

## Proximity to Rail Transit Station and Abutting Real Estate Prices: Their Relationship in the Light of Previous Studies

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### ABSTRACT

This article reviews recent and older studies on rail transit's effect on real estate prices. The effect of rail transit on real property values has been explored from numerous stand points, including analyses of diverse types of systems (e.g., commuter, heavy, light and rapid rail), of residential in opposition to commercial influences, as well as studies that have attempted to separate and isolate both positive along with negative impacts. The wide-ranging approaches make it easier said than done to compare the outcomes of one study to another. Some of the conflicting findings over the years have frequently been due to contradictory methods of data analysis, data quality, in addition to geographical differences. All the same, it is apparent that, in most occasions, proximity to rail transit station is cherished by landed property owners. There is little evidence for the suggestion that nearness to rail really diminishes or reduces real property values. A large quantity of the empirical studies has measured the effects on residential accommodation prices after the municipal transit facility is in use and implicitly assumed uniform capitalization across boundaries. Nevertheless, due to dissimilarities on local community goods provision and residents' uniqueness across jurisdictions, two alike housing units situated at the same distance to the closest metro station but in dissimilar local markets would not inevitably command the same level of capitalization. Twenty-eight out of the thirty-nine reviewed empirical studies considering heavy as well as light rail transit systems advocate a positive association between real property values and rail transit station proximity. Conversely, some of the reviewed

previous studies were indifferent of the impact. In other part of the world, twelve out of forty-three reviewed works, both heavy along with light rail transit station, advocate that there is no connection between real property values and rail transit station proximity. The general agreement amongst the past studies along with reports is that closeness to municipal transit does lead to higher housing values and rents in numerous cases. Further studies should essentially be undertaken following the opening and functioning of rail station in order to take into account the correct situation under those potential situation and therefore to be able to validate the general application of the obtainable results qualitatively as well as quantitatively.

**Key words:** Hedonic Price Model, Location Theory, Proximity Effect, Rail Transit Station and Real Estate Price.

### 1. INTRODUCTION

A good quality rail transit facility provides a high degree of access to workplace and other activities for family units in addition to customers as well as employees for businesses. The economic worth of this proximity will be reflected in the price of a house or a business, plus the value of additional features such as the explicit physical attributes of the building structure and neighbourhood characteristics (Brinckerhoff, 2001). In an attempt to lessen vehicle overcrowding and reduce travel times, several cities in the globe have been spending large amounts in community transport infrastructure. These transits spreading out generate an opportunity for

itinerant and mobile households who make use of public transport to travel to areas in the metropolis where right of entry has improved (Baum-Snow and Kahn (2000)). Consequently, and equally because accommodation supply near to public transit access is predetermined, the benefits of the municipal transport services should capitalize completely or in part on real property and residential accommodation prices (Henneberry, 1998; Oakland, 1987 and Rubinfeld, 1987 as cited by Agostini and Palmucci, 2010).

Urban transit infrastructures enhance and improvement mobility as well as access to and from commercial developments, and therefore represent a type of economic venture. As a matter of fact, they are regularly implemented as a scheme of addressing the important externalities of traffic along with urban sprawl. Simultaneously, transit facilities claim externalities of their own, causing noise, blight, and possibly either reducing or enhancing real property value (Zukerman, 2013). Beside these unswerving benefits, the supply of high overhaul quality of public transport facility such as rail transit infrastructure has in addition potentially shaped local land use as well as increased local real estate values (indirect benefits), predominantly those that are unswervingly perceived by the individual who is buying or renting a real property. The lingering question is how a rail transit facility could perhaps influences land use as well as property values (Dziauddin, Alvanidesb and Powe, 2013).

It is an established fact that there is diminutive doubt, theoretically or else practically, that the connection between transport and land use is important. The most general empirical approach employed to determine this association is to explore how landed property values differ with distance to a transport facility (Ryan, 1999). Bring in urban community transport systems into a region frequently create a noteworthy opportunity to speed up the course of action of development all the way through

affecting on the real estate prices. Improved and enhanced access, new mobility options, in addition to lower transport costs are significant factors that augment and raise the land and landed values of such areas, particularly in blighted, squalid, shattered, suburb, devastated and poor neighborhoods (Kheyroddin, Taghvaei and Forouhar, 2014). A transport facility can make an assortment of effects on adjoining areas. These impacts from time to time appear, more or less, around rail stations, now and then, around rail transit corridors and in a number of cases as a mishmash or combination of both. Metro rail facility is one of the most extensively used modes of municipal transport (Kheyroddin, et. al, 2014). The building of subways has an external or peripheral impact on the metropolitan environment. Notably among them, the most significant acceleration function lies in the real property values of residential accommodation close to subway stations as a matter of fact (Sun, Wang and Li, 2016).

Furthermore, the recent revival and reappearance of rail transit after its downfall in the in the beginning of the first half of the 20th century is among the most extraordinary turning point in transport history. It is an idea that emerges to have come, disappeared and resurface again. Even though there is a great deal of uncertainty around the second re-emergence of light rail facility, advocates and promoters of this idea wish it will gain modest ridership, slightly reduce overcrowding and air effluence, encourage higher effectiveness of land use, and give an alternative form to automobile with advanced capacity than buses alongside busy passageway. In the midst of the present and existing transportation oriented development and light rail/subway sudden increase, it is imperative to deeper recognize their dynamics (Zhuang, 2014).

Moreover, it is anticipated that the presence of a rail transit facility ought to be able to capitalize real property values in the outward appearance of real estate price

(residential along with commercial properties). Banister and Berechman (2000) claimed that the advancement in ease of access for those neighborhoods that have been provided by the rail transit infrastructures can considerably elicit numerous major optimistic location externalities, especially for landed properties situated within close propinquity to railway stations. They argued, moreover, that these positive accessibility externalities should be considered as extra benefits to the primary accessibility upgrading benefits (Dziauddin et al., 2013).

Albeit the authors investigating the rail transit effects have attained varying conclusions in their studies, the built-up environments they were studying shared convinced similarities. At the outset, these municipal settings in the past studies, more often than not, took place in the urbanized economies. Additionally, the North-American cities filled up the literature (Cambridge Systematics Inc., 1998): Toronto (Deweese, 1976; Bajic, 1983), Miami (Gatzlaff and Smith, 1993), Portland (Al-Mosaind et al., 1993; Chen et al., 1997), Washington D.C (Cervero, 1994), Atlanta (Bollinger and Ihlanfeldt, 1997; Cervero, 1994), San Francisco (Cervero and Landis, 1997; Knight and Trygg, 1977) and Los Angeles (Cervero and Duncan, 2002). Furthermore, Helsinki (Laakso, 1992), Manchester (Forrest et al., 1996), Hong Kong (So et al., 1997; Chau and Ng, 1998) and Sheffield (Henneberry, 1998) and are the additional cities with rail transit developments in urbanized and industrialized countries (Celik and Yankaya, 2006).

A good number of studies built on the theories propounded by Von Thunen (1863), who was a lead the way pioneer when explaining the connection between farmland values along with accessibility. He established that ease of access to the marketplace from farmlands informed the difference in land rent, on the assumption that the entire land is homogenous. Closer distance (easier right of entry) to the

marketplace indicated higher rents and longer distance or expanse to the marketplace revealed lower rents. Von Thunen's research outcomes were later enhanced and modified by Alonso (1964) along with Muth (1967) ensuing in a bid-rent model culminating to a rent-gradient that decreases and reduces with the distance to downtown or central business district (Pikosz and Tiberg, 2011). A substantial number of researches have been carried out on the wider arena of the economic insinuations of urban transit facilities, solving more apparent questions of real estate prices along with urban development. These associations have proven dynamic, impacting different environments in dissimilar ways, with anecdotal degrees of severity. This means that, these innumerable and countless effects have equally proven to be measurable (Mohammad, 2013). Even though easier said than done, they are not beyond the reach of urban, or more commonly, empirical economics (Zukerman, 2013).

The research philosophical foundation adopted by majority of the past empirical studies on the influence of rail transit station on real estate price revolved around objectivist epistemology. In summary, objectivist epistemology differentiates the way by which one can independently translate his discernment relating to the association between propinquity to rail station and adjoining real property values addicted to concepts that one can store up in his minds. Whereas one can "know" and discern that there are obtainable associations between proximity to rail transit station and landed property values by his view points, an individual can know what exists merely by whirling and turning precepts, laws and guiding principles into concepts, thoughts, ideas or notions. The social world in which an individual lived exists externally or superficially to the observer and the properties can be quantified directly all the way through observation.

