Sticky Asset Prices

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Abstract

We exploit an unexpected, geographically confined, and persistent increase in residential electricity prices to test whether real estate prices adjust quickly to their new fundamental value or whether they are downward sticky. We find that home prices in treated areas fall by 4.0% to 6.7% following the shock compared to controls, while transactions volume declines by 5.7% to 10.0%. The volume decline is driven by fewer listings, longer time-on-market, and increased unsold inventory—patterns inconsistent with frictionless price adjustment. Examining heterogeneous treatment effects, we show that homeowners with predicted negative equity or nominal losses are significantly less likely to sell and more reluctant to reduce prices relative to those with predicted positive equity or nominal gains. Our findings provide causal evidence of downward price stickiness, with implications for macroeconomic models and household mobility.

JEL codes: D14, E44, G12, Q41, R21, R31

Keywords: Price stickiness, asset pricing, housing, financial constraints, loss aversion

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1 Introduction

A large body of empirical research has established a strong positive correlation between asset prices and trading volume, including in equities (Karpoff, 1987) and real estate (DeFusco et al., 2022). Yet, it is an open question whether the link is causal. Given causality, the direction is not established. Given direction, the mechanism is not established. Do falling volumes cause buyers to become more cautious, thus reducing prices? Or do falling fundamental values cause prices to drop, but not as much as a frictionless model would suggest? If so, one would expect volumes to fall. If that is the case, what is the mechanism? Are sellers reluctant to realize nominal losses or constrained by mortgage obligations amid an inability of short-sale constrained arbitrageurs to push down asset prices?

This paper addresses a fundamental question in asset pricing: do asset prices adjust quickly and fully to changes in fundamental value, or are they subject to downward rigidity that distorts market clearing?

These questions have important implications for both theory and policy. Understanding whether asset prices are downward sticky, and, if so, by which mechanism(s), helps test and distinguish theories of asset pricing and housing market dynamics (Stein, 1995), and the transmission of monetary policy (see below). These questions are particularly relevant for understanding housing market dynamics during economic downturns, the effectiveness of monetary policy transmission through housing wealth effects, and the design of policies aimed at maintaining housing market liquidity during crises. Moreover, policy makers seeking to influence equilibrium quantities make assumptions about how people respond. These assumptions are largely untested when it comes to affecting asset prices. This paper tests the neoclassical assumption that asset prices adjust freely to updated fundamental values against the alternative that asset prices are sticky.

Providing compelling tests of asset price stickiness is challenging, because it is typically hard to shock assets' fundamental value. We overcome this challenge by exploiting a quasi-natural experiment: a sharp, unanticipated, persistent, and geographically confined increase in electricity prices south of a price zone border cutting through Norway that began with the 2021–2022 European energy crisis. Electricity prices south of the demarcation line surged to about ten times their pre-2021 average. This spike was largely driven by soaring gas prices in Europe and the recent permanent opening of two new grid interconnections to continental Europe (Døskeland et al., 2022; Kirkerud et al., 2023). Due to grid transmission constraints between the northern and southern regions, Northern Norway remained insulated from the shock. This led to a large and sudden divergence in electricity prices across a sharp geographic boundary. The boundary does not follow administrative borders, thus creating a source of

plausibly exogenous variation in long-term homeownership costs in "treated" areas in the south, compared to "control" homes north of the boundary.[1] This allows us to examine whether house prices quickly and fully adjust to a persistent decrease in cash flow from homeownership, whether houses are kept off the market, or whether they are priced too high relative to market-clearing levels.[2] We combine this setting with detailed transaction, listing, and administrative data from 2013 to 2023. Using a difference-in-differences approach, we compare home transaction prices, list prices, transaction volumes, time-on-market, and other outcomes before and after January 2022 across treated and control areas. We further examine heterogeneous treatment effects across homes whose mortgages would exceed the prevailing transaction price (i.e., are underwater) or who would likely realize a nominal loss if sold.

We find economically significant evidence of price stickiness. Home prices in treated areas decline by 4.0% to 6.7% while sales volumes drop by 5.7% to 10.0%—a pattern inconsistent with frictionless price adjustment, which would predict price changes with stable volumes. The results are robust to inclusion of covariates, time trends, spatial fixed effects (including county and municipality), and even to housing unit fixed effects. These results contrast a neoclassical benchmark. If prices had adjusted in a frictionless way to reflect the decline in fundamentals, one might have expected that volumes would have remained unchanged and only prices would have adjusted. By contrast, if homeowners do not adjust listing prices downward enough, become less likely to list their homes for sale, or become less willing to accept lower offers, one would expect that transaction volume would decline. The finding of a simultaneous decline in both price and volume suggests that prices are downward sticky.

Next, we explore the mechanisms underlying these findings. We identify three channels through which sellers resist price adjustment: (i) reduced listing propensity—listings fall by 7.8% to 9.3%, (ii) reluctance to lower list prices sufficiently—while list prices decrease, they do not decrease as much as sale prices, and (iii) unwillingness to accept lower offers—evidenced by a 30% increase in unsold inventory and 23% to 44% longer time-on-market. These results indicate that sellers are aware of the cost shock but are either unwilling or unable to adjust

[1] Several other features make the Norwegian setting compelling for this study. First, homes in Norway are almost entirely electrified, with per capita electricity consumption far exceeding that of the U.S. or Europe. Therefore, a given increase in electricity prices leads to a relatively large increase in costs. Second, over 90% of Norwegian households are on real-time pricing contracts, meaning they experience immediate pass-through of electricity price changes. Third, recent grid connections to Germany and the UK imply that electricity prices in Southern Norway will remain durably higher, providing a persistent shock to the cost of homeownership. The regulator of the Norwegian electricity market forecasts that long-term electricity prices (by 2028-2030) will be on average two to four times higher than prices prior to 2021 (Kirkerud et al., 2023).

[2] Electricity costs are large enough to have a potentially considerable effect on operating costs and thus fundamental value. Assume a permanent $100 monthly increase in a home's electricity bill. Using a 2% discount rate, this increase in user costs roughly corresponds to a $60,000 decline in home value, or about 15% of the median home price in our sample.

prices sufficiently.

Finally, we explore alternative mechanisms by examining treatment effect heterogeneity. The decline in sale propensity is driven primarily by homes predicted to be underwater or to incur a nominal capital loss. In contrast, homes with predicted positive equity or a nominal gain show no statistically significant decline in sales probability. We also find that sellers whose homes are predicted to be underwater or to incur a nominal capital loss are more reluctant to lower prices, compared to sellers with predicted positive equity or a nominal gain. These patterns suggest that financial constraints (Stein, 1995) and nominal loss aversion (Genesove and Mayer, 2001) are drivers of price stickiness.

First, by exploiting quasi-experimental variation in long-run homeownership costs from a geographically confined electricity price shock, our paper provides causal evidence for how frictions in price adjustment propagate shocks to asset values and distort market efficiency, contributing to a literature that examines how various price rigidities, including nominal wage rigidities and sticky product prices, distort market efficiency (e.g., Rotemberg, 1982; Hall, 2005; Bils and Klenow, 2004; Klenow and Willis, 2007; Gorodnichenko and Weber, 2016). A more recent literature emphasizes how rigidities in both product and asset markets can amplify the effects of monetary and fiscal policy shocks (e.g., Dupor et al., 2019; Auclert, 2019; Pasten et al., 2020; Chiavari et al., 2021; Baqaee et al., 2024). Our evidence supports theoretical insights from Guren (2018), who shows how strategic complementarity among sellers amplifies price adjustment frictions, and reinforces macro-level insights from Beraja et al. (2019), who demonstrate how frictions in local housing markets transmit monetary policy shocks to consumption and investment behavior. We complement this literature by providing clean empirical evidence of sticky asset prices.

Second, we are the first to use an exogenous shock to homes' fundamental value to show evidence of loss aversion and mortgage lock-in effects on home prices and volume co-movement. An extensive literature documents a positive correlation between house prices and trading volume. This pattern has been attributed to several mechanisms based on theory and cross-sectional and time-series evidence. Mechanisms include loss aversion (Genesove and Mayer, 2001; Engelhardt, 2003; Einiö et al., 2008; Hurmeranta and Lyytikäinen, 2025), credit constraints and home equity channels (Stein, 1995), mortgage lock-in effects that reduce mobility (Fonseca and Liu, 2024; Fonseca et al., 2024), and expectation-driven demand dynamics (Armona et al., 2019; DeFusco et al., 2022). Recent work by Keys and Mulder (2020) documents similar price-volume dynamics in Florida coastal markets facing sea-level rise risk, where transaction volumes declined significantly while prices remained initially stable. These studies highlight how falling prices can erode home equity, trigger behavioral reluctance to sell, or depress expectations of future appreciation—all of which contribute to

reduced market liquidity and sales. By contrast to this literature, which relies on cyclical fluctuations or cross-sectional variation for identification, our setting features a sharp, sudden, and persistent change in cash flow from homeownership. By isolating this shock, we offer a cleaner test of whether volume declines reflect price stickiness and provide evidence consistent with loss aversion and mortgage lock-in effects as underlying mechanisms. Our findings also complement structural work such as Andersen et al. (2022), who quantify the magnitude of loss aversion and reference dependence parameters using Danish housing data.

Third, we contribute new mechanisms to the growing literature on the capitalization of energy costs into home prices. Prior studies show that energy efficiency and utility costs are internalized into valuation to varying degrees. For instance, Myers (2019) finds that U.S. homebuyers rationally capitalize expected energy cost differences into prices when provided with fuel cost variation, while Mense (2018) and Aydin et al. (2020) show partial capitalization in European housing markets. More recently, Amaral and Zetzmann (2025) highlight how energy shocks affect rents differently throughout the income distribution. Brolinson et al. (2024) use Norwegian transactions data to estimate that energy-intensive homes face larger price declines during the 2022 price shock, focusing on the capitalization of energy costs into home values. By contrast to these studies' emphasis on buyer-side valuation behavior and price effects, we focus on the full market adjustment process, including prices, volume, listings, and inventory dynamics. We show that even when buyers are attentive to energy costs, seller-side frictions—especially loss aversion and financial constraints—can inhibit complete price adjustment. This generates a sticky adjustment process marked by fewer transactions, longer time-on-market, and reduced listing activity.

2 Background on the Electricity Price Shock in Norway

Norway provides a unique empirical setting to study how sudden and persistent changes in housing costs affect asset prices and market activity. In particular, the 2021–2022 European energy crisis triggered a dramatic and geographically localized increase in electricity prices in Southern Norway, while Northern Norway remained largely unaffected. The shock unfolded within a unified national context—characterized by consistent macroeconomic policies and institutions—yet produced substantial regional variation in energy costs, creating a compelling quasi-experimental setting. The key features of this shock—its unexpectedness, geographic confinement, magnitude, and persistence—make it particularly well-suited for causal identification of housing market frictions.

2.1 Electricity Price Zones and Regional Segmentation

Norway's electricity market is divided into five distinct price zones (NO1–NO5), due to limited grid transmission capacity across zones. Figure 1, Panel (a), illustrates the geographic boundaries of these price zones. Electricity prices are determined simultaneously across all bidding zones through the Nord Pool exchange, based on local supply and demand conditions and subject to available transmission capacity between zones. However, prior to 2021, transmission constraints between regions were rarely binding, and as a result, electricity prices across zones were nearly identical for most of the time series.

Importantly, the boundary between high-price (Southern) and low-price (Northern) zones does not align with administrative borders—it cuts across municipalities and counties, as shown in Figure 1, Panels (b)-(d). This quasi-random boundary generates fine-grained spatial variation in treatment exposure, which we exploit in our empirical design.

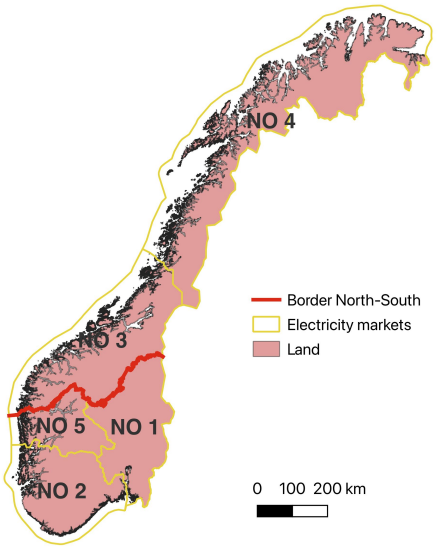
2.2 A Sudden and Persistent Electricity Price Shock

Norwegian households are highly exposed to electricity prices: nearly all homes rely on electricity for heating, hot water, and cooking, and over 90% are on real-time pricing contracts (SSB, 2023a). This makes the pass-through from wholesale electricity prices to household energy costs immediate and near-complete. Norwegian households consume, on average, over 16,000 kWh per year (SSB, 2023b)—roughly double the U.S. average and many times that of most European countries (Figure A1). This results in sizable electricity bills, especially when prices spike.

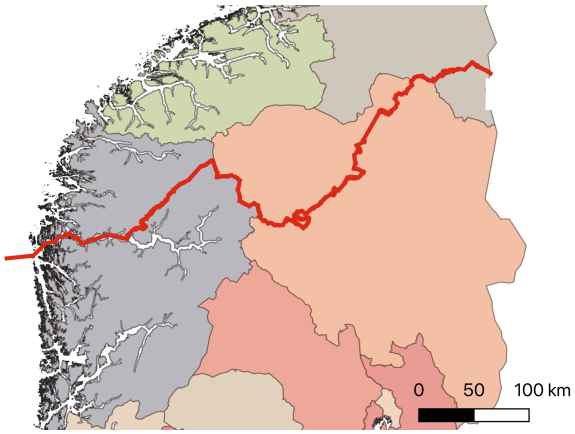
Prior to 2021, electricity prices in all five regions were low and stable —between \$0.02 and \$0.04 per kWh— and followed each other closely due to minimal transmission bottlenecks (Figure 2). However, the onset of the European energy crisis, combined with the opening of two major international interconnectors in 2021 (NordLink to Germany and North Sea Link to the UK), exposed Southern Norway (NO1, NO2, NO5) to much higher European electricity prices. Meanwhile, the Northern regions (NO3, NO4), which are poorly connected to external markets and had a local supply surplus, remained shielded.

As shown in Figure 2, the resulting divergence in wholesale electricity prices was unprecedented. Spot prices in the South reached as high as \$0.60/kWh in 2022, while Northern prices remained near historical averages.[3] In 2022, this translated into average household electricity bills of over \$5,000 in Southern Norway—more than seven times higher than in the North (NVE, 2022), with notable increases in the share of spot electricity expenditure in household

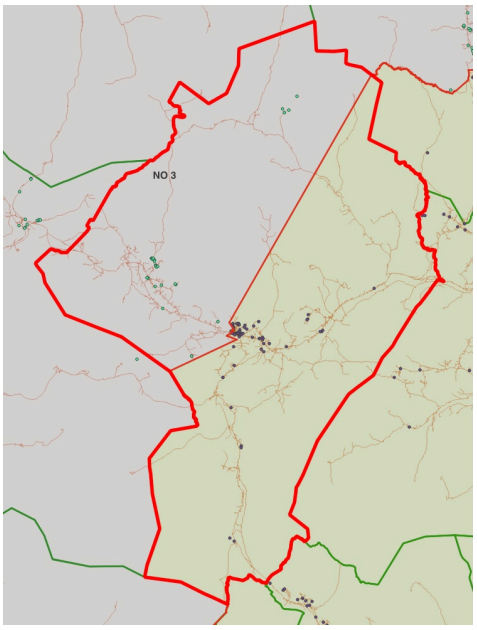
[3]We discuss the choice of the treatment start in Section 3.2.



