

Baukultur und Nachhaltigkeit



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Climate-Resilient Regional Building Traditions

- Regionally rooted building culture integrating climate, craft and social use
- Passive climate responses: windcatchers, Alpine chalets, mud buildings, shaded facades
- Low-emission natural materials can reduce VOC exposure







Source: Getty Images, Swiss Open Air Museum, BBC, 2025

Leveraging Local Lessons: Baukultur & Decarbonisation

Key challenge: to be relevant for future decarbonisation efforts Baukultur and regional building should be:

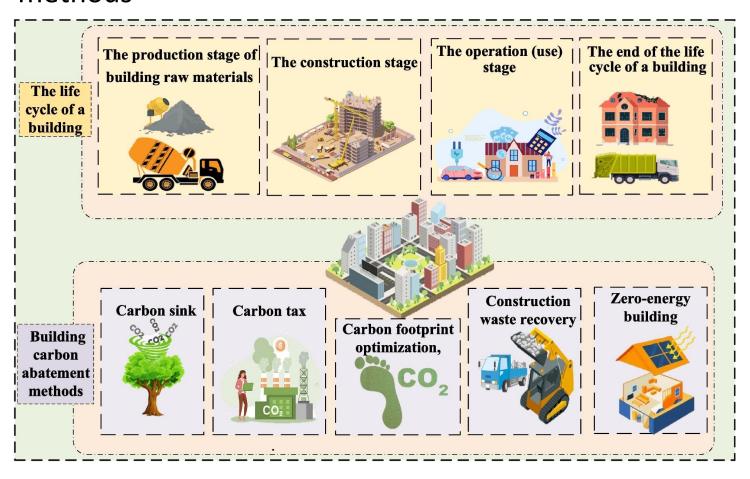
- -scalable
- -open to technology
- -flexible & adaptable

Example: TECLA, 3D-printed 60sqm clay home

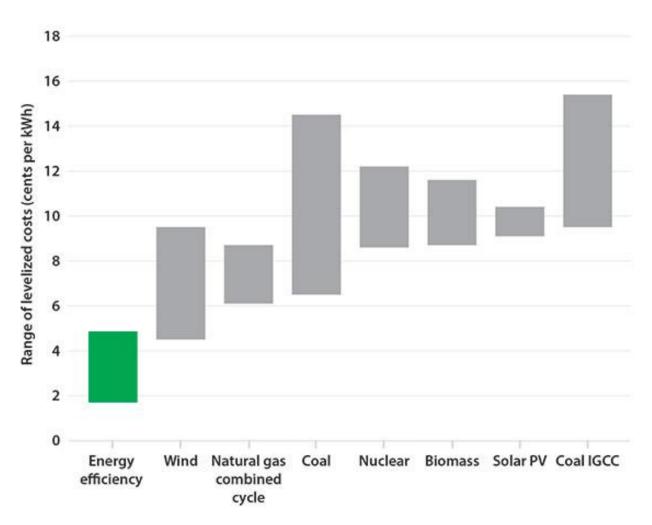


Baukultur: Heritage Buildings and Beyond

Most important lessons from Baukultur are abstract and can be applied to any type of construction and building type Examples include LCA and building carbon abatement methods

