The price of beauty: Biodiversity effects on residential housing markets*

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Abstract

We study how and why local biodiversity affects residential property values. Leveraging remotely sensed greenness indicators and a novel dataset of granular property listings, we examine how changes in vegetation load on real estate prices. Hikes in greenness are associated with higher listing prices, fewer properties listed, and reduced liquidity in housing markets. These results suggest that price hikes in housing markets are driven by supply-side constraints instead of a "greenium" that buyers might be willing to pay due to innate preferences. Exogenous zoning shocks to foster biodiversity corroborate the presence of supply side constraints as price drivers in residential housing markets. Our findings emphasize the need to calibrate biodiversity and (social) housing policy objectives more explicitly.

Keywords: biodiversity, risk, house prices, remote sensing

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1 Motivation

Financial markets appear to value biodiversity when it comes to equity prices (Garel et al., 2024; Giglio et al., 2025), commodity markets (Guidolin and Pedio, 2025), and investment decisions (Flammer et al., 2025). Yet, whether economic agents pay a "greenium" due to innate preference for sustainable investments or whether they instead price tangible benefits of biodiversity, such as well-documented ecosystem services (see Tilman et al., 1997; Loreau et al., 2001; West, 2015; Paul et al., 2020), remains an open question.[1]

To shed light on whether and why agents price biodiversity, we study valuation effects in an empirical setting that innovates in two main dimensions vis-á-vis existing literature. First, we study an asset market, which is arguably more directly exposed to the benefits and risks arising from (the lack of) ecosystem services compared to financial securities: housing.[2] To isolate valuation channels, we venture beyond the usual focus on price responses of financial assets, but study instead whether biodiversity proxies load on both equilibrium determinants: prices *and* quantities. Second, most hedonic housing price studies of biodiversity effects focus on spatially confined markets.[3] We mobilize a comprehensive sample of granular real estate listings in both urban and rural real estate markets of a large economy between 2007 and 2021: Germany. Thereby, we aim to shed light on potentially generalizable patterns beyond specific case studies of selected regions.

Residential property markets are particularly relevant to study because real estate simultaneously collateralizes mortgage loans as a key financial asset in modern financial systems, serves as a salient store of wealth for households, and represents a core item in agents' consumption baskets (Cloyne and Kleven, 2019). Market frictions may thus bear

[1] Examples are air filtration, water storage, and stormwater retention, which entail economic value because systems with fewer species deliver these services less reliably and are more vulnerable to disruption from extreme weather, habitat loss, or invasive species (Schwaab et al., 2021; Liu et al., 2025).

[2] See also Coqueret et al. (2025) for return and Arlt et al. (2024) or Giglio et al. (2025) for risk implications of (lacking) biodiversity in financial markets that depend less directly on ecosystem services.

[3] See, for example, Belcher and Chisholm (2018) or Ratzke (2023) for recent hedonic house price studies and Li et al. (2015) for an overview of models that also consider biodiversity proxies.

broader implications for financial stability (Mian and Sufi, 2018) and the distribution of wealth (Peydró and Uluc, 2024). Specifically, if agents acquire a taste for biodiversity as a valuable amenity, elevated real estate prices would simply reflect a "greenium" that investors are willing to pay given their biodiversity preferences (Ratzke, 2023). Alternatively, the pursuit of biodiversity as a policy objective may constrain housing supply and thereby distort prices, for instance due to restrictive zoning or stricter building requirements. Biodiversity induced housing price hikes may then spur gentrification (Anguelovski et al., 2022) and amplify urban inequality (Meehan et al., 2025). Thus, observationally equivalent asset price responses may conceal very different reasons—innate preferences or supply frictions—with markedly different policy ramifications.

The headline results indicate that biodiversity affects house prices by altering the available supply of housing. Within a given postal code, years with above-average biodiversity associate with higher mean listing prices per square meter of residential real estate. A one standard deviation increase in the biodiversity proxy is associated with a price increase of 1.5% per square meter. To isolate the motives for this biodiversity "greenium", we examine both price *and* quantity responses and document fewer listings in postal code areas that become greener. Together with price hikes, this pattern is consistent with tightening housing supply, rather than supporting a narrative of an amenity-driven premium incurred by consumers with particular preferences for greener localities.

Against the backdrop of evidence that land-use designation constitutes the main driver of biodiversity loss (Jaureguiberry et al., 2022), we scrutinize these empirical associations in two empirical settings, in which the supply of housing is arguably exogenously constrained. First, we observe for one large federal state in Germany, Baden-Württemberg, changes in conservation zoning to prevent biodiversity loss akin to Sacher and Singla (2025). Whereas designation decisions might reflect local preferences at broader plan-

ning levels, the timing and specific placement of new protections within a postal code are largely driven by ecological and administrative criteria rather than contemporaneous postal-code-level housing demand. Thus, we exploit within-postal-code variation in local housing markets facing plausibly exogenous housing supply contractions in comparison to localities without such frictions. The results confirm that supply side frictions rather than biodiversity preferences are more likely drivers of residential real estate equlibria as neither prices nor quantities in non-zoned postal codes respond to changes in biodiversity. Second, we test for systematic differences in subsamples of urban and rural real estate markets since the former are characterized by less elastic housing supply and distinct greening policies. The city–non-city comparisons are estimated on the full national postal-code-year panel and confirm again a negative relationship between listed housing offers in both city and non-city postal codes. Prices, in turn, only increase significantly in non-city postal codes, which are arguably subject to more elastic housing supply.

To empirically test the relationship between biodiversity and real estate prices, we mobilize and combine granular, novel, yet comparable data on both core dimensions of this question: biodiversity and residential real estate markets. First, we use the Normalized Difference Vegetation Index (NDVI), a satellite-based measure of vegetation health and density, to approximate biodiversity (see Jones and Vaughan, 2010). NDVI gauges vegetation greenness, which associates with richer ecosystems and is therefore increasingly often used in ecology and biodiversity-related applications (see, e.g., Cavender-Bares et al., 2022). More importantly, it permits us to gauge biodiversity consistently at the postal-code level for all of Germany in each year. Second, we combine this granular, salient, and time-varying biodiversity information with millions of for-sale real estate listings from ImmoScout24 (2007–2021), the country's primary online platform.[4]

We are not the first to study the effects of biodiversity on housing markets from an fi-

[4]ImmoScout24 data are curated by FDZ Ruhr; see RWI-GEO-RED at RWI Real Estate Data.

nancial economics angle, but add to this relatively nascent strand in several distinct ways. Liu et al. (2025) test for the direct effect of one specific ecosystem service, namely flood protection. Specifically, they show that properties exposed to hurricane-induced floodings in Florida face significantly lower price discounts in areas with more protection from mangroves. We add comprehensive evidence on property price effects due to biodiversity that are not conditional on a specific physical climate risk materializing, like hurricanes. Thereby, we aim for generalizable insights beyond informative, but by design narrow case study settings. Sacher and Singla (2025) study, in turn, the effects of regulation to protect biodiversity at the county level in the U.S. Combining an index of housing value with in situ proxies of biodiversity to gauge regional conservation policy shock exposure, they document that biodiversity regulation associates with higher home values. We complement their evidence on the effects of biodiversity policy with insights on the effects of actual realizations of biodiversity over a long time horizon on prices and quantities. Close to our work, Cornaggia et al. (2025) link U.S. property transactions to local biodiversity loss and document that the latter is associated with higher prices. They also conclude that high species diversity at the county level is valued as an amenity. We complement their findings beyond prices to quantities as well as the liquidity or regional residential real estate markets, which is crucial to distinguish amenity-driven demand shifts from plausibly exogenous supply shocks. Our approach to exploit within-postal-code variation over time in annual satellite greenness (NDVI) also complements their evidence, which primarily reflects cross-sectional variation between (low) biodiversity and (high) prices.

We also contribute to the urban and regional economics literature that features hedonic studies to assess the impact of observed biodiversity proxies on property prices. This strand of literature often studies selected, spatially confined markets in detail, which implies that the evidence across settings yields frequently contradicting results. For example, Ratzke (2023) uses proprietary transaction data on a local German housing mar-

ket, Hamburg, in conjunction with observed vegetation data and finds that trees in the vicinity raise property values. In contrast, Belcher and Chisholm (2018) study residential property prices in Singapore and document that closer proximity to wild tropical rainforests exhibit a significantly negative effect on prices, whereas only managed vegetation loads positively on house prices. This mixed result underpins the need for geographically comprehensive sampling of diverse regions in order to permit inference on aggregate dynamics of residential real estate asset values. Therefore, we complement this literature typically featuring the role of biodiversity in specific cities by broadening the view to all regional real estate markets over a long time horizon in one large economy.

2 Priors and institutional background

We first articulate expected associations between biodiversity and real estate market equilibria. Then we describe the institutional setup observed for a subsample of regions to isolate possible mechanisms underlying this nexus.

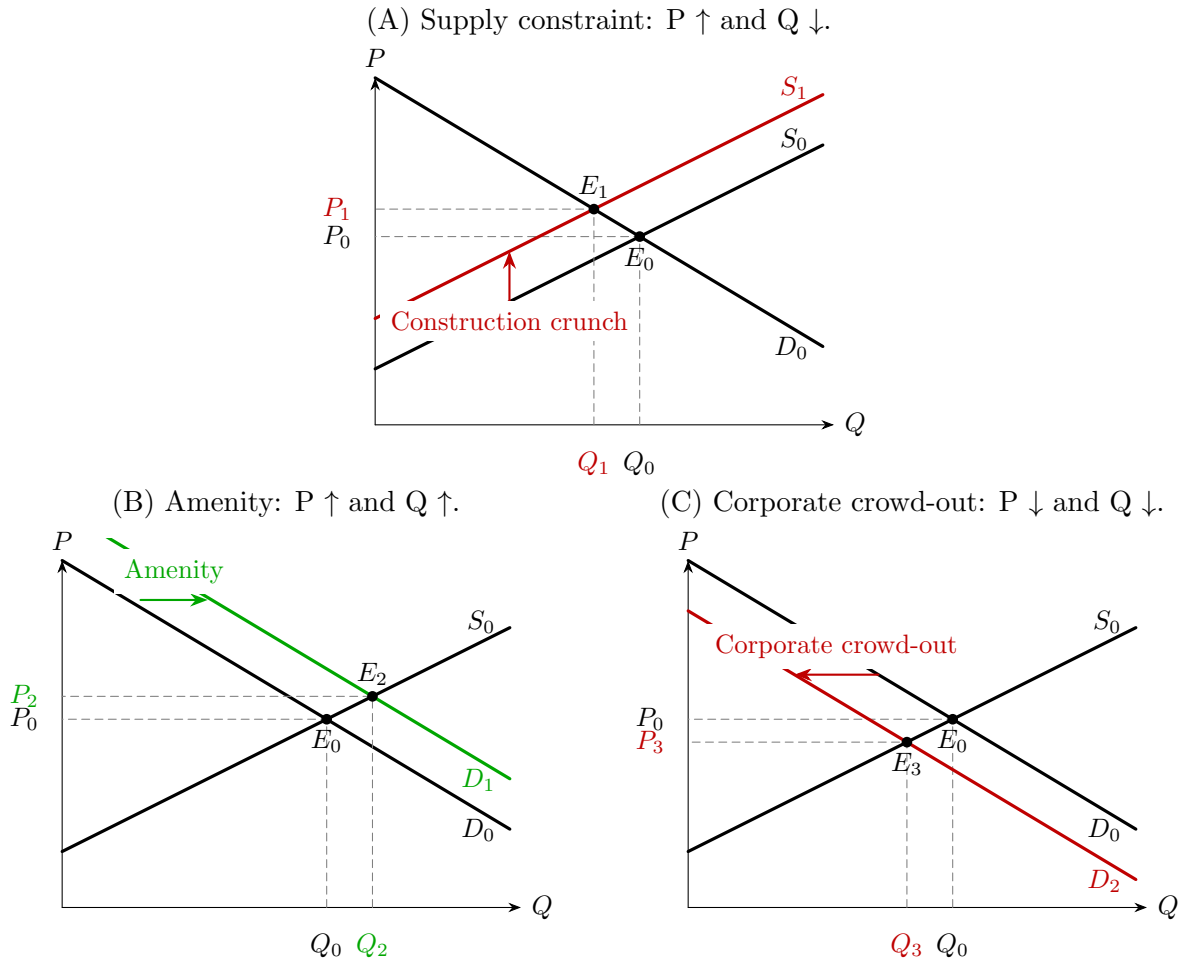
2.1 Theoretical priors

Theory yields ambiguous effects of biodiversity on housing markets because demand- and supply-side channels operate simultaneously.[5] Figure 1 depicts naïve comparative statics of demand and supply in real estate markets to illustrate the possible forces at play in prior literature. Against this backdrop, we articulate expected empirical associations.

