RATIONALITY & COMPETITION
CRC TRR 190

The Economics of Architecture

Gabriel M. Ahlfeldt (HU Berlin)
Elisabetta Pietrostefani (University of Liverpool)
Ailin Zhang (London School of Economics and Political Sciences)

Discussion Paper No. 561

January 12, 2026

Collaborative Research Center Transregio 190 | www.rationality-and-competition.de
Ludwig-Maximilians-Universität München | Humboldt-Universität zu Berlin
Spokesperson: Prof. Dr. Klaus M. Schmidt, Ludwig Maximilian University of Munich, 80539 Munich, Germany
info@rationality-and-competition.de

The Economics of Architecture *

Gabriel M. Ahlfeldt Elisabetta Pietrostefani Ailin Zhang

January 12, 2026

Abstract

We illustrate the coordination problem in the provision of distinctive architectural design that arises from design externalities within a quantitative model. To quantify the model, we conduct a quantitative review of a growing literature concerned with the costs and benefits of distinctive design as well as a survey of architectural design preferences. We find that distinctive buildings sell at a 15% premium, on average. Positive design spillovers from distinctive nearby buildings result in a 9% premium. Distinctive buildings, however, are about 25% more expensive to build. The distribution of design ratings within buildings is well described by a Fréchet distribution with a shape parameter of about 4. Parametrising the model to match these moments, we show in counterfactual simulations that the optimal subsidy of distinctive buildings amounts to 10% of construction costs.

Key words: Architecture, design, economics, regulation, welfare

JEL: R3, N9

*Ahlfeldt: Humboldt University, Berlin School of Economics (BSoE), London School of Economics and Political Sciences (LSE) and CEPR, CESifo, CEP; g.ahlfeldt@lse.ac.uk; Pietrostefani: University of Liverpool; Zhang: London School of Economics and Political Sciences (LSE). The usual disclaimer applies. We thank the Swiss Federal Office of Culture and in particular Brigitte Müller for financial support of and useful comments on a related project. Ahlfeldt gratefully acknowledges the support of the Deutsche Forschungsgemeinschaft (CRC TRR 190–project #280092119). We thank, in particular, Will Strange for bringing the super developer policy to our attention.

1 Introduction

Distinctive architectural design is an important component of housing quality. Residents living in distinctive buildings may derive value from the aesthetic quality of the building they inhabit. To access this consumption value, they pay an implicit hedonic price, just like for any other desirable building attribute, such as a larger floor area or greater energy efficiency. Likewise, residents of nearby buildings may derive utility from consuming the distinctive architectural design even if they never enter it. They, too, will pay an implicit hedonic price for the external design value, just like for any other desirable location attribute, such as a nearby park or a good public school. The difference is that the former pay the implicit price to the owner of the building they inhabit, whereas the latter pay the price to owners of other buildings. This creates a coordination problem because the returns to distinctive architectural design are shared, whereas the costs are not.

The nature of this coordination problem is intuitive and well recognised in economics and planning.[1] What the literature lacks is a synthesis of the state of knowledge on the economics of architecture that could provide guidance on how to address it. To fill this gap, we combine meta-analyses, original empirical research, and quantitative modelling techniques. Specifically, we develop a simple model and calibrate it to match key moments, borrowing from the empirical literature where the evidence base is strong and using original empirical analyses where it is thin. We then use the quantified model to evaluate the prospects of policies that seek to address the coordination problem, focusing on those that feature prominently in the related literature. The key result is that design spillovers are large enough, relative to the cost of distinctive design, to justify policies that promote distinctive design. However, not all policies are equally suited to achieve this goal efficiently. The welfare case is strongest for a Pigovian subsidy to developers who adopt a distinctive design. Under the chosen parameterisation, the welfare-maximising subsidy amounts to 10% of the construction cost (50% of the extra cost associated with distinctive design). Unless used excessively, districts with mandatory distinctive design can also increase welfare. In contrast, encouraging distinctive design by means of floor area ratio (FAR) bonuses is only welfare-enhancing if the basis of comparison is an already supply-constrained city. Taking into account the cost of binding FAR limits, which are a necessary condition for the policy to work, the net welfare effect is marginal at best and negative most of the time. Finally, delegating the development of an entire neighbourhood to a super-developer may improve welfare if the developer correctly anticipates spillover effects. Otherwise, rent-seeking behaviour may reduce the supply of distinctive designs and lead to efficiency losses.

Our first contribution is to develop a quantitative model of a neighbourhood in which workers with heterogeneous tastes for architectural design choose whether to live in architecturally distinctive or ordinary buildings, landlords choose whether to build distinctive

[1] For an economic perspective in the context of building maintenance, see Rossi-Hansberg et al. (2010). For a planning perspective in the context of preservation, see Holman and Ahlfeldt (2015).

or ordinary buildings, and the amenity value of a location is subject to a design spillover that depends on the local density of distinctive buildings. We consider a neighbourhood consisting of a finite set of parcels, each owned and developed by one developer. The neighbourhood is embedded in a wider economy that can be thought of as the rest of the city. Following the discrete choice literature in the tradition of McFadden (1974), residents have idiosyncratic tastes for living in a distinctive building in the neighbourhood, in an ordinary building in the neighbourhood, or in the rest of the city, but they are perfectly mobile within each of these submarkets. In this way, we generate downward-sloping demand for distinctive design. This is an important feature of the model, which implies that the benefits of policies promoting distinctive design are concave in the supply of distinctive buildings.

In our model, we essentially zoom into a neighbourhood that would be one of many locations in a canonical quantitative urban model (Ahlfeldt et al., 2015; Redding, 2025). We take the wage net of commuting costs as given, since it is determined within the canonical urban model but outside the neighbourhood model. There is, however, variation in amenity value across parcels within the neighbourhood, some of which is exogenous and some of which is endogenous, depending on the density of surrounding distinctive buildings and the associated housing externalities (Rossi-Hansberg et al., 2010). Because workers are perfectly mobile within submarkets, differences in amenity values across parcels map into differences in rents, as in a conventional spatial equilibrium model (Brueckner, 1987). Profit-maximising developers decide how tall to build, following Ahlfeldt and Barr (2022), and, in addition, whether to invest in distinctive design. In doing so, they face the cost of distinctive design. They take into account the effect of their decision to invest in architecture on the rental revenues they receive from their tenants, but they ignore the effect on other developers' revenues that originate from the design spillover. This creates a coordination problem, because non-investment in distinctive design can be individually rational even if the returns to collective investment in distinctive design would exceed the cost.

Our second contribution is to quantitatively review the literature on capitalisation effects of distinctive design in real estate prices. To guide the parametrisation of our model, we are interested in the effect of distinctive design on the market value of a distinctive building—the internal effect—as well as the effect on nearby buildings—the external effect. Following early pioneering work (Hough and Kratz, 1983; Vandell and Lane, 1989), the literature has recently rediscovered the topic, bringing methods of causal inference (Ahlfeldt and Holman, 2018; Füss et al., 2025) and machine learning (Lindenthal and Johnson, 2021) to the analysis.[2] We find 68 estimates from 41 studies of the internal design effect. The typical approach to measuring the distinctiveness of design in this literature is to rely on architectural awards (prizes won by buildings or architects) and certifications (e.g. preservation policies), ratings (by experts or local residents), or design features that ap-

[2]Fuerst et al. (2011) is a recent example of a more traditional hedonic analysis.

pear favourable (e.g. specific style). Weighting studies by their publication-date-adjusted citation count and restricting the sample to studies that compare distinctive buildings to ordinary buildings from the same era, we conclude that the internal effect is about 15%, for residential and commercial buildings. While the evidence base on the external design effect is somewhat thinner—consisting of 33 estimates drawn from 28 studies—the results reported in the literature are fairly consistent. The literature examines design spillovers arising from a variety of settings, including iconic stadia and ensembles of smaller, distinctive residential buildings that collectively create a distinctive neighbourhood character. On average, the estimated external effect is about 9%. This estimate is relatively insensitive to how we weigh studies, depending on their impact or method used.

Our third contribution is to provide novel evidence regarding the dispersion of tastes for architectural design. Such taste heterogeneity is important from a welfare perspective because it determines by how much the valuation of the marginal buyer (and consequently the price effect) declines as distinctive architectural design becomes more abundant. To investigate this, we run an internet survey in which we invite participants to score the design quality of selected buildings on a scale from 0 to 100. Distinctive buildings—as rated by an internationally leading architect—exhibit higher average scores, but our primary interest lies in the dispersion of ratings. The within-building standard deviation in the design score across respondents is 21.93, implying a coefficient of variation of 0.42, which indicates substantial heterogeneity in tastes. Fitting a Fréchet distribution delivers a shape parameter of about 4, which is within the range of extant estimates of similar parameters that govern the choice of different neighbourhoods within cities (see e.g. Ahlfeldt et al., 2015; Monte et al., 2018). Thus, preferences for architectural styles are about as diverse as preferences for residential locations.

Our fourth contribution is to use the quantified model to evaluate policies that seek to address the coordination problem in the provision of distinctive design. To this end, we quantify the model so as to match the internal and external design premiums uncovered from the quantitative literature reviews, and the dispersion in design preferences measured via the survey. Under the chosen parameterisation, the model-implied cost of distinctive design corresponds to about 25% of total construction cost, in line with empirical evidence (Vandell and Lane, 1989). We then solve the model for an equilibrium that delivers the spatial distribution of distinctive buildings, the design spillover, rents, heights, floor space consumption, population densities, and developer profits. In addition, we solve for the endogenous expected utility in the city. Re-solving the model under a specific policy delivers the comparative statics from which we infer the policy effect on all endogenous outcomes. The welfare effect is computed as the sum of the monetised change in expected utility and the change in aggregate developer profits, net of any subsidies, which we assume are financed through non-distortionary lump-sum taxes on developers.

Indeed, the most straightforward response to a positive non-pecuniary externality such as a distinctive-design spillover is a Pigovian subsidy. In a series of model simulations, we find that welfare is maximised with a subsidy equal to around 10% of total construction costs for distinctive buildings—roughly one third to one half of the additional cost of distinctive design. Even if developers alone bore the cost of that tax, their net profits would fall by no more than 12%, because they benefit from higher rents due to larger design spillovers. Higher subsidy rates yield negative marginal benefits, since the marginal willingness to pay for living in buildings of distinctive design falls as the supply of such buildings expands. Such subsidies, most commonly in the form of tax-deductible investments in distinctive design, are common in the context of historic preservation but are typically not applied to new developments.

In practice, a more popular policy is to award floor area ratio (FAR) bonuses to distinctive buildings. As an example, Cheshire and Dericks (2020) show that in London, a generally relatively flat city, buildings designed by award-winning architects are on average 17 floors taller. Of course, the ability of a planner to use FAR bonuses to steer developers into adopting distinctive design requires that ordinary buildings face a binding height constraint, and it is well understood that such constraints can have large welfare costs (Gyourko and Molloy, 2015).[3] It is therefore unsurprising that, in our model, relaxing height constraints on distinctive buildings in a supply-constrained city increases welfare, although the primary driver is the resulting expansion in housing supply rather than the design spillover itself. Introducing FAR constraints on ordinary buildings in order to incentivise the adoption of distinctive design, however, is a more delicate matter. Our simulations suggest that there is potential for very small welfare gains via FAR bonuses for distinctive buildings if the height constraint on ordinary buildings is just about binding—a level that will be difficult to set in practice. Once the policy becomes even slightly too restrictive, the supply-driven increase in rents causes large welfare losses that more than offset increasing developer profits, making the policy inefficient and inequitable.

Another popular policy is to designate districts in which planners can enforce distinctive design, such as conservation areas (Ahlfeldt et al., 2017; Koster and Rouwendal, 2017). Our model-based simulations reveal that a small distinctive district covering 4% of the neighbourhood and increasing the number of distinctive buildings by 4.3% can raise both expected worker utility *and* developer profits. While there is some redistribution of profits from developers inside the distinctive district with mandatory design requirements to those outside the district, the effect is small, as developers within the district benefit from higher rents due to concentrated design spillovers. If, however, the distinctive district becomes too large, the welfare effect turns negative because demand for living in distinctive buildings is downward-sloping, and distinctive design at other suitable locations is crowded out. An efficient alternative to creating a district with mandatory distinctive design is to subsidise distinctive design within a district.

Finally, a policy that is not widely implemented but features prominently in planning discourse is the development of larger areas by single developers rather than fragmented development by many small ones. The underlying idea is intuitive: a super-developer con-

[3]Relevant papers include Glaeser et al. (2005); Brueckner and Sridhar (2012); Turner et al. (2014); Ahlfeldt and Barr (2022).

trolling a large area internalises spillovers between distinctive buildings and thereby helps solve the coordination problem. Indeed, the idea that large developers can partly correct for market inefficiencies such as resource misallocation or public-good underprovision when spillovers are localised has been popular in urban economics (Henderson, 1974; Helsley and Strange, 1994, 1997). Our simulations substantiate this intuition in the context of design externalities, but they also reveal a countervailing force that receives far less attention in the debate. Heterogeneous preferences for design create an incentive for rent seeking, as the super-developer can raise markups on distinctive buildings by restricting their supply. Although, under our parameterisation, the efficiency gains from internalization outweigh these rent-seeking incentives, efficiency could easily fall if the super-developer is more attuned to scarcity premia than to design spillovers, rendering the welfare implications of such policies uncertain in practice.

The remainder of the paper is organised as follows. Section 2 introduces the model. Section 3 discusses our empirical analyses and how they guide the parametrisation of the model. Section 4 presents our counterfactual analysis of various planning policies. Section 5 concludes.

2 Model

In this section, we develop a simple quantitative model that describes the demand and supply of distinctive architectural design. The model captures the coordination problem in the provision of distinctive design and lends itself to the counterfactual analysis of policy that seeks to address the coordination problem within a realistic geography. To achieve this goal, we need to generate downward-sloping demand for distinctive buildings as well as spatial spillovers. To this end, we draw from a growing literature on quantitative urban models (Redding, 2025). However, we focus on a finer geographic scale than most of the literature by zooming into a small neighbourhood and distinguishing between different submarkets for distinctive and ordinary buildings. We therefore take the wage net of commuting cost as given, assuming that it is determined within an urban model that connects neighbourhoods (Ahlfeldt et al., 2015).

Geography. We consider a neighbourhood that consists of J parcels, indexed by i, and is embedded in a wider economy of a city. Each parcel is endowed with a developable area $\bar{K}_i$ and is owned by one developer who can develop one building.

Submarkets. We distinguish between submarkets of the housing market, which we indicate by d. The full set of submarkets is $\mathbf{C} = \{distinctive, ordinary, outside\}$: architecturally distinctive buildings within the neighbourhood, ordinary buildings within the neighbourhood, or the outside option. To ease notation, we also define a subset of submarkets within the neighbourhood as $\mathbf{D} = \mathbf{C} \backslash \{outside\}$.

Workers. There are $\bar{N}$ workers in the city. Each worker v can choose to reside in a submarket $d \in \mathbf{C}$. Worker utility is described by:

$$U(v) = \tilde{U}^d a^d(v), \tag{1}$$

where $\tilde{U}^d$ is a submarket component, and $a^d(v)$ is an idiosyncratic component drawn from a Fréchet distribution governed by the submarket-specific scale parameter A^d and the shape parameter ε. Hence, the cumulative density function takes the form:

$$F^d(a(v)) = \exp\left(-\frac{a(v)}{A^d}\right)^{-\varepsilon} \tag{2}$$

Except for their tastes for submarkets, workers are homogeneous and perfectly mobile. They earn a wage $\bar{w}$, of which they spend a fraction $1-\alpha$ on housing. Within the neighbourhood, workers receive a Cobb-Douglas utility that depends on the local amenity B_i, the consumption of non-housing goods g, and housing f:

$$\tilde{U}^d = B_i \left(\frac{g}{\alpha}\right)^{\alpha} \left(\frac{f_i^d}{1-\alpha}\right)^{(1-\alpha)} \quad \forall \quad d \in \mathbf{D} \tag{3}$$

Utility maximisation delivers housing demand

$$f_i^d = (1-\alpha)\frac{\overline{w}}{Q_i^d} \quad \forall \quad d \in \mathbf{D}, \tag{4}$$

where Q_i^d is the unit price of housing. Outside the neighbourhood, the submarket utility is anchored to a fixed reservation utility, $\tilde{U}^{d=outside} = \overline{U}$. Following the discrete choice literature in the tradition of McFadden (1974),[4] we obtain the standard result that the share of workers allocated to a submarket,

$$\mu^d = \frac{\left(\tilde{V}^d\right)^{\varepsilon}}{\left(\sum_{u \in \mathbf{C}} (\tilde{V}^u)^{\varepsilon}\right)}, \tag{5}$$

is a function of the submarket indirect neighbourhood utility defined as

$$\tilde{V}^d = A^d B_i^d \frac{\overline{w}}{\left(Q_i^d\right)^{1-\alpha}} \quad \forall \quad d \in \mathbf{D} \tag{6}$$

and $\tilde{V}^{d=outside} = A^d \overline{U} \equiv \overline{V}$. Notice that given perfect mobility within submarkets, within-submarket differences in house prices exactly offset differences in amenity levels across space. This location amenity, B_i^d depends on an exogenous component, b_i^d, and spillovers

[4] See Supplement Section I.1.1 for a formal derivation.

from other distinctive buildings, D_i, as follows:

$$B_i^d = b_i^d \times \exp[\beta(D_i)], \tag{7}$$

where $\beta \geqslant 0$ governs the external design value. We parameterise the design spillover using the market potential that is conventional in the literature on housing externalities (Ahlfeldt and Maennig, 2010; Rossi-Hansberg et al., 2010):

$$D_i = \frac{\sum_{z \in J \setminus i} \omega_{iz} \mathbb{1}\left(\tilde{d}_z = \textit{distinctive}\right)}{\max_{z \in J}\left(\sum_{z \in J \setminus i} \omega_{iz}\right)}, \tag{8}$$

where $\tilde{d}_z \in \mathbf{D}$ is a variable defining the building design at nearby parcel z and

$$\omega_{iz} = \left(\bar{K}_z\, h_z\right) \exp\left(-\tau \mathcal{D}_{iz}\right) \tag{9}$$

is a spatial weight that depends on the developed area of parcel z, $\bar{K}_z$, the height of the building at parcel z, h_z, the bilateral distance between parcels i and z, $\mathcal{D}_{iz}$, and the decay parameter $\tau > 0$. Intuitively, D_i takes a large value if there are many distinctive buildings of great volume nearby. The normalisation in the denominator of Eq. (8) by the maximum achievable market potential across all parcels ensures that $D_i \in [0, 1]$, which proves useful for model calibration. Using Eq. (8) in Eq. (6), we obtain the housing bid rent

$$Q_i^d = \left(A^d B_i^d \frac{\bar{w}}{\tilde{V}^d}\right)^{\frac{1}{1-\alpha}} \quad \forall \quad d \in \mathbf{D}. \tag{10}$$

Developers. Each developer owns one parcel of land. Developers choose a submarket $d \in \mathbf{D}$ in which to supply floor space and a building height h_i, taking prices Q_i^d as given. Following Ahlfeldt and McMillen (2018), we assume that unit costs increase in height with elasticity $\theta > 0$. Moreover, we allow costs to depend on the building's design and a subsidy rate controlled by the planner, resulting in the following cost function:

$$c_i^d = \bar{C}\, h_i^\theta \exp\left(\delta_i^d - t_i^d\right) \quad \forall\, d \in \mathbf{D} \tag{11}$$

where $\bar{C}$ is the baseline annualised unit construction cost, δ_i^d is a developer-design-specific cost shifter, and t_i^d is a subsidy rate that lowers construction cost and can vary by design and location. This results in the following profit function:

$$\pi_i^d = \left[Q_i^d h_i^d - \bar{C} \times (h_i^d)^{1+\theta} \times \exp\left(\delta_i^d - t_i^d\right)\right] \times \bar{K}_i \quad \forall \quad d \in \mathbf{D} \tag{12}$$

The first-order condition delivers the design-specific profit-maximising height:

$$h_i^{d*} = \left(\frac{Q_i^d}{(1+\theta)\bar{C} \times \exp\left(\delta_i^d - t_i^d\right)} \right)^{\frac{1}{\theta}} \quad \forall \quad d \in \mathbf{D} \tag{13}$$

As in Ahlfeldt and Barr (2022), we subject the height decision to a height limit set by a planner, $\bar{h}_i^d$ that may or may not be binding, so that the feasible design-specific height is

$$\tilde{h}_i^d = \min(h_i^{d*}, \bar{h}_i^d) \tag{14}$$

Since the planner may enforce distinctive design through land-use regulation, the decision rule for design becomes:

$$\tilde{d}_i = \begin{cases} \text{distinctive if } G_i = \textit{distinctive} \\ \arg\max_{d \in \mathbf{D}} \pi_i^d \left(h_i^d = \tilde{h}_i^d \right) \text{ if } G_i = \textit{unregulated}, \end{cases} \tag{15}$$

where G_i denotes the planning restriction. Intuitively, developers choose the design that maximises profits unless restricted by the planner. Conditional on the chosen design, the stock of a given design supplied at any parcel is given by

$$H_i^d = \tilde{h}_i^d \times \mathbb{1}(\tilde{d}_i = d) \times \bar{K}_i \quad \forall \quad d \in \mathbf{D}, \tag{16}$$

where $h_i \equiv \tilde{h}_i^d \times \mathbb{1}(\tilde{d}_i = d)$ is the realised building height.

Welfare. Aggregate welfare consists two components, the expected utility to all workers,

$$\mathbb{E}[U]\bar{N} = \Gamma\left(\frac{\varepsilon - 1}{\varepsilon}\right) \times \left(\sum_{u \in \mathbf{C}} (\tilde{V}^u)^{\varepsilon}\right)^{\frac{1}{\varepsilon}} \times \bar{N}, \tag{17}$$

and developer profits

$$\Pi = \sum_{i \in J} \sum_{d \in \mathbf{D}} \pi_i^d \mathbb{1}(\tilde{d}_i = d) + \bar{\pi}^{d=outside}, \tag{18}$$

where $\mathbb{E}$ is the expectations operator (taken over the distribution of the idiosyncratic utility component), $\Gamma(\cdot)$ denotes the Gamma function, and $\bar{\pi}^{d=\text{outside}}$ denotes developer profits outside the neighbourhood. To compute the change in welfare from a baseline scenario (superscript 0) to a policy counterfactual (superscript 1), we use that utility scales proportionately with income. Abstracting from impacts on developer profits outside the neighbourhood, we compute welfare changes as

$$\Delta W = \frac{\mathbb{E}[U]^1 - \mathbb{E}[U]^0}{\mathbb{E}[U]^0} \bar{w}\bar{N} + \Delta\Pi.$$

To evaluate the benefit-cost case of a subsidy of distinctive design, we also compute total subsidy amount as (see Appendix Section A.1 for details):

$$S = \sum_{d \in \mathbf{D}} \sum_{i \in J} \mathbb{1}(\tilde{d}_i = d) \bar{C} (h_i^d)^{(1+\theta)} \bar{K}_i \left(\exp\left(\delta_i^d\right) - \exp\left(\delta_i^d - t_i^d\right) \right) \tag{19}$$

Equilibrium. The equilibrium can be referenced by $\mathbf{V} = \{\tilde{d}_i, Q_i^d, \tilde{V}^{distinctive}, \tilde{V}^{ordinary}\}$. For given values of $\mathbf{V}$ and the primitives of the model, which consist of the parameters $\{\alpha, \beta, \delta_i^d, \varepsilon, \tau, \theta, t_i^d, \bar{C}, \bar{V}, \bar{w}\}$, the endowments $\{\bar{N}, \bar{K}_i, \mathcal{D}_{iz}\}$ and the fundamentals $\{b_i^d, A^d, G_i\}$, we can solve for all other endogenous objects $\{\mu^d, c_i^d, \pi_i^d, \tilde{d}_i, \tilde{h}_i^d, f_i^d, B_i^d, D_i, H_i^d, N_i^d, Q_i^d, \mathbb{E}(U), \Pi, S\}$. We get submarket choice probabilites μ^d from Eq. (5); the design spillover D_i from Eq. (8); local amenity B_i^d from Eq. (7); floor space consumption f_i^d from Eq. (4); feasible height $\tilde{h}_i^d$ from Eqs. (13) and (14); housing supply H_i^d from Eq. (16); population N_i^d from Eq. (20); developer profits π_i^d from Eq. (12); construction costs c_i^d from Eq. (11) and the general equilibrium scalars $\{\mathbb{E}(U), \Pi, S\}$ from Eqs. (17), (18) and (19). To pin down $\{\tilde{V}^{distinctive}, \tilde{V}^{ordinary}\}$, we as assume that housing markets clear at every location, which implies that the total floor space demand $f_i^d N_i^d$ must equal total floor space supply H_i^d at any parcel. Notice that this condition implies that if there is no housing supply of design d at a location i, there are also no workers living in buildings of that design in that location. Hence, the population living a parcel i is given by

$$N_i^d = \mathbb{1}(\tilde{d}_i = d) \frac{H_i^d}{f_i^d}. \tag{20}$$

Aggregating the population within the submarkets $d \in \mathbf{D}$, we derive the population shares μ^d, which we can use in Eq. (5) to obtain:

$$\mu^d = \frac{1}{\bar{N}} \sum_{i \in J} N_i^d = \frac{(\tilde{V}^d)^{\varepsilon}}{\sum_{u \in \mathbf{C}} (\tilde{V}^u)^{\epsilon}} \quad \forall \quad d \in \mathbf{D} \tag{21}$$

Since $\tilde{V}^{\text{outside}} = \bar{V}$, this is a system of two equations that we can solve for the two unknowns $\{\tilde{V}^{\text{distinctive}}, \tilde{V}^{\text{ordinary}}\}$. To pin down $\{\tilde{d}_i, Q_i^d\}$, we find the equilibrium values for both variables that satisfy Eqs. (10) and (15). To this end, we exploit that Eq. (10) feeds into Eq. (15) via Eqs. (12), (13), and (14), and that Eq. (15) feeds into Eq. (10) via Eqs. (7) and (8).[5] In principle, the equilibrium distribution of $\{\tilde{d}_i, Q_i^d\}$ need not be unique, which is a typical feature of models with spatial spillovers. However, it is well known that models with multiple equilibria can be "convexified" by introducing heterogeneity in fundamentals (Herrendorf et al., 2000).[6] We return to the quantification of the model after deriving empirical moments from literature and data that we wish to match within our model.

[5]For a more detailed discussion of our numerical procedure to solve for $\mathbf{V}$, see Online Supplement Section II.2.

[6]In Online Supplement Section II.4, we show that, under the parameterisation discussed in Section 3.5, the equilibrium is unique.

Intuition. As is evident from Eqs. (5) and (6), the idiosyncratic utility drawn from the distribution in Eq. (2) generates downward-sloping demand for distinctive buildings. This ensures that there is a well-behaved solution for the fraction of buildings with distinctive design within the interval $(0, 1)$. The relative cost of distinctive design, $\frac{\mathbb{E}(\delta_i^{distinctive})}{\mathbb{E}(\delta_i^{ordinary})}$, acts as a supply shifter that reduces the equilibrium fraction of distinctive buildings and increases their relative price. Likewise, the relative average taste for distinctive design, $\frac{\mathbb{E}(a(v)^{distinctive})}{\mathbb{E}(a(v)^{ordinary})}$, acts as a demand shifter that increases the equilibrium fraction and the relative price. The interaction of both determines the internal price effect of distinctive design, $\frac{\mathbb{E}(Q_i^{distinctive})}{\mathbb{E}(Q_i^{ordinary})}$, which is typically estimated in the reduced-form literature. We can exploit the reverse mapping to infer the relative average taste within the model and the relative average cost of distinctive design if we observe the relative price and the fraction of distinctive buildings in the neighbourhood as moments in the data. The model also generates what the reduced-form literature refers to as the external design effect, i.e., the capitalisation effect of nearby distinctive buildings. From Eqs. (7) and (10), the external price effect takes the form $\frac{\partial \ln Q_i^d}{\partial D_i} = \frac{\beta}{1-\alpha}$. Therefore, it is straightforward to parametrise the design spillover within the model if we obtain the external price effect as a moment in the data. Since developers do not take this external price effect into account in their investment decisions, there is a coordination problem resulting in a market share of distinctive buildings that is smaller than in the social optimum. A policy that seeks to address this coordination problem by incentivising investments in distinctive design acts as a supply shifter in the market for distinctive buildings. The degree to which the equilibrium allocation responds to these supply shocks naturally depends on the slope of the demand curve, which is governed by the idiosyncratic-utility shape parameter ε via Eqs. (5) and (6). Therefore, the key moments in the data that we wish to match in the model to conduct realistic policy counterfactuals are: the internal price premium, the external price premium, either the relative cost of distinctive design or the fraction of distinctive buildings in the neighbourhood, and the dispersion of idiosyncratic tastes for distinctive design. We turn to these empirical moments in the next section.

3 Quantification

In this section, we describe how we parametrise the model introduced in Section 2 to enable the quantitative analysis of policy counterfactuals. In principle, the model can be quantified for an existing neighbourhood by choosing a real-world geography of parcels and inverting fundamentals to match the spatial distribution of endogenous outcomes such as population, rent, or distinctive buildings. Since we intend to use the model for policy evaluation in a general way, we abstract from local idiosyncrasies and generate a stylised geography that corresponds to a symmetric urban grid on a two-dimensional plane. Yet, for the counterfactuals to be quantitatively meaningful, we need to ensure that the model captures the benefits and costs of distinctive design in ways that are quantitatively consistent with empirical evidence. To this end, we derive key moments from the literature and data throughout Sections 3.1 to 3.4 and discuss how we match them in the parametrised model in Section 3.5. We conclude the section with an illustration of the spatial structure of our stylised neighbourhood in Section 3.6.

3.1 Internal price effect

Over the years, a sizeable body of evidence has emerged concerning the effects of various aesthetically appealing features of buildings on property transaction prices. Yet, there is no synthesis of this literature that condenses the evidence into a rule-of-thumb premium that could guide our parametrisation of the model. Therefore, we build an evidence base via a systematic literature search following Ahlfeldt and Pietrostefani (2019), which we discuss in more detail in Appendix Section B.1. In total, we find 68 estimates of the internal price effect (the effect of distinctive design on the value of the building with distinctive design) published in 41 studies.[7]

The obvious challenge this literature faces is to find criteria for distinctive architecture that are objective in the sense of being independent of the author's subjective assessment. Typically, authors delegate the judgement to committees that decide on architectural awards (e.g. Hough and Kratz, 1983; Cheshire and Dericks, 2020; Liao et al., 2022) or certifications of historical significance (e.g. Asabere et al., 1994; Ahlfeldt et al., 2017; Koster and Rouwendal, 2017).[8] Occasionally, authors have asked either experts (Vandell and Lane, 1989) or local residents (Ahlfeldt and Holman, 2018) to rate the distinctiveness or beauty of architectural form. There is also some variation in how distinctive form is measured across studies. Mostly, premia are estimated using categorical variables that define buildings as being distinctive in their architectural form or not. For a consistent interpretation of parameter estimates, we therefore convert estimated marginal effects of an increase in a design score into a categorical premium. Hence, in the notation of our model, the internal price premia recovered from the literature can be interpreted as a semi-log effect of the form

$$a = \mathbb{E}\left[\ln(Q_i^d \mid d = \text{distinctive})\right] - \mathbb{E}\left[\ln(Q_i^d \mid d = \text{ordinary})\right], \tag{22}$$

which implies the percentage effect $\exp(a) - 1$.

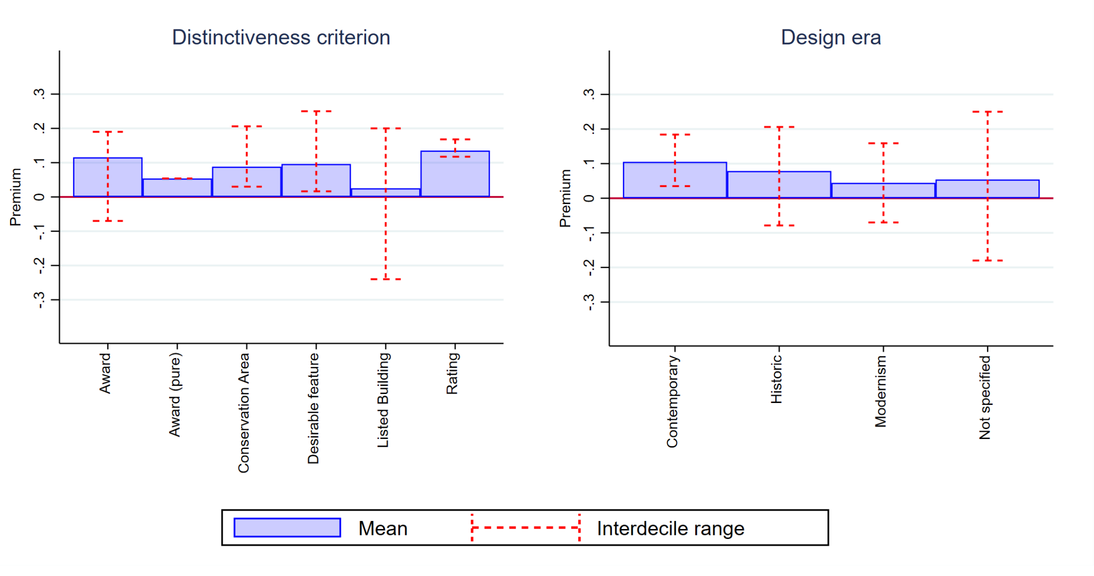
Figure 1 illustrates how the internal price premium in our evidence base varies with measures of distinctiveness and the design era of the buildings analysed. On average, the estimated premium for buildings that are top-rated by expert juries or exhibit desirable design features (e.g. specific forms or ornamentation) slightly exceeds 10 percent. Buildings that have won architectural awards or were designed by award-winning architects command a similar premium. This estimated award premium likely reflects a combination of two effects: the value of the distinctive design that led to the award, and the certifica-

[7] See Online Supplement Section II.1 for the list of included studies and encoded key characteristics.

