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Effects of Climate Change on Real Estate Value

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ABSTRACT

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Through this paper, the theme relating to the effects of climate change on the property value will be addressed. Indeed, the real estate market value is negatively affected by climate change impacts. Flooding, drought, water scarcity, water quality degradation, sea level rising are factors, which affect the property prices. An analytical approach is adopted to examine this issue based on laws texts, courts decisions, appraiser's reports and the research findings in the field.

The study is engaged in a legal doctrinal analysis of law and scientific research findings. It analyses decisions from courts and tribunals related to the impacts of climate change on property prices in order to establish their views of climate change consequences in determining real estate values and who bears the responsibility of property depreciation.

Keywords: climate change, effects, real estate appraisal, appraiser, property value.

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Effects of Climate Change on Real Estate Value

Analyse D'impact des Changements Climatiques Sur la Valeur du Foncier

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ABSTRACT

The human activities are the main cause of climate change. The impact of this change is multiple on the environment such as: drought, water scarcity, salinization, frequent storms, glacier melting and sea level rising. Its impacts affects not only the whole population in the world but also the biodiversity. In addition, its negative effects are not limited to the environment; climate change touches the real estate in general and its value in particular.

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The study is engaged in a legal doctrinal analysis of law and scientific research findings. It analyses decisions from courts and tribunals related to the impacts of climate change on property prices in order to establish their views of climate change consequences in determining real estate values and who bears the responsibility of property depreciation.

This topic is proposed to not only assess the influence of climate change on the real estate appraisal and provide land appraisers with necessary tools to take into account the impacts of climate change but also to prevent the policy makers on how this scourge affects the economy

by decreasing the value of one of the most important sector.

Keywords: climate change, effects, real estate appraisal, appraiser, property value.

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RÉSUMÉ

Les changements climatiques ont pour origine principale les activités humaines sous la pression du commerce et de l'industrie. Ils se manifestent par une dégradation de l'environnement causant sécheresse, augmentation accrue de la salinité des sols, tempêtes fréquentes, fonte du glacier et élévation du niveau de mer. Ces impacts affectent l'ensemble de la population humaine ainsi que la biodiversité. Parmi les impacts néfastes sur l'environnement, nous voulons surtout attirer l'attention sur les effets négatifs sur le foncier en général et sur sa valeur en particulier.

A travers cet article, la question sur l'analyse d'impact des changements climatiques sur la valeur du foncier est soulevée avec tous ses enjeux et dimensions. En effet, la valeur du foncier peut diminuer à cause des inondations, de la sécheresse, de la salinisation des sols, de l'augmentation du niveau de mer et de la dégradation de la qualité de l'eau. Une approche analytique est adoptée pour traiter ce sujet en se basant sur le cadre juridique et jurisprudentiel, ainsi que les rapports d'expertise et les résultats de recherche dans ce domaine.

Ce thème est proposé pour non seulement évaluer l'influence des changements climatiques sur la valeur du foncier mais aussi pour mettre à la disposition des experts immobiliers les outils nécessaires et indispensables désormais pour tenir compte de l'impact de ces changements sur le marché immobilier devenu locomotive de toute économie en plein essor.

Mots-clés: changements climatiques, effets, expertise immobilière, expert, valeur du foncier.

It is worldwide accepted that the real estate business is one of the most important economic sectors in the world. Its value depends on many factors and appraisal approaches. Real estate appraisal is an issue of particular concern. It is the process of developing an opinion regarding the value of property based on the knowledge, experience, environment and professional assessment of value by real estate appraisers. The valuation is very subjective. To assess the property's value, it is crucial to assess the influence of factors on property market value.

Many factors can affect the property value such as physical factors: location, distance from center, features, conditions, facilities connections, environment (climate change in particular) and pollution. The second kind of factors is economic factors, which play a great role in real estate valuation such as supply and demand, interest rate, economic outlook, property market performance, investment potential. The third type of factors is social factors related to all social aspects, which affect the property market value such as demographic data, jobs ...