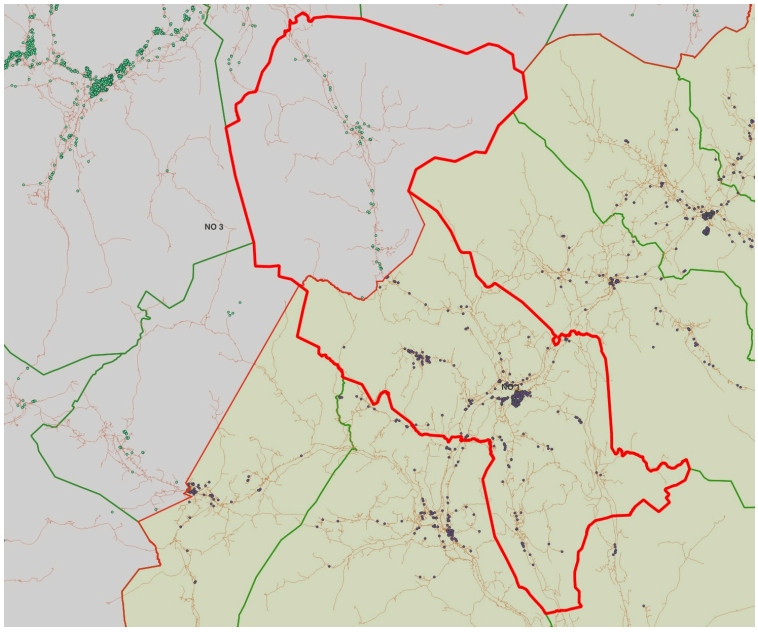
(a) Electricity price zones in Norway



(b) Counties around the North-South border



(c) Folldal municipality



(d) Tynset municipality

Figure 1 Panel (a): The five Norwegian electricity price zones, with the North-South border delineating high price markets in the South from low price markets in the North. Panel (b): Counties near the North-South border, with three counties intersecting the North-South border. Panels (c)-(d): Two selected municipalities intersecting with the North-South border. Light green: treated areas, grey: control areas. Thick red line: municipality boundaries. Light red lines: road network. Dots: sales transactions in our sample. (Data sources: NVE, Eiendomsverdi AS, and Statens vegvesen NVDB.)

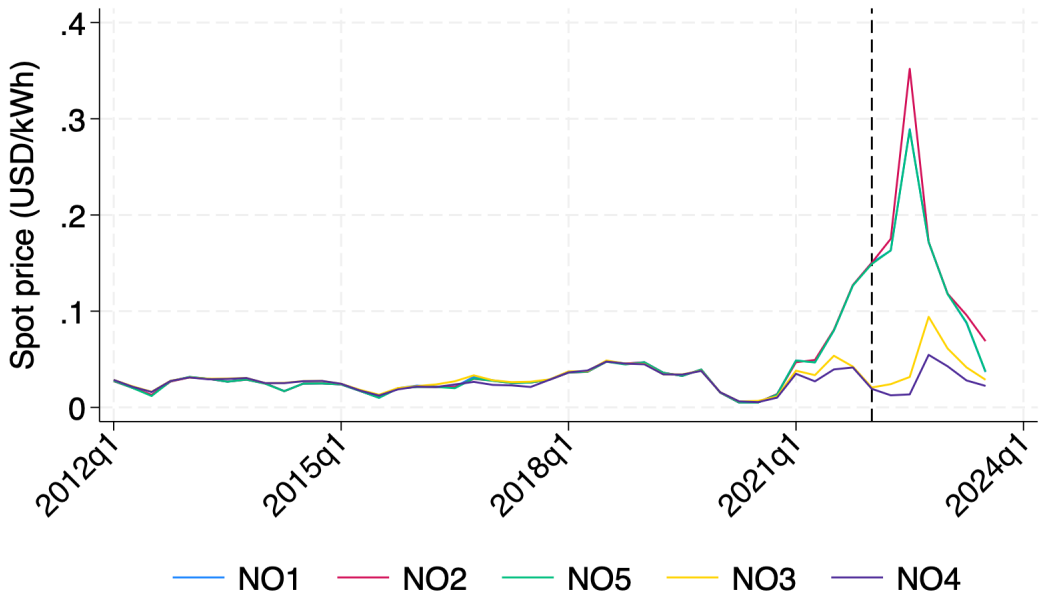


Figure 2 Quarterly spot electricity prices in each electricity price zone, with the dashed line showing treatment start on January 1, 2022. (Data source: NordPool.)

consumption rising from under 1.5% in winter 2020/2021 to over 3% in winter 2021/2022 (see Figure A2).[4]

2.3 Expectations and Household Response

The electricity price shock was not only large and sudden but also widely perceived as persistent. Norway's system operator and energy regulator both projected that prices in the South would remain elevated—around \$0.08/kWh through 2030—as Southern Norway continues to export power to the European grid (Kirkerud et al., 2023).

Households appear to have internalized this new reality. Households paid attention to this price increase, as illustrated by the sustained spike in Google searches and in the large number of media articles on electricity prices (see Figure A3). Furthermore, as shown in Figure A4, Southern homeowners significantly increased their investments in energy-saving and price-management technologies after 2022. Installations of solar panels, home retrofits, and smart energy systems all rose markedly, particularly in the treated regions. A difference-in-differences regression shows a 70% relative increase in solar panel installations in Southern Norway, consistent with forward-looking household behavior and beliefs that high prices are here to stay (Table A1).

[4]We discuss the implementation of a subsidy to households and its potential interaction with our treatment in Section 3.2.

Taken together, these features—high household energy exposure, sudden and exogenous regional price divergence, and credible long-term persistence—make the Norwegian energy crisis a powerful natural experiment for studying housing market dynamics in response to fundamental cost shocks.

3 Data

We use a rich collection of micro-level datasets to study how a sudden and geographically localized increase in energy costs affected housing market outcomes in Norway. Our analysis draws from four primary sources: home sales transactions, property listings, administrative registries, and electricity spot market data. We restrict our sample to homes located south of Bodø between 2013 and 2023 and provide detailed cleaning steps in Appendix Tables B1 and B2.

3.1 Data sets

3.1.1 Home Sales Transactions

Our main dataset consists of all recorded residential property sales between 2013 and 2023, provided by Eiendomsverdi AS. The data include transaction-level details such as sale and list prices, sale date, home characteristics (e.g., lot size, living area, number of bedrooms, year built, and home type), and geographic coordinates. We exclude cooperatively owned units (co-ops) due to their distinct legal and pricing structures and focus on individually owned dwellings.

All monetary values are deflated to 2015 prices using monthly CPI data from Statistics Norway and converted to USD using the January 2, 2023 exchange rate (1 USD = 9.8413 NOK). We implement several steps to clean the data and remove outliers: (i) we drop the 1st and 99th percentiles of the debt-free sale price within municipality-year-home type strata, (ii) drop the 1st and 99th percentiles of living area, the 99th percentile of lot size and number of bedrooms, and (iii) remove observations with extreme or missing values in key covariates, such as build year. We also remove properties built in 2023 to focus on the secondary market and those that sold multiple times within the same year. The final cleaned dataset includes 244,293 transactions between 2019 and 2023 and 184,162 repeat sales observations between 2013 to 2023 (Appendix Table B1).

We log-transform sale price, living area, lot size, and property age. Using QGIS, we geolocate each home and assign it to one of the five electricity markets (NO1–NO5), and calculate distances to the North–South electricity price zone border (as the crow flies), which

defines treatment exposure. Using OpenStreetMap, we calculate the distance and driving duration between each home in our sample and the closest of nine identified crossing points along the North-South border via the road network (omitted small roads closed in the winter). Those distances and driving times are used in Appendix D to (1) investigate potential relocation decisions on the North side of the North-South border for households who might initially have planned to locate on the South side of the border and (2) test the robustness of our main results to alternative sample restrictions.

3.1.2 Listings and Inventory Data

To examine market dynamics such as listing behavior, inventory accumulation, and time-on-market (TOM), we complement the transaction data with comprehensive listings data from Eiendomsverdi AS covering the period 2014–2023. Those data include all properties listed for sale, whether sold or unsold, and contain the same structural characteristics as the sales data. We follow a cleaning process parallel to that used for transaction data, excluding cooperative properties and outlier values based on price, size, and other key attributes. After cleaning, the listing-level dataset includes 297,504 observations between 2019 and 2023 (Appendix Table B2). This dataset allows us to construct measures of market slack (e.g., unsold share) and activity (e.g., new listings), which are used in our volume-based regressions and descriptive analysis.

Listing a home for sale in Norway is a resource-intensive process that involves both monetary and time costs, particularly when the home does not ultimately sell. Before being listed, the homeowner must hire a certified expert to inspect the property and produce a technical condition report, which is legally required to be included in the sales prospectus. The seller also incurs fixed marketing costs, including fees for creating the prospectus, professional photography, and often home styling services to enhance the property's appeal. These expenses are incurred regardless of whether the home is successfully sold. Moreover, if the home is listed again shortly after being removed from the market, it may face a stigma effect or price penalty. As such, the decision to list is costly.

3.1.3 Administrative Data on Buyers and Sellers

The home transactions data are linked to individual-level administrative registry data to explore household-level heterogeneity in responses to the electricity price shock. Those data include information on buyers and sellers from Statistics Norway's registry sources, covering balance sheets (wealth and debt), employment and income, household composition, and educational attainment. This enriched panel enables tests of potential mechanisms such as

liquidity constraints, family-related mobility shocks, and loss aversion in selling behavior.

3.1.4 Electricity Price Data

Hourly and daily electricity spot price data are obtained from Nord Pool, the Nordic power exchange, for all five Norwegian electricity zones (NO1–NO5) from 2012 to 2023. These data capture wholesale prices faced by households with real-time pricing contracts, which comprise over 90% of the residential sector in recent years.

3.2 Treatment and post period definitions

We define as treated all homes located inside the three Southern electricity price zones (NO 1, NO 2, and NO 5) since they experience a sudden, unexpected, long-term sharp increase in electricity prices, while control homes, those located in the two Northern price zones (NO 3 and NO 4), face relatively unchanged electricity prices (Figure 2).

We define the post-treatment period as beginning on January 1, 2022, to capture the point at which electricity price differences between Southern and Northern Norway became both large and widely perceived as persistent. As shown in Figure 2, spot prices in Southern Norway began to rise in mid-2021, primarily due to surging gas prices in continental Europe. However, it is unlikely that Norwegian households immediately recognized the long-term nature of this shock. Initial increases may have been perceived as transitory, and expectations of persistently high prices only became salient toward the end of 2021, coinciding with growing awareness of geopolitical developments (e.g., the war in Ukraine) and the activation of new export cables linking Norway to the European power grid. Setting January 1, 2022 as the start of treatment ensures that observed effects reflect a context in which both prices and expectations shifted markedly. We verify the robustness of this timing assumption in Appendix D. Table 1 reports summary statistics of average daily spot electricity prices before and after this date, illustrating the sharp divergence between treated (NO1, NO2, NO5) and control regions (NO3, NO4) in the post period.

A subsidy to households was announced and implemented in January 2022. This subsidy was partially decoupled from the electricity (spot) price in order to incentivize economical consumption. Households received a payment corresponding to 80% to 90% (depending on the season), above USD 0.07/kWh conditional on the average monthly electricity spot price in the household's electricity price zone exceeding the USD 0.07/kWh threshold (Norwegian Government, 2025). As depicted in Figure A2, the subsidy only partially mitigated the effect of the electricity price shock. The timing of the subsidy coincides with our treatment start date. Our treatment can thus be interpreted as the electricity price shock net of the subsidy.

Table 1 Summary statistics of daily spot prices ($/kWh) in the 5 price zones in the period Jan 1, 2019-Aug 1, 2023 (Data source: Nord Pool)

	Pre-Jan 1, 2022		Post-Jan 1, 2022	
	Mean	(sd)	Mean	(sd)
		Treated areas		
NO 1	0.04	0.04	0.16	0.10
NO 2	0.04	0.04	0.17	0.11
NO 5	0.04	0.04	0.16	0.10
		Control areas		
NO 3	0.03	0.02	0.04	0.05
NO 4	0.03	0.02	0.03	0.03
Observations	1096		578	

3.3 Sample Selection

Our empirical design relies on careful sample selection along two key dimensions: spatial comparability and temporal consistency. We define two complementary samples to separately leverage geographic variation in treatment exposure and longitudinal variation in repeated transactions. Tables B3 and B1 report summary statistics and data cleaning steps for each sample.

Spatial Comparability using Bordering Zones: To improve comparability between treated and control areas, we restrict the main sample to electricity markets that lie along the North–South market boundary: NO1 and NO5 (treated) and NO3 (control). These bordering regions are geographically proximate and exhibit more similar housing stock characteristics relative to regions further away from the price zone border. We exclude the capital county of Oslo from the sample, given its distinct housing market dynamics, urban density, and price levels. Summary statistics in Table B3 confirm that this restriction improves balance across observable characteristics, though price and housing type differences remain. In a robustness test, we restrict homes to be located within 50km (Euclidean distance) of the North-South border. As shown in Table D7, those homes are almost identical based on observable characteristics.

Length of the Time Series and Cross-Section vs. Panel: In the context of the effect of the electricity price shock on home prices, we use two temporally distinct samples tailored to different identification strategies. We focus on the most recent period, i.e., 2019–2023, for our baseline cross-sectional analysis to minimize potential confounding from structural shifts in lending standards, building quality, or neighborhood demographics that may have

evolved over the past decade. By narrowing the window to 2019–2023, we reduce the risk of spurious trends and improve the comparability of treated and control regions at the time of the electricity price shock. This sample includes all eligible transactions in the restricted spatial set over that period.

To account for time-invariant unobservable characteristics such as location quality or structural attributes, we construct a repeat-sales panel comprising units that transact at least twice during the 2013–2023 period. This sample allows us to control for unit fixed effects and better isolate within-home price changes associated with treatment exposure. While extending the panel introduces older transactions that may be less comparable, the fixed-effects framework helps mitigate potential bias from persistent unobserved heterogeneity.

This dual-sample strategy balances the strengths of each approach. The shorter cross-section improves identification by focusing on a stable period around the shock, while the longer repeat-sales panel ensures broader representativeness and stronger internal validity through within-unit comparisons. Notably, the longer time window is necessary to attain sufficient sample size for the repeat-sales model, as using only post-2019 repeat transactions would exclude many homes and potentially introduce sample selection bias. By extending the repeat-sales window to 2013, we maintain statistical precision and reduce concerns about representativeness.

In the context of the effect of the electricity price shock on sales volume, we use the cross-section of homes around the time of the price shock, i.e., 2019-2023, while for the sale propensity analysis, we leverage the full time series, i.e., 2013-2023, to allow for the largest possible sample of homes to transact.

3.4 Construction of expected underwater and nominal loss variables

To examine the role of financial frictions and loss aversion in household selling behavior, we construct two variables at the unit level: a binary indicator for whether the household's mortgage would be *underwater* and for whether the household would realize a *nominal capital loss*, *if* the property were to hypothetically be sold at the onset of the electricity price shock. Both measures rely on estimating the predicted price a seller would have received had they sold the home at the onset of the electricity price shock. Both the underwater and nominal loss measures are then used to stratify the sample and test whether sales propensity and price stickiness vary by underwater status or unrealized capital losses.

Predicting baseline prices: We predict the sale price that would have been obtained in 2021Q4—just before treatment. We predict prices for non-repeat sales homes using a hedonic regression model that includes home characteristics (unit type, size, lot area, age, number

of bedrooms), year-quarter, and county fixed effects, and county linear time trends, and for repeat sales homes using year-quarter and unit fixed effects, and county linear time trends (corresponding to columns (4) and (6) in Table 2, respectively). Predicted prices for 2021Q4 for cross-section (non-repeat sales) homes and repeat sales homes are depicted in Figure 3, panel (a). Residuals are shown in Figure B1. Both regression models are estimated for homes selling in the pre-treatment period, thus, homes that only sell in the treatment period are excluded from this analysis. To obtain predicted prices in the absence of treatment at the onset of treatment, we apply the housing price appreciation of 2.4% reported by SSB (2022).

