

# The Influence of Flooding on the Value of Real Estate

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**Key words:** flooding, real estate, price, valuation

## SUMMARY

The issue of climate change and its consequences is all over the media and has moved up the political agenda. Occurrence and severity of natural disasters increases. Originated by heavy rain or snowmelt and sea level rise but also by extending settlement, flooding is one of the most common natural disasters in the world. For Germany predictions say that events that have occurred on average every 50 years in the past will take place every 25 years in the future. Flood damages on property can multiply and economical losses should not be underrated.

Price theory predicts that buyers will attempt to discount property prices for flood risk if they are aware of it. Home owners are not alone in their concerns about the value of their property. Valuation experts and mortgage lenders need to know about the value of property at risk to advise their clients and protect their investments. Literature research on national and international studies has shown that a flood event and flood risk in general influences the market value of real estate. But there exists a large spread when it comes to discount rates. In practice valuation experts use individual loadings or discounts based on their own experiences to consider the fact of flooding. Using specific numbers derived from comprehensive fundamental analysis would be a better alternative.

The general conditions on the value of the property market at the valuation date and the relevant property status at the quality date have to be considered. Flooding itself, location in a floodplain area or the risk of recurrent flood events affects the value of real estate. On the other side the positive effect of waterfront location have to be considered. Both effects overlap each other. That makes analyses even more complicated. There are several possibilities to include the influence of flooding in the real estate valuation process. These possibilities for adjusting (e.g. rent or cost of installing and maintaining) are introduced in this paper and described in detail on valuation methods used in Germany.

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## 1. Introduction

The risk of flooding has always been present for buildings close to rivers or coasts. But it has been growing in recent years. Major floods all over the world over the past decade have shown that flooding is a significant environmental hazard. New Orleans (USA) in 2005, Pakistan in 2010 or Thailand in 2011 are only some examples that illustrate the risk for infrastructure, local economy, housing, living conditions and not to forget for human lives. The substantial costs of damaging natural and built environment, of cleaning up and the following renovations run into billions.

Pryce et al. (2011) sees three important reasons for being able to predict the influence of floods on the house price. Householders do weigh up the costs and benefits of potential interventions. It refers to costs of insurance and also for investments for flood protection. As the subprime crisis in the US has shown housing plays an important part in the financial system. Changes in the values of real estate could have unpredictable consequences. Invest in real estate is a major source for saving for retirement. Flooding and in its extreme case the total destruction of the property could make pension plans unreachable.

Global warming will very likely increase frequency and intensity of natural disaster such as floods, storms and heat waves. Storminess and rainfall in combination with expansion of human settlement in floodplains leads to a higher number of homes located at risked areas. According to reasonable judgment flood risk seriously affects the value and amenity of your home or business property. Consideration should be given on a discount on the regular market value or other adjusting parameters within valuation. This paper points out these parameters and discusses their reliability.

## Climate change and flood risk

As already mentioned climate change and as a direct consequence global warming will increase frequency and severity of floods. Rising global average air and ocean temperatures will support the rate of evaporation and the water holding capacity of the air what results in an intensification of the water cycle. There will be more energy to drive storms and hurricanes (Stern, 2006; IPCC 2007).

There are a number of causes of flooding. Most commonly surface water flooding in times of heavy rain, river and coastal flooding will result in flooded property. In addition due to increase of global temperatures average sea level will raise. That will especially endanger regions situated just some centimeters above sea level. Even if dammed adequate increased groundwater can also destroy property and cause high costs. Areas with large coastal settlements, for example in South and East Asia, might experience dramatic disasters. For example Foresight (2004) predicts for the UK that the number of people at high risk from river and coastal flooding could increase from 1.6 million today to between 2.3 and 3.6 million over the

next 70 years. Based on predictions figure 1 shows the increase of returning flood events and the corresponding costs of caused damages. Events that have previously occurred in average every 50 years will take place very likely every 25 years (GDV, 2011).

