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”Quality sells”
High-quality *Baukultur* as a success factor for the construction and real estate industry[*]

Abstract: *High-quality Baukultur* (HQB) is a concept that stresses the quality of the built environment as well as the processes that lead to its creation. We provide the first systematic and quantitative review of the existing literature concerned with characteristics and effects of HQB. From the analysis of 382 empirical analyses, three important insights emerge. First, HQB can result in a variety of social returns in the form of quality of life and a more sustainable use of land. Second, HQB not only generates social returns but also private returns that exceed costs, making them profitable from a private investment perspective. Third, because the provision of HQB is subject to market failures, a collaborative approach between the private and public sector that coordinates investments into HQB and signals HQB to consumers may yield private and social returns.

Key words: Architecture, *Baukultur*, development, form, function, governance, net present value, urban design, quality

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1 Introduction

Baukultur as discussed in the Davos Declaration is a holistic concept that encompasses quality of construction, the responsible treatment of the existing built environment and the processes in its creation (Swiss Federal Office of Culture 2018). A central hypothesis is that high-quality *Baukultur* (HQB) not only generates social returns, but also tangible economic returns to those who invest in HQB because there is a positive willingness to pay on the market. This is consistent with some findings in an emerging literature on the effects of building and urban design, but, as of today, there is no comprehensive summary of the state of knowledge in the literature.

This research project aims at filling this gap. To this end, we provide a systematic and quantitative review of the existing literature that consists of three steps. First, we identify the theoretical *mechanisms* through which various *characteristics* of HQB impact on various economic, social, and environmental *outcomes*. Second, we conduct a systematic literature search based on dedicated keywords for each element in a matrix that connects characteristics and outcomes. Third, we subject the findings from the literature to statistical analyses using techniques that we borrow from meta-analytic research. Eventually, we quantify how HQB affects return on investment (ROI). From this analysis, three headline findings emerge. First, HQB can result in a variety of social returns in the form quality of life and a more sustainable use of land. Second, HQB not only generates social returns but also private returns that exceed costs, making them profitable from a private investment perspective. Third, because the provision of HQB is subject to market failures, a collaborative approach between the private and public sector that coordinates investments into HQB and signals HQB to consumers may yield private and social returns.

The ambition of this paper is not to add an additional original analysis of a specific aspect of HQB to an already fragmented literature, but to synthesise the extant evidence within a quantitative framework. In doing so, we make theoretical and empirical contributions. Our point of departure is the Davos *Baukultur* Quality System (henceforth DBQS, Swiss Federal Office of Culture 2021), which provides a framework for the assessment of the quality of *Baukultur*. It is, however, not designed to guide a quantitative evaluation of causal effects of HQB. More generally, the related literature tends to either focus on selective aspects of HQB and its relationship to specific outcomes or remains generic in the sense that it abstracts from causal mechanisms that govern the effects of characteristics on outcomes.[1] There is no systematic and accessible typology of mechanisms that serves to guide a comprehensive empirical evaluation of the economic, social, and environmental impact of HQB. Therefore, our theoretical contribution---which consists of synthesizing the theoretical literature to a matrix that connects various characteristics of HQB to economic, social, and environmental outcomes---is an important and necessary step towards building an evidence base on the effects of HQB.

To ensure coherence of contents, we develop our theory matrix under the constraint that all criteria in the DBQS (Swiss Federal Office of Culture 2021) have their correspondence as either characteristics or outcomes. We identify four key characteristics of HQB. *Function* captures how well the choice of volume, material, and layout serve the practical needs of the users of a building, irrespectively of the aesthetic appeal. *Form* comprises all interior and exterior design elements that improve the aesthetic value of a building relative to the least-cost configuration that serves a given

[1] These include but are not limited to the following literature strands: Cultural Heritage studies, Engineering, Environmental Economics, Environmental Psychology, Urban Design, Urban Planning, Urban Economics, Real Estate, Sustainable Development and Tourism (Licciardi and Amirtahmasebi 2012; Fuerst and Warren-Myers 2018; Carmona 2021; Vandell and Lane 1989).

level of *function*. *Urban design* concerns the spatial arrangement of developments and the public spaces in between them, including their design in terms of form and function. *Governance* relates to the processes that govern the legislation, regulation, and management of the built environment. Governance has a direct effect on HQB by influencing the spatial allocation and intensity of land uses and an indirect effect, by facilitating, encouraging, or enforcing high-quality form, function, and urban design. We connect these four characteristics to 16 outcomes that feature prominently in the related literatures as well as in the Davos Declaration (2018). Some of these outcomes, such as real estate prices and rents, construction cost, or operation cost, are directly relevant to profit-oriented investors and developers. Other outcomes capture broader benefits to society, such as the wellbeing of residents or the environmental impact of the built environment. We acknowledge that the sharp distinction between mechanisms that originate from selected characteristics and impact on selected outcomes implies some abstraction from the holistic concept of *Baukultur*. Yet, it is an unavoidable step towards a quantification of the effects of HQB that relies on clearly defined causal mechanisms that can be tested empirically.

Building on our theoretical contribution, we address the second major limitation: there is a literature that empirically investigates the effects of various characteristics of *Baukultur,* but the evidence is scattered across several literatures and is sometimes used in a confused and confusing manner. There is no consolidated self-contained empirical literature on effects of the built environment. Instead, most of the relevant evidence is spread across separate literature strands which are often only implicitly concerned with specific effects and selected aspects of the built environment.[2] Our empirical contribution is to connect the separate literatures with a view to understanding how HQB not only serves the betterment of society, but also the interests of those who shape the built the environment with the intent of maximizing profits.

Guided by the theoretical matrix connecting HQB characteristics to outcomes, we build an evidence base in a systematic literature search. We follow Ahlfeldt & Pietrostefani (2017; 2019) and conduct searches for all cells of the theory matrix using keywords that combine attributes of characteristics and outcomes. With this approach, we identify 382 empirical analyses, each of which establishes how one characteristic of HQB impacts on a selected outcome. Collectively, they represent a unique resource that allows us to summarize the state of knowledge on the effects of HQB. Consistent with the twofold aims of the paper, we use this evidence base in two ways.

