SFI-SSF Conference

The Low-Carbon Rent Premium of Residential Buildings

s:fi EVENT

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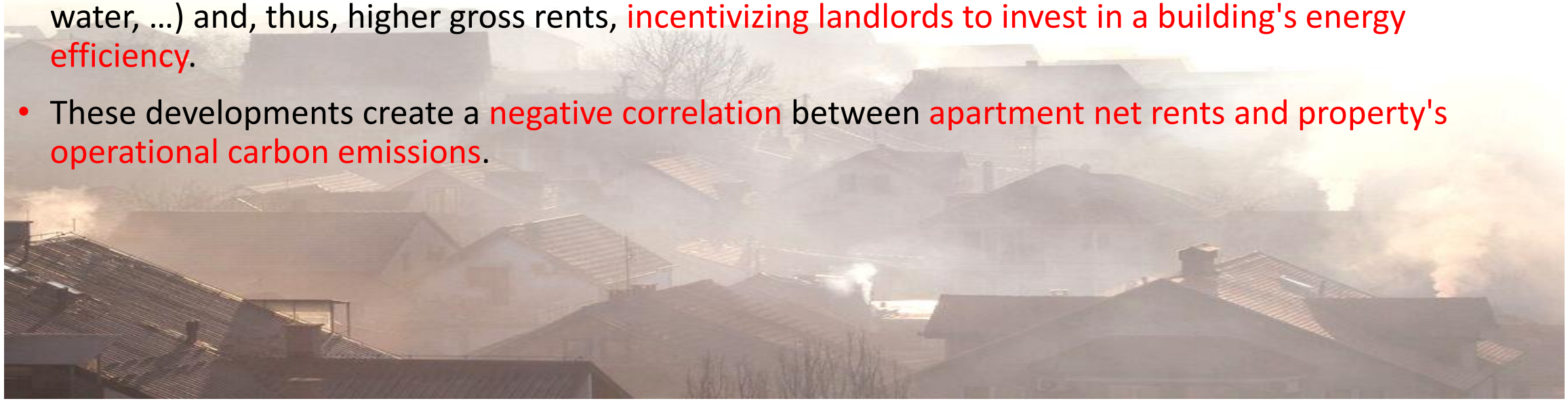
Motivation

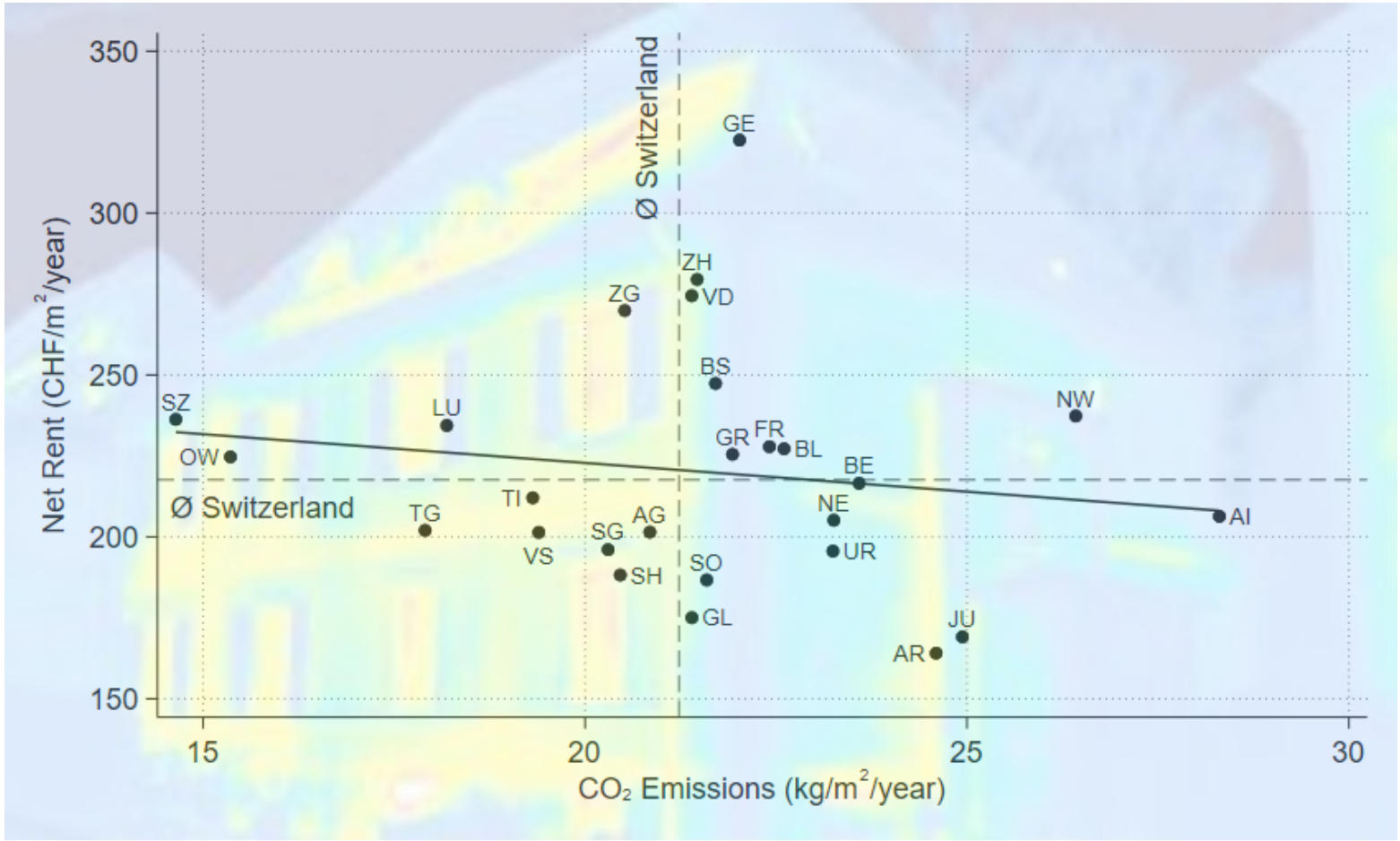
From "brown" buildings to net zero.