The previous studies investigated the facts (sold prices of landed properties, structural characteristics of the real properties and genuine quantifiable distance to social amenities), but not with values or worth. The outcome of the research of previous works had presented as objective facts in addition to established truth. The past literature approached knowledge or facts by testing evidence with the purpose of validating or refuting formerly or previously held theories and facts in further case studies or else price-predicting models (Au, 2007). It is against this back-drop that this study attempts to review and analyze existing and current literature on the effect of proximity to rail transit station on adjoining housing prices with a view to identifying unfilled research gap worthy of investigation for future researchers.

## **2. REVIEW AND ANALYSIS OF RELATED EMPIRICAL LITERATURE**

This section highlights on related empirical and previous studies that explored the relationship and association between transportation infrastructure, railway station, subway lines, metro station, light and heavy rail station and abutting, surrounding as well as adjoining real estate prices. The extensive review will go a long way in identifying the major contribution of the previous studies on the subject matter. This review would equally recommend research gap worthy of investigation which was not explored by the past literature.

### **2.1 Theoretical Models on Proximity to Transport Infrastructure and Adjoining House Price**

In the word of Celik and Yankaya (2006), theoretical and hypothetical studies in urban land economics have, for quite some time, been explaining the connections and interactions between transport infrastructures and urban structure. Ground-breaking and earlier studies by Alonso (1964), Muth (1969) as well as Mills (1972) have modeled and hypothesized a mono-centric city. They tacitly assumed that entire the employment happened at the city center,

downtown and central business district. In this pattern, the difference in commuting time would be the main indicator of the urban rent curve, *ceteris paribus*. The rent is anticipated to be uppermost at the inner-city, indicating the saving in travelling time, and the smallest or lowest at the city periphery where the fee and price of commuting is taken away from the rent, with the same household's position uniformly in-between depending on their usefulness functions. Conversely, simple, these models assisted one in establishing his fundamental perception that land rent relates to the opportunity cost of transport. In addition, any enhancement and modification in transport facility that could lead to a reduction or decrease in commuting cost which would be integrated and capitalized into land and landed property values, all things being equal. Apparently, the term "holding everything else invariably constant" indicates a short-term partial or fractional equilibrium as a matter of fact (Celik and Yankaya, 2006).

Alternatively, a long-term equilibrium, where the whole thing is considered changeable, is more unclear, hard to model, and extremely contextual (Henderson, 1988 and Fujita, 1989). Whereas if the city periphery is allowed to transform, an improvement in transportation facilities will lead to a decrease in the land curve and in the overall equilibrium, given that the enhanced transport will lead to a metropolis expansion connected with a boost in land supply. While short-term consequences can without difficulty be determined and quantified by monitoring the variations in the land rent curve, the long-term impacts of transport facilities portray themselves in other determinants, including land-use, compactness, inhabitants, employment, earnings and developmental transformations in addition to the changes in the rent curve. Moreover, the revelations in all these determinants may be very unique in different urban location, culminating to a potential discrepancy in the notable urban economic theory (Celik and



Yankaya, 2006).

Nevertheless, one can observe the efforts to examine the long-term impacts of rail transit improvements from diverse perspectives in metropolises even if they are somehow more confined than the efforts of assessing the short-term effects. Cervero and Landis (1997), for instance, examined the long-term consequences of San Francisco's Bay Area Rapid Transit (BART). The other empirical studies: Bollinger and Ihlanfeldt (1997) concerning Atlanta's MARTA (Metropolitan Atlanta Rapid Transit Authority); and Cervero (1994) in relation to the Washington DC Rail System along with MARTA are merely a few examples of the empirical studies exploring the long-term effects of rail transit facilities. These previous studies attempted to observe the variations by investigating also the land use, populace, employment levels, developmental changes close to stations and transit corridors, and none of the past works was self-assuredly able to uncover the long-term preservative impacts of the rail transit facilities. It was concluded that, despite the fact that there were convinced developments adjacent and along the rail infrastructure, these improvements were imperceptibly attributed to the rail facilities (Celik and Yankaya, 2006).

The short-term impact past studies employing hedonic price model, by and large, studied the land rent change owing to the transit facility. The dependent variable is considered to be the price of the real property (either asking or else transaction price). Three vectors of variables: structural characteristics; neighbourhood facilities or characteristics; and accessibility or location attributes are included as the independent variable set in the equations. Accessibility variables are specified in three broad forms: the physical distance to rail transit stop or rail transit line (Al-Mosaind et al., 1993; Gatzlaff and Smith, 1993; Chen et al., 1997 and Henneberry, 1998; ), a dummy variable indicating that the subject property is situated within a specified distance (Laakso, 1992; Al-Mosaind et al., 1993; Forrest et al.,

1996; Chau and Ng, 1998; So et al., 1997; Cervero and Duncan, 2002) or the overall travel time to rail transit stop or a preferred destination (Deweese, 1976; Bajic, 1983). Theoretical perception for the physical distance along with travel time variables might be negatively correlated. Therefore, the distance dummy positively and certainly correlated with the real property value. While a dummy variable unconnectedly estimates the impact of rail transit development, the physical distance or else commuting time variables permit the decision-makers to incorporate predictable parametric elasticities in their daily decisions and to use them in satisfaction derivation of the value of travel time (Bajic, 1983 as cited by Celik and Yankaya, 2006).

Therefore, the experimental testing of the hypothesis is usually done by means of significance statistics of the projected parameters. It is promising to say that the existing fact or theory was not validated homogeneously in all the past studies. Whereas some empirical studies unveiled a significant positive effect on real property values (Deweese, 1976; Bajic, 1983; Laakso, 1992; Al-Mosaind et al., 1993; Chen et al., 1997; So et al., 1997 and Chau and Ng, 1998), a few others were unable to establish any significant positive impacts (Gatzlaff and Smith, 1993; Henneberry, 1998 and Forrest et al., 1996). Furthermore, the selected functional forms in the entire studies largely incorporated linear and log-linear, even though in a few cases a Box-Cox (Chau and Ng, 1998) specification is also employed. Goodness of fit,  $R^2$  for the models differed between 0.52 (So et al., 1997) along with 0.94 (Laakso, 1992), but were usually around 0.70 (Celik and Yankaya, 2006).

As a broad-spectrum assessment, it is not doable or feasible to make a valuable elasticity and parameter judgment across studies given that the monetary or economic units, time durations, specifications in some distance variables, in addition to serviceable forms are dissimilar in each and every of the past studies. These wide-ranging points

equally show that, not merely do the short-term impacts of rail transit improvements display uniformity, but rather they could in addition be extremely contextual. Additionally, it should also be noted that municipalities from industrialized countries, particularly the North American conurbations, have certain resemblances, and are considerably dissimilar from cities in third world. Cities in urbanized countries are, more often than not, geographically more spread out in general, and need longer and wider rail-tracts; land-uses are more dissimilar and uniform owing to an ample land supply and rigorously enforced land use zoning regulations. Therefore, land-use concentrations in residential neighborhoods are lower compare to cities in the third world countries. All these variations make the theory or preposition worth testing in a dissimilar urban setting for its short-term effects (Celik and Yankaya, 2006).

## **2.2 Railway Sound Emissions**

Sound or noise can be portrayed and expressed in numerous ways, but the connotation most generally used by the broad-spectrum public is that noise is unwanted and/or extremely loud capable of being heard sounds affecting a person's ears. For example, deafening music piercing from a house may be absolutely satisfactory to one neighbor who takes pleasure in listening to the similar type of music. On the other hand, a different neighbor may think about the music to be blare, such as, annoying sound emissions. Consequently, noise or sound is subjective in nature, with the essential criteria changing from individual to another. Additionally, the side effects of noise vary from a trivial inconvenience; to the disturbance of and obstruction with activities within and around the house; to physiological injury, such as increased yearning and agitation and nervousness, slumber deprivation, tiredness or fatigue, and higher blood pressure (Saremi et al., 2008; Ising et al., 1999 and Babisch, 2000). Apart from the direct impacts on individuals, noise has equally been revealed to affect real estate values

(Bellinger, 2006 and Cushing-Daniels and Murray, 2005). Up till today, accurate and quantifiable physiological noise effects remain easier said than done to measure, but the subjective and real-world confirmation is obvious. Noise has indisputable tangible consequences on individuals' lives as well as health (Anderson, 2009).

Railways are disreputable for noise-producing activities, a lot of which have, pleased, delighted, mesmerized and fascinated children and train fans and enthusiasts for virtually two hundred years. Nevertheless, alike sounds have, as well, been considered disappointing, annoying, displeasing, disturbing, upsetting, and entirely infuriating to people who were reluctantly subjected to the noise emissions. Each individual's view point of railway noise emissions, by and large, depends on the individual's interest in rail trains as a leisure pursuit and relaxation as well as the proximity or nearness of the individual's residence to an operative and functional railway, particularly pathway on which a) train activities take place 24-hours a day; b) horn use is rampant; and 3) locomotive or steam engine idling is likely. The problem of train sound is unfavorably upsetting people, particularly those in residential or housing neighborhoods. It has turn out to be a most important starting place of controversy and argument in the parish (city) of Teaneck, New Jersey, for the period of the past ten years since many of its inhabitants have suffered from a number of levels of all three forms of train-sound impacts (Anderson, 2009).