In the first part of the empirical analysis, we seek to provide the first systematic evidence-based evaluation of the phenomenon of HQB, acknowledging that HQB materializes in the form of different characteristics and touches many aspects of the everyday life of current and future generations. Given the heterogeneity of the evidence base in terms of outcomes, data, and methods, we focus on qualitative results at this stage of the analysis. To this end, we encode whether the effect of HQB is found to be positive, negative or ambiguous in a normative sense. In general terms, the question we ask is whether the ambitious claims regarding the positive effects HQB on a broad range of outcomes can be substantiated by evidence. Indeed, we find that the evidence concerning the effects of HQB on outcomes is overwhelmingly positive. Across all characteristics and outcomes, 77% of all empirical analyses find normatively positive effects associated with HQB. Moreover, the

[2] For example, there is a plethora of studies examining the price premiums associated with sustainable or energy-efficient stock in both the commercial and residential sectors (Ade and Rehm 2020; Amecke 2012; Eichholtz, Kok, and Quigley 2010) , however these studies do not address the effects of other aspects of functionality of buildings beyond energy efficiency. There are also various studies on the effects of listed buildings and conservation areas on house and rent prices (Ahlfeldt and Holman 2018; Ahlfeldt and Kavetsos 2014; Koster and Rouwendal 2017).

positive evidence tends to be concentrated in characteristics-outcome cells where the theoretical literature expects positive effects.

There is strong evidence that buildings that are better designed in terms of form and function provide private and social benefits. They are more sustainable, increase wellbeing of residents, add to sense of place, have lower operating cost and, as a result, rent and sell at higher market prices. However, the evidence base also confirms theoretical expectations that buildings of better design – in terms of form and function – are more expensive to build and that policy attempts to promote HQB can result in less elastic housing markets. This can lead to a supply-driven increase in house prices which is often blamed for affordability problems (Hilber and Vermeulen 2016). The evidence also suggests that HQB can lead to spatial segregation because HQB tends to be particularly appreciated by wealthier households who, therefore, outbid and displace less affluent households unless HQB becomes a universal feature of the built environment. An important lesson for good governance in the context of HQB is that a planning system that seeks to promote, facilitate, or enforce HQB should be transparent, rule-based, and predictable, to avoid supply-driven increases in housing costs that can be detrimental to aggregate welfare and equity (Mayo and Sheppard 2001; Cheshire 2018).

In the second part of the empirical analysis, we zoom into selected characteristic-outcome cells to quantitatively evaluate to what extent HQB can yield returns to the real estate industry. This exercise is at the heart of the "quality sells" hypothesis, which states that HQB is in the interest of profit-maximizing developers and investors. Based on a subset of analyses in the evidence base whose quantitative results can be converted into comparable metrics, we compute the premia at which properties characterized by high functionality or distinctive architectural form rent and sell on the market. Taking a conventional discounted cash flow approach, we indirectly infer the effects of form and function on operating costs and durability from the difference in the capitalization effects on rents and sales prices. Since there are many dimensions of building function, many of which are typically not observable in standard data sets, quantifying the effect of function is challenging. Our interpretation of the evidence base is that high functionality increases rents by about 11% on average. Over the lifecycle, high functionality can reduce the cost associated with operation and depreciation to the equivalent of about 9% of rental income. A distinctive form similarly increases the market value by about 11%, but we find no evidence of an effect on operating costs and depreciation. Turning to construction cost, the evidence base suggests that high functionality inflates construction cost by about 9%, whereas distinctive form increases total cost by about 25%, on average. Importantly, our analysis reveals two sources of potential revenues associated with HQB that are beyond the control of a small-scale investor: A credible certification of HQB can lead to an additional premium for distinctive form of slightly more than 5%. A distinctive form of nearby buildings can increase property value by about 10%.

Based on these premia and cost inflators we then compute how adopting HQB affects the ROI from the development of a hypothetical land parcel. We derive a HQB investment premium that reflects by how much the ROI, in relative terms, increases if the investor opts for a HQB development instead of an ordinary (least-cost) project. The advantage of this approach is that the HQB investment premium is transferrable across institutional contexts with different baseline ROIs. We compute the HQB investment premium in a Monte Carlo approach in which we draw the parameters governing the premia and inflators discussed above from distributions that reflect the uncertainty in the evidence base. With this approach, we obtain a distribution of HQB investment premiums, which is consistent with the success of HQB involving an element of chance. In the most conservative scenario, in which a small-scale developer does not benefit from a certification of HQB and does not benefit from HQB of nearby buildings, HQB increases the ROI with a 53% probability.

On average, the ROI under HQB increases by some 2 percentage points. In an alternative scenario, in which a credible certification adds to transparency regarding HQB, the probability of success increases to 67% and the expected HQB premium increases to close to 8 percentage points. In another alternative scenario, in which all investors in the neighbourhood collectively invest in HQB, the success probability increases to 75% and the expected HQB investment premium increases to more than 12 percentage points. These simulation results lend support to the quality sells hypothesis and suggest a collaborative approach between the private and public sector is best suited to realize private and social returns to investment into HQB.

Quantifying the effects of a multi-faceted concept such as HBQ is an ambitious undertaking that does not come without limitations. Some of the limitations follow from the requirements of a quantitative research design, some are intentional given the scope of the research question, and others are dictated by the evidence base. As we already discussed, a typological framework of separable and additive causal effects of HQB requires a reductionist definition of characteristics and outcomes that abstracts from many simultaneities and assumes that various characteristics of HQB can be changed *ceteris paribus*. While public buildings and infrastructure such as roads or bridges are part of *Baukultur*, the focus of this study is on yield-orientated development and, therefore, we abstract from elements of *Baukultur* that tend to be in the public domain. In terms of scale, we focus on buildings and developments, the spaces in-between and their spatial contextual arrangements, but we abstract from interior furnishing or landscaping. Given the focus on the "quality sells" hypothesis, only private costs and benefits incurred by the developer are itemized in the ROI calculation, but it is important to notice that social benefits would have to be considered in a social cost-benefit appraisal. As an example, sustainability enters the calculation via energy savings and lower operation cost, but a lower carbon footprint during and after construction remains unconsidered as this represents a social return that is not appropriated by an investor. Owing to limited evidence, we focus on new-built and abstract from redevelopments and retrofitting. For the same reason, we abstract from teardown and re-development cost in lifecycle cost and focus on construction and operational cost.

The remainder of this paper is organized as follows. Section 2 introduces the theoretical context. Section 3 describes the evidence base. Section 4 provides a holistic evaluation of the economic, environmental, and social effects of HQB. Section 5 quantitatively evaluates mechanisms that are of first-order relevance from an investment perspective. Section 6 presents the evaluation of the effects of HQB on ROI. Section 7 concludes with an emphasis on policy implications.

2 *Baukultur* in theory

In this section, we synthesize the extant theoretical literature to a matrix that connects the characteristics of HQB to economic, environmental, and social outcomes via causal mechanisms. The identified mechanisms will guide the compilation of an evidence base in Section 3.

