

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:

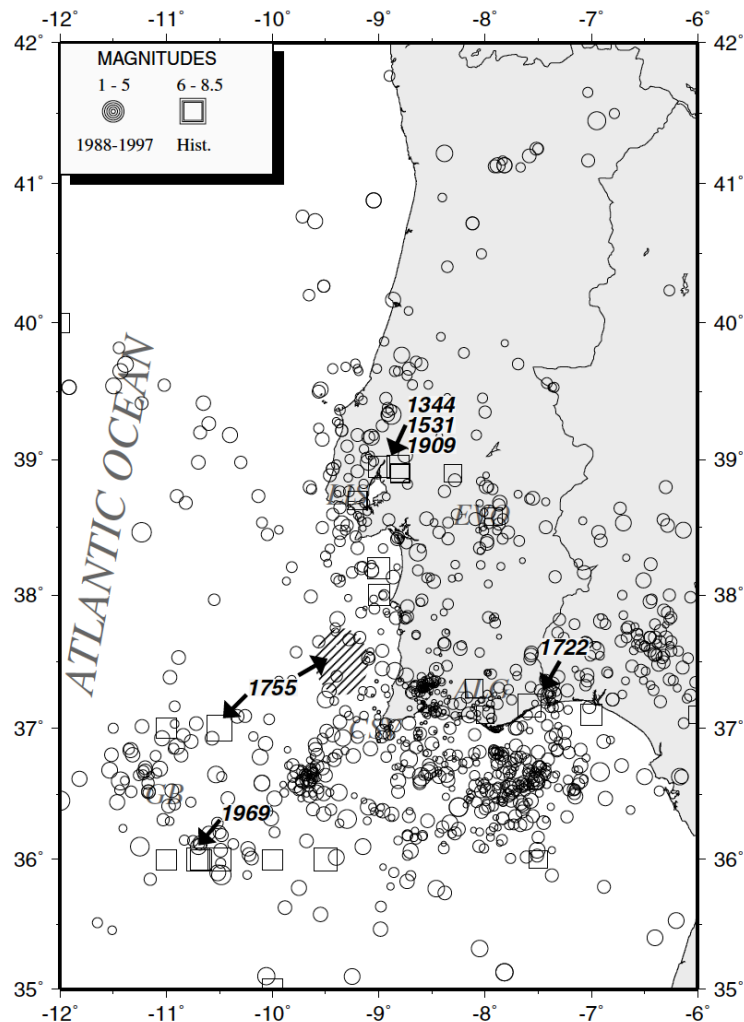
- Introduction
- Objectives
- State-Of-The-Art
- Exploratory Data Analysis (EDA)
- Key Points
- Next Steps

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- Lisbon has become one the most attractive markets to investors
- *Golden Visa*, Safe, Tech-Friendly
- National and Foreign Investors
- Largest store of value



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in "Seismotectonics of Portugal and its adjacent Atlantic Area" (Borges et al., 2000)

- 2 major earthquakes: **1531** and **1755**
- Located near the Azores-Gibraltar Fault
- *Moderate seismicity*
- 1755 earthquake reached **X** in the **Modified Mercalli Intensity Scale** according to records

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How is risk perceived? What would be its impact?



- Location, location, location
- Number of rooms, useful area, condition
- Nearby area



- Largest storage of value -> Economic loss
- Price should reflect risk assessment
- How is it quantified? Is it being taken into account?

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Who cares about risk ?