Consider to that end panel (A) in Figure 1 first, which we label the "construction crunch" scenario. Conservation designations and related rules can reduce developable land or raise building costs (Nolte, 2020). Such policies would shift supply inward from S_0 to S_1, resulting in higher prices and lower quantities, an effect that would be amplified

[5] We remain agnostic as to the expected effect of biodiversity on liquidity, which is a priori ambiguous.

Figure 1: Three scenarios on biodiversity effects in residential real estate markets



Notes: This figure illustrates comparative statics for prices on the vertical axis (P) and quantities on the horizontal axis (Q) in stylized real estate markets. Panel (A) depicts a "supply constraint" scenario featuring a shift from S_0 to S_1, raising P and lowering Q. Panel (B) shows an "amenity" scenario with a demand shift from D_0 to D_1, raising both P and Q. Panel (C), the "corporate crowd-out" case shifts demand inward to D_2, lowering P and Q. Dashed lines mark equilibria; colored curves highlight the shifted schedule.

when short-run supply is inelastic (Quigley and Raphael, 2005; Saiz, 2010).

Crucially, this price hike induced by supply side frictions is observationally equivalent to that in response to demand shocks, as shown in panel (B) of Figure 1. A demand shift from D_0 to D_1 to the new equilibrium E_2 yields identical prices $P_1 = P_0$ and an expansion of listed real estate, such that $Q_1 < Q_2$. This quantity response isolates the amenity channel from the construction crunch scenario. Higher willingness to pay is consistent with biodiversity being an amenity with recreational benefits and well-being in household utility (see, e.g. Bratman et al., 2019; Giglio et al., 2024; Cornaggia et al., 2025), urban greening as a hedonic pricing factor of real estate (as in Tyrväinen and Miettinen, 2000; Li et al., 2015), or enhanced ecosystem services like cooling, runoff retention, and flood buffering that reduce risks (e.g., Schwaab et al., 2021; Liu et al., 2025).

Alternatively, demand may contract if conservation-related policies hamper corporate activity, such as local investment and employment (Bartram et al., 2022). This "corporate crowd-out" scenario is depicted in panel (C) of Figure 1. Higher costs faced by firms can compress wages (Walker, 2011), eventually reducing households' willingness to pay for housing (Roback, 1982). Finally, buyers may discount properties if they expect higher regulatory costs in high-biodiversity areas (Sacher and Singla, 2025). All these forces correspond with an inward shift of demand from D_0 to D_2, resulting in a new equilibrium at E_3 that is characterized by lower prices and quantities.

We test these predictions by estimating the relationship between a measure of biodiversity (NDVI) and prices, quantities, and liquidity. Considering both prices and quantities distinguishes demand from supply forces. An increase in prices alone is observationally equivalent to either an outward demand shift or an inward supply shift. The change in quantities is, in turn, distinct. Quantities rise only under amenity-driven demand shifts, whereas they contract under supply constraints.

2.2 Institutional setting to isolate supply shocks

Whereas the three scenarios outlined in subsection 2.1 help to fix which empirical associations to expect, we recognize the potential endogeneity between biodiversity, housing prices, and the number of listings. For example, if local housing demand rises, public and private actors may upgrade green amenities (e.g., street trees, parks, gardens), causing NDVI and prices to move together. Households with stronger environmental preferences and higher incomes may also sort into greener areas and sustain vegetation privately. To draw firm causal inference in this setting would require to identify drivers of biodiversity that are orthogonal to both the supply and the demand of residential real estate. Given that Jaureguiberry et al. (2022) identify designation of land use as the prime driver of loss in biodiversity, it is hard to envision such perfect instruments. We thus caution throughout to interpret the documented associations causally.

Despite this inevitable imperfection, we can exploit institutionally driven shocks that shift housing supply arguably exogenously while we aim to hold demand empirically constant. To that end, we exploit within-postal-code conservation zoning events for one of the 16 federal states that provide spatially granular zoning data: Baden-Württemberg.[6]

Whereas biodiversity protection policies may constitute in other jurisdictions like the U.S. sharply delineated events in both space and time (Sacher and Singla, 2025), this is not the case in German federalism. Appendix A provides details on the process. In a nutshell, spatial planning is a multilevel legislative process that stipulates at the top level a Spatial Planning Act (Raumordnungsgesetz, or ROG) at the federal level. Each of the 16 federal states then adopts a binding spatial planning framework that must align with the ROG. State spatial plans guide major land-use policies, such as settlement patterns, infrastructure, and conservation. Regional plans further refine state-

[6]Empirically, we also conduct comparisons between rural and urban real estate markets for the full national postal-code-year panel given well-documented lower supply elasticities in more densely populated localities (e.g. Saiz, 2010).

level principles into detailed land-use allocations. These allocations include, for instance, industrial, residential, agricultural, and conservation zones (Danielzyk and Münter, 2018).

We obtain regional planning data of land designations for green infrastructure and conservation zoning in the state of Baden-Württemberg at the psotal code level. Conservation zoning aim to maintain open space, ecological connectivity, and landscape character.[7] Regional plans are developed in an iterative process with municipalities that usually takes several years. These plans are adopted for a period of 10–15 years by the regional assembly and bind all lower-level land use planning. Environmental designations constitute binding objectives of spatial planning and, therefore, constrain local development.

Our institutional setting implies that economic agents at the postal code level are quasi-randomly exposed to exogenous frictions in the provision of residential housing following conservation zoning. Contrary to Sacher and Singla (2025), the iterative development and dynamically fuzzy enactment preclude a sharply defined timing of a treatment in the vein of empirical identification like difference-in-differences approaches. Instead, we estimate below reduced-form associations, which we compare across zoned and unzoned localities. In doing so, we control for observable and unobservable demand drivers by means of covariates and fixed effects. Before detailing the empirical methodology, we discuss measurement, sampling, and data next.

3 Data and Summary Statistics

3.1 Measuring Biodiversity

Purvis and Hector (2000) define biodiversity as "the total sum of all biotic variation, from the level of genes to ecosystems". Collecting biodiversity data *in situ* (on-site) at comparable scales is time-consuming, limiting precise measurement across broad spatial extents

[7] Zoning types are green corridors, green breaks, and nature conservation and landscape management.

and long time spans. Therefore, we approximate biodiversity using satellite-based remote sensing because it provides consistent, spatially continuous coverage over large areas and extended periods. Remote sensors (e.g., satellites) can continuously and comprehensively approximate ecological conditions. Trade-offs comprise lower spatial and temporal resolution, limited ability to distinguish species-level diversity, and potential measurement error from atmospheric interference or sensor calibration. Yet, ample validation efforts of remote-sensing indicators against *in situ* observations exhibit generally strong positive correlations (recent overviews are: Reddy, 2021; Cavender-Bares et al., 2022).

We employ the *Normalized Difference Vegetation Index* (NDVI) from 2007 onward, which is widely used to assess vegetation greenness and photosynthetic activity (Jones and Vaughan, 2010).[8] Whereas NDVI directly measures vegetation health and density, it also correlates positively with *ecosystem productivity* and *ecosystem stability*. Contemporary research supports a robust, positive relationship between ecosystem productivity and biodiversity, or more specifically, species richness (see, e.g., Gaston, 2000; Tilman, 2000; Purvis and Hector, 2000; Dronova et al., 2022).[9]

NDVI is calculated from spectral bands with different wavelengths, namely the near-infrared (NIR) and red bands, capturing the high red light absorption and strong NIR reflectance characteristic of healthy green vegetation (Tucker, 1979): $\text{NDVI} = \frac{\text{NIR}-\text{Red}}{\text{NIR}+\text{Red}}$. NDVI ranges between -1 and 1 and high values indicate dense, healthy vegetation. Low values correspond to sparse vegetation, bare soil, or water surfaces. Values above 0.6 are typical of dense, healthy vegetation (often forests). Values between 0.1 and 0.5 characterize shrubs and grasslands. Values near 0 indicate bare soil or built-up surfaces. Open water typically approaches -1 (Jones and Vaughan, 2010).

[8]Satellites that regularly cover large areas typically provide a spatial resolution from roughly 10 to 300 meters. Higher-resolution aerial imagery exists for specific places and times.

[9]This positive relationship is attributed to a *selection* and a *complementarity* effect. The former entails that more diversity increases the odds that one species contributes disproportionately to vegetation growth and organic matter accumulation. The latter channel suggests that more diversity enhances efficient resource use (Tilman et al., 1997; Loreau et al., 2001).

3.2 Sample Selection and Variable Construction

To measure local biodiversity, we collect monthly NDVI observations for each of the 8,170 German postal codes between 2007 and 2021.[10] NDVI data are sourced from the Moderate Resolution Imaging Spectroradiometer (MODIS) product MOD13A1, version 6, with a spatial resolution of 500 meters. All available images in a given month are combined into a Best Available Pixel (BAP) composite to extract NDVI data from satellite imagery after purging low-quality pixels that are due to, e.g., clouds or snow. To obtain monthly observations at the postal code level, we average NDVI value across all BAP pixels within each postal-code area. These are aggregated into annual averages to abstract from seasonal fluctuations and to mitigate residual measurement error after BAP compositing.

Real estate market data are sourced from ImmoScout24, the leading online real estate marketplace in Germany. This dataset is maintained by FDZ Ruhr and comprises 25 million observations on for-sale listings of houses and apartments between 2007 and 2021. It features various house and apartment traits, prices, and geographic coordinates to geo-locate properties.[11] We use the logarithm of the mean listing price per postal code together with the median number of bedrooms, floors, and rooms, as well as the median property age in the respective postal code. We rely on listing prices because comprehensive data on transaction prices for German real estate are not available. We aggregate listing-level data for each of the 8,170 German postal codes to align the level of outcomes with that of NDVI, the key explanatory variable. This approach also mitigates concerns to oversample postal codes with many listings and the resulting panel structure allows to saturate the specification with fixed effects to gauge known unknwowns.