2.1 High-quality *Baukultur*

Culture is increasingly being perceived as a central component of sustainability and sustainable development (UN 2013; ICOMOS 2020; Cominelli and Greffe 2019; Bandarin and Oers 2012). Following a range of international policies, including the New Urban Agenda (2016), the 2030

Agenda for Sustainable Development (2015)[3], the UNESCO Recommendation on the Historic Urban Landscape (2011) and the Hangzhou Declaration (2013) among others, the Davos Declaration (2018) argues that there can be no democratic and peaceful sustainable development without culture. At the same time, we cannot ignore how the growing economic reality of culture is often interlinked with built heritage (Cominelli and Greffe 2019; Sagger, Philips, and Haque 2021).[4]

Baukultur addresses the cultural value of the quality of the built environment, where cultural heritage and contemporary creation are understood as a single entity. It encompasses the entire built environment and there is no implicit judgement of quality associated with the term *per se*. It can exist in the form of HQB or low-quality Baukultur (LQB). The criteria that distinguish HQB from LQB are defined by the criteria of the DBQS (Swiss Federal Office of Culture 2021). Accordingly, HQB is expressed in the application of conscious, well-debated, high-quality design to all building and landscaping activities, ensuring that cultural values are placed center-stage and human social and cultural needs are satisfied (Swiss Federal Office of Culture 2018). Moreover, the concept comprises that the built environment must provide good, safe and healthy living conditions, as well as a cultural environment. HQB is thus embedded in the acknowledgement of the role of culture within sustainable development, regardless of disciplinary differences regarding the use of the concept of culture (Roders 2014).

Our aim is to quantitatively synthesize the extant evidence on the effects of HQB. To this end, we need to break down the holistic concept of Baukultur into a typology of characteristics and outcomes that are connected by mechanisms. This is a necessary step to develop and analyze an evidence base that consists of quantitative empirical research establishing causal bivariate relationships. To test the "quality sells" hypothesis, it is further important that the mechanisms are separable and additive in their effects. This is to ensure that the effects can be aggregated to obtain the net effect of an investment into HQB on the ROI. The criteria of the DBQS (Swiss Federal Office of Culture 2021) provide a framework for the assessment of the qualities of *Baukultur* and were not developed with the intent of providing a framework for the evaluation of causal effects of HQB. Our contribution is to develop a typology of outcomes and characteristics that serves the latter purpose, in a way that is complementary to the DBQS (Swiss Federal Office of Culture 2021). To this end, we treat each of the eight Davos criteria as a characteristic or an outcome, depending on their role in a causal inference framework. If a criterion captures a phenomenon that is typically captured by an exogenous variable in empirical research, we map it into a HQB characteristic. If it is typically captured as an endogenous variable, we map it into one or more outcomes.

We provide the mapping from the Davos criteria to the characteristics and outcomes of HQB defined in Table 1. Since we have defined more characteristics and outcomes than there are criteria in the DBQS, one criterion can map to multiple outcomes. Specifically, we have eight different outcomes that correspond to the Davos criterion "Economy" to differentiate between mechanisms through which HQB generates economic value. This is consistent with the focus on yield-oriented development in this study. Previewing our typology, we generally distinguish between the *function* - which captures how a building or urban space serves its use-specific purpose - and the *form* - which captures how the shape and appearance appeals to potential users - and view *design* as the combination of both. *Governance*, in turn, captures how the institutional framework shapes the design process. We acknowledge that this typology abstracts from many of the nuanced facets of HQB as these characteristics are often related rather than independent. However, the relatively sharp distinction we make between the different characteristics is essential to establish separable

[3] The 2030 Agenda for Sustainable Development frames the central role played by culture in the form of several *sustainable development goals* (SDGs), and goal no. 11 directly refers to it (UN 2015).

[4] This is often manifested through the flows of expenditure and jobs generated by enhancement activities: festivals, exhibitions, creation of design objects and new cultural products, tourism, etc.

and additive mechanisms. Before we return to our typology of characteristics and outcomes in more detail in Section 2.4, we briefly introduce some public and urban economics concepts that guide our choices in Section 2.2 and 2.3.

Tab. 1. Mapping of Davos criteria to characteristics and outcomes

Criterion in Davos *Baukultur* Quality System	Characteristic (Table 1)	Outcome (Table 2)
Beauty	Form (B)	
Context	Urban design (C)	
Diversity		Spatial inclusion (7)
Economy		Internal value: residential (1)
		Internal value: commercial (2)
		Construction cost (3)
		Operating cost (4)
		Durability (5)
		External value of space (6)
		Housing supply elasticity (11)
		Tourism (12)
Environment		Open space (14)
		Sustainability (15)
		Biodiversity (16)
Functionality	Function (A)	
Governance	Governance (D)	
Sense of place		Sense of place (8)
		Safety (9)
		Subjective wellbeing (10)

Notes: Criteria are defined in the Davos *Baukultur* Quality System (Swiss Federal Office of Culture 2021).

2.2 Capitalization, market failures and coordination

In market economies, the creation and maintenance of the built environment lie, to a large extent, in the hands of private agents such as developers and investors who seek to maximize profits. The vision of a built environment shaped by the ideal of a HQB does not necessarily contradict this objective. The canonical spatial equilibrium framework applied in neoclassical (Alonso 1964; Brueckner 1987) and quantitative (Ahlfeldt et al. 2015; Redding and Rossi-Hansberg 2017) urban models predicts that competition among users of real estate leads to the capitalization of the value of internal property characteristics and external neighborhood and city characteristics in property rents and prices. Intuitively, residential, and commercial users of real estate have a willingness to pay for attributes that make buildings and locations more attractive. In a competitive market, potential users of a building compete for the right of use in a process that resembles an auction. The fundamental assumption of bid-rent theory is that all else equal, the right to use is awarded to the user who bids the highest rent. Through this competitive bidding process, this willingness to pay translates into higher market rents, cash flows, and sales values for those who own or develop real property. This process is not only theoretically understood, but also empirically proven for a wide range of property (e.g. for large floor space or energy efficiency) and location (e.g. a good connection to public transit or a high quality of nearby public schools) attributes and there is no reason why the logic should not extend to HQB in the form of functional and well-designed buildings and spaces in between.