Estimating the individual treatment effect: We then subtract from this predicted baseline price for treated homes the estimated depreciation in asset value caused by the electricity price shock. We show in Appendix C that our estimated effects on home prices are consistent with full capitalization of the regulator's long-term electricity price forecast. This price penalty is thus calculated by assuming full capitalization of the expected increase in long-run electricity prices (from \$0.04 to \$0.08 per kWh) in perpetuity using a 4% discount rate, and taking into account each home's estimated annual electricity consumption.[5] The distribution of the estimated NPV of the increase in electricity costs is depicted in Figure 3, panel (b).

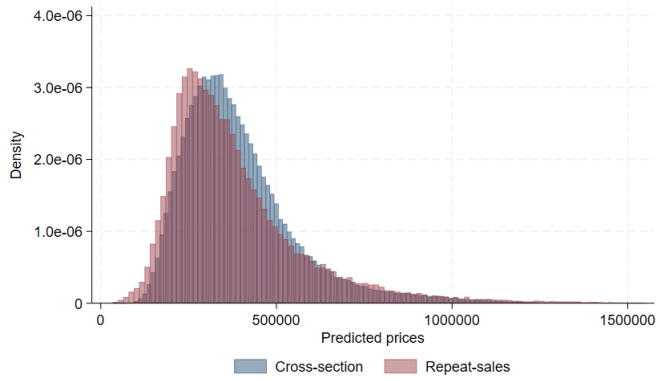
Predicting home equity and underwater status: We infer mortgage balances from debt data using administrative registry data at the individual level at the end of the calendar year of the purchase of a home.[6] We exclude observations with missing debt, ownership information, or with no sales in the pre-treatment period from this analysis. Home equity is calculated by substracting from the predicted transaction price in 2022Q1 the sum of the mortgage liabilities of all listed owners of the property. Figure 3, panels (c) and (d) show the predicted home equity for all homes in our sample and the realized home equity for homes that actually sold in 2021Q4 and 2022Q1, respectively. We define a home as predicted to

[5]The risk free rate in Norway for the past 10 yrs was 4%, motivating our choice of a 4% discount rate. Furthermore, electricity spot prices in Norway in the 2010-2021 period averaged \$0.02 to \$0.04 per kWh; we pick the upper bound. The regulator forecast an average spot price of \$0.08 per kWh in 2030. We omit the high electricity during the energy crisis and use this long-term average instead. As a robustness check, we assume that all treated homes face a 4% discount based on our empirically estimated average treatment effect on home prices from Table 2, although we recognize that the price penalty estimate may not be an unbiased estimate of the true penalty for a given home. Nevertheless, both methods yield similar counterfactual price estimates. Results available upon request.

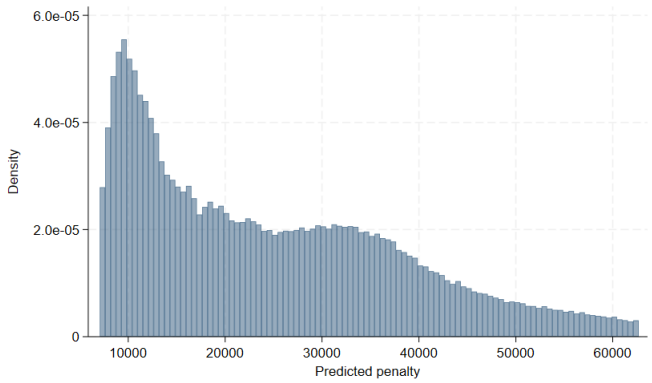
[6]The administrative data contain *total debt* net of *student debt*. We use this difference as a proxy for mortgage debt. Total debt may include mortgages for multiple homes. Thus, since the administrative data feature real estate wealth separately for the primary home (legal primary residence) and secondary home(s), we restrict the analysis to individuals only owning a primary home, and therefore likely having a single mortgage. Figure B2 shows loan-to-value in the year of purchase. Although a small number of homes are purchased without a mortgage, LTV increase steadily until 85% of the purchase price, which is the general LTV limit since 2015 in Norway. In practice, banks have some flexibility for increasing LTV beyond 85%. Furthermore, other rules may bind before the 85-% LTV, e.g., debt-to-income regulations.

Figure 3 Predicted prices, home equity, and nominal gains prior to treatment (2021q4) and at the beginning of treatment (2022q1).

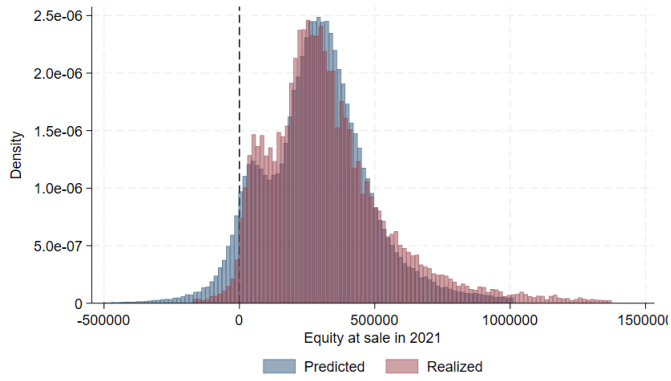
(a) Predicted prices in 2021Q4



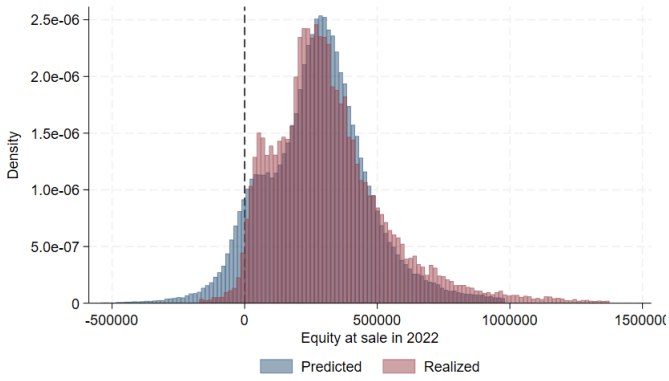
(b) NPV of increase in electricity cost



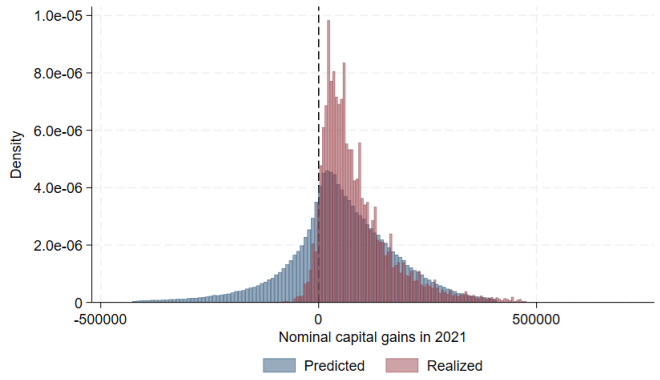
(c) Equity in 2021



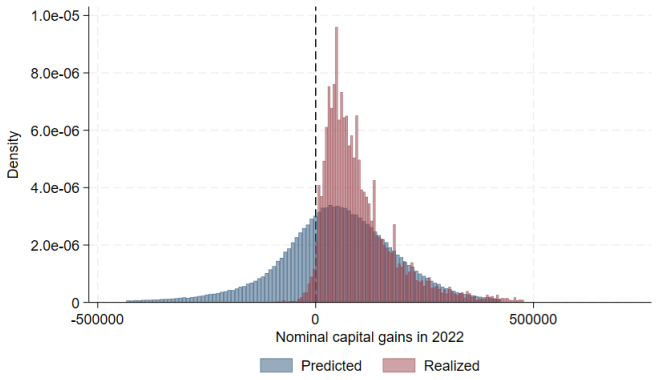
(d) Equity in 2022



(e) Nominal gains in 2021



(f) Nominal gains in 2022



be underwater (0/1) if the combined mortgage liabilities of all listed owners of the property exceed the predicted transaction price at the onset of the electricity price shock (in 2022Q1).

Predicting nominal capital gains and nominal loss status: We construct a variable capturing the predicted nominal capital gains one would realize by selling at the onset of the electricity price shock by substracting from the predicted nominal sale price in 2022Q1 the observed nominal price from the prior transaction. For homes with multiple transactions in 2013-2023, we construct this variable using the most recent sale prior to the treatment period as the reference sale. We omit from the analysis homes with a single observed transaction, if that transaction occurs during the treatment period. Figure 3, panels (e) and (f) show the predicted nominal gains for homes in our sample and the realized nominal gains for homes that actually sold in 2021Q4 and 2022Q1. We define the predicted nominal loss indicator as equal to one if the predicted nominal capital gains are negative at the onset of the electricity price shock (in 2022Q1).

4 Empirical Framework

We examine the effect of the electricity price shock on asset price stickiness using a range of housing market outcomes, including transaction prices, propensity to sell, time-on-market, and municipality-level aggregates of sales volume, listings, and the share of unsold homes. Our empirical strategy is based on a difference-in-differences (DiD) framework that compares changes in these outcomes before and after the onset of the electricity shock between treated and control regions.

The key identification assumption is that, in the absence of the electricity price shock, treated homes would have experienced outcome trends similar to those of control homes. That is, any divergence in post-treatment trends can be attributed to the electricity price shock. We show that the parallel trends assumption holds in Section 5.5.1.

4.1 Effect on Home Prices

We begin by estimating the impact of the electricity price shock on home sale prices using the following DiD specification:

$$\ln p_{it} = \beta_0 + \beta_1 \text{Treat}_i \times \text{Post}_t + \beta_2 \text{Treat}_i + \mathbf{X}'_{it}\boldsymbol{\beta}_X + \lambda_t + \mu_g + \theta_{gt} + \varepsilon_{it} \tag{1}$$

where $\ln p_{it}$ is the log sale price of home i sold on day t, Treat_i indicates whether home i is located inside one of the three Southern electricity price zones, and Post_t equals one after January 1, 2022. The coefficient β_1 captures the average treatment effect on the treated

(ATT). $\mathbf{X}_{it}$ includes logs of standard home-level covariates: home type, lot size, building age, unit size, and number of bedrooms. We also allow for yearly trends interacted separately with each of the three latter controls. We include year-by-quarter fixed effects (λ_t) to control for macroeconomic shocks and county or municipality fixed effects (μ_g) to absorb time-invariant local unobservables. Spatial fixed effects are particularly important given the potential for spatial confounders such as labor demand or building regulations that likely vary persistently across local housing markets. We further control for a linear yearly county trend to allow for differential appreciation of the housing market across counties over the years (θ_{gt}). Standard errors are clustered at the municipality level.

Furthermore, we estimate an alternative specification with housing unit fixed effects to control for time-invariant attributes. This matters as such attributes may correlate with treatment, e.g., building material, sun exposure, local micro-climate, or energy efficiency.

To explore the effect of the electricity price shock, we re-estimate model (1) using the natural log of the list price as the dependent variable.

4.2 Effect on Sales Volume

We next examine how the shock affected housing market liquidity by estimating its effect on the number of sales per municipality per quarter. The DiD model is:

$$\ln V_{jt} = \beta_0 + \beta_1 \text{Treat}_j \times \text{Post}_t + \beta_2 \text{Treat}_j + \lambda_t + \mu_g + \varepsilon_{jt} \tag{2}$$

where V_{jt} is the natural log of the number of home sales in municipality j in quarter t. The rest of the notation mirrors equation (1). Note that because the outcome variable is aggregated at the municipality by quarter level, model (2) does not include any housing attribute. Furthermore, we do not include county linear trends as sales volumes do not display differential trends. Standard errors are robust and clustered at the municipality level.

Given that sales counts are count data with overdispersion, we also estimate a negative binomial model:

$$\mathbb{E}[V_{jt}] = \exp\left(\beta_0 + \beta_1 \text{Treat}_j \times \text{Post}_t + \beta_2 \text{Treat}_j + \lambda_t + \mu_g\right) \tag{3}$$

where the error distribution is assumed to follow a negative binomial distribution. The fixed effects are identical as in model (2). Robust standard errors are clustered at the municipality level.

4.3 Sale Propensity Model

Because aggregating sales volume comes at the expense of reducing the number of observations available for estimation, we examine an alternative measure of seller sale behavior at the home level: the likelihood that an individual home is sold in a given period. For this, we convert our data into a home-by-quarter panel. For each home sold at least once during 2013–2023, we observe whether it transacts in each quarter. We estimate a linear probability model (LPM) specification:

$$\Pr(\text{Sold}_{it} = 1) = \alpha + \beta_1 \text{Treat}_i \times \text{Post}_t + \beta_2 \text{Treat}_i + \boldsymbol{\gamma}' \mathbf{X}'_{it} + \lambda_t + \mu_g + \theta_{gt} + \varepsilon_{it} \tag{4}$$

where *Sold* is a binary variable equal to one if the home sells in a given quarter and zero otherwise. All other variables, fixed effects and trends are as in model (1). As for the price effect, we also estimate an alternative specification with housing unit fixed effects to account for unobserved heterogeneity in baseline sales propensity across homes. Standard errors are robust and clustered at the municipality level.

Because our panel is restricted to units that sold at least once, the analysis focuses on liquidity dynamics within the active resale market, rather than the full housing stock. This restriction implies that our findings speak to resale dynamics within the active segment of the market, and may not generalize to the full set of owner-occupied units. We estimate models both with and without controls for the time since last sale (i.e., inter-sale duration), allowing us to assess whether holding time influences responsiveness to the shock.

4.4 Effect on Time-on-Market (TOM)

We also estimate the impact of the electricity price shock on time-on-market (TOM). Longer TOM is often indicative of reduced liquidity or overly optimistic pricing. We use the same DiD structure as in the price model:

$$\ln TOM_{it} = \beta_0 + \beta_1 \text{Treat}_i \times \text{Post}_t + \beta_2 \text{Treat}_i + \mathbf{X}'_{it} \boldsymbol{\beta}_X + \lambda_t + \mu_g + \theta_{gt} + \varepsilon_{it} \tag{5}$$

where $\ln TOM_{it}$ is the natural logarithm of the number of days a property remains listed before sale. All other variables, fixed effects and trends are as in model (1). As for the price effect, we also estimate an alternative specification with housing unit fixed effects to account for unobserved heterogeneity in baseline sales propensity across homes. Standard errors are robust and clustered at the municipality level.

4.5 Listings Market Outcomes

Finally, we assess market slack by estimating the effect of the electricity price shock on the number of active listings and the share of unsold homes at the municipality level. These outcomes capture seller behavior—whether by foregoing or postponing listing or being unable to complete a sale. The DiD model takes the form:

$$\ln W_{jt} = \beta_0 + \beta_1 \text{Treat}_j \times \text{Post}_t + \beta_2 \text{Treat}_j + \lambda_t + \mu_g + \varepsilon_{jt} \tag{6}$$

where W_{jt} is the natural logarithm of either the number of listings or the share of listings unsold by the end of the quarter. All other variables and fixed effects are as in model (2). Standard errors are robust and clustered at the municipality level.

5 Results

5.1 Effect on Home Prices

Table 2, Panel A, reports the difference-in-differences estimates of the electricity price shock on the log of home sale prices. Across all specifications using the restricted sample from 2019–2023 (Columns 1–5), we find a negative treatment effect. The point estimates range from -0.9% to -4.1%, depending on the inclusion of controls and fixed effects. The results are robust to increasingly saturated specifications, including models with county and municipality fixed effects, linear county-specific trends, and a full set of home-level covariates, for which estimates are consistent and statistically significant, ranging from -4.0% to -4.1%. In Column (6), which uses the repeat-sales panel covering 2013–2023 and includes unit fixed effects, we estimate a slightly less but still statistically significant decline of approximately -6.7% in treated regions after the onset of the shock. Applying the estimates from columns (3) and (6) to the median home value in the 2019-2021 sample of $322,748 yields price declines ranging between $12,813 and $21,592, respectively. These results suggest that the rise in electricity prices led to a meaningful and robust decline in the market value of residential properties in Southern Norway.

Table 2 DiD results - Effect of being located South of the North-South market border on log home prices and log of list prices.