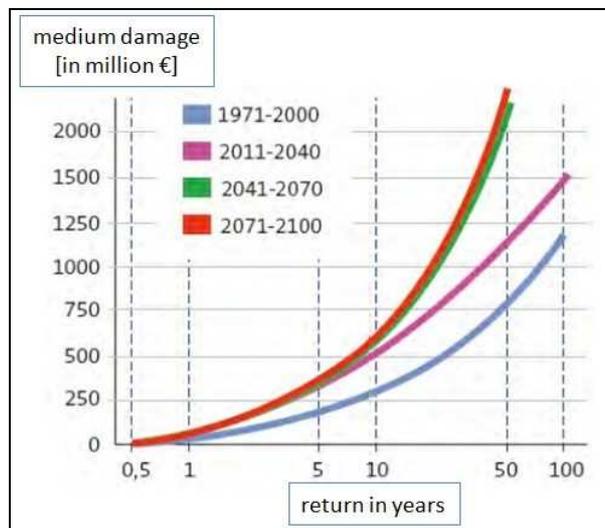


Figure 1 “Predicted return of flood events in the future” (based on GDV, 2012)

Specific statements regarding the exact risk of sea level rise or the growth of danger of flooding are difficult to make. Stern (2008) claims that an increase of the average air temperature will lead to sea level rise of 10 meters or more. Predictions derived from climate models differ depending on the used model. However, there is broad scientific agreement that these models offer a plausible spectrum of climate scenarios (Royal Society, 2010).

### Legal framework in the European Union and Germany

In times of growing population and limits of available area for settlement the pressure on remaining space is getting stronger. Very often the remaining areas used to be floodplains but the big construction boom in the past excludes this fact. An effective preventive flood protection does not only mean technical flood protection but also water retention in the area. Only through specific and binding legal regulations it can be ensured that in a case of a flood catastrophe the consequences stay as limited as possible. The European Union issued different directives (e.g. Directive 2000/60/EG or 2007/60/EG) for an effective flood protection which have to be implemented in the single states. The aim of these directives is a harmonized integrated water policy in Europe. Developing of flood risk maps and flood risk management plans are a top priority to support a coordinated management between affected states (Magendanz, 2011). As well known floods do not stop at borders between countries.

The water resource act in combination with federal acts for the states is implementing the European directives in Germany. According to these regulations floodplains and flood risk areas have to be designated and have to be kept free of any development in general. Exceptions underlie strict conditions (WHG, 2009).

## 2. Existing literature

There is several literature on the influence of flooding on the market value of real estate. Most of the publications are based on events and data from North America, the number for European research is more limited. Research goes back to the 60's. Table 1 below gives an overview about existing subject related literature back to the year 2001.

Author	Year	Study Area	Method	Result
Harrison et al.	2001	Florida, USA	hedonic model	floodplain location results in a discount between \$985 to \$2.100
Eves	2002	Sydney, Australia	comparison of mean prices of objects influenced by flood and objects flood free (t-test)	short term discount
Bin and Polasky	2004	North Carolina, USA	hedonic model	floodplain location lowers real estate values by 5,7 %
Troy and Romm	2004	California, USA	hedonic model	floodplain location lowers real estate values by 4,2 %
Hallstrom and Smith	2005	Florida, USA	repeat sales	decline of 19 % of housing prices in flood zones
Lamond and Proverbs	2006	UK	regression	no significant long term impact
Bin and Kruse	2006	North Carolina, USA	hedonic model	floodplain location lowers real estate values by 5-10 %
Bin et al.	2008	North Carolina, USA	hedonic model & spatial data	price discount depends on flood rate, lies between 6,2-7,8 %
Pope	2008	North Carolina, USA	hedonic model	floodplain location lowers real estate values by 3,8-4,5 %
Lamond et al.	2009	UK	repeat sales	temporary impact of flooding on property values, normal market value after 3 years
Pryce et al.	2011	different areas	analyzing housing prices in combination with findings of behavioral economics and sociology risks	uneven pattern of inertia followed by rapid tipping-point declines