- In Switzerland, the residential building stock accounts for 18% of the country's overall operational CO_2 emissions (2022).
- Real estate must make a significant effort to achieve the Swiss net zero target and to be carbon neutral by 2050.
- Increasing energy prices directly affect tenants through higher ancillary costs (heating, electricity, water, …) and, thus, higher gross rents, incentivizing landlords to invest in a building's energy efficiency.
- These developments create a negative correlation between apartment net rents and property's operational carbon emissions.



Average net rents and operational carbon emissions

… are negatively correlated.



Cofounders:

- Location
- Building conditions
- Market conditions
- Hedonics

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Hypotheses
Willingness-to-pay, preferences, or economic calculation?

- **Hypothesis 1 – Low-carbon rent premium:**

  Apartment net rents in low-carbon properties are higher due to tenants' willingness to pay.

- **Hypothesis 2 – Ancillary cost savings and preferences for sustainability:**

  Tenants' willingness to pay for sustainable apartments is simultaneously driven by savings in ancillary costs and by preferences.

Data

Novel measure to quantify operational carbon emissions.

- CO_2 Emissions: Residential buildings are either equipped with a heat pump (low carbon building) or with an oil or gas heating system. Carbon emissions of our dataset's properties are quantified with the CO_2 calculator of Wüest Partner.

Mandatory inputs:
- Year of construction
- Building location (exact geo-coordinates)
- Building area and area type
- Number of heated floors
- Use type(s) of the building
- Heating system

Optional inputs:
- Refurbishment year and details
- Insultation values
- Window properties
- Shading factors
- Ventilation type and heat recovery efficiency
- Building system efficiencies

- Covariates: Property and municipality-specific parameters.
- Oil/gas-fired heating systems emit 25 kg /m^2 / year and heat pump have an average of 3 kg / m^2 / year of CO_2.

Net Rents and Control Variables

It is essential to control for building's quality.

- **Swiss Rental Contracts:** The dataset includes 92'600 rental contracts between Q1 2015 and Q3 2023.