	Cross-section sample: 2019-2023					Repeat sales sample: 2013-2023
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Ln home prices					
treatxpost	-0.0094	-0.0090	-0.0114**	-0.0397***	-0.0407***	-0.0669***
	(0.0089)	(0.0070)	(0.0057)	(0.0092)	(0.0074)	(0.013)
N	188810	188810	188810	188810	188810	144461
Adj-R2	0.07	0.44	0.61	0.61	0.77	0.96
	Panel B: Ln list prices					
treatxpost	0.0103	0.0108	0.0085	-0.0234**	-0.0246***	-0.0491***
	(0.0085)	(0.0079)	(0.0058)	(0.0093)	(0.0062)	(0.012)
N	188699	188699	188699	188699	188699	144190
Adj-R2	0.07	0.45	0.61	0.61	0.78	0.96
Year×Qtr FE	✓	✓	✓	✓	✓	✓
Covariates		✓	✓	✓	✓	
Cty trend			✓	✓	✓	✓
County FE				✓		
Muni FE					✓	
Unit FE						✓

Notes: Home controls: home type, log lot size, log building age, log unit size, number of bedrooms, yearly trends interacted separately with each of the three latter controls. Robust standard errors clustered at municipality level. * p<0.1, ** p<0.05, *** p<0.01

5.2 Effect on Sale Propensity and Sales Volume

We assess the effect of the electricity price shock on housing market liquidity using both micro- and macro-level outcomes. Panel A of Table 3 presents difference-in-differences estimates of the effect on the probability that an individual home is sold in a given quarter (sale propensity conditional on selling at least once in the 2013-2023 period), using a home-by-quarter panel. Across specifications, we find a statistically significant decline in the probability of sale in treated areas post-shock. The estimated reductions in the quarterly probability range from 0.20 to 0.23 percentage points, with our preferred estimates ranging from -0.20 to -0.21 percentage points when using county or municipality fixed effects or unit fixed effects (columns 4-6). The baseline (2013-2021) quarterly sale probability in both treated and control regions prior to the shock was 3.1%. The estimated decline of 0.2 percentage points thus corresponds to a 6.5% reduction in sale likelihood relative to this baseline.

Table 3 DiD estimates - Effect on sale propensity and sales volume aggregated at the municipality and quarter level.

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Sale propensity (2013-2023)					
treatxpost	-0.0023***	-0.0023***	-0.0023***	-0.0021***	-0.0021***	-0.0020***
	(0.00068)	(0.00061)	(0.00061)	(0.00070)	(0.00070)	(0.00068)
N	12196400	12196400	12196400	12196400	12196400	12196400
Year×Qtr FE	✓	✓	✓	✓	✓	✓
Covariates		✓	✓	✓	✓	
Cty trend			✓	✓	✓	✓
County FE				✓		
Muni FE					✓	
Unit FE						✓
	Panel B: Sales volume (2019-2023)					
	Log sales; OLS			Sales; Neg. binomial		
treatxpost	-0.1056***	-0.0999***	-0.0933***	-0.0743***	-0.0571**	-0.0795***
	(0.036)	(0.034)	(0.033)	(0.021)	(0.025)	(0.020)
N	3436	3436	3436	3436	3436	3436
Year×Qtr FE	✓	✓	✓	✓	✓	✓
County FE		✓			✓	
Municipality FE			✓			✓

Notes: Covariates in Panel A: Home controls: home type, log lot size, log building age, log unit size, number of bedrooms, yearly trends interacted separately with each of the three latter controls. Standard errors clustered at municipality level. * p<0.1, ** p<0.05, *** p<0.01

At the aggregate level, Table 3, Panel B presents estimates of the treatment effect on transaction volume at the municipality-quarter level. The first three columns report log-

linear OLS regressions, while Columns (4)–(6) report negative binomial models to account for the count nature of the outcome and overdispersion. Across both model types, we consistently find a statistically significant and negative impact of the electricity price shock on sales volume in treated municipalities. The estimated reduction ranges between -10.5% to -9.3% for the OLS model and -5.7% to -8.0% for the negative binomial model, depending on the specification. The effect remains robust across models, including with county or municipality fixed effects, as well as year-quarter fixed effects. These effects are consistent with the 6.5% decline in sale propensity estimates obtained in Panel A.

5.3 Mechanisms: Mortgage Underwater and Nominal Loss Aversion

To better understand the mechanisms behind the decline in sales, we estimate pooled regressions that interact treatment status, the post-shock period, and its interaction with indicators for whether a home was predicted to be underwater on its mortgage or to incur a nominal loss if the home were to be sold at the onset of the treatment period. This approach allows us to directly compare the treatment effect across homes predicted to be underwater or not underwater, and across homes predicted to experience a nominal gain or a nominal loss.

Table 4 reports results for the sale propensity outcome. The key coefficient of interest is the interaction term $treat \times post \times \omega$, where ω denotes underwater or nominal loss status. For non-underwater or non-nominal loss homes, the coefficient on $treat \times post$ gives the average treatment effect. For homes predicted to be underwater and with nominal loss, the relevant treatment effect is the sum of $treat \times post$ and $treat \times post \times \omega$, reported in the rows labeled 'Underwater effect (total)' and 'Nominal loss effect (total)'.

The decline in sale propensity is driven by homes predicted to be underwater (Underwater effect (total), Panel A), which experience a statistically significant decline in sale propensity (-0.30 and -0.36 percentage points when using county, municipality, or unit fixed effects (columns 4-6), while the effect is economically small and non-significant at the 10% level for non-underwater homes, i.e., those with positive equity. Similarly, we find a 0.4 percentage points decline in sale propensity for homes predicted to experience a nominal loss, statistically significant decline at the 5% level in the case of the unit fixed effects specification (Nominal loss effect (total), Panel B, column 6). The point estimates are two times smaller and not significant at the 10% level in the case of the county or municipality fixed effects specifications (columns 4 and 5). In contrast, the effect is economically small and non-significant at the 10% level for homes predicted to realize a nominal gain across all specifications. These patterns suggest that mortgage constraints and reluctance to realize nominal losses both amplify the decline in sales.

Table 4 DiD results - Effect of being located South of the North-South market border on sale propensity, interacted with predicted underwater or nominal loss status (2013-2023).

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Underwater predicted status					
treatxpost	0.0004	-0.0003	-0.0003	-0.0007	-0.0007	0.0001
	(0.0012)	(0.00055)	(0.00054)	(0.00058)	(0.00058)	(0.00094)
treatxpostxUnderwater	-0.0040**	-0.0025**	-0.0025**	-0.0023**	-0.0023**	-0.0037***
	(0.0017)	(0.0012)	(0.0012)	(0.00098)	(0.00098)	(0.0013)
Underwater effect (total)	-0.0036*	-0.0028**	-0.0028**	-0.0030***	-0.0030***	-0.0036***
se	0.0019	0.0011	0.0011	0.0011	0.0011	0.0013
N	7190560	7190560	7190560	7190560	7190560	7190560
	Panel B: Nominal loss predicted status					
treatxpost	0.0006	-0.0007	-0.0007	-0.0005	-0.0005	0.0009
	(0.0013)	(0.00085)	(0.00085)	(0.0012)	(0.0012)	(0.0013)
treatxpostxNominal loss	-0.0041**	-0.0018	-0.0018	-0.0018	-0.0018	-0.0040**
	(0.0019)	(0.0014)	(0.0014)	(0.0013)	(0.0013)	(0.0017)
Nominal loss effect (total)	-0.0035**	-0.0025**	-0.0025**	-0.0023	-0.0023	-0.0031**
se	0.0016	0.0012	0.0012	0.0016	0.0016	0.0015
N	8863760	8863760	8863760	8863760	8863760	8863760
Year×Qtr FE	✓	✓	✓	✓	✓	✓
Covariates		✓	✓	✓	✓	
Cty trend			✓	✓	✓	✓
County FE				✓		
Muni FE					✓	
Unit FE						✓

Notes: The coefficient on $treat \times post$ gives the DiD effect for homes predicted to not be underwater (Panel A) or to not face a nominal loss (Panel B). The coefficient on $treat \times post \times \omega$ captures the additional effect for underwater or nominal loss homes, where ω denotes underwater or nominal loss status. The rows labeled 'Underwater effect (total)' and 'Nominal loss effect (total)' report the total treatment effect for underwater or nominal loss homes, respectively, computed as the linear combination $treat \times post + treat \times post \times \omega$ using the `lincom` command in Stata 18. Home controls: home type, log lot size, log building age, log unit size, number of bedrooms, yearly trends interacted separately with each of the three latter controls. Robust standard errors clustered at municipality level. * p<0.1, ** p<0.05, *** p<0.01

Table 5 shows that the decline in sale prices is more pronounced for homes predicted to have positive equity, while the effect is half the size for homes predicted to be underwater in the case of the unit fixed effects specification (Underwater effect (total), Panel A, column 6). However, the difference between underwater status is no longer significant at the 10% level with county or municipality fixed effects (columns 4 and 5). In contrast, we find that across all preferred specifications (Panel B, columns 4-6), homes predicted to face a nominal loss, experience a less pronounced decline in sale price relative to homes predicted to face a nominal gain. These findings suggest that sellers whose mortgage is likely to be locked-in or likely to be subject to nominal loss aversion may respond by not accepting lower prices. Furthermore, Table D8 shows that such sellers tend to list their homes with higher list prices than sellers of homes predicted to face positive equity or nominal gains.

These results are consistent with the presence of financial frictions and loss aversion: when homes are underwater or would sell at a nominal loss, owners may be unable to transact or unwilling adjust prices downward due to mortgage debt overhang, lack of liquidity, or behavioral reluctance to realize losses. This supply-side contraction echoes the findings of Genesove and Mayer (2001) and Stein (1995), who document that sellers are often reluctant to list or accept lower offers when facing capital losses or tighter financing conditions.

5.4 Channels: Why Did Sales Decline?

To better understand the mechanisms behind the observed decline in home sales, we explore three key dimensions of housing market dynamics: the number of new listings, the share of homes that remain unsold, and the average time-on-market (TOM) for transacted properties.

First, we observe a significant drop in the number of listings in treated areas following the electricity price shock. As shown in Columns (4)–(6) of Table 6, the number of new listings per municipality and quarter fell by 7.8% to 9.3% relative to control areas, depending on the fixed effects. This decline in new listings suggests that some potential sellers may have postponed or abandoned plans to enter the market in response to the shock, possibly due to worsened affordability conditions, greater uncertainty, or expectations of lower transaction prices.

Second, even among homes that are listed, a greater share remains unsold. Columns (1)–(3) of the same table show that the log share of unsold inventory increased by 33% to 35%, depending on the specification, in treated municipalities post-shock. The pre-shock (2019-2021) averages for treated and control homes are 4.6% and 6.5%, respectively. A 35% increase from the treated group's baseline implies the unsold share rose to approximately 6.2%, nearly closing the pre-existing gap with control areas. This elevated inventory indicates

Table 5 DiD results - Effect of being located South of the North-South market border on log home prices, interacted with predicted underwater or nominal loss status.

	Cross-section sample: 2019-2023					Repeat sales sample: 2013-2023
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Underwater predicted status					
treatxpost	-0.0258	-0.0214	-0.0558***	-0.1003***	-0.0762***	-0.0756***
	(0.029)	(0.022)	(0.016)	(0.020)	(0.015)	(0.012)
treatxpostxUnderwater	-0.0036	-0.0312	0.0128	0.0141	0.0181	0.0391***
	(0.023)	(0.021)	(0.014)	(0.014)	(0.021)	(0.011)
Underwater effect (total)	-0.0294	-0.0526**	-0.0430**	-0.0863***	-0.0581***	-0.0365**
se	0.0192	0.0216	0.0170	0.0217	0.0166	0.0181
N	102237	102237	102237	102237	102234	105836
Adj-R2	0.10	0.36	0.62	0.62	0.79	0.96
	Panel B: Nominal loss predicted status					
treatxpost	-0.0307	0.0005	-0.0390**	-0.0615**	-0.0445***	-0.0849***
	(0.023)	(0.024)	(0.020)	(0.026)	(0.016)	(0.011)
treatxpostxNominal loss	0.0336	-0.0335	0.0532**	0.0545**	0.0387***	0.0425***
	(0.040)	(0.034)	(0.022)	(0.022)	(0.014)	(0.012)
Nominal loss effect (total)	0.0029	-0.0330	0.0141	-0.0070	-0.0059	-0.0424**
se	0.0363	0.0299	0.0133	0.0159	0.0109	0.0167
N	126779	126779	126779	126779	126777	130895
Adj-R2	0.21	0.50	0.81	0.81	0.86	0.96
Year×Qtr FE	✓	✓	✓	✓	✓	✓
Covariates		✓	✓	✓	✓	
Cty trend			✓	✓	✓	✓
County FE				✓		
Muni FE					✓	
Unit FE						✓

Notes: The coefficient on $treat \times post$ gives the DiD effect for homes predicted to not be underwater (Panel A) or to not face a nominal loss (Panel B). The coefficient on $treat \times post \times \omega$ captures the additional effect for underwater or nominal loss homes, where ω denotes underwater or nominal loss status. The rows labeled 'Underwater effect (total)' and 'Nominal loss effect (total)' report the total treatment effect for underwater or nominal loss homes, respectively, computed as the linear combination $treat \times post + treat \times post \times \omega$ using the `lincom` command in Stata 18. Home controls: home type, log lot size, log building age, log unit size, number of bedrooms, yearly trends interacted separately with each of the three latter controls. Robust standard errors clustered at municipality level. * p<0.1, ** p<0.05, *** p<0.01

Table 6 DiD estimates - Effect on log of Unsold share and Number of listings at the municipality and quarter level (2019-2023)

	Ln Share unsold			Ln Number listings		
	(1)	(2)	(3)	(4)	(5)	(6)
treatxpost	0.3480***	0.3479***	0.3322***	-0.0910***	-0.0926***	-0.0781***
	(0.068)	(0.067)	(0.063)	(0.031)	(0.029)	(0.024)
N	2744	2744	2740	3620	3620	3620
Adj-R2	0.16	0.24	0.55	0.10	0.27	0.93
Year×Qtr FE	✓	✓	✓	✓	✓	✓
County FE		✓			✓	
Municipality FE			✓			✓

Notes: Standard errors clustered at municipality level. * p<0.1, ** p<0.05, *** p<0.01

that listed homes are failing to convert into sales at the same rate as before, likely due to a mismatch between buyer willingness to pay and seller reservation prices.

Third, we find a substantial increase in the time-on-market for homes that do sell. Table 7 reports that the log of TOM increases by between 23% and 44% across specifications. Pre-shock (2019–2021), homes in treated markets had an average TOM of 41 days, compared to 69 days in control markets. The estimated increase implies that post-shock, TOM in treated areas rose to between 50 and 59 days—an increase of approximately 9 to 18 days. This result is robust across both the 2019–2023 cross-sectional sample and the 2013–2023 repeat-sales panel. The longer marketing duration reinforces the interpretation of market friction: rather than immediately adjusting list prices downward in response to the shock, sellers appear to hold out longer—possibly anchoring to pre-shock price expectations or waiting for better market conditions.

Panel B of Table 2 shows that sellers in treated areas responded to the electricity price shock by reducing their list prices. Across specifications, the estimated declines in log of list prices range from 2.3% to 4.9% (statistically significant at the 1% to 5% level) for the cross-section specifications with county or municipality fixed effects and for the repeat sales. This downward adjustment indicates that sellers are aware of the demand shock and make efforts to incorporate the new market conditions into their pricing strategy. However, this response appears insufficient to fully clear the market: as shown above, time-on-market increased substantially and the share of unsold homes rose by over 30%. These results suggest that although sellers acknowledged the shock, they did not—or could not—adjust prices far enough to restore liquidity.