- Home buyers
- Investors and Developers
- Insurance Companies
- Policymakers

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The objectives are twofold

1

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

2

- Develop a cost-impact function to determine its impact on the real estate market in Lisbon

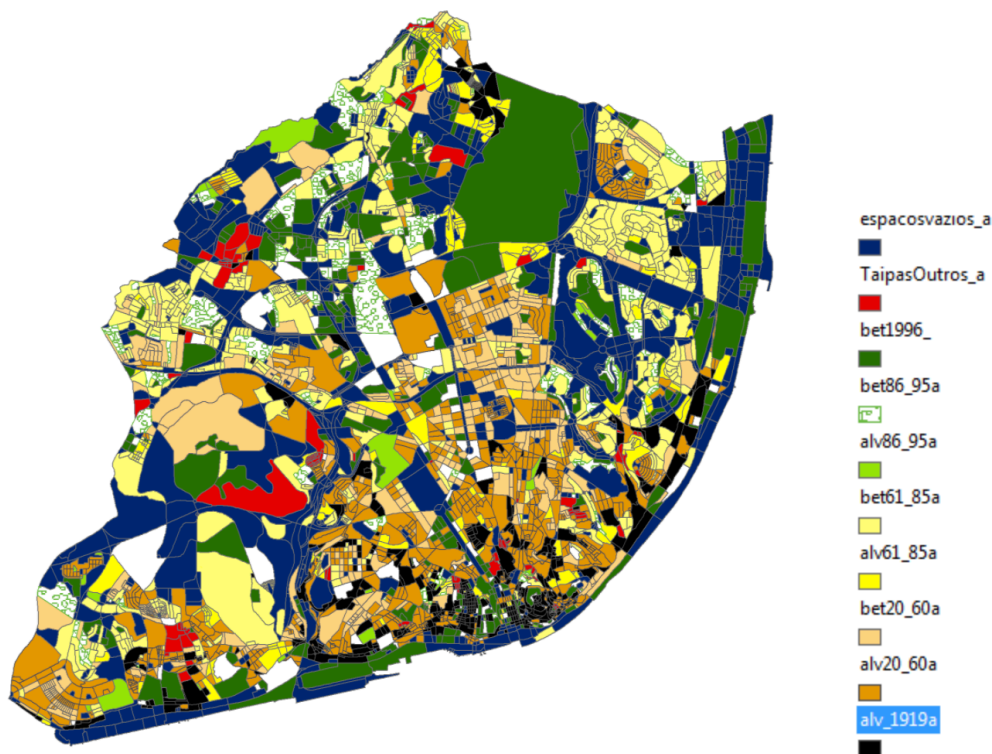


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3 main phases

Index	<ul style="list-style-type: none">▪ Define a natural hazard risk index (based on the seismic risk) that can be applied to the city of Lisbon. The seismic risk should include both direct consequences, such as structural damage or collapse due to soil vibration and displacement, and indirect consequences, in particular tsunami and fire.
Reveled Preferences	<ul style="list-style-type: none">▪ Direct revealed preference by developing a hedonic pricing and information about 50.000 real estate transaction in Lisbon (2008- 2018)▪ Indirect revealed preference by analyzing the risk premium charged;▪ Structured interviews will also be used to identify risk perception and willingness-to-pay for real estate with less exposure to risk
Value-at-risk	<ul style="list-style-type: none">▪ Build a cost-impact function: characterize the existing building stock in Lisbon, and, based on the potential impact of a natural hazard, calculate the expected loss of value for the real estate market.

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in “Estimativa de cenários de danos para a cidade de Lisboa” (P. Teves Costa et al, 1999)

Building stock composed by different types of construction:

- Pré-pombalinos (< 1755);
- Pombalinos (> 1755);
- Gaioleiros (late XIX century);
- Transition (wood/masonry and reinforced concrete);
- Reinforced Concrete (RC) (< 1985)
- Modern RC ;