Specifically, we construct two measures at the postal-code-year level from the listing

[10] Postal codes are from Deutsche Post Direkt GmbH, accessed on May 22, 2023. Postal codes for large customers (Großkunden) and selected areas are purged: 87491 Jungholz, 87567 Riezlern 87568 Hirschegg and 87569 Mittelberg. © Deutsche Post Direkt GmbH.

[11] Most importantly postal codes, see RWI-GEO-RED/REDX: Real Estate Data and Indices.

data: a *quantity* measure (average listing stock) and a *liquidity* measure (average time on market, or stickiness). To compute these, we first construct listing "spells" for each advertised property. A new spell begins when the gap to the previous observation of the same listing exceeds three months or for discontinuous trait adjustments, specifcally changes in postal code, listing type, floor area by more than 20%, or more than one room.

Using these spells, we compute the supplied quantities of residential real estate as follows. Let $\text{Stock}_{i,m}$ be the number of active spells in postal code i in month m. The quantity measure at the postal-code-year level is the 12-month average stock,

$$\text{Quantities}_{i,t} \;=\; \frac{1}{12}\sum_{m=1}^{12}\text{Stock}_{i,m}\;, \tag{1}$$

which equals the total listing-months in i during year t divided by 12. To gauge stickiness, we track monthly spell entries and exits. We compute the average elapsed duration (in months) since the spell started for the set of active listings each month. Stickiness for postal code i in year t is the 12-month average of this monthly mean duration and serves as a proxy for local real estate market liquidity. If listings stay longer on the platform, stickiness increases, indicating lower market liquidity and slower local housing turnover.

Detailed annual zoning data at the postal code level are not available for all 96 regional planning regions in the Federal Republic of Germany. However, we obtained detailed information for one of the largest German states: Baden-Württemberg. The data are obtained from the Geoportal Raumordnung Baden-Württemberg.[12] We observe zoning information on green corridors, green breaks, and nature conservation. We gauge year-to-year changes to identify postal codes that exhibit an increase in these designations to distinguish "unzoned" from "zoned" areas. The latter are those that are exposed at least once to any of the three land designations above.[13] We also collect socioeconomic and

[12]Data as of January 2024 from Geoportal Raumordnung Baden-Württemberg ©.

[13]We also construct a zoning-intensity measure equal to the increase in zoned relative to the total postal code area in the year of the increase, and zero otherwise.

regional control variables from the federal and various regional statistical offices at the administrative district level (Kreise und Kreisfreie Städte).[14]

Administrative districts typically comprise multiple postal codes. We use district-level controls to absorb regional economic and policy shocks that affect all postal codes within a district, e.g. labor-market conditions. Note that key explanatory variables, NDVI and zoning, vary at the postal code level, which allows us to estimate the effect of local greenness (NDVI) on prices within a postal code while holding constant common regional dynamics across postal codes in a district. For example, an industrial expansion may raise district GDP without directly increasing residential housing demand in the industrial area postal code itself. However, nearby residential postal codes in the same district can experience higher housing demand as the regional economy grows.

We only sample real estate listings with non-missing information on prices per square meter, biodiversity, housing characteristics, and regional controls. We winsorize housing prices at the 1st and 99th percentiles separately for apartments and houses for sale and exclude properties listed under multiple postal codes. Based on these restrictions, we construct two samples. The first is a postal-code-year panel (2007–2021) covering all of Germany, which permits a comprehensive documentation of correlations between biodiversity and housing prices. Second, we construct a postal-code-year panel pertaining only to the state of Baden-Württemberg (2007–2021) that includes detailed zoning information. This sample permits a better isolation of supply-side frictions as a potential mechanism by which biodiversity is reflected in real estate asset prices.

[14]Regional controls include GDP growth, unemployment rate, business registrations, insolvencies, population size, the second vote share for the Green Party in the federal election, the share of total area used for settlement and traffic, and the share of agricultural area. In 2016, the basis of data collection changed for the share of settlement and traffic area as well as the share of agricultural area. We normalize these controls by dividing the postal code share by the total share of the corresponding district area. We linearly interpolate missing values for the unemployment rate and for insolvencies. Business registrations, settlement, and traffic area are observed as of 2008, which we use for 2007 as well.

3.3 Summary Statistics

Table 1 presents summary statistics for both samples. The national sample in panel A covers 117,606 postal-code-year observations for property sales between 2007 and 2021. The mean (median) listing price per square meter across houses and apartments is €1,896 (€1,594). On average, 15.7 properties with 2.95 bedrooms and 4.73 rooms in total are listed per postal code for an average spell of around 1.26 months. The average NDVI value is 0.62, indicating dense and healthy vegetation. Appendix Figure 2 visualizes NDVI differences at the 25th and the 75th percentiles of the sample, indicating distinct amounts of green space. Panel B of Table 1 comprises 17,716 postal-code-year observations in the state of Baden-Württemberg

The top panel of Table 2 indicates at times substantial differences of this sub-sample vis-á-vis the rest of Germany. Average prices are around 15% higher (€2,186) whereas the NDVI of 0.64 is fairly comparable. Normalized differences indicate that these differences are also significant. The middle panel also shows that nearly 50% of all postal codes in this state were zoned at some point. Zoned and unzoned postal codes differ considerably. In particular, zoned postal codes are characterized by higher housing prices, lower biodiversity, and higher quantities. The final sub-sample comparisons pertains to cities and non-city areas, which also exhibit substantial heterogeneity in prices, biodiversity, and quantities. These patterns motivate estimating effects separately for these areas, as the underlying housing markets differ.

[Table 1 about here]

The evolution of NDVI in our sample is in line with Eisfelder et al. (2023). They report average NDVI increases by 0.15 points in Europe from 1981 to 2018, which closely resembles the average NDVI dynamics in our sample between 2007 and 2021 as well. Likewise, spatial and seasonal patterns depicted in Appendix Figure 1—average NDVI

in March (left) and August (right)—mimic those reported in Eisfelder et al. (2023), too.

[Figure 1 about here]

The spatial distribution of the postal-code-level NDVI trend is shown in Figure 2A. We estimate these trends using the Theil–Sen slope estimator, i.e. the median of all year-pair slopes, as in Eisfelder et al. (2023) and report NDVI units per decade. Darker green areas indicate larger NDVI increases whereas lighter green and yellow areas suggest lower growth or stagnation in vegetation greenness. Red areas indicate a decline in NDVI. NDVI trends vary markedly across Germany, with gains concentrated in the south and largely stable or declining patterns across central regions. The largest NDVI declines pertain to (i) lignite-mining districts (Welzow, Inden, Cottbus), (ii) urban areas (Hannover, Wiesbaden), and (iii) forest-dieback hotspots in the Harz region (Schierke, Harsleben). Rural areas, such as Spiekeroog and Zwenkau, but also cities, such as Frankfurt am Main, Mannheim, and Nürnberg, exhibit the largest increases in NDVI. Housing price and quantity dynamics exhibit spatial heterogeneity as well. Prices broadly increased across Germany (Figure 2B), especially in large metropolitan cores such as Berlin, Hamburg, and the Munich area. In contrast, the number of offered properties contracted most sharply around major cities (Figure 2C).

[Figure 2 about here]

Figure 3 shows the same postal-code-level trend estimates as in Figure 2 for the state of Baden-Württemberg. Postal codes that received green infrastructure or conservation zoning during 2007–2021 are outlined in black, which concerns around half of all localities. Zoning changes are spatially clustered. Planning regions that updated their land-use plans exhibit increases in most postal codes. Importantly, both zoned and unzoned postal codes exhibit variation in NDVI, prices, and quantities.

[Figure 3 about here]

4 Property Prices and Biodiversity

4.1 Empirical Methodology

We study the effects of within-locality biodiversity changes on regional real estate markets at the postal-code-year level, which allows for postal code and time fixed effects. To obtain suggestive evidence on the three scenarios illustrated in Figure 1, we assess the impact of biodiversity on real estate market equilibria by specifying:

$$\mathbf{Y}_{i,t} = \beta_0 + \beta_1 \text{Biodiversity}_{i,t} + \beta_2 \mathbf{Z}_{i,t} + \beta_3 \mathbf{X}_{i,t} + \alpha_t + \gamma_i + \epsilon_{i,t} \ , \tag{2}$$

where $\mathbf{Y}_{i,t}$ alternatively denotes (i) the natural logarithm of the average asking price per square meter in postal code i during year t, (ii) the average number of active listings in postal code i in year t, and (iii) the average liquidity, i.e., the average duration for which a listing remains on the market in postal code i in year t. Our proxy for $\text{Biodiversity}_{i,t}$ is the average annual NDVI in postal code i in year t. The vector $\mathbf{Z}_{i,t}$ contains median property-specific controls in postal code i in year t. Regional controls at the administrative district level are captured by $\mathbf{X}_{i,t}$ (see footnote 14), to account for local economic conditions and political preferences that may jointly affect biodiversity and housing market outcomes. For instance, higher GDP growth may be associated with increased construction activity and land conversion, which can reduce biodiversity while simultaneously increasing property values. In addition, median housing characteristics (e.g., dwelling size and number of rooms) help absorb compositional changes in the housing stock that may be correlated with both prices per square meter and local greenness. For example, a higher median number of rooms per dwelling typically reflects larger units, which may correlate with lower prices and greener, less dense neighborhoods.

In all regressions, we include year fixed effects, α_t, and postal code fixed effects, γ_i.

Year fixed effects (α_t) capture common shocks across all postal codes in a given year, such as changes in national interest rates or macroeconomic conditions that might drive variation in housing prices or quantities. Postal code fixed effects, γ_i, absorb any unobserved time-invariant local characteristics that systematically affect prices or quantities. These include the time-invariant component of biodiversity, as well as other baseline amenity endowments, neighborhood composition, distance to employment centers, topography, and persistent local policies. By including these fixed effects, β_1 is identified from deviations in biodiversity within a postal code from its own average level over the sample period, net of year shocks that are common to all postal codes in the country.

In some specifications, we replace α_t with state×year fixed effects that allow for state-specific time variation, which might include state business cycles, state policies, statewide weather, or conservation programs. With state×year fixed effects, β_1 is identified from changes in NDVI within postal codes over time that deviate from other postal codes in the same state and year, net of shocks common to all postal codes in that state-year. We cluster standard errors at the postal code level to allow the error terms to be correlated across years within the same postal code.

4.2 Headline Results

The headline results are reported in Table 3. Columns (1) and (2) report the point estimates for the specification with house prices as the dependent variable in Eq. (2), including postal code and year fixed effects. We estimate that postal codes that become greener over time experience, on average, higher housing prices per square meter. These findings are robust to including state×year fixed effects in column (2). A standard deviation increase in NDVI (0.09) within a postal code is associated with a 1.5% increase in the price per square meter (columns (1)–(2)). To illustrate the economic magnitude of this effect, consider a postal code where the NDVI rises from the 25th to the 75th percentile

of the sample distribution (see Appendix Figure 2), corresponding to a increase from 0.58 to 0.68. The point estimates imply that such a change is associated with 1.7–1.8% higher listing prices per square meter. At the sample mean of about €1,900/m^2, this estimate corresponds to an increase of around €30/m^2, or roughly €3,000 for a typical 100 m^2 dwelling.

