Malaysian Journal of Tropical Geography, 2020, 46(1&2): 48-68

THE IMPACT OF URBAN RAIL TRANSIT SYSTEMS ON COMERCIAL PROPERTY VALUES: A SYSTEMATIC LITERATUR REVIEW

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ABSTRACT

Evidence is mounting to suggest a highly significant positive relationship between proximity to urban rail transit and commercial property values. The purpose of this systematic review therefore is to assess and provide a systematic overview on current knowledge about the impact of urban rail transit on commercial property values. This systematic review evaluates and finally selected a total of 19 journal articles on the impact of urban rail transit on commercial property values. Findings of previous studies show that although the impact of rail transit on commercial property values is generally positive, there is inconsistency in terms of the impact size and direction. The inconsistency of the findings of previous studies is influenced by several factors, such as the selection of the catchment area, the treatment of time, the study design, the method of analysis, the type of urban rail transit and internal and external factors. The positive and significant impacts of urban rail transit on commercial property values are shown by the majority of studies using an observation area situated 400 metres from the station. The majority of previous studies also chose to adopt a longitudinal research approach and use the hedonic pricing model. Greater positive and significant impacts are also shown by the majority of studies whose case studies were heavy rail transit. Finally, factors such as the physical characteristics of the building, the neighbourhood and the environmental characteristics of a location also contribute to the differences in the findings of the studies.

Keywords: Urban rail transit systems, commercial property, systematic literature review, hedonic pricing model, longitudinal approach

INTRODUCTION

The development of urban rail transit has a significant impact on the changes in property values, especially commercial properties[1] that are in close proximity to these transportation facilities (Billings, 2011). Commercial firms will usually ensure that their business locations are placed in strategic locations, such as those with high level of accessibility and visibility. This is important to ensure that their firm earns maximum profit in the long run. Thus, locations that have level of accessibility and are easy to find are among their main considerations. Therefore, properties located close to a rail transit station have the advantage of accommodating commercial activities. According to Xu et al., (2016) commercial property values located near (within 400 meters distance) the rail transit station is usually more expensive compared to commercial properties located beyond this distance. The location around the rail transit station not only offers the benefits of accessibility and visibility, but is also capable of enhancing land use development activities.

A study conducted by Bhattacharjee and Goetz (2016) in Denver County, Colorado found that commercial land use development activities increased from 2000 to 2010. This was proven by the 45% growth in commercial land use activities in the surrounding areas that received the urban rail transit service, compared to other areas (Bhattacharjee & Goetz, 2016). The high levels of commercial activities in the area near urban rail transit stations have also resulted in commercial property values to increase significantly. For example, a study conducted by Lin and Yang (2019) in Taipei, Taiwan, found that there was an increase in commercial land use activities every year since the metro rail station began operating, and the rapid development of commercial land use around the metro station has increased commercial property values in the area. This was proven by the increase in commercial property values at the BR18 station in Taiwan, from NT$ 1903 in 2012 to NT$ 2036 in 2013 (Lin & Yang, 2019). In addition, the shop rental rate within 138 meters from the BR19 station in Taiwan was NT$ 2339. While within 283 meters from the BR19 station, the rental value was NT$ 932 (Lin & Yang, 2019). This situation clearly proves that areas located near rail transit stations have a significant impact on the change in commercial property values. Another study conducted by Debrezion et al., (2007) found that the impact of rail transit systems on commercial property values is very significant and will increase by 12.2% within the observation zone, 400 meters from a transit station.

The purpose of this systematic review is to assess and provide a systematic overview on current knowledge about the impact of urban rail transit on commercial property values. Several researchers have published the literature review related to the impact of urban rail transit facilities on residential properties values (Cervero & Duncan, 2002; Diaz & Mclean, 1999; Ryan, 1999; Smith et al., 2009; Smith & Gihring, 2006), however, little or almost non-existent systematic literature review about the impact of urban rail transit on commercial property values. This systematic literature review is conducted to fill the gaps left by previous researchers and is expected to provide useful information related to

estimating the impact of urban rail transit systems on commercial property values so that it can serve as a guidance to other researchers who are interested.

This review used 19 journal articles published in refereed journals indexed by International Scientific Indexing (ISI) and Scopus. The focus of this systematic literature review is on several important aspects such as catchment area, treatment of time, study design, methods and data sources, types of urban rail transit and internal and external factors used by previous studies.

MATERIALS AND METHODS

The discussion in this section focuses on article selection criteria, data sources and search strategies used to conduct this systematic literature review.

