97.5%	2	2.5%			43	53.75%	37	46.25%
Air pollution	56	70%	24	30%			2	2.5%	78	97.5%
Source of waste	63	78.75%	17	21.25%			3	3.75%	77	96.25%
Absence of crossing	79	98.75%	1	1.25%			78	97.5%	2	2.5%

Source: own survey, 2018

4.5.4 LRT and LRT station as a problem

As the table above 22 reveals, 78.75% of respondents said that there is no Problem of security around LRT station. However, 21.25% of them have replied that there is a robbery and security problem around LRT station. Based on the response of most of the respondents, it can draw the conclusion that there is no significant difference from other areas related to security.

The other problem that can be considered as a problem around the station is noise. According to the survey, 68.75% of the respondents have observed noise problem around the station. Nonetheless, 31.25% of the respondents have not considered noise as a problem. Despite the fact

that theoretically in many of literature one of the major problems around LRT station is noise, 31.25 % of respondents did not consider noise as a problem.

According to the survey data shown in table 23, almost all respondents assure that there is high traffic congestion. For all respondents, 97.5% has assured that there is a problem of traffic congestion. However, 2.5% did not recognize the problem of traffic congestion around LRT station. The problem of congestion is coming for different reasons. The first one is the LRT station is the only option for crossing for a pedestrian to access the opposite side services. As a result, many more cars are waiting to pass after pedestrians are crossed. The second one is the absence of care crossings in a short interval. It is not to access the next services for car drivers in short distance this makes more cars are congested and it aggravates the congestion problem.

The other problem is related to fenced LRT station and, 97.5% of the respondents have said that there are the problems related to social and any business relationships between the opposite side colleagues, friends, and relatives. Only 2.5% of the respondent said that there is no problem interrupting of any relationships. And in fact, the fenced LRT station of Addis Ababa affects the relationships between two sides of the tram. This problem is very hardened where areas that far from LRT station.

One of the questions given to the respondent is there air pollution and waste around LRT station. About 70% and 30% respondent responds that there is and there is no pollution respectively.

However, 30% of respondents did not believe that pollution around LRT station, particularly Addis Ababa LRT which is characterized by high car congestion around station pollution is very high. As a result, cars are spending more time if there is congestion. It can be summarized as LRT particularly around the station is a source of air pollution due to car congestion.

As far as LRT stations and accumulation of waste around the stations is concerned, 78.75% of respondents have observed garbage accumulated around LRT station. However, 21.25% of the respondents have not observed accumulation of garbage around the LRT station. This garbage comes from the passengers and anyone who cross the train using LRT station. In LRT station, there are not enough garbage collectors. If there is no proper garbage management and if there are not enough garbage collectors, the LRT stations will be full of dirt and sources health problems.

The other issue which most respondents considered as the main problem is the absence of Pedestrian as well as car crossings. About 98.75% of the respondents clearly visualize the problems that come due to the absence of crossings. Only 1.25% doesn't recognize the absence of crossing as a problem. Practically, the absence of crossing is a source of many problems including interruption of business and social relationships, increase noise around LRT station, increase congestion pollution.

4.5.5 The effect of problems on property value and business

To draw up the conclusion, the impact of the above problems related to LRT line and LRT station on property value and business, 80 respondents were asked how these problems have affected. Does those problems positively, negatively or no change at all? Depending on the above table (22) the impact is described as follows.

According to the survey conducted all problems have no positive impact on property value and business. Almost all respondents assure that air pollution and waste has no impact on property value and business.

The noise around the station has neither positive nor negative impact on property value particularly occupancy level of building and rent level of space. This indicates that Business activity and property value are independent of noise in Addis Ababa LRT stations. This implies that tenants do not want suitable environment related to the noise rather they only focus on how customers access their business area easily.

When it comes into traffic congestion, 53.75% of respondents' traffic congestion affects their business and property and 46.25% said that their business and property is not affected by traffic congestion. The negative impact comes from that create an unsuitable condition to access the commercial houses easily for customers. Particularly for car driver customers, it imposes an unnecessary delay, so that car drivers want to pass through other routes if they have another choice of routes.

One of the questions is the impact status of the absence of crossing and barriers of relationships on property value and business activity. According to the survey that shows in table 18, 97.5% and 53.75% has a negative impact on the absence of crossing and fenced LRT station as a barrier respectively. The negative impact of the absence of pedestrian cross between two consecutive

stations is free movement of customers. Even though most respondents considered the absence of crossing has a negative impact on their commercial building value and business, during observation buildings near to LRT is almost fully occupied. The fenced LRT line has a negative impact as it is a barrier-free movement of customers, business friends, and relatives that creates a different neighborhood within the same area. In short a barrier to the relationship is the consequent absence of crossing between two consecutive LRT stations.

Chapter Five

5. Conclusion and recommendation

5.1 Conclusion

The LRT of Addis Ababa, which was inaugurated in September 2015, has two directions, East-West route (Ayat to Torhiloch) and North-South route (Minilik II square to Akaki). It covers a total of 34 kilometers. The introduction of the LRT has several impacts including property value. In this study, an attempt has been made to analyze the impact of LRT station on commercial property focus on the rental price of commercial spaces and the occupancy level of the buildings.