Yet, this competitive bidding process is not without limitations. An owner of a property has control over the design of a building. As per the capitalization process described above, they benefit from

higher rents and greater asset value if the property is more attractive. This creates an incentive to move beyond the least-cost configuration and invest into HQB. However, only part of the value generated - the *internal value* - will be appropriated by the owner. For example, an aesthetically appealing building will also make buildings on the other side of the street more attractive, generating *external value*. While the capitalized value in rents and value will benefit other owners of real estate in the neighborhood, this provides little comfort to the one who invests into HQB but does not receive a monetary compensation from the beneficiaries of the external effect. While it would be in the collective interest of all owners to invest in HQB to maximize internal *and* external value, owners may find it individually rationale to ignore the external value in their investment decision in the hope that others will invest into the external appearance of their building. This situation, which resembles the prisoner's dilemma, results in underinvestment in HQB. This is the so-called *freeriding problem,* which naturally arises in the presence of non-pecuniary externalities. Whenever individual decisions concerning the production of goods have positive effects on others, individually rationale producers will produce less than the socially desirable amount, a classic *market failure* (Stiglitz 2020). Typical examples include public goods such as roads or hospitals, which would remain underprovided if left to free markets. Similarly, market failure results in an underinvestment into HQB which is not only harmful to society as a whole, but also to owners of real estate in a neighborhood who fail to coordinate their investments.

Another market failure can arise from an *information asymmetry*. Since the seminal contribution by Akerlof (1970), it is well understood that producers may underdeliver on quality if there is uncertainty with respect to quality of a product on the side of consumers. One typical example is the market for used cars. While buyers will naturally prefer a used car in good condition, the way the previous user has used and maintained the car is not fully transparent. Potential buyers have to base their willingness to pay on the expected quality, which will be a mix of good and bad quality. This creates an incentive for sellers to specialize in low-quality cars. In the context of buildings, there is often a similar degree of uncertainty regarding the level of maintenance, the longevity of the design, and the durability of structure and materials. As with the example of used cars, this can be detrimental to the investments in HQB.

Both market failures result in sub-optimal investments into HQB from a social perspective. They lead to developers and owners missing out on opportunities to capitalize on an existing willingness to pay. It is in the interest of society, as well as profit-seeking private agents, to overcome the *freeriding problem* and the *information asymmetry*. However, overcoming market failures is typically difficult for the private sector alone and requires a collaborative approach with the public sector. This is already common practice, also in the context of the built environment. For example, zoning (master plans) can steer the location of retail development to high streets where retailers benefit from shopping externalities and developers benefit from higher rents, solving a collective action problem similar to the one in the context of the external value of HQB. Energy performance certificates reduce uncertainty regarding future energy bills and generate incentives to increase the energy efficiency of existing and new building stock because of higher market rents.

In creating incentives to internalize external value of HQB and making HQB more transparent, the public sector can assist the private sector in overcoming market failures. In doing so, it can rely on hard or soft governance measures. A typical hard measure to address the *freeriding* problem would be to increase the legally allowed floor area ratio (FAR) in return for a developer running credible design competitions. If the zoning plan is binding in the sense that the profit-maximizing FAR exceeds the legally allowed FAR, a higher legally allowed FAR creates a tangible incentive to invest in HQB. Importantly, design competitions must be binding in the sense that developers must be legally committed to the outcome. This commitment must be transferrable to potential buyers for this hard measure to be effective. In terms of soft governance, the literature has recently suggested reflexive governance as a measure to address the *freeriding* problem (Voß and Bornemann 2011;

Johnston et al. 2021). Multi-stakeholder fora that require interested parties to address externalities (here, the external effects of proposed developments or re-developments) may facilitate the coordination of investments into HQB among local landlords. The participation of local residents, locally based organizations and government officials invested in local needs, can help landlords and developers to understand how the design of proposed (re-)developments can enhance the attractiveness of location and, hence, the market value of their properties. Given that design externalities are highly localized (Ahlfeldt and Holman 2018), it is important that such multi-stakeholder fora are established at the neighborhood level. To address the information problem in the context of HQB, a certification system that helps potential users and buyers in assessing if a building complies with all criteria of HQB represents an obvious soft governance approach that has proven effective in the context of energy performance certificates (Miller, Spivey, and Florance 2008; Glossner, Adhikari, and Chapman 2015). By encouraging investments into HQB, this measure would also, indirectly, mitigate the consequences of the *freeriding* problem.

Key to overcoming the *information asymmetry,* is to signal to potential buyers and renters of real estate if and to what degree a development complies with the criteria of HQB. A certification scheme audited by a credible and neutral institution would be a natural avenue to pursue to provide such information in a transparent and accessible manner. An Alliance of investors, developers, public bodies as well as civil society where membership entails a credible commitment to complying with the criteria of HQB could serve a similar purpose.

2.3 Aggregate demand and supply

In the presence of market failures, such as those described in Section 2.2, free markets generally do not deliver the socially optimal quantities of goods such as housing in general terms, or HQB in more specific terms. In fact, market failures represent the key economic motivation for why planning systems regulate housing markets with the intention of increasing welfare. Put simply, the correction of the market failure, by means of regulation (for, example, via land use planning or the imposition of minimum standards), taxation (for example, via a carbon tax) or subsidies (for example, for affordable housing) represents the benefit side of spatial planning. As discussed above, the correction of a market failure, such as the *freeriding problem* or an *information asymmetry*, not only benefits consumers (users) of real estate, but also producers (development) since at least a fraction of the willingness to pay for a more attractive building capitalizes in market rents and prices of real estate.

Yet, spatial planning is far from uncontroversial. Any regulation that limits the potential use of a parcel of land or imposes quality standards potentially represents a restriction of a developer's ability to put a land parcel to its most profitable use, which can lower its value. This can reduce the incentive for a developer - or even make it impossible - to (re)develop the parcel to such that it accommodates more usable space. Participatory processes and discretionary power of local planning offices, which are implemented with good intentions, can increase the uncertainty regarding the likely outcome of a planning process and reduce the incentive to develop. A canonical view among economists, therefore, is that restrictive planning systems lead to less elastic housing markets (Cheshire 2018). Since the price elasticity of housing supply governs how quickly quantities of housing supplied by the market respond to increases in prices, a lower supply price elasticity implies that there will be less available housing space in the long run and prices will be higher. Indeed, there is evidence showing that in places where the planning system is more restrictive, housing supply expands slower to respond to increasing prices (Saiz 2010) and, as a result, houses are less affordable (Cheshire and Sheppard 2004; Hilber and Vermeulen 2016). The same logic extends to the office market (Cheshire and Hilber 2008). Hilber and Schoeni (2016)

discuss these unintended consequences of restrictive spatial planning in Switzerland, the United Kingdom, and the United States.[5]

From a welfare perspective, it is important to distinguish between price increases that originate from greater demand for and reduced supply of housing. On economic markets, prices adjust to equalize demand and supply in equilibrium. If spatial planning solves a market failure, the willingness to pay increases as discussed in Section 2.2. This leads to a demand-driven increase in the equilibrium price that is reflective of a welfare gain. If a restrictive planning system leads to less housing supply, the equilibrium price also increases. However, this price increase is not driven by a willingness to pay, but instead by a scarcity of space. Consequently, the welfare effect is negative. Price effects of spatial planning policies that originate from the demand and supply side of spatial planning policies are difficult to distinguish. But there is evidence that the net-effect of ambitious planning systems can be negative (Cheshire and Sheppard 2002; Turner, Haughwout, and Klaauw 2014). Therefore, a good spatial planning system must not only set incentives and standards that facilitate, encourage, or enforce HQB effectively, it must also do this efficiently. In particular, it is important that developers can predict rule-based approaches that lead to outcomes on planning prices with a decent degree of confidence (Mayo and Sheppard 2001; Cheshire 2018).