Selection Criteria

The research method used is based on the use of Scopus and ISI database engines as the main database in this study. These search engines were selected based on the function of a database system known as an indexed journal database. The Scopus and ISI databases are among the comprehensive search engines that select only quality and good research as references. Hence, this study preferred to use Scopus and ISI as the primary database systems. In addition to Scopus and ISI, journal article search of other database engines was also used, such as JTLU, J-STAGE, SAGE journal, ScienceDirect, KoreanScience, SpringerLink, Semantic Scholar, ResearchGate and Transportation Research Forum. The use of various search engines is one way to reduce bias that might have occurred if only Scopus and ISI were used. Tables 1 and 2 show the database engines used in article selection.

Search strategies and data sources

The search strategy used to select articles is based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The guidelines provided by PRISMA help in the effort to properly and accurately evaluate and assess the quality of the studies. In addition, the PRISMA approach can help researchers prepare some minimum requirements as a prerequisite for the study protocol (Moher et al., 2015). By using the PRISMA protocol, the study can identify the criteria of the articles to be selected and removed, so that the studies highlighted are in accordance with the title of the study determined earlier, and at the same time, the systematic highlights will be more well-planned and organised.

Article selection process

The selection of articles that are relevant to the title of the study depends on three main stages. In the first stage, identification is done through the use of keywords that are synonymous with the title of the study. The search for study keywords is done by using thesaurus database, dictionary and terms used by past researchers. Table 3 shows the string of database search used to find the articles.

Table 1: Database engine used in article selection

DATABASE SYSTEM	DESCRIPTION	SEARCH COST
KOREAN SCIENCE	Database system created to facilitate access to technical and scientific journals from Korea.	Free
JTLU	A journal that publishes articles by highlighting several disciplines that are interrelated with the study of transport interactions with land use.	Free
J-STAGE	An electronic journal platform for science and technology information in Japan, it was developed and operated by the Japan Science and Technology Agency (JST).	Free
SAGE JOURNALS	Publishes approximately 1,000 journals of various disciplines.	Free
SCIENCE DIRECT	A database that helps find interdisciplinary research, article excerpts are also based on Scopus which helps evaluate research articles relevant to the study.	Subscription (university)
SCOPUS	Possess the largest collection of excerpt and abstract databases for research studies.	Subscription (university)
SPRINGER LINK	A database covering various disciplines (articles, books, book series and conference papers).	Subscription (university)
SEMANTIC SCHOLAR	A database that scientifically applies literature reviews established by a group of researchers and engineers from the Allen Institute, to get free article excerpts.	Free
TRANSPORTATION RESEARCH FORUM	An independent forum organization by transportation professionals. This forum also provides accurate information that can be used in research.	Free
RESEARCHGATE	A professional network for scientists and researchers. Approximately 17 million members from around the world use this database for research activities.	Free

Table 2: ***Database/journal title engines used in article selection***

JOURNAL/DATABASE	SEARCH THEME	AUTHOR'S NAME
REGIONAL SCIENCE AND URBAN ECONOMIC	Transit	Billings, 2011
REGIONAL SCIENCE	Impact Transit on Commercial	Yu et al., 2017
INTERNATIONAL JOURNAL OF HIGH-RISE BUILDINGS	Accessibilities and Commercial	Zhang and Zhuang, 2019
JOURNAL OF THE TRANSPORTATION RESEARCH BOARD	Light Rail Transit	Weinberger, 2001
JOURNAL OF THE TRANSPORTATION RESEARCH BOARD	Light Rail Transit	Nelson et al., 2015
JOURNAL OF THE TRANSPORTATION RESEARCH BOARD	Light Rail Transit	Cervero and Duncan, 2002
JOURNAL OF PUBLIC TRANSPORTATION	Impact Transit on Commercial	Ko and Cao, 2013
JOURNAL OF PUBLIC TRANSPORTATION	Transit on Commercial Property Value	Nelson, 1999
JOURNAL OF TRANSPORT AND LAND USE	Effect Transit on Commercial	Mohammad et al., 2017
JOURNAL OF TRANSPORT AND LAND USE	Impact Transit on Property Values	Pacheco-Raguz, 2010
JOURNAL OF REAL ESTATE FINANCE AND ECONOMIC	Impact Transit on Commercial	Debrezion et al., 2007
TRANSPORTATION	Impact Transit on Commercial	Seo et al, 2018
TRANSPORTATION RESEARCH PART A	Impact Transit on Commercial	Xu et al., 2016
TRANSPORTATION RESEARCH FORUM	Effect Transit on Commercial	Cervero, 2004
URBAN STUDIES	Light Rail Transit	Ryan, 2005
URBAN GEOGRAPHY	Transit on Commercial Property Value	Kopczewska and Lewandowska, 2018
JOURNAL OF EASTERN ASIA SOCIETY FOR TRANSPORTATION STUDIES	Rail Transit Station	Chalermpong and Wattana, 2010
INTERNATIONAL REAL ESTATE REVIEW	Commercial Land Values	Kim and Zhang, 2005
REGIONAL SCIENCE AND URBAN ECONOMICS	Transit on Commercial Property Value	Cohen and Brown, 2017