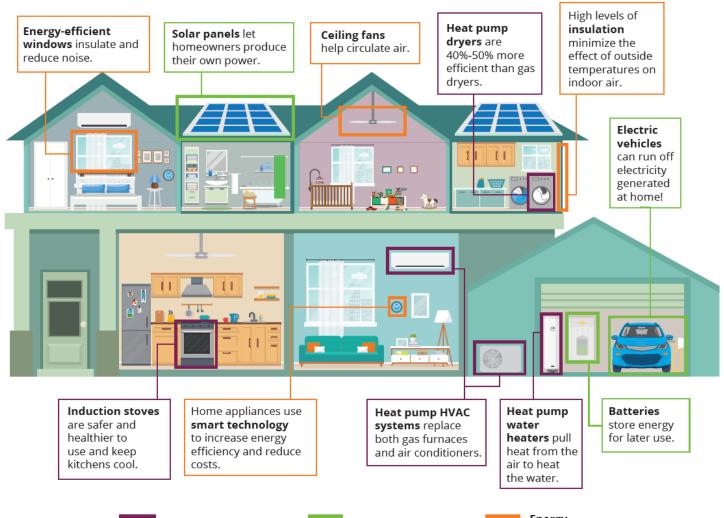


Cost of saving energy vs. generating energy



Source: ACEEE, 2014

Should We Ignore Buildings on the Way to Net Zero? "Fabric First" vs. "Building Electrification"



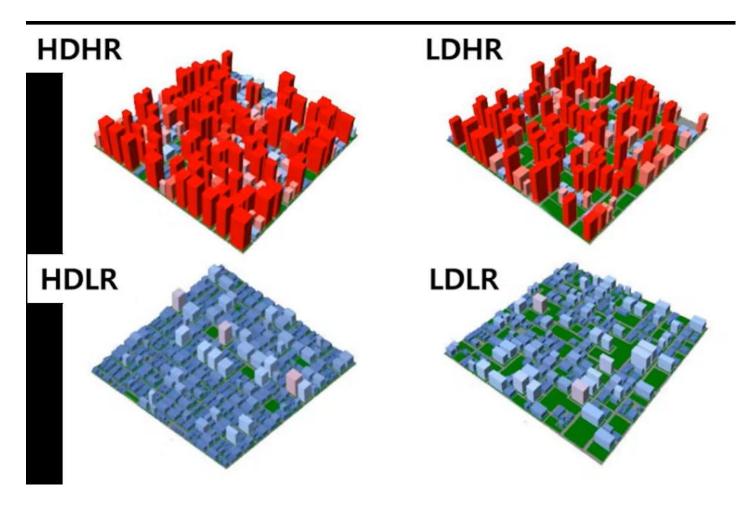






Source: Edison Int. 2022

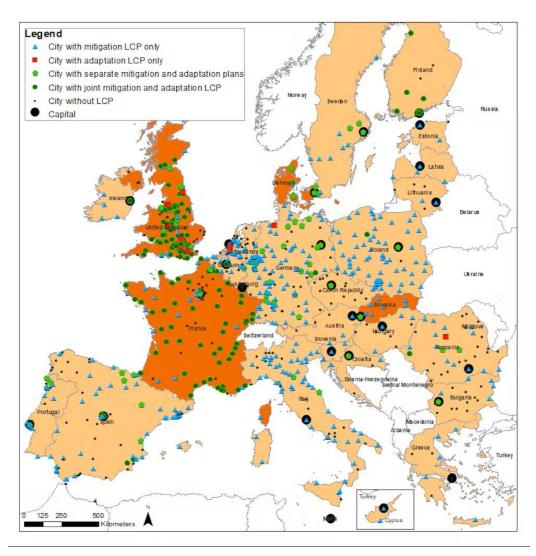
Are High Density – Low Rise Cities Best for Cutting Carbon Emissions?



High-density low-rise cities, such as Paris more environmentally friendly than high-density high-rise cities, such as New York (average increase in whole life-cycle carbon emissions between HDHR and HDLR) 142%.

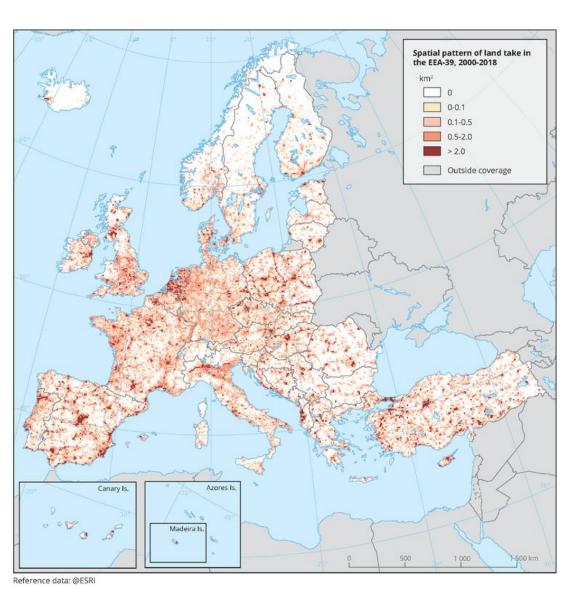
Baukultur's Local Focus Aligns Well With Climate Action