Away from the specific noise-related troubles connected with pass by trains and idling steam engines, further noises are formed by substances on or contained by the train cars linked to the idling steam engine. Other noise sources comprise refrigeration units affixed to cargo truck trailers as well as shipping crates being loaded on the train cars; a tiny, incessantly running generator steam engine at the rear of the preceding train car, possibly providing electrical power in the direction of a red caution light;

and the stuffing of the train cars, that is to say automobiles, some of whom have alarms and have been equally reported to continually sound for more than 24 hours contained by a visibly audible range of houses. Additionally, the knocking of rail train cars, as in the porch of the associations between the cars, produces a noisy shockwave of echo that spreads from the frontage to the backside of the rail trains when they leave after idling. A lot of inhabitants uttered further worries connected to the protection of populace crossing the rail tracks all the way through an idling train, repeatedly ignorant of the likelihood of pass by trains. Plentiful problems and concerns connected with railway activities have been brought to light by Teaneck residents (Anderson, 2009).

Noise emissions from railway activities have been explored and researched in various places all over the world, together with Europe (Pronello, 2003 and Talotte et al., 2003) and the Middle East (Ali, 2005). On the other hand, the enormous majority of railway activity studies were focused on the effect of passenger trains in built-up environments (Anderson, 2009).

### **2.3 Different Types of Rail Transit Station Effects**

According to Brinckerhoff (2001), indication for rail's effects on residential property value has been established more evidently than for commercial developments (Nelson 1998). Nevertheless, this owes more to data along with analysis complicatedness than to a lack of impact. Landis et al. (1995) stated three reasons for the difficulty: (1) a lack of all-inclusive as well as dependable data; (2) a lesser zone of effect that restricts the amount of observations; and, (3) whilst residential property values are estimated in the marketplace, the values of just individual commercial property transactions may symbolize merely the worth of one pair of buyers along with sellers. More current studies have critically attempted to correct previous analysis troubles (Weinberger 2001 and 2000, FTA 2000). They have

discovered statistically significant as well as positive impacts of light rail station (Weinberger) along with rapid rail transit (FTA) on commercial developments. It is possible, as observed by Brinckerhoff 1999 that the extent and degree of the effect on commercial development will differ according to:

- How much proximity or nearness is enhanced,
- The virtual attractiveness of the neighborhoods close to the rail station area, and
- The real property market in the county.

It has been hypothetically theorized that nearness to a rail transit station would have a pessimistic impact on residential accommodation prices, owing to nuisance effects such as noise in addition to vibration. The nuisance consequence has not been convincingly supported (Brinckerhoff, 2001). Two disconnected studies, one that dwelled on closeness to Portland, Oregon's light rail station (Chen et al. 1998), and one that examined nearness to BART lines (Landis et al. 1995) did not discover statistically significant nuisance impacts. Nonetheless, Landis et al. did unearth a sign of a nuisance consequence for homes adjoining to the Cal Train traveler line in San Mateo region. The authors guessed that the disamenity effect for Cal Train was most likely an upshot of sound levels that are to a large extent higher compare to BART's". Additionally, they propose that because the Cal Train track bed is austere separated from adjoining uses, and knowing well that the Cal Train cars are not specially designed for silent operation, this is not an astonishing discovery (Brinckerhoff, 2001).

Hence, the predicament of nuisance sound effects is an issue that can be reduced or annulled in the course of high-quality system design. There is confirmation that rapid as well as commuter rail transit-oriented systems have a larger impact on real estate prices than do light rail transit (LRT) oriented systems (Cervero 1984), owing to rapid in addition to commuter

rail's high speeds along with greater regional access. The boosts in service uniqueness offers rapid as well as commuter rail a larger sphere of impact while for light rail transit station; smaller quantity of land parcels can twist gains in proximity into high land values. On the other hand, Landis et al. (1995) uncovered likewise strong effects on home values for BART (a quite rapid rail system) and for the San Diego Trolley (a light rail locomotive system) owing to the high quality of service these two rail systems provide (Brinckerhoff, 2001). Consequently, capitalization benefits rely on consistent, regular and fast or speedy service to a big market area.

In one of the small number of analyses that examined commuter rail in particular, Armstrong (1994) explored on the effect of Boston's Fitchburg rail line on residential accommodation prices, together in terms of amenity as well as nuisance values. Armstrong established that houses situated within census tracts that contain rail stations have a 6.7 percent premium for house sale prices. When he examined the influence of closeness to the rail line station itself (estimated as a house being located within 400 feet of the rail line), Armstrong came to realize an approximate 20 percent decline in value (Brinckerhoff, 2001). He warns that solid conclusions and inference cannot be drawn from this result owing to the verity that the traveler rail station line shares right-of-way amid a freight system alongside the rail line. The truth that both freight rail line service and commuter rail line service function and work upon the Fitchburg line makes it easier said than done if not impracticable to correctly distinguish between the two separate sources of closeness impacts.

For that reason, the research outcomes relating to the effects of commuter rail line station created proximity impacts, autonomous of freight rail generated nearness influences, are open to doubt and full of loopholes (Brinckerhoff, 2001). As highlighted previous in this article, real estate prices impacts have a

propensity to be extremely localized abutting rail stations (chiefly for commercial developments), which indicates that immense consideration ought to be given to the location of rail stations as well as the course of action, strategies, procedures and guiding principles that steer development within them.

## **2.4 Metro Station and Real Estate Prices**

As a matter of fact, there have been plentiful studies, the purpose of which was to discover the relations or connection between the two systems in spatial degree or extent as well as in terms of the magnitude of impact. A significant amount of them have centered on how transport facilities' break though can have an effect on real property value. For instance, in the USA numerous studies which have investigated the impact of newly established rail transit station on real estate prices have, by and large, uncovered positive effects, buttressing significant statistical substantiation of landed property value price highly increases (attaining or exceeding the 25% in most cases), which have been connected with newly developed rail transit improvements, albeit with various mixed result outcomes (Cervero and Landis, 1993; Landis et al., 1995; Bowes and Ihlanfeldt, 2001; Riley, 2001; Cervero and Duncan, 2002; Hess and Almeida, 2007). Other authors and scholars studied the impact of trams as well as light rail stations on residential accommodation prices, office rents along with retailing, in 15 metropolises in Canada, France, Germany and UK encompassing developments ever since the late 1970s (Roukouni, Basbas and Kokkalis, 2012).

In spite of this prediction the previous empirical studies on the influence of nearness to community transport accessibility on real estate prices is varied, diverse and assorted in its results. The confirmation presented by Dewees (1976), Damm et al. (1980), Bajic (1983), Grass (1992), Al-Mosaind et al. (1993), Voith (1991, 1993), Cervero (1994) and Debrezion, Pels and Rietveld (2003) indicates positive impacts in the case of rail



trains as well as subways in dissimilar cities of the USA as well as Canada; whereas the findings of Dornbusch (1975), Armstrong (1994), Bowes and Ihlanfeldt (2001), and Landis et al. (1995) revealed a negative impacts for rail trains. A number of other past studies have discovered no effect by any means. For instance, Gatzlaff and Smith (1993) discovered no impacts of having publicized and broadcasted the new rail train system in Miami; Redfearn (2009) discovered no capitalization of proximity to light rail in Los Angeles; and Debrezion et al. (2007) found no reliable relationship involving proximity to railway stations and real estate values in a critical review and analysis of past empirical literature (Agostini and Palmucci, 2010).

A large amount of the past empirical studies measures the effects on residential accommodation prices following the municipal transit facility is functioning and absolutely assumes uniform capitalization transversely across jurisdictions. There are some substantiation of capitalization taking place before a newly established transit infrastructure operating (Damm et al. 1980; McDonald and Osuji 1995; McMillen and McDonald (2004); Agostini and Palmucci (2008) add up to that literature estimating the predictable effect of the pronouncement of a newly developed metro line station in the municipality of Santiago in Chile.

There is, furthermore, some proof of momentous disparity in property tax capitalization across cities, indicating that residential accommodation prices vary methodically with jurisdictions tax levy rates along with tax bases (Goodman, 1983), which indicates that the capitalization of improved transit proximity might equally vary by jurisdiction. Indeed, the effect of rail transit station proximity on landed property values varies accordingly with distance from the rail station, distance to central business district, and equally with the middle income of the environs (Bowes and Ihlanfeldt 2001 as cited by Agostini and Palmucci, 2010).