[8] Other notable studies include Coulson and Lahr (2005); Ahlfeldt and Maennig (2010); Koster et al. (2016); Pietrostefani (2019).

tion and signaling value associated with winning the award. In contrast, Liao et al. (2022) estimate what we call the 'pure' award premium from a comparison of market values of the same buildings before and after winning the award. This pure award premium is naturally smaller, since it excludes the effect of the distinctiveness of the design that causes the award, as this effect is absorbed by the building fixed effect. Still, at 5.4%, it is sizeable, suggesting that there is a willingness to pay for a certification of good design, consistent with imperfect information that can cause adverse selection. Indirectly, the fact that the gross award premium exceeds the pure award premium reveals that there is a sizeable willingness to pay for distinctive design, irrespective of the certification by an award.

Figure 1: Internal price effect by distinctiveness criterion and design era



Note: This figure illustrates the distribution of distinctiveness premiums (log points increases in property price associated with distinctive form) in our evidence base separately for the groups defined in each panel. Contemporary styles comprise late modernist architectural styles (including postmodernism) implemented since the 1970s. Awards refer to the effect of architectural prizes awarded to buildings or their architects. The pure award premium is identified from a before-after comparison controlling for building fixed effects and, hence, captures the pure value of the award net of the design that caused the award. Desirable features are elements of architectural form that are considered desirable by the authors, e.g. a specific type of ornamentation. Rating refers to design ratings by experts. Modernism is broadly defined as a collection of modern styles in the tradition of International Style and Bauhaus that established the minimalistic formal vocabulary during the early and mid-20th century. Historic styles comprise ancient, medieval, Renaissance, and Neoclassical styles.

Buildings in conservation areas and listed buildings that are deemed to stand out relative to their respective cohorts command lower distinctiveness premia, on average. In particular, the effect for listed buildings is close to zero. However, it is important to acknowledge that historic designation is not merely a recognition of architectural and/or historical significance. Depending on the institutional context, it also comes with restrictions on how properties can be amended, in terms of both form and function. These restrictions can increase maintenance and modernisation costs and may constrain owners' ability to alter buildings to suit their needs, which can in turn reduce the market value of listed properties. We use ”conservation area” to refer to policies that protect groups of buildings of architectural and historic significance from undesirable changes. While similar policies exist in many countries, there is significant variation in the stringency of regulation (Pietrostefani and Holman, 2021). Moreover, in some countries, owners are compensated for these restrictions through favourable tax laws, which can increase the market value of listed buildings. As a result, estimated premia for conservation areas and listed buildings capture the combined effect of the distinctive-form externality and the offsetting costs and benefits of legal designation. Because the way planning systems treat designated buildings varies across countries, it is no surprise that there is considerable variation in the estimated price effects associated with historic designation (reflected by the large inter-decile range). The fact that listed buildings command a low premium, on average, does not necessarily imply that owners and renters do not value the distinctive form. It is entirely conceivable that a positive distinctiveness premium is negatively offset by legal constraints.

The right panel of Figure 1 shows that positive internal price premia are found across architectural styles, ranging from historic to contemporary. While the premium is largest for contemporary styles, this does not necessarily mean that distinctive design in historic or modern styles is less appreciated, as buildings from these eras are more likely to be subject to historic preservation laws, which may negatively affect their value, as discussed above. As we found for listed buildings, the variation in results across studies is large, likely reflecting heterogeneity in restrictions and tax incentives associated with ownership of protected buildings.

In Table 1, we follow standard practice in meta-analytic research and regress the point estimates of the distinctiveness premia encoded from the literature on selected study criteria. We begin with a parsimonious model in which we include only two dummies indicating either commercial or residential use in Column (1). Since these indicators sum to one, we omit the constant. The internal price effect for residential buildings, at about 10%, exceeds the distinctiveness premium for commercial properties by roughly a quarter. To evaluate whether this difference is attributable to a composition effect, we add a set of indicator variables in Column (2). Indicators for conservation areas and listed buildings control for constraints associated with historic preservation laws that may reduce value. The pure award indicator is included because it captures only the certification value of the award, not the effect of the distinctive design that justifies the award. We also control for an indicator of historic architectural style, as the suitability of historic floor plans for contemporary uses may differ across uses. Controlling for compositional differences substantially reduces the gap in the estimated premia.

In Column (3), we take two steps to narrow the evidence to estimates that are likely more robust. A standard approach in meta-analytic research is to weight observations by the inverse of the standard error. Since our evidence base is highly heterogeneous with respect to the empirical approaches used, we follow Ahlfeldt and Pietrostefani (2019) and weight studies by the number of citations. With this approach, we assume that more rigorous analyses are more impactful and, therefore, cited more often. Because citation

Table 1: Internal price premium of distinctive design

	(1) Internal premium		(2) Internal premium		(3) Internal premium	
Commercial	0.095***	(0.02)	0.101***	(0.02)	0.146***	(0.02)
Residential	0.077***	(0.02)	0.099**	(0.04)	0.164***	(0.04)
Conservation Area			-0.021	(0.03)		
Listed Building			-0.084*	(0.05)		
Award (pure)			-0.045	(0.04)		
Historic Style			0.010	(0.05)		
Weighted	No		No		Yes	
Sample	All		All		Cohort control	
r2	0.4		0.4		0.7	
N	68		68		17	

Notes: Standard errors in parentheses. Each observation is an estimate of the effect of distinctive design on property price or rent (internal premium) from the literature in log points. All explanatory variables are dummy variables. Baseline distinctiveness measure is listed building (see left panel of Figure 1). Modern covers the style groups contemporary, modernism, and transitional from Figure 12 (right panel). Quality weights are proportionate to Google citation counts, regression adjusted for publication years. We omit the constant since the commercial and residential dummies add to one. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

counts naturally increase with the time elapsed since publication, we residualise the Google citation count using an auxiliary regression of the log number of citations (adding one) on a linear year trend. A key identification concern in estimating internal price premia is that they may reflect not only the quality of architectural form but also correlated cohort effects. An obvious example is conservation areas or listed buildings. Historic preservation is intended to protect buildings that stand out in terms of design quality or historic significance relative to their respective cohorts. However, there may also be a positive (or negative) willingness to pay for the style *per se*, over and above any particular manifestation of that style. The ideal empirical comparison is therefore between a distinctive building and an otherwise ordinary building from the same cohort. Unfortunately, not all studies control for cohort effects. Accordingly, in addition to citation-based weighting, we focus on a subset of studies that include such controls and may be regarded as particularly robust in Column (3). With this approach, we find that the distinctiveness premium increases, and the gap between uses is small in relative terms. Based on these preferred estimates, we conclude that distinctive architectural form increases property value by about 15%.

3.2 External price effect

As with the internal price effect in Section 3.1, we conduct a systematic literature search (see Appendix Section B.1 for details) to build an evidence base on external price effects—that is, the effect of distinctive design on the value of nearby buildings. With 33 estimates from 28 studies, the evidence is somewhat thinner than for the internal price effect but still sizeable.[9]

[9] See Online Supplement Section II.1 for the list of included studies and encoded key characteristics.

Again, there is some variation in how exposure to distinctive design is measured, with some measures being continuous (e.g. distance from a distinctive building) and others being discrete (e.g. within a certain distance of a building that won an architectural award). For a consistent interpretation, we again convert estimated marginal effects into a categorical premium, the most common form of measurement in the literature. In the notation of our model, the external price premia recovered from the literature can be interpreted as a semi-log effect of the form

$$e = \mathbb{E}\left[\ln(Q_i^d \mid D_i \geqslant \underline{D})\right] - \mathbb{E}\left[\ln(Q_i^d \mid D_i < \overline{D})\right], \tag{23}$$

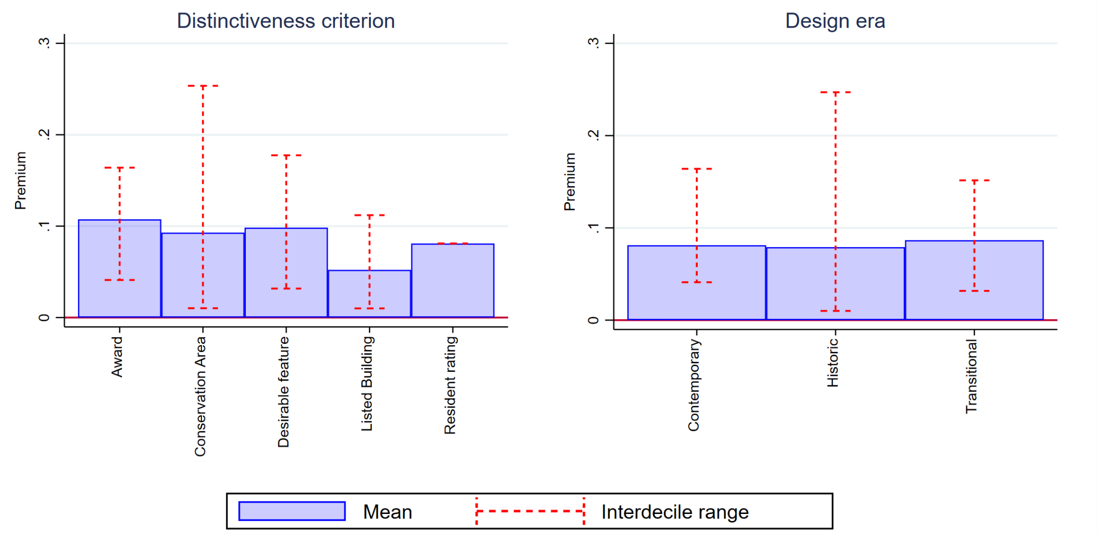
which implies the percentage effect $\exp(e) - 1$.

We illustrate the estimates of external price effects recovered from the literature in Figure 2, in the same way we illustrate the internal price effect in Figure 1. On average, we find positive spillover effects, irrespective of how distinctive design is measured or the style of the distinctive design. There is significant variation across studies, as the analysed buildings in the evidence base differ markedly in size, ranging from single-family homes to football stadia. Yet, the mean estimates across the various categories are similar, averaging around or slightly below 0.1. The estimates remain within the same range for nearby historic listed buildings and other buildings in conservation areas. This supports the interpretation that the relatively low average internal distinctiveness premia for preserved buildings found in Figure 1 are driven by a negative price effect associated with restricted property rights, rather than limited appreciation of historic styles. On average, we find a premium associated with distinctive architectural form in the neighbourhood of about 9%, irrespective of whether we weight observations by adjusted (for year of publication) citations or not.

This estimate of the external design premium is certainly of interest in its own right. However, for the purpose of calibrating our model, we require an estimate of the premium that would result from moving from complete absence of exposure to distinctive design ($D_i = 0$) to full exposure ($D_i = 1$). This theoretical premium will necessarily exceed the empirically observed 9% premium, but the available evidence does not allow us to determine by how much. In the absence of a better alternative, one could assume that the observed 9% premium corresponds to the interdecile range of a normally distributed distinctive design spillover. A move from the 1st to the 99th percentile would imply a premium that is approximately 1.815 times larger.[10] This would place the external premium in the range of 15%, which is broadly consistent with the internally estimated premium derived from comparisons between non-distinctive and distinctive buildings.

[10]This multiplier corresponds to the ratio of z-score ranges in the standard normal distribution: the 1st-to-99th percentile range divided by the 10th-to-90th percentile range.

Figure 2: External price effect by distinctiveness criterion and design era



Note: This figure illustrates the distribution of architectural form premiums (log points increases in property price associated with distinctive form of nearby buildings) in our evidence base separately for the groups defined in each panel. Awards refer to the effect of architectural prizes awarded to buildings or their architects. Desirable features are elements of architectural form that are considered desirable by the authors, e.g. a specific type of ornamentation. Residential rating refers to design ratings by local residents. Contemporary styles comprise late modernist architectural styles (including postmodernism) implemented since the 1970s. Modernism is broadly defined as a collection of modern styles in the tradition of International Style and Bauhaus that established the minimalistic formal vocabulary during the early and mid-20th century. Historic styles comprise ancient, medieval, Renaissance, and Neoclassical styles. Transitional captures a variety of styles that sit in the middle between historic and modern styles with respect to the use of ornamentation and were popular around the turn from the 19th to the 20th century, such as Art Deco, Art Nouveau, expressionism, Prairie style, among others.

3.3 Distinctive design cost

It is intuitive that departures from the least-cost configuration that improve function and form are typically associated with additional costs for materials, statics, or architects. Indeed, the USA's *National Building Cost Manual* illustrates the higher construction costs of increased ceiling height, larger windows, and more durable choices of flooring (Moselle, 2017). Related evidence has shown that flexible, more complex ceiling height designs are more expensive (Martani et al., 2018), and that in the 2.5–3 meter interval, a 10cm reduction in height entails savings of about 1% in construction costs (Technion, 1958). Other studies have also documented higher costs of energy-efficient windows (Raimundo et al., 2021; Saadatian et al., 2021).

Yet, systematic evidence on the relative cost of distinctive design is scarce. We found no more than two studies that provide estimates of the relative cost of distinctive design:

$$v = \mathbb{E}\Big[\ln(\delta_i^d \mid d = \text{distinctive})\Big] - \mathbb{E}\Big[\ln(\delta_i^d \mid d = \text{ordinary})\Big] \tag{24}$$

Based on the small number of studies, however, the added cost for distinctive design appears to be sizeable. Vandell and Lane (1989), in their review of engineering-based cost studies (Canestero, 1981; O'Brien, 1977; Grimes, 1976), conclude that there is an additional cost for distinctive design in the range of 10%-30%. Their own empirical analysis substantiates this range, though they cannot establish statistical significance at conventional levels owing to a small number of observations. More recently, Cheshire and Dericks (2020), at 13%, find an extra cost that falls within the range. So, based on the evidence, it appears sensible to view 10%-30% (0.11-0.35 in log units) as a plausible rule-of-thumb range. Unfortunately, the evidence base is too thin to derive a precise point estimate of the mean cost of distinctive design.

3.4 Distinctive design preference heterogeneity

The aggregate housing expenditure in submarket $d \in \mathbf{D}$ is given by $(1-\alpha)\bar{N}\bar{w}\mu^d$, where the endogenous submarket share μ^d depends critically on the inverse taste heterogeneity parameter ε (see Eq. 5). A lower ε implies greater taste dispersion, which steepens the submarket demand curve—i.e., the valuation of the marginal buyer declines more rapidly, and μ^d becomes less responsive to changes in indirect utility $\tilde{V}^d$. Consequently, an expansion of distinctive supply will lead to a stronger decline in the rent premium of distinctive buildings. Conversely, a higher ε reflects more homogeneous preferences, flattening the demand curve such that even small reductions in relative price induce substantial increases in demand. As no estimates of ε exist in the literature, we elicit it via an original survey as described below.

Design survey. We conduct an image-based survey in which participants rate ten architectural photographs on a 0–100 scale. Images were drawn from Google Street View and organised into ten matched pairs of distinctive and ordinary buildings from the same design eras and neighbourhoods to ensure contextual comparability. One image from each pair was then randomly selected, resulting in two questionnaire versions, each containing ten images. Participants are randomly assigned to one of these two questionnaire groups. Distinctive buildings were pre-classified based on expert ratings by starchitect Stefano Boeri, typically featuring sophisticated form, façade, or materials, while ordinary buildings blended into the urban background. The survey offers no monetary compensation, using comparison with Boeri's scores as a non-monetary incentive. As of August 2025, the resulting sample includes 3,140 ratings from 314 respondents. See Appendix Section B.2 for further detail.[11]

Estimation. From the survey, we obtain a distribution of individual design ratings for each of the $\mathcal{B} = 20$ sampled buildings, which we index by b. We treat these ratings as the empirical analogue of the individual preference $a(v)$ in the model. Intuitively, we estimate the preference heterogeneity parameter ε in the model by finding the value that generates

[11] The survey is accessible via this link.

a distribution resembling the distribution of design ratings we measure empirically. Under the assumption that $a_{vb} \sim \text{Fréchet}(A_b, \varepsilon)$, the first and second moment conditions of $\forall\, b \in \mathcal{B}$ in GMM estimation are defined as:

$$g_1(\varepsilon, A_b) = \hat{\mu}_b - \mathbb{E}[a_{vb}] = \hat{\mu}_b - A_b \Gamma\left(1 - \frac{1}{\varepsilon}\right) = 0,$$

$$g_2(\varepsilon, A_b) = \hat{\sigma}_b^2 - \text{Var}[a_{vb}] = \hat{\sigma}_b^2 - (A_b)^2 \left[\Gamma\left(1 - \frac{2}{\varepsilon}\right) - \left(\Gamma\left(1 - \frac{1}{\varepsilon}\right)\right)^2\right] = 0.$$

We use the Generalized Method of Moments (GMM) to structurally estimate a universal shape parameter ε and building-specific shifts A_b by minimising the sum of squared deviations between the empirical and model-implied mean and variance across all buildings $b \in \mathcal{B}$:

$$\arg\min_{\varepsilon, \{A_b\}} \sum_{b \in \mathcal{B}} \left[(\hat{\mu}_b - \mathbb{E}[a_{vb}])^2 + \left(\hat{\sigma}_b^2 - \text{Var}[a_{vb}]\right)^2 \right],$$

where a_{vb} denotes the score assigned by respondent v to building b, $\hat{\mu}_b$ and $\hat{\sigma}_b^2$ are empirical moments observed from the survey, and $\mathbb{E}[a_{vb}]$ and $\text{Var}[a_{vb}]$ are model-implied moments for any presumed values of ε and A_b.

Results. Table 2 reports estimates of the shape parameter ε, alongside average moments of ratings and estimated shifts A_b. The key estimate based on all respondents and buildings is $\varepsilon = 4.04$. We obtain similar estimates when restricting the sample to respondents who exhibit either high similarity (correlation > 0.7) or substantial divergence (correlation < 0.3) in taste relative to the Starchitect (rows 2-3). Splitting by buildings into two equally sized groups ranked high or low by the Starchitect reveals that buildings ranked highly by the Starchitect are, on average, also ranked highly by survey participants (rows 4-5). Indeed, the estimated taste shift parameter A_b is more than 70% higher for these buildings. Moreover, the dispersion parameter is somewhat larger, consistent with distinctive buildings not only being appreciated more, on average, but also being more consensual. We present results from alternative estimators—including a variance-based GMM and a nonparametric CDF-matching approach—in Appendix B.2 for comparison. Across all specifications, the estimated ε remains relatively close to 4.

Table 2: GMM Estimates of Preference Heterogeneity Parameters ε

Group	Mean rating	Variance	Shift A_b	Shape ε
All respondents, all buildings	52.72	480.88	42.73	4.04
People similar to Starchitect	51.34	416.81	39.53	4.06
People different from Starchitect	52.99	586.57	42.16	3.79
Buildings ranked high by Starchitect	65.63	486.86	55.89	4.69
Buildings ranked low by Starchitect	39.80	474.90	32.39	3.40

Notes: This table reports GMM estimates based on matching the first and second moments of the building-level rating distributions to those implied by a Fréchet model. The shape parameter ε governs preference heterogeneity, while A_b reflects the building-specific location shift. Groups are defined based on respondent-level or Starchitect-level ranking similarity (see Appendix 3.4).

3.5 Parametrisation

The primitives of the model described in Section 2 consist of the exogenous parameters $\{\alpha, \beta, \delta_i^d, \epsilon, \tau, \theta, t_i^d, G_i, \bar{C}, \bar{V}, \bar{w}\}$, the endowments $\{\bar{N}, \bar{K}_i, \mathcal{D}_{iz}\}$, and the exogenous fundamentals $\{b_i^d, A^d\}$. We set them as follows.

Geography. We create a stylised neighbourhood that consists of 900 parcels, which are grouped into 10×10. Each parcel has an area of $\bar{K}_i = 25 \times 25 = 625$ square meters. Blocks are separated by 25 meters to accommodate streets. We measure bilateral distance $\mathcal{D}_{iz}$ along straight lines that connect parcel centroids.[12]

Set parameter values from literature. We are comfortable with setting several parameters to values that are canonical in the literature. We set the housing expenditure share to $1 - \alpha = 0.33$ (Combes et al., 2019). We set the rate of spatial decay in the design spillover to $\tau = 5$ which is consistent with localised housing externalities that do not spread much beyond a walkable area (Rossi-Hansberg et al., 2010). We set the height elasticity of construction cost to $\theta = 0.2$ since we model a neighbourhood with short buildings (Ahlfeldt and McMillen, 2018).

Parameter values informed by empirical moments. With the empirical moment of the adjusted external price premium of 15% discussed in Section 3.2 and a canonical housing expenditure share of $1 - \alpha = 0.33$, we calibrate the design spillover to $\beta = 0.05$ using the model-implied external design effect $\frac{\partial \ln Q_i^d}{\partial D_i} = \frac{\beta}{1-\alpha}$. As discussed in Section 2, we can use the structure of the model to indirectly infer the average internal distinctive design amenity value, A^d, using an empirical estimate of the internal distinctive design rent premium $\hat{a}$. Since the literature reviewed above only provides a very crude indication of what the average cost of distinctive design might be, we also choose to indirectly infer the average distinctive design cost using a neighbourhood fraction of distinctive buildings of $\hat{s}$ as the targeted moment. To this end, we assume the following for the parcel-specific distribution of distinctive design cost:

$$\delta_i^d = \begin{cases} \sim \mathcal{N}(\bar{\delta}^{distinctive}, \sigma^2) & \text{if } d = \text{distinctive} \\ 0 & \text{if } d = \text{ordinary} \end{cases}$$

We set $\frac{\sigma}{\bar{\delta}^{\text{distinctive}}} = 0.2$, which is roughly consistent with the descriptive evidence in Vandell and Lane (1989). We employ a Simulated Method of Moments (SMM) approach to calibrate $\{A^{distinctive}, \bar{\delta}^{distinctive}\}$ as follows:

[12] Using Manhattan distances does not materially affect our results.

$$\underset{A^{\text{distinctive}},\bar{\delta}^{\text{distinctive}}}{\arg\min} \left[\left(\mathbb{E}\left[\ln(Q_{sim,i}^{d=\text{distinctive}})\right] - \mathbb{E}\left[\ln(Q_{sim,i}^{d=\text{ordinary}})\right] - \hat{a} \right)^2 + (\%\text{distinctive} - \hat{s})^2 \right],$$

where $\mathbb{E}\left[\ln(Q_{sim,i}^{d=\text{distinctive}})\right] - \mathbb{E}\left[\ln(Q_{sim,i}^{d=\text{ordinary}})\right]$ is the simulated distinctive design rent premium and %distinctive is the simulated share of distinctive buildings in the model.

This is a fixed-point problem that can be solved by nesting our numerical equilibrium solution algorithm, discussed in Section 2, within another algorithm that iterates over values of $\{A^{distinctive}, \bar{\delta}^{distinctive}\}$ until convergence is achieved.[13] We set $\hat{a} = 0.15$ based on our quantitative literature review of the internal distinctive design value in Section 3.1, and $\hat{s} = 0.2$, which is a typical value for a European inner-city neighbourhood (BDA, 2016). Reassuringly, this approach delivers an average cost of distinctive design of 0.22 log units, which is in the range of the few empirical estimates in the literature discussed in Section 3.1. Of course, this calibration approach can be tailored to any real-world city by setting empirically observed values of the internal and external premia, as well as the fraction of distinctive buildings in the neighbourhood. For further detail on the SMM procedure, we refer to Appendix Section B.3.

Other set primitives. We set the number of workers in the city to $\bar{N} = 300{,}000$, the baseline annualised construction cost to $\bar{C} = \$500$, and the wage level to $\bar{w} = \$55{,}000$. These values roughly correspond to a mid-sized European city and could easily be chosen to match data from a real-world city. In an application to a real-world city, the product of the scale parameter in the ordinary submarket, $A^{\text{d=ordinary}}$, the exogenous reservation utility, $\bar{V}$, and the exogenous local amenity, b_i^d, can be inverted from observed floor space prices using the bid-rent function in Eq. (10). In the present stylised-city application, we set $\bar{V} = 6{,}500$, $A^{\text{d=ordinary}} = 1$, and $b_i \sim \mathcal{N}(1,\ 0.01^2)$, which ensures that the model generates endogenous outcomes such as heights, floor space prices, and employment densities that are empirically plausible.[14] In the baseline scenario without policy intervention, both the subsidy rate on construction, t_i^d, and the planning restriction on design choice, G_i, are uniformly set to zero for all parcels $i \in J$.

3.6 Neighbourhood structure

Figures 3 and 4 characterise the baseline equilibrium structure of the stylised neighbourhood. Figure 3 shows the spatial distribution of building types and the resulting pattern

[13] The equilibrium solution algorithm is laid out in Supplement Section II.2. The fixed-point solver is described in Supplement Section II.3.

[14] The standard deviation used in the draw of the local amenity, b_i, which we keep invariant to the design of the building for simplicity, is consistent with the dispersion of the inverted amenity from the actual Chicago height gradient in Ahlfeldt and Barr (2022).

of design spillovers. Distinctive buildings represent 20% of the total buildings and are spatially dispersed across the neighbourhood rather than concentrated in a single location. Their distribution generates several localised spillover hotspots, with exposure peaking around 0.2 (the theoretical maximum would be 1) in the central areas and diffusing outward.

This distribution of design features generates the spatial gradients in key economic outcomes depicted in Figure 4. Spillovers are hump-shaped in the east–west dimension since exposure is maximised in the neighbourhood centre. Since design spillovers are capitalised in rents, there is also a weak hump shape in floor space rents. On average, the market rent of distinctive buildings is $135 higher per year and unit. Given non-binding height constraints in the baseline, building heights rise monotonically with rents, reaching around 10 floors at the peak. Owing to higher construction costs, distinctive buildings remain, on average, slightly shorter than ordinary ones (5.3 vs. 5.4 floors). Population density is slightly higher at the centre of the neighbourhood, where rents are somewhat higher owing to design spillovers, leading to taller buildings and lower per-capita floor-space consumption, particularly in distinctive buildings. On average, each distinctive building houses around 170 residents with a mean floor-space consumption of 19 square meters, compared to 150 residents per ordinary building and a mean consumption of 22 square meters. Developer profits are generally similar across distinctive and ordinary buildings, except for some tall distinctive buildings that received a favourable draw in terms of the relative cost of distinctive design–the model analogue to the 'design lottery' described by Vandell and Lane (1989).

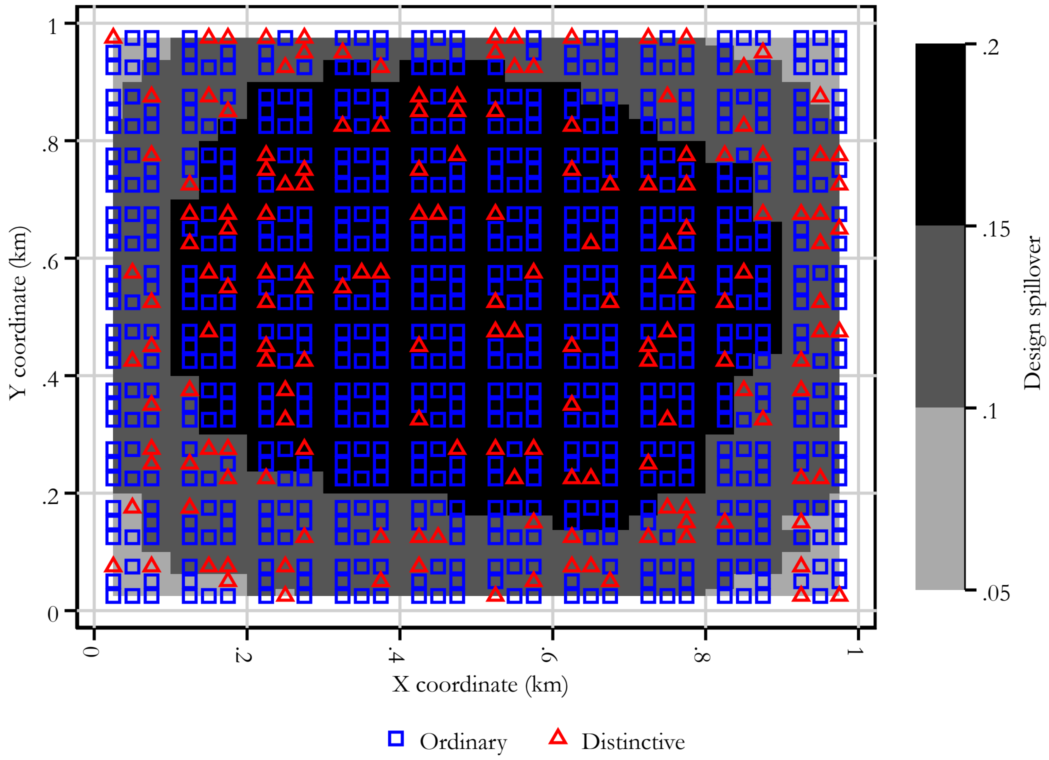
4 Policy counterfactuals

In this section, we use the quantified model to simulate the effects of policies that promote the development of distinctive architectural design. We examine four policies, as well as selected combinations of them. A subsidy to developers who adopt distinctive design is perhaps the most obvious instrument from the public economics toolbox. Floor-area ratio (FAR) bonuses and designated distinctive-design districts capture the types of interventions most commonly used in practice. Finally, we consider the introduction of a strategic "super-developer" who internalises design spillovers, an idea that has featured prominently in the theoretical urban economics and planning debate.

4.1 Pigovian incentives for distinctive design adoption

The textbook response to a design externality is to implement subsidies or taxes that align private prices with social costs and benefits. In this spirit, we simulate a Pigovian subsidy to construction costs that reduces developers' effective construction costs for distinctive buildings as defined in Eq. (11). This policy is similar to the tax deductibility of investments in listed buildings, which is common in many countries, except that here the subsidy

Figure 3: Neighbourhood structure I

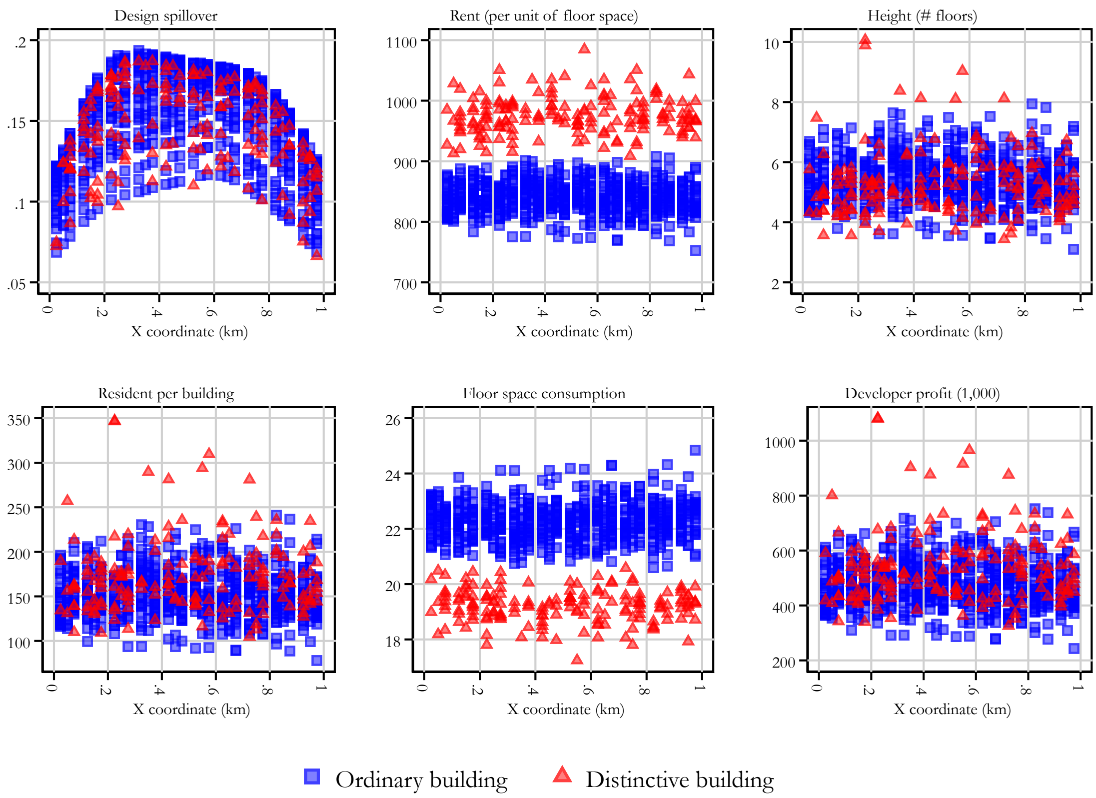


Note: We report solutions to the model developed in Section 2. Design spillover is the distance-weighted sum of the volume of distinctive buildings, normalised by the maximum attainable value.

is conditional solely on architectural significance, irrespective of the period in which the development occurred. For now, we apply the same subsidy rate, $t_i^{distinctive} = \bar{t}^{distinctive}$, to all parcels within the neighbourhood. Ordinary developments remain unaffected by the policy, such that $t_i^{ordinary} = 0$.