[Table 3 about here]

In the next two columns, we employ housing quantities as the dependent variable. In general, we observe a negative association between a postal code becoming greener over time and housing quantities (columns (3) and (4)). Again, these findings remain robust if we control for shocks common to all postal codes in a given state-year. Specifically, a standard deviation increase in NDVI is associated with about 0.8–2.0 fewer active listings, i.e., a 5–13% decline relative to the mean (15.7) (columns (3)–(4)). Effects on market liquidity, approximated by the average time for which a listing remains on the market (stickiness), are reported in columns (5) and (6). Empirically, the estimated effects are small and not robust across specifications. The coefficient in column (5) is positive but only marginally significant and becomes indistinguishable from zero when state×year fixed effects are specified in column (6). Overall, we do not find systematic evidence that changes in greenness affect how quickly properties are sold; the main margins of adjustment appear to be prices and quantities rather than liquidity.

Taken together, the combination of higher prices and lower quantities is most consistent with the *construction crunch* narrative in greener postal codes, as depicted in Figure 1A, rather than innate preferences for biodiversity that command a "greenium".

4.3 Supply-Side Frictions: Sample Splits

The headline results suggest that, on average, greening postal codes are associated with increases in prices and a reduction in quantities, a pattern that is most consistent with

the tightening of supply depicted in Figure 1A. However, this specification still averages over very different housing markets and institutional environments. In particular, (i) supply elasticities differ sharply between dense cities and the rest of the country (Saiz, 2010), and (ii) the biodiversity proxy employed here, NDVI, is itself shaped by land-use regulation and green infrastructure planning (Wilson et al., 2003).

To test this proposition, we proceed in two steps. First, we split the national panel into city and non-city postal codes and re-estimate the headline specification separately (subsubsection 4.3.1). This specification allows us to assess whether the greenness-price-quantity relationship differs between more densely populated, high-priced urban markets in comparison to arguably more elastic non-urban markets. Second, we exploit variation in explicit green infrastructure and conservation zoning in Baden-Württemberg (subsubsection 4.3.2). Comparing postal codes that received such zoning in the sample period between 2007 and 2021 to those that never did aids in isolating whether the headline pattern is concentrated where formal planning decisions directly restrict development, as implied by a supply-constraint interpretation.

4.3.1 City vs. Non-City Areas

We expect housing markets in large cities to differ fundamentally from those in non-city areas.[15] In cities, demand is spatially concentrated, buildable land is scarce, and planning constraints and neighborhood externalities are more salient. As a result, short-run housing supply is typically much less elastic: adding new units often requires re-densification, redevelopment, or costly height extensions rather than simple greenfield construction.

A second motivation is measurement. The employed greenness proxy (NDVI) behaves systematically differently in dense urban cores: levels are mechanically lower, and

[15] See, for example, Koetter et al. (2025) on evidence that staggered changes in real estate transaction taxes affected real estate prices in urban and rural areas significantly differently in Germany.

dynamics are different because built-up surfaces dominate the pixel, while relatively small pockets of green space (street trees, pocket parks, courtyards) can generate noticeable changes over time. The same change in NDVI may therefore reflect very different underlying processes in cities (e.g., rooftop greening, park upgrades, or the conversion of brownfields into parks) than in rural or suburban areas (e.g., afforestation or conservation of larger open spaces). In particular, increases in NDVI within cities may often be associated with the greening of underused or shrinking areas, rather than with tighter constraints on residential construction.

For these reasons, we re-estimate Eq. (2) separately for postal codes in Germany's ten largest cities[16] and for all remaining postal codes. This split allows us to explore heterogeneity in the biodiversity-housing market relationship between large cities and the rest of the country. In particular, we assess how the *construction crunch* pattern documented in the headline findings differs between city and non-city areas.

The results in Table 4 confirm the headline pattern for non-city areas. Within-postal-code increases in NDVI are associated with higher prices per square meter and lower quantities. These results for housing prices are robust to controlling for state×year fixed effects. The magnitude of the coefficient resembles the headline results as well and remains similar across specifications (columns (1) and (2)). A one standard deviation increase in NDVI (0.07) is associated with an 1.4–1.5% increase in listing prices per square meter. On the quantity side, we find a robust negative association between NDVI and the number of listings. This result is consistent with the earlier construction crunch interpretation in which local greening is accompanied by a tighter effective housing supply.

[Table 4 about here]

In the ten largest cities, by contrast, higher biodiversity is associated with declines in

[16]Berlin, Hamburg, Munich, Cologne, Frankfurt(M), Stuttgart, Düsseldorf, Leipzig, Dortmund, Essen.

both quantities and prices.[17] This finding could indicate that NDVI in large cities captures greening by shrinkage or overgrowth, or greening on nonmarket parcels. Outside large cities, more green space might coincide with binding land constraints, yielding the construction-crunch pattern. By contrast, in large cities, NDVI increases might align with vacancy, demolition fallows, or public-realm greening. Consider, for example, a relatively disadvantaged postal code at the edge of a large city. These peripheral neighborhoods may attract less in-migration than central, well-connected areas; therefore, housing demand is weak, and prices and listing activity gradually decline. At the same time, the maintenance of public spaces is scaled back, some small plots fall vacant, and leftover strips of land or informal green spaces are allowed to "grow wild." Trees and shrubs become denser, vacant lots re-naturalize, and unkempt parks become bushier. Through the lens of the satellite-based NDVI measure, all such narratives would increase measured NDVI, possibly explaining the price reversal despite falling quantities.

The NDVI coefficients on quantities become substantially more negative once we include state×year fixed effects (columns (4) and (8)). This pattern suggests that, in the specification without state×year fixed effects, common state-level shocks that increased both greenness and listing volumes attenuate the negative within-postal-code relationship, biasing the coefficient toward zero. The results are robust to alternative definitions of city areas (see Table 2 and Table 3 in the Appendix).[18]

[17] This pattern seems concentrated in city postal codes. In Table 4 in the Appendix, the results for suburban ("donut") postal codes (Figure 3 in the Appendix) revert to the baseline pattern: prices rise while quantities fall.

[18] When defining cities as the 10% or 15% largest postal codes by population (Table 2 and Table 3 in the Appendix), the non-city coefficients on prices and quantities are very similar to Table 4, and the NDVI–quantity relationship in city areas remains large and negative. The negative NDVI–price association, however, becomes smaller and mostly insignificant, indicating that the price reversal is driven by the very largest cities rather than by urban areas more generally.

4.3.2 Zoned vs. Unzoned Areas

A concern remains that NDVI is not only a driver of housing outcomes but also an outcome of local preferences and policies. Municipalities may become greener in response to rising demand, and environmentally minded, higher-income households may self-select into greener areas. Such forces may still bias the headline relationships estimated above, despite saturating the specification with controls and fixed effects.

To sharpen the supply-side interpretation, we therefore turn to explicit green infrastructure and conservation zoning in Baden-Württemberg. The considered zoning designations, including regional green corridors, green breaks, and areas for nature conservation and landscape management, are planning instruments that restrict or strongly condition future development and are adopted in discrete revisions of regional plans. Whereas the broad orientation of these plans reflects regional preferences, the exact timing and location of new designations within a regional planning region are largely driven by ecological and planning criteria, rather than contemporaneous postal-code-specific housing demand.

We split the Baden-Württemberg sample into postal codes that have ever experienced an increase in such zoning during the sample period ("zoned") and those that never do ("unzoned"). We then re-estimate the headline specification (Equation 2) for each subsample. A stronger relationship between biodiversity and the housing market in zoned postal codes would provide further suggestive evidence in favor of the construction crunch narrative.

Table 5 reports the results for the zoned postal codes in columns (1) and (2) and for the unzoned postal codes in columns (3) and (4). Consistent with the headline results, an increase in NDVI is associated with higher prices and lower quantities in zoned areas. In the unzoned group, coefficients are small and statistically insignificant. This concentration of effects, where supply frictions increase, also corroborates the construction crunch hypothesis. Greenness coincides with designations that reduce developable capacity (or

potentially raise development costs), yielding higher prices and lower quantities.

[Table 5 about here]

Zoning changes are plausibly exogenous to short-run, postal-code-specific housing market fluctuations, because they are mainly driven by ecological and planning criteria. However, they are still policy choices rather than the outcome of a randomized experiment. For example, a fast-growing municipality that anticipates high future demand and attracts higher-income, environmentally minded households may decide to protect its remaining open spaces by designating them as regional green corridors. In such a case, stronger demand and tighter regulation coincide spatially. The zoning split, therefore, does not deliver a fully causal estimate. However, the stark difference between zoned and unzoned areas, combined with the alignment of the zoned results with our headline pattern, mitigates a pure sorting- or demand-driven greening explanation and supports a supply-side interpretation.

4.4 Zoning Intensity and Housing Market Responses

To further exploit the heterogeneity in how strongly individual postal codes are affected by planning decisions, we move beyond a simple "zoned" vs. "unzoned" comparison (see Table 5) to a measure of zoning intensity. When a regional plan is revised, almost all postal codes in the relevant planning region typically receive some additional green infrastructure or conservation designation. However, the amount of newly zoned land differs across postal codes. To capture this heterogeneity, we construct an annual zoning-intensity measure defined as the newly zoned area divided by the total area of the postal code. The variable is zero in years without zoning expansions. Because planning constraints and housing supply conditions differ markedly between dense cities and non-city areas, we estimate this specification separately for the full sample and for the sample

excluding city postal codes. Including this measure alongside NDVI allows us to distinguish between the long-run association between greenness and housing outcomes and the short-run response to a discrete tightening of development rights.

Formally, for postal code i in year t in Baden-Württemberg, we estimate

$$\mathbf{Y}_{i,t} = \beta_0 + \beta_1 \text{Biodiversity}_{i,t} + \beta_1 \text{Zoning}_{i,t} + \beta_3 \mathbf{Z}_{i,t} + \beta_4 \mathbf{X}_{i,t} + \alpha_t + \gamma_i + \epsilon_{i,t} \ , \qquad (3)$$

where $\mathbf{Y}_{i,t}$ alternatively denotes (i) the logarithm of the average price per square meter, (ii) quantities, and (iii) stickiness. $\text{Biodiversity}_{i,t}$ is the average annual NDVI in postal code i in year t, and $\text{Zoning}_{i,t}$ is the share of the postal code area newly subject to green infrastructure or conservation zoning in year t. The vectors $\mathbf{Z}_{i,t}$ and $\mathbf{X}_{i,t}$ collect property-level and regional controls (see footnote 14), and γ_i and α_t are postal code and year fixed effects.

We estimate Eq. (3) separately for all postal codes in Baden-Württemberg (columns (1)–(6) in Table 6) and for a subsample that excludes postal codes in Stuttgart (columns (7)–(12) in Table 6), the only one of Germany's ten largest cities located in Baden-Württemberg. Adding the zoning-intensity measure allows us to isolate the contemporaneous adoption-year response to new zoning while controlling for the level of NDVI. Controlling for NDVI is important as greener areas may be systematically more likely to receive green infrastructure or conservation designations.

