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Potential Study of Applying Traffic Congestion Index to Simulate Property Price Changes

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Abstract

Urban congestion issue is considered as part of major issues that affects the urban development progress and also the living qualities. One of the impacts is reducing the properties prices due to demolishing in property values. This paper provides an insight onto the possibility to simulate the changes of property prices due to variation in different traffic congestion conditions. Firstly, a number of discussions are conducted onto lack of proper analysis tool in assessing the relationship between the extent of urban traffic congestion condition and the fluctuations of property prices in urban areas. Secondly, the aim of this paper is to simulate and generate a modelling framework in order to fill up the niche areas in order to justify the validation of this tool in analyzing the implication of urban traffic congestions onto the changes of property prices. In order to ensure the research work can be implemented, thus a combination of traffic congestion data and property price data which are further integrated using Overlay Mapping Method by referring to i-PLAN, and outcomes are further evaluated through correlation analysis and hypothesis testing. Based on these research inputs, it is thus estimated that generated outputs in index format is able to provide an important guideline for the further developer in making their decisions to acquire property for development.

Keywords

Traffic Congestion, Property Prices, Place of Interest, Simulation Index

Introduction

Traffic congestion problem in urban areas is considered as long term issue to be resolved as it may not only bring negative impacts onto the quality of urban living environment, it is also cause inefficiency in land use and productivity.

A number of studies have been carried out to relate the implication of traffic congestion with the progress of urban development. According to Sethi (2018), rapid urbanization often leads to traffic congestion which also disrupts the developments in the surrounding area.

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Traffic congestion happens in line with the increasing population in the cities. The more population in a city, the more is demand for private vehicle usage which directly lead to congestion on road.

It was evident that transport would bring both positive and negative externalities (Guijarro, 2019). Positive externalities are associated with proximity with road traffic such as access to public transport and amenities. Whereas negative externalities are much related to the traffic congestion, air pollution, and noise pollution that will be caused by the usage of the vehicle itself.

When a property price is about to be decided, by using the road traffic impact, it would usually be determined by evaluating both the positive and negative externalities. According to the study by Guijarro (2019), both the negative externalities and the positive externalities affects the residential property in the case study of Madrid, Spain. Having dwellings within the nearest access to amenities affects positively the price of residential properties. Whereas the amount of daily traffic does negatively impact the residential property prices.

As for the price of commercial properties, a study by Alliyu et.al (2015) denotes that the effects of traffic congestion are different from the effect of traffic congestion on residential property as stated above. Based on the study in Bauchi, Nigeria it was concluded that traffic congestion has a mostly positive impact on the value of commercial property due to the booming rate of business in such areas. Whereas for the negative impact, it is mostly insignificant in terms of choices of certain businesses in such area due to the risk of air pollution.

Similar to the above-mentioned case study of traffic congestion impact on residential properties, many other studies also have been carried resulting in a similar outcome. Which states that traffic congestion does negatively impact the properties prices as many dwellers are not willing to be located in an area with high traffic as it would lead to more negative externality to them compared to the positive externality.

However, it is different for the relationship between traffic congestion and the price of commercial property as there aren’t many case studies done on that. More studies are needed to have significant data to determine whether traffic congestion would be impacting property prices positively or negatively. Therefore, it would be much appropriate to carry out a case study regarding the relationship between traffic congestion and the price of commercial property.

In order to fill up the research gap in these both areas, the paper studies the possibility of integrating these two key problems in urban areas and generate a comprehensive framework to justify the applicability of the prototype modelling in assisting to optimize the potential of urban development.

Methodology

Besides the changes of property prizes due to variations in demand and supply of urban development, property demand is related to predicted pollution and commuting time. These 2 major factors which occupants in a particular area are affected by traffic congestion, namely time delay in travelling and environmental impact on the local noise and air pollution. A case study on Texas, USA suburban cities by Long Wen et al (2013). by show that an increase in one additional minute on average commuting time raises 1.9 dollars less housing price per square foot (p- value: 0.038). For air pollution a case study centered in Shanghai, China by Yajing Li (2020) finds that residents in areas with relatively poor air quality are more willing to pay for clean air. A case study for the City of Bari, Italy by Morano et al (2021) found that a building's location characterized by a noise high level causes a reduction in residential market values. The level of tolerance for these factors must embedded in the proposed research modelling.

Impact due to Travel Time

One of the major contributions of road user costs is travel time which is a function of travelling speed. A study on the traffic outflow from Klang Valley, Malaysia by Nik Hashim Nik Mustapha et al, (2016), compares the maximum speed and traffic density. According to the study, speed of on the studied highways which somewhat higher exhibited the least congestion level in term of density. A study by Yu Sang Chang et al, (2018) find for cities with population more than 5 million people, as the size of population grow 1%, the congestion level experienced by drivers will increase from 0.338% to 0.424%.

In order to study travel time to the intended property, a transportation modal survey needs to be carried out to determine the percentage of those affected by congestion. If the property is next to a transit station then congestion may have less impact, when compared those using personal car or public transport utilizing roads. It must be found how many of the occupants are effected by congestion. For example, motorcyclists which is associated by lower income groups are more tolerable to congestion when compared to personal car users. The mode of transportation is related to income and education level demonstrated by a study by Mohammed, Ahmed M et al (2015) .

Impact due to Environment

Another important is the environmental impact due to noise and air pollution coming from traffic congestion. Congestion will slow down traffic which in turn causes are pollution in the area. One study Hwang et al (2020) found that emission levels were the highest when a vehicle stopped and lowest when the average speed was 65 km/h. A case study by Yu et al (2021) on measurement of air quality in the traffic congestion area on the Hsuehshan tunnel and at the Toucheng interchange, Taiwan recorded higher maximum values during rush hour traffic.