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Literature Review

1. Lisbon City Council

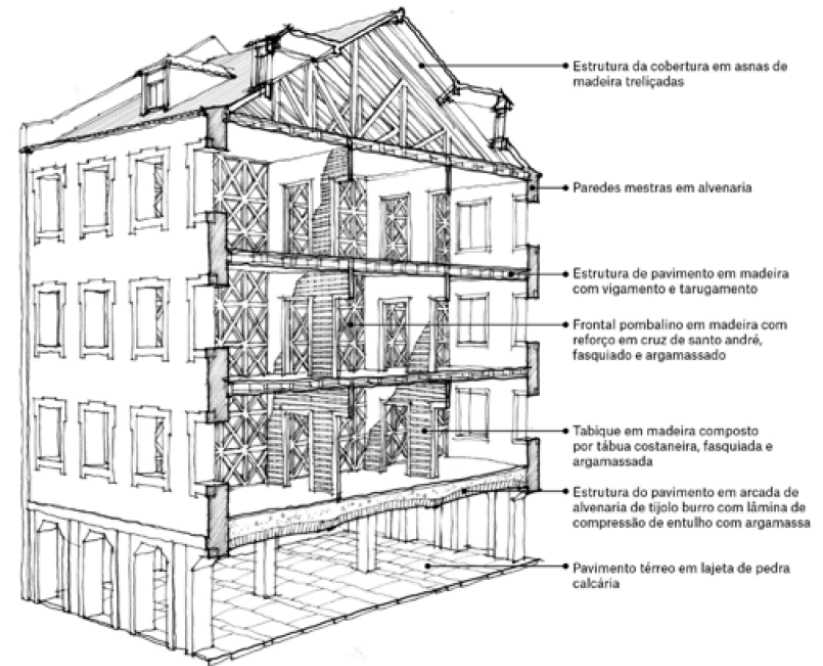
- Working papers on the seismic risk;
- Data on building stock and its vulnerability to risk;
- Do not model the economic impact or risk perception;

2. Bento R, Simões A, Lagomarsino S

- Seismic performance-based assessment of “gaioleiro” buildings;

3. Other authors

- Analysis of seismic reinforcement and its costs;
- Specific building types;



Pombalino building type. in “Reabilitação e conservação do património Arquitectónico”, Cadernos Técnicos, Ordem dos Arquitectos

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Literature Review

1 Friedman (1972)

“Insurance and the natural hazards”

- Assessing **value-at-risk**
- Data on the **susceptibility of the structures** and its cost of repair;
- Knowledge on **potential hazards**;
- Past experience is not a good indicator; **Types of construction, building codes and property market value**;

2 Willis (1997)

“The Impact of Earthquake Risk on Housing Markets: Evidence from Tehran Real Estate Agents”

- market is **sensitive** to seismic risk;
- **Risk awareness** improves this sensitivity;
- **Structured interviews** with Real Estate agents;
- Variance in **willingness-to-pay**

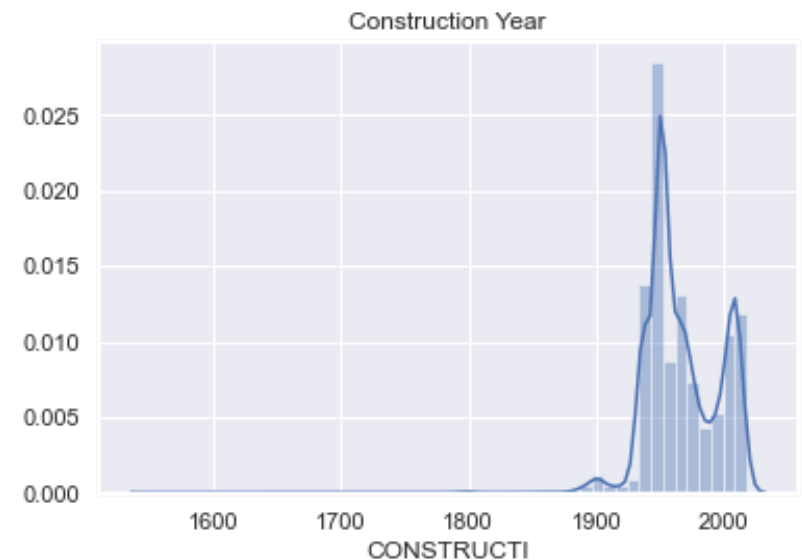
3 Kim (2017)

“Estimating Damage Costs from Natural Disasters in Korea”