2.4 A typology of characteristics, outcomes, and mechanisms

To guide our empirical literature search, our first step is to review and categorize the theoretical literature on the potential effects of HQB. To this end, we link key HQB characteristics to a range of outcome dimensions. We establish a matrix of causal mechanisms where we view characteristics as origins and outcomes as the effects of HQB. Not all cells in this matrix are necessarily populated, but where they exist, we isolate the mechanisms through which characteristics cause effects, as well as the theoretically expected direction of the effect. The purpose of this exercise is not to provide an in-depth survey of the theoretical literature, but to present a systematic overview of the literature.

2.4.1 High-quality *Baukultur* characteristics

Consistent with *Baukultur* being a holistic concept as noted in Section 2.1, our characteristics of HQB relate to a rich interdisciplinary and multi-faceted literature. We provide a summary of this broader literature and how it relates to our HQB characteristics in Table 2. In the below, we provide a narrower discussion that focuses on how these characteristics relate to selected concepts that are of first-order relevance to the present study, particularly those introduced in Section 2.2 and 2.3.

Function. Arguably, a necessary condition that HQB must satisfy is that buildings serve their *function*, i.e. the need of accommodating an intended use, in a frictionless manner. A frictionless use implies that the use of a building is safe, healthy, and comfortable. It also implies that it is easily amenable to accommodate different intended uses, which can change over time. In urban economics models, floor space is treated as a consumption good that enters the utility function of residents or as an input factor in the production function of firms (Duranton and Puga 2015). Floor space is itself an output that is constructed according to a production function that uses land and capital (including materials in a narrow sense, and architecture and structural engineering in a wider sense) as input factors (Epple, Gordon, and Sieg 2010). In a strictly functional sense, HQB implies that scarce production factors are put to a use that maximize real estate services and, ultimately, utility and output as defined by utility or production functions. These treat real estate as homogenous consumption good or input factor. As such the function of a building is best

[5] In addition to causing higher prices in the long run, restrictive planning can also result in a greater cyclicity of housing markets (Hilber and Vermeulen 2016), longer commutes (Cheshire, Hilber, and Koster 2018), and lower energy efficiency of protected historic buildings (Hilber, Palmer, and Pinchbeck 2019).

understood as cost-efficient provision of floor space that is suitable for a frictionless use over the entire lifecycle of a building (incorporating construction cost, operating cost, depreciation, etc.).

Form. Besides serving a functional purpose, buildings are perceived as expressions of cultural acts, many as cultural symbols or works of art. Entire eras of civilization are commonly associated with architectural milestones that exemplify economic success and human ambition. Even smaller structures have become landmarks that represent entire cities. Much more generally, viewers may derive a utility from the aesthetically appealing buildings that resembles enjoyment of visual arts (Singer 1978). Viewers may also derive intangible values closely associated with these buildings (Cominelli 2020). There can also be productivity effects via an effect increased morale of employees and signalling effects (Liu, Rosenthal, and Strange 2018). We acknowledge that according to the ideal of architectural modernism, an aesthetically appealing *form* should follow naturally from a building's function. In practice, however, there is usually a least-cost configuration that serves the intended purpose of the building as defined by function. And then there is an array of design configurations that may (or may not) improve the aesthetic perception, holding its functionality constant, that would increase cost (Vandell and Lane 1989). HQB implies that the form is chosen such that it generates aesthetic utility to users and observers, both material and immaterial (Cominelli and Greffe 2019). For our purposes it is sensible to treat function and form as separate characteristics of HQB because they can have different effects on different outcomes via different mechanisms. While we acknowledge, that form and function are often related in practice, it is essential for the purposes of this quantitative literature review to have characteristics that are separable and have additive effects.

Urban design. Neighborhoods and cities consist of ensembles of buildings and spaces in between. Abstracting from individual buildings, we refer to how the arrangement of buildings and the way connecting space are designed in terms of function and form as *urban design*. Hence, HQB means that good *urban design* creates spaces that are enjoyable and efficient from a use perspective, i.e. save and walkable. Notice that urban design refers to spaces between buildings in cities as much as villages and towns. Urban design does not only matter for new developments. In fact, a city's physical character is at the genesis of place-based identity, making design a rationale often integrated into planning, housing and local economic development strategies (Listokin, Listokin, and Lahr 1998; Bandarin and van Oers 2014; Licciardi and Amirtahmasebi 2012). A multi-disciplinary literature argues that existing built fabric, including cultural heritage assets, contemporary creations and harmonious urban fabric, areas such as parks, squares and other public or semi-public spaces, must be understood as a single entity (Tweed and Sutherland 2007; Cornu 2003; Smith 1979; Dalmas et al. 2015). The existing fabric provides an important *Baukultur* reference for the future design of our built environment.

Governance. The legislation, regulation and management of the built environment is governed by an institutional framework that can consist of governmental agencies, public-private partnerships (PPPs), and non-governmental organizations (NGOs). Good governance in the context of *Baukultur* means that the institutional framework facilitates, encourages, or even enforces HQB effectively and efficiently. Good governance working towards HQB should aim at supporting suitable expertise and skills in society through educational training and selective immigration such as visa exemptions for accredited professionals. Efficacy requires a regulatory framework that defines HQB criteria, establishes well-designed participatory processes (ICOMOS 2020) and implements practices to foster transparent and rule-based HQB. This would allow developers to predict the outcomes of planning processes (Cheshire 2018). As discussed in Section 2.2, good governance can play an important role as a facilitator of HQB by solving market failures that would be detrimental to building design and urban design. As such, good governance can be view as a determinant of function, and form, and urban design. We refer to this mechanism as the indirect effect. However, good governance can also help shaping awareness and behavior towards *Baukultur*, resulting in

direct effects on outcomes such as external value or awareness. Zoning and specifically the allocation of space to different urban uses (e.g. residential, industrial) also falls in the realm of governance. Because of these direct effects we treat governance as a characteristic of HQB. While good governance is also important within companies in the private sector, we focus on the public sector because of its critical role in solving the market failures described in Section 2.2.