Together, these results paint a consistent picture: the electricity price shock reduced market liquidity not only by discouraging new listings, but also by impairing the market-

Table 7 DiD estimates - Effect on log of time-on-market

	Cross-section sample: 2019-2023					Repeat sales sample: 2013-2023
	(1)	(2)	(3)	(4)	(5)	(6)
treatxpost	0.2821***	0.2807***	0.2820***	0.2342***	0.2323***	0.4305***
	(0.034)	(0.033)	(0.034)	(0.042)	(0.044)	(0.068)
N	187026	187026	187026	187026	187026	142320
Adj-R2	0.05	0.09	0.10	0.10	0.12	0.16
Year×Qtr FE	✓	✓	✓	✓	✓	✓
Covariates		✓	✓	✓	✓	
Cty trend			✓	✓	✓	✓
County FE				✓		
Muni FE					✓	
Unit FE						✓

Notes: Home controls: home type, log lot size, log building age, log unit size, number of bedrooms, yearly trends interacted separately with each of the three latter controls. Robust standard errors clustered at municipality level. * p<0.1, ** p<0.05, *** p<0.01

clearing process among listed homes. Sellers were either unwilling or unable to reduce prices sufficiently, leading to longer TOM and a buildup of unsold inventory. This behavior is consistent with models of price stickiness or partial price adjustment driven by reference-dependent preferences, nominal loss aversion, or reluctance to sell at perceived discounts, such as those described in Andersen et al. (2022) and Bokhari and Geltner (2011).

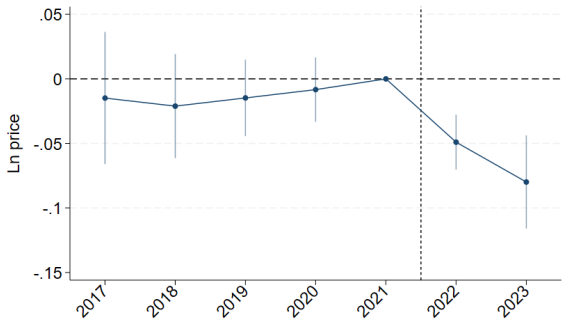
5.5 Validity

5.5.1 Event studies

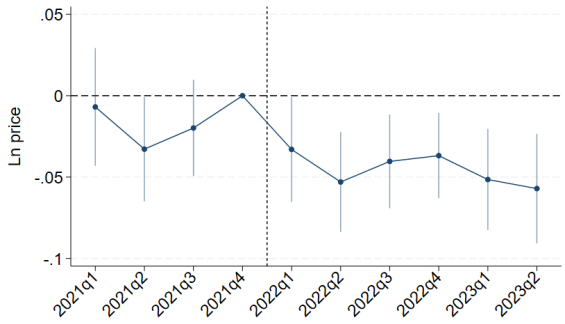
Modifying models (1)-(3) by replacing *Post* with year dummies or year×quarter dummies, we conduct event studies to investigate the dynamic effect of the electricity price shock and test the validity of the parallel trends assumption. Figure 4, panels (a)-(d) show the event studies for the effect of the electricity price shock on home prices, panels (e)-(f) show the event studies for the effect of the electricity price shock on home sales volumes at the municipality and quarter level, while panels (g)-(h) show the event study for the effect of the electricity price shock on log of time-on-market and log of number of listings, respectively. Figure 4 shows no evidence of differential pre-trends between the treated and control groups prior to January 1, 2022.

Figure 4 Event studies: Effect of the electricity price shock on the log of home prices, home sales volume, log of time-on-market (TOM), and log of number of listings, depicted with 95%-confidence intervals.

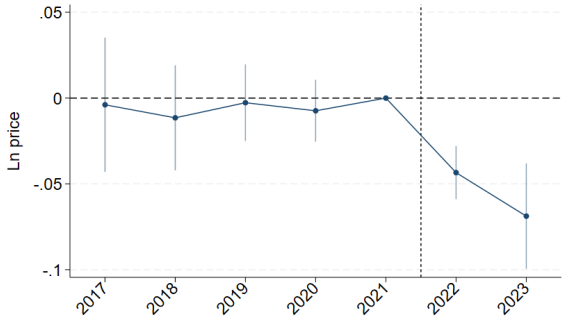
(a) Log home prices - Table 2, col. 4



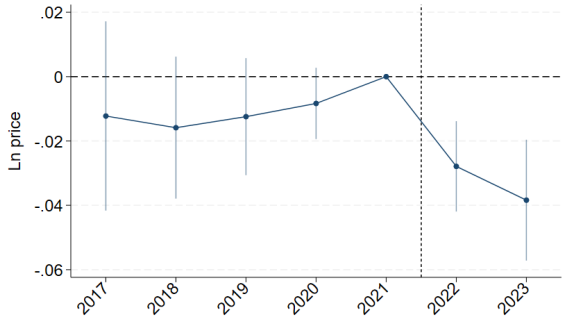
(b) Log home prices - Table 2, col. 4



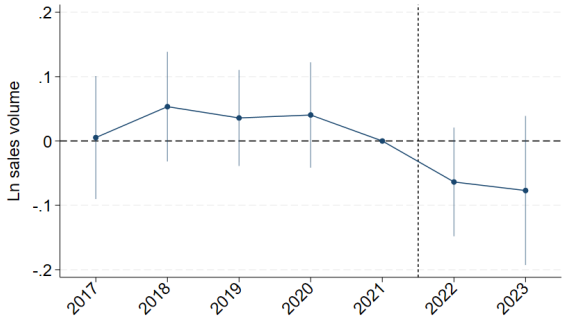
(c) Log home prices - Table 2, col. 5



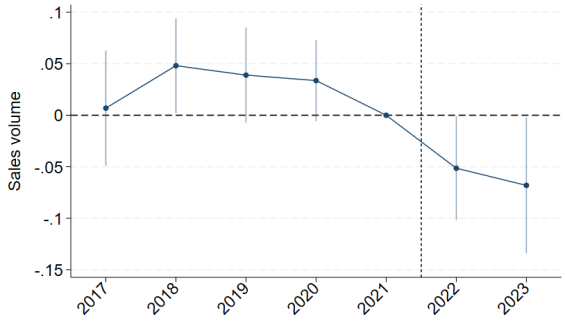
(d) Log home prices - Table 2, col. 6



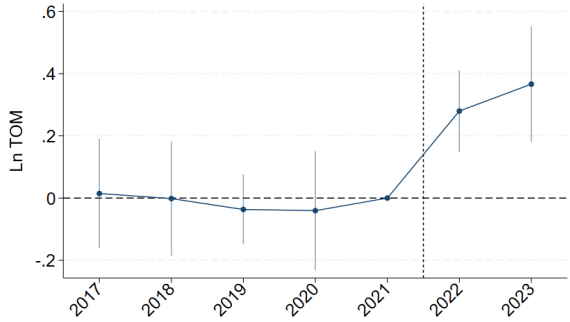
(e) Log sales volume; OLS - Table 3, col. 3



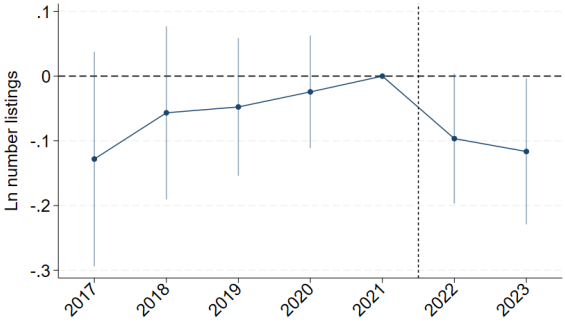
(f) Sales volume; Neg binomial - Table 3, col. 6



(g) Log TOM - Table 7, col. 6



(h) Log number listings - Table 6, col. 5



5.5.2 SUTVA assumption

A key identification assumption in our difference-in-differences framework is the Stable Unit Treatment Value Assumption (SUTVA), which requires that the treatment status of one unit does not influence the outcomes of other units. In our context, a potential violation arises if households located near the electricity price zone boundary in treated areas (Southern Norway) respond to the shock by relocating to nearby control areas (Northern Norway). Such cross-border migration could contaminate the control group, thereby attenuating the estimated treatment effect by introducing similar market pressures on both sides of the border.

To address this concern, we re-estimate our main regressions after excluding homes located within 50 kilometers of the North–South electricity market border. This geographic buffer is designed to remove municipalities most likely affected by spillovers or household relocation behavior. Appendix D.1 reports summary statistics for this restricted sample and presents all corresponding regression results. Across all our main outcomes—prices and transaction volume—we find results that are qualitatively similar to those from our main sample, indicating that our findings are robust to this form of potential contamination.

Taken together, these robustness checks suggest that any cross-border mobility effects are limited, and that our estimated treatment effects are unlikely to be driven by violations of SUTVA. If anything, the potential contamination of the control group would likely attenuate our estimates, implying that our baseline results represent conservative (lower-bound) estimates of the true treatment effect.

5.6 Robustness and sensitivity

5.6.1 Restricting the Sample to Homes Near the North–South Market Border

To assess the sensitivity of our results to geographic sample selection, we restrict the treatment and control groups to homes located within varying distances of the North–South electricity market border. This approach improves comparability by focusing on homes in closer spatial proximity along the existing road network, thus minimizing potential differences in unobserved regional characteristics.

We use Open Street Map to calculate the distance between each home in our sample and the North-South border using the road network, and the corresponding driving time. Figure D2 illustrates the road distances and driving times averaged at the municipality level. Figure D3 presents results using bandwidths of 100 km to 250 km, in increments of 50 km. All specifications include year-by-quarter fixed effects, the same housing covariates as in our main

specifications, county fixed effects, and linear county-specific trends. Although confidence intervals widen as the sample is geographically narrowed, the estimated treatment effects remain stable. Panels (a) and (b) show a consistently negative impact of the electricity price shock on log home prices across all bandwidths. For log sales volume, a similarly negative effect is observed, although estimates are less precise and become statistically insignificant when restricting to homes within 100 km of the border. These results indicate that our main findings are robust to alternative geographic sample definitions.

5.6.2 Excluding Oslo County

To assess the sensitivity of our results to excluding the capital region of Oslo, we re-estimate our main results on a subsample that excludes Oslo County. Results are qualitatively similar (Appendix D.2).

6 Conclusion

This paper provides new causal evidence of asset price stickiness in the housing market by exploiting a unique natural experiment: a large, unexpected, and geographically confined increase in residential electricity prices in Southern Norway beginning in 2022. Because Norwegian homes are highly electrified and most households are on real-time pricing contracts, the shock directly affected the user cost of housing and thus its fundamental value—without being driven by broader macroeconomic changes or regulatory interventions.

Our key contribution is to isolate a shock to asset fundamentals and show that housing market prices do not fully adjust in response. As a result of a persistent and economically meaningful increase in ownership costs, transaction prices in treated areas decline by 4.0% to 6.7%—while sales volume falls by roughly 6% to 10%. These results are robust across specifications. Together, they demonstrate that housing markets feature significant downward rigidity, consistent with theories of asset price stickiness.

To further understand the decline in market activity, we examine underlying channels. The electricity price shock leads to fewer listings, a substantial rise in the share of unsold homes (by over 30%), and a 23–44% increase in time-on-market. These dynamics suggest that sellers do recognize the shock—as evidenced by modest reductions in list prices—but do not adjust sufficiently to clear the market, contributing to liquidity declines.

Furthermore, we provide evidence that financial frictions and behavioral factors play a key role in amplifying these effects. The reduction in sale propensity is concentrated among homes that are predicted to be underwater or would realize a nominal loss. In contrast, homes with positive equity or nominal gains show limited decline in sale likelihood.

By documenting how asset price stickiness arises even in the face of a clear cost shock—and identifying the roles of financial constraints and behavioral frictions—our findings contribute to a broader understanding of housing market dynamics, the limits of rational price adjustment, and the mechanisms through which shocks propagate in real asset markets. These insights are relevant for theories of asset pricing, macroeconomics, and the design of housing and energy policy.

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A Additional background on the electricity price shock

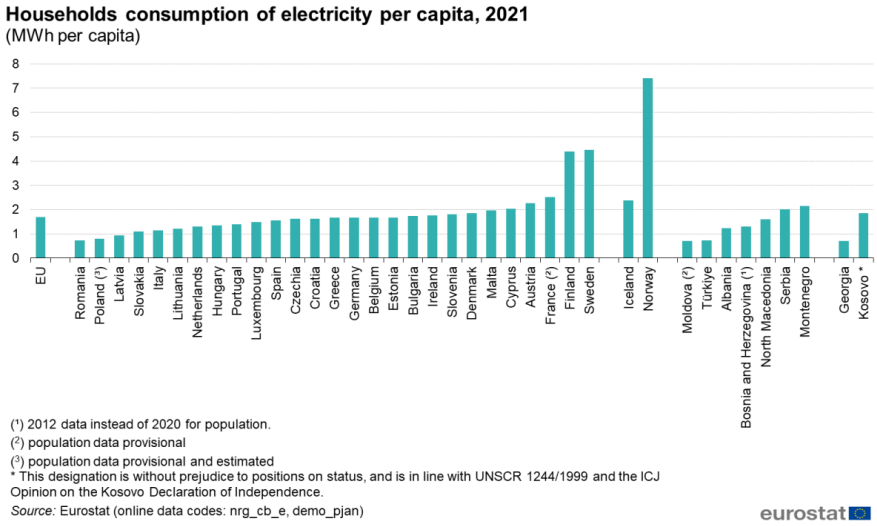
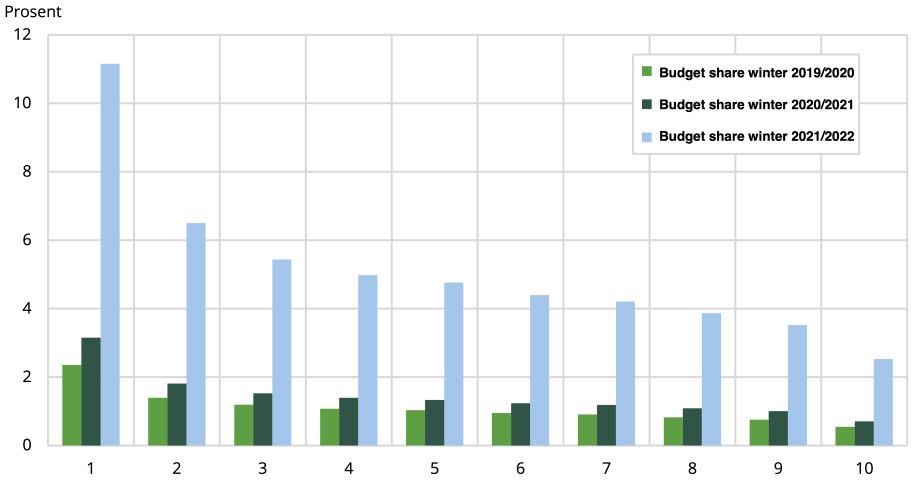
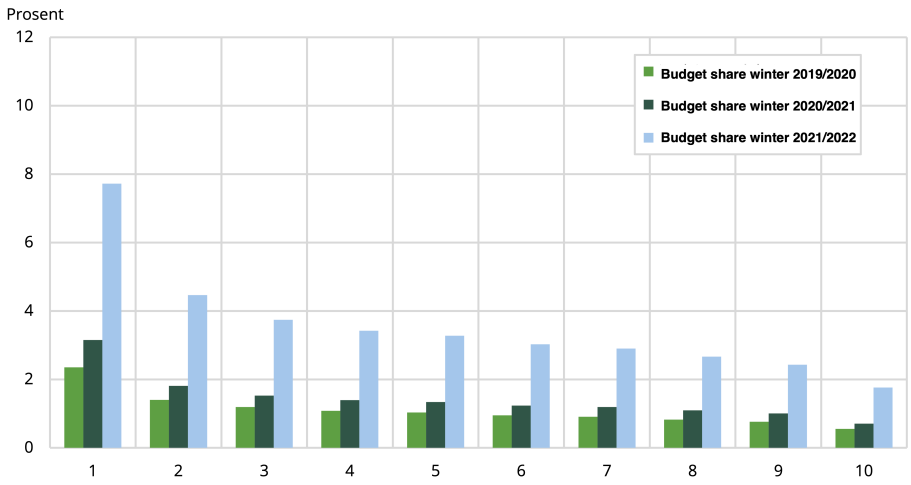


Figure A1 Households consumption of electricity per capita in 2021. (Source: Eurostat)

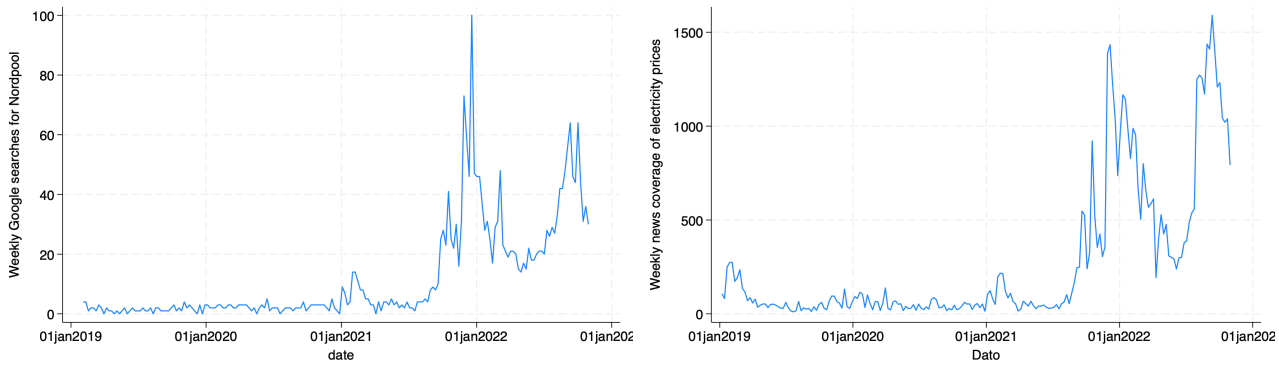


(a) Without the subsidy



(b) With the subsidy

Figure A2 Share of (spot) electricity expenditure (with and without the electricity subsidy implemented from January 1, 2022) in total household consumption by decile of disposable income in Southern Norway (2019-2022). (Source: SSB)



(a) Google Searches for "electricity prices" **(b)** Norwegian media coverage of "electricity prices"

Figure A3 Weekly trends in Google searches for electricity prices in Norway (NordPool market) and Norwegian media coverage of electricity prices during the period 2019-2023. (Data sources: Google trends and Atekts.)