  Net rents of buildings with …

  (1) … at least two residential units
  (2) … gas or oil-fired or with heat pump
  (3) … between 20 and 340m^2 with monthly rent between CHF 500 and CHF 5,000
  (4) … unfurnished apartments
  (5) … rental contracts signed between January 2015 and October 2023 with current market rents
- **Building quality:** (1) condition, (2) age of dwelling, and (3) renovations costs = (4) Quality Index
- **Property and apartment characteristics:** (1) property's standard, (2) usability, (3) # of rental units, (4) size, (5) # of rooms, and (6) floor apartment is located
- **Micro and macro location:** dwellings' immediate neighborhood (terrain, infrastructure, recreational opportunities, noise emission, and population density) versus economic, socio-demographic, and information on connectivity and infrastructure

Further Control Variables

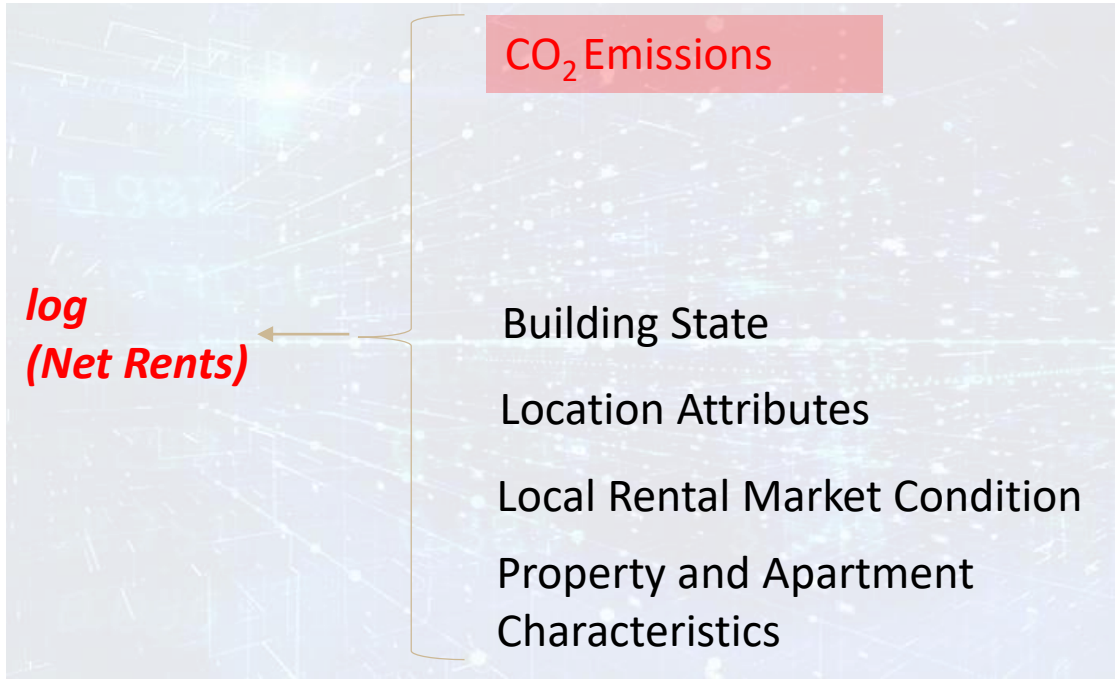
Signaling effect of green building certificates and preferences.

- **Green building certificates:** to account for the signaling effect of green building certificates (Swiss Minergie labels)
- **Local rental elasticities:** to control for “loose” and “tight” rental market conditions (rental offer rates)
- **Municipal characteristics:** each rental contract can be linked to one of **2,173 Swiss municipalities**, one of **26 Cantons**, as well as to one of **9 postal regions**. Municipalities can also be categorized as **urban**, **sub-urban**, or **rural**.
- **Voting results:** referendum, June 13, 2021, on the revised Federal Act on the Reduction of Greenhouse Gas Emissions (CO_2 Act)
- **Yearly heating degree days:** indicator of local climate conditions

Estimation Procedure

Based on hedonic regression and event study approach.

Simple hedonic **low-carbon rent premium model:**



Simple hedonic **difference-in-difference model** with **Europe's energy crisis**:

Control group: **Carbon-neutral apartments**
Treatment group: **CO_2 emitting apartments**

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Empirical Results – Low-Carbon Rent Premium

Linear results for five different specifications.