- Uses both personal and local income as socioeconomic factors; Higher incomes may lead to **better prevention** to natural disasters;
- **Average % of damage cost by building type**;
- Uses **MLR** to model cost

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- *Dataset of 8726 property sales*
- *61 Variables:*
 - Location*
 - Year of sale*
 - Price*
 - Construction year*
 - Type of property*
 - Number of rooms and Area*
 - ...
 - Vulnerability to floods (VULInund)*
 - Vulnerability to earthquakes (VULSismo)*
 - VULMass*



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Parishes	
Arroios	833
Avenidas Novas	808
Santa Maria Maior	738
Estrela	623
Benfica	603
Santo António	530
Campo de Ourique	527
Misericórdia	489
Ajuda	377
Olivais	368
Alcântara	367
Lumiar	347
São Vicente	332
Penha de França	310
Belém	285
Alvalade	276
São Domingos de Benfica	208
Carnide	169
Santa Clara	146
Areeiro	138
Beato	114
Marvila	74
Campolide	64

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----- Brief Analysis of VULInund -----		
	VULInund	Percentage
0	6119	70.123768
1	1443	16.536787
3	833	9.546184
2	331	3.793262

----- 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

----- Brief Analysis of VULMass -----		
	VULMass	Percentage
0	8551	97.994499
2	73	0.836580
1	65	0.744900
3	37	0.424020

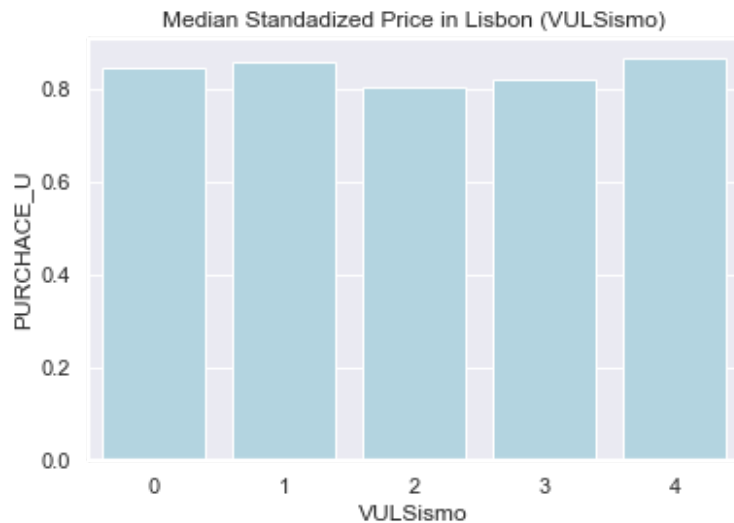


PARISH (VULSismo)	
Santa Maria Maior	20.007315
Arroios	14.374543
São Vicente	11.082663
Penha de França	9.473299
Misericórdia	6.949525