Figure 5 summarises the simulation results for varying subsidy levels. The main finding is that a 10% subsidy maximises aggregate social welfare. At this rate, the neighbourhood hosts 177 distinctive buildings and aggregate welfare increases by about \$0.5 million. At a 5% discount rate, this amounts to \$36 per capita of initial neighbourhood population. In other words, the relatively small 0.3% gain in workers' expected utility, once monetised across the entire population, outweighs the roughly 11% reduction in developers' net profits (after taxes) and generates a 0.1% welfare gain for the city as a whole. We observe positive welfare effects up until a subsidy level of 17%. Beyond this level the monetised net benefits become negative. As distinctive supply expands, the marginal willingness to pay declines and utility gains diminish. At the same time, developers that are less productive in delivering distinctive buildings are incentivised to adopt distinctive design. Indeed, the rent premium for distinctive buildings already falls under the optimal subsidy and almost disappears under an excessively high subsidy rate of 20% (see for Appendix

Figure 4: Neighbourhood structure II



Note: We report solutions to the model developed in Section 2.

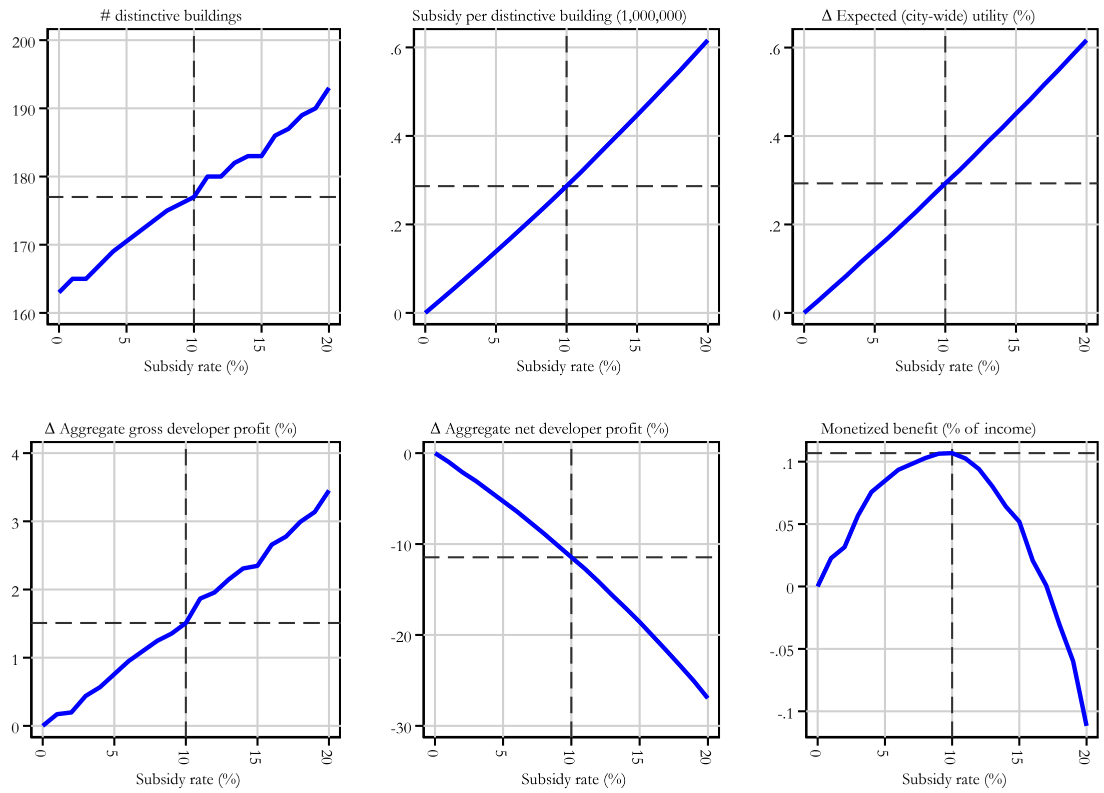
Sections C.1.1 and C.1.2). The welfare results are relatively insensitive to the choice of the taste dispersion parameter, remaining qualitatively and quantitatively similar when $\epsilon = 8$, twice the baseline value (see Appendix Section C.1.3).

Taxing ordinary design. An alternative policy is to tax ordinary buildings. As detailed in Appendix Section C.1.4, a tax rate of about 4% maximises welfare, but the gains are smaller than under the optimal subsidy. Higher taxes shift development towards distinctive design but compress overall floor-space supply, raising rents and reducing expected utility, which renders it a less effective welfare instrument than the subsidy.

4.2 FAR bonuses for distinctive buildings

Many planning systems exert strong control over building height and volume through zoning regulations. This gives planners leverage to ”convince” developers to adopt distinctive design by offering relaxations of floor-area restrictions. This mechanism only works, however, if the zoning constraint is sufficiently binding for the allowance to offset the additional cost of distinctive design. If the objective is to raise welfare by correcting the underprovision of distinctive design, planners therefore face a trade-off: tightening restrictions can

Figure 5: subsidising distinctive buildings



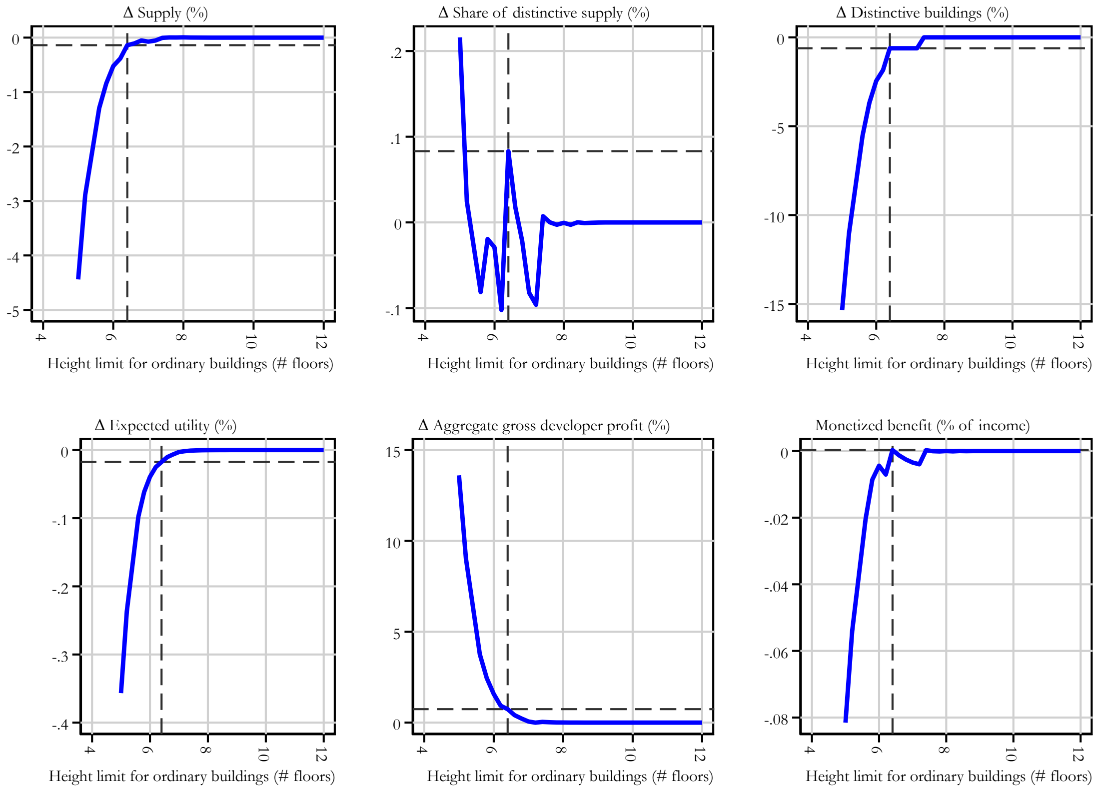
Note: We report solutions to the model developed in Section 2 under varying values of a subsidy. The subsidy rate t represents the fraction of construction cost of distinctive buildings (in log points) that is subsidised. For non-distinctive buildings the subsidy is $t^{d=ordinary} = 0$. All other parameter values are kept constant at the levels reported in Section 3.5. Aggregate net developer profit is the total gross profit net of the total value of the subsidy. Monetised net benefit is sum of the monetised expected utility effect and the aggregate gross profit net of the total value of the subsidy. The expected utility effect is monetised by computing the total income effect that would cause an equivalent utility effect (the product of the percentage utility effect, wage, worker endowment). Vertical dashed lines mark the subsidy rate that maximises the monetised benefit.

help promote distinctive design but may also reduce aggregate floor-space supply and thus lower welfare. To explore this trade-off, we run a series of simulations in which we vary the height limit on ordinary buildings while leaving distinctive buildings unconstrained.

Figure 6 traces outcomes as the height cap on ordinary buildings tightens, with lower values on the X-axis denoting a stricter cap. As the cap moves from 12 (non-binding) to roughly 6.4 floors, monetised net benefits peak at a tiny welfare increase of less than 0.01%. This minor improvement arises purely on the intensive margin: by constraining ordinary floor space, the share of distinctive supply in the neighbourhood increases, strengthening design spillovers and allowing a small increase in distinctive developers' profits through higher rent premia. However, since distinctive buildings can be built taller, the demand for distinctive design is satisfied with fewer distinctive buildings.

Tightening the cap to even slightly less than 6.4 (to the left of the dashed line) leads to welfare losses that very quickly become sizeable. The share of distinctive building stock increases, though this is achieved via taller, not more, distinctive buildings. Importantly, less floor space is supplied, which raises equilibrium rents and lowers housing consumption. This housing supply effect vastly outweighs the utility gains from greater design spillovers, leading to lower expected utility and out-migration. Monetised across the entire city population, these utility losses outweigh any profit gains, resulting in a net welfare loss. In short, the welfare improvement from height caps is a knife-edge, intensive-margin effect: once the constraint becomes even slightly too binding, supply contraction dominates incremental spillover gains, resulting in lower housing affordability and welfare. Moreover, it transfers welfare from renters to landlords, making the policy both inefficient and inequitable.

Figure 6: Restricting height of ordinary buildings



Note: We report solutions to the model developed in Section 2 under varying height limits for ordinary buildings. For distinctive buildings, there is no height limit. All other parameter values are kept constant at the levels reported in Section 3.5. Monetised net benefit is sum of the monetised expected utility effect and the aggregate gross profit. The expected utility effect is monetised by computing the total income effect that would cause an equivalent utility effect (the product of the percentage utility effect, wage, worker endowment). Vertical dashed lines mark the subsidy rate that maximises the monetised benefit.

Relaxing FAR for distinctive buildings in a constrained city. When FAR incentives are introduced in an already supply-constrained city, the picture naturally changes. Relaxing height limits for distinctive buildings increases welfare both through stronger design spillovers and through greater floor-space supply. In our model, the policy is there-

Table 3: Effect of designated distinctive district

Size of district	Distinctive build.	Population	Distinctive supply	Supply	Expected utility[a]	Developer profits
Small	4.321%	0.021%	0.568%	–0.132%	0.003%	0.018%
Large	76.687%	–0.421%	12.991%	–2.419%	–0.063%	–0.408%

Notes: [a] Effect to the population of the neighbourhood and the rest of the city. All other effects measured at the neighbourhood scale. Designation effects are from model-based simulations comparing the equilibrium with a designated distinctive district to the market equilibrium. The small (large) distinctive district imposes mandatory distinctive design for 32 (288) out of 800 parcels in the neighbourhood.

fore unambiguously welfare-improving. It is important to emphasize, however, that this result should not be interpreted as a justification for height restrictions in the first place. Such restrictions would need to be justified on other grounds, for example by mitigating negative externalities from road congestion, crowding of public spaces, or shadowing. See Appendix Section C.2.2 for details.

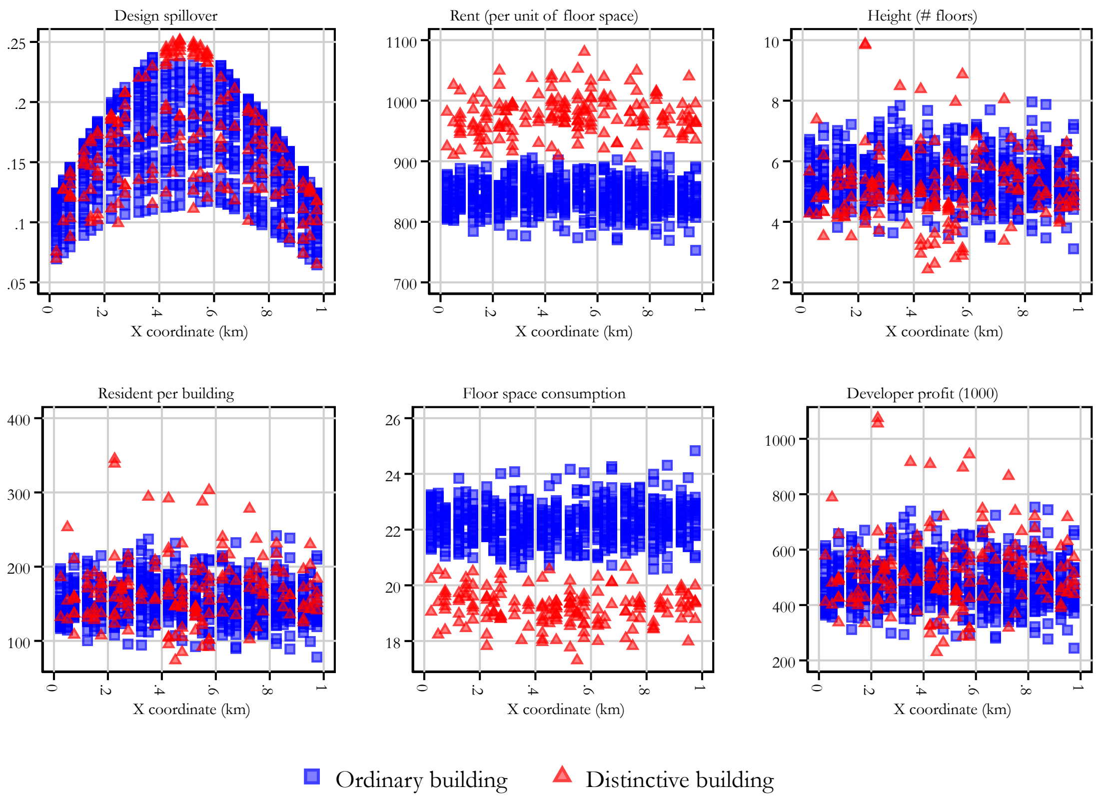
4.3 Distinctive districts

An intuitive approach to solving the coordination problem among developers, which arises from shared benefits, is to mandate cooperation. This strategy is commonly applied in conservation areas, where preserving neighbourhood character requires imposing high design standards on renovations of existing buildings as well as on new construction.

We simulate the effects of designating a central square distinctive district covering 4% of neighbourhood parcels. As shown in Figure 7, the policy generates a steep local gradient in design spillovers and correspondingly higher floor-space prices within the district, driven by both internal and external price effects. Aggregate outcomes are summarized in Table 3. A key result is that this moderately sized distinctive district yields a slight increase in both expected utility and developer profits, highlighting its conceptual appeal as a relatively straightforward solution to the coordination problem that does not require large public spending. In practice, however, the main challenge is determining the appropriate size of the district. The table also shows that when a larger district covering 36% of the neighbourhood is designated as distinctive, expected utility and developer profits decline, reflecting diminishing returns to distinctive design and negative effects on aggregate housing supply. Hence, mandatory distinctive design districts are a policy that needs to be used with reason rather than excessively.

Subsidising distinctive buildings in a designated district. An alternative way to promote the adoption of distinctive design within a designated district is to earmark subsidies for parcels within a designated part of the neighbourhood. This policy generates strong positive externalities within the district due to the local concentration of distinctive buildings. However, the aggregate welfare effects are smaller than under a subsidy available to all developers, since the unrestricted subsidy is taken up by those developers who are most productive in delivering distinctive design. Further details are provided in Appendix

Figure 7: Neighbourhood structure with distinctive district II



Note: We report solutions to the model developed in Section 2. Underlying parameter values are discussed in Section 3.5. We impose that buildings in the distinctive district must be distinctive.

Section C.3.2.

FAR bonuses in a designated district. The distinctive district policy can also be combined with an FAR bonus. As detailed in Appendix Section C.3.3, relaxing height limits for distinctive buildings within the district increases their appeal but compresses ordinary supply, raising rents and generating utility losses that exceed gains in developer profits. As with FAR bonuses at the neighbourhood level, this intervention is not welfare-improving.

4.4 Super developer

Another intuitively appealing way to address the coordination problem arises from the possibility that developers who control larger lots have greater incentives to internalise design externalities. The idea is rooted in the classic view that "large agents" or "entrepreneurial agents"—such as powerful land developers or local governments—can coordinate city development and partly correct market inefficiencies such as resource misallocation or public-good underprovision when spillovers are localised (Henderson, 1974; Helsley and Strange, 1994, 1997). For example, Helsley and Strange (1997) show that the first-best allocation arises when a single developer assembles the full city site, whereas land-assembly frictions generate "limited developers" who cannot internalise all spillovers and thus underprovide local infrastructure. At the neighbourhood scale, Thorsnes (2000) shows that larger developers internalise neighbourhood externalities by coordinating subdivision-wide amenities (i.e., restrictive covenants), effectively providing a private complement to zoning.

We apply a similar logic to the micro-scale of architectural design by considering a super-developer who owns the entire neighbourhood and maximises aggregate profits across parcels. Because simultaneous optimisation is combinatorially complex, we use a greedy algorithm in which the developer sequentially converts the most profitable parcel from ordinary to distinctive until no further profitable conversions remain (see Appendix Section C.4 for details).

We begin by considering a *fully-myopic* developer who evaluates each project in isolation, taking spillovers and rents as given at their pre-decision equilibrium levels and ignoring any feedback from the current project. We then compare this scenario with a *fully-strategic* developer who perfectly forecasts the equilibrium rent adjustments induced by both the additional spillovers generated by a new distinctive building and the price effects arising from changes in the overall distinctive supply. As reported in the first row of Table 4, the *fully-strategic* developer builds 3.07% more distinctive buildings, increasing total distinctive floorspace by 0.16%. Both the super developer and workers benefit: the developer's profits rise by 0.06%, while expected utility increases by 0.01%. The neighbourhood's heightened attractiveness is reflected in a 0.06% increase in its population.

While the results qualitatively conform to the intuition that a large-scale developer internalises externalities and thereby generates welfare gains, the impact is quantitatively more modest than one might have hoped. To understand the limited impact, it is useful to recognise that in our model—and likely in reality—there is a force that works against large-scale developers expanding distinctive supply: monopoly rents. The heterogeneity in preferences for distinctive supply we have documented in Section 3.4 implies that a reduction in distinctive supply is associated with a higher distinctive design premium. Therefore, the monopolist has an incentive to restrict the supply of distinctive buildings in order to raise the markup on distinctive rents and maximise profits.[15]

To disentangle the two mechanisms, we consider a third *strategic-without-spillovers* scenario, in which the developer behaves as a monopolist who anticipates price feedbacks but abstracts from the consequences of their decisions on design spillovers. The results reported in the second row of Table 4 confirm that, in isolation, the effect of internalising distinctive design on development decisions is consequential. Ignoring spillovers, the developer builds 13.7% fewer distinctive buildings. The efficiency loss is reflected in

[15]The potential efficiency-dampening effects of large developers are rarely studied. One exception is Helsley and Strange (1994), who show in a dynamic city-formation game that a leading developer can use first-mover public-good commitments to strategically overprovide relative to the welfare-maximising optimum, thereby attracting population and deterring entry. In their framework, market power operates mainly through influencing citywide population flows via public-good provision, whereas in our setting it arises from affecting local rents through design and the supply of floor space within a neighbourhood.

Table 4: Super developer under greedy algorithm

Scenario comparison	Dist. build.	Dist. supply	Supply	Rents	Expected utility	Pop.	Profits
Myopic → Strategic	+3.07%	+0.16%	-0.31%	+0.44%	+0.01%	+0.06%	+0.06%
Strategic → ∼ w/o spillover	-13.69%	-3.34%	+0.34%	-0.43%	-0.02%	-0.13%	-0.12%

Notes: The table reports equilibrium outcomes under three super-developer scenarios using the greedy algorithm. Under the *fully-myopic* scenario the super developer make sequential parcel choice based on fixed rents and historical spillover. In the *fully-strategic* developer is monopoly who anticipate current equilibrium spillover.

lower expected utility and profits. Both mechanisms—internalising spillovers and exercising market power—are therefore important. However, because they operate in opposite directions, their effects partially offset each other (in row 1).

While the parameterisation of our model implies that delegating neighbourhood development to a super-developer yields a small but positive net welfare gain, this result hinges critically on the developer correctly anticipating the spillover effects. From a policy perspective, it is important to recognise that this assumption is, of course, debatable. If developers are more attuned to scarcity premia than to design spillovers, rent-seeking motives may dominate the internalization of externalities, potentially reducing distinctive supply and generating welfare losses. Further details are provided in Appendix C.4.

5 Conclusion

As substantiated by our quantitative literature review, positive externalities arising from distinctive architectural design are likely to result in an undersupply of distinctive design under laissez-faire market conditions. This is due to a coordination problem that we tackle within a quantitative spatial equilibrium model: developers underinvest in distinctive architecture because they bear the full costs of distinctive design but do not capture the full social returns. Among the evaluated policies, a construction cost subsidy targeted at distinctive buildings, as often implemented in the context of historic preservation, emerges as the most efficient intervention to address the market failure, with a rate of 10% yielding the largest welfare gains.

There is, by now, a sizeable literature on the internal and external effects of distinctive design, which has proven useful in the calibration of our quantitative model. There are, however, also areas where the evidence base has remained thin. More research is needed to understand how the internal and external design premia depend on context—e.g., whether distinctive architecture creates value because it complements the surrounding built environment or because it introduces variety. Another priority area is the cost of distinctive design. This concerns the average cost of adopting a distinctive design, but also how this cost varies across developers. The latter is particularly important, since the *welfare cost* of a policy-induced expansion of distinctive design depends on the cost of distinctive design for the *marginal developer*. In the same vein, we need to learn more about the dispersion of tastes for distinctive design, since the *welfare benefit* of a policy-induced expansion of distinctive design depends on the benefit of distinctive design for the *marginal resident*.

References

Ahlfeldt, Gabriel M. and Daniel P. McMillen, "Tall buildings and land values: Height and construction cost elasticities in Chicago, 1870-2010," *Review of Economics and Statistics*, 12 2018, *100* (5), 861–875.

_ **and Elisabetta Pietrostefani**, "The economic effects of density: A synthesis," *Journal of Urban Economics*, 2019, *111* (February), 93–107.

_ **and Jason Barr**, "The economics of skyscrapers: A synthesis," *Journal of Urban Economics*, 5 2022, *129*, 103419.

_ **and Nancy Holman**, "Distinctively Different: A New Approach to Valuing Architectural Amenities," *Economic Journal*, 2 2018, *128* (608), 1–33.

_ **and W. Maennig**, "Substitutability and complementarity of urban amenities: External effects of built heritage in Berlin," *Real Estate Economics*, 2010, *38* (2).

_ **, Kristoffer Moeller, Sevrin Waights, and Nicolai Wendland**, "Game of zones: The political economy of conservation areas," *Economic Journal*, 2017, *127*, 421–445.

_ **, S J Redding, D M Sturm, and N Wolf**, "The Economics of Density : Evidence from the Berlin Wall," *Econometrica*, 2015, *83* (6), 2127–2189.

Asabere, Paul K, Forrest E Huffman, and Seyed Mehdian, "The Adverse Impacts of Local Historic Designation: The Case of Small Apartment Buildings in Philadelphia," *Journal of Real Estate Finance and Economics*, 1994, *8*, 225–234.

BDA, Bund Deutscher Architekten, "Bestand braucht Haltung," *Bund Deutscher Architekten BDA, Landesverband Nordrhein-Westfalen e.V.*, 2016.

Brueckner, Jan K., "The structure of urban equilibria: A unified treatment of the muth-mills model," *Handbook of Regional and Urban Economics*, 1987, *2*, 821–845.

_ **and Kala Seetharam Sridhar**, "Measuring welfare gains from relaxation of land-use restrictions: The case of India's building-height limits," *Regional Science and Urban Economics*, 2012, *42* (6), 1061–1067.

Canestero, J., "An introduction to the design analysis of office buildings," *Urban Land Institute Development Component Series*, 1981.

Cheshire, Paul C. and Gerard H. Dericks, "'Trophy Architects' and Design as Rent-seeking: Quantifying Deadweight Losses in a Tightly Regulated Office Market," *Economica*, 10 2020, *87* (348), 1078–1104.

Combes, Pierre-Philippe, Gilles Duranton, and Laurent Gobillon, "The Costs of Agglomeration: House and Land Prices in French Cities," *The Review of Economic Studies*, 10 2019, *86* (4), 1556–1589.

Coulson, N. Edward and Michael L. Lahr, "Gracing the land of elvis and beale street: Historic designation and property values in Memphis," *Real Estate Economics*, 9 2005, *33* (3), 487–507.

Fuerst, Franz, Patrick McAllister, and Claudia B. Murray, "Designer buildings: Estimating the economic value of 'signature' architecture," *Environment and Planning A*, 2011, *43* (1), 166–184.

Füss, Roland, Kathleen Kürschner Rauck, and Alois Weigand, "Residential rent externalities of photovoltaic systems: The relevance of view," *Regional Science and Urban Economics*, 9 2025, *114*, 104138.

Glaeser, Edward L., Joseph Gyourko, and Raven Saks, "Why Is Manhattan So Expensive? Regulation and the Rise in Housing Prices," *The Journal of Law and Economics*, 10 2005, *48* (2), 331–369.

Grimes, C. T., "Building Design Trade-Offs. Inivitial Costs vs. Operating Costs vs. Rental Income," *Appraisal Journal*, 1976, *44* (1), 40–54.

Gyourko, Joseph and Raven Molloy, "Chapter 19 - Regulation and Housing Supply," in Gilles Duranton, J. Vernon Henderson, and William C. Strange, eds., *Handbook of Regional and Urban Economics*, Vol. 5 of *Handbook of Regional and Urban Economics*, Elsevier, 2015, pp. 1289–1337.

Helsley, Robert W and William C Strange, "City formation with commitment," *Regional Science and Urban Economics*, 1994, *24* (3), 373–390.

_ **and** _ , "Limited developers," *Canadian Journal of Economics*, 1997, pp. 329–348.

Henderson, J Vernon, "The sizes and types of cities," *The American Economic Review*, 1974, *64* (4), 640–656.

Herrendorf, Berthold, Ákos Valentinyi, and Robert Waldmann, "Ruling Out Multiplicity and Indeterminacy: The Role of Heterogeneity," *The Review of Economic Studies*, 4 2000, *67* (2), 295–307.

Holman, Nancy and Gabriel M Ahlfeldt, "No Escape? The Coordination Problem in Heritage Preservation," *Environment and Planning A: Economy and Space*, 1 2015, *47* (1), 172–187.

Hough, Douglas E. and Charles G. Kratz, "Can "good" architecture meet the market test?," *Journal of Urban Economics*, 1983, *14* (1), 40–54.

Koster, Hans R A, Jos N van Ommeren, and Piet Rietveld, "Historic amenities, income and sorting of households," *Journal of Economic Geography*, 1 2016, *16* (1), 203–236.

Koster, Hans R.A. and Jan Rouwendal, "Historic Amenities and Housing Externalities: Evidence from the Netherlands," *Economic Journal*, 10 2017, *127* (605), F396–F420.

Liao, Wen Chi, Kecen Jing, and Chaun Ying Rachel Lee, "Economic return of architecture awards: Testing homebuyers' motives for paying more," *Regional Science and Urban Economics*, 3 2022, *93*.

Lindenthal, Thies and Erik B Johnson, "Machine Learning, Architectural Styles and Property Values," *Journal of Real Estate Finance & Economics*, 2021.

Martani, Claudio, Laurent Cattarinussi, and Bryan T. Adey, "A new process for the evaluation of the net-benefit of flexible ground-floor ceiling in the face of use transition uncertainty. The application case of an office building in London," *Journal of Building Engineering*, 1 2018, *15*, 156–170.

McFadden, Daniel, "The measurement of urban travel demand," *Journal of Public Economics*, 1974, *3* (4), 303–328.

Monte, Ferdinando, Stephen J Redding, and Esteban Rossi-Hansberg, "Commuting, Migration, and Local Employment Elasticities," *American Economic Review*, 2018, *108* (12), 3855–3890.

Moselle, Ben, *National Building Cost Manual*, Craftsman Book Company, 2017.

O'Brien, J. J., *Value Analysis in Design and Construction*, Graw-Hill, 1977.

Pietrostefani, Elisabetta, "Conservation planning and informal institutions: heterogenous patterns in Italian cities," *Working Paper*, 2019.

_ **and Nancy Holman**, "The politics of conservation planning: A comparative study of urban heritage making in the Global North and the Global South," *Progress in Planning*, 2021, *152*, 100505.

Raimundo, António M., Nuno Baía Saraiva, Luísa Dias Pereira, and Ana Cristina Rebelo, "Market-oriented cost-effectiveness and energy analysis of windows in Portugal," *Energies*, July 2021, *14* (13).

Redding, Stephen J., "Quantitative urban economics," *Handbook of Regional and Urban Economics*, 1 2025, *6* (1), 73–141.

Rossi-Hansberg, Esteban, Pierre-Daniel Sarte, and Raymond Owens, "Housing Externalities," *Journal of Political Economy*, 6 2010, *118* (3), 485–535.

Saadatian, Shiva, Nuno Simões, and Fausto Freire, "Integrated environmental, energy and cost life-cycle analysis of windows: Optimal selection of components," *Building and Environment*, January 2021, *188*, 107516.

Technion, "A Study of the Influence of Ceiling Height in Dwelling Houses," *Ekistics*, 6 1958, *5* (33), 288–293.

Thorsnes, Paul, "Internalizing neighbourhood externalities: the effect of subdivision size and zoning on residential lot prices," *Journal of Urban Economics*, 2000, *48* (3), 397–418.

Turner, Matthew A., Andrew Haughwout, and Wilbert van der Klaauw, "Land Use Regulation and Welfare," *Econometrica*, 7 2014, *82* (4), 1341–1403.

Vandell, Kerry D. and Jonathan S. Lane, "The Economics of Architecture and Urban Design: Some Preliminary Findings," *Real Estate Economics*, 1989, *17* (2), 235–260.

The Economics of Architecture
Online Appendix

Gabriel M. Ahlfeldt Elisabetta Pietrostefani Ailin Zhang

January 12, 2026

Abstract

This online appendix contains material that complements the paper *The Economics of Architecture: A Synthesis*. It does not replace the reading of the main paper.

Key words: Architecture, design, economics, regulation, welfare

JEL: R3, N9

*Ahlfeldt: Humboldt University, Berlin School of Economics (BSoE), London School of Economics and Political Sciences (LSE) and CEPR, CESifo, CEP; g.ahlfeldt@lse.ac.uk; Pietrostefani: University of Liverpool; Zhang: London School of Economics and Political Sciences (LSE). The usual disclaimer applies. We thank the Swiss Federal Office of Culture and in particular Brigitte Müller for financial support of and useful comments on a related project. Ahlfeldt gratefully acknowledges the support of the Deutsche Forschungsgemeinschaft (CRC TRR 190–project #280092119). We thank, in particular, Will Strange for bringing the super developer policy to our attention.

A Model

This section complements Section 2 in the main paper by providing further detail on the model.

A.1 Subsidy

The subsidy a developer receives amounts to the difference in the after-subsidy profit and the operating profit before subsidy, $\tilde{\pi}_i^d$:

$$S_i^d = \tilde{\pi}_i^d - \tilde{\pi}_i^d \quad \forall \quad d \in \mathbf{D} \tag{A.1}$$

It is straightforward to derive the operating profit from Eq. (12) by setting $t_i^d = 0$:

$$\tilde{\pi}_i^d = \left[Q_i^d h_i^d - \bar{C} \times (h_i^d)^{1+\theta} \times \exp\left(\delta_i^d\right) \right] \times \bar{K}_i \quad \forall \quad d \in \mathbf{D} \tag{A.2}$$

Using Eqs. (12) and (A.2) in Eq. (A.1), we obtain

$$S_i^d = \bar{C}(h_i^d)^{(1+\theta)} \bar{K}_i \left(\exp\left(\delta_i^d\right) - \exp\left(\delta_i^d - t_i^d\right)\right) \quad \forall \quad d \in \mathbf{D}.$$

Summation over all developers delivers Eq. (18).

B Quantification

This section complements Section 3 in the main paper by providing additional details on the quantitative literature review and the analysis of preference heterogeneity for distinctive design.

B.1 Literature review

This section adds to Sections 3.1 and 3.2 by describing how we collect and encode the evidence base.

B.1.1 Collection

We aim to collect an evidence base that allows quantifying how the adoption of distinctive design affects rents and construction costs. In building the evidence base for our quantitative literature review, we follow standard best-practice approaches of meta-analytic research, as reviewed by Stanley (2001). To prevent publication bias, we explicitly consider studies published as edited book chapters, in refereed journals, or in academic working paper series (we are also open to other types of publications).

In searching for evidence, we pursue a three-step strategy. We begin with the standard practice of a keyword search in academic databases (EconLit, Web of Science, and Google Scholar) and specialist research institute working paper series (NBER, CEPR, CESifo, and IZA). To ensure a transparent and theory-consistent literature search, the selection of keywords is guided by a matrix that connects outcomes to four central characteristics of high-quality building design, which Ahlfeldt and Pietrostefani (2022) synthesize from a large interdisciplinary literature:

- *Function* reflects the ability of buildings to support intended uses safely, comfortably, and flexibly over their lifecycle, ensuring that scarce production factors are deployed efficiently to generate real estate services, as conceptualized in urban economics.
- *Form* concerns the aesthetic dimension of buildings: beyond functional adequacy, architectural design choices—regarding shape, proportion, materials, and visual articulation—can generate utility for users and observers, create cultural meaning, and even enhance productivity, independently of functionality.
- *Urban design* shifts attention from individual structures to the spatial configuration of buildings and the quality of the spaces between them: coherent ensembles, public spaces, and existing built fabric—including heritage assets—shape identity, walkability, and the experiential quality of cities and towns.
- Finally, *governance* encompasses the institutional framework that regulates and manages the built environment. Effective governance enables HQB by correcting market failures, establishing transparent and predictable planning processes, and fostering the skills and awareness necessary for good design, thereby exerting both indirect effects (via improved function, form, and urban design) and direct effects on Baukultur outcomes.