Table 3: Database search string

Database	Database search string
Scopus	(("rail transit" OR "subway" OR "rapid transit" OR "metro" OR "railway" OR "urban transportation service" OR "light rail" OR "metro" OR "mass transit" OR "LRT" OR "heavy rail" OR "commuter") AND ("commercial" OR "retail" OR "trade" OR "business") AND ("land value"))

Journal articles screening process

Once the identification level is completed, each article listed will be screened to remove articles that are not related to the relevant title. Table 4 shows a summary of article selection criteria.

Table 4: Article selection criteria

CRITERIA	STUDY'S ELIGIBILITY	STUDY'S EXEMPTION
LITERATURE TYPE	Journal (Article Research)	book series, books, chapters in books and conference proceedings
LANGUAGE	Studies that use English	Studies that do not use English
YEAR	1999	2020

Eligible articles (*Eligibility*)

Once all the articles passed the screening process, a thorough evaluation was conducted for each selected study. For example, conclusions on whether an article was to be included were drawn based on the abstract of the study so that only articles related to the study title were used as a sample in the process of producing this systematic literature review. The final search resulted in 19 studies related to the topic and suitable for use in this systematic literature review. Figure 1 shows a summary of the journal article search process conducted.

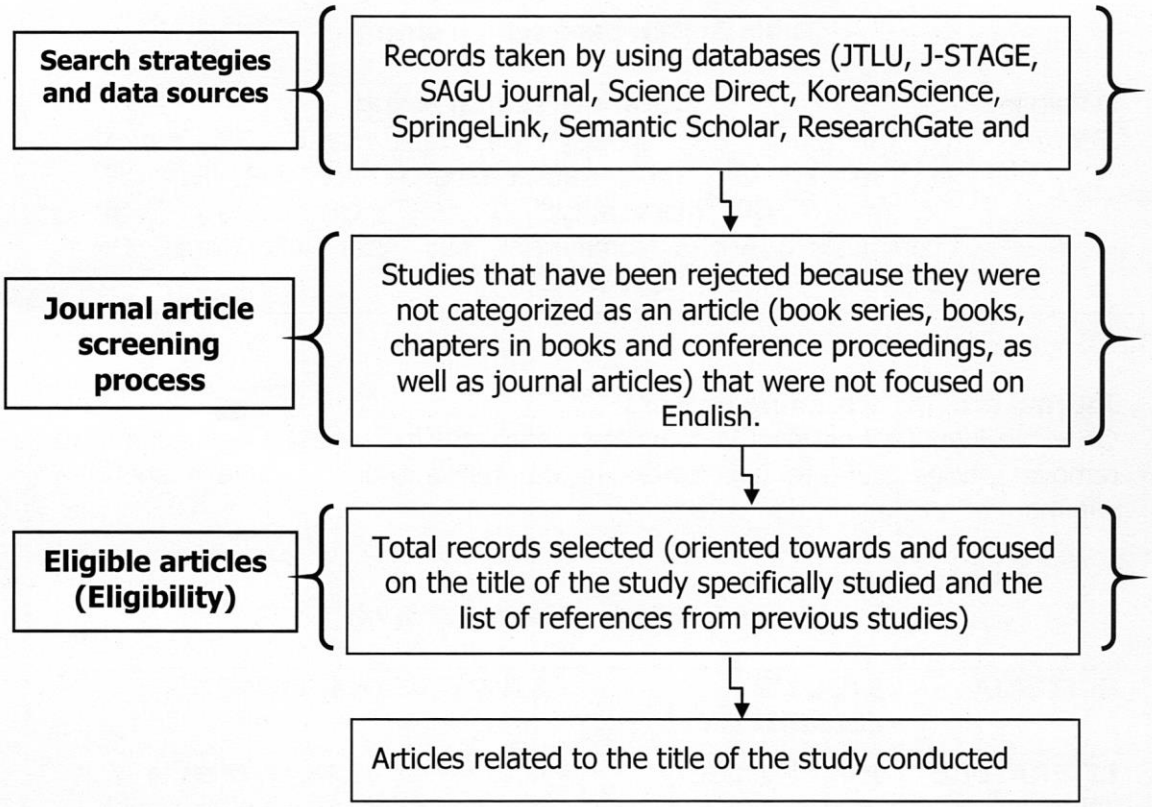

Figure 1: The study methods used

EMPIRICAL EVIDENCE OF THE IMPACT ON URBAN RAIL TRANSIT ON THE VALUE OF COMMERCIAL REAL ESTATE

Theoretical expectations (microeconomic theory and land values)

The microeconomic economic theory of urban land use presented by Alonso (1964), Muth (1969) and Mills (1972) is a theory used by most studies to understand the relationship between accessibility and land values. According to Debrezion et al. (2007), Seo and Nam (2019) and Xue and Sun (2020) land use economics theory is an important foundation for understanding how urban rail transit interacts with property values (e.g., commercial and residential properties) in areas with a network of transportation facilities. In addition, Seo and Nam (2019) also stated that locations with a good network access affect the property values in the area.