Roukouni, et al.'s (2012) study revealed that nearness to rail facility has a positive impact on land and landed property value in the gigantic majority of case studies. Furthermore, Gibbons and Machin, (2011) recognized substantial increase in home prices following Jubilee's rail line extension in London in neighborhoods that are situated within the rail line's impact zone. The same results were discovered by other previous empirical studies that have been carried out with case studies municipalities situated in northern Europe (Du and Malley, 2007; Ghebreegsiabiher et al., 2007; Ahlfeldt and Feddersen, 2010 and Smith et al., 2010).

A pertinent research in Greece, considered as a case study Athens, has been conducted in 2007. It dwelled on the effect of 7 Athens metro rail stations contained by a buffer zone of 250m with the sole aim of identifying the connection involving commercial land development and rail transit improvements. It was observed that there is an increase in commercial activity in the non-domestic properties situated around 100m of the rail stations, whilst other positive results entail an increase of the pedestrians flow along with the improvement on the part of employees' mobility, as well as an overall upgrade of the area's urban surroundings (Tzouvadakis et al., 2007 as cited by Roukouni, Basbas and Kokkalis, 2012).

## **2.5 Heavy and Light Rail Transit Systems Effects**

A number of previous empirical studies have attempted to measure the impact of heavy as well as light rail transit facilities, chiefly in terms of location externalities that are created by the rail transit improvements upon real estate values. The confirmation from empirical studies both in the UK as well as North America indicate incoherent results and anecdotal extent, degree, level and enormity on the impacts of heavy along with light rail transit infrastructures on housing values. This is as a result of the distinctive research methods, unique local transport facilities as

well as land use settings (Hess and Almeida, 2007 as cited by Dziauddin, Alvanidesb and Powe, 2013).

It is worthy to note that twenty-eight of the thirty-nine past empirical studies considering heavy along with light rail transit improvements advocate a positive association between real property values and rail transit facilities proximity. Early empirical studies have brought to light this connection (for example Boyce et al., 1972; Lerman et al., 1978; Dvett et al., 1979; Damm et al., 1980; Bajic, 1983; Voith, 1991; Nelson, 1992; Al-Mosaind et al., 1993; Gatzlaff and Smith, 1993; Benjamin and Sirmans, 1994). This relationship could equally be noticeable in more recent empirical studies by Chen et al. (1997), Workman and Broad (1997), Dueker and Bianco (1999) and Knapp et al. (1999). Other recent literature include: Chesterton (2000), FTA (2000), Weinberger (2000), Cervero (2002), Cervero and Duncan (2001, 2002), Garrett and Castelazo (2004), Du and Mulley (2006) and Hess and Almeida (2007) as quoted by Dziauddin et al. (2013).

On the other hand, several studies were indifferent on the effect. Eleven of the thirty-nine both heavy as well as light rail transit facilities studies revealed that there is no association between home prices and rail transit improvements proximity (see for example, Dewess, 1976; Nelson and McClesky, 1990; VNI Rainbow Appraisal Service, Inc., 1992; Cervero and Landis, 1993; Armstrong, 1994; Landis et al., 1995; Landis and Loutzenheiser, 1995; Forrest et al., 1996; Ryan, 1997 and Henneberry, 1998). For example, in Atlanta, previous empirical studies unearthed that rail transit developments had almost no effect on real estate values. Another study by Gatzlaff and Smith (1993) in Miami's Metrorail station came to a similar conclusion. Almost more than a decade, Portland's Metropolitan Area Express (MAX) rail transit facility has also received consideration (Dziauddin, et al., 2013). In another two studies that were carried, it was found that only very diffident

and limited to a small area effects on landed property values were noticed (Al-Mosaind et al., 1993). Preliminary findings of a study on Toronto rail transit facility which was conducted by Dewess (1976) have revealed nearly no effect on housing values. Conversely, a study on the same rail transit facility which was conducted by Bajic (1984) disclosed that the city's rail station corridors have experienced concentrated development and that residential accommodation prices are considerably higher close to a rail line facility than somewhere else.

Furthermore, in a study of Pennsylvania's rail user facility, Voith (1991) came to a conclusion that homes or apartments provided by a commuter rail facility had a 4 per cent to 10 per cent premium over and above those that were not provided by a commuter rail facility. However, he discovered that travel time to the downtown was important in determining property values. In the UK, for instance, measuring the impact of rail transit improvements on housing values started in the early 1990s. For instance, a research carried out by the Centre for Urban and Regional Development Studies (CURDS) (1990) on the influence of Tyne along with Wear Metro on home prices established that there was no noticeable effect (Dziauddin, et al., 2013).

Nevertheless, in another study carried out by Du and Mulley (2006) on a similar basis established that apartment units in a number of of the areas that are situated within close up proximity to rail transit stations increased considerably in value. A number of elucidations are accessible for these discrepancies and contradictions ensuing from the impacts of heavy along with light rail transit facilities on real estate values (see for example Knight and Trygg, 1977; Landis et al., 1995; Ryan, 1999 and Giuliano, 2004). As a matter of fact, an early clarification was buttressed by Knight and Trygg (1977). They came to a conclusion that the indicators of real property value in a

municipal area are connected to landed property value controls in addition to economic development relatively than transport investment. Ryan (1999), furthermore, observed that many had overwhelmingly supported the conclusions drawn by Knight and Trygg. Nevertheless, the incapability of other studies to duplicate and repeat the variables employed by Knight and Trygg eventually led to weak evidence in supporting prior and earlier ideas of Knight and Trygg. Instead of that, Landis et al. (1995) suggested entirely different point of view to support research inconsistencies, for example, new transport improvements that could have an effect on property values (Dziauddin, et al., 2013).

However, another justification as to why previous empirical evidence (chiefly from the 1980s as well as 1990s) varies from theoretical or hypothetical expectations was asserted by Ryan (1999). Ryan critically affirmed that past empirical confirmation is dissimilar compared to theoretical anticipations. She supported and promoted the fact that the distance of a real property to the transport improvement as a variable has confirmed and proved to be more correct compared to other identified variables. The value or worth of the real estate where it is situated will be tendered up if there is evident time saving.

A connection between locations and real property values is to be anticipated when the estimate of access captures the spirit of travel time saving. Imprecision in estimating variations in the travel time eventually leads to erroneous changes in the real property value. Consequently, studies should focus on examining whether transport facility actually improves the commuter travel time for a particular section of travelers. Ryan stated that all of the advantages are internalized in the course of the transport time measurement and that there is no justification to research further into the impact on the real estate value (Dziauddin, et al., 2013).

The clarification given by Ryan appears to be reasonable because as has

been earlier noted, the most important objective of establishing rail transit facilities was basically to improve ease of access to the downtown or central business district. For this reason, for a lot of households, the lone way to enhance ease of access to the city center is by being situated nearer to the rail transit facility; households want to pay for a home in the connected area if they desire to take pleasure in the benefit of the rail transit facility. Therefore, capitalizing the price of homes could be anticipated if the rail transit facility has actually enhanced ease of accessibility to the downtown (Dziauddin, et al., 2013). As one would forecast, due to the controversy that for those family units who actually welcome and value the improvement of ease of access to the business district, they will bargain for such service.

Giuliano (2004) proposes an elucidation for the contradiction and unreliable evidence of the impacts of rail transit developments on real estate values. She is certain that the first few empirical studies of the influence of heavy rail transit improvements on housing values were excessively premature given that it might take decades of course before the landed property market could react to the accessibility of rail transit facilities in the area. Nevertheless, it is essential to put it at the back of the mind that if the techniques that have been incorporated to measure the effects are the most suitable and befitting methods, collectively with the excellence or quality of data, the positive association between rail transit infrastructures and real estate values can be established (Dziauddin, et al., 2013).

## **2.6 Merit and Sin of Rail Transit System**

The broad-spectrum approach in the midst of today's scholars is to classify the attributes or determinants of land and landed property values as environmental or neighborhood, physical or structural and accessibility or location. Bowes and Ihlanfeldt (2001), when estimating the impact on real property values created by MARTA (Metropolitan Atlanta Rapid

Transit Authority) indicated two factors that are said to capture positive effect on home prices along with two negative ones. One of the convincing positive indicators is realized to be the access and convenience benefit provided by the rail transit station. If the rail transit facility provides a lesser amount of stressful way of traveling and decreases commuting time, commuters should be eager and keen to willingly pay more for housing apartments near to rail transit stations. The second positive indicator is that business establishments confirm strong propensity to be concerned to these areas (Pikosz and Tiberg, 2011).

Furthermore, two other negative indicators that are mentioned in some of the previous studies are the increase of crime activities, owing to easier entrance from outside the neighborhood and the hideousness of the rail transit facility. Other factors such as pollution as well as noise were equally highlighted in the past literature. Similar negative externalities were as well indicated by Diaz and Allen (1999). In a number of studies yet, no negative impact were discovered. Rail transit facilities' effect might in addition be of demographic character. Incomes as well as social divisions are general.