66% of EU cities have a mitigation or adaptation plan in place. Top countries: Poland – where 97% of cities, Germany (81%), Ireland (80%), Finland (78%) and Sweden (77%).



Baukultur and Land Stewardship

- Land take as a result of urban sprawl and increasing concern for resource use, biodiversity & GHG.
 Map shows high-res Copernicus Corine Land Cover data 2000-2018, areas
- converted to urban and/or built-up areas.



Source: Eurostat, 2024

Baukultur: Longer Building Life Cycles -> Lower

GHG Emissions

- Future-proofing our building stock also means increased longevity of buildings
- Counteracting the accelerated shortening of building life cycles as a key strategy
- Ghorbany & Hu (2024): increasing building lifespan to 80 years with a 20% reduction in building sizes can decrease carbon emissions to 33% of current value.

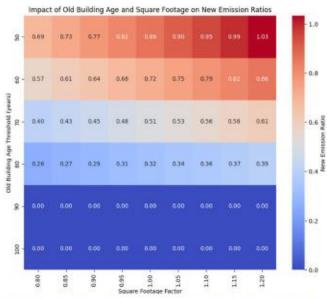


Figure 7. The heatmap of the new emission ratio for different building areas and age thresholds.

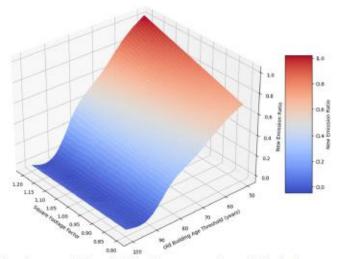


Figure 8. The emission changes sensitivity analysis for different areas and ages 3D visualization.

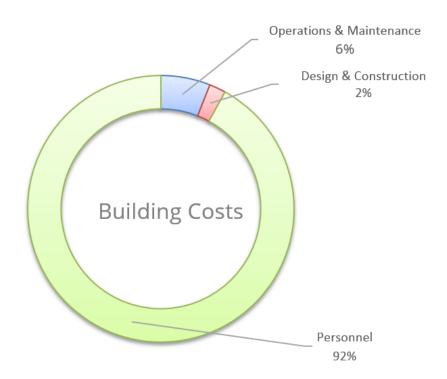
Health Effects of Traditional Design

- Cross-ventilation and thermal mass reduce heat and moisture stress
- Timber, stone, lime render often emit fewer VOCs than some synthetics
- Bioclimatic adaptation can stabilise temperatures and improve comfort

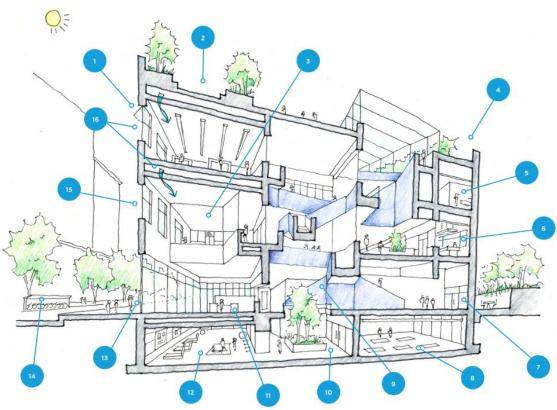


Why Are Health & Well-Being Important for Real Estate Investors?

- The "3-30-300" Rule of Thumb: for every \$3 spent on utilities, a typical company will spend \$30 on rent and \$300 on employee salaries etc.
- This makes the 'human factor' a far bigger lever than the other two.