In terms of noise pollution from traffic, a study by Herni Halim et al (2014) on the Sungai Besi Expressway and Duke Highway in the Klang Valley, Malaysia found that heavy traffic flow highway recorded higher noise level compared to low traffic flow highway.

Both of these factors are further integrated through the land use patterns which is obtained from i-PLAN. Using the concept of Overlay Mapping methods, all the figure based data are expressed in graphical form based on different weightages among the data components, and correlation study is conducted to justify the validity of the outcomes from the model. The model framework of the Congestion-Property Price Index is illustrated in Figure 1.

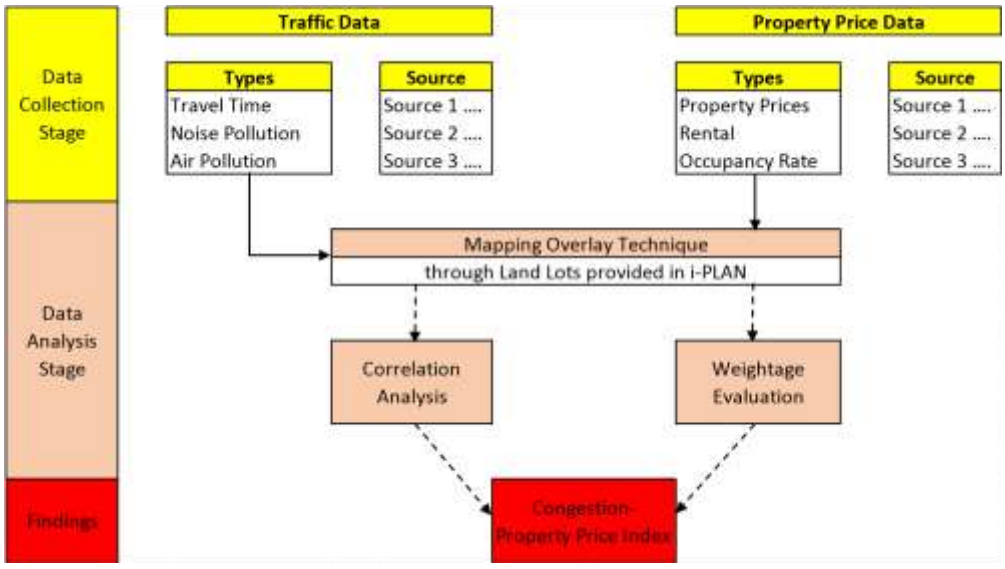

Figure 1. Modelling Framework of Congestion-Property Price Index

The preliminary parameters in the model consists of (i) Traffic Data which includes (1) Travel Time, (2) Noise Pollution Level and (3) Air Pollution Level; which (ii) Property Price Data which includes (1) Market Prices of the properties, (2) Rental rate of the properties and (3) Occupancy Rate of the properties. The data on these parameters can be then assigned to land lots according to the online database, called i-PLAN, according to their proximity. The parameters can be justified using the average values or identified indices that will be matched and mapped into the land lots displayed in i-PLAN, as shown in Figure 2 below.

Figure 2. Land Lot Information provided by i-PLAN

Correlation are then studied to match with each property lots based on its usage and also location from the traffic. Appropriate weightage is given to classify the importance of each parameters using the approach of Analytical Hierarchy Process (AHP). The outcomes of the analysis are displayed in tabulation format based on the zoning and district identified as highlighted in Figure 3.

Zone	Traffic Data				Property Price Data				Index
	(1)	(2)	(3)	Total	(4)	(5)	(6)	Total	
1a-z …	=a*(1)	=b*(2)	=c*(3)	A	=d*(4)	=e*(5)	=f*(6)	B	A//B
2a-z…	…	…	…	…	…	…	…	…	…
3a-z…	…	…	…	…	…	…	…	…	…
4a-z…	…	…	…	…	…	…	…	…	…
5a-z…	…	…	…	…	…	…	…	…	…
…	…	…	…	…	…	…	…	…	…

Figure 3. Prototype of Traffic Congestion Index based on Property Price Changes

Weightage of evaluation are distributed to the six parameters based on AHP analysis as shown in Figure 3 labelled as (1), (2) …. (6). Each condition of the sub-zone, such as Zone 1a, 1b, 1c …. etc. are scaled accordingly such as a, b, c ….. Both accumulated weightage of Traffic Data and Property Price Data by each sub zone are obtained as shown as A and B accordingly. Each subzone are then compared the relationship between A and B as stated in the final Index column. After this, all the indices of each sub-zones are identified. These values are further assessed and generate a composite index value for Zone 1, after conducting Hypothesis Testing to confirm its validity. This applies to other zones, such as Zone 2, 3, 4 … etc. Finally, after all the composite index values of Zone 1, 2, 3 … etc are obtained.

Hypothesis tests are conducted once again to justify the validity of the index values for each different zones based on its traffic condition and development status.

Results and Discussion

This model framework acts as a prototype to provide a gross projection to estimate the simulation of property price changes due to the traffic congestion factor, which may bring other environmental issues such as traffic noise and pollution, besides the social economics issues, which may lead to productivity and resources utility. Through this operation of prototype, a set of estimation standards with different index values for different development status and traffic condition can then be used as important inputs or reference for the developers to justify the potential of land development of particular locations and land lot.

Conclusion

In conclusion, it is possible to integrate the parameters relating to traffic congestion and property prices into a comprehensive framework towards development of prototype modelling which is beneficial for urban development planning.

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