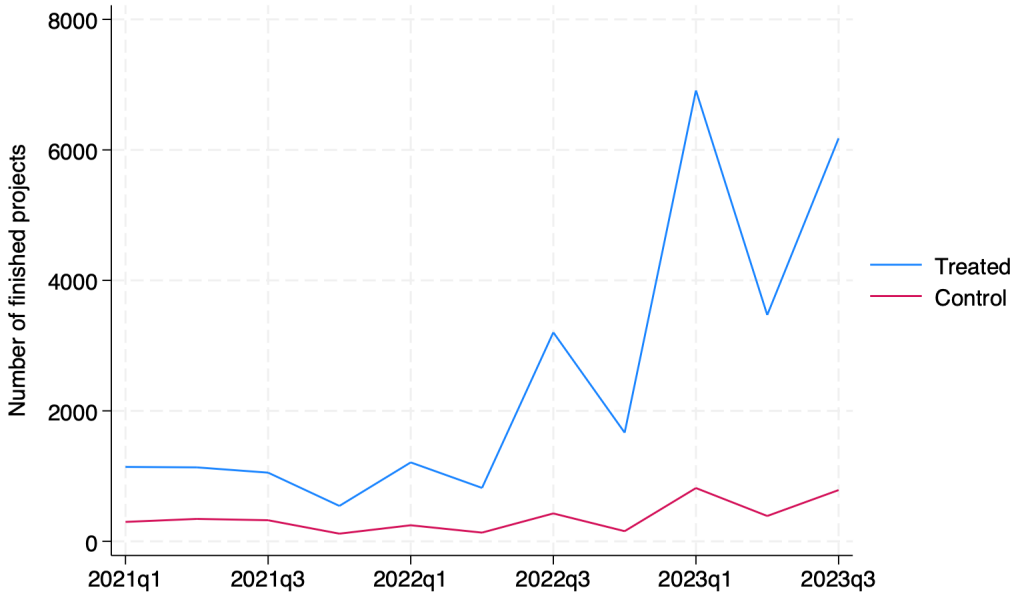


Figure A4 Times series of the quarterly number of completed home energy renovation and solar panel installation projects, including heat pumps, ventilation, insulation of attic or walls, installation of smart water heating systems, installation of smart home management systems. 'Smart' denotes systems that run appliances using the 1-day ahead hourly price forecast. 'Treated' denotes: municipalities in NO1, NO2, and NO5; 'Control' denotes: municipalities in NO3 and NO4. Project dates correspond to when a project was completed, the bills submitted to ENOVA and approved by ENOVA. There is therefore a delay between a household's decision to install a new technology and the date the project is completed and receipts are approved by ENOVA. (Data source: ENOVA).

Table A1 DiD estimates of the effect of the electricity price shock on the log number of subsidized solar panel projects in treated municipalities (Southern Norway; NO1, NO2, NO5) compared to control municipalities (Northern Norway; NO3 and NO4).

	(1)	(2)	(3)
(4)	(5)		
treatxpost	0.854***	0.837***	0.695***
	(0.124)	(0.0485)	(0.0416)
N	10988	10963	10963
R^2adj	0.117	0.883	0.915
Municipality FE		✓	✓
Month FE		✓	
Year FE		✓	
YearxMonth FE			✓

Notes: Data source: ENOVA. Robust standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01

B Additional data background and statistics

B.1 Sales transaction data

Data Cleaning and Sample Construction: We begin by cleaning the transaction-level housing data to ensure quality and consistency across treated and control areas. First, we restrict the dataset to individual ownership types by excluding cooperative-owned properties, which follow distinct pricing and financing structures. All values, e.g., sale and list prices, are converted to USD using the January 2, 2023 exchange rate (1 USD = 9.8413 NOK), and all monetary variables are deflated to 2015 values using the monthly CPI from Statistics Norway.

To reduce the influence of outliers and improve comparability across municipalities, we drop the 1st and 99th percentiles of debt-free sale price within municipality, year, and home type to reduce the influence of outliers. We drop the 1st and 99th percentiles of living area and the 99th percentile of lot size and number of bedrooms so as to remove small units like garages or annexes and large units such as hotels or farm properties. We drop the 1st percentile of building year and properties listed as built in 2023 so as to remove extremely old properties and new constructions. We further drop units that sell more than once within a year to reduce the probability of "house-flippers".

We also compute a range of log-transformed and derived variables used in the empirical analysis, including the logarithm of sale price, price per square meter, lot and living area, time-on-market (TOM), and property age.

Table B1 Dataset Preparation

Data operation	Number of sales
All transactions in 2013-2023	775,568
Drop coops	544,431
Debt-free sale price non-missing and 1-99 percentile by municipality, year, and home type	538,179
Living area non-missing and 1-99th percentile	519,543
Lot size non-missing and 0-99th percentile	507,916
Nr. bedrooms non-missing and 0-99th percentile	497,110
Build year non-missing and 0-100th percentile and not 2023	496,072
Drop sales with holding time < 1 year	491,823
Number of repeat sales observations	184,162
Unique number of observations in the repeat sales data	86,994
Observations in period 2019 -2023	244,293

B.2 Listings data

Data Cleaning and Sample Construction: We begin by cleaning the listing-level housing data to ensure quality and consistency across treated and control areas. We follow the

same procedure as for the sales transaction data. First, we restrict the dataset to individual ownership types by excluding cooperative-owned properties, which follow distinct pricing and financing structures. All values, e.g., sale and list prices, are converted to USD using the January 2, 2023 exchange rate (1 USD = 9.8413 NOK), and all monetary variables are deflated to 2015 values using the monthly CPI from Statistics Norway.

To reduce the influence of outliers and improve comparability across municipalities, We drop the 1st and 99th percentiles of debt-free sale price within municipality, year, and home type to reduce the influence of outliers. We drop the 1st and 99th percentiles of living area and the 99th percentile of lot size and number of bedrooms so as to remove small units like garages or annexes and large units such as hotels or farm properties. We drop the 1st percentile of building year and properties listed as built in 2023 so as to remove extremely old properties and new constructions.

Table B2 Dataset Preparation - listings

Data operation	Number of listings
All listings in 2014-2023	775,568
Drop coops	659,921
Debt-free sale price non-missing and 1-99 percentile by municipality, year, and home type	555,627
Living area non-missing and 1-99th percentile	536,050
Lot size non-missing and 0-99th percentile	526,654
Nr. bedrooms non-missing and 0-99th percentile	516,249
Build year non-missing and 0-100th percentile and not 2023	513,961
Observations in period 2019 -2023	297,504

B.3 Summary statistics in pre-treatment period (prior to Jan 1, 2022)

Table B3 Summary statistics for the sales transactions.

	Cross-section sample 2019-2021				Repeat sales 2013-2021			
	Treated		Control		Treated		Control	
	mean	sd	mean	sd	mean	sd	mean	sd
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sale price (USD 1,000)	420.6	(248.0)	283.9	(141.6)	401.7	(211.9)	278.1	(116.9)
List price (USD 1,000)	414.2	(243.9)	282.8	(137.8)	395.7	(207.9)	276.8	(113.8)
Spread sale to list price	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)
TOM (days)	40.6	(77.5)	69.3	(123.2)	36.7	(68.5)	60.7	(108.0)
Lot size (m2)	3207.3	(5439.8)	2040.6	(3427.6)	3540.0	(5863.3)	2183.5	(3597.4)
Living area (m2)	107.7	(53.0)	112.8	(53.8)	94.4	(46.7)	97.9	(47.7)
Year built	1977.1	(35.2)	1980.1	(32.6)	1973.3	(38.2)	1978.6	(35.6)
# bedrooms	2.7	(1.1)	2.9	(1.2)	2.4	(1.1)	2.6	(1.2)
Detached home	0.3	(0.5)	0.4	(0.5)	0.2	(0.4)	0.3	(0.4)
Cabin	0.1	(0.3)	0.1	(0.3)	0.0	(0.2)	0.0	(0.2)
Appartment	0.4	(0.5)	0.4	(0.5)	0.6	(0.5)	0.5	(0.5)
Row house	0.1	(0.2)	0.1	(0.2)	0.1	(0.2)	0.1	(0.3)
Condos	0.1	(0.3)	0.1	(0.3)	0.1	(0.3)	0.1	(0.3)
Euclidean distance to border (km)	163.2	(60.7)	92.4	(33.5)	166.4	(57.3)	92.5	(30.0)
Road distance to border (km)	245.8	(81.7)	164.5	(59.6)	249.3	(78.0)	163.9	(55.8)
Driving time to border (hours)	3.6	(1.0)	2.9	(1.1)	3.6	(0.9)	2.9	(1.0)
Observations	101331		26394		37243		9192	

Table B4 Summary statistics for the number of listings.

	(1)		(2)	
	mean	sd	mean	sd
Sale price (USD 1,000)	4154.38	(2475.52)	2810.63	(1419.01)
Lot size (m2)	3155.20	(5290.13)	2021.73	(3376.79)
Living area (m2)	106.62	(53.39)	111.41	(54.17)
Year built	1977.40	(35.91)	1980.13	(33.47)
# bedrooms	2.69	(1.13)	2.90	(1.22)
Detached home	0.31	(0.46)	0.37	(0.48)
Cabin	0.09	(0.29)	0.09	(0.29)
Appartment	0.45	(0.50)	0.36	(0.48)
Row house	0.06	(0.24)	0.06	(0.24)
Condos	0.09	(0.29)	0.11	(0.32)
Observations	109964		27327	

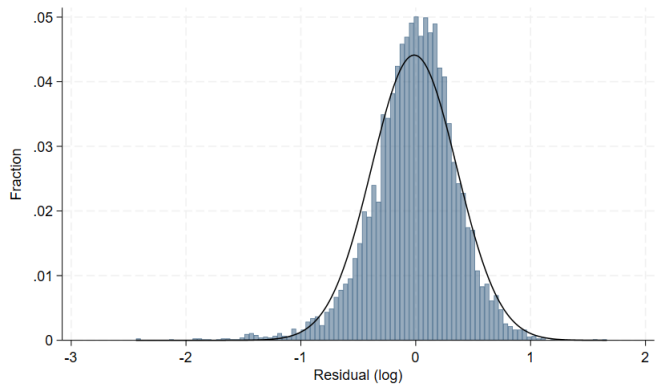
B.4 Predicting home prices, equity, and nominal capital gains

Figure B1 Predicted prices prior to treatment (2021q4).

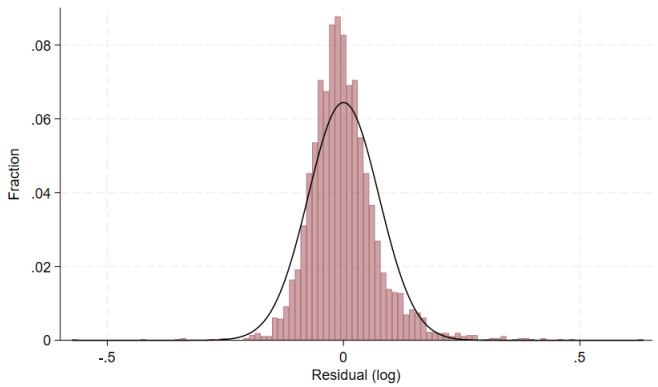
(a) Residuals vs. fitted log prices; Cross-section

(b) Residuals vs. fitted log prices; Repeat sales

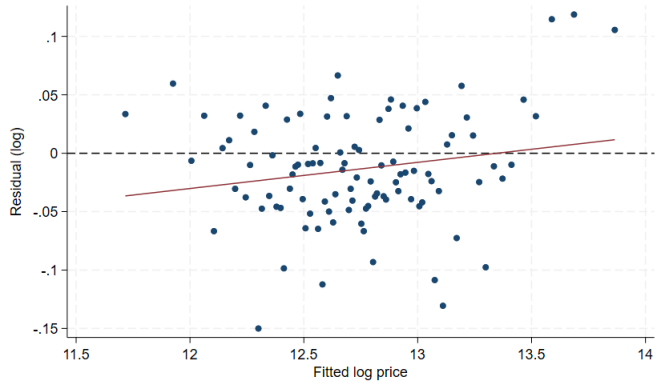
(c) Residuals distribution; Cross-section



(d) Residuals distribution; Repeat sales



(e) Binscatter plot; Cross-section



(f) Binscatter plot; Repeat sales

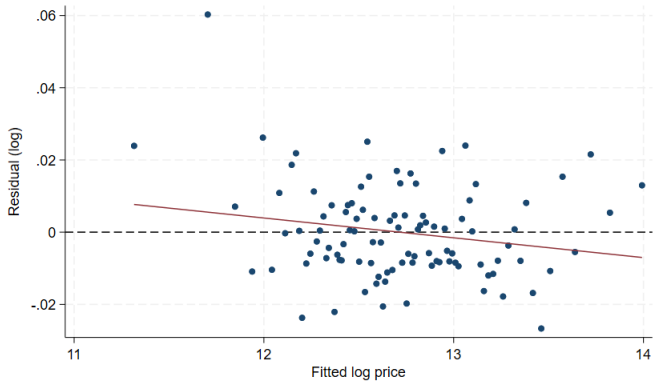
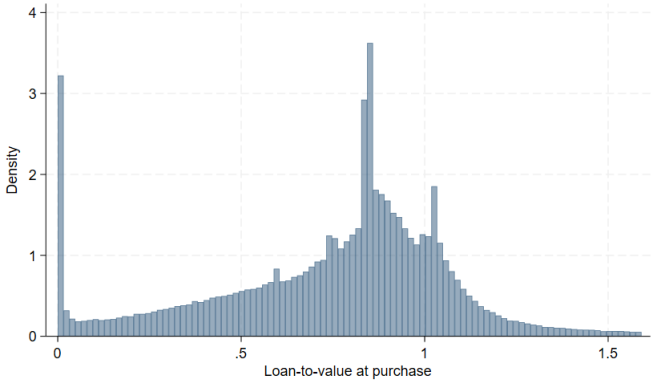


Figure B2 Loan-to-value at purchase.