Comparing columns (1) and (7), which resemble the headline results in Eq. (2) for postal codes in Baden-Württemberg, we find that the coefficient on NDVI is small and statistically insignificant when all postal codes are included. It turns positive and marginally significant once we exclude Stuttgart. This mirrors the city vs. non-city results reported before: large cities exhibit different greenness-price dynamics, so pooling the postal codes of Stuttgart with the rest of Baden-Württemberg attenuates the average NDVI-price association. When we add the zoning intensity variable in columns (2) and (8), the find-

ings are very similar with and without Stuttgart: the contemporaneous price response is driven almost entirely by zoning intensity, while the NDVI coefficient becomes small and statistically insignificant. A natural interpretation is that prices react immediately when development rights are tightened, and the zoning variable captures this discrete legal change. Once we condition on zoning intensity, little additional systematic price variation remains to be explained by short-run movements in NDVI, which adjust only gradually.

[Table 6 about here]

Turning to quantities (columns (3), (4), (9), and (10)), we find that NDVI remains negatively associated with the number of active listings, whereas zoning intensity in year t is positively associated with quantities. This pattern is consistent with a distinction between short-run and medium-run effects. In the year of a major zoning expansion, projects that are already in the pipeline or landowners who anticipate future restrictions may bring additional units to the market, generating a temporary increase in observed listings where zoning intensity is high. Over time, however, as newly protected areas re-naturalize and the effective stock of developable land shrinks, NDVI captures the resulting decline in active listings. The non-city subsample shows very similar results.

Taken together, the zoning-intensity results reinforce the supply-side interpretation. Over time, a higher NDVI is associated with higher prices and lower quantities, while in the adoption year, zoning shocks are capitalized into prices and, if anything, temporarily raise quantities rather than offset the longer-run decline. Although demand-side forces such as the sorting of greenness-preferring households or demand-induced greening remain possible, they would typically predict rising prices along with higher quantities and faster turnover, which is not what we observe once we account for zoning intensity.

5 Conclusion

This paper studies how biodiversity relates to housing markets by combining a large panel of real estate listings for Germany (2007–2021) with remotely sensed greenness (NDVI). Leveraging a postal-code-year design with rich controls and fixed effects, we document two main results. First, within a given postal code, years with higher greenness are associated with higher residential prices per square meter. Second, greener postal codes exhibit lower market quantities and, if anything, slightly longer times on the market, a pattern more in line with supply tightening than with a demand premium.

Taken together, the evidence points to a *construction crunch* narrative. As areas become greener, especially where regional zoning constrains developable land, the effective housing supply tightens, and prices rise. The urban reversal suggests that greenness gains in dense cores often occur on non-residential or transitional land (public-realm greening, corridors, demolition sites, or temporary fallows), which weakens how greenness is priced in owner-occupied sales.

These findings have policy implications that differ by context. Where conservation designations overlap with developable land, especially in suburban or peri-urban areas, protecting land reduces housing capacity, which tends to raise prices and lower listing inventory. In those places, pairing conservation with targeted supply measures in less sensitive locations, such as selective upzoning, modest density increases outside protected corridors, and predictable mitigation and compensation procedures, can balance ecological goals and affordability.

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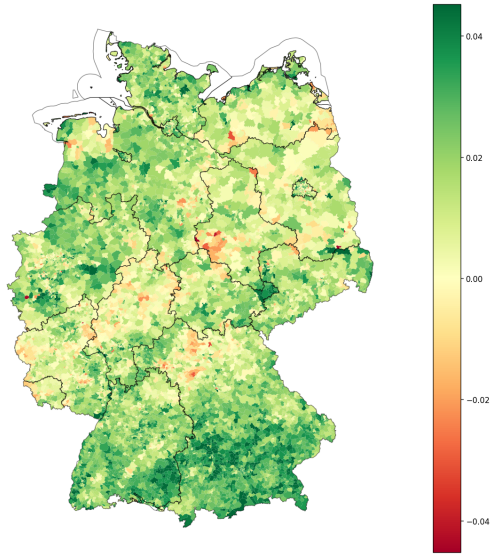
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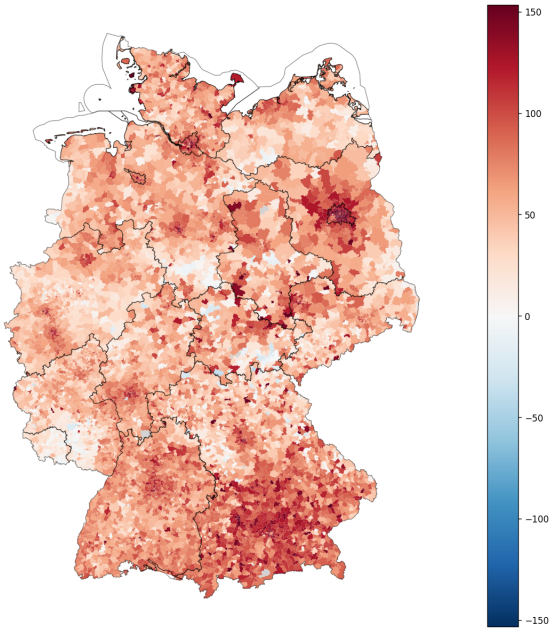
Figures and Tables

Figure 2: Postal-code-level trends in biodiversity (NDVI), housing prices and housing quantities in Germany (2007–2021)

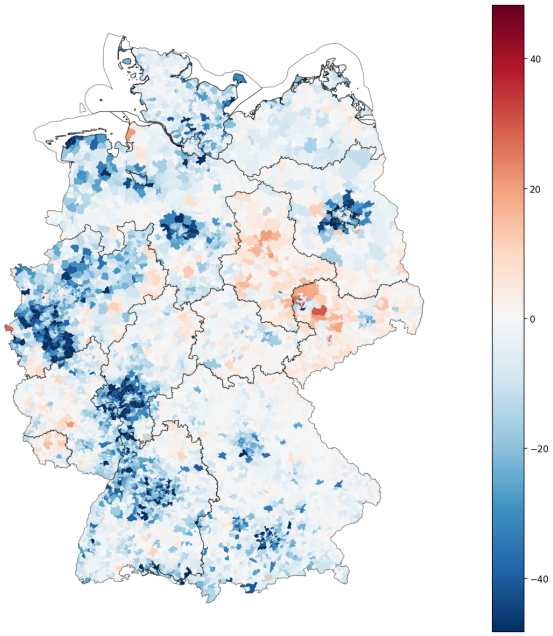
(A) Trend in biodiversity



(B) Trend in prices



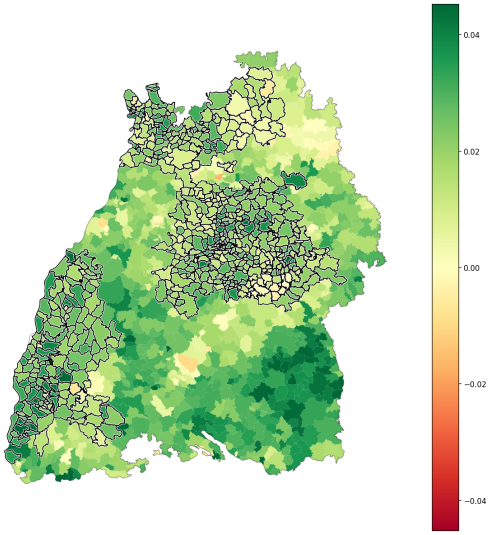
(C) Trend in quantities



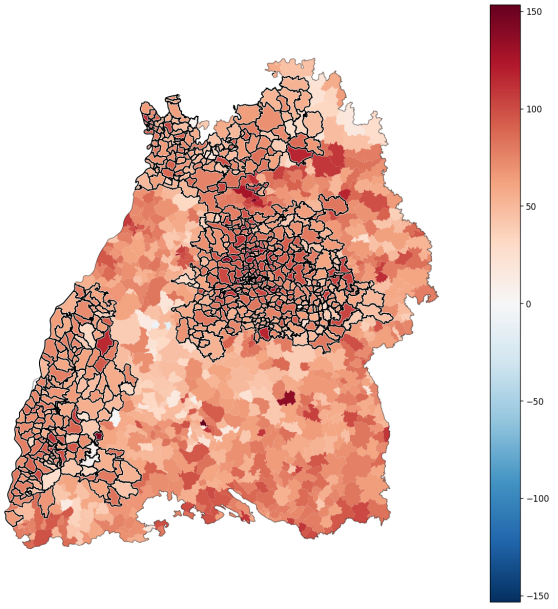
Each map reports a postal-code-specific time trend estimated on annual data for 2007–2021 using the Theil-Sen estimator, i.e., the median of all pairwise slopes of the variable on calendar year for that postal code. This yields a robust slope in "per year" units; we multiply by 10 to express the trend *per decade*. We require at least 8 usable years per postal code; areas with fewer observations are shown in grey. State borders are overlaid for reference. (A) Biodiversity (NDVI). Value = Theil-Sen slope in *NDVI units per decade*; green = greening, red = browning. (B) Prices. Estimated on $\log(\text{price}/\text{m}^2)$ and converted to % per decade via $[100 \exp(10\hat{s}) - 1]$ (e.g., $+50 \approx +4.1\%/\text{yr}$). (C) Quantities. Estimated on *levels* of inventory; value = *units per decade* (Theil-Sen slope $\times 10$). For example, +12 means roughly 12 additional units per decade.

Figure 3: Postal-code-level trends in biodiversity (NDVI), housing prices and housing quantities in Baden-Württemberg (2007–2021)

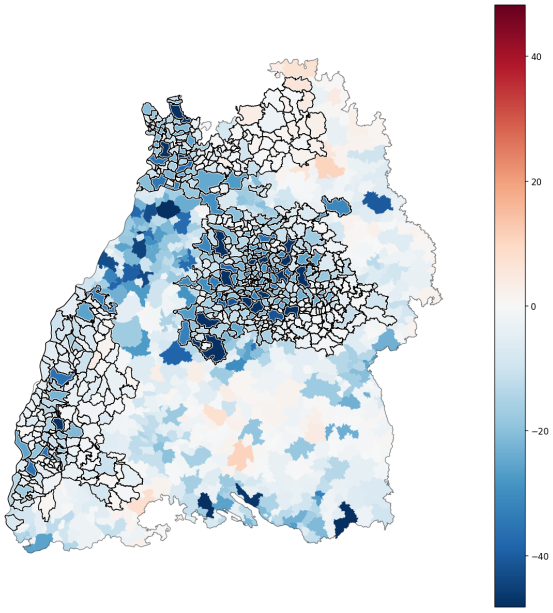
(A) Trend in biodiversity



(B) Trend in prices



(C) Trend in quantities



Each map reports a postal-code-specific time trend estimated on annual data for 2007–2021 using the Theil-Sen estimator, i.e., the median of all pairwise slopes of the variable on calendar year for that postal code. This yields a robust slope in "per year" units; we multiply by 10 to express the trend *per decade*. We require at least 8 usable years per postal code; areas with fewer observations are shown in grey. Postal codes that ever received a zoning designation during 2007–2021 are outlined with a black boarder. (A) Biodiversity (NDVI). Value = Theil-Sen slope in *NDVI units per decade*; green = greening, red = browning. (B) Prices. Estimated on $\log(\text{price}/\text{m}^2)$ and converted to % per decade via $100\,\exp(10\hat{s}) - 1]$ (e.g., $+50 \approx +4.1\%/\text{yr}$).(C) Quantities. Estimated on *levels* of inventory; value = *units per decade* (Theil-Sen slope $\times 10$). For example, +12 means roughly 12 additional units per decade.

