

## EFFECT OF EARTHQUAKE RISK ON THE REAL ESTATE MARKET

An application to Lisbon

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# Effect of earthquake risk on the real estate market – an application to Lisbon



## Contents:

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- Case study
- Exploratory Data Analysis (EDA)
- Methodology
- Work done and next steps

## Motivation

- Real Estate is the largest store of value; Prices have been increasing in recent years increasing the value at risk;
- Lisbon considered to be of moderate seismicity due to proximity to Azores-Gibraltar fault, with two significant earthquakes in 1531 and 1755
- Unawareness of risk to investors and homeowners; How is it valued?
- 63,9% of Lisbon's building stock built before any seismic code



## Main Goals of this PhD Work

- Understand how the real estate market values natural hazard risks
- Quantify the risk perception by investors and its impact on property prices
- Analyzing natural hazard value-at-risk on the real estate market in Lisbon

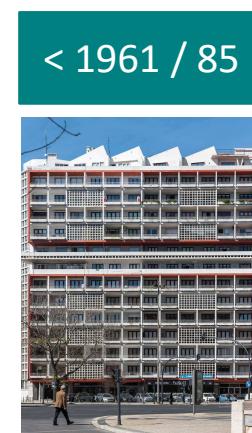
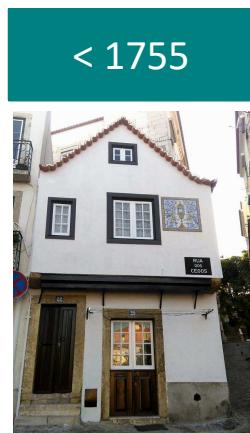
### Practical application:

- Homebuyers
- Investors and Developers
- Insurance Companies
- Policymakers



# Case Study – Lisbon's Real Estate Market

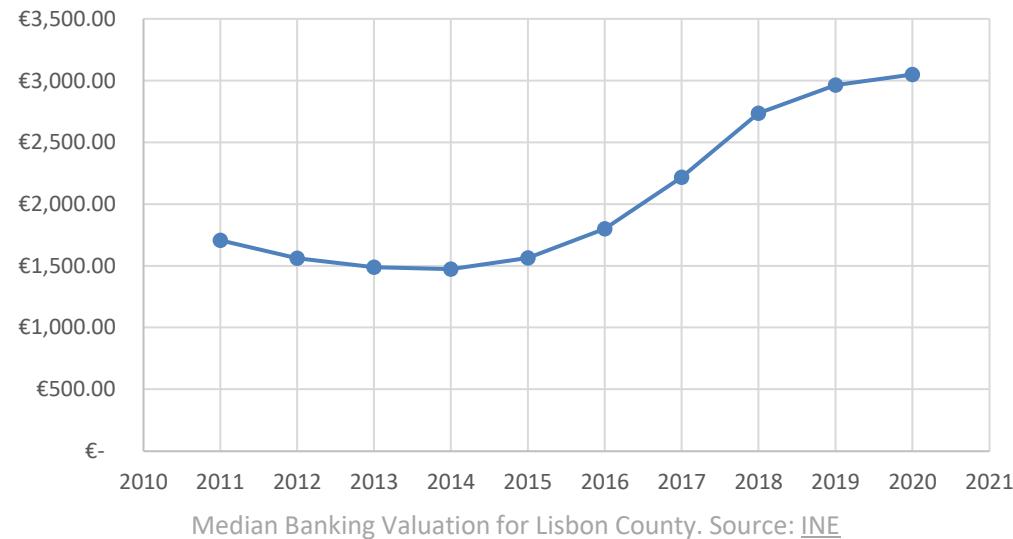
| Housing stock



## Case Study – Lisbon's Real Estate Market

| Price Increase

Median banking Valuation



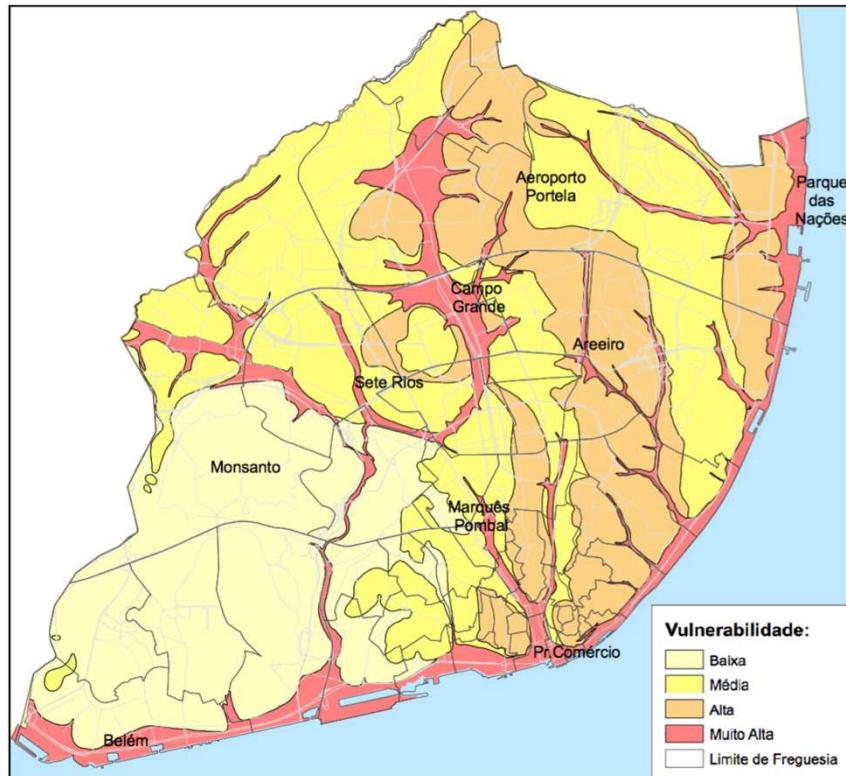
Median Banking Valuation for Lisbon County. Source: [INE](#)

As of 2018, according to the Portuguese Insurance Association, **only 16% of dwellings have an insurance coverage for earthquake risk**

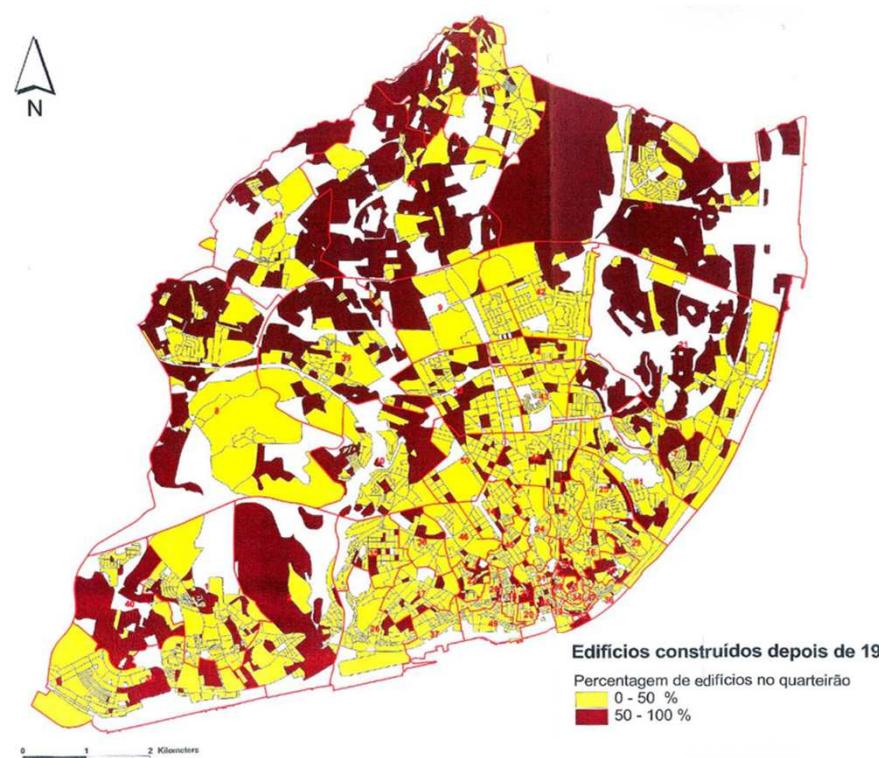


# Case Study – Lisbon's Real Estate Market

| Vulnerability



Lisbon Seismic Vulnerability Map (CML 2008)



Percentage (%) of buildings (per block) built after 1960. Source:  
CMLisboa

↑ VALUATIONS + ↑ VULNERABILITY + ↓ AWARENESS = HIGHER VALUE-AT-RISK !