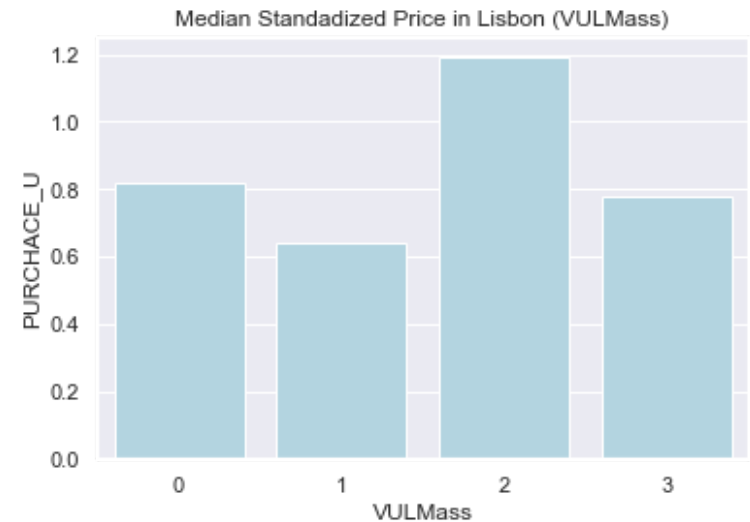
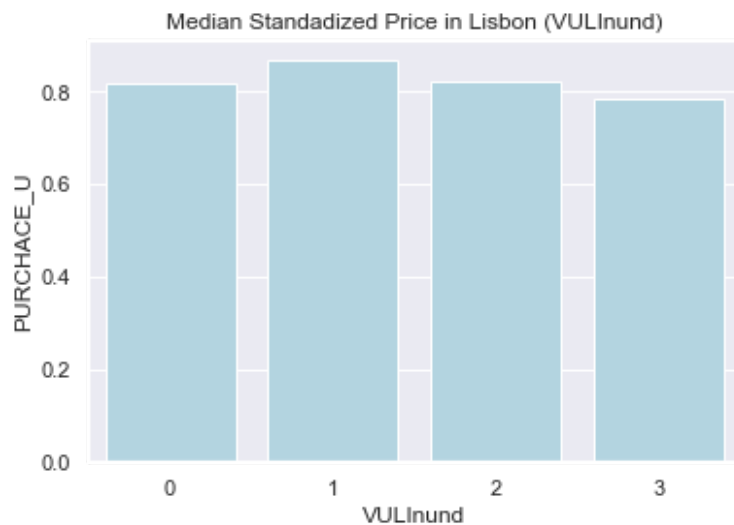
PARISH (VULInund)	
Santa Maria Maior	45.138055
Arroios	12.244898
Estrela	11.044418
Misericórdia	6.002401
Avenidas Novas	5.162065

PARISH (VULMass)	
Santa Maria Maior	67.567568
Penha de França	16.216216
Misericórdia	5.405405
Marvila	2.702703
Campo de Ourique	2.702703

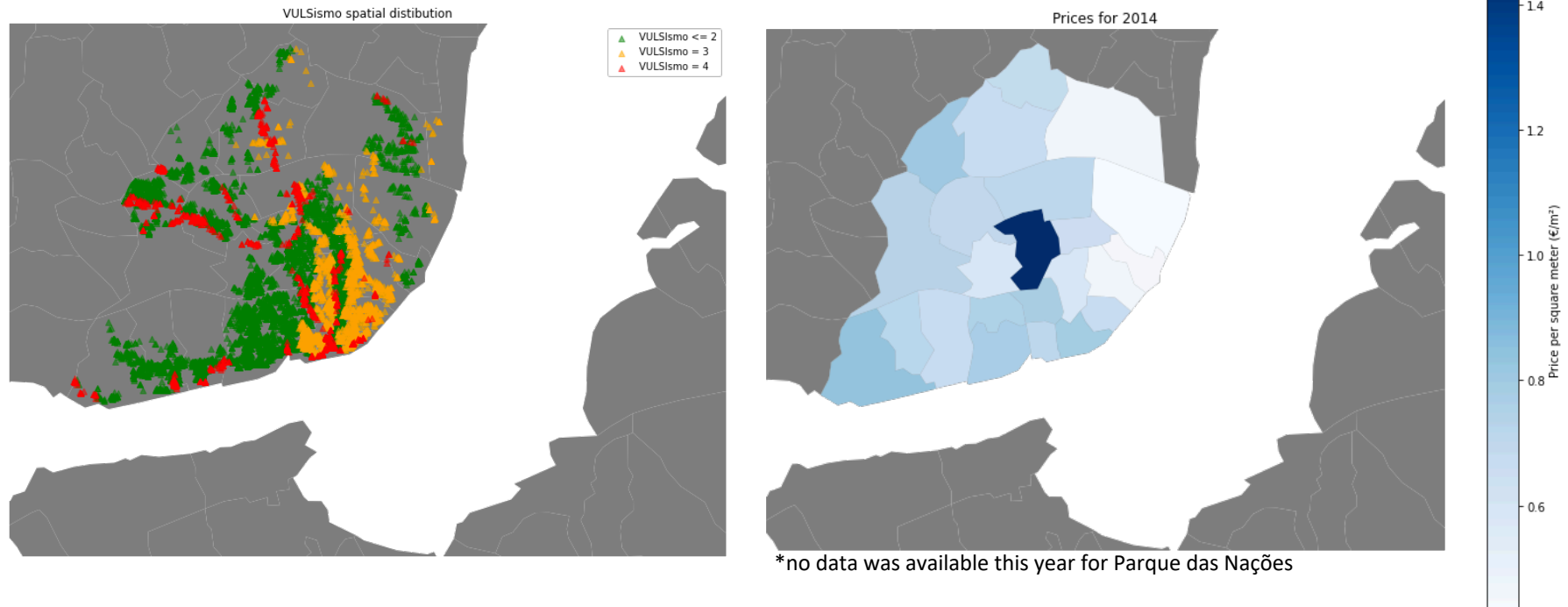
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At a first glance, investors seem to be oblivious to the surrounding risks