Table 1: Summary statistics

Variable	N	Mean	SD	p25	p50	p75
Panel A: Germany						
Price per sqm	117,606	1,896.70	1,130.47	1,180.39	1,594.38	2,244.68
Log Price per sqm	117,606	7.41	0.52	7.07	7.37	7.72
Quantities	117,606	15.66	20.76	3.42	9.08	20.58
Stickiness	117,606	1.26	0.21	1.13	1.23	1.34
Biodiversity	117,606	0.62	0.09	0.58	0.64	0.68
Panel B: Baden-Württemberg						
Price per sqm	17,716	2,186.49	892.96	1,571.15	1,971.90	2,589.07
Log Price per sqm	17,716	7.62	0.38	7.36	7.59	7.86
Quantities	17,716	14.68	17.23	3.92	8.75	19.17
Stickiness	17,716	1.28	0.20	1.16	1.25	1.36
Biodiversity	17,716	0.64	0.08	0.60	0.65	0.69
Zoning Indicator	17,716	0.46	0.50	0.00	0.00	1.00
Zoning	17,716	0.02	0.16	0.00	0.00	0.00

This table reports the summary statistics for houses and apartments for sale in Germany over different samples. Panel A covers the panel data for Germany during the period 2007 to 2021. Panel B reports the panel data for Baden-Württemberg for houses on sale during the period 2007 to 2019. The price per square meter is winsorized at the 1% and 99% levels. Biodiversity is measured as the average NDVI where the listing is located. Higher NDVI values indicate greener and healthier vegetation, reflecting higher biodiversity. Detailed definitions of variable constructions and data sources are provided in the Appendix Table 1.

Table 2: Summary statistics and mean differences for city, zoning, and regional subsamples

Baden-Württemberg vs. Germany (excluding Baden-Württemberg)

	Baden-Württemberg (N=17849)			Germany (excluding Baden-Württemberg) (N=103 944)			Comparison	
Variable	Mean	Median	SD	Mean	Median	SD	Raw diff.	Norm diff
Price per sqm	2184.212	1970.072	894.492	1821.501	1499.465	1154.353	362.712	0.351$^+$
Log price per sqm	7.615	7.586	0.378	7.356	7.313	0.533	0.260	0.561$^+$
Biodiversity	0.645	0.651	0.079	0.621	0.635	0.086	0.024	0.289$^+$
Quantities	14.573	8.667	17.209	15.621	9.000	21.109	-1.048	-0.054
Stickiness	1.281	1.253	0.201	1.260	1.225	0.219	0.021	0.099

Zoned vs. Non-Zoned

	Zoned (N = 8214)			Not Zoned (N = 9635)			Comparison	
Variable	Mean	Median	SD	Mean	Median	SD	Raw diff.	Norm diff
Price per Sqm	2384.338	2134.960	948.261	2013.602	1812.100	807.758	370.736	0.421$^+$
Log price per sqm	7.706	7.666	0.373	7.538	7.502	0.365	0.167	0.454$^+$
Biodiversity	0.633	0.636	0.084	0.654	0.660	0.073	-0.021	-0.266$^+$
Quantities	17.041	10.250	19.785	12.469	7.333	14.330	4.571	0.265$^+$
Stickiness	1.286	1.259	0.190	1.277	1.248	0.211	0.008	0.041

City vs. Non-City

	City (N = 9096)			Non-City (N = 112707)			Comparison	
Variable	Mean	Median	SD	Mean	Median	SD	Raw diff.	Norm. diff.
Price per sqm	3442.630	2978.052	1850.128	1748.315	1523.552	939.995	1694.315	1.155$^+$
Log price per sqm	8.003	7.999	0.539	7.345	7.329	0.488	0.658	1.279$^+$
Biodiversity	0.488	0.501	0.104	0.635	0.643	0.073	-0.148	-1.645$^+$
Quantities	33.207	23.750	40.234	14.034	8.000	17.318	19.173	0.619$^+$
Stickiness	1.253	1.235	0.136	1.264	1.228	0.222	-0.011	-0.061

Raw mean differences between groups are reported in column "Raw diff." Normalized differences are reported in column "Norm. diff." A "+" indicates normalized differences exceeding 0.25 in absolute value, following the rule-of-thumb threshold in Imbens and Rubin (2015). Detailed definitions of variable constructions and data sources are provided in the Appendix Table 1.

Table 3: Biodiversity effects on real estate prices and quantities

	Log square meter price		Quantities		Stickiness	
	(1)	(2)	(3)	(4)	(5)	(6)
Biodiversity	0.174***	0.159***	-9.215***	-22.345***	0.067*	0.025
	(5.65)	(4.58)	(-3.87)	(-7.05)	(1.87)	(0.63)
Observations	117603	117603	117603	117603	117603	117603
R^2	0.914	0.919	0.752	0.768	0.212	0.222
Housing__Controls	Yes	Yes	Yes	Yes	Yes	Yes
Region__Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year__FE	Yes	Implied	Yes	Implied	Yes	Implied
State__FExYear__FE	No	Yes	No	Yes	No	Yes
PostalCode__FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code

This table shows the results of the headline specification in Eq. 2. The Normalized Difference Vegetation Index (NDVI) approximates biodiversity on the postal code level. We construct monthly quantities at the postal code level from listings by first building "spells" for each listing. A new spell starts when the gap to the previous observation of the same listing exceeds three months or when observable attributes change discontinuously (postal code, listing type, >20% jump in square meters, or >1-room change). The variable *Quantities* is the 12-month average of monthly stock in a postal-code-year; it equals total listing-months in that year divided by 12. The variable *Stickiness* measures the average duration of listings in a postal-code-year. We compute monthly stock duration by tracking entry and exit events of spells for each month. Thereby, we can compute for the set of active listings the average elapsed duration since entry. All specifications include median listing controls per postal code, regional controls, year fixed effects, and postal code fixed effects. Listing controls are the median of the house age, number of rooms, and number of bedrooms per postal code. Regional controls are GDP growth, the unemployment rate, business registrations, insolvencies, population size, the share of votes for the Green Party, the share of total area used for settlement and traffic, and the share of total area used for agriculture. State x Year fixed effects are included in column (2), (4), and (6). We omit the city dummy because it is constant within a postal code and therefore collinear with postal code fixed effects. We cluster standard errors at the postal code level. T-statistics are in parentheses. Detailed definitions of variable constructions and data sources are provided in the Appendix Table 1. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 4: Real estate responses in urban and rural areas

	Non Cities				**Cities**			
	Log Square Meter Price		Quantities		Log Square Meter Price		Quantities	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Biodiversity	0.209***	0.205***	-4.004**	-13.815***	-0.359***	-0.357***	-35.021*	-77.084***
	(6.51)	(5.69)	(-2.54)	(-7.86)	(-3.84)	(-3.27)	(-1.87)	(-2.77)
Observations	108600	108600	108600	108600	9003	8988	9003	8988
R^2	0.901	0.905	0.810	0.824	0.953	0.958	0.596	0.616
Housing__Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region__Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year__FE	Yes	Implied	Yes	Implied	Yes	Implied	Yes	Implied
State__FExYear__FE	No	Yes	No	Yes	No	Yes	No	Yes
PostalCode__FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code

This table extends the headline specification in Eq. 2 by estimating separate regressions for non-city and city postal codes. Cities are postal codes belonging to Germany's ten largest cities: Berlin, Hamburg, Munich, Cologne, Frankfurt am Main, Stuttgart, Düsseldorf, Leipzig, Dortmund, and Essen. Columns (1)–(4) restrict the sample to non-city postal codes; columns (5)–(8) to city postal codes. Within each group, the dependent variable is log price per square meter in columns (1), (2), (5), and (6), and quantities in columns (3), (4), (7), and (8). We use the Normalized Difference Vegetation Index (NDVI) to approximate biodiversity on the postal code level. We construct monthly quantities at the postal level from listings by first building "spells" for each listing. A new spell starts when the gap to the previous observation of the same listing exceeds three months or when observable attributes change discontinuously (postal code, listing type, >20% jump in square meters, or >1-room change). The variable *Quantities* is the 12-month average of monthly stock in a psotal-code-year; it equals total listing-months in that year divided by 12. All specifications include median listing controls per postal code, regional controls, year fixed effects, and postal code fixed effects. Listing controls are the median of the house age, number of rooms, and number of bedrooms per postal code. Regional controls are GDP growth, the unemployment rate, business registrations, insolvencies, population size, the share of votes for the Green Party, the share of total area used for settlement and traffic, and the share of total area used for agriculture. State x Year fixed effects are included in column (2), (4), (6), and (8). We cluster standard errors at the postal code level. T-statistics are in parentheses. Detailed definitions of variable constructions and data sources are provided in the Appendix Table 1. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 5: Effects of supply constraints in real estate markets: zoned vs. unzoned areas

	Zoned Areas		**Unzoned Areas**	
	Log Square Meter Price	Quantities	Log Square Meter Price	Quantities
	(1)	(2)	(3)	(4)
Biodiversity	0.216**	-17.328*	-0.027	-3.313
	(2.34)	(-1.93)	(-0.28)	(-0.72)
Observations	8188	8188	9527	9527
R^2	0.933	0.818	0.891	0.831
Housing__Controls	Yes	Yes	Yes	Yes
Region__Controls	Yes	Yes	Yes	Yes
Year__FE	Yes	Yes	Yes	Yes
PostalCode__FE	Yes	Yes	Yes	Yes
Cluster	Postal Code	Postal Code	Postal Code	Postal Code

This table extends Eq. 2 by estimating separate regressions for postal codes that were ever zoned versus never zoned during 2007–2021. Zoned postal codes are those that, in any year of our sample, experienced an increase in green-infrastructure and conservation zoning; Unzoned postal codes never did. Columns (1) and (2) restrict the sample to zoned postal codes; columns (3) and (4) to unzoned postal codes. Within each group, the dependent variable is log price per square meter in columns (1), (3), and quantities in columns (2), (4). We use the Normalized Difference Vegetation Index (NDVI) to approximate biodiversity on the postal code level. We construct monthly quantities at the postal code level from listings by first building "spells" for each listing. A new spell starts when the gap to the previous observation (of the same listing) exceeds 3 months or when observable attributes change discontinuously (postal code, listing type, >20% jump in square meters, or >1-room change). The variable *Quantities* is the 12-month average of monthly stock in a postal-code-year; it equals total listing-months in that year divided by 12. All specifications include median listing controls per postal code, regional controls, year fixed effects, and postal code fixed effects. Listing controls are the median of the house age, number of rooms, and number of bedrooms per postal code. Regional controls are GDP growth, the unemployment rate, business registrations, insolvencies, population size, the share of votes for the Green Party, the share of total area used for settlement and traffic, and the share of total area used for agriculture. We cluster standard errors at the postal code level. T-statistics are in parentheses. Detailed definitions of variable constructions and data sources are provided in the Appendix Table 1. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

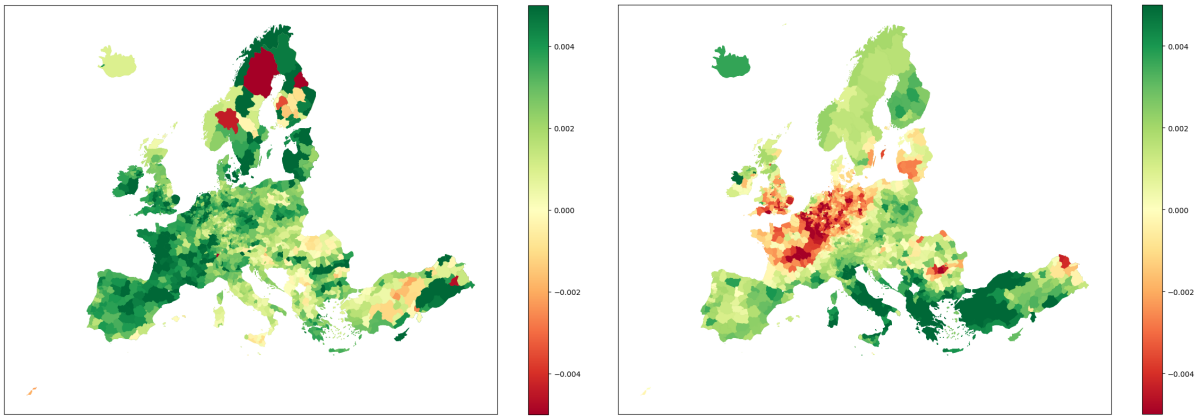
Table 6: Baden-Württemberg: Biodiversity and Zoning Intensity.