Microeconomic approach that is often associated with changes in property values according to this theory is the bid-rent function and the trade-off model. Bid-rent function is a concept that explains the ability and willingness of a buyer to pay to obtain a property at a certain distance from the city centre. It means that property prices become lower as the distance from the city centre increases.

Instead, transportation costs will increase in response to increasing distances from the city centre. The city centre, commonly referred to as the central business district (CBD), where employment and economic activities are concentrated, has become a key point in the majority of urban land value determination studies. In the context of the relationship between properties and urban rail transit, property values are likely to respond positively when accessibility to the city centre and other places increases. Thus, properties that are close to urban rail transit stations are usually sold at higher prices as buyers will compete with each other to benefit from an increase in accessibility.

The trade-off model is a model that explains how a company chooses a capital structure by taking into account the impact of taxes and also the cost of bankruptcy in the operations of the company (Cekrezi, 2013). In the context of urban rail transit, the trade-off model involves 'exchange' by reducing one element of quality or quantity to benefit from other aspects. For example, a company pays a high property value (reducing one element of quantity) to place their business premises close to a transit station (benefit). This situation means firms can use their firm location as capital to increase profits in the long run because the location of a rail transit station is a strategic choice as it is a focal area of urban community to move and commute to/from workplace or for other activities.

Catchment area

In estimating the impact of urban rail transit on commercial property values, accessibility is determined by measuring the distance (either distance of a straight line or road network) of each commercial unit to a rail transit station. Based on the findings of the previous study shown in Table 5, it can be concluded that although there is inconsistency in the distance of the observation area used to estimate the impact of urban rail transit on commercial property values, the majority of studies use observation area within 400 meters (1/4 miles) from the city rail transit station. Another conclusion that can be drawn from previous studies is that commercial property values are very high when they are located within the observation distance of 400 meters from the urban rail transit station (Cervero & Duncan, 2002; Debrezion et al., 2007; Ko & Cao, 2013; Xu et al., 2016; Yu et al., 2018). In fact, Cervero (2004) also stated that the impact of urban rail transit on commercial property values is very low for distances of 800 meters and above. This statement is supported by (Debrezion et al. (2007), wherein, based on the meta-analysis conducted, the increase in commercial property values occurs for areas within the range closest to an urban rail transit station. Overall, it can be emphasised here that the observation area within a distance of 400 meters (1/4 mile) from the transit station is the most suitable observation distance to estimate the impact of urban rail transit on commercial property values.

Table 5: The impact size of the observation distance of a transit rail station on commercial property values

STUDY	DISTANCE	STUDY FINDINGS
DEBREZION ET AL., 2007	¼ Mile	The difference between the value of commercial and residential properties within this distance is 12%, of which the value of commercial property is (16.4%) more expensive than residential property (4.2%).
RYAN, 2005	-	Property value for office firms are higher in areas far from urban rail transit station.
COHEN AND BROWN, 2017	400 meters	One-minute travel time savings from transit station to downtown Vancouver, the value of commercial property on average increased by 2%.
XU ET AL., 2016	400 meters	Within 0-100 meters, the value of commercial properties can reach up to 16.76% (6193.85 yuan). Meanwhile, property values within a range of 100-400 meters experienced fluctuations around 8% (7.81%, 8.52%, 7.29%).
CERVERO AND DUNCAN, 2002	0.25 mile	Property values close to the Caltrain station and properties within the CBD area can reach over $25 per square foot.
NELSON ET AL., 2015	0.25 mile	The rental value of the office will be reduced by 25% over a distance of more than 0.25 miles from the city rail transit station and this rental value will decrease as it gets farther from the transit station.
KO AND CAO, 2013	¼ mile	Property values within ¼ mile increase by about $6,000 per meter from LRT stations, meanwhile, property values will decrease by approximately $4,000 within ½ mile range.
WEINBERGER, 2001	0.25 mile	Property value increased by up to 9% in the first distance from the city rail transit station, while property value increased by 7% in the next 402 meters.
YU ET AL., 2017	0.25 mile	The value of commercial properties can increase by about $7.4 per square foot within this range of distance from the transit station.
CERVERO, 2004	¼ – ½ mile	High property values at the Coaster city centre station (91.1%) and also on the Mission Valley route (71.9%). The effect of unfavourable property value within ½ miles from the Coaster station (territory outside the city centre).