# Case Study – Lisbon’s Real Estate Market

## | Previous Studies

(Brookshire et al 1985)  
California, USA

(Beron et al 1997)  
California, USA

(Halstrom and Smith 2005)  
Florida, USA

(Willis and Asgary 1997c)  
Tehran, Iran

(Peng 2021)  
Japan

(Florax, Travisi and  
Nijkamp 2005)  
Meta-analysis

(Lamond Proverbs and  
Hammond 2010 )  
UK



# Case Study – Lisbon’s Real Estate Market

## | Previous Studies

### Building Stock Loss

- LNECLoss  
(Sousa et al 2004; Afonso 2008; Spence 2007; Costa et al 2008)
- Earthquake Damage Simulator (SMP/CML)  
(Sousa 1992; Pais et al 1996a, 1996b; Pais et al 2001; Pais 2002)
- RISK-EU  
(Teves-Costa, Barreira and Omira 2011 )

### Risk Assessment

- Pombalinos  
(Appleton 2001; Simões & Bento 2012; Simões et al 2015)
- Gaioleiros  
(Appleton 2005; Mendes & Lourenço 2010; Simões et al 2014; Neves 2016; Simões 2018 )
- “Placa”  
(Marques et al 2017)
- 1<sup>st</sup> Phase RC  
(Caruso & Bento 2019; Jarimba 2016)

### Real Estate Market

- History  
(Braga 2013; Antunes & Seixas 2020)
- Trends  
(Mendes 2017 ; Amore, Bernardis & Arvanitis 2020 )
- Surveys  
(Century21 2020)

# Exploratory Data Analysis

| Overview



## PARISH (VULSismo)

Santa Maria Maior	20.007315
Arroios	14.374543
São Vicente	11.082663
Penha de França	9.473299
Misericórdia	6.949525



## ----- Brief Analysis of VULSismo -----

VULSismo	Percentage
2	3504 40.155856
3	1932 22.140729
1	1459 16.720147
0	1029 11.792345
4	802 9.190924

# Methodology

## | Revealed Preferences

### Contingent Valuation Method (CVM)

Estimate economic values attributed by the market to earthquake insurance and seismic resistance of buildings  
*(currently under design)*

### Moran-I

Spatial patterns in revealed preferences of willingness-to-pay for earthquake resistance and insurance

Spatial Dependency?

