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Structural, Locational and Environmental Attributes effects the Residential Property Value in Flood Risk Area

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Structural, Locational and Environmental Attributes effects the Residential Property Value in Flood Risk Area

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Abstracts. The arts and science in determining the residential property value make property value has evolved due to the changing in external factors such as economy, environmental and social. This research is aim to determine the residential property value by taking into account the economic attributes that could affect the value of residential property in flood risk areas. The economic attributes consist of structural, locational and environmental attributes involved in residential property valuation in relations with flooding. This paper will discover the significance and effect of each economic attributes in determining residential property value in flood risk area. An extensive review of previous studies in economic valuation of property for different floods disaster studies. It is considered to be the main restrictive factor resulting in lack of empirical studies in this field. Practitioners and researchers will find this study useful in developing an improved understanding of the economic valuation of flooding. The finding reveals that the economic attributes response to floods for a residential property value with positive, negative and none expected effects.

1. Introduction

Various factors can affect property value and market price. The factor that very significant to make changes in property value and market price such as location, building specification, surrounding facilities, and amenities provided at the residential area. Flood considered one of the most common and widely distributed natural risks to life and property (Balica et al., 2013). Flood considered the common disaster affecting millions of peoples around the world after the earthquake and tsunami.

The impact of the flood on residential property damages can divide into two (2) types, such as flood and property characteristics. Based on the previous studies identified, there are few or no consideration is given to the flood characteristic when assessing or valuing the residential property to determine the current market value (IVSC, 2011). The damage caused by the flood is considered by many to be an easy problem to solve, but it is a complex phenomenon (Soetanto & Proverbs, 2006) to the valuer and property owners. Due to the rapid development of residential projects, the property players and the

government need to have a responsibility to avoid developing residential projects in the flood-prone area.

The damages from a natural disaster (floods) have a significant impact on the property value, development and investment decision for the stakeholder and property players in the real estate industry and practices (Cradduck, 2016). Studies have found evidence that flood risk gives impact and damages to the property (Albano et al.,2017), including residential and industrial areas.

Evidence has shown in other countries, given scenarios of a 0.5% or 1% flood-risk, valuer would make yield adjustments on investment valuations in the range 0.5 – 1.5% on a base yield of 10%, which would result in capital value reductions of around 5 – 15%. An increase in flood-risk driven by climate change could, therefore, have a significant value impact in affected areas (Kenne et al. 2006).

The expertise of valuers and real estate agents, all relevant variables influencing real estate values were weighted and synthesised in a set of cardinal indicators.

2. Research Methodology

The research methodology is presented in Figure 1. The research aims and objectives were achieved through a literature review and analysis of previous research from local and international studies. The methodology is designed by separating this research works into three (3) main stages as below:
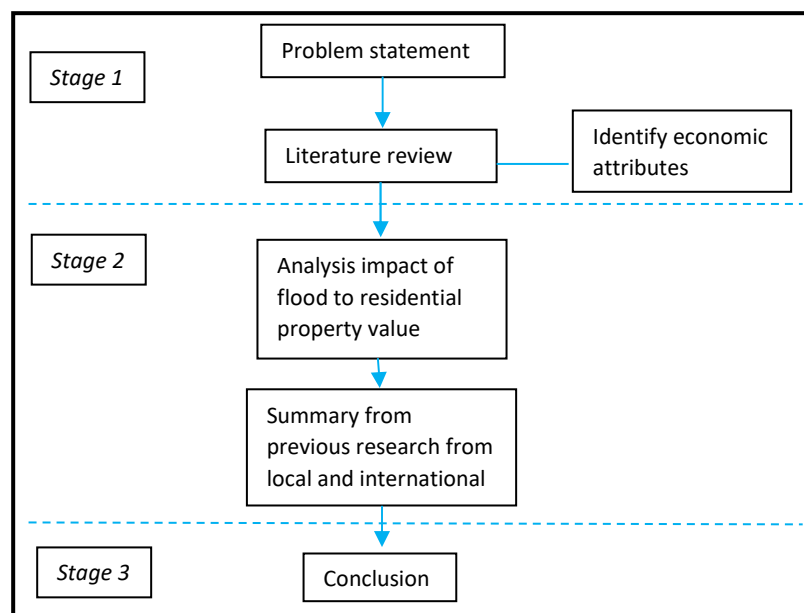

Figure 1: Research Methodology Flowchart

Based on Figure 1, there are three (3) stages involved in completing the research, as follows:

Stage 1

During the first stage, the problem statement, objectives and research methodology will be determined. The investigation begins with a literature review relating to flood-risk and property, examining previous research journals and reports. The literature review covers overseas and local experience and focuses on flood disaster and the impact on property value.