Table 5: (continued)

ZHANG AND ZHUANG, 2019	**500 METER**	**THE AVERAGE SPACE FOR COMMERCIAL LAND USE IS THE HIGHEST IN THE DISTANCE CLOSEST TO THE METRO STATION WHICH IS 33%.**
KOPCZEWSKA AND LEWANDOWSKA, 2018	500 meters	Offices located in the CBD area have a higher rental value (15-20£) per square foot per year compared to office rental value in other areas.
PACHECO-RAGUZ, 2010	2,000 meters	The value of commercial properties consistently increased slightly compared to the value of residential properties which showed a greater impact with LRT1 in Manila.
SEO ET AL., 2018	300,600,900 & 1200 meters	Property values within a distance of 300 meters from the LRT station are 1.8 times higher than properties within the distance of 1200 meters.
CHALERMPONG AND WATTANA, 2010	1,000 meters	The change in the value of commercial properties is not as significant as residential properties as the increase in the value of commercial properties close to the rail transit station is about 19 Baht per square meter.
MOHAMMAD ET AL., 2017	1 km	The value of commercial properties had a positive impact of 39% (0.5km), 42% (1km) and 41% (1.5km). However, a significant positive impact is within 1 km distance with a 30% increase in commercial property value.
BILLINGS, 2011	1 mile	The limited number and too diversified samples, and commercial properties take time to respond positively to the existence of LRT.
NELSON, 1999	1 mile	The value of commercial properties increases to $443 when located within the station area and decreases to about $75 per meter as it gets farther away from the station.
KIM AND ZHANG, 2005	2 km	The value of commercial properties is very high at rail transit stations located in the CBD region of Seoul (US$7.54) compared to Samsung (US$5.88) and also Kangnam (US$1.69).

Treatment of time

The difference between the before and after scenarios of urban rail transit development can affect property values in an area (Nelson, et al., 2015). Based on Table 6, most of the existing literature empirically prove that the impact of urban rail transit on commercial properties begins after rail transit services start their operations (Cervero & Duncan, 2002; Cervero, 2004; Ko & Cao, 2013; Lin & Yang, 2019; Mohammad et al., 2017; Nelson et al., 2015; Ryan, 2005; Seo et al., 2019; Weinberger, 2001; Xu et al., 2016; Yu et al., 2018).

Pacheco-Raguz (2010) conducted a study to estimate the impact of accessibility of the light rail transit (LRT) system on commercial properties in developing countries such as the Philippines demonstrates high property values after the construction of the LRT system compared to before the existence of the LRT system. Even though the commercial property values did not have as great an impact as residential properties in Manila, the increase in commercial property values after the construction of the LRT showed a positive impact (Pacheco-Raguz, 2010)

However, there are also researchers who use the period after the announcement was made by the authorities for the construction of urban rail transit. For example, Cohen and Brown (2017) found that two major metropolitan areas in Canada, namely Bringhouse (85%) and Vancouver (75%) CBDs, are expected to benefit from reduced travel time with the availability of urban rail transit facilities. This situation has led most commercial firms to expect that urban rail transit is capable of increasing population accessibility to downtown areas (Cohen & Brown, 2017). This expectation resulted in an increase in the development of land use such as hotels and commercial activities in Bringhouse and Vancouver CBDs, causing the property values in the city centre area to rise even before the construction of rail transit systems was completed.

METHODS, STUDY DESIGN AND DATA SOURCES

Most of past studies have used the hedonic price model analysis to estimate the impact of urban rail transit on commercial property values. Table 7 shows a summary of the literature review on the findings of the study of the impact of urban rail transit system on commercial property values from the aspect of the analysis of study methodology. This hedonic pricing model is a pricing model presented by Rosen (1974), and it is a mathematical model that can show the value of each independent variable used to estimate the impact of urban rail transit on commercial property values (Cervero, 2004; Debrezion et al., 2007; Xu et al., 2016). However, this analysis has some drawbacks where it does not identify the causal relationship between rail transit systems and property values (Mohammad et al., 2017).