Variables	Dependent Variable: log(Net rent)				
	(1) Condition	(2) Age	(3) Costs	(4) All	(5) Index
CO_2 emissions	-0.0015***	-0.0041***	-0.0033***	-0.0019***	-0.0011***
Condition	0.0812***	-	-	0.0913***	-
Building age	-	0.0002***	-	0.0003***	-
Renovation costs	-	-	-0.0009***	-0.0005***	-
Quality index	-	-	-	-	0.0824***
Hedonic controls	Yes	Yes	Yes	Yes	Yes
Minergie dummies	Yes	Yes	Yes	Yes	Yes
Cantonal dummies	Yes	Yes	Yes	Yes	Yes
Quarterly dummies	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.7585	0.7440	0.7477	0.7610	0.7581

Empirical Results – Low-Carbon Rent Premium

Derived from traditional hedonic regression (2015-2023).

- A hedonic regression model is used to analyze the impact of a building's CO_2 emissions on net apartment rents:

Reduction by 22 kg / m^2 / year
(Fossil-fueled building goes low-carbon)

Increase in net rent by 4.18 %
(0.19 x 22 kg / m^2 / year)

Basis of a net rent: CHF 16,800 / year
(1,400 / month)

Increase in net rent by around **CHF 702 / year**
(16'800 x 4.18 %)

Change in heating costs when changing from fossil heating (CHF 34 / m^2 / year) to a heat pump (CHF 29 / m^2 / year)

Reduction in ancillary costs of CHF 400 / year for an averaged sized apartment of 80 m^2!

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Empirical Results – Low-Carbon Rent Premium

Derived from traditional hedonic regression (2015-2023).

Win-win-win situation:

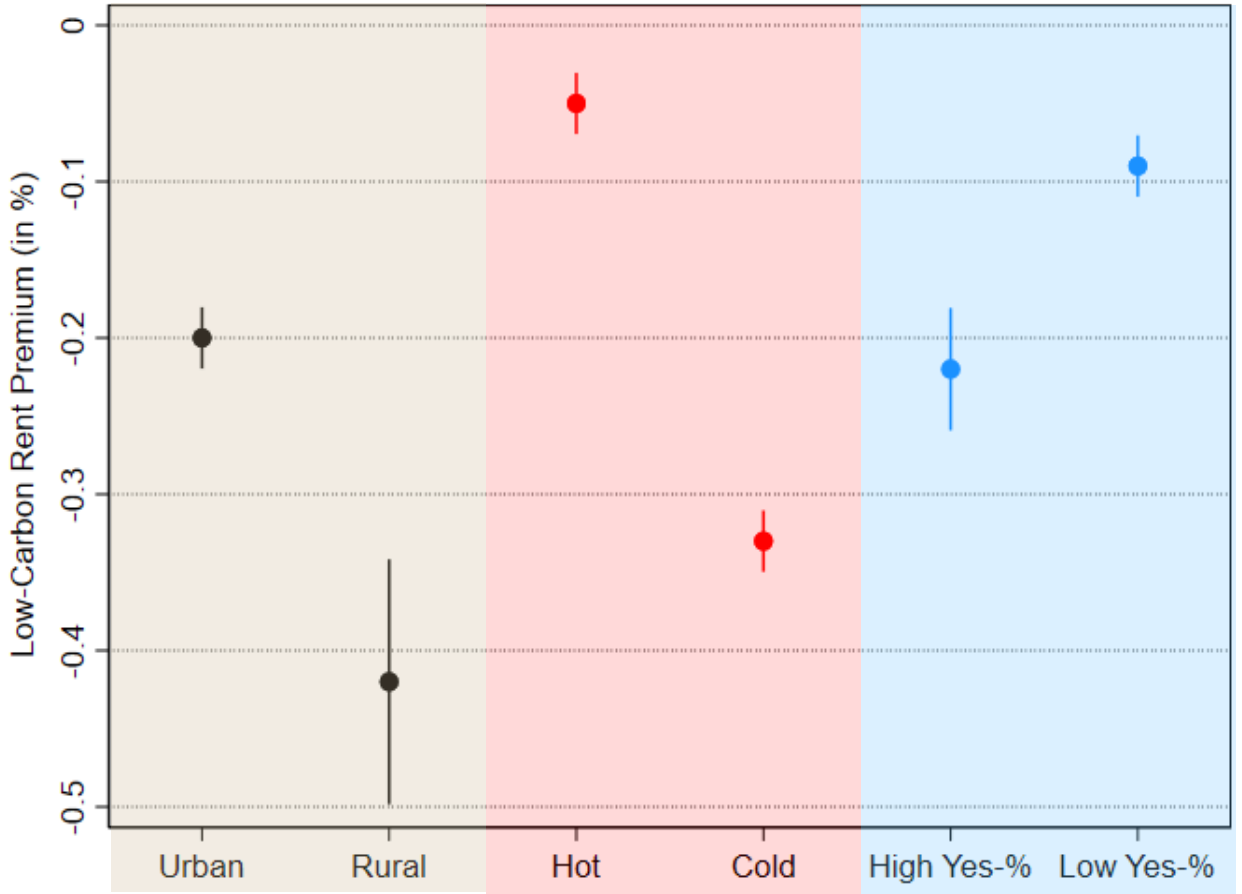
Average building with 65 apartments and average sized apartment of 80 m^2:

- Landlord: **45,630 CHF** cash flow increase p.a. (65 units x 702 CHF / year)
- Tenants: **26,000 CHF** cost savings p.a. (65 units x 400 CHF / year)
- Society: **114 tons CO_2** reduction p.a. for average multi-family home (65 units x 80 m^2 x 22 kg / m^2 / year)

Ancillary Costs vs. Preferences for Sustainability

Various sample splits.

- We can document regional heterogeneity in the size of the low-carbon rent premium!



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Empirical Results – Low-Carbon Rent Premium

Derived from event study regression (DiD).

Europe's energy crisis in 2021/2022:

- 89% increase in average monthly gas price and 43% increase in average monthly oil price

→ Use the energy crisis of October 2021 as an exogenous shock!

9 months before the crisis

Δ between CO_2 emitting (treatment) and low-carbon (control) apartments:
-2.8% and -8.6%

Higher rent premium →

9 months after the crisis

Δ between CO_2 emitting (treatment) and low-carbon (control) apartments:
-4.5% and -10.2%

→ Treatment effect ranges between **-1.50% and -1.7%** ←

- Europe's energy crisis causally increased the low-carbon rent premium through the channels of …
  - … increased ancillary costs and/or
  - … an aversion towards fossil heating systems (fuel shortages)

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Further Evidence – Low-Carbon Cap Rate Premium
Derived from traditional hedonic regression (2017-2023)

- Based on capitalization rates of 611 private transactions between Q1 2017 and Q3 2023, we find:

Reduction by 22 kg / m^2 / year
(Fossil-fueled building goes low-carbon)

Decrease in cap rates by 5.50-7.04bps

Average cap rate in the dataset: 2.82%

Low-carbon cap rate premium increases market prices by **1.95 to 2.50%**

Investment costs of oil heating system costs CHF 1'300, gas heating costs CHF 1'200, and heat pump CHF 9'300

The effect of higher net rents and lower cap rates offsets higher investment costs for going low-carbon!

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Increase in Total Return – Net Rent Discounted

Value creation by sustainable investments!

- Example:

Average building with fossil heating:

- Net rental cash flow: 1,092,000 CHF
  (65 units x 16,800 CHF / year)
- Going-in cap rate: 2.82 %
- Price = 1,092,000 / 0.0282 = 38.7 mn CHF

Average building with heat pump:

- Net rental cash flow: 1,137,630 CHF
  (65 units x 17,502 CHF/year)
- Going-in cap rate: 2.76 % (-1.95%)
- Price = 1,137,630 / 0.0276 = 41.2 mn CHF

6.44 % increase in value!

- Cap rate = risk-free rate + risk premium – growth in future cash flows
- Price increase compensates for higher investment costs

Conclusion and Policy Implications

- Apartments in low-carbon buildings have higher net rents than identical dwellings, which emit more carbon emissions.
- From the tenants' point of view, this higher willingness to pay stems from ancillary cost savings when living in a sustainable property and a higher preference for living in an environmentally friendly apartment.
- Win-win-win situation for tenants, landlords, and the society.
- Market intervention mechanisms like CO_2 taxes are key instruments to induce a green residential real estate market transition. Counting on peoples' sustainable behavior is an additional but not stand-alone mechanism to achieve climate goals.
- From the investment perspective, policymakers must carefully evaluate incentive structures for sustainable housing, as higher market values of low-carbon buildings compensate investors for cutting CO_2 emissions.

Thank you for your attention!