Table A1: Key word searches

	Characteristic			
Outcome	Function	Form	Urban Design	Governance
Internal value of space: residential	building; function*; rent OR "house prices" OR "land value"	building; design AND form OR heritage; rent OR "house prices" OR "land value" OR "willingness to pay"	building; "urban design"; rent OR "house prices" OR "land value" OR "willingness to pay"	building; legislation; regulation; value; residential
Internal value of space: commercial	building; function*; productivity OR "commercial prices"	building; design AND form OR heritage; productivity OR "commercial prices"	building; "urban design"; productivity OR "commercial prices"	building, planning, policy, zoning, productivity OR commercial
Construction costs	building; function*; "construction cost"	building; design AND form OR heritage; "construction cost"	—	building, planning, policy OR regulation; "construction cost"
External value of space	—	building; design AND form OR heritage; externality OR spill over	building; "urban design"; externality OR spill over	building; legislation; regulation; "external value"; residential

With this approach, we run searches that are specific to the mechanisms governing the causal effects of characteristics on outcomes. Note that the effect of a characteristic on an outcome can operate through multiple mechanisms. In several instances, we run more than one search for a given outcome–characteristic combination to cover different empirically observed variables and thus maximise the evidence base. In each case, we use combinations of keywords that relate to the outcome, the design characteristic, and, if applicable, a mechanism. For example, in searching for papers on the effect of building function on the internal value of residential space, we search for: *building*; *function**; *rent* OR "house prices" OR "land value". We use the term *building* throughout the searches in reference to the built environment. We use the terms *form*, *design*, and *heritage* for the form category, in order to capture built heritage, contemporary design, and iconic architectural examples. We use the term *urban design* as defined in our characteristics. For *governance*, we conduct a separate, generic search since the literature is small. The full set of keywords is summarized in Table A1.

It is worth noting that Google Scholar, unlike the other databases, tends to return a vast number of documents ordered by potential relevance. In several trials preceding the actual evidence collection, we found that the likelihood of a paper being relevant for our purposes was marginal after the 50th entry. Therefore, following Ahlfeldt and Pietrostefani (2019), and in an effort to keep the literature search efficient, we generally did not consider documents beyond this threshold.

This keyword search generates a broad evidence base that is amenable to research questions extending beyond the scope of this paper, in which we are primarily interested in the characteristic *form*. Nevertheless, it has also proven useful for our purposes, as the searches for other characteristics also returned papers analysing the impact of *form*, which we would have missed in a narrower search. In total, the keyword search returned 92 studies speaking to the mechanisms in Table A1.

Based on the evidence collected in step 1, we then conduct an analysis of citation trees in step 2. In particular, we select studies that review the related literature and cross-check their references with papers identified by our keyword search. We find that the evidence is reasonably self-contained, in the sense that the studies identified by the keyword search tend to cite each other but not other relevant work. A few exceptions include papers on the implications of green energy-certified buildings on construction costs (Sun et al., 2019; Weerasinghe and Ramachandra, 2018), and studies on the external and existence value of heritage buildings (Wright and Eppink, 2016). A further 11 studies were added to the database from the citation tree analysis.

In the final step 3 of the evidence collection, we add 34 relevant empirical studies that were known to us prior to the evidence collection or were suggested by colleagues.

B.1.2 Encoding

With our keyword search, we uncover studies from various disciplines. As such, these include studies that provide qualitative insights into the direction of a relationship. We focus on a subset of studies that quantify the effects of distinctive design. Most quantitative results in our evidence base are recovered from multivariate regressions where the dependent variable is measured on a log scale. There is more variety in how distinctive design is captured empirically via explanatory variables. The most popular approach is to define distinctive design via a binary indicator (dummy) variable (e.g., to describe whether a building has won an award). This conventional semi-log specification delivers the following premium associated with distinctive design on an outcome Y:

$$E(\ln Y \mid d = distinctive, X) - E(\ln Y \mid d = ordinary, X) \;=\; \hat{b},$$

where d is the indicator for distinctive design and X is a set of covariates that the authors control for when estimating the premium. This log-point premium can be converted into a percentage premium, following Halvorsen and Palmquist (1980):

$$PV = \exp(\hat{b}) - 1.$$

Instead of a discrete indicator variable, some authors employ continuous metrics (e.g. a design rating), which delivers the following marginal effect:

$$\frac{\partial \ln Y}{\partial \tilde{d}} = \hat{\beta},$$

i.e. $\hat{\beta}$ establishes the log-point increase in Y associated with a one-step increase in the continuous metric $\tilde{d}$. For a straightforward comparison across studies, we use such estimated marginal effects to compute a distinctive design premium as follows:

$$\hat{b} = \hat{\beta} \times \Delta\tilde{d},$$

where $\Delta\tilde{d}$ is the change in the employed metric that corresponds to a shift from an ordinary design (a very low score) to a distinctive design (a very high score). Where authors report results from lin-lin or log-log models, we convert the reported coefficients so that they correspond to the conventional log-lin model, using information from the descriptive statistics reported in the paper. We list the number of quantitative results in our evidence base by outcome category in Table A2. Since one study can provide numerous results, the result count is naturally larger than the study count. Note that we only consider an estimate to be a separate result if it is estimated for a different outcome or a distinctly different sample, such as from a different city or for a different property type (e.g., flats vs. houses). Robustness checks and sensitivity analyses are not considered separate results.

Along with the design premium and the outcome, we encode further variables, including the the number of Google Scholar citations and the publication year, how distinctive design was measured, or whether a study controls for the property's vintage.

Table A2: Counts of Analyses and studies

Outcome Label	Result count	Study count
Internal value of space: residential	51	34
Internal value of space: commercial	17	8
Construction costs	3	2
External value of space	33	28

B.2 Distinctive design preferences

This section complements Section 3.4 in the main paper by providing additional detail on the survey design and the estimation of the taste–heterogeneity parameter ε.

B.2.1 Survey design

This section provides additional information on the image–based survey used to recover the taste heterogeneity parameter ε in Section 3.4, outlining the sampling procedure, image construction, expert benchmark, and randomisation protocol that underlie the dataset.

B.2.1.1 Sampling and implementation

The survey was administered online using the KoboToolbox platform. Participation was voluntary and anonymous. Respondents were invited through social media (for example, X, formerly known as Twitter), university mailing lists and social networks and were informed that the study focused on how people evaluate architecture. Before starting, each participant saw a short information sheet, confirmed informed consent, and was informed there would be no monetary compensation. As an intrinsic incentive, participants were told that, upon completing the survey, they would receive feedback on the similarity between their ratings and those of the *Starchitect* Stefano Boeri.

Each participant evaluated 10 images and subsequently completed a socio-demographic questionnaire collecting standard background variables: age, gender, highest level of education completed, current employment status, and primary field of education or study. The questionnaire took approximately five minutes to complete. In total, 314 respondents completed the survey (165 assigned to Version A and 149 to Version B), yielding 3140 individual image ratings.

B.2.1.2 Image selection

We constructed a balanced set of 20 images, organised into ten matched pairs of distinctive and ordinary buildings. The distinctive buildings are well-known examples of iconic architecture, listed in Table A3: Bosco Verticale (Milan), the Flatiron Building (New York), the Shard (London), Casa Milà (Barcelona), the Dancing House (Prague), the Barbican (London), Mira Tower (San Francisco), Habitat 67 (Montreal), the Royal Crescent (Bath), and the Museu de Arte do Rio (Rio de Janeiro). For each landmark, we selected a nearby "ordinary" building from the same neighbourhood and broadly similar construction period (historic, modernism, or contemporary), so that pairs share local context and urban fabric.

All images were taken from Google Street View. This choice avoids photography and post-production bias that is common in openly shared, highly stylised images. For each pair, we chose viewpoints and framing to keep as many visual features as possible constant across the distinctive and ordinary building: approximate camera distance, field of view, lighting and weather conditions, sky visibility, and absence of passing cars or pedestrians in the foreground. Each image shows a single primary building rather than a streetscape with multiple competing focal points.

B.2.1.3 Expert benchmark and classification

Before fielding the survey, we asked Stefano Boeri — a leading Italian architect and urban planner best known for designing Milan's "Vertical Forest" — to rate all 20 buildings on a 0–100 scale, where 100 corresponds to the highest architectural quality. His ratings are reported in Column (4) of Table A3. Within each pair, the building with the higher Boeri score is classified as *distinctive*, and the other as *ordinary*.

B.2.1.4 Randomization and questionnaire versions

To ensure internal validity, we designed the survey as a simple image-based randomised control exercise. For each of the ten distinctive–ordinary pairs, we created two questionnaire versions:

- Version A contains exactly one image from each pair, where some of these are the distinctive buildings and others are the ordinary buildings.
- Version B contains the complementary set of ten images (i.e., wherever Version A shows the distinctive building, Version B shows the corresponding ordinary building, and vice versa).

Respondents were randomly assigned by the survey software to Version A or Version B. Within each version, the order of the ten images was independently randomised for every respondent. This double randomisation (assignment to questionnaire version and image order) balances observable and unobservable respondent characteristics across the distinctive and ordinary images, and minimises potential order or spillover effects in the ratings.

B.2.1.5 Rating task and outcome variables

For each image, participants were asked to:

> *"Rate this building from 0 to 100."*

They entered a whole number between 0 and 100 using a slider. Let a_{vb} denote the score assigned by respondent v to building b. Our raw dataset consists of one record per

(v, b) pair, containing: (i) the image identifier (e.g., `rio_1`, `nyc_0`); (ii) the distinctive dummy $distinctive_b$; (iii) the survey score a_{vb}; (iv) the expert score.

To prepare for the structural estimation, we collapse the data to the building level and compute the mean rating $\hat{\mu}_b$ and variance $\hat{\sigma}_b^2$ for each of the 20 buildings. The mean building-level rating is around 53 points, while the within-building standard deviation averages approximately 22 points, consistent with the substantial taste heterogeneity highlighted in the main text. Column (5) of Table A3 reports these mean and standard deviation pairs in the format "mean (SD)", for example, 62 (22) for one of the Rio images.

Overall, the design yields a compact, internally valid dataset of subjective evaluations of architectural form, with expert and lay scores observed for the same set of buildings under tightly controlled visual conditions.

Table A3: Buildings included in the survey: survey ratings and descriptive attributes

Picture ID	Building	Location	Mean (SD)	Type	Year	Criteria	Architects	Original Use
rio_1	MAR – Museu de Arte do Rio	Rio de Janeiro	62 (22)	Historic/Contemporary	2013	Award + Listed	Bernardes & Jacobsen	Residential (partial)
nyc_1	Flatiron Building	New York	73 (19)	Historic	1902	Listed building	Daniel Burnham	Commercial & residential
shard_0	Ordinary near The Shard	London	35 (20)					
barcelona_1	Casa Milà	Barcelona	75 (21)	Historic	1912	Listed building	Antoni Gaudí	Residential
prague_0	Ordinary near Dancing House	Prague	37 (21)					
barbican_1	The Barbican	London	61 (25)	Historic–Modernism	1982	Listed building	Chamberlin, Powell & Bon	Residential
sanfan_0	Ordinary near Mira Tower	San Francisco	46 (24)					
montral_1	Habitat 67	Montreal	55 (25)	Historic–Modernism	1967	Award	Moshe Safdie	Residential
bath_0	Ordinary near Royal Crescent	Bath	29 (19)					
milan_0	Ordinary near Bosco Verticale	Milan	39 (23)					
rio_0	Ordinary near MAR	Rio de Janeiro	34 (21)					
nyc_0	Ordinary near Flatiron	New York	42 (21)					
shard_1	The Shard	London	57 (23)	Contemporary	2012	Award	Renzo Piano	Residential (partial)
barcelona_0	Ordinary near Casa Milà	Barcelona	48 (22)					
prague_1	Dancing House	Prague	58 (23)	Contemporary	1996	Award	Milunić & Gehry	Residential
barbican_0	Ordinary near Barbican	London	40 (23)					
sanfran_1	Mira Tower	San Francisco	66 (24)	Contemporary	2019	Award	Studio Gang	Residential
montreal_0	Ordinary near Habitat 67	Montreal	50 (24)					
bath_1	Royal Crescent	Bath	72 (19)	Historic	1774	Listed building	John Wood the Younger	Residential
milan_1	Bosco Verticale	Milan	76 (19)	Contemporary	2014	Award	Stefano Boeri	Residential

Notes: Picture IDs correspond to the two questionnaire versions: for each building pair, the suffix "1" denotes the distinctive landmark and "0" denotes its matched ordinary counterpart drawn from the same neighbourhood. "Mean (SD)" gives the mean and standard deviation of respondents' ratings for each image. For distinctive buildings, additional descriptive attributes are reported. "Type" classifies the architectural style or period (e.g., Historic, Modernism, Contemporary). "Year" refers to the year of completion. "Criteria" records the basis for the building's recognition (e.g., formally listed heritage status or major architectural awards). "Architects" lists the principal designers, and "Original Use" indicates the intended function when the building was first constructed. These fields are intentionally left blank for ordinary buildings, which serve solely as contextual controls without architectural distinction. The architectural quality rating assigned by Starchitect Stefano Boeri is available upon request subject to his approval.

B.2.2 Taste heterogeneity parameter ϵ estimation methods

With the survey results, we estimate the Fréchet taste heterogeneity parameter ϵ and the building-specific shift parameters $\{A_b\}_{b=1}^{\mathcal{B}}$ using three methods. Our baseline specification in the main paper relies on a joint GMM estimation that uses both first and second empirical moments across all buildings. The alternative two approaches—a simplified GMM procedure and an NLS CDF-matching estimator—serve as robustness checks. Throughout, we assume that the latent taste draw a_{ib} for respondent i and building b follows a Fréchet distribution with CDF:

$$F(a) = \exp\left(-(a/A_b)^{-\epsilon}\right), \quad A_b > 0, \ \epsilon > 1.$$

The properties of Fréchet distribution yield the first two moments as follows:

$$\mathbb{E}[a_b] = A_b \, \Gamma\left(1 - \frac{1}{\epsilon}\right), \qquad \text{Var}(a_b) = A_b^2 \left[\Gamma\left(1 - \frac{2}{\epsilon}\right) - \Gamma\left(1 - \frac{1}{\epsilon}\right)^2\right].$$

B.2.2.1 Baseline: Full GMM Estimation

As discussed in Section 3.4, The baseline approach jointly estimates ϵ and the building–specific shift parameters $\{A_b\}$ by matching observed means and variances of survey ratings to the corresponding theoretical moments.

For each building $b = 1, \ldots, \mathcal{B}$, we have sample mean and sample variance:

$$\hat{\mu}_b = \frac{1}{n_b} \sum_{i=1}^{n_b} a_{ib}, \qquad \hat{\sigma}_b^2 = \frac{1}{n_b - 1} \sum_{i=1}^{n_b} (a_{ib} - \hat{\mu}_b)^2.$$

The moment conditions corresponding to the theoretical mean and variance are:

$$g_b^{\mu}(\theta) = \hat{\mu}_b - A_b \, \Gamma\left(1 - \frac{1}{\epsilon}\right) = 0,$$

$$g_b^{\sigma}(\theta) = \hat{\sigma}_b^2 - A_b^2 \left[\Gamma\left(1 - \frac{2}{\epsilon}\right) - \Gamma\left(1 - \frac{1}{\epsilon}\right)^2\right] = 0,$$

where $\theta = (\epsilon, A_1, \ldots, A_{\mathcal{B}})$ is the vector of unknown parameters. Stacking 2×20 moments ($n_b = 20$ buildings in our sample) yields an overidentified system. Estimation proceeds via one–step GMM with identity weighting.

B.2.2.2 Robustness: Simplified GMM Estimation

As an alternative, we first compute the sample mean rating for each building $\hat{\mu}_b$ and treat the building–specific shift as a function of unknown ϵ:

$$\tilde{A}_b(\epsilon) = \frac{\hat{\mu}_b}{\Gamma(1 - 1/\epsilon)}.$$

Substituting this expression into the theoretical variance yields the predicted variance as a function of ϵ only:

$$\tilde{\sigma}_b^2(\epsilon) = \left(\frac{\hat{\mu}_b}{\Gamma(1-1/\epsilon)}\right)^2 \left[\Gamma\left(1-\frac{2}{\epsilon}\right) - \Gamma\left(1-\frac{1}{\epsilon}\right)^2\right].$$

We estimate ϵ via:

$$\hat{\epsilon} = \arg\min_{\epsilon} \sum_{b=1}^{\mathcal{B}} \left(\hat{\sigma}_b^2 - \tilde{\sigma}_b^2(\epsilon)\right)^2.$$

This "plug-in" estimator is computationally light and uses only second moments for identification. Because this simplified procedure sets A_b by plugging in the sample means rather than jointly estimating them with ε, the implied A_b's inherit all idiosyncratic noise in the building-level means. To rationalize the observed variances given this more dispersed cross-building pattern of A_b, the estimator tends to select a larger ε.

B.2.2.3 Robustness: NLS CDF–Matching Estimator

Our third approach uses the entire empirical distribution of ratings for each building rather than only mean and variance. For a grid of rating values $\{x_k\}_{k=1}^K$ of each building $b \in \mathcal{B}$, we compute the empirical CDF:

$$\hat{F}_b(x_k) = \frac{1}{n_b}\sum_{i=1}^{n_b} \mathbf{1}(a_{ib} \leqslant x_k).$$

The theoretical CDF implied by the Fréchet distribution is:

$$F_b(x_k;\epsilon, A_b) = \exp\left[-(x_k/A_b)^{-\epsilon}\right].$$

We jointly estimate $(\epsilon, \{A_b\})$ by minimising the sum of squared deviations:

$$\min_{\epsilon, A_1,\dots,A_{\mathcal{B}}} \sum_{b=1}^{\mathcal{B}}\sum_{k=1}^{K}\left[\hat{F}_b(x_k) - F_b(x_k;\epsilon, A_b)\right]^2.$$

This NLS estimator exploits the entire CDF shape and is therefore sensitive to tail behavior, and likely to yield smaller estimates of ϵ as the Fréchet distribution has heavy tails.

B.2.3 Results and heterogeneous analysis

As Table A4 shows, across the three estimation methods, the overall patterns of taste heterogeneity and shift parameters A_b are consistent. For the full sample of respondents and buildings in the first row, the baseline GMM estimator—which jointly matches the first and second moments of the building-level rating distributions—yields a shape parameter of $\hat{\varepsilon} = 4.04$. The simplified GMM estimator, which targets second moments only, delivers a very similar estimate of $\hat{\varepsilon} = 4.17$. The CDF-matching NLS procedure produces a lower value of $\hat{\varepsilon} = 2.48$, reflecting its greater sensitivity to the heavier tails observed in the empirical distribution of ratings.

Rows (2)–(5) of Table A4 report heterogeneity analyses across five subsamples. Row (2) isolates respondents whose tastes are similar to the Starchitect, defined as having a correlation above 0.7 between their rating vector and the Starchitect's ratings (about 21% of the sample). Row (3) considers respondents with dissimilar tastes (correlation below 0.3; about 23% of the sample). Row (4) focuses on the ten buildings ranked highest by the Starchitect, and the final row reports results for the ten buildings ranked lowest by the Starchitect.

The heterogeneity analysis under all three estimation methods reveals the same substantive patterns: taste heterogeneity is lower (higher ε) among respondents whose preferences are closer to the Starchitect, and higher among those with dissimilar tastes. Likewise, buildings favoured by the Starchitect exhibit more homogeneous appeal, while buildings ranked low display greater dispersion in ratings. These findings suggest that buildings appreciated by architectural experts tend to have broader popular appeal and less elastic demand.

Table A4: Comparison of Preference Heterogeneity Parameter Estimates Across Methods

	Data moments		**GMM1**		**GMM2**		**NLS**	
	Mean	Var	Shift A_b	ε	Shift A_b	ε	Shift A_b	ε
All respondents, all buildings	52.72	480.88	42.73	4.04	43.49	4.17	42.78	2.48
People similar to Starchitect	51.34	416.81	39.53	4.06	42.96	4.42	42.54	2.57
People different from Starchitect	52.99	586.57	42.16	3.79	42.81	3.86	42.39	2.31
Buildings ranked high by Starchitect	65.63	486.86	55.89	4.69	55.84	4.77	57.92	3.31
Buildings ranked low by Starchitect	39.80	474.90	32.39	3.40	30.92	3.41	28.33	2.02

Notes: Mean and variance in columns (1)-(2) report the average of building-level mean ratings and the average of building-level variances, respectively. Columns (3)-(4) shows the results under GMM1, the baseline method that jointly optimizes first and second moments, where "Shift A_b" reports the average of buildings' scale parameters, and ϵ is the estimated design preference heterogeneity parameter. GMM2 in columns (5)-(6) optimizes second moments (variances) only. NLS in columns (7)-(8) matches empirical and theoretical CDFs. Row (1) reports estimates based on the full sample. Row (2) uses the subsample of respondents whose tastes are similar to the Starchitect, defined as those whose rating vectors have a correlation coefficient above 0.7 with the Starchitect's ratings (approximately 21% of the sample). Row (3) reports estimates for respondents whose tastes differ from the Starchitect, defined as those with a correlation coefficient below 0.3 (approximately 23% of the sample). Row (4) reports estimates for the subsample of the 10 buildings ranked highest by the Starchitect, and the last row reports estimates for the subsample of the 10 buildings ranked lowest by the Starchitect.

B.3 Calibrating average design preferences and distinctive design cost

We calibrate the average distinctive design preference shift $A^{d=\text{distinctive}}$ and the distribution of distinctive design cost $\delta_i^{d=\text{distinctive}}$ using a joint simulated method of moments (SMM) procedure. To this end, we define the distinctive design cost as

$$\delta_i^{d=\text{distinctive}} = \bar{\delta}^{d=\text{distinctive}} \left(1 + \sigma \frac{\tilde{\delta}_i^{d=\text{distinctive}}}{\bar{\delta}^{d=\text{distinctive}}}\right) \tag{A.3}$$

where $\bar{\delta}^{d=\text{distinctive}}$ is the mean of the distribution, $\tilde{\delta}_i^{d=\text{distinctive}}$ is the developer-specific shock drawn from a normal distribution with a zero mean and unit standard deviation, and $\frac{\sigma}{\bar{\delta}^{d=\text{distinctive}}} = 0.2$ is the value of the coefficient of variation that is roughly consistent with the dispersion of distinctive design cost reported in Vandell and Lane (1989).

The calibration of $\{A^{d=\text{distinctive}}, \bar{\delta}^{d=\text{distinctive}}\}$ relies on two empirical moments: (i) the internal price premium of distinctive over ordinary buildings, estimated at $\hat{a} = 0.15$, and (ii) the real-world share of distinctive buildings, set to $\hat{s} = 20\%$. The latter value strikes a balance between the typically low rate of listed historic buildings (typically 3–5%) and expert opinions suggesting that up to 30% of all buildings (including from recent periods) across many European inner-city neighbourhoods are worth protecting (BDA, 2016).

The algorithm operates in three nested loops (see Supplement II.3 for pseudo code). In the innermost loop, given utilities and implied submarket population shares, developers choose design types, building heights, and rents under guessed values of $A^{d=\text{distinctive}}$ and $\delta_i^{d=\text{distinctive}}$, until no developer (parcel) has an incentive to switch design type. The middle loop updates utilities and submarket population shares until the housing market clears. The outer loop then updates the distinctive shift parameter $A^{d=\text{distinctive}}$ and the mean of the distinctive costs, $\bar{\delta}^{d=\text{distinctive}}$, such that the model-implied internal premium and distinctive share jointly match their empirical counterparts. To maintain realistic heterogeneity, the developer-specific cost of distinctive design, $\delta_i^{d=\text{distinctive}}$, is updated according to Eq. (A.3) at each iteration. Formally, the algorithm minimises the weighted distance between model-implied and empirical moments:

$$\underset{A^{\text{distinctive}},\bar{d}^{\text{distinctive}}}{\arg\min} \Bigg[\left(\mathbb{E}\left[\ln(Q_{sim,i}^{d=\text{distinctive}})\right] - \mathbb{E}\left[\ln(Q_{sim,i}^{d=\text{ordinary}})\right] - \hat{a} \right)^2 + \left(\frac{\sum_{z\in J} \mathbb{1}(\tilde{d}_z = \text{distinctive})}{J} - \hat{s} \right)^2 \Bigg],$$

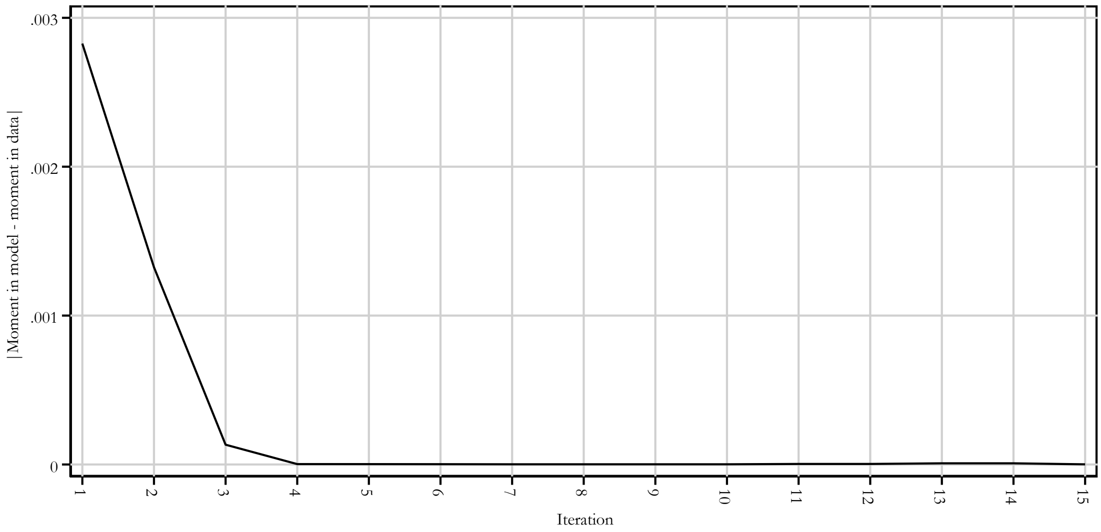
where $\hat{a} = 0.15$ is the empirical internal premium, $\hat{s}$ is the target distinctive share; $\mathbb{E}\left[\ln(Q_{sim,i}^{d=\text{distinctive}})\right] - \mathbb{E}\left[\ln(Q_{sim,i}^{d=\text{ordinary}})\right]$ is the internal premium estimated from a regression of equilibrium rents Q_i on a distinctive dummy, controlling for the design spillover D_i defined in Eq. (7), while $\frac{\sum_{z\in J} \mathbb{1}(\tilde{d}_z = distinctive)}{J}$ is the share of distinctive buildings in the neighbourhood.

The calibration yields a unique vector of $(A^{d=\text{distinctive}}, \bar{\delta}^{d=\text{distinctive}})$ that reproduces both the internal premium and the equilibrium distinctive share, ensuring that the model's baseline neighbourhood structure mimics the observed prevalence and price premium of distinctive architecture. Figure A1 reports the convergence path of this joint SMM procedure, revealing quick conversion. As a result, $A^{d=\text{distinctive}}$ is calibrated to 0.772 and $\bar{\delta}^{d=\text{distinctive}}$ is calibrated to 0.219 which we map into $\delta_i^{d=\text{distinctive}}$ via Eq. A.3.

B.4 Summary of parameters

Table A5 below summarizes the calibrated parameters and those taken from the existing literature.

Figure A1: SMM convergence path of distinctive design amenity and cost estimation



Note: We choose $A^{\text{d=distinctive}}$ and mean of distinctive construction cost $\bar{\delta}_i^{\text{d=distinctive}}$ simultaneously so to match the internal price effect of distinctive design of 0.15 log points estimated in the literature and a target 20% share of distinctive buildings in a typical European inner-city neighbourhood, conditional on setting $A^{\text{d=ordinary}} = 1$. Figure reports the convergence of the calibration procedure, i.e. the sum of squared deviations between the empirical and model-implied internal price premium, and between the empirical and model-implied distinctive share, computed over iterations.

Table A5: Parameter values

	Parameter	Value	Sources
$1-\alpha$	Share of floor space at consumption	0.33	(Combes et al., 2019)
θ	Height elasticity of construction cost	0.2	(Ahlfeldt and McMillen, 2018)
τ	Residential amenity decay	5	(Rossi-Hansberg et al., 2010)
$\bar{\delta}^{d=\text{distinctive}}/\sigma$	Coefficient of Variation of distinctive cost	0.2	(Vandell and Lane, 1989)
β	Design spillover	0.05	Calibrated with external price premia
ϵ	Design preference shape parameter	4	Calibrated with distinctive survey
$\bar{\delta}_i^{d=\text{distinctive}}$	Mean of distinctive cost	0.22	Calibrated with internal premia and distinctive share

Notes: Parameter values combine external evidence and model-based calibration. External parameters ($1-\alpha$, θ, τ) are informed by the urban economics literature. The remaining parameters are calibrated to match the empirical moments targeted in the paper: (i) the internal price premium of distinctive buildings, (ii) the external design spillover premium, (iii) the distribution of architectural ratings obtained from our survey, and (iv) the target share of distinctive buildings in the neighbourhood. The cited references provide background and empirical ranges rather than exact point estimates used in the calibration. We set the following scale parameter arbitrarily to to generate a neighbourhood structure: $\bar{N} = 300{,}000$, $\bar{C} = 500$, $\bar{w} = 55{,}000$, $\bar{V} = 6{,}500$, $A^{\text{d=ordinary}} = 1$, $b_i \sim \mathcal{N}(1,\ 0.01^2)$, and another fundamental $A^{\text{d=distinctive}}$ is calibrated to 0.772 using joint SMM procedure. There are no land use regulation or subsidy in the baseline parametrisation ($\bar{h}_i^d = \infty$, $t_i^d = 0$).

C Policy counterfactuals

This section complements Section 4 in the main paper. It documents the full set of simulated outcomes under various policy interventions, including subsidies for distinctive buildings, taxes on ordinary design, floor-area ratio (FAR) bonuses, and the introduction of a strategic "super developer." The figures and analyses presented here extend the main results by illustrating spatial patterns, design spillovers, rent gradients, and welfare implications under each scenario.

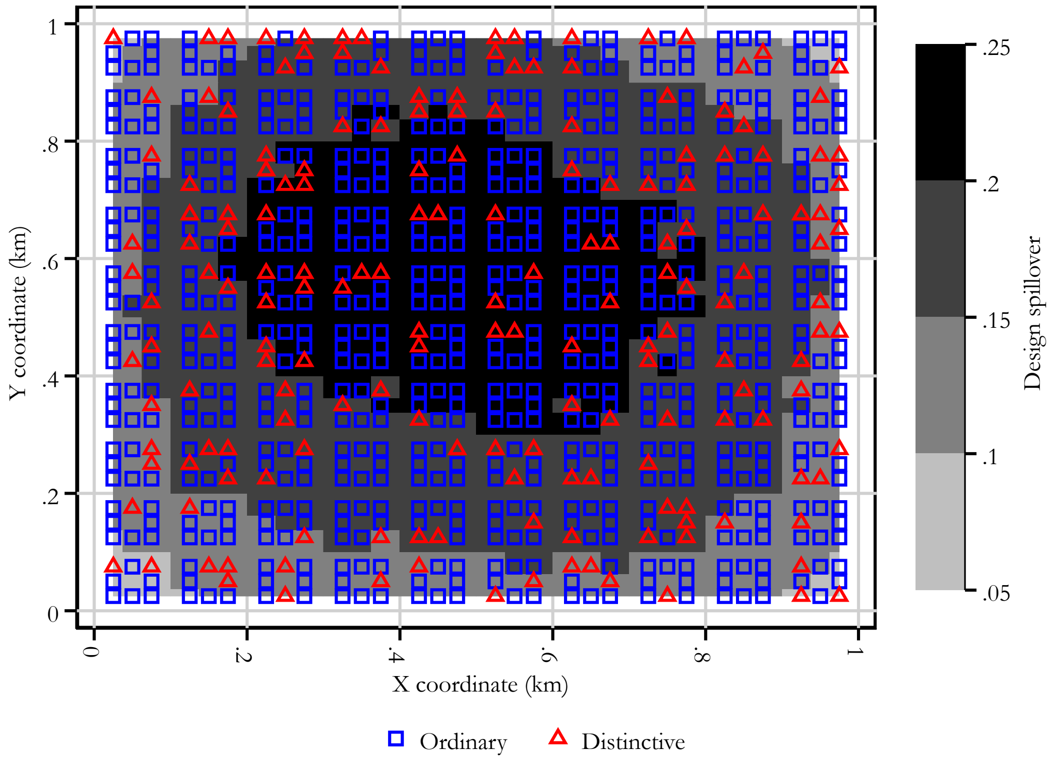
C.1 Subsidising distinctive buildings

This section complements Section 4.1 in the main paper.