According to different kinds of literature and studies conducted throughout the world commercial property value near to LRT station is appreciated than property far from LRT station since, LRT station crates node and CBD. In this area, there is a high concentration of population, economic concentration and transportation breaks. LRT station also attracts business activity around it. Bus and taxi station are also near to LRT station because LRT station is the only option for a pedestrian to access the opposite side services. Consequently, business is attracted to the LRT station from far area of LRT station and commercial spaces near to LRT station is become fully occupied and the building far from the station is become vacant.

According to the quantitative measurement of the monthly rental price per meter square with respect to the distance from LRT station, the linear association is negative but the impact is insignificant. The rental price per square meter of the commercial space is independent of the distance from LRT station. The rent per square meter is determined by the total rent, floor level, an area of space, building type, number of rooms and other observed characteristics.

This study reveals that there is a high level of tenant displacement from the mid area of two consecutive stations; however, tenant displacement from near to LRT station is very low. Most of the building near to LRT station is fully occupied. Numerically 43.33% of owners were near to LRT station, from this 40% of owners assures that there is no tenants turn over. The reduction of tenant turnover maintains the level of occupancy as high.

Concerning the LRT station and business activity, the survey result assures that commercial space near to LRT station is more suitable than those buildings far from the station. The

numerical evidence indicates that 73.75% of the respondents are strongly agreed and 17.5% of respondents agreed that building near to LRT station is better off than the buildings far from LRT station.

Indeed LRT is very important for passengers particularly the long distance travelers that it is free from traffic congestion; however, it is a source of several impediments. The first and the foremost problem is the LRT line is fenced and it has no enough vehicular crossings as well as pedestrian crossings. The fenced LRT station affects the free movement of peoples from one side of LRT to the other side. This has a great negative consequence on business activity as well as the vacancy level of the building and finally, the area will turn into the dead.

The LRT station is serving as both pedestrian cross as well as boarding alight area of the passenger. Due to this reason, the LRT area is characterized by noise, high traffic congestion, pollution from jammed motor vehicles, waste and theft and robbery is some observed problem. The impact of these problems is assessed from business and property value perspective involving owners and tenants. The statistics from the respondent shows that noise, robbery, and theft, pollution and waste have no significant impact on business, commercial space rent and occupancy level of the building. But to some extent 28.75% respondents recognize traffic congestion as negative impacts on business and property value.

The impact on property value is not in terms of rental price rather it manifests in terms of decreasing occupancy level of buildings. Vacancy level and turnover of tenants from buildings which is far from LRT station are increased and the property near to LRT station has greater value than property far from LRT station. The building which is near to LRT station is more suitable for the most business activity. As a result building near to LRT station is more occupied. It can be drawn that business activity and property occupancy level has a direct relationship.

Finally, it can be concluded that commercial properties near LRT station have more value than property far from LRT station. This is because of the value for commercial property driven from its rent per unit and occupancy condition of the property itself.

5.2 Recommendation

According to the result rental price of commercial space is independent of LRT station, however, the occupancy level of the building and business activity is highly affected particularly properties found at the mid-distance of two consecutive stations are highly harmed due to their location related to the LRT station. This is because of the absence of crossing.

Based on the findings the following recommendations have been suggested.

- To alleviate this problem pedestrian crossing should be constructed. The design of the pedestrian cross also should be considered either underground or overpass, on the surface pedestrian cross may have other consequence such as traffic congestion. However, a feasibility study should be conducted to select the design for the proposed pedestrian cross.
- The concerned body should take the lesson for future projects. If the future project of LRT line underground that has not an additional impact on business and property value. The design for the future project of LRT should be considered.
- This study strongly recommended for future related potential researchers to expand the scopes and include different station types that are underground, on the surface and an overpass as well as including more variable, such as function of commercial spaces. It is better if it has conducted in comparison.
- It is better if it has conducted using sales data, using the large scale in different period's commercial property sale price before the commencement of construction, during construction and after the commencement of LRT. And it is a potential topic if it is conducted the impact of LRT on residential land and houses at the destination area

References

Books and journals

- Abidoeye, B.R., Chan, P.A. (2017). Critical review of hedonic pricing model application in property price appraisal: A case of Nigeria, *International Journal of Sustainable Built Environment* (2017) 6, 250–259.
- Aggarwal, A., & Upadhyay, A.K. (2002). *Civil estimating, costing and valuation with contracting*, seventh edition, S.K Kataria and Son's publisher of engineering and computer books, New Delhi.
- Alebel, B., & Berihu A. (2017). A critical assessment of urban land leasehold system in Ethiopia, paper prepared for presentation at the “2017 world bank conference on land and poverty” The World Bank - Washington DC, March 20-24, 2017.
- Andualem, A., & Takele, N. (2018). Analysis of the spatial accessibility of Addis Ababa light rail transit: The case of east-west corridor, *springer-urban rail transit*, <https://doi.org/10.1007/s40864-018-0076-6>.
- Armstrong, R., Sundell, D., Armstrong, N., & Lund, T. (2005). The anticipated economic impacts of introducing light rail to New York City's 42nd Street, *urban economics* 115 Fifth Avenue, 3rd Floor New York, NY 10003 212-353-7465, In association with Georges Jacquemart of BFJ Planning Amos Ilan of A. Ilan Consulting.
- Balchin, P. N., Bull, G. H., and Kieve, J.L. (1995). *Urban land economics and public policy*, fifth edition, Palgrave Houndmills, Basingstoke, Hampshire RG21 6XS and 175 Fifth Avenue, New York, N. Y. 10010, ISBN 978-0-333-71692-2.
- Ball, M., Lizieri, C., and MacGregor, D.B. (1998). *The economics of commercial property markets*, Rutledge 11 New Fetter Lane, London EC4P 4EE, ISBN 0-203-01311-5.
- Blackledge, M. (2009). *Introducing Property Valuation*: Rutledge 2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN, ISBN 0-203-87617-2 Master e-book.