A few reports give emphasis that ease of access of public transportation is of higher value to low-income family units compare to higher income households. The justification for this is asserted to be that most low-income households depend on community transport to a larger extent. Nevertheless, this assertion is challenged by Bowes and Ihlanfeldt (2001) whose research findings revealed that high-income areas are more probably to benefit from rail transit access in the enormous majority of cases (Pikosz and Tiberg, 2011). The way of getting to the rail transit station more often than not consists of time-consuming modes (walking along with cycling). A general consensus is that distance or expanse further away from the rail transit station experience a smaller amount of economical as well as accessibility impacts.

In a vast majority of studies, when estimating real property values, scholars mostly employed a hedonic price model. The hedonic price model, emanating from the real property value estimation methods by Rosen (1974) takes dissimilar property's attributes into account. The incorporation of such data might for instance include physical, ease of access and environmental attributes to elucidate property value difference. Apart from employing the hedonic price model, Bowes and Ihlanfeldt equally include neighborhoods crime in addition to retail service equations to estimate the indirect impacts that rail transit stations might have (Debrezion, Pels and Rietveld, 2007).

One of the earliest empirical studies conducted by Dewes (1976) revealed that residential accommodations contained by a distance of 1/3 mile of a metro rail station commanded higher rents; afterward, Grass (1992) discovered a direct association between real property values and ease of access to newly constructed rail transit stations. Previous empirical studies carried out concerning some of the US-metro rail systems revealed dissimilar values when measuring landed property values close to rail stations. On the other hand, there appears to be a broad-spectrum consensus in these past studies concerning the fact that nearer proximity to a rail station commands a larger impact on real property values. In the US alone, there are established cases signifying that commuter rail facilities have a bigger positive effect on real estate values on houses abutting rail station, than light rail or other types of heavy rail. No, or unimportant connection between rail transit accessibility and real property values are also revealed in few studies (Pikosz and Tiberg, 2011).

Furthermore, negative values produced by the closeness to rail transit stations are equally obtainable in a small amount of reports. Bowes and Ihlanfeldt established in their study that housing value impacts are negative within a relative distance of 1/4 mile to a rail transit station; on



the other hand, the homes within a 1 and 3 mile radius of the rail transit station produced a considerably higher value compare those farther away. Other indicators that come hooked on to play when determining the association between rail transit stations and housing values are: the ease of access to a parking lot, which has a positive effect on home values; and the complex configuration of the rail transit facility. In broad-spectrum, the surrounding area of hub-stations is highly attractive and indicates larger property value appreciation than rail transit stations standing alone (Pikosz and Tiberg, 2011).

It is worthy to note that the value effect of commercial developments in relation to rail transit stations has equally been investigated. The research outcomes differ to a greater extent in this context as well. Bollinger and Ihlanfeldt (1997) discovered no considerable value impacts when studying MARTA's impact on commercial developments. Previous empirical studies conducted by Dvett et al. (1979) and Cervero (2003) discovered minute positive impacts produced from San Francisco's community Bay Area Rapid Transit (BART). Another study conducted on Washington's metro rail facility by Damm et. al. (1980), as well as that of the Dallas Area Rapid Transit (DART) metro rail facility by Weinstein and Clower (1999) on the other hand indicates large impacts on commercial property prices. This could be in line with the wide-ranging view and the perception that rail transit stations attract commercial undertakings, pulling people as well as businesses together, creating an increase of commercial property price (Pikosz and Tiberg, 2011).

Negligible value impacts can probably be explicated with a citation from Knight and Trygg (1977), who studied the association between real property values and public transport system in the 70's. According to them modern urban transit-oriented systems seldom, if ever, generate a major effectual increase in ease of access, because the neighborhoods provided have a

propensity to be already more easy to get to by vehicle. Bollinger and Ihlanfeldt (2001) eventually came to a conclusion that this could be the scenario in their study, when investigating the detailed case of MARTA.

In Stockholm, on the other hand, motorization is not as prevalent as what has been witnessed in the US. Additionally, public transport facility is more or less not stigmatized in Sweden and not related with similar social aspects as the case might be in some parts of the US. Increased urban concentration over the previous years, particularly in Stockholm, requires an substitute to motorized commuting. For this reason, the impact on commercial developments is likely to be much more important than presented in a number of the North American empirical studies (Pikosz and Tiberg, 2011).

## **2.7 Impacts of Railway Stations on Surrounding Areas**

Even though transit-oriented facility is pertinent to all forms of public transport developments, but rail rapid transit services, yet (particularly metro networks) have more significance than other forms and bearing in mind their unique and exceptional advantages concerning: carrying capacity, safety, speed and pollution. Many studies have been carried out concerning the impacts of rail transit stations on abutting housing prices. The preponderance and great part of these past studies estimated and measured rail's effect on land and landed property values (particularly residential accommodation) as one of the mainly apparent consequences of urban transport developments (Diaz, 1999). These studies frequently found positive impacts. The general consensus in the midst of these studies as well as reports is that closeness or nearness to public transit-oriented development does create higher housing values and rents in numerous cases (Wardship, 2011).

In actual fact, these past studies validated that the prudent planning abutting the public transit rail stations is generally accompanied by increasing land values"

(Debrezion et al., 2007). For instance an evaluation of the Dallas Area Rapid Transit (DART) light rail transit facility on rateable property valuations (ERA, 2006), a study of Central London's Cross-rail station on the housing values (KFC, 2013), a study of the Epping Cross-worth rail line station of Sydney (Janet Ge et al., 2012) and moreover a new study of the Jakarta Metropolitan Area (Indonesia) (Syabri, 2011) indicated that residential accommodation situated within a walking distance (up to a half a mile in the vast majority of cases) of a rapid transit ease of access point were discovered to benefit higher rising property values over and above those further away from it as a matter of fact (Kheyroddin, Taghvaei and Forouhar, 2014).

Essentially, in such regions transit alternatives and transit ease of access play major role in residential accommodation prices. Cervero and Duncan (2001; 2002a) were of the opinion that increasing in landed property values following the construction of rail transit infrastructures is a direct end result of incessant demand which is eventually due to improvement on ease of access or spatial quality in these neighborhoods. Naturally, as location appears more attractive owing to convinced characteristics, demand boosts and consequently the bidding procedure pushes prices up in a spirited real property market (Debrezion et al., 2007). Such slowly changes in real estate values abutting rail transit stations can enhance the quality of adjoining neighborhoods by inspiring economic vivacity in such districts. As Cervero (2003) established in his far-reaching study, encouraging local policies as well as demographics, well structured rail stations, efficient as well as effective rail transit facilities, and a vibrant real estate market must function for rail transit to have an important effect on home value and development (ERA, 2006 as cited by Kheyroddin, et al., 2014).

This prototype was not generally felt, so that a number of studies such as an empirical study concerning Eastside MAX

light rail transit-oriented line in built-up Portland (Dueker et al. 1998) and a different study on the east rail line of MARTA in DeKalb County (Nelson, 1992) indicated that, opposing to the broad-spectrum hypothesis and postulation, a number of negative nuisance factors can equally reduce the latent home value impacts. This negative externality effect might be as a result of such factors as air, noise and visual pollution. Other factors include increased bus as well as vehicle traffic and increased discernments of crime (Diaz, 1999).

These ranges of incidents are completed by further studies which established that rail transit facilities made either no impact or very small effect on home values. For example an examination of single family house prices close to the Metro rail facility in Miami-Dade County revealed that the establishment of Metrorail either imperceptibly increased the housing values or approximately no relative advantages (Diaz, 1999). Furthermore, a different empirical research in Beijing (China) came to a conclusion that the effect of Batong rail line on residential accommodation prices (whether near to the rail transit stations or otherwise) is irrelevant and unimportant in the entire study area (Yizhen, 2005 as quoted by Kheyroddin, et al., 2014)

Moreover, there are small number of Swedish reports relating to the connection between real estate values and public transportation. Two reports, conversely, have been of major interest. One was made in Lunds Tekniska Hogskola in which the Jonsson (2007) carried out a study concerning housing values in connection to Vastkustbanan. The study was conducted using hedonic price models with regression models to create property values using diverse attributes. The estimation was conducted on the rail line constructed in 2000 extending between Landskrona and Helsingborg with reference to 8 rail transit stations. The major finding highlighted in the report indicates no sign of the rail transit facility effect on home values in any of the

rail stations with the exception of one which indicates tendencies of small increase of housing values within a radius of 2 km beginning from the rail station (Pikosz and Tiberg 2011).