Many studies have examined the effects of various factors on real estate values such as location, transportation, conditions, and homes features. However, the energy is not much analyzed as factor of real estate value despite its great role in determining the property values. The energy can be considered as a price setting factor in market price of real estate.

In this study, we focused on the impact of climate change on real estate appraisal in order to provide real estate appraiser tools to assess the property value taking into account the climate change

phenomenon and its impacts on property market value. Then, some sub-questions are asked like how climate change factors increase/decrease the property values? To which extend, climate change affects the real estate appraisal and appraisers reports? and does courts take into account the climate change disasters in determining the property value?

It is a difficult task to determine why real estate prices differ and how much this difference can be attributed to particular distinguishing features such as drought, sea level rising, temperature increasing and its relationships with other factors. The theme is very important in order to highlight climate change aspects that decrease the real estate market value and provide practitioners (judges, real estate appraisers, expert witness...) some rules to assess the property value according to the climate change factors.

This paper makes two contributions to the literature. First, the effects of climate change on real estate value are not well analyzed in the literature out of the US. Moreover, when it is explored it studies the effects on scientific point of view not in legally way. Second, previous studies examining the link between climate change and real estate price using scientific approaches. However, our research is the first to examine the effects of climate change on real estate using analytical approach by treasuring scientific research findings and regulatory framework associated with courts decisions in the field. To the best of our knowledge, there is a lack of systemic approach on the effects of climate change on property value.

This paper aims to provide important implications for policymakers, property investors, homeowners, buyers, sellers, real estate appraisers, courts all over the world about property losses due to climate change and its risks.

In real estate sector, there are many factors that increase or decrease the property market value. However, the risk is rising exponentially due to climate change and damage that can cause. Damages due to climate change are increasing and hit high records in the last decade in many

regions in the world. For example in the US, climate change such flood, mudslides and wildfires cost more than \$300 billion in damage of residential and commercial properties¹. Climate change appears a new wild card in real estate market that called the costs of climate change. Sea level rise and other impacts of climate change have received some previous interest in the literature. Then, many researches have noted a significant negative relationship between climate change and farmland values².

According to World Bank reports updated in October 2021, 132 million people will be pushed into poverty by climate change over the next 10 years; 216 million will be driven to migrate within their own countries by 2050. Natural disasters cost at least 390 billion a year due to wider disruption caused to households and firms. Moreover, according to the Washington post, June 24, 2014, \$700 billion of coastal property could be below sea level by the end of the century and an additional \$750 billion could be at high risk (high tides) without new policies against climate change.

Not all of this information are just alarming but they are the alarm bells for policymakers, real estate investors, homeowners, real estate appraisers because real estate business is most vulnerable for climate change.

The paper is organized in two sections. First section talks about direct effects of climate change on real estate value. However, the second section is analyzing the indirect effects of climate change on property market prices.

¹ Olick O., (2019), Climate values change will crush real estate for investors who don't prepare, new report says, <https://www.cnbc.com/2019/04/08/climate-change-will-crush-real-estate-values-for-unprepared-investors-report.html>, accessed 22/12/2021 at 14h41.

² Schlenker W., Hanemann M. W., Fisher A. C., (2005), Will US agriculture really benefit from global warming? Accounting for irrigation in the hedonic approach, *American economic review*, 95 (1), pp.395-406.

I. DIRECT EFFECTS OF CLIMATE CHANGE

1.1. Rising sea levels

Rising sea level could be the origin of two problems for homeowners, which affect negatively the property prices. The first is the high risk of temporary flooding events and the second is related to risk of seeing the site ultimately being flooded (underwater).

Since 1993, global sea level has increased by an average of 3.2 mm/year and it is projected to climb by another 0.26- 0.82 meters by 2100³. The ocean would increase by 39 inches and homes would be swamped by the end of the century in many coastal regions. Homeowners described this situation as a “death sentence for ever trying to sell house” according to the Washington post, June 24, 2014.

A study from the proceedings of the national Academy of sciences of the United States of America confirms that 200 million people worldwide will be displaced by 2100 because of rising sea levels.