Table 1 “Summary of studies on the influence of flooding on the value of real estate”

Main objective of the conducted studies is the price effect of a particular flood event or in general the risk of flooding (for example by designation of floodplain). Various methods from regression, repeat sales analysis to the hedonic approach (most often) were used to gather results. The studies reveal that the location of real estate in a floodplain result in lower real estate values compared to objectives outside of a floodplain. As you can see in Table 1 the rate of the discount varies in a wide range. Some studies also revealed that there is no negative effect or even a positive effect on the value of real estate (Babcock and Mitchell, 1980; Tobin and Montz, 1989). The authors explain their findings as a result of investments after a flood event that results in significant improvements in the quality of the real estate. Lamond (2009) figured out that flooding has only a temporary impact on property values and that after three years price has returned to their normal market level. For further information please employ the stated literature.

Valuation experts usually are aware of the risk of flooding and take it into account by a discount based on their own experiences. But specific numbers derived from comprehensive fundamental analysis would be the better alternative.

### 3. Market value of real estate

#### 3.1 Market value of real estate – general notes

The market value of real estate (developed or undeveloped) is determined by a large number of value-influencing factors. Next to the common conditions of the real estate market at the valuation date (also includes the economic situation) three quality components need to be considered (ImmoWertV, 2010). These are the location, usability (legal situation determined by regulations and laws) and property conditions (actual characteristics). Figure 2 gives an overview about the most important value-influencing factors. Depending on the object other factors not listed below might be considered in the valuation process.