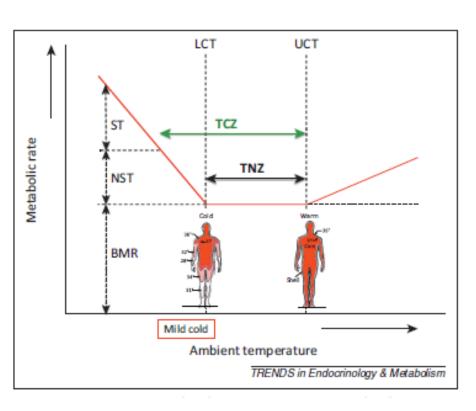
What is a 'Healthy Building'?



- Daylight in regularly occupied spaces
- 2. Tobacco-free rooftop garden and outdoor space
- Break area with hygiene signage and enhanced cleaning
- 4. Fruit and vegetable garden
- 5. Bathrooms with hand hygiene signage and PPE
- 6. Flexible multi-purpose room and views of nature
- 7. Tobacco-free indoor space
- 8. Meditation and yoga studio
- 9. Open and visible stair with enhanced cleaning
- 10. Biophilia / indoor greenery
- 11. PPE and sanitation stations
- 12. Gym facility plus showers and lockers
- 13. Health and wellness certification plaque
- 14. Covered and secure bike parking
- 15. Views of nature
- 16. Enhanced IAQ and operable windows

Link between Thermal Comfort and Body Weight

Energy efficiency and obesity: van Marken, Lichtenbelt et al (2014). Cold exposure and energy expenditure



- •Thermo-neutral zone (TNZ) basal energy expenditure
- Thermal comfort zone (TCZ)
- Nonshivering thermogenesis (NST)
- •Shivering thermogenesis (ST) take place.
- Lower & Upper critical temperature (LCT, UCT) > increased energy expenditure

Commercial RE Markets and Healthy Building Certifications



Contents lists available at ScienceDirect

Journal of Environmental Management





Research article

Indoor and outdoor health factors in the pricing of commercial real estate: A hedonic analysis of U.S. office buildings

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ARTICLE INFO

Keywords: Healthy buildings Green buildings Voluntary certification schemes Office rents Air pollution Accessibility to health services Walkability

ABSTRACT

Research on the connection between occupant health and the financial performance of commercial buildings is scarce. This study tests the willingness to pay for health-promoting features and estimates the relative contribution of indoor and outdoor features. For this purpose, a hedonic framework is applied to assess the effect of different attributes on prices. Based on a proprietary, assembled dataset of physical and financial characteristics, a sample of health-certified U.S. office buildings is compared to a large sample of non-certified buildings in the same markets. Potential biases are mitigated by statistical methods such as panel data estimation and propensity score matching. Health-certified offices are found to achieve a rental premium of 4–6 % on average, across model specifications. In addition, proximity to health services and an encouraging environment for active transport modes of commuting tend to increase office rents while outdoor air quality and hospital quality ratings yield mixed results. Comparing the individual price effects of indoor and outdoor health-related features shows that higher active commuting scores or walkability have the strongest positive association with office rents. Overall, both indoor and outdoor health-related features are found to drive rental rates, but it appears that neighborhood characteristics exert a larger cumulative impact on rent than building health certification. Our findings suggest that health aspects of the built environment, although not widely monitored or tracked by owners or tenants, are nonetheless valued and reflected in pricing within the analyzed office markets.