	Baden-Württemberg						**Non Cities Baden-Württemberg**					
	Log Square Meter Price		Quantities		Stickiness		Log Square Meter Price		Quantities		Stickiness	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Biodiversity	0.095	0.087	-9.690**	-10.871**	0.211**	0.208**	0.119*	0.112	-11.770**	-12.692***	0.218**	0.216**
	(1.39)	(1.28)	(-2.04)	(-2.29)	(2.06)	(2.04)	(1.73)	(1.63)	(-2.47)	(-2.66)	(2.06)	(2.04)
Zoning		0.015***		2.464***		0.005		0.016***		2.276***		0.004
		(2.73)		(5.30)		(0.66)		(2.87)		(4.80)		(0.56)
Observations	17715	17715	17715	17715	17715	17715	17205	17205	17205	17205	17205	17205
R^2	0.915	0.915	0.822	0.822	0.211	0.211	0.909	0.909	0.823	0.823	0.211	0.211
Housing_Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region_Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year_FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PostalCode_FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code

This table augments Eq. 2 by adding a measure of zoning intensity. For a postal-code-year, Zoning is non-zero only when green-infrastructure and conservation zoning expands; it equals the additionally zoned area divided by the total area of the postal code. Columns (1)–(6) use all postal codes in Baden-Württemberg; columns (7)–(12) exclude city postal codes (i.e., the non-city subsample; in Baden-Württemberg this primarily removes Stuttgart). Within each group, the dependent variable is log price per square meter in columns (1), (2), (7), (8), quantities in columns (3), (4), (9), (10), and stickiness in (5), (6), (11), (12). Biodiversity is our proxy for biodiversity, the Normalized Difference Vegetation Index (NDVI) on the postal code level. We construct monthly quantities at the postal code level from listings by first building "spells" for each listing, i.e., a new spell starts when the gap to the previous observation (of the same listing) exceeds 3 months or when observable attributes change discontinuously (postal code, listing type, >20% jump in square meters, or >1-room change). The variable Quantities is the 12-month average of monthly stock in a postal-code-year; it equals total listing-months in that year divided by 12. The variable Stickiness measures the average duration of listings in a postal-code-year. Monthly stock duration is computed following a standard flow-stock identity: for each month, we keep track of entry and exit events of spells, which allows us to compute for the set of active listings the average elapsed duration since entry. All specifications include median listing controls per postal code, regional controls, year fixed effects, and postal code fixed effects. Listing controls are the median of the house age, number of rooms, and number of bedrooms per postal code. Regional controls are GDP growth, the unemployment rate, business registrations, insolvencies, population size, the share of votes for the Green Party, the share of total area used for settlement and traffic, and the share of total area used for agriculture. We cluster standard errors at the postal code level. T-statistics are in parentheses. Detailed definitions of variable constructions and data sources are provided in the Appendix Table 1. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Appendix

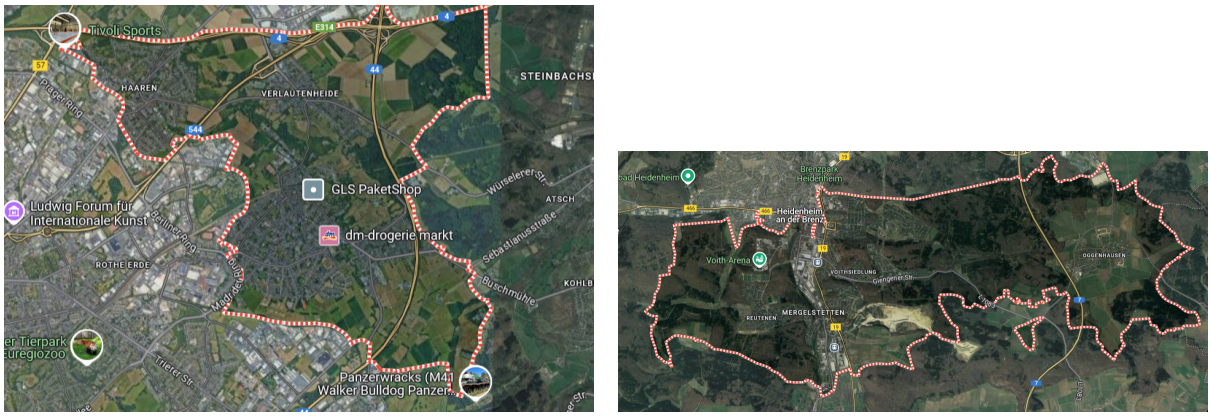
Appendix Figure 1: NDVI change between 2007 and 2021 for Europe's NUTS3 regions.



March August

The maps show estimated trends in vegetation greenness (NDVI) between 2007 and 2021 at the NUTS3 level. For each NUTS3 region and month (March on the left, August on the right), we regress the NDVI observations from 2007 onward on a linear time trend and plot the estimated slope coefficient. Positive (negative) values indicate increasing (declining) NDVI over time.

Appendix Figure 2: Examples of NDVI differences between the 25th and 75th percentiles.



p25 p75

This figure shows example postal codes at the 25th (left panel) and 75th (right panel) percentiles of the NDVI distribution. The red borders delineate the respective postal code boundaries; greener areas correspond to higher NDVI values. Source: Google Maps.

Appendix Figure 3: Illustration donut postal codes.



This figure highlights the postal codes within a 25-km radius of the ten largest cities in Germany. Colors indicate the nearest assigned city. These "donut" postal codes constitute the suburban sample used in Table 4.

Appendix Table 1: Variable definitions

Variable	Definition	Unit	Mean	SD	Source
$\text{Biodiversity}_{i,t}$	Proxy for biodiversity, namely the Normalized Difference Vegetation Index (NDVI) for postal code i and year t, averaged over the postal code's area.	Index $\in [-1, 1]$	0.62	0.09	Satellite imagery (MODIS: MOD13A1 version 6).
$\text{Price per sqm}_{i,t}$	average listing price per square meter in postal code i, year y for all properties (houses and apartments) on sale.	Euro	1,896.70	1,130.47	RWI-GEO-RED
$\text{Log price per sqm}_{i,t}$	Natural logarithm of average listing price per square meter in postal code i, year y for all properties (houses and apartments) on sale.	$\ln(\text{EUR/m}^2)$	7.41	0.52	RWI-GEO-RED
$\text{Quantities}_{i,t}$	12-month average stock of active listings (spells) in postal code i and year y: $Quantities_{i,t} = \frac{1}{12}\sum_{m=1}^{12} Stock_{i,m}$, where $Stock_{i,m}$ is the number of active listing spells in month m (i.e., total listing-months in i during t divided by 12).	Listings	15.66	20.76	Own computation based on RWI-GEO-RED
$\text{Stickiness}_{i,t}$	Average time on market (months) for active listings in postal code i and year t: each month m, compute the mean months since spell start across active spells, then average these 12 monthly means over the year.	Months	1.26	0.21	
$\text{MedianAge}_{i,t}$	Median house age of listings in postal code i, year t.	Years	33.91	29.03	RWI-GEO-RED
$\text{Rooms}_{i,t}$	Median number of rooms of listings in postal code i, year t.	Count	4.73	1.31	RWI-GEO-RED
$\text{Bedrooms}_{i,t}$	Median number of bedrooms of listings in postal code i, year t.	Count	2.95	0.89	RWI-GEO-RED
$\text{GDP Growth}_{r,t}$	Year-over-year GDP growth for region r in year t. Regions are the administrative district level (Kreise und Kreisfreie Städte)	% (e.g., 1 = 1%)	2.98	3.94	VGRdL (Regionalatlas)
$\text{Unemployment}_{r,t}$	Registered unemployment rate in region r (Kreise/kreisfreie Städte) in year t.	% (e.g., 1 = 1%)	5.70	2.90	Bundesagentur für Arbeit, via Regionalatlas Deutschland.
$\text{Business Registration}_{r,t}$	Annual business registrations (Gewerbeanmeldungen) per 10 000 inhabitants in region r (Kreise/kreisfreie Städte) and year t.	Count per 10 000 inhabitants	82.15	21.77	Gewerbeanzeigenstatistik (Destatis/Länder), via Regionalatlas
$\text{Insolvencies}_{r,t}$	Applications for corporate insolvency (beantragte Unternehmensinsolvenzen) per 10 000 taxable enterprises (steuerpflichtige Unternehmen) in region r (Kreise/kreisfreie Städte) and year t	Count per 10 000 taxable enterprises	66.06	37.56	Insolvenzstatistik (Destatis), via Regionalatlas Deutschland

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(continued)

Variable	Definition	Unit	Mean	SD	Source
$\text{Population}_{r,t}$	Residents per square kilometer in region r (Kreise/kreisfreie Städte) in year t.	Inhabitants per km^2	596.46	925.38	Bevölkerungsfortschreibung (Destatis/Länder), via Regionalatlas Deutschland.
$\text{Green Votes}_{r,t}$	Share of valid second votes (Zweitstimmen) for Bündnis 90/Die Grünen in region r (Kreise/kreisfreie Städte) in year t. For non-election years t, we carry forward the most recent result.	% (e.g., 1 = 1%)	9.08	3.92	Die Bundeswahlleiterin, via Regionalatlas Deutschland
$\text{Settlement Traffic}_{r,t}$	Share of total land area in region r classified as settlement and transport (*Siedlungs- und Verkehrsfläche*) in year t.	Share of region area	0.0024	0.002	Land-use statistics (ALB/ALKIS), via Regionalatlas Deutschland
$\text{Agriculture}_{r,t}$	Share of total land area in region r classified as agriculture in year t.	Share of region area	0.0025	0.0009	Land-use statistics (ALB/ALKIS), via Regionalatlas Deutschland
Zoned_i	Indicator for postal codes i that ever experienced an increase in green-infrastructure or conservation zoning between 2007 and 2021.	Indicator	0.46	0.50	Geoportal Raumordnung Baden-Württemberg
$\text{Zoning}_{i,t}$	Zoning-intensity measure. It equals the increase in zoned area relative to the total postal code area in the year of the increase, and zero otherwise.	Share of postal code area	0.02	0.16	Geoportal Raumordnung Baden-Württemberg

This table summarizes the variables used in the analysis. For each variable we report its unit, mean, standard deviation, and data source. Means and standard deviations are calculated over the full German panel from 2007 to 2021, except for the zoning variables, for which we only consider the Baden–Württemberg postal codes. GDP Growth is taken from the Arbeitskreis "Volkswirtschaftliche Gesamtrechnungen der Länder" (VGRdL), via *Regionalatlas Deutschland* (Statistische Ämter des Bundes und der Länder). For *Settlement Traffic* and *Agriculture*, ALB-based series are used up to the ALKIS switchover; from 2015/2016 onward, ALKIS-based series are used.