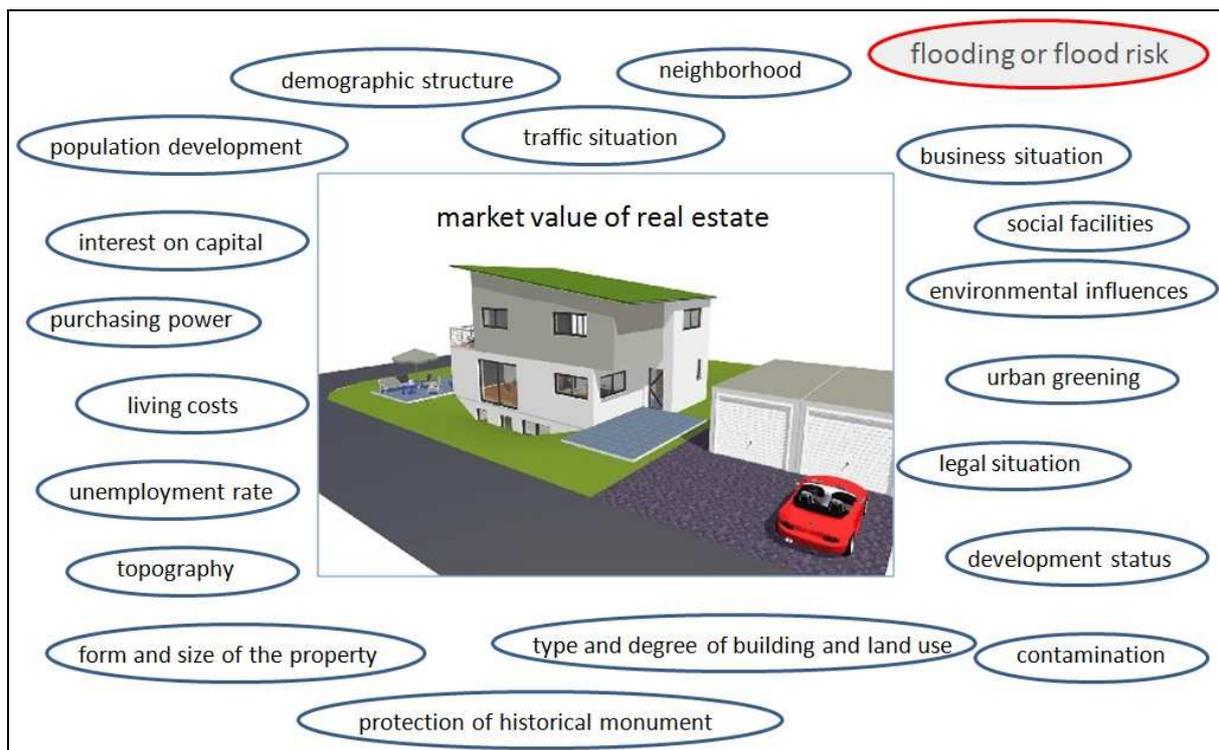


Figure 2 “Most important value-influencing factors of real estate“

Location includes external characteristics of the area (on a local and a spacious scale) as traffic situation, neighborhood (e.g. residential or business area) but also environmental influences. Location situation is crucial for determining the land value. Usability covers the legal situation as the development status as well as type and degree of building and land use and describes the condition of the property.

Flooding itself, location in a floodplain area (justified by a legal designation of the flood area for example through flood risk maps) or the risk of recurrent flood events can affect the value of real estate substantial. On the other side the positive effect of waterfront location have to be considered and taken into account the calculation. Chapter 2 gives an indication about the range for consideration in the existing international research. Based on the common valuation

methods used in Germany the single valuation components will be introduced and explained in the following. The statements refer to a local flood event. In case of a large-scale event, like in Pakistan in 2010, conditions might change substantial.

### 3.2 The impact of flooding on the market value of real estate

As we learned in the chapters before flood risk or the event of a flood can cause extreme devastation to real estate. The question is if this (recurring and very likely increasing) factor affects the value of real estate and if how strong the influence is. Although some studies has shown no affect or a even a positive one (Babcock and Mitchell, 1980; Tobin and Montz, 1989) the author believes in a negative effect. In the valuation process the flood risk factor need to be considered for example by a discount or a reduction of operating life period. The reduction in the real estate value might range from negligible to severe. Depending on different object specific circumstances like presented in figure 2. In general the common conditions on the property market should not be influenced by a local and time limited flood event. A large scale event like in Pakistan in 2010 will affect the whole real estate market.

Before talking about the negative effects that have to be considered in the valuation process the positive effect of water front location must be looked at closely. Water sited location is a not to underestimated advantage of an object (e.g. view, recreation) and is deemed to be exclusive. An increase of value has already been confirmed (Sprengnetter, 2012). Geppert (2006) for example detected in the state of Brandenburg in Germany a factor of 1.6-3.0 on the regular land value for property with a direct access to a lake or a river. Positive and negative effects of water front location do overlap.

In-depth analysis very often fails due to the small numbers of purchase prices (conducted by land valuation boards and collected in the purchase price collection). Especially in exclusive residential areas transfer of ownership is rarely. If derived factors from fundamental analysis for consideration of flood risk are not available over approaches (respectively adjusting screws/components) need to be used. In the following these components will be introduced and explained with regard to valuation methods used in Germany according to the German regulations. These regulations are the "BauGB (2011), ImmoWertV (2010) and several directives as WertR (2006) or Sachwertrichtlinie (to be published in 2012)". The common valuations methods justified by ImmoWertV are the comparison, replacement cost and the discounted cash flow method.

#### a. Reduction of the remaining operating life period

Building structure of periodical flooded objects is more affected by negative ascendancies. Chances of occurring of building defects are higher. That is why the total operating life period is lower compared to objects that did not experience a flood event. Impairment hardly depends on the period of being underwater and the altitude of the water level related to the building. At the same time a shorter total operating life period results in a modified shorter remaining operating life period. This needs to be taken into account in the valuation calculation process and will lead to a lower market value.