The study conducted by Bernstein states that sea level rise decrease the homes prices by 7% than comparable homes. Moreover, this study warns about increasing of sales in high risk areas starting in 2013. Therefore, the same study shows that the value of properties exposed to sea level rise is depreciated by 7% than observably equivalent unexposed properties equidistant from the beach and 4% of discount among coastal properties not projected to be flooded for almost a century⁴.

³ Walsh P., Griffiths C., Guignet D., Klemick H., (2015), Adaptation, sea level, and property prices in the Chesapeake bay watershed, National center for environmental economics, U.S. environmental protection agency, pp.1-33.

⁴ Bernstein A. Gustafson M. T., Lewis R., (2019), Disaster on the horizon: the price effect of sea level rise, *Journal of financial economics*, 134, pp.253-272.

In addition, findings of some research indicate that the value of homes located in the threatened sea level rise areas, unprotected by adapted structures (bulkheads, ripraps, groin fields...) decreases by 19 to 23% on average. However, protected homes see its value increase by 21%⁵. Other research findings have confirmed that property values within 5 miles of the coast decrease about 10% in months plagued by red tide due to harmful algal blooms. Moreover, property prices drop 1-2% further for each additional month a bloom persists⁶.

In addition, sunny day flooding is a new phenomenon related to climate change, which occurs without any precipitation and is driven only by lunar tides. This phenomenon causes losses to real estate values. For example, losses totaled \$337 million from 2005 to 2017 in Miami⁷.

The sea level rise is a factor that affects the real estate value. This factor is generally associated with flooding.

1.2. Flooding

Real estate market may be contorted by events such as flooding those changes the perceived importance of previously ignored risks⁸. The value of properties located in flood affected suburbs

⁵ Walsh P., Grffiths C., Guignet D., Klemick H., (2015), Adaptation, sea level, and property prices in the Chesapeake bay watershed, National center for environmental economics, U.S. environmental protection agency, pp.1-33.

⁶ Berchard A., (2020), External costs of harmful algal blooms using hedonic valuation: the impact of *Karenia brevis* on southwest Florida, Environmental and sustainability indicators, 5, pp. 1-12.

⁷ Rivera J., (2020) The Impact of Climate Change on Real Estate Valuations and Decisions, <https://www.capright.com/the-impact-of-climate-change-on-real-estate-valuations-and-decisions-2/> accessed 22/12/2021 at 14h50.

⁸ Lamond J., Proverbs D., Hammond F., (2010), The impact of flooding on the price of residential property : a transactional analysis of the UK market, housing studies, Vol. 25, N° 3, pp. 335-356.

decreases because of flooding risks⁹. Moreover, Flood affects negatively the property value and influences immediately the rental property market¹⁰.

Study conducted by Bin finds a significant price differentials after flooding events amounting from 6.0 to 20.5% for properties sold in flood zone¹¹.

The value of properties located in flood affected areas are really depreciated, this depreciation of value is about 9% regardless of the degree of damage caused by the storm¹². Other research findings reveal a depreciation of flood plain property by 6.2% than an otherwise similar properties situated outside the flood plain if the property was sold before the flood plain maps were available if not, the depreciation rate becomes 2.3%¹³. In the same context, many researchers examine large concrete structure to be used in order to reduce erosion and reduce climate change risks.

Finally, Daniel et al find that an increase in flood risk of 1% in a year corresponds to 0.6% decrease of homes prices¹⁴.

⁹ Rajapaksa D., Zhu M., Lee B., Hoang V., Wilson C., Managi S., (2017), The impact of flood dynamics on property values, Land use policy, 69, pp. 317-325.

¹⁰ Eves C., Wilkinson S., (2014), Assessing the immediate and short-term impact of flooding on residential property participant behavior, Nat Hazards, 71, pp.1519-1536. Doi: 10.1007/s11069-013-0961-y

¹¹ Bin O., Landry C. E., (2013), Changes in implicit flood risk premiums: empirical evidence from the housing market, Journal of environmental economics and management, 65, 2013, pp.361-376.