Table 6: Treatment of time for each study

RESEARCHER'S NAME	BEFORE THERE WAS A TRANSIT SYSTEM	DURING THE CONSTRUCTION OF THE TRANSIT SYSTEM	AFTER THE EXISTENCE OF THE TRANSIT SYSTEM	YEAR THE DATA OBTAINED	YEAR THE TRANSIT IS IN OPERATION
BILLINGS, 2011	X		X	Year 1994-2008	Year 2000
CERVERO AND DUNCAN, 2002			X	Year 1998-1999	Year 1990/1991
CERVERO, 2004			X	Year 1999, 2000 and 2001	Year 1996/1997
CHALERMPONG AND WATTANA, 2010			X	Year 2007-2008	Bangkok Transit System (Year 1999) Mrt (Year 2004)
KO AND CAO, 2013	X		X	Year 2000-2008	Year 2004
WEINBERGER, 2001	X		X	Year 1984 and 2000	Year 1987
YU ET AL., 2017			X	Year 2015	Year 2010
RYAN, 2005				Year 1986-1995	Year 1986
MOHAMMAD ET AL., 2017	X	X	X	Year 2007-2011	Year 2009
PACHECO-RAGUZ, 2010			X	Year 1989-1996	Year 1984
NELSON, 1999			X	Year 1980-1994	Year 1980
SEO ET AL., 2018			X	Year 2009-2014	Year 2008
XU ET AL., 2016			X	Year 2014-2015	Year 2012
KOPCZEWSKA AND LEWANDOWSKA, 2018			X	Year 2015	Year 1863
KIM AND ZHANG, 2005			X	Year 2003	Year 1974
COHAN AND BROWN, 2017	X			Year 1995-2017	Year 1998

Table 7: Literature review of the findings of the study on the impact of the TRB system on commercial property values from the aspect of analysis of the study methodology

Researcher's name	Methodology us								
	Hedonic	***GWR***	***DID***	***SDM***	***Multiple linear regression/spatial regression analysis***	***Other analyses***	**Transaction data**	**Rental data**	**Case study**
Cervero and Duncan, 2002	X						X		X
Cohan and Brown, 2017						X	X		X
Cervero, 2004	X						X		X
Chalermpong and Wattana, 2010	X				X			X	X
Ryan, 2005	X							X	X
Kim and Zhang, 2005	X				X		X		X
Billings, 2011	X		X				X		X
Pacheco-Raguz, 2010						X	X		X
Ko and Cao, 2013	X						X		X
Kopczewska and Lewandowska, 2018				X				X	X
Nelson, 1999						X	X		X
Nelson et al., 2015	X							X	X
Seo et al., 2018	X				X		X		X
Xu et al., 2016					X		X		X
Weinberger, 2001	X							X	X
Mohammad et al., 2017	X		X				X		X
Yu et al., 2017		X		X			X		X
Zhang and Zhuang, 2019						X			X
Total	**11**	**1**	**2**	**2**	**4**	**4**	**12**	**5**	**18**

Therefore, there is a tendency amongst recent researchers to use the difference-in-differences (DID) technique (Billings,2011; Mohammad et al., 2017). The DID technique is one of the more effective statistical approaches in estimating the impact of urban rail transit on commercial property values. However, this analysis requires a large set of longitudinal data that can facilitate the effort to examine the growth of commercial property values before and after the existence of any urban rail transit system. The larger the amount of data used, the more accurate the analysis (Mohammad et al., 2017).

In addition, the different geographical variations of each area also cause non-uniformity in commercial property values between one area and another. To overcome this problem, the geographically weighted regression (GWR) technique proposed by Forheringham et al., (1998) was chosen by the researcher to estimate the impact of urban rail transit on commercial property values (Yu et al., 2018). The advantage of GWR analysis is that it can take into account the geographical variations of the local area where each and every unit of a commercial property sample used in the study is located.

Case study is a common study design used by most of the literature highlights to estimate the impact of urban rail transit on commercial property values in the study areas (Billings, 2011; Cervero & Duncan, 2002; Cervero, 2004; Ko & Cao, 2013; Kopczewska & Lewandowska, 2018; Pacheco-Raguz, 2010; Mohammad et al., 2017; Nelson, 1999; Nelson et al., 2015; Ryan, 2005; Seo et al., 2019; Weinberger, 2001; Yu et al., 2018; Zhang & Zhuang, 2019). The case study design is used because it is able to produce research findings that are more focused on only a specific aspect of an area by highlighting on the microeconomic impact.

In terms of data sources, the majority of past researchers have used secondary data sources, which are the sale transaction values of commercial properties. Commercial property transaction value data serve as a dependent variable in a research analysis in addition to be an important source for modelling and processing data. These data are obtained from government agencies such as the Property Valuation Office, which controls and records commercial information that is within the administrative boundary of their administration (Cervero & Duncan, 2002; Cervero, 2004; Xu et al., 2016).

Among other commercial property information obtained are the physical characteristics of the buildings such as the floor area of the building, number of floors of the building, number of shops, age of the building, lease information and parking ratio. Meanwhile, there are also past studies that obtained commercial property information through the internet using a number of specific database systems that contain information related to commercial property prices (Seo et al., 2019). In addition, there are also studies that use a questionnaire method (Xu et al., 2016) and interview with commercial firm owners (Lin & Yang, 2019) as additional sources of information for their studies.