- Brooks, C. (2010). Real estate modeling and forecasting, Cambridge University Press The Edinburgh Building, Cambridge CB2 8RU, UK ISBN-13 978-0-511-68397-8 eBook (Dawsonera).
- Cebula., J.R. (2009). The hedonic pricing model applied to the housing market of the city of savannah and its savannah historic landmark district, the review of regional studies Vol. 39, No. 1, and pp. 9–22.
- Cellmer R., and Szczepankowska, K. (2015). Use of statistical models for simulating transactions on the real estate market, real estate management and valuation, Vol. 23, No. 2, pp. 99-108.
- Chiarazzo, V., Dell’Olio, L., Ibeas, A., and Ottomanelli, M. (2014). Modeling the effects of environmental impacts and accessibility on real estate prices in industrial cities Procedia - Social and Behavioral Sciences 111 (2014) 460 – 469
- Crampton, R.G. (2003): Economic development impacts of urban rail transport paper prepared for the ERSA2003 Conference Jyvaskyla, Finland. 27-30 August 2003
- Creswell, J.W. (2014). Research design: qualitative, quantitative and mixed methods approach, 4th edition, Washington DC, USA, SAGE Publications Inc.
- Epley, R.D., Rabianiski, S.R., & Haney, R. (2002). Real estate decisions, Southwestern a division of Thomson learning in the United States of America, ISBN 0-324-14361-3.
- Evans, W.A. (2004). Economics and land use planning, Blackwell Publishing, ISBN 1-4051-1861-X
- Evans, W.A. (2004). Economics, real estate and supply of land, Blackwell Publishing Ltd, ISBN 1-4051-1862-8
- Eyasu K. and Melaku T. (2016). The impact of the current land lease law on business and investment expansion Submitted to Addis Ababa Chamber of Commerce & Sectoral Associations (AACCSA).

- Ezebilo, E.E. (2017): Evaluation of House Rent Prices and Their Affordability in Port Moresby, Papua New Guinea, *Buildings* 2017, 7, 114; doi: 10.3390/buildings7040114. www.mdpi.com/journal/buildings
- Francesca Pagliara, F., and Papa, F. (2011). Urban rail systems investments: an analysis of the impacts on property values and residents' location *Journal of Transport Geography* 19 (2011) 200–211
- Fuerst, F. (2007). Office rent determinants: a hedonic panel analysis, University of Reading, And Henley Business School.
- Ghebreegziabiher, D., Pels, E., & Rietveld. P. (2007). The impact of railway stations on residential and commercial property value: A meta-analysis, *J Real Estate Finan Econ* (2007) 35:161–180, DOI 10.1007/s11146-007-9032-z.
- Hartenian, E., Horton, J.H. (2015). Rail trails and property values: Is there an association, *Journal of Statistics Education* Volume 23, Number 3 (2015).
- Harvey, J. (1996). *Urban land economics* fourth edition, Macmillan press LTD Houndmills, Basingstoke, Hampshire RG216XS and London, ISBN 978-1-349-24441-6 (eBook).
- Hui, K.S., Cheung, A., and Pang, J. (2010). A hierarchical Bayesian approach for residential property valuation: application to Hong Kong housing market, *international real estate review*, Vol. 13 No.1: pp. 1 – 29.
- Jacobus, J.C. (2010). *Real estate principles*: Cengage learning, 5191 Natorp Boulevard, Mason, OH 45040, USA.
- Javier F. (2010). Assessing the impacts of light rail Transit on urban land in Manila, *The Journal of transport and land use*, <http://jtlu.org>, vol. 3 No. 1 [Spring 2010] pp. 113–138 doi: 10.5198/jtlu.v3i1.13.
- Joshua, W., and Duke, M.J. (eds) (2014). *The Oxford handbook of land economics*, Oxford university press, 198 Madison Avenue, New York, NY 10016,
- Karytinis, A., and Vlachostergiou V. (2001). Estimating commercial property rentals in the Greek Market, using Multiple Regression Analysis, EFG Eurobank properties.