Tab. 2. Characteristics of High-quality *Baukultur*

	Characteristic	Summary
A	Function	Is a measure of the extent to which space supports its intended function or purpose. In the context of HQB functionality implies that a building is well suited to accommodate the activities of the user (Evans and McCoy 1998). Functionality must be adaptable to existing and changing uses and purposes and includes elements such as structure, layout; building materials; heating, ventilation and sanitary services; comfort; and accessibility (Larssen and Bjorberg 2004). Characteristic A is limited to the function of selected buildings or groups of buildings that belong to the same development. In the latter case, the function comprises communal spaces between buildings within a development, but it excludes public spaces between developments.
B	Form	Form refers to the shape or configuration of a building. A number of aspects must be considered to analyze an architectural form, including shape, mass/size, scale, proportion, rhythm, articulation, building materials, texture, color, and light (Ching 2007). In general terms, form refers to the aesthetic design of buildings, including built heritage, contemporary design and iconic architectural examples (Smith 1979; Larkham 1992). HQB implies a choice of architectural form, including materials, as well as interior and exterior design elements, that increase the aesthetic value of a building, independently from its functionality. While function satisfies basic needs and purposes of a building, form addresses non-basic needs and is value-added holding functionality constant. Characteristic B is limited to the form of buildings and communal spaces that belong to a development, but it excludes public spaces between developments.
C	Urban design	Refers to the design of urban and natural areas. Urban design is interlinked to the concept of scale as the intermediate between planning (the settlement) and architecture (individual buildings) (Carmona 2021). HQB characterizes urban design that adds to spatial coherence as defined in the literature in the context of conservation areas (Bonfantini 2012), cultural landscapes (Bandarin & Oers 2012), open spaces, parks and green urban areas, infrastructures (Larkham 1990). Characteristic C captures the form and function of space between developments as well as the contextual spatial arrangement of developments.
D	Governance	Refers to the different levels of governmental administration, governmental agencies, public-private partnerships (PPPs), non-governmental organizations (NGOs), community-based organizations and private sector entities that have a role in the legislation, regulation and management of the built environment (Labadi & Logan 2016; Shipley & Kovacs 2008; Ripp & Rodwell 2016; Pietrostefani & Holman 2020). Good governance in the context of HQB implies efficacy and efficiency, i.e. HQB is achieved through processes that are transparent and predictable. Direct effects: Governance has direct effects on *Baukultur* outcomes such as shaping awareness and behavior towards *Baukultur*. Indirect effects: Governance has an indirect effect on *Baukultur* outcomes through function, form, and urban design.

Notes: This table provides our own synthesis of the characteristics of high-quality *Baukultur* based on extant theoretical literature.

2.4.2 High-quality *Baukultur* outcomes

We discuss a range of outcomes on which HQB may impact in Table 3. These outcomes are regularly associated with various dimensions of the built environment in the related theoretical literature. The purpose of Table 3 is to develop the intuition for the considered outcomes. While we allude to mechanisms that relate outcomes to characteristics, this is purely for a better illustration of the nature of the outcome. The comprehensive typology of mechanisms is in Table 4.

The characteristics of HQB we summarize in Table 2 have effects on various outcomes that operate at different spatial scales. Some of them materialize at the *property level* (i). As such they are of immediate relevance to the owners, be they developers or investors. In fact, these outcomes constitute the key ingredients in conventional discounted cash flow analysis that used to determine the (net present) value of investments (Linneman and Kirsch 2018). Construction costs map to the initial investment. Value of space maps to gross returns, which together with operating costs determine the net operating income. Durability affects how the capital stock, and the associated returns, depreciate over time.

Some of the effects of HQB operate within ensembles of buildings at *neighborhood level* (ii). A building can constitute a design amenity (or dis-amenity) for users of nearby buildings. This way, HQB can generate an external value, which is appropriated by owners of the other buildings in the neighborhood. As discussed in Section 2.2, such a spill over creates a coordination problem since all owners would be collectively better off if they chose to consider the external effect in their investment decisions, but, individually, it may appear rational to focus on the outcomes that operate at the property level. Notice that to the extent that the other outcomes in (ii) may also capitalize into rents and prices via the competitive bidding process described in Section 2.2, the external value represents a monetized gross effect that encompasses the effects of the design externality effects of the other outcomes.

HQB can also have effects that spread even farther. We have grouped candidate outcomes in *wider level* (iii). Notice that inclusion in (iii) does not preclude a neighborhood effect, but merely suggests that the effects are likely to spread beyond the neighborhood.

Tab. 3. Outcomes of High-quality *Baukultur*

Index	Outcome category	Summary
(i) Property level		
1	Internal value of space: residential	A positive willingness to pay that capitalizes in higher rents and prices in a competitive real estate market and can originate from i) utility derived from the use of housing services and ii) "aesthetic" utility (similar to arts consumption) derived from interior and exterior design (Vandell and Lane 1989; Roulac 2007).
2	Internal value of space: commercial	A positive willingness to pay that capitalizes in higher rents and prices in a competitive real estate market and can originate from i) suitability of space as a production factor and ii) an "aesthetic" productivity effect via e.g. morale of employees, signalling (Newsham et al. 2019).
3	Construction costs	Compared to the least-cost configuration, a different choice of architecture, design and material can lead to higher construction cost (including time cost) (Newton, Asce, and Christian 2006). The effect on construction cost may be different for new developments, re-developments, or extensions.
4	Operating costs	Well-designed buildings can have lower operating costs. We assume that any running cost borne by the tenant capitalizes into rents in a competitive market. To avoid double counting with outcome 1, we focus on costs borne by the landlord here, e. g. those related to the maintenance of the building.
5	Durability	Good design, durable materials and improved function can lead to a lower rate of depreciation and reduced maintenance costs, greater longevity of the design amenity, and, thus, greater value in the long run (Soronis 1992; Hooton and Bickley 2014).
(ii) Neighbourhood level		
6	External value of space	Aesthetic and other values attributed to viewing high-quality building and urban design. Unlike with the internal effect, the design amenity and the capitalization effect occur to different buildings.
7	Spatial inclusion	Spatial inclusion refers to social mixing of different socio-economic groups within neighborhoods. If HQB is a luxury good (valued more at higher income levels), differences in the quality of the built environment can result in spatial income segregation unless the spatial planning system promotes social mixing. Social inclusion (the participation of different social groups in societal processes) are only considered to the extent that they originate from spatial inclusion.
8	Sense of Place	The built environment is a central element in both environmental psychology and social geography in understanding people's sense of attachment to places, defined as meaningful locations (Lewicka 2011; Logan and Molotch 2007; Pietrostefani 2022)
9	Safety	Decrease in crime and reported feelings of safety considering good perception of place (Carmona 2021; Chalfin, Kaplan, and LaForest 2021).
10	Subjective well-being	Both high-quality design and functionality result in increased happiness, satisfaction measures and reduced anxiety (Jackson 2003; Trajković, Milovanović, and Nikezić 2021; Power and Smyth 2016).