Appendix Table 2: Real estate responses in urban and rural areas: cities are the top 10% of postal codes by population

	Non Cities				**Cities**			
	Log Square Meter Price		Quantities		Log Square Meter Price		Quantities	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Biodiversity	0.214***	0.204***	-3.523**	-12.638***	-0.091	-0.151*	-25.543**	-50.261***
	(6.52)	(5.49)	(-2.16)	(-7.05)	(-1.12)	(-1.72)	(-2.04)	(-2.73)
Observations	105637	105637	105637	105637	11966	11952	11966	11952
R^2	0.903	0.907	0.816	0.831	0.954	0.961	0.589	0.615
Housing__Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region__Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year__FE	Yes	Implied	Yes	Implied	Yes	Implied	Yes	Implied
State__FExYear__FE	No	Yes	No	Yes	No	Yes	No	Yes
PostalCode__FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code

This table replicates the results of Table 4, but using an alternative definition of cities. Here, we define cities as the 10% largest postal codes, as measured by postal code population. Columns (1)–(4) restrict the sample to non-city postal codes; columns (5)–(8) to city postal codes. Within each group, the dependent variable is log price per square meter in columns (1), (2), (5), and (6), and quantities in columns (3), (4), (7), and (8). We use the Normalized Difference Vegetation Index (NDVI) to approximate biodiversity on the postal code level. We construct monthly quantities at the postal code level from listings by first building "spells" for each listing. A new spell starts when the gap to the previous observation of the same listing exceeds three months or when observable attributes change discontinuously (postal code, listing type, >20% jump in square meters, or >1-room change). The variable *Quantities* is the 12-month average of monthly stock in a postal-code-year; it equals total listing-months in that year divided by 12. All specifications include median listing controls per postal code, regional controls, year fixed effects, and postal code fixed effects. Listing controls are the median of the house age, number of rooms, and number of bedrooms per postal code. Regional controls are GDP growth, the unemployment rate, business registrations, insolvencies, population size, the share of votes for the Green Party, the share of total area used for settlement and traffic, and the share of total area used for agriculture. State x Year fixed effects are included in column (2), (4), (6), and (8). We cluster standard errors at the postal code level. T-statistics are in parentheses. Detailed definitions of variable constructions and data sources are provided in the Appendix Table 1. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Appendix Table 3: Real estate responses in urban and rural areas: cities are the top 15% of postal codes by population

	Non Cities				**Cities**			
	Log Square Meter Price		Quantities		Log Square Meter Price		Quantities	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Biodiversity	0.193***	0.190***	-1.729	-11.341***	-0.033	-0.079	-23.759**	-42.921***
	(5.61)	(4.82)	(-1.05)	(-6.32)	(-0.52)	(-1.15)	(-2.57)	(-3.22)
Observations	99620	99620	99620	99620	17983	17983	17983	17983
R^2	0.899	0.903	0.821	0.835	0.954	0.961	0.606	0.632
Housing__Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region__Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year__FE	Yes	Implied	Yes	Implied	Yes	Implied	Yes	Implied
State__FExYear__FE	No	Yes	No	Yes	No	Yes	No	Yes
PostalCode__FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code	Postal Code

This table replicates the results of Table 4, but using an alternative definition of cities. Here, we define cities as the 15% largest postal codes, as measured by postal code population. Columns (1)–(4) restrict the sample to non-city postal codes; columns (5)–(8) to city postal codes. Within each group, the dependent variable is log price per square meter in columns (1), (2), (5), and (6), and quantities in columns (3), (4), (7), and (8). We use the Normalized Difference Vegetation Index (NDVI) to approximate biodiversity on the postal code level. We construct monthly quantities at the postal code level from listings by first building "spells" for each listing. A new spell starts when the gap to the previous observation of the same listing exceeds three months or when observable attributes change discontinuously (postal code, listing type, >20% jump in square meters, or >1-room change). The variable *Quantities* is the 12-month average of monthly stock in a postal-code-year; it equals total listing-months in that year divided by 12. All specifications include median listing controls per postal code, regional controls, year fixed effects, and postal code fixed effects. Listing controls are the median of the house age, number of rooms, and number of bedrooms per postal code. Regional controls are GDP growth, the unemployment rate, business registrations, insolvencies, population size, the share of votes for the Green Party, the share of total area used for settlement and traffic, and the share of total area used for agriculture. State x Year fixed effects are included in column (2), (4), (6), and (8). We cluster standard errors at the postal code level. T-statistics are in parentheses. Detailed definitions of variable constructions and data sources are provided in the Appendix Table 1. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Appendix Table 4: Zooming into the suburbs

	Log square meter price (1)	Quantities (2)	Stickiness (3)
Biodiversity	0.292***	-26.744***	0.040
	(4.39)	(-3.41)	(0.53)
Observations	17486	17486	17486
R^2	0.956	0.822	0.291
Housing__Controls	Yes	Yes	Yes
Region__Controls	Yes	Yes	Yes
Year__FE	Implied	Implied	Implied
State__FExYear__FE	Yes	Yes	Yes
PostalCode__FE	Yes	Yes	Yes
Donut_FE	Yes	Yes	Yes
Cluster	Postal Code	Postal Code	Postal Code

This table reports the results from estimating Eq. 2 for postal codes located within a 25-km radius of the 10 largest cities in Germany over 2007–2021. The Normalized Difference Vegetation Index (NDVI) approximates biodiversity on the postal code level. We construct monthly quantities at the postal code level from listings by first building "spells" for each listing. A new spell starts when the gap to the previous observation of the same listing exceeds three months or when observable attributes change discontinuously (postal code, listing type, >20% jump in square meters, or >1-room change). The variable *Quantities* is the 12-month average of monthly stock in a postal-code-year; it equals total listing-months in that year divided by 12. The variable *Stickiness* measures the average duration of listings in a postal-code-year. We compute monthly stock duration by tracking entry and exit events of spells for each month. Thereby, we can compute for the set of active listings the average elapsed duration since entry. All specifications include median listing controls per postal code, regional controls, year fixed effects, and postal code fixed effects. Listing controls are the median of the house age, number of rooms, and number of bedrooms per postal code. Regional controls are GDP growth, the unemployment rate, business registrations, insolvencies, population size, the share of votes for the Green Party, the share of total area used for settlement and traffic, and the share of total area used for agriculture. State x Year fixed effects are included in column (2), (4), and (6). We also include Donut fixed effects, which capture city-specific suburban areas: for each of the ten cities, all postal codes within the 25-km radius are assigned to that city's suburban (donut) category. We cluster standard errors at the postal code level. T-statistics are in parentheses. Detailed definitions of variable constructions and data sources are provided in the Appendix Table 1. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

A Appendix on institutional details

In Germany, spatial planning is a multilevel system that includes federal, state, and regional authorities. The federal level sets spatial planning principles through a legal framework, namely the Federal Spatial Planning Act (Raumordnungsgesetz, or ROG). For instance, § 2(2) ROG calls for concentrating settlement in existing places and protecting open-space through a large-scale, ecologically effective open space network. At the state level, each of Germany's sixteen states adopts a binding spatial planning framework that must align with the federal ROG. State spatial plans guide major land-use policies, such as settlement patterns, infrastructure, and conservation. They also prioritize certain land uses, designating areas for purposes such as nature preservation or wind energy development. Regional plans further refine state-level principles into detailed land-use allocations. These allocations include, for instance, industrial, residential, agricultural, and conservation zones (Danielzyk and Münter, 2018).

We use regional planning data from Baden-Württemberg on green infrastructure and conservation zoning. Specifically, we use data on green corridors, green breaks, and nature conservation and landscape management, which function as development-restricting designations intended to maintain open space, ecological connectivity, and landscape character. These designations serve distinct purposes: green breaks are intended to maintain undeveloped buffers between settlements while also preserving local climatic conditions and ecological exchange in these areas. Green corridors secure large, continuous open-space systems across municipalities to maintain soil, water, climate, species, and habitat functions, as well as agriculture, forestry, and nature-based recreation. Nature conservation and landscape management protect and develop areas of high importance for biodiversity, habitat networks, and landscape functions. These areas are designated in the respective regional planning regions, of which there are 96 in Germany and 12 in Baden-Württemberg. Regional plans are updated roughly every 10–15 years and are

developed in close coordination with municipalities (Danielzyk and Münter, 2018).

Developing a regional plan is an iterative process that usually takes several years. After the regional assembly issues a formal mandate to the planning administration, the administration drafts an initial plan and carries out a Strategic Environmental Assessment (SEA). The draft and SEA report are then published for a consultation period of six to eight weeks, during which public hearings are held and written submissions are invited. All feedback is recorded in a balancing resolution (Abwägungsbeschluss) and may lead to a revised draft and further consultation. Once finalized, the plan is adopted by the regional assembly and, after a short legal objection period, enters into force and binds all lower-level planning.

Once an area is designated in the regional plan, the decision is binding on municipal land-use planning, with restrictiveness determined by the specific designation. In our Baden-Württemberg setting, we observe three regional environmental designations, namely a green corridor, a green break, and nature conservation and landscape management. These are typically set as binding objectives of spatial planning and, therefore, constrain local development; limited, plan-text-specific exceptions may apply and require a formal deviation procedure.

Spatial planning zones for green infrastructure and conservation designations typically build upon protected areas (e.g., nature reserves, landscape protection areas, or Natura 2000 sites); however, they also extend to formerly unprotected farmland, forest stands, or regional green corridors that had no formal conservation status beforehand. Prior to designation, these lands were often intensively farmed, used for timber production, or left fallow without any specific protection under the Federal Nature Conservation Act (BNatSchG).

In Baden-Württemberg, the regional designations we use are adopted as binding objectives of spatial planning, typically mapped as priority areas, and therefore constrain

municipal land-use planning.Regional green corridors and green breaks are to be kept free of developement, with only narrowly defined, site-bound exceptions specified in the plan text.[19]Where an exception is sought, it requires a formal deviation from the planning objective under § 6 ROG.Any project permitted remains subject to the usual environmental procedures, namely Environmental Impact Assessment Act (UVPG) (e.g., §§ 6, 18) and the BNatSchG avoid–mitigate–compensate rules (§§ 13–15).

[19]E.g., the Verband Region Stuttgart specifies a general ban on construction for green breaks. The Regional Plan for the Southern Upper Rhine states that regional green corridors are to be kept free of settlement (PS 3.1.1).