Stage 2
The impact of flooding on property value needs to be determined at this stage. The literature review analysis and summary of prediction on economic attribute factors that have affected property value due to flood disasters need to be analysed based on previous studies from local and international scenarios.

Stage 3
The determination of economic attributes that are significant in valuing residential properties needs to be considered in the valuation process. Besides, the impact of flooding also needs to be determined to make sure that valuers have a full understanding and knowledge of the value, starting from the initial inspection towards preparing the valuation report. As the final stage, these findings can be a benchmark to valuers and property players while carrying out a valuation inspection and assessing flood risk for residential property.

3. Economic attributes are affecting the residential property value in flood risk areas.

Residential property considered a basic human need as a safety shelter (Silva, 2010) for the community and families. The United Nation's Social program of housing in urban area refining the concepts in 1992 says that "A house provides not only shelter for a family, but refer to house purchase intention consists of house features, living space, distance and environment (Chia et al., 2016)

Nowadays, the demand for low-cost housing in the urban area increased due to population growth, urbanisation and industrialisation factor (Huong & Pathirana, 2013). Therefore several researchers have studied the determinants of the residential property value in the real estate industry (Abidoye & Chan, (2016), Gwamna, et al. (2015), Adegoke (2017).

The highly significant attributes will use in the formation of economic valuation model development in determining the residential property value considering the flood impact based on the literature review survey, which the summary tabulated in Table 2. The economic attributes can divide into three (3) categories, such as (i) Structural (ii) Locational and (iii) Environment.

3.1. Structural attributes
Structural attributes are referring to the building design (internal and external), ownership, space, and material used for the residential property. The building specification for the residential property consists of a number of bathrooms, bedrooms, parking space, living area, swimming pool, age of the house, building size (McKenzie & Levendis, 2010).

Some titles of the property impact as positive while others are a negative impact on property value. For instance, in land tenure (Mitchell et al., 2015) itself, the freehold property carries a positive effect on property value compare to a leasehold property. The age of the house also has a negative impact on property value (Clapp & Giaccotto, 1998). Numerous study reveals that the specification of the residential house, including the number of bedrooms, bathroom, floor area is positively related to the sales price of the house. Most of the house buyers willing to purchase a house and pay more for space especially functional space (Aluko, 2011).

Since the structural attributes are the main factors in determining the property value, the model development has considered the most significant attributes such as age, building size, land size, and property condition in this research.

3.2. Locational attributes
In valuation, the locational qualities refer to the distance of each of the facilities and amenities at the neighbourhood area to residential property (Gallimore et al., 1996). The attributes consist of the neighbourhood quality amenities provided by the government to the residential area such as school,

convenience store, hospital, LRT /MRT, a mosque and recreational area. All facilities provided in the neighbourhood area have a positive impact on property value. The development of the industrial area close to the residential area will have a negative effect on property value (Ismail et al., 2016). As a summary, this research considered the factor of distance to highways and convenience store as a main significant factor in contributing to the model development.

3.3. Environment attributes

The environmental attributes refer to the externalities factor such as crime rate, disaster-prone area (flood and earthquake) and greenery area (Netusil, 2015). The environment attributes that are more often evaluated and are believed to have a considerable impact on natural disasters (flood) and real estate value are related to the flood-prone area. The environmental attributes and residential area located at the highest crime rate also will have a negative impact on property value (Sasaki & Yamamoto, 2018).

Flood attributes generally refer to the level of flood that will give impact (Lamond et al., 2010) to the structure of the building or area. Numerous study has indicated the level of flood based on the frequency, depth, and duration of flood events. The flood events will have a negative impact on property value (Aliyu. et al.,2016) and give damages to the building and flood-affected area (Osti & Nakasu, 2016).

UK–based results show that the events of the flood-affected the value of the property, the effect is marginal in which the properties have not flooded even though they are considered risky. Recent flood events may result in a reduction in the market value of about 12%, despite the severe floods in 2001 resulting in a 20% reduction in house prices in Maidstone, Kent, while the less severe floods in Sussex have minimal impact (Kenney et al., 2006).