The second or subsequent report "Vardering av stads kvaliteter" by Stahle (2011) was carried in Stockholm. Through employing regression by means of both urban construction analysis as well as statistical analysis, the report indicates how dissimilar attributes affect real estate values. It was established that proximity to urban activities, for example, cultural activities, restaurants and stores have a great positive impact on apartment buildings' prices. If proximity to urban activities upwardly increases by 100% the market worth or value per square meter in apartment houses increase by 1760kr. Proximity to urban activities solely rely on the concentration of homes, workplaces as well as the numeral of outward-facing way in from buildings. With reference to proximity to rail transit stations, the study reveals that residential accommodation farther than 500 meters away commencing from a rail transit facility indicates a value reduction and diminishing of 1370kr/sqm (Pikosz and Tiberg 2011).

## **2.8 Review and Analysis of International Empirical Studies**

In a more recent review by Sun, Wang and Li, (2016), they asserted that since the 1970s, a substantial amount of international and intercontinental research studies have provided close attention on the mutual impacts of track transit facility on housing values. Damm, Lerman, Lerner-Lam and Young (1980) furthermore investigated the pre-service influences of the Washington metro. Gatzlaf and Smith (1993), on the other hand, studied the association between transit-oriented development costs and accommodation expenses to indicate the transaction of municipal housing.

Additionally, Stegman (1969) in his earlier study came up with a computational model intended for residential property values along with locations and traffic or

travel costs. Ever since afterward, a huge amount of scholars, researchers and authors have conducted empirical and pragmatic research to confirm and validate that the establishment of rail transit developments considerably enhance and increase the added worth or value of real properties abutting subway rail lines. The study carried out by Dewees et al. (1976) arrived at the conclusion that the cost decrease, decline, diminution and lessening resulting from urban transport will culminate to upward increases in the prices and worth of residential developments (Allen, 1987; Dewees, 1976; Huang, 1996 and Dowall and Monkkonen, 2007 as cited by Sun, et al., 2016)

Furthermore, other past empirical studies revealed that the construction of urban rail transport facility might eventually result in a 1/3 value-added impact of the whole and entire investment of the roadway for close by real properties (Weinstein and Clower, 1999; Knaap, Ding and Hopkins, 2001; Pior and Shimizu, 2001 and Tang and Lo, 2008;). For instance, Weinstein and Clower (1999) carried out a research on the residential accommodation close to the Dallas Area Rapid Transit (DART) light rail transit (LRT) facility. They established that the prices of residential developments close to subway rail stations had indicated a 32.1% upward increase following the establishment of the light transit rail facility (So, Tse and Ganesan, 1996).

Indeed, in another previous empirical study on the values and worth of an assortment of residential developments, the value and price of adjoining condominiums upwardly increased by 46% and the price or value of single family accommodation upwardly increased as well but by 17% (Cervero, 1996). In the meantime, various scholars and researchers have conducted comparative empirical studies on the impacts on nearby housing apartments as a result of the construction of rail transport improvement, based on diverse time as well as space conditions (Smart, Miller and Taylor, 2009). Moreover, Bae,

Jun and Park (2003) reached a conclusion, following investigating Seoul's subway rail line 5 that, prior to the establishment of the rail transport lines in the area, the distance and expanse to rail transit facility had a considerable impact on housing prices; three years subsequent to the establishment, the decrease, lessening and reduction of the impact might have been almost complete (Sun et al., 2016).

Kim, Ulfarsson and Hennessy (2007) asserted that residential housing values close to urban rail transit facility decline and diminish with increasing and rising distances beginning from subway rail facilities. Cervero and Kang (2011), after researching Seoul's BRT facility, came to the conclusion that the BRT station plays a discernible role in the upward increase of the value or price of residential developments situated within 300 meters of it, and also a more reasonable role for housing accommodation further than 300 meters. Cervero (1994) was able to develop a research study which investigated housing apartments in a central business district and in a noncommercial or profitable centre. Land prices or values within a 400m radius of a rail transit station close to the business centre upwardly increased by 120%, and the close by other light rail transit stations that were near to the noncommercial or business centre increased by 23%.

Armstrong and Rodriguez (2006) measured local as well as regional ease of access advantages of commuter or traveler rail facilities in Massachusetts. They discovered that the impact of nearness or closeness to commuter and traveler rail right-of-way revealed a negative impact on home values. Bowes and Ihlanfeldt (2001) estimated its effect on Atlanta residential housing prices. They discovered that the rail transit stations may perhaps move up or increase the value of surrounding real properties. In another study of the Izmir region in Turkey, Celik and Yankaya (2006) argued that rail line in addition to transit investments will give extra and further

economic value further than or beyond direct ticket revenues (Sun et al., 2016).

Debrezion et al. (2011) employed a hedonic pricing model to determine the influence of the rail transit network on home prices in the country of Netherlands; they established that there is a association between the home price and the rail transit investment. Kahn (2007) examined the effect of 14 rail transit facilities constructed in the US; the study discovered that the radius of the house price-distance gradient upwardly increased due to the improved rail ease of access. Duncan (2011) in his study estimated the capitalization advantages of light rail transit in San Diego on housing accommodations. He disclosed that rail transit stations have to some extent positive effect on adjoining housing values. In the early and mid 1990s, public observed the affluence, opulence and wealth that was produced by the establishment of rail transit station in China (Sun et al., 2016).

A great deal of empirical studies on the way in which real estate values were reacted to transport investment came into sight. It was alleged and assumed that the expediency and ease of transportation has a positive impact on the upward increase of land and landed property prices (Cheng, Li and Wu, 2010; and Hailong and Fang, 2010). Accordingly, Glascock et al. (2011) estimated its effect on Hong Kong residential housing prices. They established that the prices of residential housing situated close to subways rail line, buses, as well as ferries were considerably influenced. Other renown empirical studies confirmed and validated the assertion that a subway line's degree of impact on the value and prices of close-by residential housing, prior to and following the establishment of subway rail lines, was inversely relative or proportional to its distance starting from the subway site (Yin and Tang, 2008 and Feng, Li and Zhao, 2011 as cited by Sun et al., 2016).

Subsequent to targeting Beijing rail line 1 as a theme of research, Zhang, Hui and Xuejun (2012) established that the impact of subway rail stations on residential



accommodation prices is the consequence, outcome and upshot of specific ease of access variables and the collective effects of other circumstances. Other notable empirical studies discovered that the pattern of spread of the values of housing accommodations alongside the rail lines will be changed, forming a slow and steady decrease in the spatial network of distribution of home prices alongside the two opposing sides of the roadway or trail (Wang, Daolin, and Mingming, 2004; Wang, 2008 and Wang, 2009). The effect of rail transit station on housing prices has a chronology or sequence. The time-based effect of rail transit facility on the adjoining housing accommodation is largely centered on the time from the pronouncement of establishment to the opening or functioning of the rail line, as well as prior to and subsequent to the beginning of construction (Liu and Guoqiao, 2007 as stated by Sun et al., 2016).

More so, a general review and analysis of the domestic as well as international or global empirical studies indicates that scholars and researchers have, first and foremost, been investigating the extent and level of impact on the increase of the value of abutting housing developments which has been generated by the establishment of rail transit facility in an assortment of conurbations from an empirical standpoint. They have affirmed that travel upgrading, perfection, upgrading, enhancement and development is an essential factor influencing land and landed property appreciation (Martinez and Araya, 2000; Briceno et al., 2008 and Bravo et al., 2010).

On the other hand, owing to varying degrees of development in cities' financial system, their town planning as well as their urban transportation greatly affects the degree to which the improvement of rail transport system has an influence on real estate appreciation. Match up to other major municipalities, the underpinning of subway line development in Tianjin, as observed by Sun et al. (2016), is pathetic, but it has

immense possibility for development. In quite recent years, the fast and quick spreading out of cities has fashioned a better urge for subway line construction. Joint with the explicit individuality of Tianjin as stated Sun et al., it is imperative to meticulously and systematically study the impact of subway line construction on the housing prices adjoining to the site with the intention of facilitating pertinent planning for the metropolis in the near future.

### **3. METHODOLOGY ADOPTED BY PREVIOUS STUDIES**

The majority of the preceding and earlier empirical studies employed hedonic property price model to estimate the association between rail transit station and values or worth of obtainable and current real estate prices. Etymologically, the word "hedonic" is derived or gotten from the Greek expression *hedonikos*, which basically means enjoyment, happiness and delight. In an economic perspective, it means the utility or else satisfaction individual derives in the course of the consumption of goods as well as services. A hedonic price model calculates and measures home price as a function of a set of location and property-specific characteristics.

Henneberry (1997) emphasizes that hedonic analysis is a deep-rooted technique employed to recognize the influence on price of lone or one factor in the midst of many. Therefore, property is conceptualized or hypothesized as a bunch, bundle or package of individual features or attributes and each one of which contributes or add to the overall employment of the dwelling house (Henneberry, 1997). Consequently, the price paid for a fastidious or particular real property is the sum or totality of the inherent or implied prices that the real property market ascribes to the different attributes enclosed in the bundle (Au, 2007).