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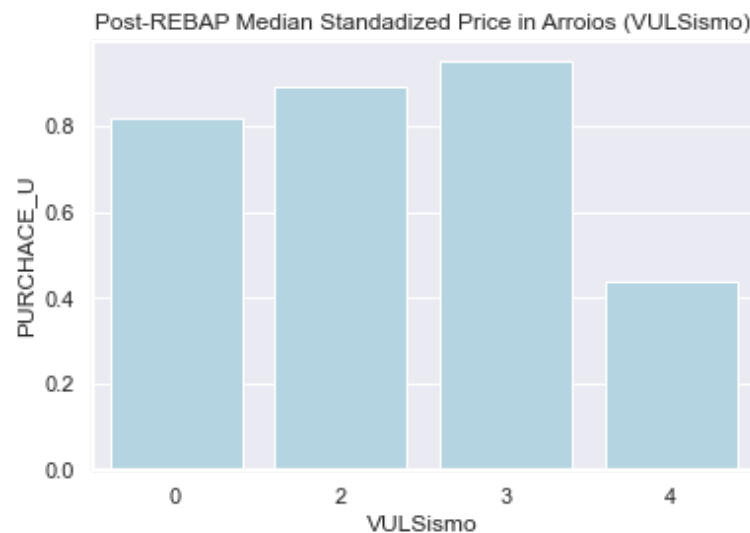
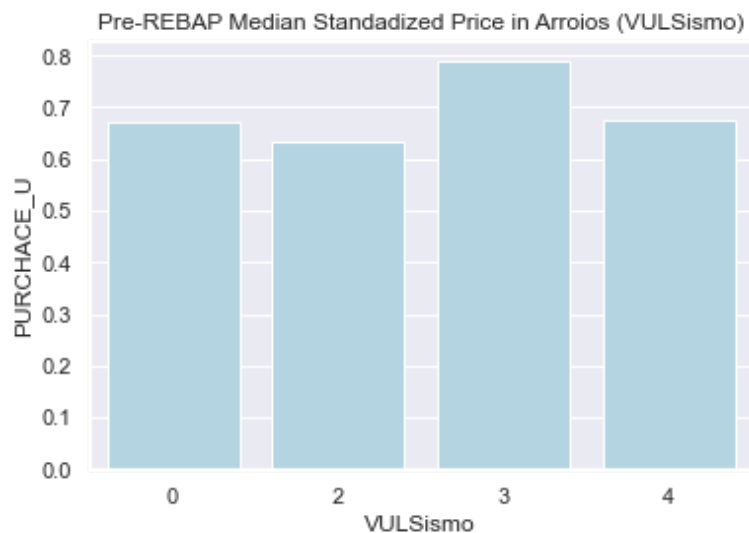
REBAP¹ (1970) Impacts

Arroios

Sample size: 71 Pre-REBAP (1957-1970) and 43 Post-REBAP (1970-1983)