Types of urban rail transit

The capability and efficiency of rail transit stations not only encourage community movement, but they can also increase the number of passengers and the intensity of activities around the station resulting in high commercial property values. Different types of urban rail transit systems indirectly affect the change in commercial property values of a certain location. According to Debrezion et al. (2007), different rail transit systems in each area can result in different property values. For example, property values are higher in areas close to heavy-duty transit systems compared to areas close to light rail transit (LRT) or commuter systems (Cervero & Duncan, 2002; Debrezion et al., 2007; Landis et al., 1995). This situation occurs because heavy-duty transit often operates more frequently,

faster, has a larger design size and is capable of accommodating a larger number of passengers than other types of urban rail transit (Debrezion et al., 2007). In fact, comparing between commuter traffic and LRT, commercial property values that are close to commuter traffic is more expensive. This is because, the network size of the commuter system is larger than that of the LRT system (Debrezion et al., 2007). Table 8 shows the types of urban rail transit systems and the size of impact produced in several studies.

Table 8: Types of urban rail transit and size of impact produced

RESEARCHER'S NAME	TYPE OF URBAN RAIL TRANSIT	STUDY FINDINGS
CERVERO AND DUNCAN, 2002	LRT & commuter	The value of commercial properties near the LRT station is about $4 (RM16.85) lower compared to properties near the commuter station which is $25 (RM103.74).
CERVERO, 2004	LRT & commuter	The value of commercial properties is quite high in the area close to the Coaster/commuter station (91.1%) compared to the Mission Valley-LRT line station (71.9%)
DEBREZION ET AL., 2007	Heavy-duty transit rail, LRT & commuter	The development of heavy rail transit (0.9%) and commuter (14.1%) has a high impact on property values compared to LRT.

Other factors influencing commercial property values

As mentioned earlier, urban rail transit is one of the elements that can be an important contributor in increasing commercial property values in an area (Ping et al., 2019). However, it is not necessarily the sole element that increases commercial property values because there are other factors that may also increase the value of this type of properties (Chalermpong & Wattana, 2010; Debrezion et al., 2007). Through the literature review, we found some factors that can have a positive impact on commercial property values. At the same time, there are some other local factors that can have a negative impact, causing commercial property values to decline. Table 9 shows the findings from previous studies showing the other factors that also influence the change in commercial property values in an area.

Internal factors

Internal factors are associated with the facilities and capabilities available at rail transit stations in an area. Rail transit stations equipped with public facilities such as toilet, bus stop, taxis, parking area and even pedestrian walkway can increase

the value of commercial land if compared to urban rail transit stations that are not equipped with such facilities (Debrezion et al., 2007). In turn, commercial property values will increase if the existence of urban rail transit actually increases accessibility from one location to another and saves travel costs (time and money) of the population (Cohen & Brown, 2017).

External Factors

Physical characteristics of commercial buildings

The physical characteristics of the building such as the age of the building, the number of shops, the number of floors in the building, the floor area and the size of the building have a positive impact on the growth of commercial property values around an urban rail transit station. A quality building design structure encourages buyers and investors to buy or rent the building (Nelson, 1999; Ping et al., 2019). Furthermore, the quality of the design of the building will indirectly result in lowering the cost of management and repair of the premises (Ping et al., 2019). Xu et al. (2016) explains that the physical characteristics of the building have a positive impact at 5.2% on commercial property values in Wuhan, China. In addition, a study conducted by Cervero (2004) found that building structure and lot size also affect commercial property values even though the increase in the value of these properties occurs in low amounts.

Neighbourhood features

Neighbourhood features are also one of the characteristics that can influence the change in commercial property values (Ping et al., 2019). According to Cervero (2004), land use activities such as offices, grocery business, restaurants and hotels have a higher rental value if compared to the rental value of shopping malls, entertainment centres and grocery shops in San Diego, California.

In addition, commercial property values are also influenced by household income (Cervero & Duncan, 2002). Property values will increase in the neighbourhoods of high-income groups (Cervero, 2004). According to Ryan (2005), unequal population income can be an important characteristic for checking the value of rental properties in the eastern district as well as in downtown San Diego. This is because office firms have to pay high rent in areas close to high-income neighbourhoods compared to other neighbourhoods (Ryan, 2005). Similarly, Cervero and Duncan (2002) states that if household income increases by $10,000, then the increase in commercial property values will increase by $1.41 per meter.