¹² Ortega F., Taspinar S., (2018), Rising sea levels and sinking property values: hurricane sandy and New York's housing market, Journal of urban economics, pp.1-48. Doi: 10.1016/j.jue.2018.06.005.

¹³ Samarasinghe O., Sharp B., (2010), Flood prone risk and amenity values: a spatial hedonic analysis, The Australian journal of agriculture and resource economics, 54, pp.457-475.

¹⁴ Daniel V. E., Florax R., Rietveld P., (2009), Flooding risk and housing values: an economic assessment of environmental hazard, Ecological economics, 69, pp.355-365.

1.3. Drought

Climate conditions matter in housing, land prices and rents. Drought is an important factor that impacts negatively and significantly real estate value.

The research finds an evidence positive relationship between increase in reducing drought severity and property prices. A 1% increase in rainfalls is associated with up 0.07% increase in real estate price and 0.05% in rents. In addition, a 1% increase in temperature reduces the real estate value by up to 0.99% and rents by 0.55%¹⁵.

Moreover, research conducted by Glaeser has confirmed that temperature and precipitation as climate-related amenity variables are very important demand-side determinants of real estate values¹⁶.

Furthermore, the drought lets real investors use some adapted materials. Therefore, research finds that 1% increase in construction costs is associated with an increasing of housing prices, housing rents and land prices by 0.76%, 0.67% and 0.89% respectively¹⁷.

The direct effects of climate change reduce the real estate value and increase the risks, which influence the property market price by affecting the offer and demand. Furthermore, the climate change has some indirect effects on real estate value.

II. INDIRECT EFFECTS OF CLIMATE CHANGE ON REAL ESTATE VALUE

2.1 Extreme weather

The climate change is the main cause of temperature increasing. Higher temperatures is not only the source of weather events but they increase the homes prices because higher temperatures is the cause of using more energy to air conditioning and fans and more water to keep lawns and landscaping alive¹⁸.

Moreover, climate change factors such as extreme temperatures, temperature difference, precipitation, relative humidity have a significant and positive impact on housing in China¹⁹.

In the same line, high global temperatures (longer summer heat waves) will extend the capacity of houses to air conditioning and increase utility costs. In addition, long periods of drought restrict building water usage and increase the chances of wildfires²⁰. Therefore, that phenomenon requires a higher resiliency of building materials. As consequence, the costs of construction increase and the value of real estate will be seen increasing.

The temperature rising does not affect residential properties value in hot regions but also in cold areas where the snow is an amenity that increase the real estate value. Therefore, research findings have confirmed that the prices of residential properties located around ski resorts in the western United States and western Canada are

¹⁵ Farzanegan R. M., Feizi M., Fereidouni G. H., (2019), Drought and property prices: empirical evidence from Iran, Marburg Centre for institutional economics, pp. 1-32.

¹⁶ Glaeser E. L., Gyourko J., Saiz A., (2008), Housing supply and housing bubbles, Journal of urban economics, 64, pp.198-217.

¹⁷ Farzanegan R. M., Feizi M., Fereidouni G. H., (2019), Drought and property prices: empirical evidence from Iran, Marburg Centre for institutional economics, pp. 1-32.

¹⁸ Dehan A., (2021), How does climate change affect real estate prices?, <https://www.rocketmortgage.com/learn/climate-change-real-estate-prices>, accessed 22/12/2021 at 14h00.

¹⁹ Huang D. J., Leung C. K., Qu B.,(2015), Do bank loans and local amenities explain Chinese urban house prices ?, China economic review, 34, pp. 19-38.

²⁰ Rivera J., (2020) The Impact of Climate Change on Real Estate Valuations and Decisions, <https://www.capright.com/the-impact-of-climate-change-on-real-estate-valuations-and-decisions-2/> accessed 22/12/ 2021 at 14h50.

reduced due to global warming and reduction in snowfall intensity²¹.

In addition of value depreciation caused by temperature increasing, this climate factor is almost responsible of wildfire, which affects the real estate value.