Notes: Household debt is obtained by summing household debt (net of student debt) at the end of the purchase year of purchase across all individuals listed on the deed.

C Long-term electricity price expectations and full capitalization assumption

A central assumption in our empirical strategy is that the long-term increase in electricity prices forecast for Southern Norway is fully capitalized into housing values. This assumption is consistent with a large literature showing that recurrent household expenditures, such as energy costs, are internalized into the value of durable assets like housing. For instance, Myers (2019) documents full capitalization of fuel price differences into house prices in Massachusetts, while Mense (2018) shows that expected heating costs are partially but systematically reflected in the German housing market. Similarly, Aydin et al. (2020) provide evidence from the Netherlands that energy efficiency improvements translate into higher home values, although the extent of capitalization depends on the quality of information available to buyers. More recently, Brolinson et al. (2024) find that homes with higher energy consumption in Norway experienced disproportionate price declines after the 2022 electricity price shock, again consistent with capitalization of energy cost shocks.

The Norwegian setting makes it particularly reasonable to assume that buyers and sellers internalize changes in long-run electricity costs into home values. Norwegian households rely almost exclusively on electricity for heating, hot water, and appliances. Using the median household electricity consumption of about 13,000 kWh annually (SSB, 2023b) and the prevailing spot prices, Table C1 shows (spot) electricity expenditures of around $516 per year before 2022, while after the shock, average bills increased more than five-fold for treated homes, to about $2,582 per year. Such large and salient cost differences are unlikely to be ignored in housing transactions.

Table C1 Median household spot electricity expenditures for treated households.

	Pre-Jan 2021	Pre-Jan 2022	Post-Jan 2022
Elec. (spot) price $/kWh	0.03	0.04	0.20
Annual elec. (spot) exp.	$387	$516	$2,582

Notes: Expenditures are calculated assuming the median household electricity consumption of about 13,000 kWh annually (SSB, 2023b) and the prevailing spot prices from Nordpool. The grid charge in not included. It adds about $0.025/kWh, or $320/year.

Market participants appear to have updated their expectations accordingly. The Norwegian regulator forecasts long-term wholesale prices of around $0.08/kWh by 2028–2030, a doubling relative to pre-2022 levels. Households have responded to the shock by making large investments in energy-saving durables: the average retrofit cost (net of subsidies) is estimated at about $11,300, and since 2022 the rate of energy retrofits has risen to 2.1% of households (based on our own analysis using Enova data on home retrofits and solar panel installations). This behavior suggests that households anticipate persistently higher electricity costs and adjust both their housing investments and willingness-to-pay accordingly.

To quantify the capitalization effect, we compute the present value of a permanent increase in annual electricity expenditures under different discount rates assuming full capitalization and no electricity consumption adjustment. The net present value (NPV) of an

annual electricity bill increase ΔC in perpetuity is given by $NPV = \frac{\Delta C}{r}$, where r is the discount rate.

Table C2, Panel A reports the increase in electricity costs consistent with a loss in the median home value of $12,813 (corresponding to a 4.0% price decline; Table 2, cross-section estimate, column 4) or $21,592 (corresponding to a 6.7% price decline; repeat-sales estimate, column 6) per year, assuming full capitalization. At a discount rate of 2%, the implied increase in annual spot electricity costs ranges between $256 and $432 depending on the price effect estimate. At a 5% discount rate, the range is $642 to $1,080, while at a 8% discount rate, the range is $1,027 to $1,728.

Panel B reports the associated expected future spot electricity price consistent with the increase in electricity costs calculated in Panel A, assuming a $0.04/kWh spot electricity price for the pre-2022 period and no adjustment in electricity consumption. For a 4% discount rate, the expected future spot price is $0.08/kWh, in line with the regulator's forecast, when using the cross-section price decline estimate of 4.0%, while the expected future spot price is $0.08/kWh for discount rates between 2% and 3% when using the repeat-sales price decline estimate of 6.7%.

Table C2 Future electricity cost increases compatible with full capitalization.

Effect on median home price	Discount rate r					
	2%	3%	4%	5%	6%	8%
	Panel A: Annual expected electricity bill increase ($)					
-$12,813	256	385	513	642	770	1027
-$21,592	432	648	864	1080	1296	1728
	Panel B: Expected future spot price ($/kWh)					
-$12,813	0.06	0.07	0.08	0.09	0.10	0.12
-$21,592	0.07	0.09	0.107	0.124	0.140	0.174

Notes: The effect on the median home price is obtained by multiplying the 4.0% and 6.7% price decline estimates from Table 2 (columns 4 and 6, respectively) by the median home value in our sample of $322,748.

The hypothesis of full capitalization is consistent with our estimated effects on home prices. Thus, we assume full capitalization of the long-term, forecast spot price increase. This motivates our empirical approach, in which we compute the treatment effect as the discounted flow of higher electricity costs in perpetuity and predict counterfactual prices for treated homes as of 2022Q1 accordingly.

D Additional robustness results

D.1 Excluding homes right around the North-South market border from the sample

Table D1 Summary statistics - Sample excluding homes within 50km (Euclidean distance or distance via the road network) from the North-South border.

	Cross-section sample 2019-2021				Repeat sales 2013-2021			
	Treated		Control		Treated		Control	
	mean	sd	mean	sd	mean	sd	mean	sd
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: 3 electricity price zones, less Oslo and excluding homes <50km from border (Euclidean distance)								
Sale price (USD 1,000)	372.0	(203.9)	288.3	(142.0)	345.2	(168.2)	280.3	(117.0)
List price (USD 1,000)	367.4	(200.8)	287.1	(138.2)	341.6	(165.6)	278.9	(113.8)
Spread sale to list price	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)
TOM (days)	43.1	(79.1)	68.2	(121.3)	40.2	(72.8)	60.4	(107.9)
Lot size (m2)	2892.5	(4972.1)	2022.5	(3410.2)	3288.0	(5507.7)	2150.8	(3569.5)
Living area (m2)	114.9	(53.4)	113.0	(54.0)	103.1	(48.6)	97.8	(47.9)
Year built	1980.5	(31.6)	1979.7	(32.9)	1979.5	(33.4)	1978.1	(35.9)
# bedrooms	2.9	(1.1)	2.9	(1.2)	2.6	(1.1)	2.6	(1.2)
Detached home	0.4	(0.5)	0.4	(0.5)	0.3	(0.5)	0.3	(0.4)
Cabin	0.1	(0.3)	0.1	(0.3)	0.1	(0.2)	0.0	(0.2)
Appartment	0.3	(0.5)	0.4	(0.5)	0.4	(0.5)	0.5	(0.5)
Row house	0.1	(0.3)	0.1	(0.2)	0.1	(0.3)	0.1	(0.3)
Condos	0.1	(0.3)	0.1	(0.3)	0.1	(0.3)	0.1	(0.3)
Euclidean distance to border (km)	161.5	(63.5)	97.2	(29.7)	161.1	(63.9)	95.4	(27.5)
Road distance to border (km)	242.9	(86.0)	172.4	(53.8)	241.3	(87.2)	168.7	(52.0)
Driving time to border (hours)	3.6	(1.0)	3.0	(1.0)	3.5	(1.0)	2.9	(0.9)
Observations	73559		24519		25173		8780	
Panel B: 3 electricity price zones, less Oslo and excluding homes <50km from border (Road distance)								
Sale price (USD 1,000)	367.8	(203.5)	286.3	(141.4)	342.8	(168.0)	279.2	(116.7)
List price (USD 1,000)	363.4	(200.3)	285.1	(137.6)	339.3	(165.4)	277.8	(113.6)
Spread sale to list price	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)
TOM (days)	44.2	(81.9)	68.5	(121.6)	40.8	(74.4)	60.3	(107.5)
Lot size (m2)	2869.3	(4928.6)	2046.6	(3431.6)	3270.3	(5474.4)	2192.4	(3611.8)
Living area (m2)	114.6	(53.3)	112.9	(53.8)	103.0	(48.5)	97.9	(47.7)
Year built	1980.7	(31.5)	1980.2	(32.6)	1979.6	(33.2)	1978.6	(35.6)
# bedrooms	2.9	(1.1)	2.9	(1.2)	2.7	(1.1)	2.6	(1.2)
Detached home	0.4	(0.5)	0.4	(0.5)	0.3	(0.5)	0.3	(0.4)
Cabin	0.1	(0.3)	0.1	(0.3)	0.1	(0.2)	0.0	(0.2)
Appartment	0.3	(0.5)	0.4	(0.5)	0.4	(0.5)	0.5	(0.5)
Row house	0.1	(0.3)	0.1	(0.2)	0.1	(0.3)	0.1	(0.3)
Condos	0.1	(0.3)	0.1	(0.3)	0.1	(0.3)	0.1	(0.3)
Euclidean distance to border (km)	157.6	(66.2)	93.9	(32.1)	158.6	(65.5)	93.2	(29.2)
Road distance to border (km)	238.7	(88.2)	167.0	(57.1)	238.6	(88.6)	165.1	(54.5)
Driving time to border (hours)	3.5	(1.1)	2.9	(1.0)	3.5	(1.0)	2.9	(1.0)
Observations	75887		25912		25677		9110	

Table D2 DiD results - Effect of being located South of the North-South market border on log home prices, while excluding homes right around the North-South market border from the sample

	Cross-section sample: 2019-2023					Repeat sales sample: 2013-2023
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Excluding homes within 50 km from the border as the crow flies					
treatxpost	-0.0077	-0.0116*	-0.0104	-0.0392***	-0.0432***	-0.0586***
	(0.0096)	(0.0064)	(0.0066)	(0.010)	(0.0082)	(0.013)
N	145147	145147	145147	145147	145146	105853
Adj-R2	0.05	0.45	0.51	0.51	0.73	0.95
	Panel B: Excluding homes within 50 km from the border using the road network					
treatxpost	-0.0074	-0.0125**	-0.0122*	-0.0390***	-0.0408***	-0.0583***
	(0.0093)	(0.0062)	(0.0063)	(0.0098)	(0.0081)	(0.012)
N	150536	150536	150536	150536	150533	108415
Adj-R2	0.04	0.45	0.51	0.51	0.73	0.95
Year×Qtr FE	✓	✓	✓	✓	✓	✓
Covariates		✓	✓	✓	✓	
Cty trend			✓	✓	✓	✓
County FE				✓		
Muni FE					✓	
Unit FE						✓

Notes: Home controls: home type, log lot size, log building age, log unit size, number of bedrooms, yearly trends interacted separately with each of the three latter controls. Robust standard errors clustered at municipality level. * p<0.1, ** p<0.05, *** p<0.01

D.2 Excluding homes from Oslo County

Table D3 Summary statistics when excluding Oslo county

	Cross-section sample 2019-2021				Repeat sales 2013-2021			
	Treated		Control		Treated		Control	
	mean	sd	mean	sd	mean	sd	mean	sd
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sale price (USD 1,000)	365.4	(203.3)	283.9	(141.6)	341.6	(167.9)	278.1	(116.9)
List price (USD 1,000)	361.0	(200.1)	282.8	(137.8)	338.1	(165.2)	276.8	(113.8)
Spread sale to list price	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)
TOM (days)	44.8	(83.5)	69.3	(123.2)	41.1	(75.0)	60.7	(108.0)
Lot size (m2)	2849.9	(4898.6)	2040.6	(3427.6)	3252.5	(5452.6)	2183.5	(3597.4)
Living area (m2)	114.4	(53.3)	112.8	(53.8)	103.0	(48.6)	97.9	(47.7)
Year built	1980.7	(31.5)	1980.1	(32.6)	1979.7	(33.2)	1978.6	(35.6)
# bedrooms	2.9	(1.1)	2.9	(1.2)	2.7	(1.1)	2.6	(1.2)
Detached home	0.4	(0.5)	0.4	(0.5)	0.3	(0.5)	0.3	(0.4)
Cabin	0.1	(0.3)	0.1	(0.3)	0.1	(0.2)	0.0	(0.2)
Appartment	0.3	(0.5)	0.4	(0.5)	0.4	(0.5)	0.5	(0.5)
Row house	0.1	(0.3)	0.1	(0.2)	0.1	(0.3)	0.1	(0.3)
Condos	0.1	(0.3)	0.1	(0.3)	0.1	(0.3)	0.1	(0.3)
Euclidean distance to border (km)	155.5	(67.8)	92.4	(33.5)	157.3	(66.6)	92.5	(30.0)
Road distance to border (km)	235.4	(91.2)	164.5	(59.6)	236.5	(90.5)	163.9	(55.8)
Driving time to border (hours)	3.5	(1.1)	2.9	(1.1)	3.5	(1.1)	2.9	(1.0)
Observations	77087		26394		25939		9192	

Table D4 Summary statistics - Listings

	(1)		(2)	
	mean	sd	mean	sd
Sale price (USD 1,000)	3601.66	(2017.79)	2810.63	(1419.01)
Lot size (m2)	2804.55	(4754.78)	2021.73	(3376.79)
Living area (m2)	113.25	(53.68)	111.41	(54.17)
Year built	1981.09	(32.29)	1980.13	(33.47)
# bedrooms	2.86	(1.11)	2.90	(1.22)
Detached home	0.38	(0.49)	0.37	(0.48)
Cabin	0.12	(0.33)	0.09	(0.29)
Appartment	0.33	(0.47)	0.36	(0.48)
Row house	0.06	(0.25)	0.06	(0.24)
Condos	0.11	(0.31)	0.11	(0.32)
Observations	83300		27327	

Table D5 DiD results - Effect of being located South of the North-South market border on log home prices and list prices.

	Cross-section sample: 2019-2023					Repeat sales sample: 2013-2023
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Ln home prices					
treatxpost	-0.0079	-0.0128**	-0.0123**	-0.0392***	-0.0398***	-0.0563***
	(0.0093)	(0.0062)	(0.0062)	(0.0094)	(0.0079)	(0.012)
N	152992	152992	152992	152992	152992	109470
Adj-R2	0.04	0.45	0.51	0.51	0.73	0.95
	Panel B: Ln list prices					
treatxpost	0.0118	0.0071	0.0076	-0.0227**	-0.0235***	-0.0361***
	(0.0090)	(0.0069)	(0.0065)	(0.0094)	(0.0067)	(0.0086)
N	152890	152890	152890	152890	152890	109241
Adj-R2	0.04	0.46	0.52	0.52	0.74	0.95
Year×Qtr FE	✓	✓	✓	✓	✓	✓
Covariates		✓	✓	✓	✓	
Cty trend			✓	✓	✓	✓
County FE				✓		
Muni FE					✓	
Unit FE						✓

Notes: Home controls: home type, log lot size, log building age, log unit size, number of bedrooms, yearly trends interacted separately with each of the three latter controls. Robust standard errors clustered at municipality level. * p<0.1, ** p<0.05, *** p<0.01

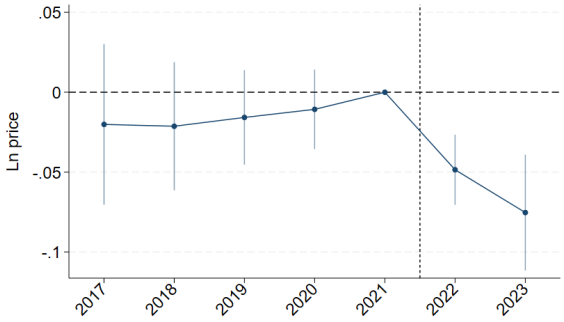
Table D6 DiD estimates - Effect on sale propensity and sales volume aggregated at the municipality and quarter level.