C.1.1 Optimal subsidy

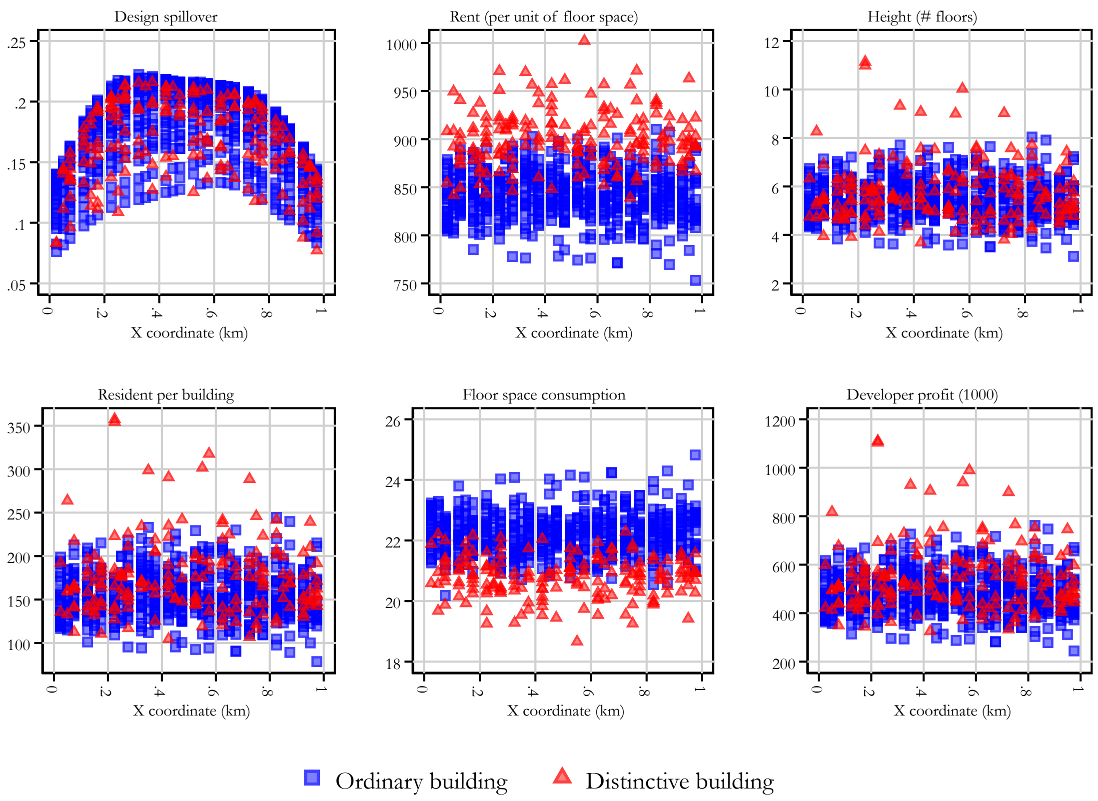
Figure A2 shows the spatial distribution of distinctive buildings and the design spillover under the optimal subsidy found in Section 4.1. Evidently, the density of distinctive buildings is higher, leading to a spillover effect with a peak larger than in the baseline no-subsidy scenario. Figure A3 summarizes the distribution of additional key outcomes. As the supply of distinctive buildings has expanded, the marginal renter has a lower willingness to pay for distinctive design. Therefore, rents of distinctive buildings are now much closer to their ordinary counterparts. Consequently, floor space consumption of residents living in distinctive and ordinary buildings is more alike.

Figure A2: Neighbourhood structure with optimal subsidy



Note: We report solutions to the model developed in Section 2. Underlying parameter values are reported in Table A5. Design spillover is the distance-weighted sum of the volume of distinctive buildings, normalised by the maximum attainable value.

Figure A3: Neighbourhood structure with optimal subsidy

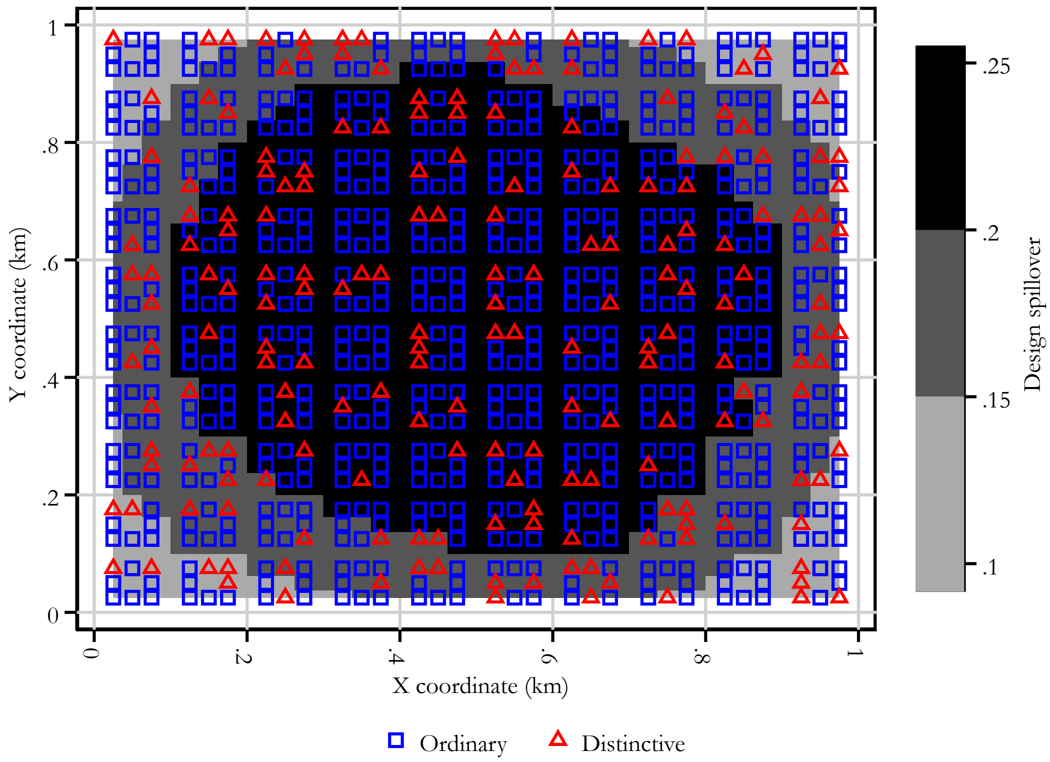


Note: We report solutions to the model developed in Section 2 under the optimal subsidy ($t^{d=distinctive} = 0.10$). The subsidy rate t represents the fraction of construction cost of distinctive buildings (in log points) that is subsidised. For non-distinctive buildings the subsidy is $t^{d=ordinary} = 0$. All other parameter values are kept constant at the levels reported in Table A5.

C.1.2 Too high subsidy

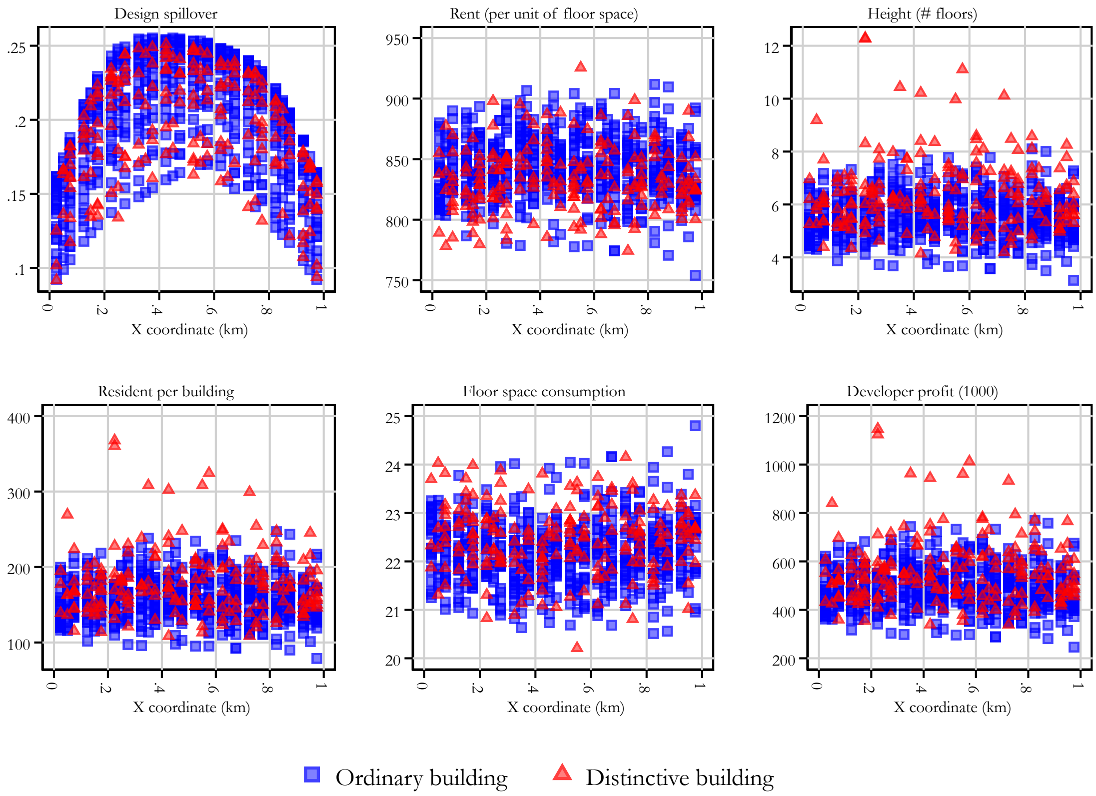
Figures A4 and A5 illustrate the same outcomes under a higher subsidy rate of 20%. Unsurprisingly, the density of distinctive buildings and the design spillover increase further. The design spillover is now strong enough that an inverse-U shape becomes visible in rents. Moreover, the supply of distinctive buildings is now so large that the marginal renter has a sufficiently low willingness to pay for the distinctive design premium on rent to disappear.

Figure A4: Neighbourhood structure with 20% subsidy



Note: We report solutions to the model developed in Section 2. Underlying parameter values are reported in Table A5. Design spillover is the distance-weighted sum of the volume of distinctive buildings, normalised by the maximum attainable value.

Figure A5: Neighbourhood structure with 20% subsidy

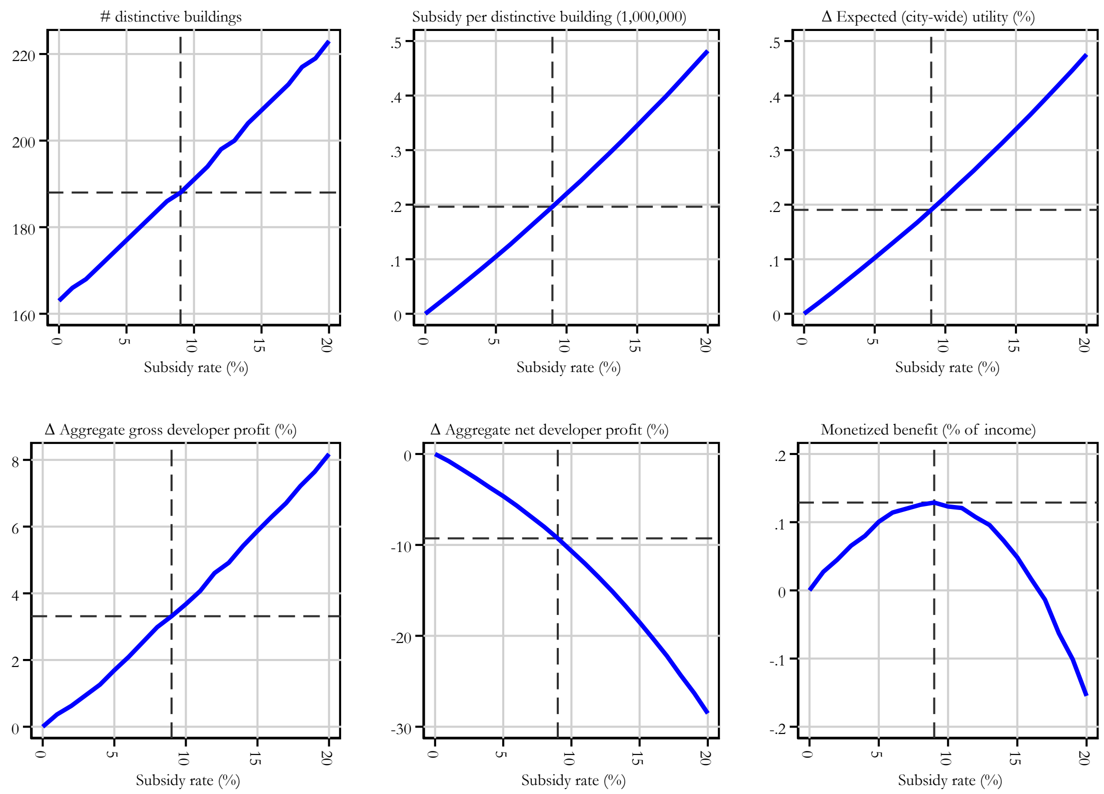


Note: We report solutions to the model developed in Section 2 under a subsidy of ($t^{d=distinctive} = 0.20$). The subsidy rate t represents the fraction of construction cost of distinctive buildings (in log points) that is subsidised. For non-distinctive buildings the subsidy is $t^{d=ordinary} = 0$. Underlying parameter values are reported in Table A5.

C.1.3 Optimal subsidy under more elastic demand

We simulate the optimal subsidy under a Fréchet shape parameter of $\epsilon = 8$, which implies a more elastic demand for distinctive design (owing to lower dispersion in tastes). To this end, we repeat all stages of the inversion and simulation described in Sections 3.5 and 4.1 of the main paper, and key outcomes are summarized in Figure A6. The headline finding is that the optimal subsidy decreases to 9%, and yet there is a greater increase in the supply of distinctive design than in the baseline. Consequently, the monetised welfare benefit increases by 0.01% of income. Intuitively, residents' willingness to pay declines less as the policy induces developers to expand investment in distinctive design. Therefore, the policy is more impactful. At the same time, a relatively large change in the taste dispersion parameter (from $\epsilon = 4$ to $\epsilon = 8$) leads to relatively small changes in the simulation results, indicating that our main results are relatively insensitive to the choice of the parameter value.

Figure A6: subsidising distinctive buildings under more elastic demand



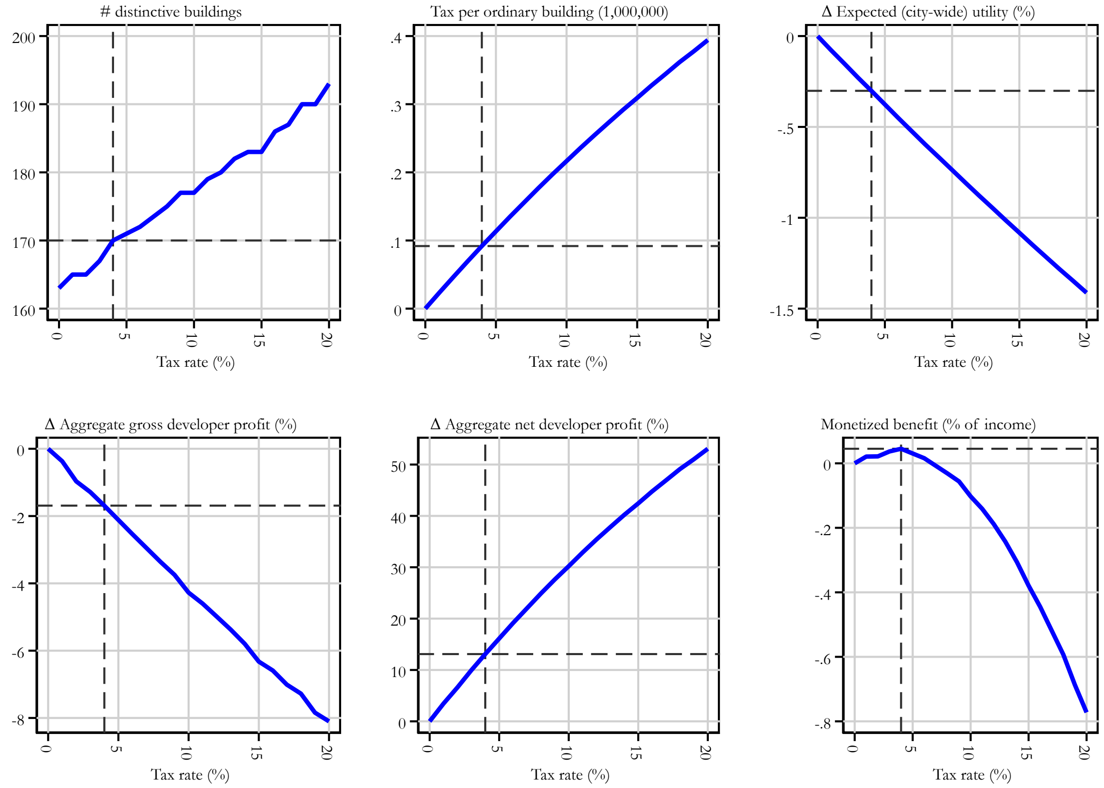
Note: We report solutions to the model developed in Section 2 under varying values of a subsidy under more elastic demand with $\epsilon = 8$. The subsidy rate t represents the fraction of construction cost of distinctive buildings (in log points) that is subsidised. For non-distinctive buildings the subsidy is $t^{d=ordinary} = 0$. All other parameter values are kept constant at the levels reported in Section 3.5. Aggregate net developer profit is the total gross profit net of the total value of the subsidy. Monetised net benefit is sum of the monetised expected utility effect and the aggregate gross profit net of the total value of the subsidy. The expected utility effect is monetised by computing the total income effect that would cause an equivalent utility effect (the product of the percentage utility effect, wage, worker endowment). Vertical dashed lines mark the subsidy rate that maximises the monetised benefit.

C.1.4 Taxing ordinary design

As a complement to the subsidy experiment, we simulate a policy that taxes ordinary buildings at varying rates. Figure A7 shows that a tax rate of 4% on ordinary buildings maximises welfare, though the gain is smaller than under the optimal subsidy. As taxes rise, developers gradually shift towards distinctive design, raising its share to levels comparable to those under optimal distinctive subsidies. However, this comes at the cost of reduced aggregate floor space supply, higher rents, and lower expected utility. Gross developer profits decline steadily as the aggregate supply shrinks, and even if developers are rebated all tax revenues, their net profit would increase by less than 15% at the optimal tax rate. The associated marginal welfare gains are modest and quickly turn negative once tax rates exceed 4%. Figures A8 and A9 describe the neighbourhood structure and various gradients under the optimal tax rate.

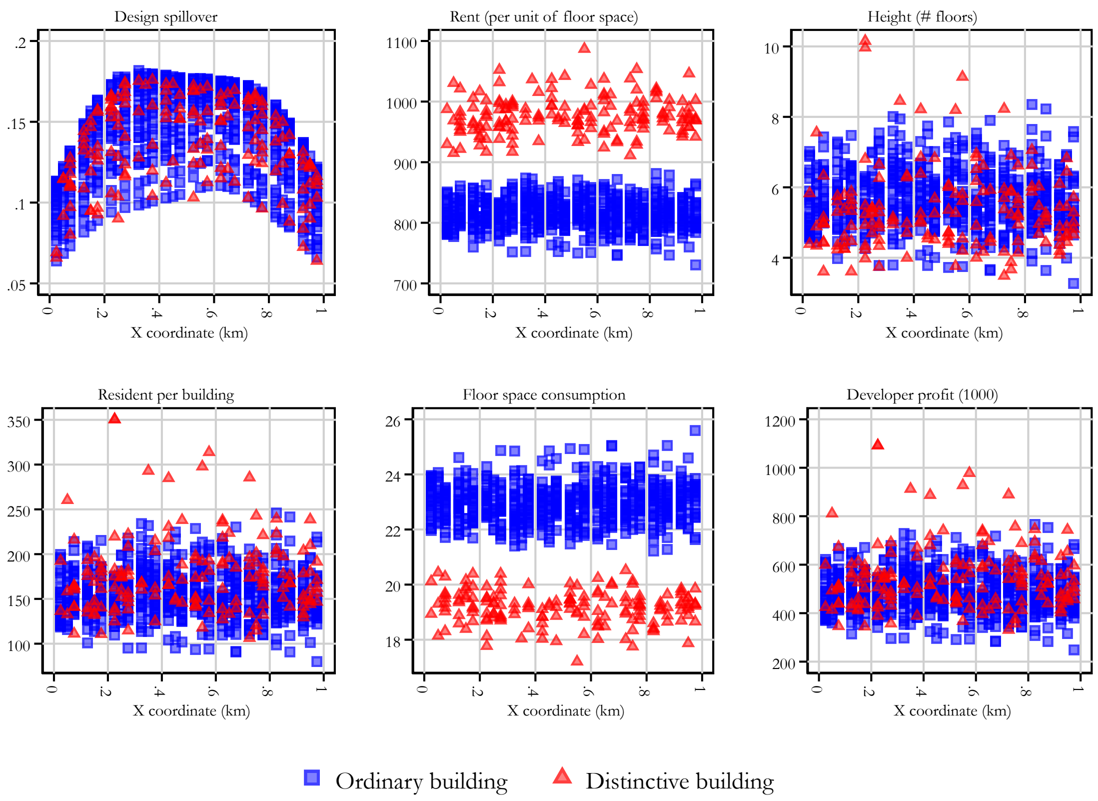
In contrast to subsidies, which directly address the under-provision of distinctive buildings by internalising their positive spillovers, taxes operate indirectly by penalising ordinary buildings. This measure compresses overall supply, reduces housing affordability, and potentially generates regressive distributional effects.

Figure A7: Taxing ordinary buildings



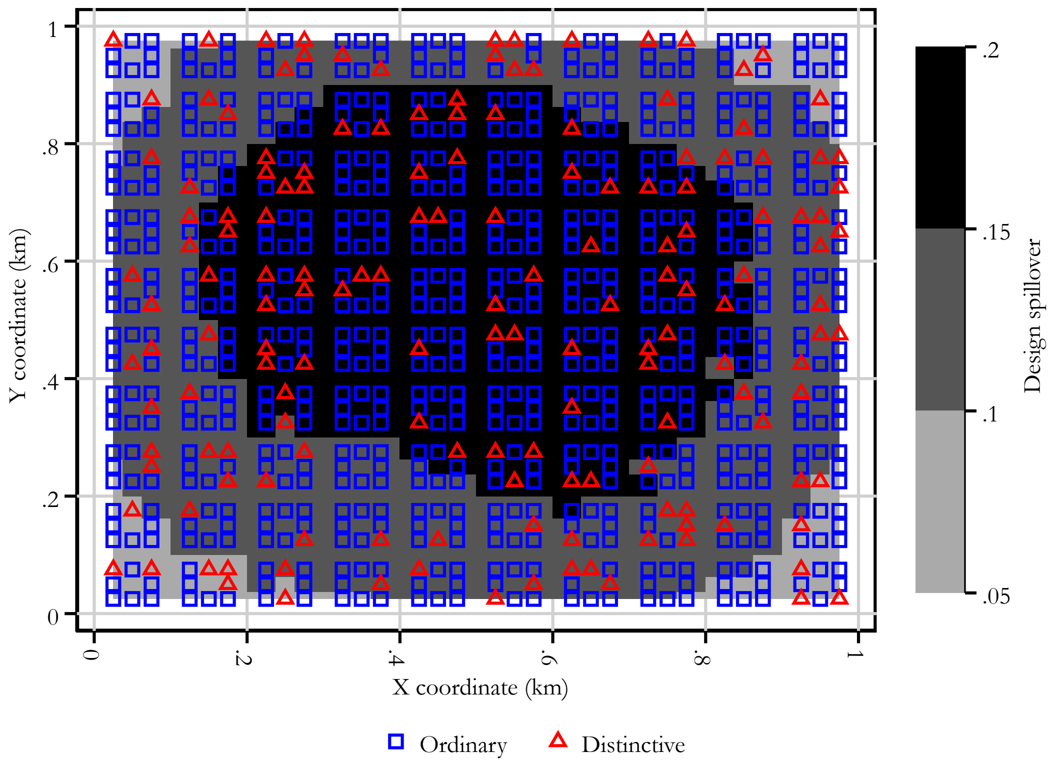
Note: We report solutions to the model developed in Section 2 under varying values of a tax on ordinary buildings. The tax rate t denotes the share of construction costs (expressed in log points) that is levied on ordinary buildings. For distinctive buildings the tax is $t^{d=distinctive} = 0$. All other parameter values are kept constant at the levels reported in Section 3.5. Aggregate net developer profit is the total gross profit plus the total value of the tax. Monetised net benefit is sum of the monetised expected utility effect and the aggregate gross profit net of the total value of the tax. The expected utility effect is monetised by computing the total income effect that would cause an equivalent utility effect (the product of the percentage utility effect, wage, worker endowment). Vertical dashed lines mark the tax rate that maximises the monetised benefit.

Figure A8: Neighbourhood structure with optimal subsidy



Note: We report solutions to the model developed in Section 2 under the optimal tax rate ($t^{d=ordinary} = 0.04$). The tax rate t represents the fraction of construction cost of distinctive buildings (in log points) that is subsidised. For distinctive buildings the tax is $t^{d=distinctive} = 0$. All other parameter values are kept constant at the levels reported in Section 3.5.

Figure A9: neighbourhood structure with optimal subsidy



Note: We report solutions to the model developed in Section 2 under the optimal tax rate ($t^{d=ordinary} = 0.04$). Underlying parameter values are reported in Table A5. Design spillover is the distance-weighted sum of the volume of distinctive buildings, normalised by the maximum attainable value.

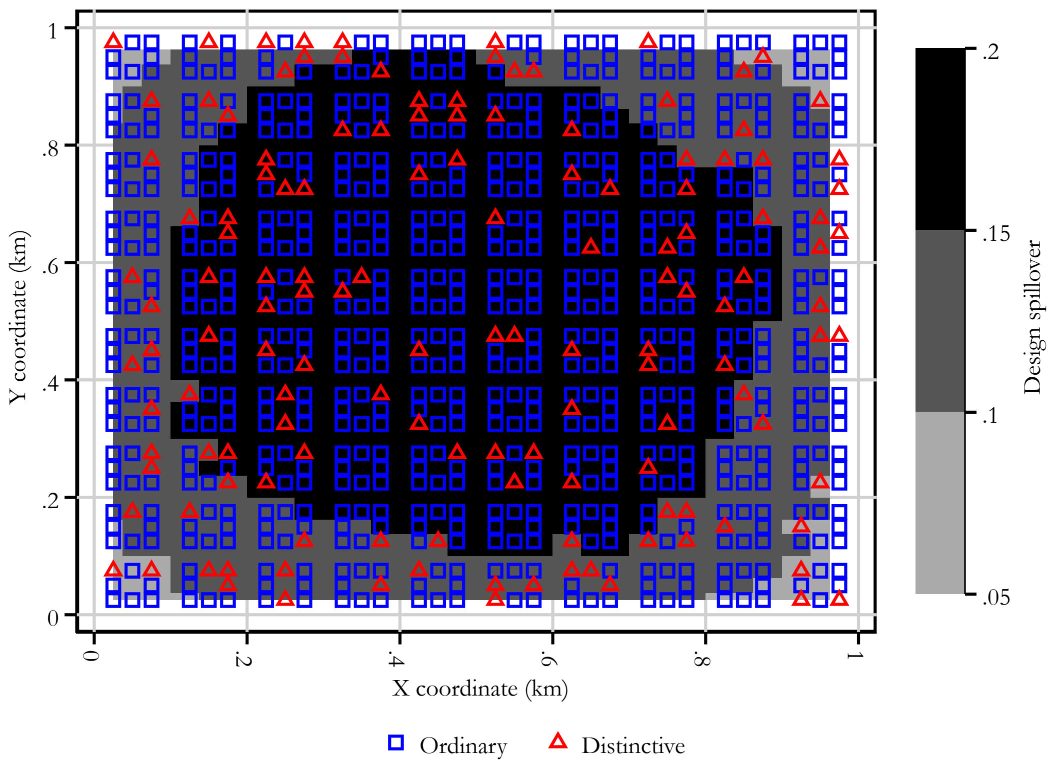
C.2 FAR bonuses for distinctive buildings

This section complements Section 4.2 in the main paper.

C.2.1 FAR bonus in an unconstrained city

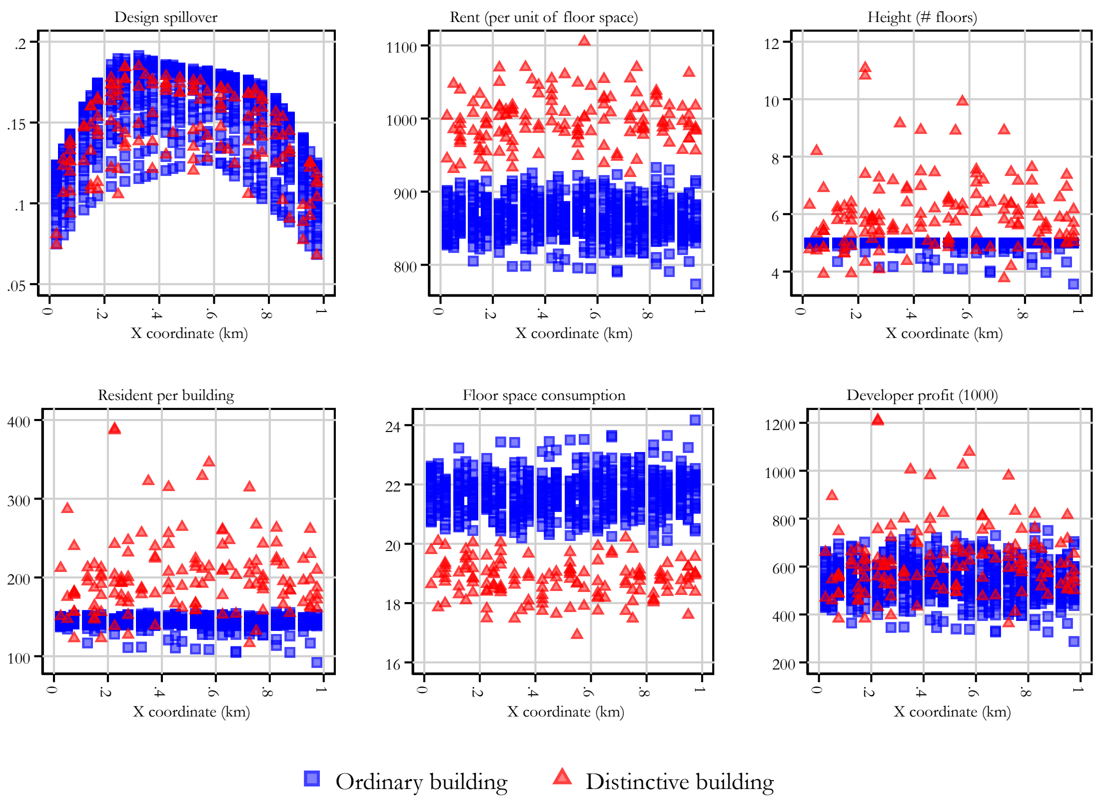
Figures A10 and A11 depict the equilibrium neighbourhood structure under a five-floor height cap for ordinary buildings. The number of distinctive buildings falls slightly, yet those that remain become noticeably taller, with the tallest reaching 11 floors. As a result, the design spillover attains a marginally higher peak. While the overall floor space supply decreases by roughly 0.4%, the share of distinctive supply within the neighbourhood increases by 0.1% relative to the baseline.

Figure A10: Neighbourhood structure with height limit for ordinary buildings I



Note: We report solutions to the model developed in Section 2 under a height limit of five floors for ordinary buildings. Underlying parameter values are reported in Table A5. Design spillover is the distance-weighted sum of the volume of distinctive buildings, normalised by the maximum attainable value.

Figure A11: Neighbourhood structure with height limit for ordinary buildings II



Note: We report solutions to the model developed in Section 2 under a a height limit for ordinary buildings of five floors. All other parameter values are kept constant at the levels reported in Table A5.

C.2.2 Relaxing FAR for distinctive buildings in a constrained city

As discussed in Section 4.2, the FAR bonus provides a welfare-improving intervention if the benchmark is the situation in a supply-constrained city. The policy effects operate through two reinforcing channels. First, relaxing the height limit for distinctive buildings strengthens design spillovers by allowing taller structures to generate larger amenity benefits for their surroundings. Second, the additional floor space supplied by these taller buildings alleviates the scarcity created by the binding cap, reducing rents and raising residential utility. To illustrate these mechanisms, we consider neighbourhoods operating under baseline height caps of 4, 6, and 8 floors, and then remove the cap exclusively for distinctive buildings. This design allows us to trace how the effectiveness of the FAR bonus varies with the tightness of the initial constraint.

Table A6 summarizes the simulation results. When height constraints are tight, relaxing the cap for distinctive buildings triggers large adjustments along both the spillover and supply channels. Under a binding four-floor cap, distinctive supply increases by nearly 18%, total supply by 12%, and expected utility rises by 0.8%, corresponding to an aggregate monetised utility gain of about \$132 million. These gains come at the expense of developer profits, which fall by 14.66% as additional supply depresses rents. Although the number of distinctive buildings falls, those that remain are on average taller and accommodate more residents, generating the observed increase in distinctive supply. As the initial cap becomes less restrictive, the impact of relaxing the distinctive FAR weakens substantially. Starting from a six-floor cap, the utility gain falls to only 0.03% (about \$4.5 million), and when the baseline cap is eight floors—where the constraint is essentially non-binding—the improvement shrinks to just 0.01% (roughly \$0.9 million).

These patterns should not be interpreted as evidence that the FAR bonus is intrinsically modest or universally beneficial. Instead, they confirm that the policy operates by correcting distortions created by binding height limits. When the cap is already lax, there is little room for welfare gains. Most importantly, the welfare gains relative to a supply-constrained baseline cannot be used to justify supply constraints in the first place.