2.2 Wildfires

Wildfires have become a frightening reality in many countries of the world. Wildfires destroyed millions of hectares and thousands of structures last decade devastating people's houses. Therefore, this situation increases the real estate prices in the areas unaffected by fires²².

Clayton, analyzing literature related to climate change, confirmed that the value of real estate decreases from 5% to 14% depending on the proximity to the fire²³. This position is supported by supreme court state of north Dakota²⁴.

2.3 Algal blooms

Eutrophication phenomenon will be made worse by climate change. Climate change increases temperatures as is predicted to occur in many areas of the world. The blue green algae is more developed by both increased nutrients and high water temperatures and lakes with warm water. Moreover, the density of fish species eating zooplankton, microscopic animals very effective in

controlling algae evolution, are higher in lakes and reservoirs with warm water²⁵.

Excessive level of nutrients and warm water stimulate harmful algal blooms, which are more severe and more difficult to be controlled due to warming caused by climate change.

Harmful algal blooms occur in reservoirs, lakes, dams and estuary at different levels. The first is related to high concentration of nutrients (Nitrogen and phosphorus in particular), warm water and adequate light. The second is associated with drought because of decreasing of the volume of lakes and reservoirs. Therefore, the concentrations of nutrients in water is higher and fish stir up more sediments. The third level is in relation with very hot and sunny days without cloud cover. Those days help harmful algal blooms to form just below or on the water surface. Algal blooms are as much as five times as severe in drought years as in wet years²⁶. In general, drought influences the intensity of the harmful algal blooms in lakes, reservoirs, dams and estuary. Therefore, the harmful algal blooms affect the view and decrease the residential property prices as consequence.

A study performed in 2017 from Ohio state university estimated that algal blooms as result of warm weather cost Ohio homeowners who live near lakes \$152 million from 2009 to 2015²⁷.

²⁵ Havens K., (2018), The future of harmful algal blooms in Florida inland and coastal waters, TP-231, Sea grant college program, pp.1-4.

²⁶ Havens K., (2018), The future of harmful algal blooms in Florida inland and coastal waters, TP-231, Sea grant college program, pp.1-4.

²⁷ Williams G., (2019), How Climate Change Could Impact Your Home Value, <https://realestate.usnews.com/real-estate/articles/how-climate-change-could-impact-your-home-value>, accessed 22/12/2021 at 14h27.

²¹ Busic V., Hanak E., Valletta R. G., (2011), Climate change and housing prices: hedonic estimates for ski resorts in western north America, Land economics, 87 (1), pp. 75-91.

²² Dehan A., (2021), How does climate change affect real estate prices?, <https://www.rocketmortgage.com/learn/climate-change-real-estate-prices>, accessed 22/12/2021 at 14h00.

²³ Clayton J., Devaney S., Sayce S., Van De Weterin J., (2021), Climate risk and commercial property values: a review and analysis of the literature, UNEP FI available at atunepfi.org/publications/investment-publications/climate-risk-and-commercial-property-values.

²⁴ Edwin Schulz vs Adam Helmers, Supreme case N°. 20210025, April 28, 2021.

III. CONCLUSION

Many studies have found that climate factors reduce property value. This study differs from above mentioned research in at least two reasons. First, the study uses an analytical approach of regulatory framework, research findings, real estate appraisers, courts decisions, and real estate reports. Second, it provides real estate practitioners with tools to be used in assessment of property value object of climate change impacts.

Climate change creates a high risks area: sea level rising, flooding, drought, temperatures increasing, harmful algal blooms. Those phenomena decrease the real estate value in one hand and increase the cost of construction in the other hand. Therefore, increased homeowner's insurance costs are observed in high risk areas.

Climate change does not only affect the property value but also induces many events increasing risks. Then homeowners pay more for insurance. The insurance premiums are raising when extreme weather events are likely repeated.

Also, drought, flooding, sea level rising, extreme weather are the main causes of degradation of the biodiversity. As consequence, groundwater is contaminated by sea water intrusion and soils salinization is observed. Moreover, surface water quality is degraded in addition of water quantity decreasing. All those factors induce de real estate value depreciation due to climate change.

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