- Kim, K., and Lahr, L.M. (2013). The impact of Hudson-Bergen Light Rail on residential property appreciation Papers in Regional Science 2013 RSAI.
- Klau, H.C., Crampton, G., & Benjari, R. (2004). Economic impact of light rail, environmental and transport planning, 10 Clermont Terrace, Brighton BN1 6SH
- Ko, K., and Cao, J.X. (2013). The Impact of Hiawatha light rail on commercial and industrial property values in Minneapolis, journal of public transportation, Vol. 16, No. 1, 2013.
- Kumar, R. (2011). Research methodology, a step-by-step guide for beginners, third edition sage publication Los SAGE Publications Ltd, 1 Oliver's Yard, 55 City Road London EC1Y 1SP ISBN 978-1-84920-300-5.
- Lichao, J. (2015). Study on the influence of urban rail transit on the value of real estate based on information system, the Open Construction and Building Technology Journal, 2015, 9, 73-80.
- Ligus, M., and Peternek, P. (2016). Measuring structural, locational and environmental effects: A hedonic analysis of housing market in Wroclaw Poland: Procedia Social and Behavioral Science, 19th international conference enterprise and competitive environment 2016, ECE 2016, 10-11 March 2016, Czech Republic.
- Ling, D., and Archer, W. (2018). Real estate principles value approach, McGraw-Hill Education, 2 Penn Plaza, New York, NY 10121, Fifth Edition, ISBN 978-0-07-783636-8.
- Litman, T., Skene, M., and FitzGerald, S. (2002). Light rail economic opportunity study evaluating light Rail transit as a solution to capital regional transportation problems, victoria transport policy Institute, 1250 Rudlin Street, Victoria, BC, V8V 3R7, Canada www.vtpi.org info@vtpi.org.
- Mooya, M.M. (2016). Real estate valuation theory: A critical appraisal, Springer-Verlag Berlin Heidelberg, ISBN 978-3-662-49163-8.
- Nallet, C. (2018). The challenge of urban mobility, a case study of Addis Ababa light rail Ethiopia, the institute francais des relation internationals (IFRI), ISBN 978-2-36567-843-8.

- Needham, B. (2006). *Planning, law, and economics, an investigation of the rules we make for using for land*, Routledge, 2 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN, ISBN13: 978-0-415-34373-2.
- O'Toole, R. (2014). *The worst of both the rise of high-cost, low-capacity rail transit, policy analysis CATO institute June 3, 2014, number 750.*
- Pan, Q. (2013). *The impacts of an urban light rail system on residential property values: a case study of the Houston Metrorail transit line, transportation planning, and technology, 36:2, 145-169.*
- Pol., R. (2003). *Valuation of properties and economic models of real estate markets*, University of Berlin.
- Roukouni, A., and Medda, F. (2012). *Evaluating the value capture mechanism as a funding source for urban transport the case of London cross rail Procedia social science and behavioral sciences 48(2012)2393-2404.*
- Sanghvi, D., Varia, H. R. (2013). *Light rail transit - today's need for developing cities in India, international journal of science and research (IJSR), ISSN (Online): 2319-7064.*
- Shimizu, C., and Karato, K. (2015). *Property Price Index Theory and Estimation: A Survey, International real estate studies (IRES), Working Paper Series, and national university of Singapore.*
- Sun, J., Chen, T., Cheng, Z., Wang, C.C., and Ning, X. (2017). *A financing mode of urban rail transit based on land value capture: A case study in Wuhan City transport policy 57(2017)59-67.*
- Tilahun, M. (2014). *Demands for urban public transportation in Addis Ababa journal of intelligent transportation and urban planning July 2014, Vol. 2 Iss. 3, PP. 121-128.*
- Wayland, V.S. (2011). *The Impact of Light Rail Transit on Low-Income Households a Neighborhoods* retrieved from <https://raisethehammer.org/article/1479/the-impact-of-light-rail-transit-on-low-income-households-and-neighbourhoods>
Published October 12, 2011, raise the hammer.

- William, L., Gallo, L.L. (2015). Consideration of economic development potential: light rail transit in Durham and orange counties, development planning and financing group INC., North Carolina.
- Wyatt, P. (2013). Property valuation, second edition John Wiley & Sons, Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, United Kingdom ISBN 978-1-119-96865-8
- Xu, T., Zhang M., and Aditjandra (2016). The impact of urban rail transit on commercial property value: New evidence from Wuhan, China. Transportation Research Part A: Policy and Practice 2016, 91, 223-235.
- Yan, S., Delmelle, E. and Duncan, M. (2012). The impact of a new light rail system on single-family property values in Charlotte, North Carolina Journal of transport and land use, Vol. 5 No. 2 [2012] pp. 60–67 doi: 10.5198/jtlu.v5i2.261
- Yang, J.H., Song, J., and Choi, M.J. (2016). Measuring the Externality Effects of Commercial Land Use on Residential Land Value: A Case Study of Seoul Sustainability 2016, 8, 432; doi: 10.3390/su8050432, www.mdpi.com/journal/sustainability
- Yehualaeshet, J. (2012). Addis Ababa light rail transit Project report presentation Ethiopian railway corporation (ERC), Retrieved from, https://www.icafrica.org/fileadmin/documents/ICA_sponsored_events/IGAD_HoA_Conf_2012/Ethiopia_ERC_IGADConf_March%202012.pdf
- Yigzaw, N., Dawit, W., and Tsegaye, G. Economic benefit and effect of addis ababa light rail transit on private business firms a case area study from Ayat station to Stadium station. <http://www.eaecon.org/sites/default/files/forms/Yigzaw.pdf>

Reports

- Crossings and shared corridors safety criteria for light rail pedestrian crossings don Irwin tri-county metropolitan transportation district of Oregon, transportation research circular ec058:9th national light rail transit conference, retrieved from http://onlinepubs.trb.org/onlinepubs/circulars/ec058/08_02_irwin.pdf

Downtown to NAIT LRT station visioning workshops saturday, november 22, 2008, Robbins health learning Centre, Grant MacEwan College.