J Lamond et al., (2005) reviewed fifteen (15) studies that have to find in floods effects to residential property value in the United States of America. The author extracted the impact of floods in residential property value, and most of the studies show that the flood has a negative impact and reduce the property price between 2.9% to 12%. A total of four (4) studies shows there is no impact of the flood on residential property value. This finding indicates that the flood attributes are considered to have a significant effect on the residential property value at flood plain areas in Table 1.

The flood attributes are the most significant in valuation model development that consists of flood duration, frequency, and depth. The data of floods from the Department of Irrigation and Drainage Malaysia be the primary sources for this research.

Table 1: Summary of finding from US flooding studies

(Source: J Lamond, et al., 2005)

In model development, this research considered the natural disaster (flood) attributes as a significant attribute in this research. The relationship between each category of attributes shown in Table 2.

Table 2: Literature review summary for economic attributes

	Attributes	References
STRUCTURAL ATTRIBUTES	Age of house	Diakakis, et.al, (2017), Chiang, et. al, (2015), (Hansen, et.al, (2015), Posey & Rogers (2010)
	Floor/building size	Diakakis, et al., (2017), Cupal (2015), Chiang et al., (2015)
	Land size	(Cupal, 2015), Sirmans,et.al,(2006)
	Tenure / title	Candas,et.al,(2015)
	Type of house/building	Gharbia et al. (2016)
	Building material	Diakakis, et.al, (2017)
	Number of bathrooms	Hansen, et.al, (2015), Posey & Rogers (2010)
	Number of bedrooms	Hansen, et.al,(2015), Amenyah & Fletcher (2013)
	Parking space	Sirmans,et.al,(2006)
	Living area	Posey & Rogers (2010)
	Garage	Hansen, et.al,(2015), Cupal (2015), Sirmans,et.al,(2006)
	Swimming pool	Sirmans,et.al,(2006)
	Air conditioning	Sirmans,et.al,(2006)
	Property condition	Diakakis et al., (2017), Cupal (2015)
	Sewerage	Merz, et.al, (2010)
	Elevator / Lift	Candas,et.al,(2015)
LOCATIONAL ATTRIBUTES	Education Institution	Downes & Zabel,(2002), Clark & Herrin (2000),
	Park/lake	Kovacs & Larson (2015), Hansen, et.al, (2015), Luttik (2000)
	Golf	Netusil (2015)
	Mosque / Church	Faris (1985)
	Convenience store	Chiang, et. al, (2015)
	Hospital	Candas,et.al,(2015), Chiang, et. al,(2015)
	MRT / LRT Station	Chiang, et. al,(2015), Dziauddin,et.al (2013), Andersson,(2010), Bowes & Ihlanfeldt (2001)
	Bank	Chiang et al. (2015)
	Bus Rapid Transit (BRT)	Mulley & Tsai (2016)
	Industrial area	Ismail et al., (2016), (Beekmans, et.al, (2014)
	Commercial Area / Mall	Candas,et.al,(2015)
	Sea / River	Cutter, et.al,(2015), Candas,et.al,(2015), Netusil (2015)
	Highway / Road	Candas,et.al,(2015)
ENVIRON MENT	Neighbourhood greenery	Luttik, (2000), Harrison, et al. (2001)
	Crime rate	Sasaki & Yamamoto (2018), Kousky (2015), Bello & Moruf (2010)
	Earthquake zone	Hansen, et.al, (2015), Candas,et.al,(2015), Naoi, et.al,(2009)
	Floodplain	Newburn & Berck (2015), Hansen, et.al, (2015), Bin & Polasky (2007), Earnhart (2006)

4. Expected effects of the economic attributes in flood risk area

The hedonic-based regression approach has been employed extensively in the housing market in most developed countries. Based on the past literature, this method to investigate the relationship between house prices and housing characteristic (Babawale, 2012). The main goal of the hedonic assessment model is (i) to clarify the formation of property assets (residences) by identifying significant attributes response to property prices, (ii) to isolate and measure the effects of various attributes such as floods, structures, real estate value, (iii) to account for changes in the process of price formation throughout the region or over time.

The analysis of data on the economic attributes using linear regression which were carried out using Eviews software and presented inferentially as descriptive statistics using the hedonic price model. The dependent variable (property value) and independent variable (flood, structural, locational, and environmental attributes) used in hedonic model analysis with their respective code and measurements. The expected results for the study based on the previous research as Table 3 below:

Table 3: List of the predicted effect of housing attributes in Hedonic Price Models.