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Sale propensity					
treatxpost	-0.0023***	-0.0026***	-0.0026***	-0.0003	-0.0003	-0.0003
	(0.00073)	(0.00072)	(0.00072)	(0.0011)	(0.0011)	(0.00099)
N	4513608	4513608	4513608	4513608	4513608	4513608
Year×Qtr FE	✓	✓	✓	✓	✓	✓
Covariates		✓	✓	✓	✓	
Cty trend			✓	✓	✓	✓
County FE				✓		
Muni FE					✓	
Unit FE						✓
	Panel B: Sales volume					
	Log sales; OLS			Sales; Neg. binomial		
treatxpost	-0.1061***	-0.1006***	-0.0939***	-0.0772***	-0.0573**	-0.0809***
	(0.036)	(0.034)	(0.033)	(0.023)	(0.025)	(0.020)
N	3418	3418	3418	3418	3418	3418
Year×Qtr FE	✓	✓	✓	✓	✓	✓
County FE		✓			✓	
Municipality FE			✓			✓

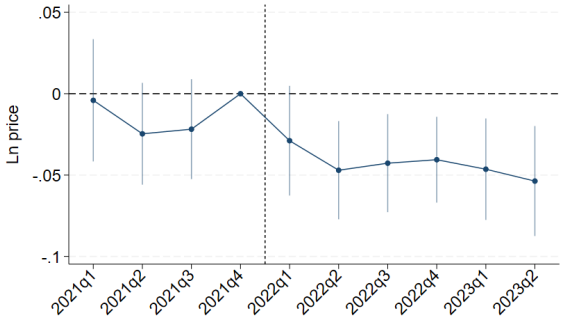
Notes: Standard errors clustered at municipality level. * p<0.1, ** p<0.05, *** p<0.01

Figure D1 Event studies: Effect of the electricity price shock on the log of home prices, home sales volume, log of time-on-market (TOM), and log of number of listings, depicted with 95%-confidence intervals.

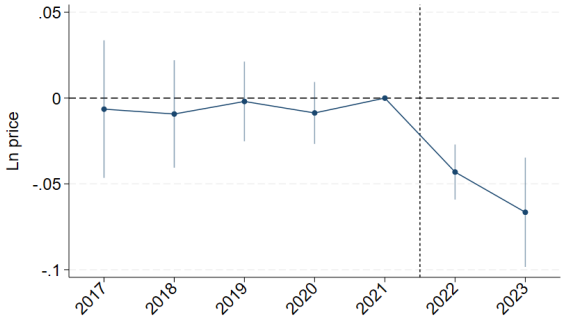
(a) Log home prices - Table 2, col. 4



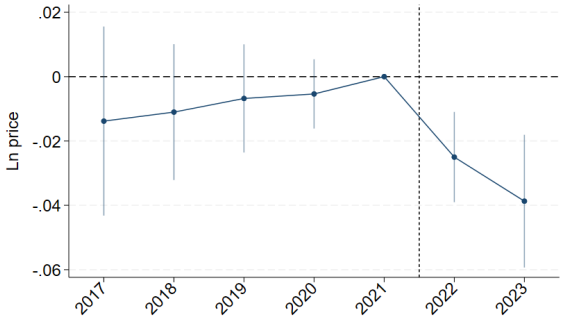
(b) Log home prices - Table 2, col. 4



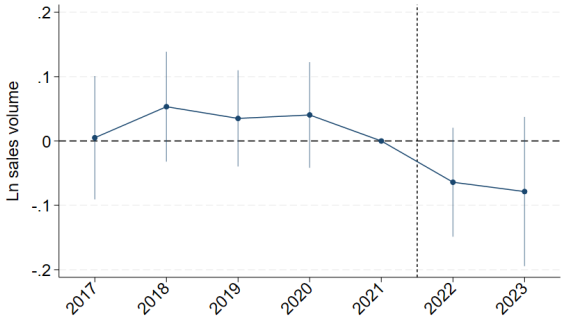
(c) Log home prices - Table 2, col. 5



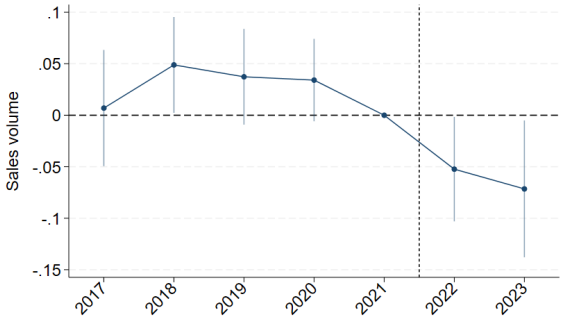
(d) Log home prices - Table 2, col. 6



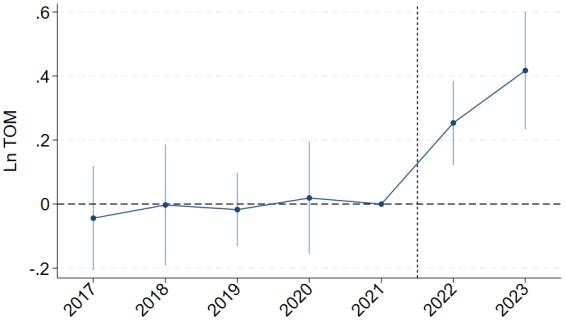
(e) Log sales volume; OLS - Table 3, col. 3



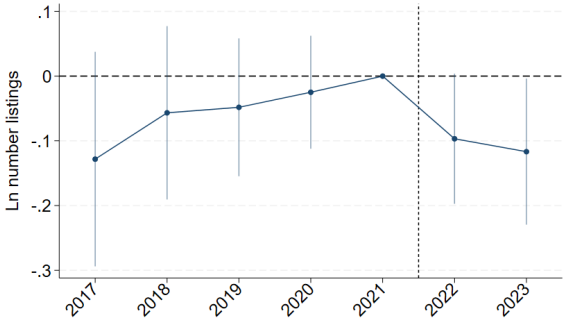
(f) Sales volume; Neg binomial - Table 3, col. 6



(g) Log TOM - Table 7, col. 6



(h) Log number listings - Table 6, col. 5



D.3 Restricting the sample to homes located closer to the North-South border

Table D7 Summary statistics - Sample with homes within 50km of border (Euclidean distance).

	Cross-section sample 2019-2021				Repeat sales 2013-2021			
	Treated		Control		Treated		Control	
	mean	sd	mean	sd	mean	sd	mean	sd
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sale price (USD 1,000)	309.5	(153.8)	310.5	(145.3)	300.9	(127.5)	297.7	(117.9)
List price (USD 1,000)	305.6	(149.6)	308.7	(141.3)	297.3	(123.8)	295.7	(114.7)
Spread sale to list price	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)
TOM (days)	52.7	(101.0)	61.8	(109.7)	45.9	(88.4)	53.4	(93.7)
Lot size (m2)	2233.4	(3514.2)	2191.4	(3539.3)	2364.3	(3734.2)	2378.3	(3756.8)
Living area (m2)	104.2	(50.9)	108.9	(54.3)	92.1	(45.4)	92.4	(46.4)
Year built	1978.9	(34.4)	1981.5	(34.0)	1975.0	(38.4)	1978.9	(37.5)
# bedrooms	2.8	(1.2)	2.8	(1.2)	2.5	(1.1)	2.5	(1.2)
Detached home	0.3	(0.5)	0.3	(0.5)	0.2	(0.4)	0.2	(0.4)
Cabin	0.2	(0.4)	0.1	(0.3)	0.1	(0.3)	0.0	(0.2)
Appartment	0.4	(0.5)	0.4	(0.5)	0.5	(0.5)	0.6	(0.5)
Row house	0.1	(0.2)	0.1	(0.2)	0.1	(0.3)	0.1	(0.3)
Condos	0.1	(0.3)	0.1	(0.3)	0.1	(0.3)	0.1	(0.3)
Euclidean distance to border (km)	64.8	(18.3)	77.5	(18.0)	66.7	(15.3)	80.4	(14.7)
Road distance to border (km)	120.4	(34.9)	143.0	(46.2)	120.0	(28.2)	146.0	(42.8)
Driving time to border (hours)	2.2	(0.6)	2.5	(0.9)	2.2	(0.5)	2.6	(0.8)
Observations	22118		19525		7373		7147	

Figure D2 Distance and driving time to the nearest crossing point on the North-South border using Open Street Map, averaged at the municipality level.

(a) Driving distance (km) **(b)** Driving time (hours)

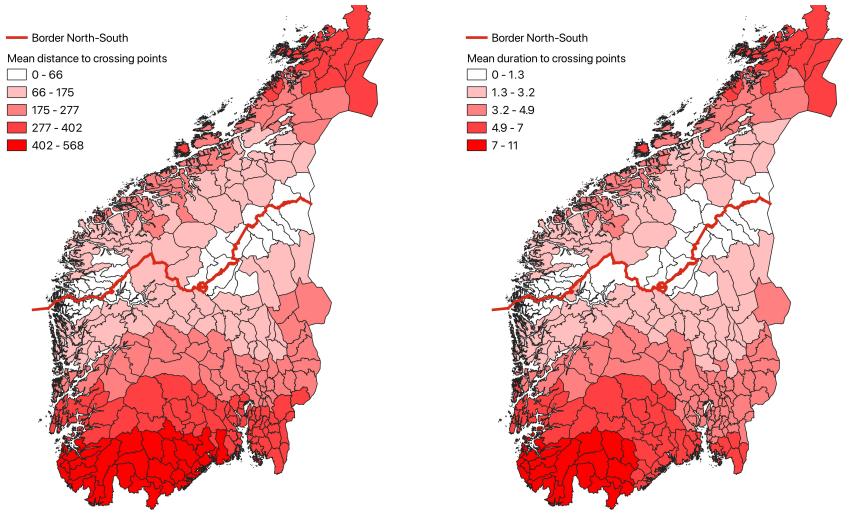
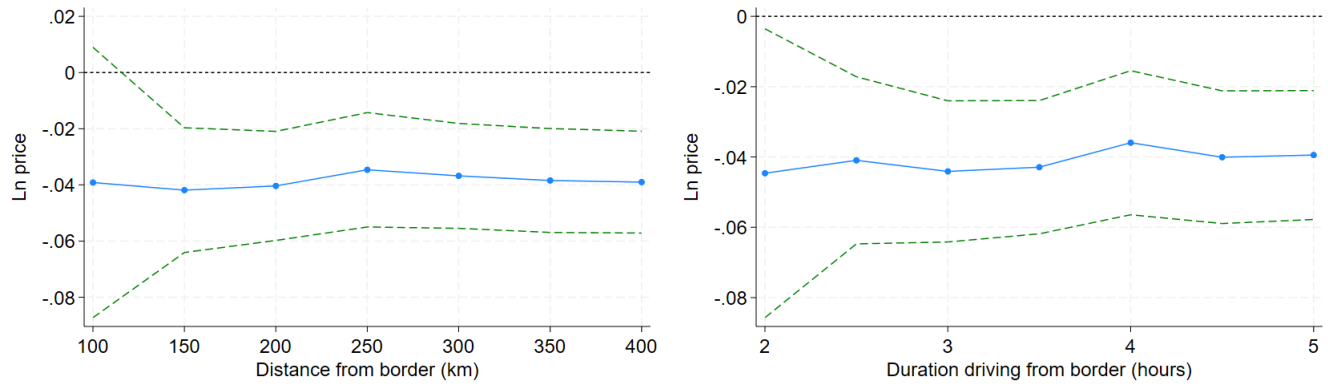
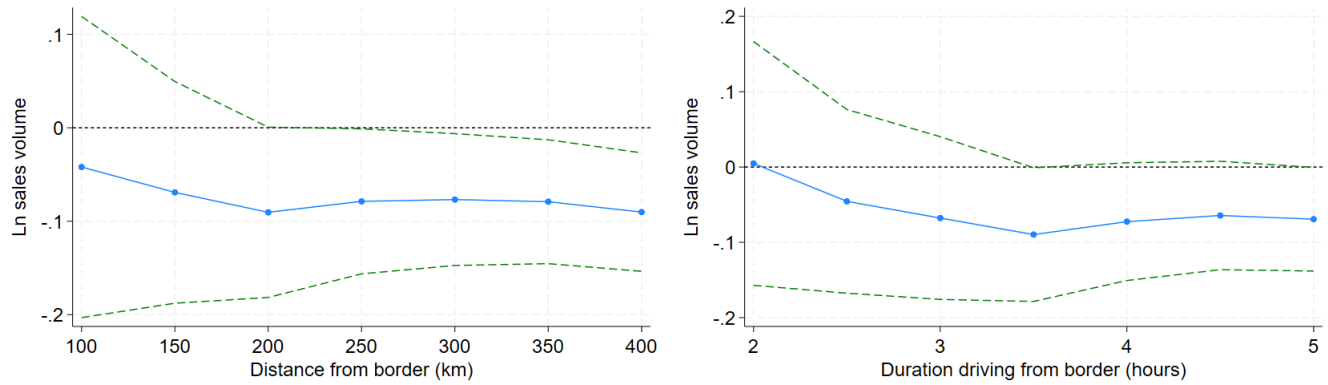


Figure D3 Effect on log home prices and log sales volume of restricting the sample to be located within different distances using the road network or driving distances

(a) Ln prices; driving distance (km) **(b)** Ln prices; driving time (hours)



(c) Ln volume; Driving distance (km) **(d)** Ln volume; Driving time (hours)



D.4 Pooled mechanism results

Table D8 DiD results - Effect of being located South of the North-South market border on log of list prices separately by predicted underwater or nominal loss subsample.

	Cross-section sample: 2019-2023					Repeat sales sample: 2013-2023
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Underwater predicted status					
treatxpost	-0.0024	0.0025	-0.0313**	-0.0788***	-0.0566***	-0.0559***
	(0.027)	(0.020)	(0.013)	(0.015)	(0.0099)	(0.011)
treatxpostxUnderwater	-0.0069	-0.0370*	0.0062	0.0097	0.0144	0.0337***
	(0.022)	(0.021)	(0.013)	(0.013)	(0.017)	(0.0077)
Underwater effect (total)	-0.0093	-0.0345	-0.0251	-0.0691	-0.0423	-0.0222
se	0.0215	0.0227	0.0165	0.0192	0.0157	0.0130
p-value	0.668	0.130	0.129	0.000	0.008	0.089
N	102156	102156	102156	102156	102153	105618
Adj-R2	0.09	0.37	0.62	0.62	0.80	0.96
	Panel B: Nominal loss predicted status					
treatxpost	-0.0043	0.0279	-0.0107	-0.0368	-0.0223	-0.0626***
	(0.022)	(0.024)	(0.019)	(0.026)	(0.016)	(0.010)
treatxpostxNominal loss	0.0230	-0.0475	0.0373*	0.0414*	0.0269*	0.0342***
	(0.041)	(0.034)	(0.022)	(0.021)	(0.014)	(0.0099)
Nominal loss effect (total)	0.0186	-0.0195	0.0266	0.0046	0.0046	-0.0284
se	0.0380	0.0315	0.0155	0.0168	0.0119	0.0132
p-value	0.625	0.536	0.088	0.786	0.702	0.032
N	126693	126693	126693	126693	126691	130645
Adj-R2	0.20	0.50	0.81	0.81	0.86	0.96
Year×Qtr FE	✓	✓	✓	✓	✓	✓
Covariates		✓	✓	✓	✓	
Cty trend			✓	✓	✓	✓
County FE				✓		
Muni FE					✓	
Unit FE						✓

Notes: The coefficient on $treat \times post$ gives the DiD effect for homes predicted to not be underwater (Panel A) or to not face a nominal loss (Panel B). The coefficient on $treat \times post \times \omega$ captures the additional effect for underwater or nominal loss homes, where ω denotes underwater or nominal loss status. The rows labeled 'Underwater effect (total)' and 'Nominal loss effect (total)' report the total treatment effect for underwater or nominal loss homes, respectively, computed as the linear combination $treat \times post + treat \times post \times \omega$ using the `lincom` command in Stata 18. Home controls: home type, log lot size, log building age, log unit size, number of bedrooms, yearly trends interacted separately with each of the three latter controls. Robust standard errors clustered at municipality level. * p<0.1, ** p<0.05, *** p<0.01