European Union, International Labor Organization, International Monetary Fund, Organization for economic co-operation and Development, United Nations Economic Commission for Europe, The World Bank. (2013). Handbook on residential property prices indices, publications office of the European union, doi: 10.2785/34007, isbn 978-92-79-25984-5.

Sound Transit Board. (2007). Sound transit-2 sound transit plans, builds and operates regional transit systems and services to improve mobility for Central Puget Sound. Sound Transit mission statement.

Stat News #83. (2012). Interpreting coefficients in regression with log-transformed variables, Cornell university cornel statistical consulting unit, retrieved from <https://www.coursehero.com/file/22761782/Interpreting-Coefficients-in-Regression-with-Log-Transformed-Variables/>

Summary of studies. (2001). The effect of rail transit on property values: research carried out for project 21439s, task 7 neorail ii, Cleveland, Ohio Parsons Brinckerhoff draft, February 27, 2001

The World Bank group. (2015). Enhancing urban resilience, Addis Ababa, Ethiopia

Un-Habitat. (2017). The state of Addis Ababa, ISBN Number (Series): 978-92-1-133397-8, ISBN Number (Volume): 978-92-1-132745-8.

Numbered website sources

1. <https://www.centreforpublicimpact.org/case-study/light-rail-transit-in-addis-ababa/>
2. <https://www.theguardian.com/cities/2015/sep/25/addis-ababa-first-sub-saharan-light-rail-network>, <http://ethiopianembassy.be/en/2017/01/06/railway-development-in-ethiopia/> and <https://www.economist.com/news/middle-east-and-africa/21665199-addis-ababa-has-opened-first-part-new-light-rail-system-sub-saharan-africa>
3. <http://www.erc.gov.et/AddisAbaba-LRT>
4. The Ethiopian Herald:<http://www.ethpress.gov.et/herald/index.php/technology/item/2206-addis-light-rail-eases-transportation-problem>

5. The Reporter: <http://www.thereporterethiopia.com/old/content/city-roads-reshuffles-top-management>
6. The Reporter: <http://www.thereporterethiopia.com/old/content/city-roads-reshuffles-top-management>
7. Center for public impact ABCG foundation: <https://www.centreforpublicimpact.org/case-study/light-rail-transit-in-addis-ababa/>
8. <http://www.eeacon.org/sites/default/files/forms/Yigzaw.pdf>
9. Downtown to NAIT LRT Station Visioning Workshops Saturday, November 22, 2008
Robbins Health Learning Centre, Grant McEwan College.
10. Safety Criteria for Light Rail Pedestrian Crossings, Transportation Research Circular E-C058:9th National Light Rail Transit Conference
11. <http://blogs.lse.ac.uk/usappblog/2017/10/25/why-public-transit-can-be-good-for-business-even-in-the-auto-oriented-sunbelt/>
12. <https://www.google.com/search?q=Economic+benefit+and+effect+of+Addis+Ababa+light+rail+transit+on+private+business+firms&oq=Economic+benefit+and+effect+of+Addis+Ababa+light+rail+transit+on+private+business+firms&aqs=chrome..69i57.4055j0j8&sourceid=chrome&ie=UTF-8>
13. New World Encyclopedia retrieved on August 30, 2018 from <http://www.newworldencyclopedia.org/entry/Addis>
14. Transit cooperative research program sponsored by the federal transit administration.
TCRP report 17, 1996
15. https://www.google.com/search?tbm=isch&sa=1&ei=G2ezWqi0McS0sQG31b7ICw&q=Addis+ababa+LRT+station++lists+&oq=Addis+ababa+LRT+station++lists+&gs_l=psyab..3...19389.24768.0.25793.13.13.0.0.0.177.2137.0j13.13.0....0...1c.1.64.psyab..0.0.0....0.10zToNKQqZ0#imgrc=9GlzmWSbZ5CF-M
16. <https://www.latlong.net/place/addis-ababa-ethiopia-1084.html>
17. The Google earth and https://www.researchgate.net/figure/281460707_fig1_Fig-1-Map-of-Addis-Ababa-City
18. Statistics Solutions, Advancement through clarity retrieved from <http://www.statisticssolutions.com>
19. <http://www.eeacon.org/sites/default/files/forms/Yigzaw.pdf>

Appendices

Appendix 1-statistical results from SPSS and Stata

Appendix 1.1

Shapiro-Wilk W test for normal data					
Variable	Obs	W	V	z	Prob>z
RentperMet~e	172	0.89955	13.148	5.882	0.00000