Index	Outcome category	Summary
(iii) Wider level		
11	Housing supply elasticity	The housing supply elasticity describes how quickly the quantity of housing supplied responds to changes in prices on real estate markets. In an elastic housing market, small demand-induced changes in housing prices lead to large adjustments in housing stock via increased construction activity (replacement or expansion of existing buildings). In an inelastic housing market, the supply of housing stock does not respond to changes in prices, leading to inertia. A greater durability of buildings makes the stock less malleable (lower incentives for redevelopment). Compared to an unconstrained free-market equilibrium, a more demanding planning system (enforcing the preservation and development of HQS) can make housing supply less elastic unless the planning system is very efficient (Hilber and Vermeulen 2016). We adopt the term housing supply elasticity because it is customary in the literature, but the concept comprises the supply of space for other uses such as retail and office.
12	Tourism	Buildings of attractive functional form and urban spaces that satisfy high standards in terms of form and function can attract tourists and tourist activities (Scerri, Edwards, and Foley 2018).
13	Existence value	Residents of the city, the country or the world value the existence of cultural heritage, contemporary creations and homogenous urban spaces. Unlike the internal and external value, the existence value does not derive from the regular and direct consumption of the design amenity (Mourato and Mazzanti 2002; Licciardi and Amirtahmasebi 2012).
14	Open space preservation	More efficient use of land, e.g. higher density, preserves open space as it reduces the area occupied by urban use. Good governance considers the opportunity costs associated with urban sprawl (Neuman 2005; Wolsink 2016; Ikin et al. 2013).
15	Sustainability	Captures the environmental sustainability measured by the carbon footprint during construction and operation of buildings (Dutil, Rousse, and Quesada 2011). The built environment also impacts indirectly on the carbon footprint of cities because higher density facilitates the adoption of sustainable transport modes (Cervero and Kockelman 1997; Ewing and Cervero 2010) .
16	Biodiversity	The integration of plants and natural ecosystems into buildings and spaces contribute to conserving natural resources and biodiversity, mitigating climate change, and thus supporting sustainability (Dover 2015).

Notes: This provides our own synthesis of the outcomes on which high-quality *Baukultur* is expected to impact based on extant theoretical literature.

2.4.3 Linking *high-quality Baukultur* characteristics to outcomes

In Table 4, we link the characteristics of HQB defined in Table 2 to the outcomes introduced in Table 3 via a matrix of causal mechanisms. Because one characteristic can have an effect via different mechanisms on one outcome, it is possible that the effect is ambiguous. In such cases, we list multiple mechanisms in a characteristic-outcome cell and the theoretically expected direction of the effects that operate though each of the mechanisms. To add to the intuition of the established relationships, we also add concrete empirically observed variables in which the effects typically

materialize. These variables are also considered in the keyword literature search that is guided by Table 5.

Tab. 4. Theoretically expected effects of *high-quality Baukultur*

	Baukultur outcomes		*Baukultur* characteristics			
	Characteristic	Empirically observed	Function	Form	Urban Design	Governance
1	Internal value of space: residential	Land values, house prices, rents, stated WTP	*Positive effects* High functionality increases utility (capitalization effects in rents) (+) Utility bills paid by the tenant decrease, (capitalization effects in rents) (+)	*Positive effects* due to utility from building design (capitalization effects in rents) (+)	*Positive* effects due to utility from exterior design including values attributed to spatial coherence, open and green spaces (+)	*Positive effects* Direct effect: Good governance shapes awareness and behavior (+) Indirect effect: *Positive* via (a), (b), (c) (+)
2	Internal value of space: commercial	Commercial prices, commercial rents	*Positive effects* High suitability of space fosters higher productivity (+) Utility bills paid by the tenant decrease, (capitalization effects in rents) (+)	*Positive effects* as well-design buildings can impact productivity via e.g. morale of employees, signaling (+)	*Positive effects* as greater workplace amenity and enhanced spill overs (knowledge or retail si s overs) adds to productivity (+)	*Positive effects* Direct effect: Good governance collocation of complementary economic activity (+) Indirect effect: *Positive* via (a), (b), (c) (+)
3	Construction costs	Time, architect, engineer, materials and administrative costs	*Negative effect* -departure from least-cost configuration increases construction cost (-)	*Negative effects* - departure from least-cost configuration increases construction cost (-)	x	*Positive effects* Direct effect: *Positive as* an efficient planning process may reduce the time and cost of development (+)
4	Operating costs	Maintenance costs	*Positive effect* as highly functional buildings reduce maintenance costs to the landlord (+)	x	x	*Positive effects* Indirect effect: *Positive* via (a), (c) (+)
5	Durability	Longer lasting built fabric	*Positive effect* as more sophisticated engineering solutions and materials increase durability (+)	*Positive effect* via longevity of design (+)	x	*Positive effects* Direct effect: Good governance regulates materials durability and sustainability (climate, earthquakes) (+) Indirect effect: Positive effect via (a) (b) (+)
6	External value of space	Prices, rents, stated WTP, visit counts	x	*Positive effect* due to utility from building design spill over which increases value of location (external view) (+)	*Positive effect* due to utility from urban design (external), linked to utility of open, well-designed spaces (+)	*Positive effects* Direct effect: Good governance shapes awareness and behavior towards HQB (+)