In addition, property values tend to increase if an area has high employment opportunities. Employment factors can indirectly affect population density and create rapid commercial property growth in areas close to transit stations (Yu et al., 2018). For example, a professional service company located next to an urban rail transit station is likely to cause property values to increase by $7.41 per square foot (Cervero & Duncan, 2002).

Location environmental features

The different environmental characteristics of each area can also result in the difference in commercial property values of that area. This is because each area that has different environmental characteristics can produce different property values (positive or negative). Based on the literature review, the development of a rail transit system located in the CBD has a significant influence on commercial property values compared to the rail transit station located outside the CBD (Cervero, 2004; Chalermpong, & Wattana, 2010; Ryan, 2005; Xu et al., 2016). For example, commercial property values at the Austin metro station located in the CBD have increased by $0.843 (Yu et al., 2018), whereas, the property values in the CBD area in Wuhan have increased by 0.1% for every 100 meters increase (Xu et al., 2016). As a result, the high floor space competition for commercial land use activities in the CBD has resulted in high property values in that area (Ko & Cao, 2013; Xue & Sun, 2020).

However, there are a few characteristics that can have a negative impact such as cultural influences and community beliefs as shown by (Xu et al., 2016). They found that the culture of the Chinese society could have an impact on the devaluation of commercial properties in Wuhan. According to Xu et al. (2016), Chinese society thinks that commercial firms located close to a hospital can lead to death and that illness and can produce a negative productivity aura to employees such that it can cause commercial property values to be low.

CONCLUTION

This article enhances our understanding of how to estimate the impact of urban rail transit on commercial property values. This is because the review of previous studies found that the selection of catchment areas, treatment of time, analysis methods and study design and internal and external factors determine whether the impact of urban rail transit on commercial property values is positive and significant or negative and insignificant. For example, a positive and significant impact was obtained for the majority of studies using a catchment area 0.25 miles or 400 meters away from the station. Similarly, the catchment areas where the positive and significant impact involves a sample of data taken after several years of operation of an urban rail transit system.

Review of previous studies also found that even though the hedonic price models was used in the majority of studies, there are some studies that began to use analytical methods such as the difference-in-differences (DID) to obtain more accurate impact estimates. There is even a tendency for researchers to use geographically weighted regression (GWR) technique to estimate the impact of urban rail transit on commercial property values. This type of analysis technique is capable of showing geographical variation based on where the observation sample of each commercial property unit is located.

Table 9: Other factors influencing the value of commercial properties

CATEGORY	SUB-CATEGORY	ELEMENTS INVOLVED	RESEARCHER'S NAME
INTERNAL FACTORS	Transit service capabilities	❖ New/poor rail transit ❖ Lack of transit area network ❖ Lack of facilities	❖ Chalermpong and Wattana, 2010 ❖ Debrezion et al., 2007 ❖ Debrezion et al., 2007
EXTERNAL FACTORS	Physical factors of the building	❖ Building's age ❖ Number of floors of a building ❖ Total floor of the building (land area width) ❖ Parking ratio (per 100 square meters) ❖ Indoor/roofed parking lot	❖ Billings, 2011 ❖ Nelson, 1999 ❖ Cervero and Duncan, 2002 ❖ Kopczewska and Lewandowska, 2018 ❖ Nelson, 1999 ❖ Seo et al., 2018
	Neighborhood features	❖ Types of commercial land use activities ❖ Household income of the residents ❖ Occupational factor ❖ White/black society	❖ Cervero 2004 ❖ Ryan, 2005 ❖ Yu et al., 2017 ❖ Cohen and Brown, 2017
	Location environment features	❖ Distance to the CBD ❖ Distance to the highway ❖ Culture and belief	❖ Ryan, 2005 ❖ Xu et al., 2016

Finally, this systematic literature review can serve as a useful guide for transport planners and engineers to plan urban rail transit systems in the future. The findings of the study clearly show that the impact of urban rail transit on commercial property values is the highest and most significant for properties located within close proximity to transportation facilities. In addition, there is clear evidence shown by previous studies that the positive and significant impact of urban rail transit is on commercial properties that are located near the city centre. Therefore, efforts should be made to plan a route that connects to the existing economic and social activity centres of the residents rather than expecting urban rail transit system to attract such activities to be concentrated around the station area.

Note:

[1] Commercial property is a type of property that houses business buildings and are used for various economic activities such as convenience stores, shopping malls, office buildings and even industrial parks. The offices serve to provide professional services, perform administrative activities as well as activities involving the government, while convenience stores are commercial entities that sell various necessities such as groceries and they also include buying and selling activities such as shopping complexes (Ping et al., 2019).

Acknowledgement

This study obtained financial funding from the Ministry of Higher Education Malaysia under the provisions of the Fundamental Research Grant Scheme (FRGS) (Code: 2019-0021-106-02).

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