As a matter of fact, with enough information on the market prices of housing properties and their different attributes, it is likely to derive all the way through analysis

the understood and inherent equilibrium property market price (the hedonic price) of each one attribute (Henneberry, 1997). An effectual and efficient application of the hedonic price model normally requires a great number of property transactions and their matching, equivalent and resultant housing accommodation attributes (Au, 2007). Bae, Jun and Park (2003) posed it that the hedonic real property price model has inherent non-negligible conceptual or theoretical problems owing to an insufficient specification of demand as well as supply functions. They additionally asserted that the hedonic property price model or approach has reached, achieved and accomplished a broad degree of acceptance and recognition as a serviceable, useful practicable and functional reduced-form model, in spite of its fundamentally theoretical shortcomings and weaknesses.

Moreover, the hypothetical and theoretical justification or rationalization for incorporating hedonic price approach has been given by Rosen (1974). Rosen put in plain words that the leading studies employed the hedonic real property price model to examine the effects of transport development on accommodation values. For instance, Bajic (1983) applied the hedonic real property price model to investigate the impacts of a newly constructed subway line on home prices in municipality of Toronto. Bae et al. (2003) examined the influence of Seoul's subway rail line 5 on residential accommodation prices for four years, consequent to the pronouncement of the subway line, a year for the period of construction, the completion time, and three years following its opening.

Strand and Vagnes (2001) incorporated dual or twofold methods (hedonic prices along with real estate brokers' appraisals) to measure and calculate the connection between real estate values and railroad nearness or closeness. Eventually, the hedonic price study as well as the real estate broker study revealed similar findings and results. When taking into account accommodation units

surrounded by a 100-meter range of the closest railroad line station, there was a significant as well as strong association between the housing accommodation value as well as railroad proximity. These aforementioned studies, furthermore, entails that when designing the overall research methods, the hedonic price study as well as real estate broker study will produce similar results (Au, 2007).

A quite number of previous empirical studies that estimate the effect of transport infrastructures on housing values employed several methods such as discrete choice models, experiment-control analysis, with-and-without comparisons, the regression model as well as test control technique. Ling and Hwang (2003) observed that nearly all impact empirical studies were carried out prior to transport facilities opening employing with-and-without comparison, such as Lee (1988), Feng and Yang (1989) along with Hsu (1989). Feng et al. (1991) conducted a before-and-after comparison by investigating the impact of project pronouncement and construction housing values, but yet the effect of system operation and functioning remains unstudied (Au, 2007).

Furthermore, experiment-control analysis is yet a different method for carrying out an impact study method (Ryan, 1999). This method estimates the statistical variations sandwiched between experimental samples above and beyond the subway line system along with control samples situated elsewhere. In the words of Lin and Hwang (2003), this technique should be applied simply when the samples are not easy to reach (Au, 2007). A distinct and discrete choice model is more or less an econometric model in which the actors or players are supposed to have prepared a choice from a discrete set. Lin and Hwang asserted that Feng and Yang in addition to Chen and Anas (1994) applied a discrete choice models in their analysis as the method is relatively appropriate for measuring with-and-without comparisons prior to facility opening (Au, 2007).

Furthermore, Ryan (1999) asserted that VNI Rainbow Appraisal Service used a test control technique to investigate the San Diego light rail facility on property values in 1992. Ryan classifies the impact studies into two generations which approximately correspond or match to the waves of rail line construction (heavy as well as light rail construction) in the United States. Ryan recapitulates that the first generation empirical rail studies analyzed and evaluated heavy rail transit facilities constructed in the 1960s and 1970s, while the second generation empirical studies investigated the more current and latest light rail transit facilities. Regression analysis was mainly employed in both generations of the rail empirical studies to consider and analyze the hedonic property price model (Au, 2007).

The majority of the previous empirical studies incorporated distinctive methodologies in both the data collection as well as analysis stages. For instance, the objective of Roukouni et al.'s (2012) investigation was to determine the predictable impact of the newly constructed metro line of Thessaloniki, and Papafi rail stations particularly on the land use of the region. This was accomplishing through logical and systematic recording of the land use system as well as through a stated preference survey. The collected data were eventually analyzed quantitatively using the technique of principal components analysis intended for categorical data which indicated interesting inter-relationships.

In another study by Dziauddin et al. (2013), the data were firstly classified into five categories: location attributes the selling price of individual homes along with their structural attributes, socio-economic attributes of the property market and transport access variables. House price market transactions for 2004 and 2005 were selected to be the required sample for their study. This symbolizes a period following numerous years of rail transit facilities operated in the Klang Valley. In totality, 2338 units of accommodations selling prices

were eventually collected. Conversely, after going through a number of steps to screen the sample dataset by getting rid of the unbefitting data and subsequently updating the unavailable and missing data, the Dziauddin et al.'s (2013) study was eventually left with 1,580 observations. This cross-sectional data set was named as the residential housing situated within just two kilometres (straight-line-distance) of light rail transit (LRT) improvements.

In order to calculate and estimate the distance to a light rail transit station along with other amenities from a particular house, the latest geographical information systems (GIS), and in particular, network analysis was used in Dziauddin et al.'s study. GIS was employed to systematize, sort out, arrange, classify, categorize and manage bulky spatial datasets (that is to say, units of houses) and certainly their structural as well as location attributes too. Most significantly, GIS was incorporated to position or station each observation along with location attribute correctly on a local map by means of employing the geographical coordinates.

Furthermore, the grouping between GIS as well as spatial analysis has been principally valuable in Dziauddin et al.'s study in which the correct distance and closeness were estimated perfectly by calculating the distance beginning from one point to another by means of network distance approach such as the distances starting from the observations to the adjacent station and other location attributes. In order to quantify and determine the location externalities produced by rail transit facilities upon residential housing values, Dziauddin et al. applied a standard hedonic pricing model where the home price is a function of location, neighborhood and structure, variables.

Au (2007) investigated the influence of the construction of SkyTrain Millennium Line in Burnaby's Lougheed Town Centre district on residential accommodation prices. These price effects are considered

for three years, equivalent to a year for the period of construction (2000), the finishing point date (2000) and three years following its opening (2005). A hedonic real property price model reveals that the distance starting from the SkyTrain rail station had a statistically significant negative effect on residential housing values only before the SkyTrain's opening. The model equally advocates that structural or physical variables, such as age of the building, floor space and heating are more powerful and significant than distance to SkyTrain in influencing the housing values.

#### **4. KEY FINDINGS FROM THE PAST LITERATURE**

Based on the extensive review and analysis of past literature, it could be deduced that several studies revealed dissimilar extent and level of capitalization in their findings. For instance, Agostini and Palmucci's (2010) results discovered that the extent and degree of capitalization relies not merely on the distance beginning from the dwelling apartment to the closest rail station but, moreover, on the combination of region distinctiveness and local community goods. More particularly, according to Agostini and Palmucci, two identical housing units situated at the same distance to the adjoining rail station but in dissimilar counties command different degrees and level of capitalization. As a general rule, the findings suggest considerable inter-jurisdictional variations in capitalization, ranging from as low as -15.3% to 37.8% after the construction of the newly established metro line was pronounced and between as low as -15% and 56% following the announcement of the rail stations location.

Agostini and Palmucci further asserted that if only just the accommodation units situated within a 1,000 meters array from the closest metro rail station are considered, the dissimilarities in capitalization transcending counties differ between 6% and 40.9% for the rail line construction announcement and sandwiched

between 6.9% and 50% for positioning and siting of the rail transit stations announcement. By means of parametric as well as non-parametric methods and market transaction data for Santiago, Chile, Agostini and Palmucci, furthermore, calculated and measured the predictable capitalization of newly constructed metro rail line transcending counties in the city. The research findings indicated considerable predictable impacts, sandwiched between 3.6% and 5.3%, and also huge inter-jurisdictional differences in capitalization levels and degrees and it ranges between -6% and 40%.

The calculation and measurement of the impacts of the light rail transit facility on home prices by means of hedonic house price models in Dziauddin et al's (2013) study shows a quite number of key findings. First of all, the hedonic property price models measured that dwellings situated within two kilometers of a light rail transit station in the Klang Valley reduce and decline in price as the distance from a light rail transit station increases for both straight-line-distance as well as network-distance models rationally and logically well with 78.2 per cent of adjusted and attuned R-square. In the words of Dziauddin et al., there is well established evidence to advocate and imply that a distance crumble association between home prices and the light rail transit facility strongly exists. Secondly, Dziauddin et al further established that the study outcomes of both straight-line along with network distance indicate that, all the way through the system, a distinctive house situated within two kilometers of a rail transit station can receive a premium of MYR7, 000-11,000, or else 2-5 per cent of the town's average house value which can be well thought-out as feeble and unwelcome effect. Lastly, their findings equally revealed that structural or physical attributes of the dwelling played a vital role in ascribing home prices. Dziauddin et al. further disclosed that the size or dimension of the floor area as well as the number of



bedrooms contribute more, to a great extent, to the dwelling price. This is certainly in conformity with nearly all of the hedonic house price studies. Dziauddin et al.'s studies consequently finds confirmation and validation for the hypothesis or premise that nearness to rail stations upwardly increases housing accommodation values.