Shapiro-Wilk W test for normal data					
Variable	Obs	W	V	z	Prob>z
Logrentper~e	172	0.99406	0.777	-0.576	0.71769

Stata result: Shapiro test for normality before and after transformation respectively

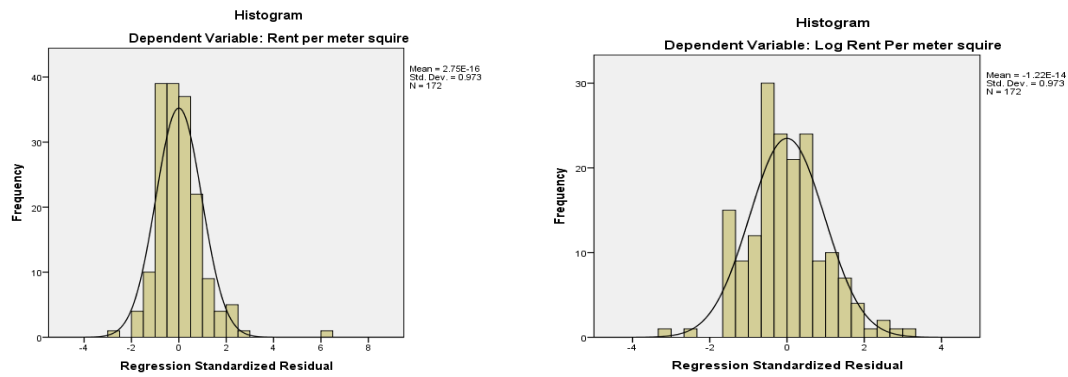


Figure 1.1 Before Log transformation and after transformation graphs

Appendix 1.2

The test result of autocorrelation

Model Summary

Model	R	R Square	Adjusted R Square	Std. error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.000 ^a	.000	-.056	.34766	.000	.000	9	162	1.000	1.851

a. Predictors: (Constant), Area, Location, Availability of toilet, Distance from LRT station, Floor Level, Building Type, Log total rent, Number of room, Availability of Water

b. Dependent Variable: Resdu12= square residuals

Appendix 1.3

Test of hetroskedasticity

Source	SS	df	MS	Number of obs =	172
Model	0	9	0	F(9, 162)	= 0.00
Residual	19.5800848	162	.120864721	Prob > F	= 1.0000
Total	19.5800848	171	.11450342	R-squared	= 0.0000
				Adj R-squared	= -0.0556
				Root MSE	= .34766

myResiduals	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Area	4.09e-11	.0013109	0.00	1.000	-.0025886 .0025886
DistancefrmLRT	-1.59e-12	.0002765	-0.00	1.000	-.0005459 .0005459
BuildingType	-2.57e-10	.0758109	-0.00	1.000	-.149705 .149705
FloorLevel	7.13e-10	.0275528	0.00	1.000	-.0544089 .0544089
No_ofrooms	-1.00e-09	.0525705	-0.00	1.000	-.1038119 .1038119
Water	-1.56e-09	.1392808	-0.00	1.000	-.27504 .27504
Toilet	1.91e-09	.1380719	0.00	1.000	-.2726527 .2726528
Location	-4.74e-10	.0611243	-0.00	1.000	-.1207031 .1207031
LogTotalrent	-1.93e-09	.052874	-0.00	1.000	-.1044112 .1044112
_cons	1.74e-08	.4752575	0.00	1.000	-.9384985 .9384986

Appendix 1.4

Test of Normal distribution of the error

Table 1.4 The test result for normal distribution of residual- BJ test

```

. sktest myResiduals

Skewness/Kurtosis tests for Normality

Variable |          Obs  Pr(Skewness)  Pr(Kurtosis)  adj chi2(2)  Prob>chi2
-----|-----
myResiduals |          172      0.0715      0.1086      5.69      0.0581
    
```

Appendix 1.5

Regression result Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.702	.493	.465	.34766	.493	17.508	9	162	.000	1.851

a. Predictors: (Constant), Log total rent, Availability of toilet, Location, Floor Level, Distance from LRT station, Building Type, Number of room, Area, Availability of Water

b. Dependent Variable: Log Rent Per meter square

ANOVA –significance of the model using SPSS

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	19.045	9	2.116	17.508	.000
	Residual	19.580	162	.121		
	Total	38.625	171			

a. Dependent Variable: Log Rent Per meter square

b. Predictors: (Constant), Log total rent, Availability of the toilet, Location, Floor Level, Distance from LRT station, Building Type, Number of room, Area, Availability of Water

Appendix 1.6

Coefficients with multi- Collinearity test result look VIF column for Multi- Collinearity