	Attributes	The expected effect on housing price
Locational	Distance from CBD	-ve
	View of the sea, lake or rivers	+ve
	View of hills/valley/golf course	+ve
	Obstructed view	-ve
	Length of land lease	+ve
Structural	Number of rooms, bedrooms, bathrooms	+ve
	Floor area	+ve
	Basement, garage, and patio	+ve
	Building services (e.g., lift, air conditional system)	+ve
	Floor level (multi-storey building only)	+ve
	Structural quality (e.g. design, material, fixtures)	+ve
	Facilities (e.g., swimming pool, gymnasium, tennis court)	+ve
	Age of the building	-ve
Neighbourhood	The income of the residents	+ve
	Proximity to good schools	+ve
	Proximity to Hospitals	?
	Proximity to places of worship (e.g., mosques, churches, temples)	+ve
	Crime rate	-ve
	Traffic/airport noise	-ve
	Proximity to Shopping Centres	?
	Proximity to Forest	?
	Environmental quality (e.g. landscape, garden, playground)	+ve

+ve: a positive impact on housing price
-ve: negative effect on housing price
?: varies from place to place, the actual impact is an empirical question
(Source: Chau & Chin, 2003)

Chau & Chin (2003) reveals that the effects of locational, structural, and neighbourhood-related housing attributes on property prices are analysed and give different results to housing prices. As a summary, most of all attributes are providing a positive effect on housing prices except the obstructed view, age of the building, crime rate and traffic/airport noise that will have a negative impact. The impact of distance to shopping centre and forest varies from place to place based on the locality of the neighbourhood area.

In considering flood attributes in valuation models, there is an empirical and statistical analysis of the property transaction data and attributes involved in valuing a residential property. Randeniya et al. (2017) developed a hedonic price model to estimate the implicit price of housing attributes in the urban neighbourhood area in Sri Lanka. The finding reveals that six (6) attributes as design type of house, distance to the local road, quality of infrastructure, garden size, number of bedrooms and age contribute to estimating the value of the residential property. Similar to Fridgen & Shultz (1999) the influence of the threat of flooding on housing value in Fargo, North Dakota and Moorhead, Minnesota, reveals that the Hedonic Valuation Method (HVM) was used to regress against the structural, neighbourhood and environment indicators and three flood risk variables. House in the 100-year flood plain sold after the 1997 flood also had a statistically significant and negative influence on housing value. Such home on average sold for $10,241 less than similar home outside the 100-year floodplain ad sold before the 1997 flood.

Hayrullahoğlu et al. (2018) in their study, related issues of the hedonic valuation model in housing markets were analyzed using hedonic models developed for the Cukurambar Region in Cankaya District of Ankara Province. The conclusion is that the structural attributes have a higher (46%) contribution overvalue compared to environmental and spatial characteristics. Several studies have applied a hedonic pricing model as tools to predict the property value and evaluate various attributes (Ajide & Kareem, 2010) such as environmental amenities, open space, water quality (Walsh et al., 2017), flood risk (Kousky, 2015), urban improvements (Rosato et al., 2017).
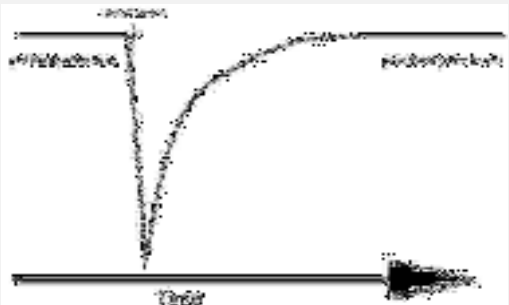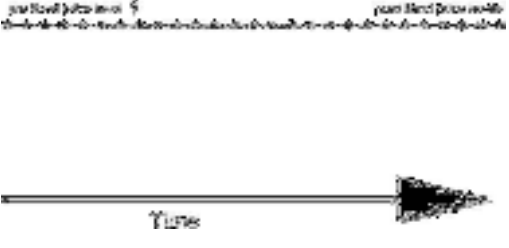
5. The scenario on the impact of the flood on residential property value
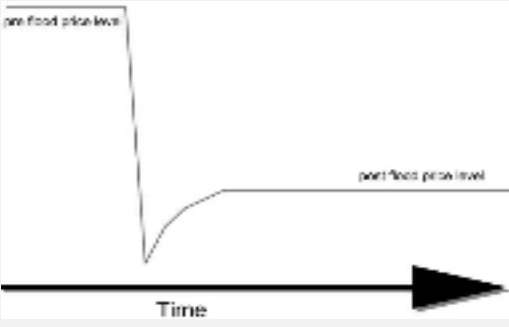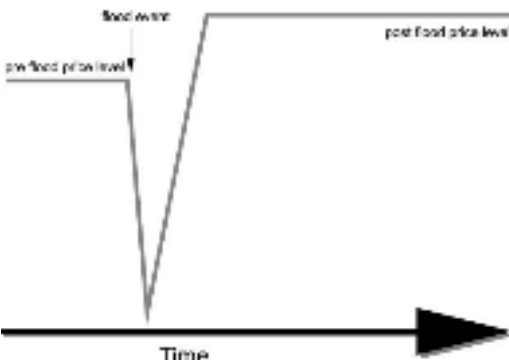
Natural hazard (floods) scenario given a negative impact on land values during flood events, with the degree of influence depends on the frequency and severity of the hazard. The main factor in determining the effects of the flood depends on the recurrence interval of flood frequency events. The property with repeated flooding does not have enough time to recover before the next flood event, and the land value remains low (G. A. Tobin & Newton, 1986).