1. Introduction

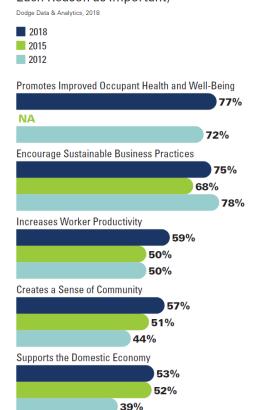
It is estimated that the population of developed countries spends approximately 90 % of its time indoors (Klepeis et al., 2001). Prolonged exposure to air pollution, noise, artificial lighting, uncomfortable climatic conditions, sedentary occupation or toxic materials can give rise to or exacerbate a number of health conditions such as respiratory or cardiovascular conditions as well as impair cognitive function and well-being (e.g., Durán et al., 2021; Fang et al., 2004; Haapakangas et al.,

reported 20,905 certified and 13,755 registered projects in 111 countries (International WELL Building Institute, 2022), whereas Fitwel listed 1,250 certified and 3,390 registered projects in 55 countries (Fitwel, 2022).

Previous research has mainly focused on the interactions between buildings and health or well-being. Moreover, a large number of studies has analyzed the financial performance of green buildings (e.g. Eichholtz et al., 2010; Fuerst and McAllister, 2011a, 2011b; Robinson et al., 2017). However, research on the nexus between health-promoting fea-

Health & Well-being Building Certificates

Top Social Reasons for Building Green(By Percentage of Global Respondents Rating Each Reason as Important)

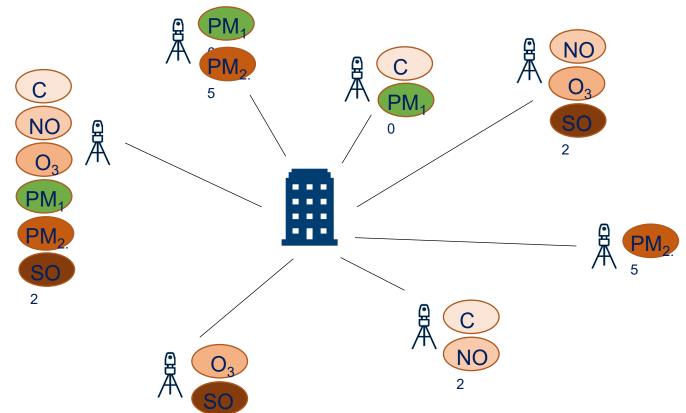


- Health & well-being increasingly integrated in sustainability ratings but no standard data and definitions
- As of 2021, WELL encompassed 4,504 projects (644 million sq.ft. in 63 countries). Fitwel had 480 certifications and 1550 registered
- Research needs to highlight trade-offs rather than pursuing an additive approach to sustainability





Air Quality: our Data Strategy



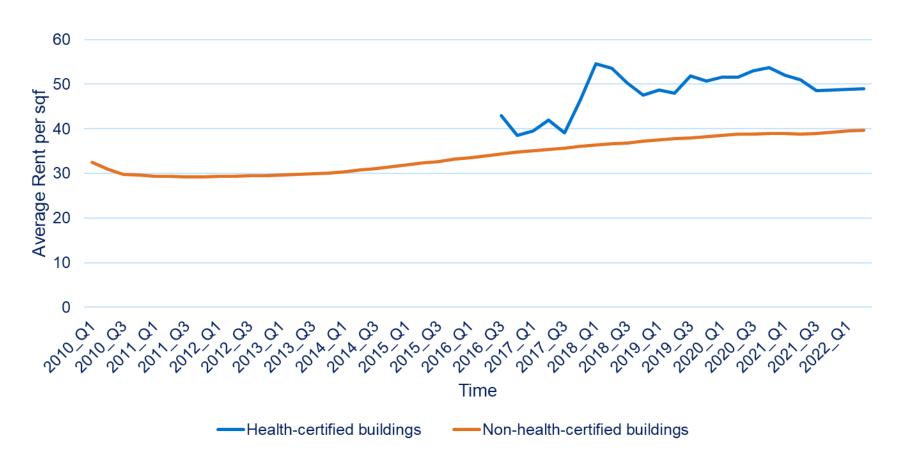
- For each building, identify mearest monitoring station for each of the 6 major air pollutants based on the national air quality database of U.S. EPA
- For each building, determine mean AQI per air pollutant by inverse distance weighting
- For each building, calculate overall AQI based on highest mean AQI value among 6 pollutants