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	3.437	.475		7.232	.000	2.498	4.375		
Area	-.008	.001	-.666	-6.324	.000	-.011	-.006	.282	3.547
Distance from LRT station	.000	.000	-.047	-.777	.438	-.001	.000	.848	1.179
Building Type	-.166	.076	-.174	-2.191	.030	-.316	-.016	.497	2.011
Floor Level	-.075	.028	-.195	-2.715	.007	-.129	-.020	.606	1.650
Number of room	-.110	.053	-.201	-2.099	.037	-.214	-.007	.340	2.942
Availability of Water	.074	.139	.067	.530	.597	-.201	.349	.193	5.176
Availability of toilet	-.010	.138	-.009	-.073	.942	-.283	.263	.194	5.165
Location	-.061	.061	-.061	-.998	.320	-.182	.060	.849	1.178
Log total rent	.361	.053	.580	6.820	.000	.256	.465	.432	2.315

a. Dependent Variable: Log Rent Per meter square

Appendix II, Questionnaire and interview questions

Questionnaire for tenants

Dear respondents, you are kindly requested to fill this Questionnaire which is used for the fulfillment of MA degree in urban land and property valuation in EIABC Addis Ababa University. The title of the study is “the impact of Light rail transit on commercial property value in case of Addis Ababa Thank you in Advance for your cooperation.

Questionnaire For tenant

I. General characteristics of respondents

1. Sex
A. Male B. female
2. Age
A. Below 25 B 25-30 C. 31-35 D. 36-40 E. above 40.
3. Level of education
A Elementary B. grade 9-12 C. College diploma D. first degree E. Above
specify_____
4. Monthly Income level(optional)
A. Below 5000 B. 5000-10,000 C. 10,000-15, 000 D. 15000-20000 E.
Above 20,000

II. The main idea of a questionnaire

5. Rent amount of your commercial space_____
6. When you rent this space
A. Before the commencement of LRT B. After commencement of LRT
7. The current function of your house
A. Shop B. café and restaurant C. store D specify if other_____
8. If you want to rent a commercial property, do you want to prefer to rent near to LRT station? A Yes B. No
9. If your answer is yes or No, Why? _____
10. If you have the choice to get rented commercial property with the same desirability and the same rent price, which is Your preferred area?
A. CMC Michael to civil service university B. Hayahulet Hulet to Hayahulet 1
11. Location of your business is found from LRT station
A. between 0 meters and 75 meter
B. between 76 meters and 150 meter
C. between 151meter to the mid-distance between two stations
12. If you want to rent other commercial space, where do you prefer from LRT station?
A. between 0 meters and 75 meter

j. Near to main road line		
k. Near to good business activity		
l. Multistory building		
m. Detached houses		
n. Safety and Security		
o. Activeness of the location		
p. Near to banks		
q. Area of space		

If any Other, Specify, _____

19. Based on question 18, would you please rank your choice in descending order? Write only Letter.

20. Do you observe the following problems around LRT station

Possible problem	Yes	No
Noise		
Robbery		
Congestion		
Social disintegration		
Pollution from car		
Waste		

Specify if any other problem

21. How the following problem affects your business?

Possible problem	Status of impact		
	Positively	Negatively	No effect
noise			
The absence of pedestrian cross			
Robbery			
Congestion			
Social disintegration			
Pollution from cars			
Waste			

22. What is the negative impact that your business is near to LRT station?

23. What is the positive impact positive impact on your business?

24. Which one is greater (negative or positive)

25. Is there rental price change on your rent house due to LRT system?

- A. Increased B. Decreased C. No change
26. It there is rent increment, do you afford it?
- A. Yes B. No

Questionnaires for Property owners/managers

Dear respondents, you are kindly requested to fill this Questionnaire which is used for the fulfillment of MA degree in urban land and property valuation in EIABC Addis Ababa University. The title of the study is “the impact of Light rail transit on commercial property value in Addis Ababa. Thank you in Advance for your cooperation.

Questionnaires for Property owners/managers

III. General characteristics of respondents

1. Sex
 - B. Male B. female
27. Age
 - B. Below 25 B 25-30 C. 31-35 D. 36-40 E. above 40.
2. Level of education

A Elementary B. grade 9-12 C. College diploma D. first degree E. Above

specify_____

The main idea of a questionnaire

3. Building level: G+_____
4. Location of your building
 - A. Hayahulet B. CMC
5. When your building is constructed?
 - A. Before the introduction of LRT system
 - B. After the introduction of LRT system
6. Where do you guess Location of your building from LRT station
 - A. Between 0 meter and 75 meter
 - B. Between 76 meter and 150 meter
 - C. Between 151meter and the mid-distance between two stations
7. If you want to build your building as new, which location do you prefer with respect to LRT station?
 - A. between 0 meters and 75 meter
 - B. between 76 meters and 150 meter
 - C. between 151 meters and mid-distance between two stations
8. Do you prefer your commercial building is very close to LRT station
 - A. Yes B. No
9. What is the advantage that your building is very close to LRT station?
10. Is there tenant displacement from your building?