Class 3 – 30% higher in Post-REBAP

Class 4 – 36% lower in Post-REBAP



¹- <http://www-ext.lnec.pt/LNEC/DE/NESDE/divulgacao/REBAP.html>

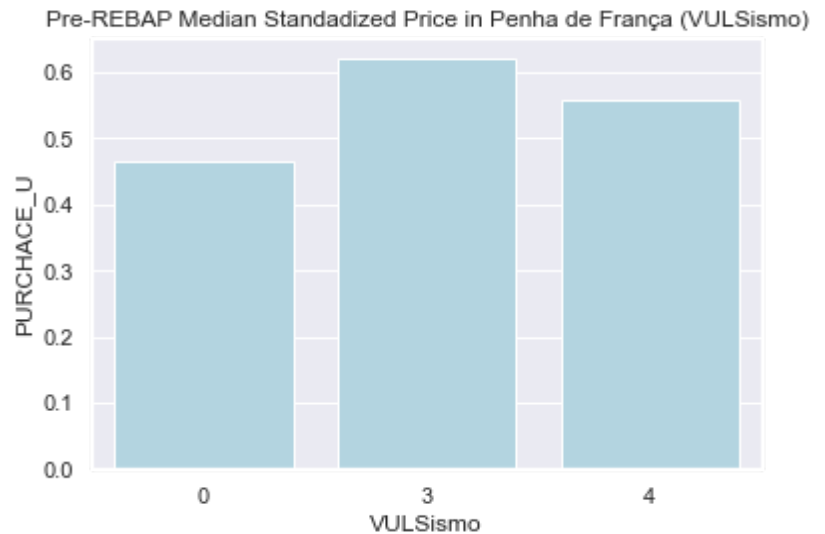
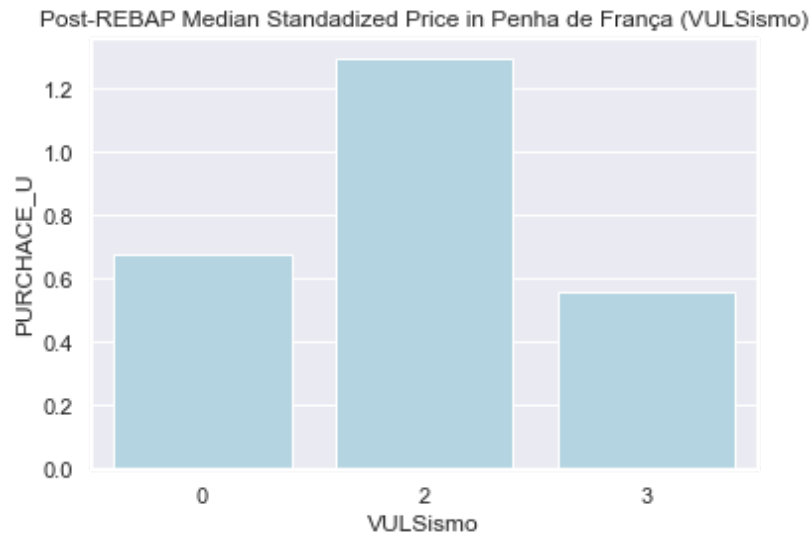
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REBAP (1970) Impacts

Penha de França

Sample size: 56 Pre-REBAP (1957-1970) and 17 Post-REBAP (1970-1983)

Class 3 – 8% higher in Post-REBAP



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Key Points

- Real Estate is an important store of value;
- Seismic risk is one of the main threats (and it is not negligible in Lisbon);
- Pricing seems not to account for risk which can be leading to a market distortion;

Next Steps

Index and Value-at-risk

- Gather more data on the risk by building type (linked to the construction year) to add to the database;
- Build an index based on location and building type;
- Build a cost-impact function;

Revealed Preferences

- Structured Interviews
- Regression Analysis
 - Spatial Regression models

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Thank you!