Yes

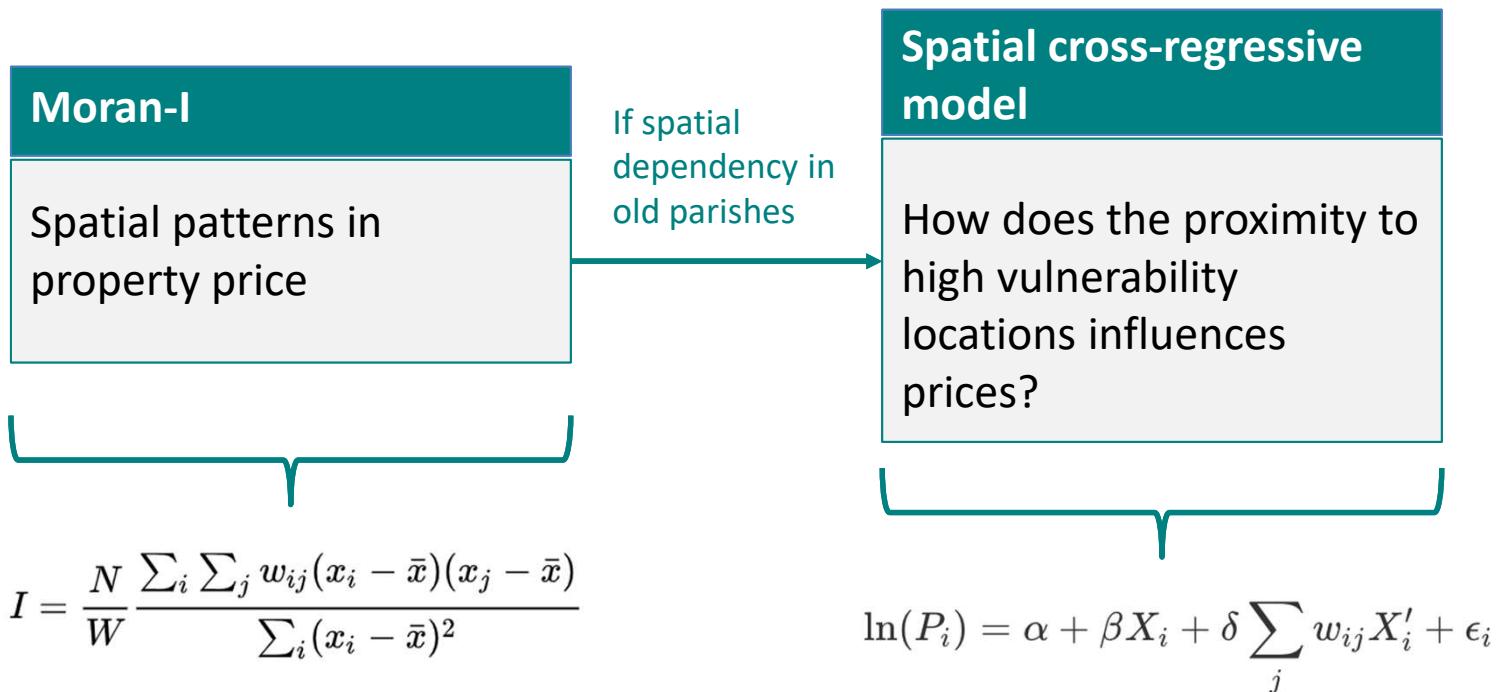
Spatial cross-regressive model

No

Multiple Linear Regression

# Methodology

## | Indirect Preferences



## Work done

- Understanding the risk inherent to Lisbon's housing stock and the legacy of the Portuguese real estate market;
- Understanding the best practices in assessing revealed preferences. Working of the design of the survey for the CVM;
- Spatial-econometrics. The effects of location in statistical analysis of price setting;
- Spatially-lagging exogenous and endogenous variables. Spillover effects;
- Practical application of spatial-econometrics.

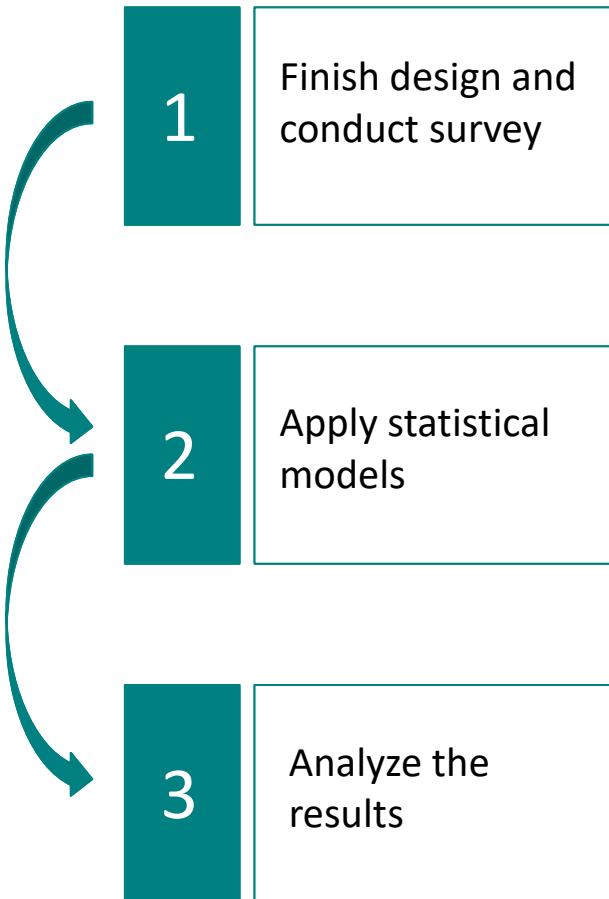
### ***Submission***

JANUÁRIO, J., Costa, Á., Cruz, C.O., Sarmento, J., Sousa, V., *Transport infrastructure, accessibility, and spillover effects: an empirical analysis of the Portuguese real estate market from 2000 to 2018.* 2021. (*under 2<sup>nd</sup> review*)

### ***Conference Paper / Oral communication***

Januário. 2021. *Seismic Risk and House Prices: cross-section modelling of Lisbon's real estate market.* DCE21-4th Doctoral Conference in Engineering. Book of Abstracts. ISBN: 978-972-752-218-7

## Next Steps



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Thank you!



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