- A. Yes B. No
11. If your answer to question 10 is yes what is the reason for displacement?
 - A. Unaffordable rental price increment
 - B. Unsuitability location for their business due to absence of pedestrian cross
 - C. If any other, specify_____
 12. Do you believe that commercial property near LRT station is important for business activity.
 - A. Strongly Agree B. Agree C. Dis Agree D. I have no idea
 13. How do you recognize the relationships between distance from LRT station and business?
 - A. Direct relationships B. inverse relationships C. no relationships D. I do not recognize
 14. How do you evaluate rental price change on your building house due to LRT system and LRT station?
 - A. Increased B. Decreased C. No change
 15. When you determine rent price, do you consider the location of your property with respect to LRT station?
 - A. Yes B. No
 16. What kind of use is suitable near to LRT station?
 - A. Office B. shops c. store D. restaurant and café F. hotel, G. if any other, Specify_____
 17. Do you believe that fenced LRT line has a negative impact on your property value such as /rent and occupancy?
 - A. Strongly agree B. agree C disagree D. I have no idea
 18. Do you think that LRT station distance from your building has a positive or negative impact on your building occupancy level
 - B. Only positive
 - C. Only negative
 - D. Both positive and negative
 - E. I do not know
 19. What is the negative impact that your property is near to LRT station?
 20. What is the positive impact positive impact on your Property?
 21. How do you evaluate the level of occupancy of your building due to fenced LRT
 - A. Increased B. decreased C. no change
 22. How do you evaluate the vacancy level of building close LRT station and far from LRT station
 - A. Vacancy near LRT station increase
 - B. Vacancy near LRT station decreases
 23. How do you evaluate the occupancy level of building close LRT station and far from LRT station

- A. occupancy near LRT station increase
 C. occupancy near LRT station decreases
24. To increase the occupancy level and reduce vacancy level, what will be your solution?
- A. Reduce rental price
 B. Sale the property
 C. Change function of building
 D. If _____ any _____ other, specify _____

25. When you want to build new commercial property, would you consider the following characteristics? Please put tick mark your consideration?

Characteristics	Yes	No
a. Near to bus station		
b. Near to Taxi station		
c. Near to corner of any road		
d. Near to LRT station		
e. Near to LRT line		
f. Near to main road line		
g. Near to good business activity		
h. Multistory building		
i. Safety and security		
j. Activeness of the location		
k. Near to banks		

If any Other, Specify, _____

26. Based on question 25, would you please rank your choice in descending order? Write only _____ Letter.

27. Do you observe the following problems around LRT station?

Possible problem	Yes	No
Notice		
Robbery		

Congestion		
Social disintegration		
Pollution		
Waste		

Specify if any other problem _____

28. If the following terms considered as problem of LRT station, how it affects your property value that is rent and occupancy?

Possible problem	Status of impact		
	Positively	Negatively	No effect
noise			
The absence of pedestrian cross			
Robbery			
Congestion			
Social disintegration			
Pollution from cars			
Waste			

Specify if any _____

29. Do you think that constructing a pedestrian cross between the consecutive station might resolve vacancy problem properties found in the mid of two stations?
A. Yes B. No
30. Do you believe that constructing a pedestrian cross makes active dead areas due to fenced LRT line?
A. yes B. no
31. Are you volunteered to participate in solution mechanisms?
A. Yes B. No
32. If you answer is yes do you participate in terms of money?
A. Yes B. No
33. If you are not willing to participate in terms of money, what will be your involvement?

34. What is your recommendation for all problems related to LRT system with respect to you property value (rent, sale, occupancy level) _____

Interview Question for Brokerages

1. How do you evaluate the difference in rent near to LRT station and far from LRT station?
2. Where is the suitable place for business activity or what location is preferred to tenants, Near to LRT station or not?
3. Do tenants prefer near to LRT station rather than far from it?

4. What kind of impact do you observe on a socio-economic and environmental impact of LRT system

Case study checklists for property manager/property owners

1. What is Occupancy condition of the building of after and before the introduction of LRT system?
2. Rental price increment after and before the introduction of the LRT system. Is there the change is it due to LRT?
3. Is any change of building use after the introduction of the LRT system
4. Is there any movement from near LRT station to others and vice versa
5. Impact on the income of commercial property owner. (if the property is found to be near or far from the LRT station)
6. If there is tenant turnover?
7. Why tenants displaced? Other place and why tenants migrated to LRT station if there is?
8. Where tenants move to and from where come to nearby LRT station property
9. What is the overall impact of LRT on the property rental price and occupancy condition on your building?
10. What is the reason for this impact?

For Academicians

Evaluate the Addis Ababa Fenced LRT system based on the following checklists and urban planner

1. What is the impact of LRT system on property value?
2. What is the impact of LRT station on property value and business movement
3. How do you evaluate the push and pull effect of Addis Ababa LRT station on tenants and building owners' perspective?
4. What is the social advantage of the LRT system for the city of Addis Ababa?
5. What is a social disadvantage of fenced Addis Ababa LRT system?
6. What is the economic advantage of Addis Ababa LRT system?
7. What is an economic disadvantage of Addis Ababa LRT system?
8. What is the positive and negative impact of Addis Ababa LRT system on the property value particularly commercial property?
9. What are the environmental impacts related to the LRT system and LRT station that affect property value? And how it affects?
10. What are the economic impacts related to the LRT system and LRT station that affect property value? And how it affects?
11. What are the social impacts related to the LRT system and LRT station that affect property value? And how it affects?
12. What is the overall impact of LRT system Addis Ababa?
13. What do you recommend to mitigate the existing practical problems?