WalkScore



Source: Maps by Google and Walk Score (2022). Walk Score. https://www.walkscore.com/NY/New_York; https://www.walkscore.com/CO/Denver; https://www.walkscore.com/GA/Atlanta

Average Rent Comparison of Health-certified and Non-health-certified Buildings



Key Results

- •Our US study of health certified office buildings indicates office buildings with a healthy building certification associated with a significant rental premium
- Impact of air quality level on rents as expected
- Distance to nearest hospital is negatively associated with office rents but quality rating of nearest hospital does not show the expected sign
- •Real estate assets in walkable neighbourhoods command a rental premium (even after controlling for submarkets)

Multiple Natural Hazards and Rental Properties in Switzerland

- Hedonic price analysis linking rental transactions to flood, debris-flow, and landslide hazards
- Nationwide dataset of leases matched with highresolution hazard maps
- Key result: statistically significant rental discounts for properties exposed to multiple hazards
- Effects are strongest for high-frequency flood and debris-flow risks

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Multiple hazards and residential rents in Switzerland: Who pays the price of extreme natural events?



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ARTICLE INFO

Keywords: Natural hazard risk Hedonic regression Rental market Real estate investment

ABSTRACT

Natural hazard risk is captured in property prices through two principal channels the risk to the building and the risk to it to eccupiers. These two effects are typically bundled up in transaction prices, thereby becoming individually unobservable. This study analyses residential rents as those should solely represent the risk to occupiers, who pay for their own lones in the case of a natural hazard event, but not for the owner's potential damage to the asset. Applying a hodonic framework to a sample of 18,839 dwellings across Switzerland, we examine the relationship between residential rents and exposure to five different climate-related natural hazards, some of which have been inhertor understudied. Strong evidence of a small rental discount of 1.4 is is found for dwellings that are subject to moderate flood hazard. Similar, albeit weaker, estimates are found for surface runoff hazard. Gravitational hazards including landslide, debris flow, and hillidope debris flow are not associated with significantly lower rents, possibly due to the small sample size. Our findings imply that not all natural hazard risk is reflected in the cost-side of the profit-equation in commercial residential real estate, but partly manifests itself in the form of reduced income, which is often less apparent.

Introduction

Climate- and weather-related extreme events are estimated to have caused 450. 520 billion euros (2020 prices) in economic losses between 1980 and 2020 in the 32-country European Economic Area (European Environmental Agency, 2022). Given that damage to buildings is the largest part of these losses, the question arises of who ends up bearing the cost between owners, tenants, insurers, taxpayers, or another party. This is of particular relevance at at time when investors are trying to get a better understanding of their exposure to climate change and central banks are conducting climate change stress tests to assess the impact on the financial system (Acharyae et al., 2023). This study investigates whether natural hazard exposure is reflected in lower rents for residential properties and thereby helps shed some light on this question.

At first glance, natural hazard risks seem to be of limited concern to property investors in Switzerland, the country of this study, as building insurance is socialized: it is mandatory to be insured and premiums are uniform regardless of risk exposure. Natural hazards, however, do not only threaten the structure of the building but also affect the occupant. The costs of a natural disaster in the context of residential property can be split into four components: the physical damage to the structure,

death or injury of the occupants, any disruption suffered by residents in the wake of the disaster, and damage to the contents of the home.

While the property-related structural costs are borne by the owner and ultimately the insurer, the latter three costs fall on the occupant. This paper asks if those tenants are paying less rent for properties exposed to natural hazard risk in Switzerland, and by extension whether the cashflows of landlords are affected. This question is especially relevant in a European context where the owner-occupier segment is relatively small, and tenants often live in rented apartments long-term, in Switzerland the rate of homeownership is only \$6.3 \text{ of (BFS, 2021)}.