In Sun, et al.'s (2016) study, the hedonic house pricing model was employed in estimating the change in the worth or value of the dwelling situated within 1,000 meters of constructed subway rail line 3 stations. With the theories or postulations of land rent as well as land location and a model of the effect of urban traffic on the abutting real estate prices, Sun, et al. analyzed and measured the sphere of impact of Tianjin Metro Line 3 on real estate prices. Finally, the article stresses the significance of municipal construction along with subway rail line building. They found that various development approaches ought to be employed based on the characteristics of the subway line in different areas of the metropolis.

The findings of Sun, et al.'s (2016) analysis revealed the following: results:

- a) The building of a subway line plays a major role in promoting and supporting increases in the adjacent land prices. By comparison, subway rail lines which have prior been constructed have a larger impact on neighboring residential housing units compared to rail lines that are being planned to be built.
- b) The development and establishment of subway rail lines has a larger effect on marginal or trivial zones of the metropolis compared to the city's central business district area. Furthermore, in non-urban centre areas, the values or prices of housing units close to rail stations indicate the lessening, falling and declining spatial allotment or distribution of the two identified sides; though, in city centre areas, the rail stations' effect on the pattern or blueprint of distribution of real estate prices is not evident, as it is in non-urban downtown areas. This might be for the reason that the impact of subway rail lines on home prices is masked, shrouded, covered and veiled by the influence of other land and landed property value indicators.
- c) Apart from the distance to the adjacent subway rail station, the inhabitants dwelling in downtown areas might focus on indicators such as the distance to the closest artery and major schools, as well as the condition or state of the nearby landscape, when selecting home. This shows that local residents are willing pay more attention and priority to comprehensive suitable transportation, the housing landscape, and the extent or degree of comfort and soothe.
- d) By and large, the sphere of impact of rail transit facility is positively connected with the distance starting from the central business district, but yet it does not consistently increase with it. Furthermore, rail transport fares, ticket as well as the price of other transport services can equally influence the sphere of impact of rail transit-oriented development.
- e) If the metropolis has suitable linking forms of transit service, they can efficiently and successfully enlarge the sphere along with accessibility of rail transport activity. Because downtowns or central business districts are repeatedly faced with a day by day flow of huge numbers of people, expedient linking transit can successfully spread out the radius of transport services, reduce, lessen or mitigate traffic congestion and overcrowding in the city center area and considerably enhance the ease of use of public transport service in the downtown.
- f) Lastly, non-urban centers do not witness a huge flow in population similar to urban centers, but enhancing linking transit can intensify the sphere of impact of rail transport service, and therefore, it can efficiently or successfully enlarge the vicinity of land which can be

developed and enhanced in the nearby or abutting rail transport service.

## **5. CONCLUSION**

It is sufficed to draw conclusion and inference that transit-oriented development (TOD) and its resultant impact on real estate values studies have yielded mixed findings. A number of scholars and authors revealed positive impacts on housing values whereas other studies reported negative or inconclusive results. Past empirical studies on cities such as Atlanta, Boston, New York City and San Francisco have centered on the closeness or nearness to rail transit stations and the negative externalities that go along with it by carrying out hedonic house pricing models. Other empirical studies have focused more particularly on residential or else commercial development and their property worth or values at varying time points of rail station development (Lambert, 2009).

It can equally be concluded that the impact appraisal and evaluation of metro rail stations on housing values is a significant issue with different results. These results prove that it is easier said than done to forecast what the long-term impacts of transit development projects will be, for the reason that each type of development (whether macro-scale or else micro-scale) might make a variety of effects on its surroundings based on the environmental situation and condition. Consequently, it is essential to determine the likely impacts as well as the consequences at before/after/during project completion or execution to intensify its positive effects as well as reducing negative consequences. So a field study entitled this issue in other metropolises like in Nigeria (regarding to the current spatial segregation between the north and the south of the country) can compare the impacts of metro rail stations in the two dissimilar urban textures. This comparison can disclose the later effect of this transit development on lessening the spatial segregation in Nigeria as a matter of fact (Kheyroddin et al., 2014).

This review article brings to light the significance of recognizing as well as analyzing the range of effect the establishment of new transport facility can have on land use along with real estate price. The following conclusion and deduction can equally be drawn from past literature finding apart from the above-mentioned. For example, the research outcomes of the previous empirical studies support and strengthen the micro-economic theory or conjecture of the bid-rent function as well as the trade-off sandwiched between proximity to the central business district, transportation along with home prices. As extensively reviewed and analyzed, the development, upgrading and enhancement of proximity to central business district or downtown through the establishment of both light and heavy rail system has tremendously increased home prices for those dwellings that have better access to its rail station (Dziauddin, 2013).

On the other hand, a number of of the past empirical literature has been less successful indicating that capitalization in facts take place and the research results are actually mixed and varied. Additionally, a good number of the studies measure the influence of public transit facility into housing prices unreservedly and absolutely assume homogeneous or consistent capitalization for housing units situated at similar and equivalent distance from the adjoining access point. Conversely, owing to existing variations on socio-economic distinctiveness as well as local public goods supply transverse or transcending counties, two indistinguishable and alike housing units situated at equivalent or identical distance to the closest metro rail station but in unlike counties (local real estate markets) would not inevitably or essentially have the same level, degree and extent of capitalization (Agostini and Palmucci, 2010).

The instantaneous conclusion of this review article is that a rail transit-oriented development would change, modify and adjust the land rent curve of nearby,

adjacent adjoining and abutting environs and vicinities. Going by this assertion, the theoretical or hypothetical premise that any development or enhancement in transport facility which is capitalized into land and landed property values in a short-term municipal partial equilibrium is confirmed and validated several times in the more compact, concentrated and densely occupied or populated urban surroundings of a developing economy, even following few years of its establishment and operation (Celik and Yankaya, 2006).

## **6. FUTURE RESEARCH OPPORTUNITIES**

A few and small reservations to this extensive review of past empirical studies could be highlighted given that the impact of rail transit station does have a considerable effect on real estate values. In view of the fact that it would be extremely and incredibly difficult to carry out a “before” analysis, individual could by no means know whether rail transit facility had any effect on the housing values. Apparently, clarification and elucidation of this statement warrants further research particularly following the completion of a rail transit station in all neighborhoods and counties with a larger property market transaction database. Additionally, the long-term effects of a rail transit facility should be observed and monitored not merely from the viewpoint and perception of the rent curve but equally in terms of variations in density, economic development, employment, land use, population and urban renewal in future research (Celik and Yankaya, 2006).

Considerable break-through has been achieved in transit as well as transport-land use research and investigation in recent years, but a great deal is left to be preferred. Researching into the variation of land use network or pattern would to a great extent improve and augment the capacity or aptitude to offer proficient, efficient, well-organized and effective transit-oriented service. Research on travel manners,

performance, conducts, density, compactness, concentration and demographic has produced, fashioned and shaped a strong underpinning for perceiving and knowing people’s travel mode preference. However, these previous studies in US western municipalities such as Dallas, Los Angeles, Phoenix as well as Salt Lake City whose urban shapes or forms crystallized in the auto epoch are limited and inadequate (Zhuang, 2014).

It is worthy to note that another major shortcoming to transit-land use analyses and research is the intricacy in estimating and calculating land use design as well as diversity level. To point toward land use design, it is more often than not the magnitude and size of land use. Nevertheless, there is insufficient and inadequate research on quality and feature of land use. Multiplicity procedures and dealings have engaged entropy conditions and a dissimilarity index and measured the distances sandwiched between a number of dissimilar retail commercial developments and residential housing units (Cervero, 1997; Frank, 1995; and Handy, 1996). While these approaches are ground-breaking and pioneering uses of existing or obtainable data, they leave a lot to be desired. Therefore, to actually illuminate and light up the multifaceted as well as intricate causes of rail transit demand, a much more vigorous and robust statistical foundry is required. Future research can consequently concentrate and center on estimating land use design along with land use mix, particularly in those uptown and automobile-dependent metropolises. (Zhuang, 2014).

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How to cite this article: Aliyu AA, Keffi MA, Anosike DA. Proximity to rail transit station and abutting real estate prices: their relationship in the light of previous studies. Galore International Journal of Applied Sciences & Humanities. 2018; 2(1): 1-30.

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