Table A6: Effect of relaxing FAR for distinctive buildings under baseline height caps

Capped	Distinctive build.	Pop.	Distinctive supply	Supply	Expected utility	Developer profits
4-floor	−39.52%	+5.73%	+17.67%	+11.94%	+0.80% (+132.15M)	−14.66% (−99.61M)
6-floor	−2.44%	+0.15%	+0.99%	+0.29%	+0.03% (+4.53M)	−0.85% (−3.39M)
8-floor	+0.00%	−0.04%	+0.41%	−0.00%	+0.01% (+0.87M)	−0.15%(−0.60M)

Notes: Table reports percentage changes resulting from relaxing FAR for distinctive buildings from a baseline where all buildings face an X-floor height cap (i.e., $X \in \{4, 6, 8\}$). Parentheses report monetary changes for the utility and profit columns (in millions).

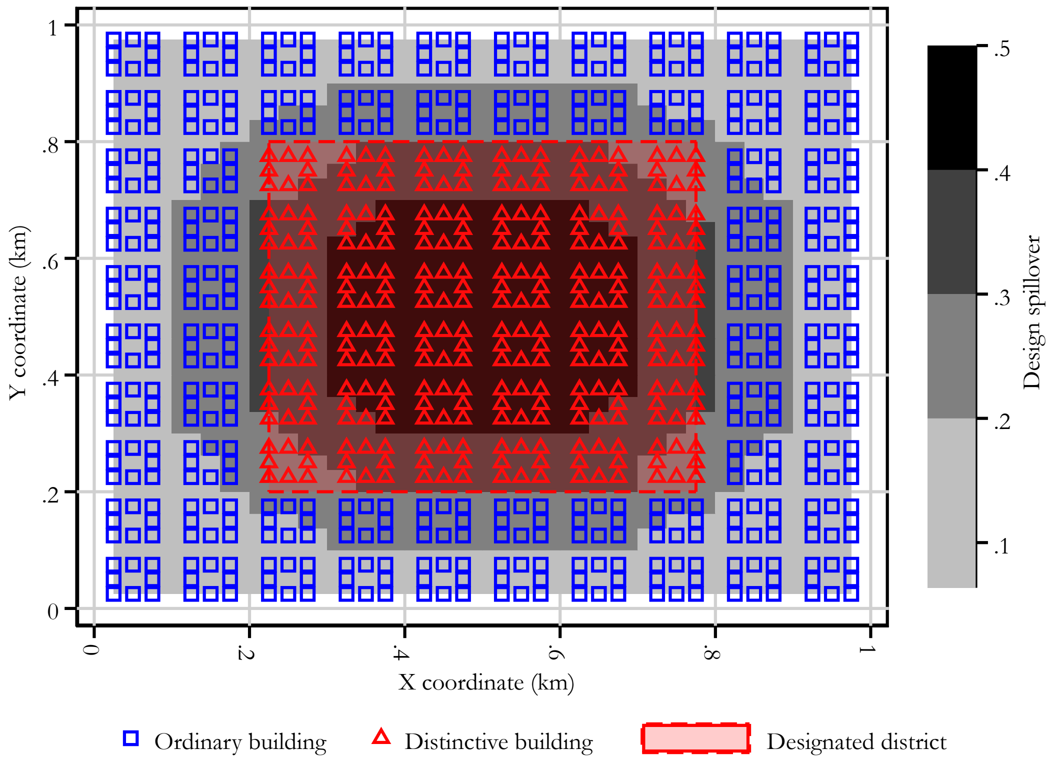
C.3 Distinctive districts

This section complements Section 4.3 in the main paper.

C.3.1 Large mandatory distinctive design districts

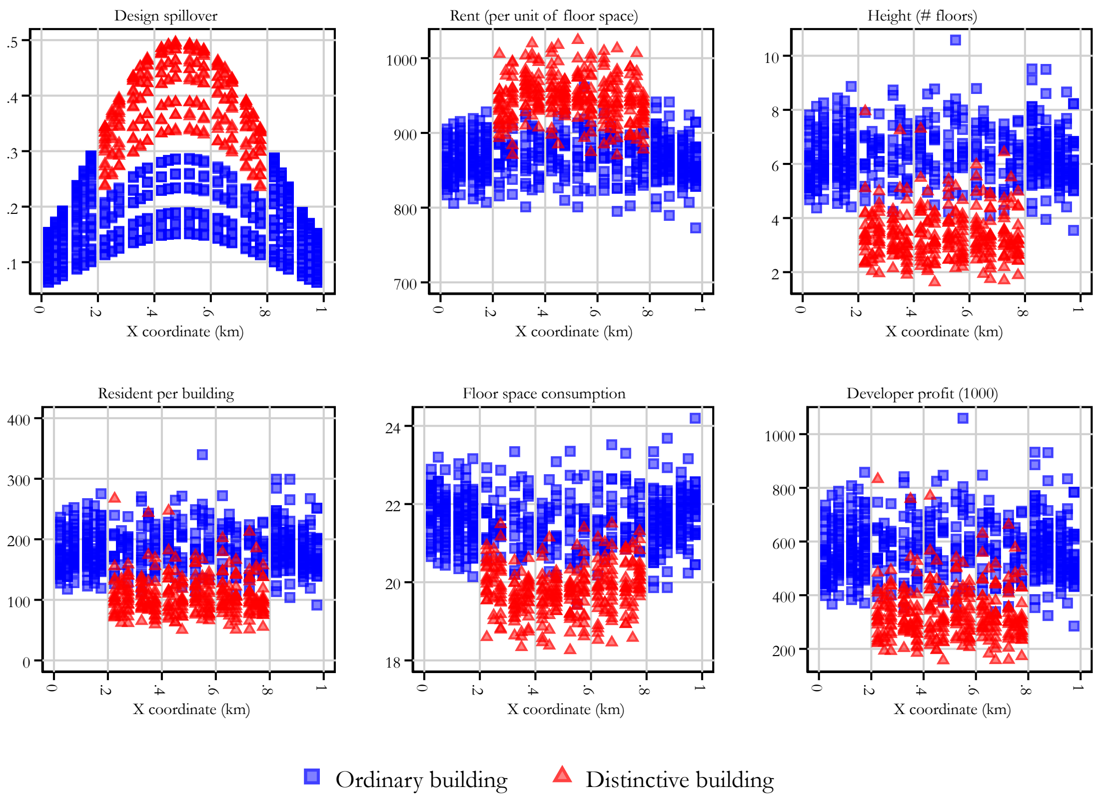
Figures A12 and A13 illustrate the neighbourhood structure with a large square distinctive district covering 288 parcels. With 36% of all buildings designated as distinctive, the design spillover peaks at nearly half of the theoretical maximum (one). Since distinctive buildings are abundant, they rent out at lower prices than in the baseline, which leads to the crowding out of distinctive design outside the distinctive district. Overall supply falls, and so does the population of the neighbourhood. Expected utility and developer profits fall too, revealing that excessive designation can be welfare-depreciating even in the presence of pronounced design spillovers.

Figure A12: Neighbourhood structure with large distinctive district I



Note: We report solutions to the model developed in Section 2. Underlying parameter values are reported in Table A5. We impose that buildings in the distinctive district must be distinctive. Design spillover is the distance-weighted sum of the volume of distinctive buildings, normalised by the maximum attainable value.

Figure A13: Neighbourhood structure with large distinctive district II



Note: We report solutions to the model developed in Section 2. Underlying parameter values are reported in Table A5. We impose that buildings in the distinctive district must be distinctive.

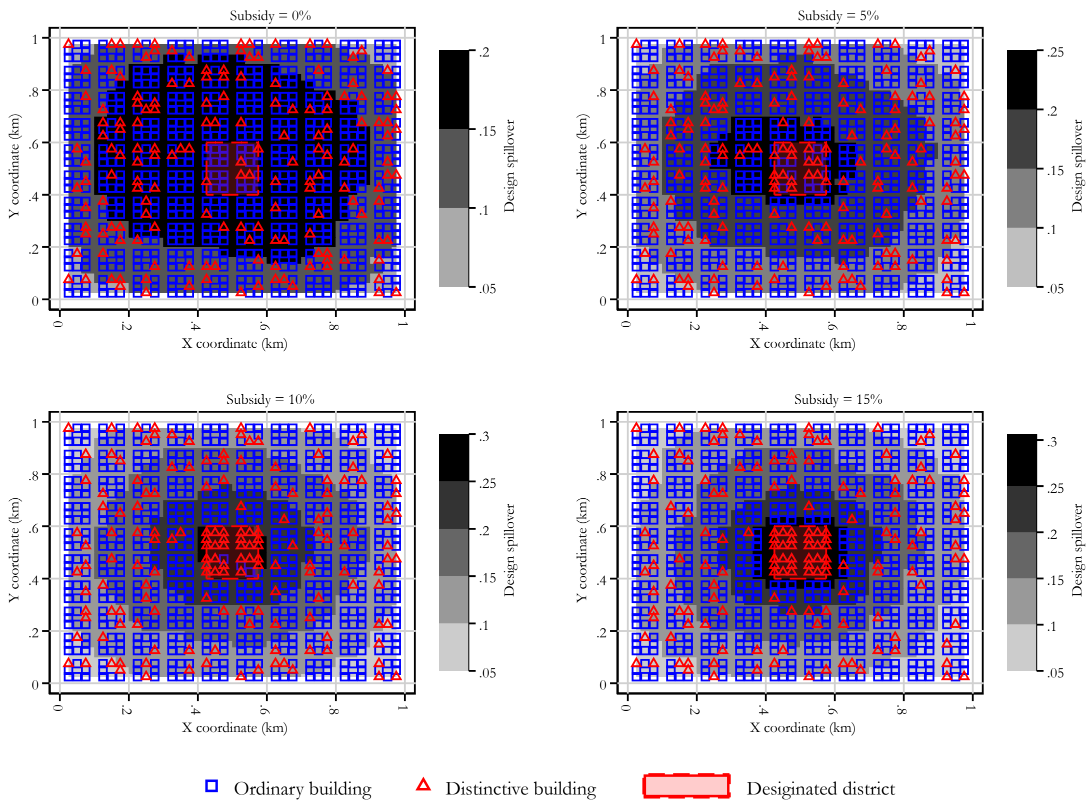
C.3.2 subsidising distinctive buildings within a distinctive district

Instead of mandating distinctive design, it can be incentivised within a distinctive district by means of a subsidy. Figures A14 and A15 illustrate the neighbourhood structure and various gradients when distinctive buildings in a small distinctive district receive varying rates of subsidies. As the subsidy rate increases, a growing share of developers in the district adopt distinctive design, and design spillovers intensify—though with diminishing marginal effects as the district becomes more converted. Both the total share of distinctive supply and the aggregate housing supply in the neighbourhood expand, as subsidies lower distinctive construction costs. However, aggregate developer profits decline once subsidies are netted out, but to a much smaller extent than in the case where subsidies are applied across the entire neighbourhood. The monetised welfare measure peaks at a small subsidy rate of around 2%.

The benefit of a spatially targeted subsidy is that it generates spillovers among designated buildings. The cost is the crowding out of distinctive design at parcels where it could be relatively more competitive. In keeping with intuition, such a district should be located in areas particularly suited for the adoption of distinctive design.

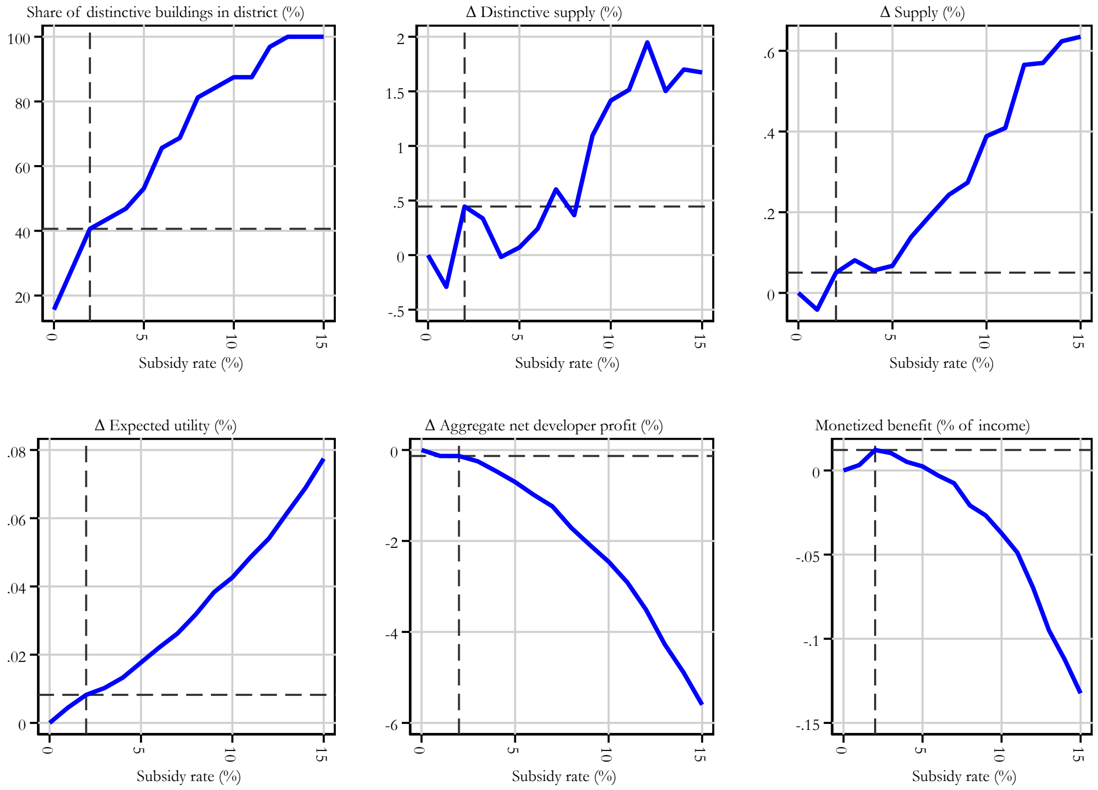
Figures A16 and A17 illustrate additional outcomes under the optimal subsidy. Under this policy, around 40% of buildings in the distinctive district are of distinctive design. Consequently, there is a steeply decreasing design spillover gradient. Though the supply of distinctive buildings has increased, the associated rent premium remains significant due to higher exposure to design spillovers. Building heights in the subsidised distinctive buildings are greater, further contributing to the design spillover.

Figure A14: Neighbourhood structure with subsidised distinctive district I



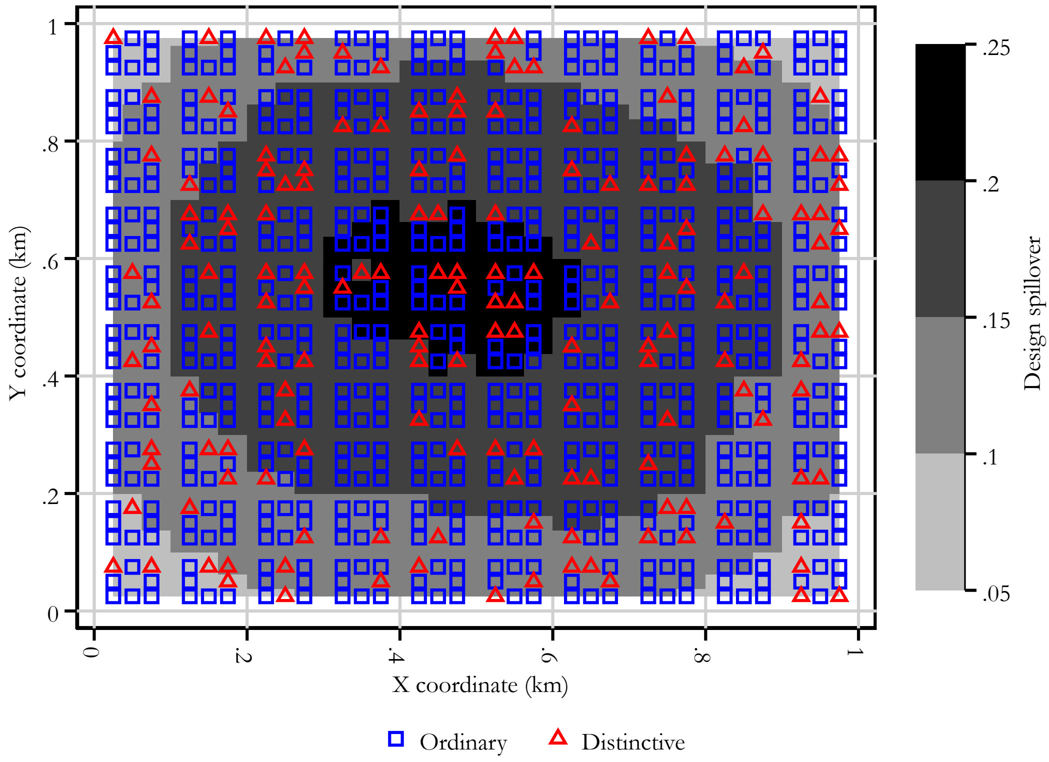
Note: We report solutions to the model developed in Section 2. Underlying parameter values are reported in Table A5. Distinctive buildings in the distinctive district received a subsidy that is proportionate to construction cost. Ordinary buildings are not subsidised. Design spillover is the distance-weighted sum of the volume of distinctive buildings, normalised by the maximum attainable value.

Figure A15: subsidising distinctive buildings in distinctive district



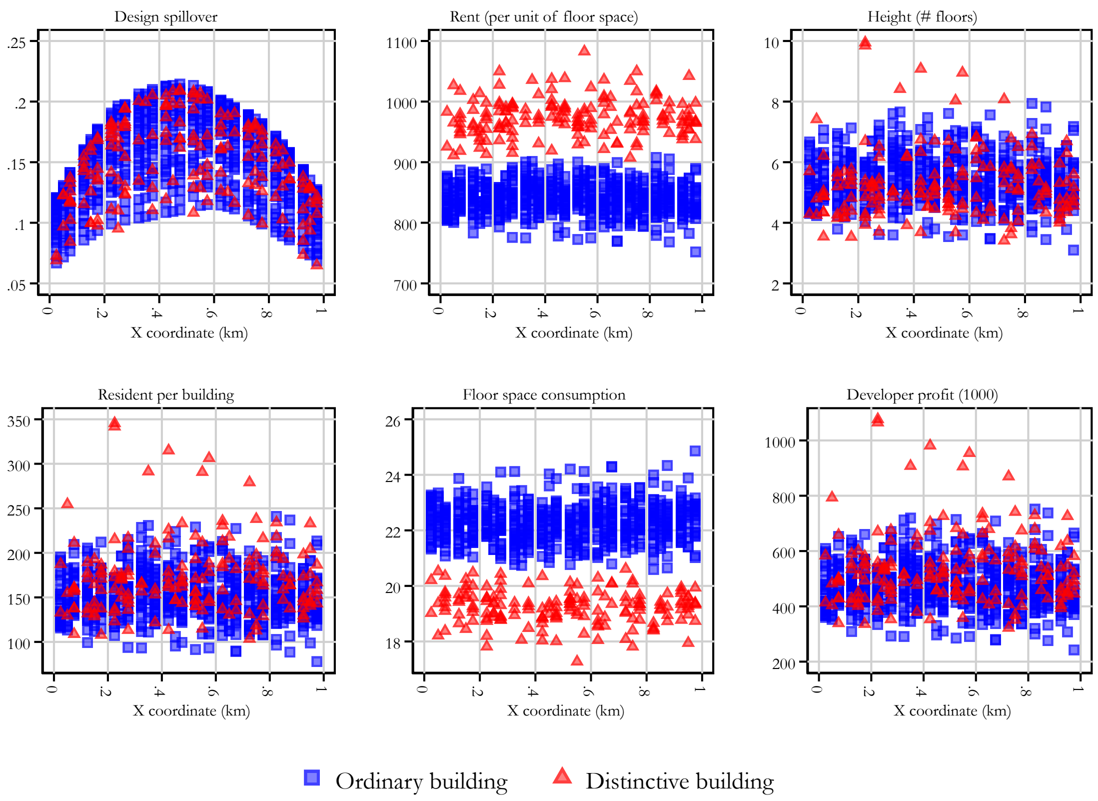
Note: We report solutions to the model developed in Section 2. Underlying parameter values are reported in Table A5. We subsidise distinctive buildings in the distinctive district, exclusively.

Figure A16: Neighbourhood structure with optimally subsidised distinctive district I



Note: We report solutions to the model developed in Section 2. Underlying parameter values are reported in Table A5. Distinctive buildings in the distinctive district received a subsidy proportionate to construction cost that maximises the welfare across the economy. Ordinary buildings are not subsidised. Design spillover is the distance-weighted sum of the volume of distinctive buildings, normalised by the maximum attainable value.

Figure A17: Neighbourhood structure with optimally subsidised distinctive district II

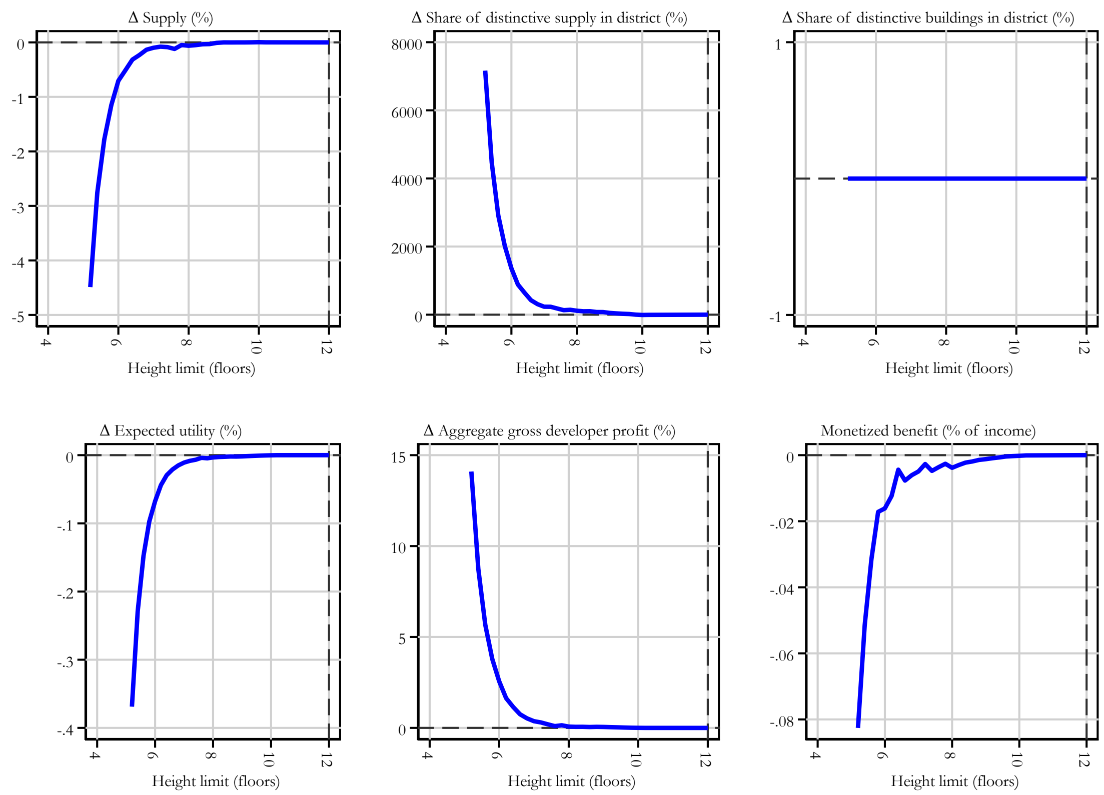


Note: We report solutions to the model developed in Section 2. Underlying parameter values are reported in Table A5. Distinctive buildings in the distinctive district received a subsidy proportionate to construction cost that maximises the welfare across the economy. Ordinary buildings are not subsidised. Design spillover is the distance-weighted sum of the volume of distinctive buildings, normalised by the maximum attainable value.

C.3.3 FAR bonus for distinctive buildings in a distinctive district

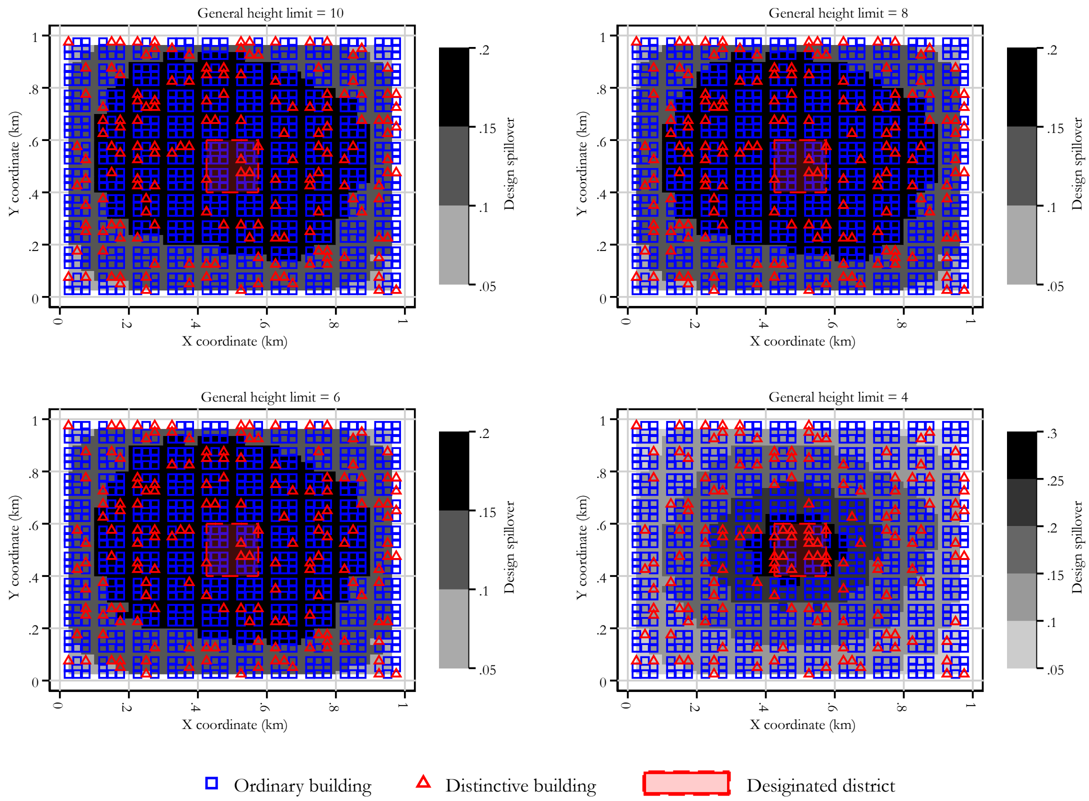
Figures A18 and A19 illustrate the various gradients and neighbourhood structure when buildings other than distinctive buildings in a small distinctive district face building height constraints. Figure A20 presents additional outcomes under a tight regulation. Because the supply of ordinary buildings is heavily constrained, rents for ordinary buildings increase significantly relative to distinctive buildings. Yet, developer profits fall, as the quantity effect dominates. Similar to FAR-based incentives that rely on restricting the supply of ordinary buildings, this policy is typically not desirable, as the monetised aggregate loss in workers' expected utility—arising from higher rents and constrained supply—consistently outweighs the increase in developer profits.

Figure A18: Restricting height outside distinctive district



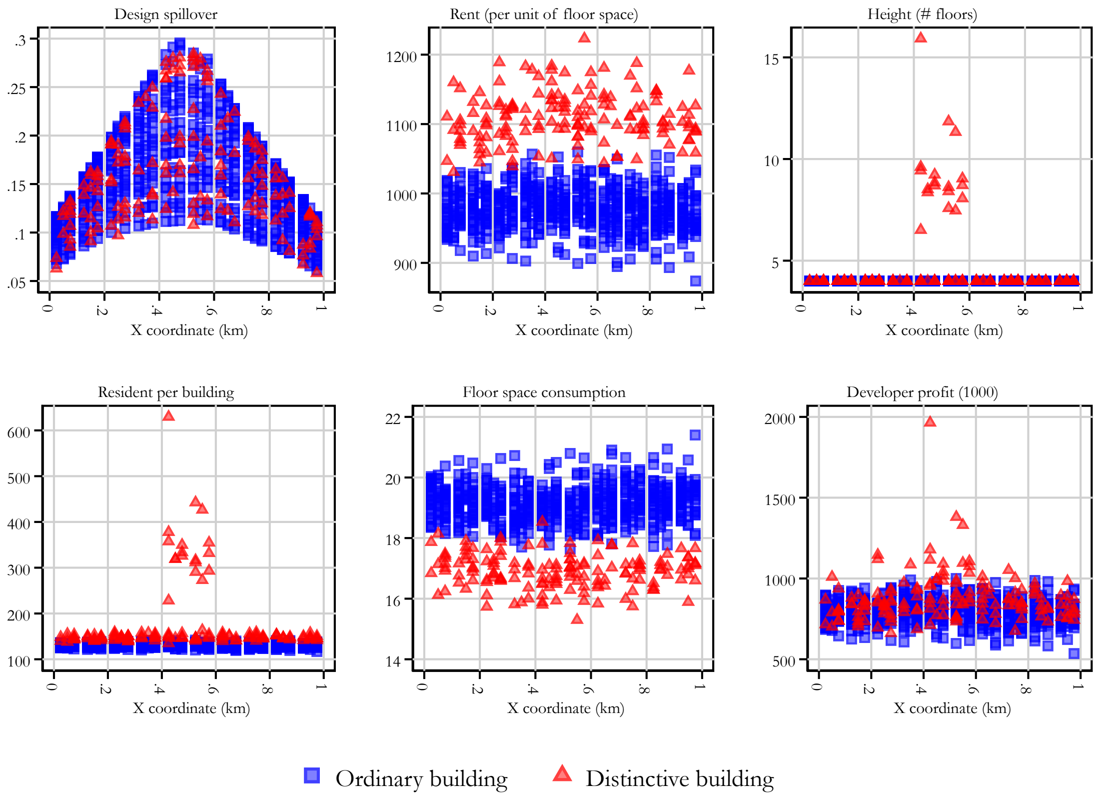
Note: We report solutions to the model developed in Section 2. Underlying parameter values are reported in Table A5. We restrict the height of all buildings except distinctive buildings within the distinctive district.

Figure A19: Neighbourhood structure with FAR bonus in distinctive district I



Note: We report solutions to the model developed in Section 2. Underlying parameter values are reported in Table A5. Distinctive buildings in the distinctive district face no height constraint. Building heights of all other buildings are regulated. Design spillover is the distance-weighted sum of the volume of distinctive buildings, normalised by the maximum attainable value.

Figure A20: Neighbourhood structure with FAR bonus in distinctive district II



Note: We report solutions to the model developed in Section 2. Underlying parameter values are reported in Table A5. Distinctive buildings in the distinctive district face no height constraint. Building heights of all other buildings are regulated.

C.4 Super developer

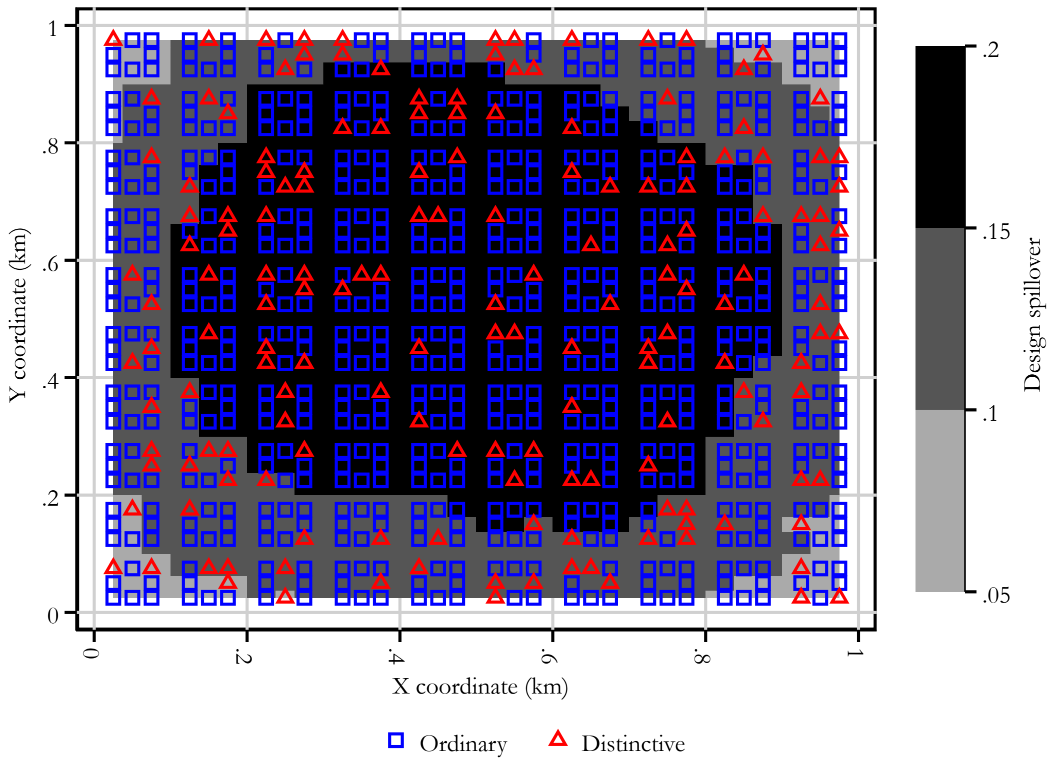
This section complements Section 4.4 in the main paper. Figures A21–A22 illustrate the equilibrium neighbourhood structure and key gradients under the *fully myopic* scenario. In this baseline, the developer evaluates each project in isolation, holding rents and spillovers fixed. The neighbourhood contains 163 distinctive buildings that are relatively dispersed, with spillovers peaking moderately around 0.2 in central areas. This case represents an economy without coordination or forward-looking behaviour, where distinctive design adoption is driven solely by returns from individual parcels.

Figures A23–A24 show the *fully strategic* scenario, in which the developer perfectly anticipates both spillover feedbacks and price effects from supply adjustments. The number of distinctive buildings rises to 168, and they become more spatially concentrated near the centre. Internalising design externalities makes central parcels more profitable, leading to higher peak spillovers (around 0.33), steeper rent and height gradients, and overall higher rents, profits, and welfare.