b. Reduction of the amount of the rent

Basis for the calculations in the discount cash flow method is the achievable rent. In case of flood event the absolute use of space on the property (refers to land outside the house as well as inside) is limited for unknown period of time. In general the limitations in the use refer to the ground floor for the period of flooding as well as the necessary reconstruction time. The rent is to reduce or unconsidered completely depending on the level of devastation. Business building will be affected more than residential because the ground floor is usually sales floor with the highest sustainable rent. Another “adjusting screw” in the discount cash flow method can be the property yield. Flood risk could be included by increasing the rate.

c. Increase of management costs

Management costs include expenses for maintenance and repair, operating, vacancy and collection loss and administrative work. All four factors increase in case of a flood event. The amount of loadings depends again on the type of the object (business or residential), interval and water level of the flood.

d. Consideration of actual costs for 100 percent insurance cover

There is some evidence that the increase in flood risk and flooding is affecting insurability of residential properties. In general insurance cover is usually required for mortgage lending. The availability, terms and conditions attached to the insurance contract and the level of premiums are influenced by fact of flood risk (Wordsworth et al., 2005). Lamond et al. (2009) found that insurance remains available for householders. Also that flooding is not the major factor in determining the level of premiums in the UK. Calculation of the premium rate for indemnity insurance is a very individual process.

In Germany the level of flood risk influences insurance premium. Information about the level of risk can be received by using the system “ZÜRS Geo” (ZÜRS Geo, 2012) provided by GDV (2012). Insurance cover for buildings located in zone four (highest threat, flood occurs statistical once in 10 years) is hard to get and depends on the insurance company. Premiums are also high. Under the assumption of a 100 percent insurance cover, the market value reduced by the costs for this insurance type (capitalized for a specific period of time) would theoretically the threat by a flood event neutralize. But the essential question is when the next flood will occur.

e. Consideration of actual costs for restoring the original condition of the property

In case of an instant flood event the market value is to reduce by the costs that are necessary to restore the conditions without flood. An important part of this overall reduction are the costs for restoring the original condition of the property (other costs for example for psychological harm caused by a flood event are even harder to monetize). As described before the essential question is when the next flood will occur and what scale it might have.

A relevant question is if the damages caused by the flood are eliminated completely. Suspicion of hidden damages, reservation and possible aversion might justify a mercantile decrease in the market value.

Another approach could be the consideration of costs for manufacturing a flood-resistant building (outside facilities excluded since generally they play a minor part) by installing flood defenses to the property to ensure peace of mind and minimize any adverse effects. That could be for example a water resistant basement (that includes also the threat through rise of groundwater level), a system preventing backwater from sewerage or installation of special demountable door, window and all opening guards (RICS, 2010).

Exists already flood-resistant than this has to be considered in a positive way, e.g. through a supplement in the amount of the additionally investments.

#### **4. Summary and conclusion**

Sea level rise, increase of storms and heavy rain that result in flooding and a general higher flood risk, this are the consequences of climate change we have to expect in the future. Even if some studies did not show an influence on the price of real estate, most of the findings of investigations see a negative influence on the market value of real estate by flooding. This paper has shown how the fact of flooding can or rather have to be considered in the real estate valuation process. Important is that there is no multiple consideration what would reduce the value unjustified.

Still many questions remain unanswered, for example for the precise amount of the discount. It depends on many factors. Table 1 gives a hint about the range of discount. Primarily the specific characteristics of an object but also the period of being flooded and the altitude of the water level play an important role. Many factors overlap (positive and negative) what makes derivation of flood risk as a separate factor on basis of fundamental data for example by using a hedonic approach so difficult. Even harder are statements to make to flood risk in general. No one knows when and in what extent the next flood event will occur or if precautions will be sufficient.

Further research on a broader range of data is needed. Alternative approaches using information and data for example as findings of behavioral economics and sociology of risk (Pryce et al., 2011), life satisfaction (Luechinger and Raschky, 2008) or GIS-based view measures (Bin et al., 2006) might result in more solid outcomes.

Climate change means that natural disasters will be more common in the future and financial losses will increase. Valuation of endangered real estate has to consider the aspects of flooding and flood risk.

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## BIOGRAPHICAL NOTES

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