In some studies found little difference in property value between flood-liable properties and a similar one that is flood-free properties. The property value tends to reduce when there are not floods during a specified period (Eves, 2002). Besides that, (Harrison et al., 2001) found that since the National Flood Insurance Reform Act NFIR in the year 1994, the findings show the increasing importance of flood zone location. The property located in the flood-liable area will reduce the property value during the property transaction. However, according to Yeo (2003), flood events can have an impact on all the property values of the whole communities, even in that area, which is not flood-liable.

The impact of a natural disaster (floods) on residential property value can be visualised clearly in Table 4.

Table 4: The scenario on the impact of the flood on residential property value

No.	Flood scenario	Descriptions
(a)	One-off or infrequent flood	G. A. Tobin & Newton (1986) present an integration of flood hazard and urban economic research to indicate the land value based on the time and frequency of flood events.
(b)	Floods affect permanently capitalised	(Eves, 2004) the recovery happens as people collectively forget about flood risk. Flooding becomes a regular event in a particular area, and housing prices already capitalised, and individual flood events might reveal no effect to the property value.

(c)	Floods affect becoming capitalised	This situation might happen when the first flood occurred in a new residential area and no previous expectation of flooding. The floods event will permanently change the expectation of residents towards the property value.
(d)	Betterment after a flood event	Tobin & Montz (1995) indicates that the property value increase after a flood event. For example, before the flood, the building is considered as the old building. Due to the reinstatement of property causes good and make changes to the building in terms of specification and building decoration that will increase the value of the property.

(Source: Lamond & Proverbs (2006)

6. Conclusion

Natural disasters (floods) cause various direct and indirect damages to the community and properties. Many researchers tried to identify the main factors of flood causes to prevent the features from damages, while minimal efforts have been made to specifically investigate the relationship of a natural disaster (flood) in valuation practice in determining the property value.

In Malaysia, there are limited studies conducted in the real estate industry about factors affecting residential property prices on the impact of floods. The consensus from the expert panel is needed to identify the significant factor that needs to consider for this research as an alternative research technique where the traditional method is not sufficient and applicable.

Based on the literature, there are three (3) types of attributes involved in property valuation, and each of the attributes has a different impact on property value. Some of the attributes have a positive effect, such as building features and material, the location of property and amenities provided. Besides that, few attributes will have a negative impact on the property value such as the age of the property, environmental (disaster) and crime rate. As property stakeholders in the real estate industry, we need to make a vice decision in relation to investment related to property. The climate change risk and natural disaster that occurs in most of the countries in the world as an additional factor need to consider will have buy and sell transactions in the property market.

This study focus on the identification and evaluation of economic attributes that influence residential property value from the impact of a natural disaster (floods). The generalisability of the results of the present research is subject to certain limitations. The limitation is because of the study needs to have an

opinion from the expert panel that being practice in the real estate industry and academician as well. The best tool to gained information on the significant economic attributes was using the questionnaire for the expert and distributed by hand to the respective respondents.

Moreover, the results of this study reveal the most significant attributes that influence residential property value, but the reliability and validity of each category of attributes (structural, locational and environment - floods) need further investigation to reveal the contributory power of each category of attributes to residential property value formation.

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