Figures A25–A26 depict the *strategic-without-spillover* case, where the developer anticipates price feedbacks but holds spillovers fixed at historical levels. The number of distinctive buildings drops to 145, reducing the central spillover peak to about 0.18, whereas distinctive rents rise slightly compared to the *fully myopic* scenario. Although the number and aggregate supply of distinctive buildings decrease, the remaining ones are, on average, taller and house more residents. This exercise reveals the pure effect of market power: a monopolist restricts supply to preserve scarcity rents. The distribution of distinctive buildings becomes more scattered as the incentive to cluster distinctive design through spillover reinforcement disappears.

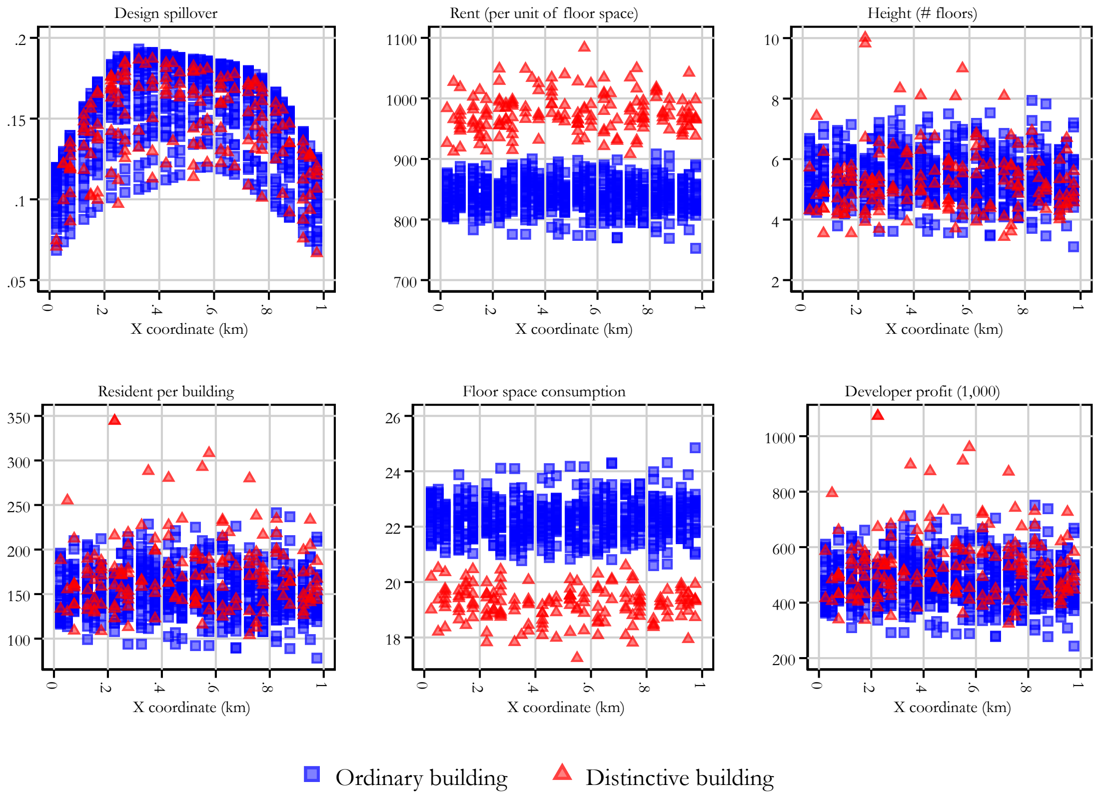
Comparing across the three settings isolates two offsetting mechanisms. Relative to the *fully myopic* benchmark, the *strategic-without-spillovers* scenario captures the *market-power channel*, in which anticipating price feedbacks alone reduces distinctive adoption. The contrast between the *fully strategic* and *strategic-without-spillovers* cases identifies the *spillover-internalization channel*, where recognising the positive externalities of distinctive design encourages additional adoption and spatial clustering. Overall, consolidation enables developers to internalise design externalities but simultaneously introduces monopoly distortions, resulting in only modest welfare gains.

Figure A21: Fully myopic super developer I



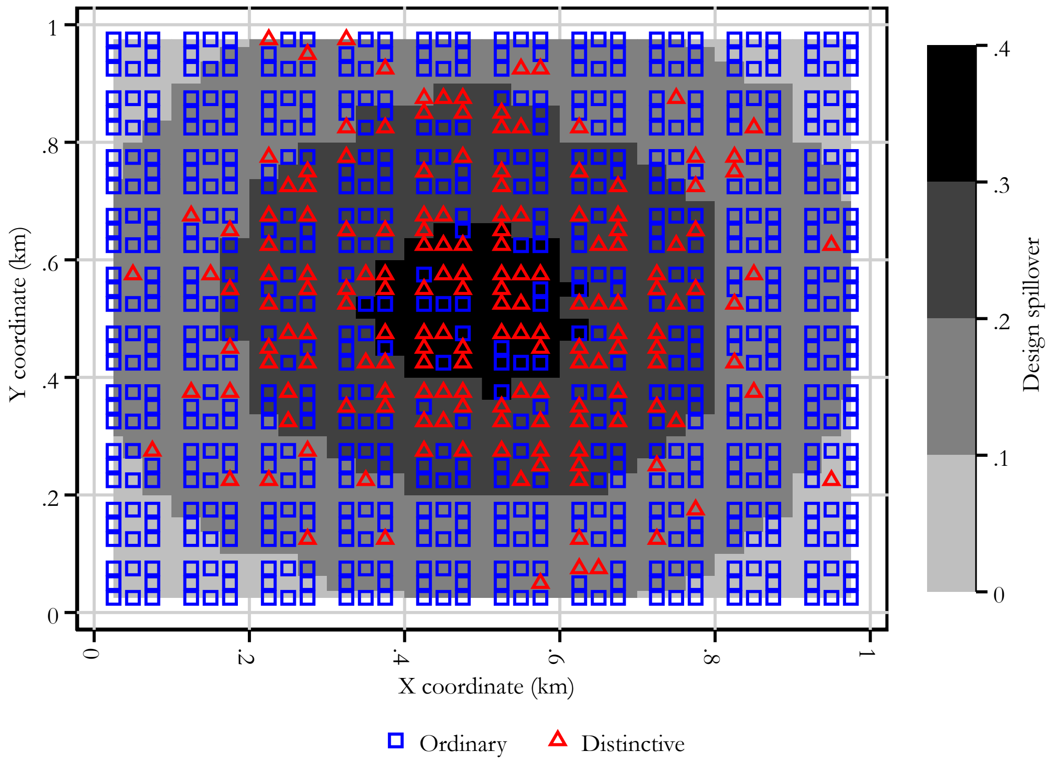
Note: We report results from the greedy algorithm under the fully-myopic super-developer scenario described in Section 4.4 and Appendix II.5. In this setting, a super developer owns the entire neighbourhood and sequentially converts ordinary buildings into distinctive ones. In the fully-myopic scenario, the developer ignores feedback effects on rents and spillovers when evaluating parcels and instead bases decisions on historical rents and spillovers. After each conversion, the realised spillovers update and the economy adjusts to a new equilibrium.

Figure A22: Fully myopic super developer II



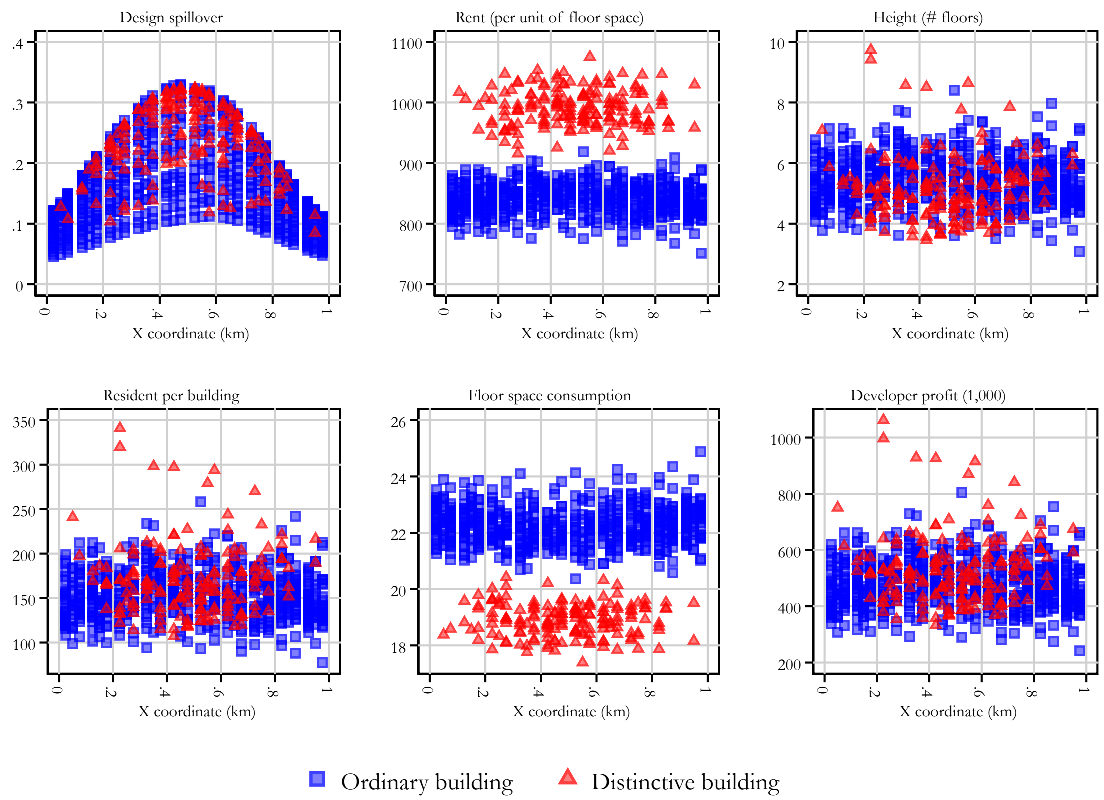
Note:We report results of key gradients from the greedy algorithm under the fully-myopic super-developer scenario described in Section 4.4 and Appendix II.5. In this setting, a super developer owns the entire neighbourhood and sequentially converts ordinary buildings into distinctive ones. In the fully-myopic scenario, the developer ignores feedback effects on rents and spillovers when evaluating parcels and instead bases decisions on historical rents and spillovers. After each conversion, the realised spillovers update and the economy adjusts to a new equilibrium.

Figure A23: Fully strategic super developer I



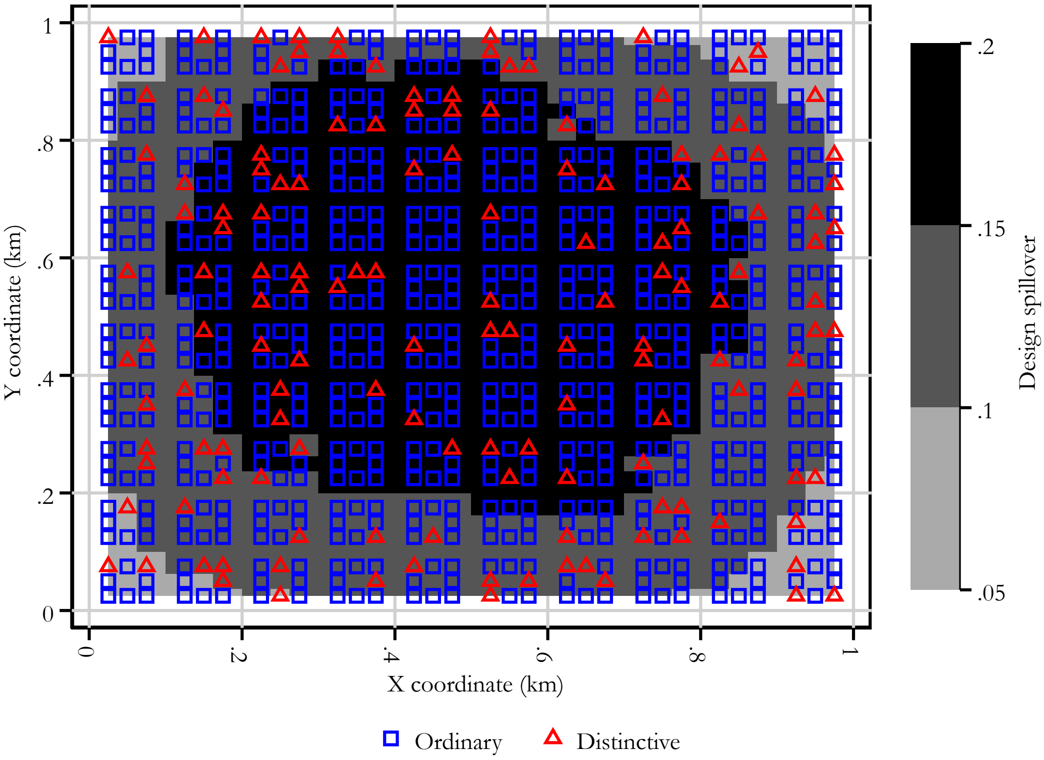
Note: We report results from the greedy algorithm under the fully-strategic (monopoly) super-developer scenario with endogenous spillover updates, as described in Section 4.4 and Appendix II.5. In this setting, a super developer owns the entire neighbourhood and sequentially converts ordinary buildings into distinctive ones. In this fully-strategic scenario, the developer internalises feedback effects on supply, rents, heights, and design spillovers when evaluating parcels, allowing spillovers to adjust endogenously to each candidate conversion. After each round of parcel selection, the developer implements the planned changes to the neighbourhood structure, and the economy re-equilibrates as the developer expected before proceeding to the next evaluation round.

Figure A24: Fully strategic super developer II



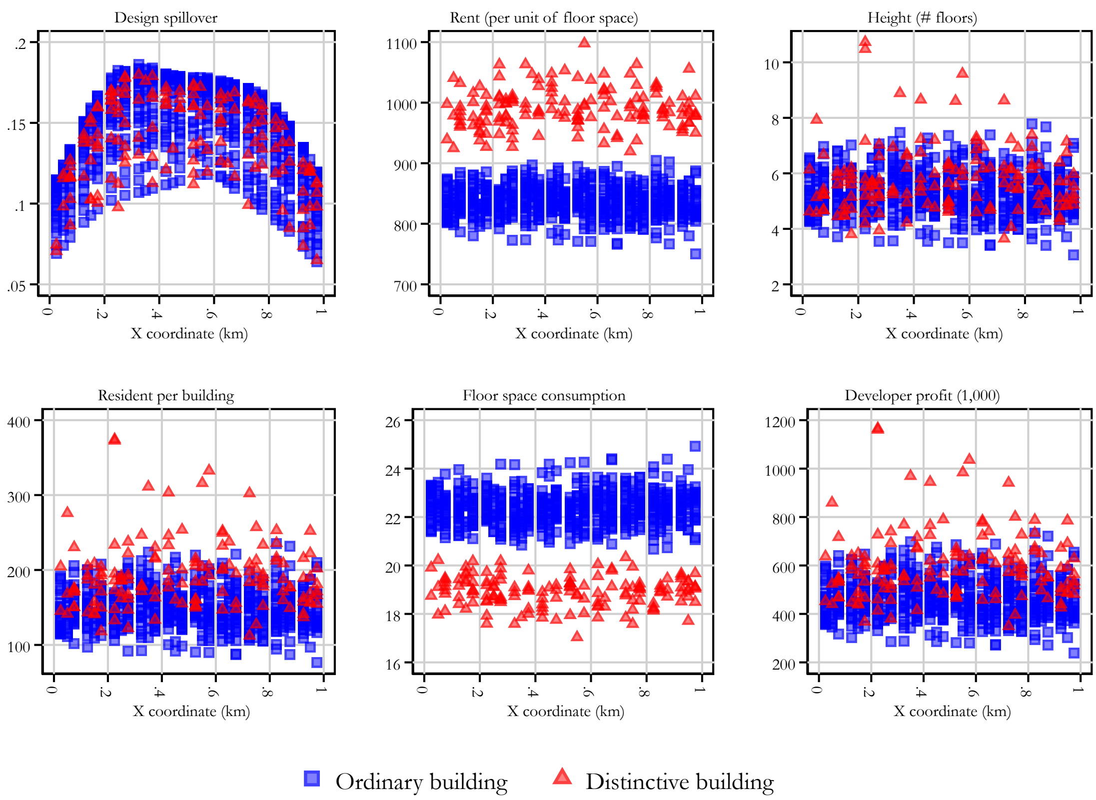
Note: We report results of key gradients from the greedy algorithm under the fully-strategic (monopoly) super-developer scenario with endogenous spillover updates, as described in Section 4.4 and Appendix II.5. In this setting, a super developer owns the entire neighbourhood and sequentially converts ordinary buildings into distinctive ones. In this fully-strategic scenario, the developer internalises feedback effects on supply, rents, heights, and design spillovers when evaluating parcels, allowing spillovers to adjust endogenously to each candidate conversion. After each round of parcel selection, the developer implements the planned changes to the neighbourhood structure, and the economy re-equilibrates as the developer expected before proceeding to the next evaluation round.

Figure A25: Strategic super developer without spillover updates I



Note: We report results from the greedy algorithm under the strategic (monopoly) super-developer scenario without spillover updates, as described in Section 4.4 and Appendix II.5. In this setting, a super developer owns the entire neighbourhood and sequentially converts ordinary buildings into distinctive ones. In this strategic-without-spillover scenario, the developer internalises feedback effects on supply, rents, and heights when evaluating parcels, but keeps design spillovers fixed at their historical levels during the evaluation stage. After each round of parcel selection, the developer implements the planned changes to the neighbourhood structure; the design spillovers are then updated, and the economy adjusts to a new equilibrium before the next evaluation round.

Figure A26: Strategic super developer without spillover updates II



Note: We report results of key gradients from the greedy algorithm under the strategic (monopoly) super-developer scenario without spillover updates, as described in Section 4.4 and Appendix II.5. In this setting, a super developer owns the entire neighbourhood and sequentially converts ordinary buildings into distinctive ones. In this strategic-without-spillover scenario, the developer internalises feedback effects on supply, rents, and heights when evaluating parcels, but keeps design spillovers fixed at their historical levels during the evaluation stage. After each round of parcel selection, the developer implements the planned changes to the neighbourhood structure; the design spillovers are then updated, and the economy adjusts to a new equilibrium before the next evaluation round.

References

Ahlfeldt, Gabriel M. and Daniel P. McMillen, "Tall buildings and land values: Height and construction cost elasticities in Chicago, 1870-2010," *Review of Economics and Statistics*, 12 2018, *100* (5), 861–875.

_ **and Elisabetta Pietrostefani**, "The economic effects of density: A synthesis," *Journal of Urban Economics*, 2019, *111* (February), 93–107.

_ **and** _ , ""Quality sells": High-quality Baukultur as a success factor for the construction and real estate industry," Report, Swiss Federal Office of Culture (BAK) 2022. Version July 2022; available as PDF at baukultur–production–storage.s3.amazonaws.com.

BDA, Bund Deutscher Architekten, "Bestand braucht Haltung," *Bund Deutscher Architekten BDA, Landesverband Nordrhein-Westfalen e. V.*, 2016.

Combes, Pierre-Philippe, Gilles Duranton, and Laurent Gobillon, "The Costs of Agglomeration: House and Land Prices in French Cities," *The Review of Economic Studies*, 10 2019, *86* (4), 1556–1589.

Halvorsen, Robert and Raymond Palmquist, "The Interpretation of Dummy Variables in Semilogarithmic Equations ," *The American Economics Review*, 6 1980, *70* (3), 474–475.

Rossi-Hansberg, Esteban, Pierre-Daniel Sarte, and Raymond Owens, "Housing Externalities," *Journal of Political Economy*, 6 2010, *118* (3), 485–535.

Stanley, Theodore D., "Wheat From Chaff: Meta-Analysis as Quantitative Literature Review," *Journal of Economic Perspectives*, 2001, *15* (3), 131–150.

Sun, Chen-Yi, Yin-Guang Chen, Rong-Jing Wang, Shih-Chi Lo, Jyh-Tyng Yau, and Ya-Wen Wu, "Construction Cost of Green Building Certified Residence: A Case Study in Taiwan," *Sustainability*, 2019, *11* (8), 2195.

Vandell, Kerry D. and Jonathan S. Lane, "The Economics of Architecture and Urban Design: Some Preliminary Findings," *Real Estate Economics*, 1989, *17* (2), 235–260.

Weerasinghe, Achini Shanika and Thanuja Ramachandra, "Economic sustainability of green buildings: A comparative analysis of green vs non-green," *Built Environment Project and Asset Management*, 2018, *8* (5), 528–543.

Wright, William C.C. and Florian V. Eppink, "Drivers of heritage value: A meta-analysis of monetary valuation studies of cultural heritage," *Ecological Economics*, 10 2016, *130*, 277–284.

The Economics of Architecture
Online Supplement

Gabriel M. Ahlfeldt Elisabetta Pietrostefani Ailin Zhang

January 12, 2026

Abstract

This online supplement is not intended for publication. It contains material that is related to the paper *The Economics of Architecture: A Synthesis*, but is not essential for the main messages of the paper.

Key words: Architecture, design, economics, regulation, welfare

JEL: R3, N9

*Ahlfeldt: Humboldt University, Berlin School of Economics (BSoE), London School of Economics and Political Sciences (LSE) and CEPR, CESifo, CEP; g.ahlfeldt@lse.ac.uk; Pietrostefani: University of Liverpool; Zhang: London School of Economics and Political Sciences (LSE). The usual disclaimer applies. We thank the Swiss Federal Office of Culture and in particular Brigitte Müller for financial support of and useful comments on a related project. Ahlfeldt gratefully acknowledges the support of the Deutsche Forschungsgemeinschaft (CRC TRR 190–project #280092119). We thank, in particular, Will Strange for bringing the super developer policy to our attention.

I Model

This section complements Section 2 in the main paper.

I.1 Derivations

I.1.1 Submarket choice probabilities

Workers: A worker v can choose between three submarkets indicated by superscript d ∈ { distinctive,ordinary, outside}: Architecturally distinctive buildings within the neighbourhood, ordinary buildings within the neighbourhood, or an outside option. The utility is described by:

$$U(v) = \tilde{U}^d a_{iv} \tag{I.1}$$

We start by outlining the probability that a worker chooses a parcel that is distinctive over a parcel that is ordinary or outside. For this to be true, the utility of distinctive needs to be higher than that of ordinary and outside which can be written as follows:

$$\mu^d = Pr(d) = Pr(U^{dist} > U^{ord} \; and \; U^{outside}) \tag{I.2}$$

We refer to μ^d as the share of workers who choose to live in a distinctive building. Since a parcel is a single unit and we assume there is no overlap between the parcels, we assume independence between the distinctive, ordinary, and outside parcels. This gives us:

$$\mu^d = Pr(\tilde{U}^{dist} a_{iv}^{dist} > \tilde{U}^{ord} a_{iv}^{ord}) Pr(\tilde{U}^{outside} a_{iv}^{outside}) \tag{I.3}$$

In the two neighbourhood submarkets, workers receive a Cobb-Douglas utility that depends on local amenity B_i the consumption of non-housing goods, g, and housing, f.

$$\tilde{U}^{d \neq outside} = B_i \left(\frac{g}{\alpha}\right) \left(\frac{f_i}{1-\alpha}\right)^{1-\alpha} \tag{I.4}$$

Rewriting this gives us:

$$Pr(\tilde{U}^{dist} a_{iv}^{dist} > \tilde{U}^{ord} a_{iv}^{ord}) \tag{I.5}$$

$$= Pr\left(B_i \left(\frac{g}{\alpha}\right)^{\alpha} \left(\frac{f_i^{dist}}{1-\alpha}\right)^{1-\alpha} a_{iv}^{dist} > B_i \left(\frac{g}{\alpha}\right)^{\alpha} \left(\frac{f_i^{ord}}{1-\alpha}\right)^{1-\alpha} a_{iv}^{ord}\right) \tag{I.6}$$

$$Pr\left(B_i \left(\frac{\alpha \overline{w}}{\alpha}\right)^{\alpha} \left(\frac{(1-\alpha)\frac{\overline{w}}{Q_i^d}}{(1-\alpha)}\right)^{1-\alpha} a_{iv}^{dist} > B_i \left(\frac{\alpha \overline{w}}{\alpha}\right)^{\alpha} \left(\frac{(1-\alpha)\frac{\overline{w}}{Q_i^d}}{(1-\alpha)}\right)^{1-\alpha} a_{iv}^{ord}\right) \tag{I.7}$$

$$= Pr\left(B_i (\overline{w})^{\alpha} \left(\frac{\overline{w}}{Q_i^{dist}}\right)^{1-\alpha} a_{iv}^{dist} > B_i (\overline{w})^{\alpha} \left(\frac{\overline{w}}{Q_i^{dist}}\right)^{1-\alpha} a_{iv}^{ord}\right) \tag{I.8}$$

$$= Pr\left(B_i \left(\frac{\overline{w}}{(Q_i^{dist})^{1-\alpha}}\right) a_{iv}^{dist} > B_i \left(\frac{\overline{w}}{(Q_i^{dist})^{1-\alpha}}\right) a_{iv}^{ord}\right) \tag{I.9}$$

Where

$$\tilde{V}^{d \neq outside} = A^d B_i \left(\frac{\overline{w}}{(Q_i^d)^{1-\alpha}} \right) \tag{I.10}$$

To reiterate, the shock a_{iv} affects utility and follows a Frechet distribution with the cdf given by

$$F_i^u(a) = exp[(-\tilde{V}^{dist})^{\varepsilon}(a_{iv})^{-\varepsilon}] \tag{I.11}$$

Where u ∈ { distinctive, ordinary }. Using the other property of the Frechet distribution gives us the pdf which allows solving further

$$f_i^u(a) = exp[(-\tilde{V}^{dist})^{\varepsilon}(a_{iv})^{-\varepsilon}]\varepsilon \left(\tilde{V}^{dist}\right)^{\varepsilon} (a_{iv})^{(-1-\varepsilon)} \tag{I.12}$$

We get

$$\int_0^{\infty} f\left(\frac{\tilde{V}^{dist} a_{iv}^{dist}}{A^{dist}}\right) F\left(\frac{\tilde{V}^{ord} a_{iv}^{ord}}{A^{ord}}\right) .da_{iv} \tag{I.13}$$

$$\int_0^{\infty} \left[exp[(-\tilde{V}^{dist})^{\varepsilon}(a_{iv})^{-\varepsilon}]\varepsilon\left(\tilde{V}^{dist}\right)^{\varepsilon}(a_{iv})^{(-1-\varepsilon)}\right].\left[exp[(-\tilde{V}^{ord})^{\varepsilon}(a_{iv})^{-\varepsilon}]\right].da_{iv} \tag{I.14}$$

$$\int_0^{\infty}\left[\varepsilon\left(\tilde{V}^{dist}\right)^{\varepsilon}(a_{iv})^{(-1-\varepsilon)}exp[-(\tilde{V}^{dist})^{\varepsilon}-(\tilde{V}^{ord})^{\varepsilon}](a_{iv})^{-\varepsilon}\right]da_{iv} \tag{I.15}$$

$$(\tilde{V}^{dist})^{\varepsilon}\int_0^{\infty}\left[\varepsilon(a_{iv})^{(-1-\varepsilon)}exp[-(\tilde{V}^{dist})^{\varepsilon}-(\tilde{V}^{ord})^{\varepsilon}](a_{iv})^{-\varepsilon}\right].da_{iv} \tag{I.16}$$

$$\tag{I.17}$$

If we then factor out both sides by $(\tilde{V}^{dist})^{\varepsilon} + (\tilde{V}^{ord})^{\varepsilon}$

$$\mu^d = \left(\frac{(\tilde{V}^{dist})^{\varepsilon}}{(\tilde{V}^{dist})^{\varepsilon}+(\tilde{V}^{ord})^{\varepsilon}}\right)\int_0^{\infty}\left[\varepsilon((\tilde{V}^{dist})^{\varepsilon}+(\tilde{V}^{ord})^{\varepsilon})(a_{iv})^{(-1-\varepsilon)}exp(\tilde{V}^{dist})^{\varepsilon}+(\tilde{V}^{ord})^{\varepsilon})(a_{iv})^{-\varepsilon}\right].da_{iv} \tag{I.18}$$

$$= \left(\frac{(\tilde{V}^{dist})^{\varepsilon}}{(\tilde{V}^{dist})^{\varepsilon}+\tilde{V}^{ord^{\varepsilon}}}\right)\left[\int_0^{\infty} f((\tilde{V}^{dist})^{\varepsilon}+(\tilde{V}^{ord})^{\varepsilon}a_{iv}).da_{iv}\right] \tag{I.19}$$

$$= \left(\frac{(\tilde{V}^{dist})^{\varepsilon}}{(\tilde{V}^{dist})^{\varepsilon}+(\tilde{V}^{ord})^{\varepsilon}}\right)\left[F((\tilde{V}^{dist})^{\varepsilon}+(\tilde{V}^{ord})^{\varepsilon}a_{iv})\right]_0^{\infty} \tag{I.20}$$

$$= \left(\frac{(\tilde{V}^{dist})^{\varepsilon}}{(\tilde{V}^{dist})^{\varepsilon}+(\tilde{V}^{ord})^{\varepsilon}}\right)\left[exp((\tilde{V}^{dist})^{\varepsilon}+(\tilde{V}^{ord})^{\varepsilon})(a_{iv})^{-\varepsilon}\right]_0^{\infty} \tag{I.21}$$

$$\left(\frac{(\tilde{V}^{dist})^{\varepsilon}}{(\tilde{V}^{dist})^{\varepsilon}+(\tilde{V}^{ord})^{\varepsilon}}\right)(1-0) = \frac{(\tilde{V}^{dist})^{\varepsilon}}{(\tilde{V}^{dist})^{\varepsilon}+(\tilde{V}^{ord})^{\varepsilon}} \tag{I.22}$$

$$\mu^d = \frac{\left(\tilde{V}^{dist}\right)^{\varepsilon}}{\left(\sum_{u\epsilon D}\left(\tilde{V}^{u}\right)^{\varepsilon}\right)} \tag{I.23}$$

II Quantification

II.1 Literature survey

Table II.1 presents an overview of the studies included in our meta-analysis. For each study, we list a unique ID (for cross-reference with our database), the citation, the outcome type (whether the study estimates the internal or external value of space, or construction costs), and the associated semi-elasticity of property value with respect to distinctive design. Where a single study reports results for multiple samples or outcome definitions, each is included as a separate entry.