This research includes most climate-related natural hazards that affect residential properties in Switzerland: flooding, surface runoff, and gravitational hazards including debris flow and hillslope debris flow. While the former hazard has been the subject of many previous studies, this study is one of the few so far to investigate the latter hazards and to examine them at the same time. The richness of the dataset allows us to control for virtually all relevant confounders.

1.1. State of research

A sizeable and growing body of literature is devoted to the question

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Climate Change & House Prices in the Swiss Alps

- Sample: 303 municipalities, 38 ski areas (2001–2019)
- House prices in ski resorts depreciate 3.6–6.0% per +1°C mean winter temperature
- No significant effect in non-ski municipalities
- Major resorts: ~0.2–0.33% lower annual appreciation per +1°C
- Market value shifts from lowerelevation to higher-elevation resorts

Conclusion: higher and colder ski resorts experienced greater price increases than lower and warmer resorts.

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Climate Risk Management





All downhill from here? Climate change and house prices in the Swiss Alps



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ARTICLE INFO

Keywords: Climate change Real estate investmen Ski tourism Regional economy

ABSTRACT

This paper investigates the relationship between climats (change) and house price development in the Dwiss Alps, testing the hypothesis that house-buyers in sld resorts switch from lower-lying, less move-secure resorts to high-altitude areas with reliable mow cover. The analysis employs a sample of 303 Gwiss municipalities across 38 different sld areas from 2001 to 2019. Regressions of municipal-level house price changes on altitude, temperature, and none cover changes eveal that house prices in sld resorts have depreciated by 3.6-6.0 % per degree Celsius mean winter temperature over the 10-year period. Temperature emerged as a better predictor of house price change than altitude. For municipalities outside sld areas, this relationship between climatic variables and price appreciation does not hold. Perhaps surprisingly, no significant direct link between changes in mowe cover and house prices is found. If ne results suggest that secondary and lower-lying sld areas have experienced relative losses in real estate asset values, possibly transmitted by changing local economic conditions.

1. Introduction

Whether the expected effects of climate change are capitalized into real estate is still an open question. Studies from coastal areas exposed to sea level rise (SLR) find mixed results: Murfin and Spiegel (2020) and Fuerst and Warren-Myers (2021) find no evidence that differences in time until inundation result in price differences between coastal properties. When accounting for heterogeneous climate change beliefs however, multiple studies find that SLR is priced into real estate only if enough people in the area are concerned about it (Balkkensen and Barrage, 2022; Baldauf et al., 2020; Bernstein et al., 2019; Giglio et al., 2021).

Two major challenges complicate the price-estimation of SLR — and the effects of climate change more generally — in real estate. Firstly, current climate risks such as flooding are highly correlated with increased future risk levels. Secondly, pricing future effects is sensitive to the choice of discount rate. A small strand of recent literature has therefore taken a different approach, and instead studies if climate change exposure affects the return on real estate (Keenan et al., 2018; Keys and Mulder, 2020; McAlpine and Porter, 2018; Tyndall, 2023). Results are more consistent here and higher relative elevation is associated with a higher rate of appreciation in low-lying coastal areas in the US, implying substantial price differences should emerge over time between SLR-exposed and unexposed properties.

This study investigates whether the same holds true in the Swiss Alps, where homes face no threat from SLR, but climate change reduces the ability to practice winter sports, especially at lower altitudes (François et al., 2023; Marty et al., 2017; Spandre et al.,

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What does all this mean for Baukultur?

- The economic case for buildings with high Baukultur, sustainability and health credentials relies on **market forces** recognising the value of benefits to users and society
- Empirical evidence supports the proposition of higher asset values, rents, occupancy rates and lower risk for high-quality buildings
- ➤ Best practices and local knowledge can be derived from Baukultur for larger benefits. Alliances (e.g. Davos Alliance) helpful for transmission. Regulations (building codes, EE codes such as MEES UK) can provide further embedding of Baukultur into the 'DNA' of construction practices
- Finally: Despite some difficult trade-offs in the scaling up process, Baukultur and green/healthy building business case are largely aligned

Thank you!

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