Table II.1: Encoded studies

ID	Author	Outcome	Design effect (log)
B149	Ahlfeldt (2009)	Internal value of space: residential	-0.07
B148	Ahlfeldt (2009)	Internal value of space: residential	0.08
B138	Ahlfeldt and Holman (2015)	Internal value of space: residential	0.10
B139	Ahlfeldt and Holman (2015)	External value of space	0.05
B89	Ahlfeldt and Holman (2018)	Internal value of space: residential	0.17
B90	Ahlfeldt and Holman (2018)	External value of space	0.08
B73	Ahlfeldt and Kavetsos (2014)	External value of space	0.16
B30	Ahlfeldt and Maennig (2010b)	Internal value of space: residential	-0.04
B31	Ahlfeldt and Maennig (2010b)	Internal value of space: residential	0.03
B50	Ahlfeldt and Maennig (2010a)	External value of space	0.07
B51	Ahlfeldt and Maennig (2010a)	External value of space	0.04
B32	Ahlfeldt and Maennig (2010a)	External value of space	0.01
B72	Ahlfeldt and Mastro (2012)	External value of space	0.09
B120	Andersson et al. (2019)	Internal value of space: residential	0.20
B121	Andersson et al. (2019)	External value of space	0.01
B62	Asabere and Huffman (1994)	Internal value of space: residential	-0.30
B61	Asabere and Huffman (1994)	External value of space	0.26
B63	Asabere et al. (1994)	Internal value of space: residential	-0.24
B64	Asabere et al. (1994)	Internal value of space: residential	0.00
B94	Auckland Council (2018)	Internal value of space: residential	-0.10
B93	Auckland Council (2018)	Internal value of space: residential	0.04
B92	Auckland Council (2018)	External value of space	0.01
B116	Bade et al. (2020)	Internal value of space: residential	-0.10
B118	Bade et al. (2020)	Internal value of space: residential	0.04
B117	Bade et al. (2020)	External value of space	0.02
B3	Barreca (2022)	Internal value of space: residential	0.08
B77	Been et al. (2016)	Internal value of space: residential	0.22
B76	Been et al. (2016)	External value of space	0.12
B82	Buitelaar and Schilder (2017)	Internal value of space: residential	0.05
B81	Buitelaar and Schilder (2017)	Internal value of space: residential	0.15
B10	Cheshire and Dericks (2020)	Internal value of space: commercial	0.13
B9	Cheshire and Dericks (2020)	Internal value of space: commercial	0.17
B12	Cheshire and Dericks (2020)	Construction costs	-0.13
B11	Cheshire and Dericks (2020)	External value of space	0.09
B103	Clark and Herrin (1997)	Internal value of space: residential	0.14
B52	Coulson and Lahr (2005)	Internal value of space: residential	0.13
B34	Coulson and Leichenko (2001)	Internal value of space: residential	0.18
B33	Coulson and Leichenko (2001)	External value of space	0.01
B95	Deodhar (2004)	Internal value of space: residential	0.11
B119	Fernandez and Martin (2020)	Internal value of space: residential	0.08
B29	Franco and Macdonald (2018)	Internal value of space: residential	0.01
B27	Franco and Macdonald (2018)	Internal value of space: residential	0.04
B28	Franco and Macdonald (2018)	External value of space	0.03
B85	Fuerst et al. (2011)	Internal value of space: residential	0.12

Table II.1 continued from previous page

ID	Author	Outcome	Design effect (log)
B84	Fuerst et al. (2011)	Internal value of space: commercial	0.05
B71	Gat (1998)	Internal value of space: commercial	0.12
B136	Heintzelman and Altieri (2013)	Internal value of space: residential	0.21
B137	Heintzelman and Altieri (2013)	External value of space	0.07
B59	Hough and Kratz (1983)	Internal value of space: commercial	0.16
B60	Hough and Kratz (1983)	Internal value of space: commercial	-0.08
B49	Jayantha and Yung (2018)	Internal value of space: commercial	0.15
B124	Kee (2018)	External value of space	0.15
B122	Kee (2018)	External value of space	0.21
B123	Kee (2018)	External value of space	0.12
B35	Koster and Rouwendal (2017)	External value of space	0.02
B86	Koster et al. (2016)	Internal value of space: residential	0.04
B87	Koster et al. (2016)	External value of space	0.02
B37	Lazrak et al. (2014)	Internal value of space: residential	0.28
B39	Lazrak et al. (2014)	Internal value of space: residential	0.29
B38	Lazrak et al. (2014)	External value of space	0.28
B101	Leichenko et al. (2001)	Internal value of space: residential	0.14
B75	Liao et al. (2022)	Internal value of space: residential	0.05
B91	Lindenthal (2020)	Internal value of space: residential	0.04
B126	Liu and Liu (2020)	External value of space	0.02
B66	Moorhouse and Smith (1994)	Internal value of space: residential	0.11
B68	Moorhouse and Smith (1994)	Internal value of space: residential	0.12
B70	Moorhouse and Smith (1994)	Internal value of space: residential	0.12
B69	Moorhouse and Smith (1994)	Internal value of space: residential	0.15
B67	Moorhouse and Smith (1994)	Internal value of space: residential	0.18
B65	Moorhouse and Smith (1994)	Internal value of space: residential	0.26
B42	Moro et al. (2013)	External value of space	0.11
B165	Morpurgo (2015)	Internal value of space: residential	0.08
B105	Narwold (2008)	External value of space	0.04
B127	Nase et al. (2013)	Internal value of space: commercial	0.25
B129	Nase et al. (2013)	Internal value of space: commercial	0.09
B128	Nase et al. (2013)	Internal value of space: commercial	-0.18
B46	Nilsson (2011)	Internal value of space: residential	0.08
B47	Nilsson (2011)	Internal value of space: residential	0.05
B57	Noonan (2007)	Internal value of space: residential	0.04
B56	Noonan (2007)	Internal value of space: residential	0.11
B146	Noonan and Krupka (2011)	Internal value of space: residential	0.05
B147	Noonan and Krupka (2011)	External value of space	0.25
B48	Nunns et al. (2015)	External value of space	0.00
B131	Oba and Noonan (2017)	Internal value of space: residential	0.10
B133	Oba and Noonan (2017)	External value of space	0.00
B24	Pietrostefani (2019)	Internal value of space: residential	0.03
B25	Pietrostefani (2019)	Internal value of space: residential	0.06
B113	Rong et al. (2020)	Internal value of space: commercial	0.10
B112	Rong et al. (2020)	Internal value of space: commercial	0.19
B110	Rong et al. (2020)	Internal value of space: commercial	0.04
B108	Rong et al. (2020)	Internal value of space: commercial	0.02
B111	Rong et al. (2020)	Internal value of space: commercial	0.12
B109	Rong et al. (2020)	Internal value of space: commercial	0.18
B142	Ruijgrok (2006)	Internal value of space: residential	0.13
B143	Ruijgrok (2006)	Internal value of space: residential	0.02
B44	Cheung and Yiu (2022)	External value of space	0.36
B45	Cheung and Yiu (2022)	External value of space	0.09
B43	Cheung and Yiu (2022)	External value of space	0.34
B53	Vandell and Lane (1989)	Internal value of space: commercial	0.12
B54	Vandell and Lane (1989)	Construction costs	-0.56
B55	Vandell and Lane (1989)	Construction costs	-0.20
B40	Zahirovic-Herbert and Chatterjee (2012)	Internal value of space: residential	0.09
B41	Zahirovic-Herbert and Chatterjee (2012)	External value of space	0.04
B114	Zheng et al. (2020)	External value of space	0.06

Notes: This table presents the studies included in the meta-analysis. The column "Design effect" reports the estimated semi-elasticity of the internal or external value of space. Multiple results (for distinctly different samples or different outcomes) from the same study are listed as separate results. ID can be used to connect a result to further information in our database.

II.2 Solving for the equilibrium

For given values of $\mathbf{V} = \{\tilde{d}_i, Q_i^d, \tilde{V}^{d=distinctive}, \tilde{V}^{d=ordinary}\}$, we can solve for all other endogenous objects $\{\mu^d, c_i^d, \pi_i^d, \tilde{d}_i, \tilde{h}_i^d, f_i^d, B_i, D_i, H_i^d, N_i, \mathbb{E}(U), \Pi, S\}$. We provide a succinct description of our numerical procedure in pseudo code in Algorithm 1. To execute that procedure, we require the reverse mapping from submarket shares, μ^d, to indirect utilities, $\tilde{V}^d$ implicitly defined by Eq. (21), which we can solve for

$$\left(\tilde{V}^{d\in\mathbf{D}}\right)^{\epsilon} = \frac{\mu^{d\in\mathbf{D}}}{1-\mu^{d\in\mathbf{D}}}\left(\left(\tilde{V}^{o\in\mathbf{D}\setminus d}\right)^{\epsilon} + \bar{V}^{\epsilon}\right)$$

This is a system of two equations that we can substitute into each other to obtain

$$\begin{aligned}\tilde{V}^{d\in\mathbf{D}} = \bar{V} \times &\left(\frac{(1-\mu^{d\in\mathbf{D}})(1-\mu^{o\in\mathbf{D}\setminus d})}{(1-\mu^{d\in\mathbf{D}})(1-\mu^{o\in\mathbf{D}\setminus d}) - \mu^{d\in\mathbf{D}}\mu^{o\in\mathbf{D}\setminus d}}\right)^{\frac{1}{\epsilon}} \\ \times &\left(\frac{\mu^{d\in\mathbf{D}}}{(1-\mu^{d\in\mathbf{D}})(1-\mu^{o\in\mathbf{D}\setminus d})}\right)^{\frac{1}{\epsilon}}\end{aligned} \tag{II.24}$$

Algorithm 1: Numerical solution algorithm

begin
- Starting from guessed values of $\mathbf{V}$
- **while** *values of* $\tilde{V}^{d\in\mathbf{D}}$ *change* **do**
  - **while** *values of design indicator,* $\tilde{d}_i$*, change* **do**
    - **for** *parcel* $z \in J$ **do**
      - compute spatial weight, ω_{iz}, using Eq. (9)
      - generate distinctive design indicator, $\mathbb{1}(\tilde{d}_z = distinctive)$
    - compute design spillover, D_i using ω_{iz} and $\mathbb{1}(\tilde{d}_z = distinctive)$ $\forall\ z \in J$ and Eq. (8)
    - compute amenity, B_i, using Eq. (7)
    - compute rent, Q_i^d, using Eq. (10)
    - compute feasible height via (13) and (14)
    - update distinctive building allocation, $\tilde{d}_i$, using Eq. (15)
  - compute local floor space demand, f_i^d using Eq. (4)
  - compute housing supply, H_i^d using Eq. (16)
  - compute local population N_i^d using Eq. (20)
  - compute submarket population shares μ^d using Eq. (21)
  - compute new values of $\tilde{V}^{d\in\mathbf{D}}$ using Eq. (II.24)
  - update $\tilde{V}^{d\in\mathbf{D}}$ values to weighted combination of initial and new values

Result: Equilibrium values of $\mathbf{V}$

II.3 Fixed-point solver for SMM

The pseudo code in Algorithm 2 describes how we treat $\Theta = \{A^{d=\text{distinctive}}, \bar{\delta}^{d=\text{distinctive}}\}$, the scale parameter for distinctive design and the mean of the distinctive cost distribution, as the two primitives to be chosen such that the model reproduces the empirical internal premium $\hat{a}$ and the target share of distinctive buildings $\hat{s}$ in the equilibrium. For any candidate Θ, the *inner* loop iterates on building types, rents, heights and spillovers until developers' choices satisfy the design optimality condition, while the *outer* loop updates the submarket shares μ^d and the indirect utilities $\tilde{V}^d$ using Eq. (21) until the housing market clears; this jointly determines all endogenous objects $\{d_i, Q_i^d, h_i^d, H_i^d, \mu^d, \tilde{V}^d, \pi_i^d, N_i^d, E(U), \Pi\}$. From the resulting equilibrium we compute the model-implied internal premium $a(\Theta)$ and the simulated distinctive-share $s(\Theta)$. The SMM procedure then updates guess on $A^{d=\text{distinctive}}$ proportionally to the ratio $\hat{a}/a(\Theta)$ and shifts $\bar{\delta}^{d=\text{distinctive}}$ so that $s(\Theta)$ converges toward $\hat{s}$ while preserving the empirical coefficient of variation of $\delta^{d=\text{distinctive}}$. Iterating on this mapping $\Theta \mapsto (a(\Theta), s(\Theta))$ yields a fixed point $\hat{\Theta}$ for which $a(\hat{\Theta}) = \hat{a}$ and $s(\hat{\Theta}) = \hat{s}$, at which the equilibrium described in Appendix II.2 exactly matches both moments and pins down all remaining endogenous variables.

Algorithm 2: Fixed-point solver for SMM

begin
- Initialize guess for parameters $A^{\text{d=distinctive}}$
- Initialize guess for $\delta_i^{\text{d=distinctive}}$ with mean $\bar{\delta}_i^{\text{d=distinctive}}$ and $\bar{\delta}_i^{\text{d=distinctive}}/\sigma = 0.2$
- Initialize guess for $\mathbf{V}$ and corresponding submarket shares μ^d
- **while** *either* $(int\_prem \neq \hat{a})$ *or* $(dshare\_e \neq \hat{s})$ **do**
  - **while** *values of* $\tilde{V}^d$ *and corresponding submarket shares* μ^d *change* **do**
    - **while** *design indicator* $\tilde{d}_i$ *not converged* **do**
      - **for** *parcel* $i \in J$ **do**
        - compute design spillover D_i using Eq. (8)
        - compute amenity B_i using Eq. (7)
        - compute rents Q_i^d using Eq. (10)
        - compute feasible heights h_i^d using Eqs. (13)–(14)
        - compute profits π_i^d under distinctive cost $\delta_i^{\text{d=distinctive}}$ and
        - update design choice $\tilde{d}_i$ via Eq. (15)
    - aggregate floor space H_i^d, demand f_i^d, and submarket population N_i^d
    - update submarket population shares μ^d using Eq. (21)
    - compute new values of $\tilde{V}^{d \in \mathbf{D}}$ using Eq. (II.24)
    - update $\tilde{V}^{d \in \mathbf{D}}$ values to weighted combination of initial and new values
  - compute internal premium int_prem and distinctive share $dshare_e$
  - update $A^{\text{d=distinctive}}$ using $\hat{a}/int\_prem$
  - update $\hat{\delta}_i^{\text{d=distinctive}}$ using $\hat{s}/dshare_e$, keeping $CV(\hat{\delta}_i^{\text{d=distinctive}}) = 0.2$

Result: Calibrated parameters $(\bar{A}^{\text{d=distinctive}}, \delta_i^{\text{d=distinctive}})$ and equilibrium values of $\mathbf{V}$

II.4 Uniqueness

This section complements the main paper by showing that the equilibrium under the parametrisation in chosen in Section 3 is unique. To this end, we solve the model in various Monte Carlo runs starting from randomized values of submarket shares, $\mu^{d \in \mathbf{D}}$, and, hence, randomized values of indirect utilities, $\tilde{V}^{d \in \mathbf{D}}$, as well randomized distinctive design allocations $\tilde{d}_i$ and, hence, randomized rents, $Q_i^{d \in \mathbf{D}}$. We then compute the probability of a parcel being developed with distinctive design across Monte Carlo runs. We summarize the procedure in pseudo code in Algorithm 3.

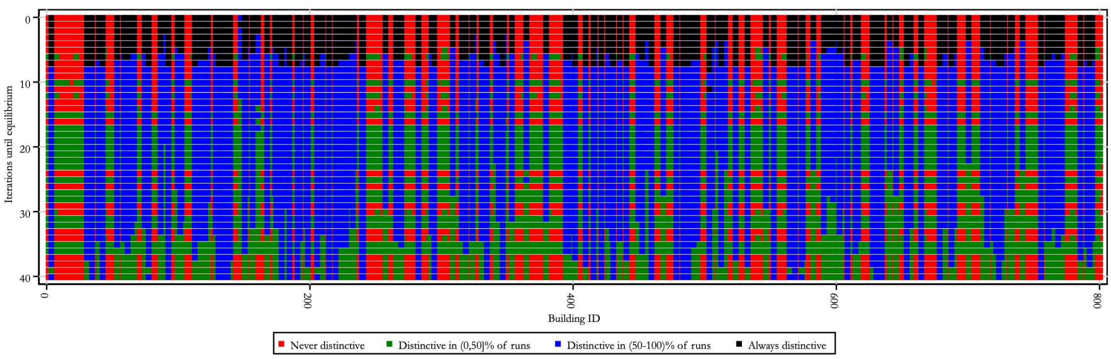
We consider the equilibrium unique if we always converge to the same allocation of distinctive design across parcels. This implies a Bernoulli distribution of distinctive design probabilities where, across Monte Carlo runs, the same parcel is either *always* or *never* developed with distinctive design. Figures II.1 and II.2 show that as we approach the equilibrium across iterations of our numerical solver described by Algorithm 1, the distinctive design probabilities by parcels across runs, indeed, converge to the Bernoulli distribution. 40 iterations before convergence, the distinctive design probabilities are generally larger than zero and smaller than one, suggesting dispersion of parcel outcomes across Monte Carlo Runs. As we approach the equilibrium we see more and more that certain parcels have a high probability of being distinctive. In equilibrium, we have a well-defined Bernoulli distribution, confirming that the equilibrium is unique.

Algorithm 3: Monte Carlo algorithm

begin
- Draw random values for $\mu^{d \in \mathbf{D}}$ from a uniform distribution over the interval (0.0.5) to generate a randomized intial allocation of wokers to submarkets
- Compute $\tilde{V}^{d \in \mathbf{D}}$ using the mapping in Section II.2
- Draw values for $\tilde{d}$ from a Bernoulli distribution to generate a randomized inital spatial distribution of distinctive buildings
- **for** *Monte Carlo run* $r \in R$ **do**
  - Call Algorithm 1 to solve for the equilibrium
  - **for** *each iteration* $z \in Z^r$ *of Algorithm 1* **do**
    - Save distinctive building allocation $\tilde{d}_i^{r,z}$
  - Compute distinctive building allocation $\tilde{d}_i^{r,m}$, where $m = Z^r - z$
- Compute mean distinctive design probability across Monte Carlo runs $\mathbb{E}(\tilde{d}_i^{r,m}) = \frac{1}{R} \sum_{r \in R} (\tilde{d}_i^{r,m})$

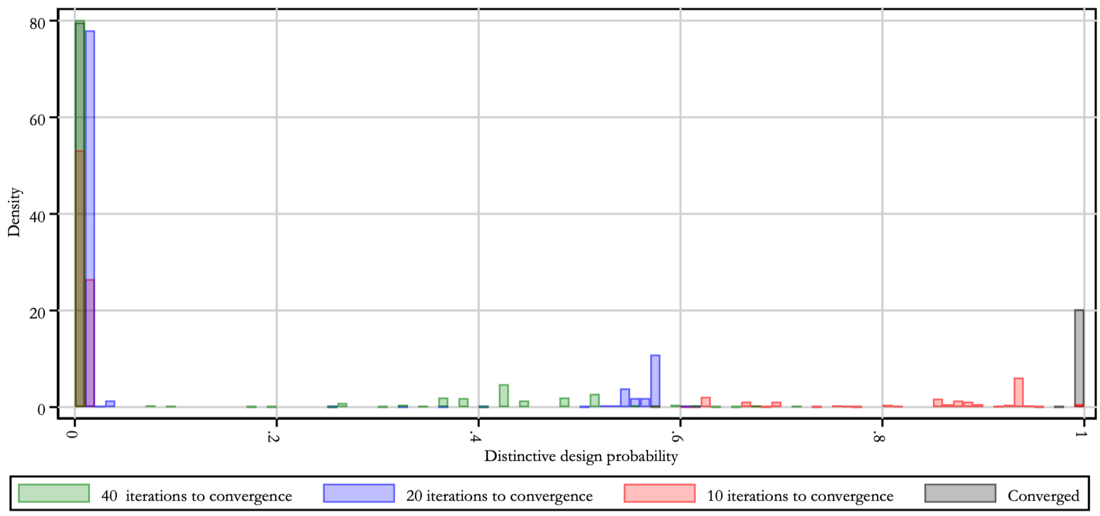
Result: Probability of a parcel being developed with distinctive design by iterations to equilibrium across Monte Carlo runs

Figure II.1: Monte Carlo outcomes I



Note: Figure shows the probability of a parcel being developed with distinctive design by iterations to equilibrium across Monte Carlo runs derived using Alogrithm 3. It reveals that starting from random starting values, we converge to a unique equilibrium in which the same parcel is either *always* or *never* developed with distinctive design.

Figure II.2: Monte Carlo outcome II



Note: Note: Figure shows the probability of a parcel being developed with distinctive design by iterations to equilibrium across Monte Carlo runs derived using Alogrithm 3. It reveals that starting from random starting values, we converge to a unique equilibrium in which the same parcel is either *always* or *never* developed with distinctive design..

II.5 Greedy algorithms for a super developer

This section complements Section 4.4 in the main paper and Appendix C.4 by formalising the greedy procedures used to simulate sequential design decisions by a super developer who owns the entire neighbourhood. Instead of jointly optimising over all possible design configurations, the developer evaluates parcels one at a time. In each iteration, the developer computes the incremental profitability of converting one additional ordinary parcel to a distinctive design, conditional on the information-dependent general-equilibrium environment relevant under the scenario considered.

We consider three scenarios, which differ in their information sets and the degree of forward-looking behaviour. In the *fully-myopic* case, as described in Algorithm 4, the developer evaluates parcels holding rents, heights, and spillovers fixed at pre-conversion levels, thereby ignoring both monopoly power and general-equilibrium feedback. In the *fully-strategic* case, described in Algorithm 5, the developer anticipates how a conversion alters the spillover field, evaluates profitability using projected spillovers, and then resolves the full equilibrium with endogenised spillovers after each committed conversion. In the *strategic-without-spillovers* case, described in Algorithm 6, the developer internalises equilibrium adjustments in rents, heights, and submarket utilities, while keeping spillovers fixed at their historical values during the assessment stage.

In all three scenarios, the greedy step selects the parcel that delivers the largest marginal increase in aggregate developer profit:

$$k^* = \arg \max_{k \in J : \tilde{d}_k = 0} \{\Pi(\text{convert } k) - \Pi(\text{status quo})\},$$

and conversion occurs only when the gain is strictly positive. The system subsequently updates to the new equilibrium $(d_i, Q_i^d, h_i^d, H_i^d, \mu^d, \tilde{V}^d, \pi_i^d, N_i^d, \Pi)$, which becomes the state for the next iteration. The algorithm terminates when no ordinary parcel yields a strictly positive incremental profit. Algorithms 4–6 summarise the procedures for the three scenarios.

Algorithm 4: Greedy algorithm: fully-myopic developer (Scenario 1)

begin
  Initialise all parcels as ordinary: set G_i = ordinary for all i
  Solve baseline equilibrium to obtain $(Q_i^d, h_i^d, \mu^d, \tilde{V}^d, D_i, \Pi^{\text{base}})$
  while *there exists an ordinary parcel with positive incremental profit* **do**
    for *each parcel* k *with* $\tilde{d}_k = 0$ **do**
      temporarily set G_k = distinctive
      hold $(D_i, \tilde{V}^d, Q_i, h_i, \pi_i)_{i \neq k}$ fixed at historical values
      compute optimal h_k, Q_k, and π_k under the historical environment
      compute aggregate trial profit $\Pi^{(k)}$
    identify $k^* = \arg\max_k \{\Pi^{(k)} - \Pi^{\text{base}}\}$
    if $\Pi^{(k^*)} \leqslant \Pi^{base}$ **then**
      stop algorithm
    commit conversion: set G_{k*} = distinctive and implement h_{k*}
    update spillovers and re-solve the full equilibrium for $(Q_i^d, h_i^d, \mu^d, \tilde{V}^d, D_i)$
    update Π^{base}

Result: Equilibrium vector $(\tilde{d}_i, Q_i^d, h_i^d, \mu^d, \tilde{V}^d, D_i, \Pi)$

Algorithm 5: Greedy algorithm: fully-strategic developer (Scenario 2)

begin
  Initialise all parcels as ordinary: set G_i = ordinary for all i
  Solve baseline equilibrium to obtain $(Q_i^d, h_i^d, \mu^d, \tilde{V}^d, D_i, \Pi^{\text{base}})$
  while *there exists an ordinary parcel with positive incremental profit* **do**
    for *each parcel* k *with* $\tilde{d}_k = 0$ **do**
      temporarily set G_k = distinctive
      project post-conversion spillovers D_i^{proj} in new equilibrium
      solve the full equilibrium $(Q_i^d, h_i^d, \mu^d, \tilde{V}^d)$ under D_i^{proj}
      compute trial aggregate profit $\Pi^{(k)}$
    identify $k^* = \arg\max_k \{\Pi^{(k)} - \Pi^{\text{base}}\}$
    if $\Pi^{(k^*)} \leqslant \Pi^{base}$ **then**
      stop algorithm
    commit conversion: set G_{k*} = distinctive
    update spillover and re-solve the full equilibrium for $(Q_i^d, h_i^d, \mu^d, \tilde{V}^d, D_i)$
    update Π^{base}

Result: Equilibrium vector $(\tilde{d}_i, Q_i^d, h_i^d, \mu^d, \tilde{V}^d, D_i, \Pi)$

Algorithm 6: Greedy algorithm: strategic-without-spillovers (Scenario 3)

begin
  Initialise all parcels as ordinary: set G_i = ordinary for all i
  Solve baseline equilibrium to obtain $(Q_i^d, h_i^d, \mu^d, \tilde{V}^d, D_i, \Pi^{\text{base}})$
  while *there exists an ordinary parcel with positive incremental profit* **do**
    for *each parcel* k *with* $\tilde{d}_k = 0$ **do**
      temporarily set G_k = distinctive
      solve the full equilibrium $(Q_i^d, h_i^d, \mu^d, \tilde{V}^d)$ under historical spillovers D_i
      compute trial aggregate profit $\Pi^{(k)}$
    identify $k^* = \arg\max_k \{\Pi^{(k)} - \Pi^{\text{base}}\}$
    if $\Pi^{(k^*)} \leqslant \Pi^{base}$ **then**
      stop algorithm
    commit conversion: set G_{k*} = distinctive
    update spillover and re-solve the full equilibrium for $(Q_i^d, h_i^d, \mu^d, \tilde{V}^d, D_i)$
    update Π^{base}

Result: Equilibrium vector $(\tilde{d}_i, Q_i^d, h_i^d, \mu^d, \tilde{V}^d, D_i, \Pi)$

References

Ahlfeldt, Gabriel M., "Gebaute Umwelt als Determinante für Lageattraktivität," *disP – The Planning Review*, 2009, *45* (179), 46–56.

__ **and Alexandra Mastro**, "Valuing Iconic Design: Frank Lloyd Wright Architecture," *Housing Studies*, 2012, *27* (8), 1079–1099.

__ **and Georgios Kavetsos**, "Form or Function?: The Effect of New Sports Stadia on Property Prices in London," *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, 2014, *177* (1), 169–190.

__ **and Nancy Holman**, "No Escape? The Coordination Problem in Heritage Preservation," *Environment and Planning A*, 2015, *47* (1), 172–187.

__ **and** __ , "Distinctively Different: A New Approach to Valuing Architectural Amenities," *Economic Journal*, 2018, *128* (608), 1–33.

__ **and Wolfgang Maennig**, "Impact of Sports Arenas on Land Values: Evidence from Berlin," *Annals of Regional Science*, 2010, *44* (2), 205–227.

__ **and** __ , "Substitutability and Complementarity of Urban Amenities: External Effects of Built Heritage in Berlin," *Real Estate Economics*, 2010, *38* (2), 285–323.

Andersson, Magnus, Fredrik Kopsch, and Peter Palm, "How Cultural Values Are Reflected on the Housing Market – Direct Effects and the Cultural Spillover," *International Journal of Housing Markets and Analysis*, 2019, *12* (3), 405–423.

Asabere, Paul K. and Forrest E. Huffman, "Historic Designation and Residential Market Values," *Appraisal Journal*, 1994, *62* (3), 396–401.

__ **,** __ **, and Seyed Mehdian**, "The Adverse Impacts of Local Historic Designation: The Case of Small Apartment Buildings in Philadelphia," *Journal of Real Estate Finance and Economics*, 1994, *8*, 225–234.

Auckland Council, "Auckland's Heritage Counts 2018 - Annual Summary," Technical Report, Auckland Council 2018. Heritage statistics and summary indicators report.

Bade, David, Jose Gabriel Castillo, Mario Andres Fernandez, and Joseph Aguilar-Bohorquez, "The Price Premium of Heritage in the Housing Market: Evidence from Auckland, New Zealand," *Land Use Policy*, 2020, *99*.

Barreca, Alice, "Architectural Quality and the Housing Market: Values of the Late Twentieth Century Built Heritage," *Sustainability*, 2022, *14* (5).

Been, Vicki, Ingrid Gould Ellen, Michael Gedal, Edward Glaeser, and Brian J. McCabe, "Preserving History or Restricting Development? The Heterogeneous Effects of Historic Districts on Local Housing Markets in New York City," *Journal of Urban Economics*, 2016, *92*, 16–30.

Buitelaar, Edwin and Frans Schilder, "The Economics of Style: Measuring the Price Effect of Neo-Traditional Architecture in Housing," *Real Estate Economics*, 2017, *45* (1), 7–27.

Cheshire, Paul C. and Gerard H. Dericks, "'Trophy Architects' and Design as Rent-Seeking: Quantifying Deadweight Losses in a Tightly Regulated Office Market," *Economica*, 2020, *87* (348), 1078–1104.

Cheung, Ka Shing and Chung Yim Yiu, "The economics of architectural aesthetics: Identifying price effect of urban ambiences by different house cohorts," *Environment and Planning B: Urban Analytics and City Science*, 2022, *49* (6), 1741–1756.

Clark, David E. and William E. Herrin, "Historical Preservation Districts and Home Sale Prices: Evidence from the Sacramento Housing Market," *Review of Regional Studies*, 1997, *27* (1), 29–48.

Coulson, N. Edward and Michael L. Lahr, "Gracing the Land of Elvis and Beale Street: Historic Designation and Property Values in Memphis," *Real Estate Economics*, 2005, *33* (3), 487–507.

__ **and Robin M. Leichenko**, "The Internal and External Impact of Historical Designation on Property Values," *Journal of Real Estate Finance and Economics*, 2001, *23* (1), 113–124.

Deodhar, Vinita M., "Does the Housing Market Value Heritage? Some Empirical Evidence," Technical Report 3/2004, Macquarie University, Department of Economics 2004.

Fernandez, Mario A. and Shane L. Martin, "What's so Special about Character?," *Urban Studies*, 2020, *57* (16), 3236–3251.

Franco, Sofia F. and Jacob L. Macdonald, "The Effects of Cultural Heritage on Residential Property Values: Evidence from Lisbon, Portugal," *Regional Science and Urban Economics*, 2018, *70*, 35–56.

Fuerst, Franz, Patrick McAllister, and Claudia B. Murray, "Designer Buildings: Estimating the Economic Value of 'Signature' Architecture," *Environment and Planning A*, 2011, *43* (1), 166–184.

Gat, Daniel, "Urban Focal Points and Design Quality Influence Rents: The Case of the Tel Aviv Office Market," *Journal of Real Estate Research*, 1998, *16* (2), 229–248.

Heintzelman, Martin D. and Jason A. Altieri, "Historic Preservation: Preserving Value?," *Journal of Real Estate Finance and Economics*, 2013, *46* (3), 543–563.

Hough, Douglas E. and Charles G. Kratz, "Can 'Good' Architecture Meet the Market Test?," *Journal of Urban Economics*, 1983, *14* (1), 40–54.

Jayantha, Wadu Mesthrige and Esther Hiu Kwan Yung, "Effect of Revitalisation of Historic Buildings on Retail Shop Values in Urban Renewal: An Empirical Analysis," *Sustainability*, 2018, *10* (5), 1418.

Kee, Tris, "Sustainable adaptive reuse – economic impact of cultural heritage," *Journal of Cultural Heritage Management and Sustainable Development*, 2018, *9* (2), 165–183.

Koster, Hans R. A. and Jan Rouwendal, "Historic Amenities and Housing Externalities: Evidence from the Netherlands," *Economic Journal*, 2017, *127* (605), F396–F420.

_ , Jos N. van Ommeren, and Piet Rietveld, "Historic Amenities, Income and Sorting of Households," *Journal of Economic Geography*, 2016, *16* (1), 203–236.

Lazrak, Faroek, Peter Nijkamp, Piet Rietveld, and Jan Rouwendal, "The market value of cultural heritage in urban areas: An application of spatial hedonic pricing," *Journal of Geographical Systems*, 2014, *16* (1), 89–114.

Leichenko, Robin M., N. Edward Coulson, and David Listokin, "Historic Preservation and Residential Property Values: An Analysis of Texas Cities," *Urban Studies*, 2001, *38* (11), 1973–1987.

Liao, Wen-Chi, Kecen Jing, and Chaun Ying Rachel Lee, "Economic return of architecture awards: Testing homebuyers' motives for paying more," *Regional Science and Urban Economics*, 2022, *93*, 103723.

Lindenthal, Thies, "Beauty in the Eye of the Home-Owner: Aesthetic Zoning and Residential Property Values," *Real Estate Economics*, 2020, *48* (2), 530–555.

Liu, Caixia and Xiaolong Liu, "Adaptive Reuse of Religious Heritage and Its Impact on House Prices," *Journal of Real Estate Finance and Economics*, 2020, *64* (1), 71–92.

Moorhouse, John C. and Margaret Supplee Smith, "The Market for Residential Architecture: 19th Century Row Houses in Boston's South End," *Journal of Urban Economics*, 1994, *35* (3), 267–277.

Moro, Mirko, Karen Mayor, Seán Lyons, and Richard S. Tol, "Does the Housing Market Reflect Cultural Heritage? A Case Study of Greater Dublin," *Environment and Planning A*, 2013, *45* (12), 2884–2903.

Morpurgo, Daniela, "Il valore del centro storico-artistico: Prezzi edonici a Perugia, Bologna e Trieste." Master / laurea thesis (dissertation), Politecnico di Milano, Milan, Italy 2015. Original Italian dissertation; hedonic price model for historic-centre premium.

Narwold, Andrew J., "Estimating the value of the historical designation externality," *International Journal of Housing Markets and Analysis*, 2008, *1* (3), 288–295.

Nase, Ilir, Jim Berry, and Alastair Adair, "Real estate value and quality design in commercial office properties," *Journal of European Real Estate Research*, 2013, *6* (1), 48–62.

Nilsson, Pia, "Cultural Landscape Characteristics and Heritage Values: A Spatially Explicit Hedonic Approach," in "Proceedings of the 50th Congress of the European Regional Science Association (ERSA 2010)" 2011. Paper originally presented at ERSA 2010, Jönköping, Sweden.

Noonan, Douglas S., "Finding an Impact of Preservation Policies: Price Effects of Historic Landmarks on Attached Homes in Chicago 1990–1999," *Economic Development Quarterly*, 2007, *21* (1), 17–33.

— **and Douglas J. Krupka**, "Making—or Picking—Winners: Evidence of Internal and External Price Effects in Historic Preservation Policies," *Real Estate Economics*, 2011, *39* (2), 379–407.

Nunns, Peter, Hadyn Hitchins, and Kyle Balderston, "The value of land, floorspace and amenities: a hedonic price analysis of property sales in Auckland 2011–2014," Technical Report TR2015/012, Auckland Council / MRCagney, Auckland, New Zealand 2015. Hedonic analysis of recent Auckland residential property sales.

Oba, Tetsuharu and Douglas S. Noonan, "The many dimensions of historic preservation value: national and local designation, internal and external policy effects," *Journal of Property Research*, 2017, *34* (3), 211–232.

Pietrostefani, Elisabetta, "Conservation Planning and Informal Institutions: Heterogenous Patterns in Italian Cities," 2019. Working Paper.

Rong, Helena Hang, Juncheng Yang, Minkoo Kang, and Andrea Chegut, "The Value of Design in Real Estate Asset Pricing," *Buildings*, 2020, *10* (10), 178.

Ruijgrok, E.C.M., "The three economic values of cultural heritage: a case study in the Netherlands," *Journal of Cultural Heritage*, 2006, *7* (3), 206–213.

Vandell, Kerry D. and Jonathan S. Lane, "The Economics of Architecture and Urban Design: Some Preliminary Findings," *Real Estate Economics*, 1989, *17* (2), 235–260.

Zahirovic-Herbert, Velma and Swarn Chatterjee, "Historic Preservation and Residential Property Values: Evidence from Quantile Regression," *Urban Studies*, 2012, *49* (2), 369–382.

Zheng, Xian, Jun-xian Li, Linzi Zheng, and Junyu Lv, "Multi-owned property, urban renewal and neighbourhood property value externalities: revisiting the Hong Kong case," *Cities*, 2020, *107*, 102915.