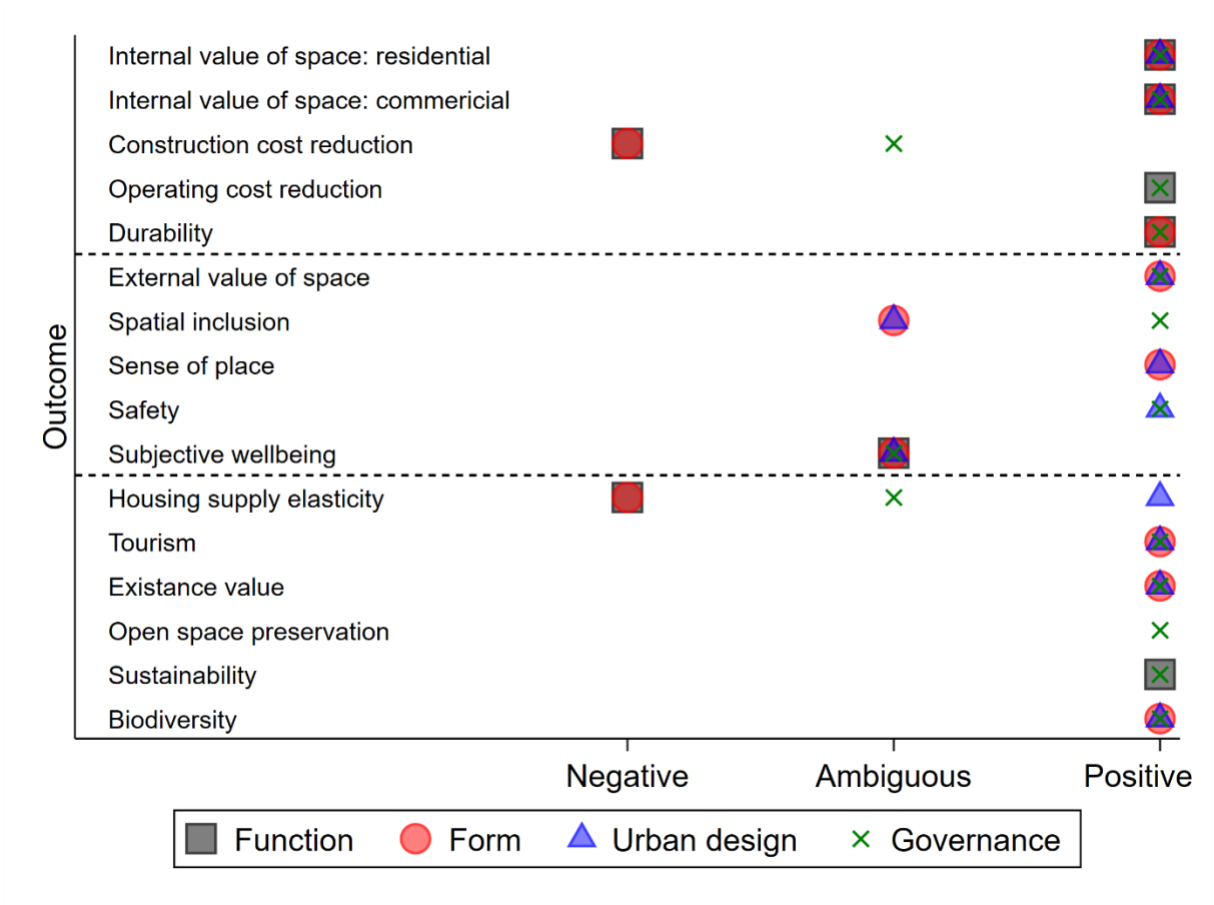
Baukultur outcomes			*Baukultur* characteristics			
	Characteristic	Empirically observed	Function	Form	Urban Design	Governance
7	Spatial inclusion	Real wage segregation, diversity (gender, income, age, ethnicity)	x	*Ambiguous effects* Potentially negative effects on affordability leads to spatial segregation (-) unless HQB becomes universal (+)	*Ambiguous effects* Potentially negative effects on affordability leads to spatial segregation (-) unless HQB becomes universal (+)	*Positive effects* Direct effect: Assuming a social welfare function that penalizes spatial inequalities, good governance encourages affordable housing which could avoid spatial segregation (+)
8	Sense of Place	Reported belonging, perception of place, reported social interaction	x	*Positive effects* Enhanced social interaction (+) Improved perception of space (+)	*Positive effects* Enhanced social interaction (+) Improved perception of space (+)	*Positive effects* Direct effect: Good governance shapes awareness and behavior towards HQB (+)
9	Safety	Crime rates, reported safety	x	x	*Positive effects* on crime rates due to good design and lighting of space. Increase in reported feelings of safety (+)	*Positive effects* Indirect effect: Positive effect via (c) (+)
10	Subjective well-being	Subjective well-being, happiness, anxiety, life satisfaction	*Ambiguous effects*: Illumination, material, and layouts affect metal health and wellbeing (+) Better function increases price which compensates for positive effects (-)	*Ambiguous effects* as dependent on all other outcomes. Less anxiety and greater happiness similar to arts consumption (+) Less domestic space due to higher rent (capitalization effect) (-)	*Ambiguous effects* as dependent on all other outcomes. Less anxiety and greater happiness similar to arts consumption (+) Less domestic space due to high prices (-)	*Ambiguous effects* Indirect effects: via (a), (b), (c)
11	Housing supply elasticity	Number of new constructions, change in built volume	*Negative effect* Durability reduces need for redevelopment (-)	*Negative effect* Longevity of design reduces need for redevelopment (-)	*Positive effect* Developers attracted by high-quality urban design and better marginal profits increase construction (+)	*Ambiguous effects* Direct effect: planning regulates morphological density Indirect effect: on demand via (b), (c)
12	Tourism	Tourism expenditure, tourism counts	x	*Positive effects* through increased tourism expenditure due to increased visits to buildings (+)	*Positive effects* through increased tourism expenditure due to increased visits to areas (+)	Indirect effect: *Positive effect* via (b), (c)
13	Existence value	Stated WTP	x	*Positive effects* for both residents of the city, the country or the world that value the existence of architectural examples (+)	*Positive effects* for both residents of the city, the country or the world that value the existence of spatially coherent spaces (+)	Direct effect: Good governance shapes awareness and behavior towards HQB (+)

	Baukultur outcomes		*Baukultur* characteristics			
	Characteristic	Empirically observed	Function	Form	Urban Design	Governance
14	Open space preservation	Size of developed area	x	x	x	Direct effect: Positive effects - More efficient use of land preserves open space (+)
15	Sustainability	Emissions	*Positive effect* Construction choices (materials, protocols) can improve carbon footprint (+) Better material and high functionality results in improved energy efficiency (+)	x	x	Direct effects: Good governance regulates energy efficiency of buildings and density (+) Positive effects through better access (transportation and mode choice) (+)
16	Biodiversity	Green space, species counts	*x*	*Positive effects* if buildings integrate plants/green	*Positive effects* - more green space improves accessibility for wildlife who contribute to the ecosystem	Indirect effects: (b), (c)

Notes: This table connects the characteristics introduced in Table 2 to the outcome introduced in Table 3 via causal mechanisms established in the theoretical literature.

We provide an accessible summary of the theoretically expected directions of the effects by characteristics and outcomes in Figure 1. The main insight from Figure 1 is that there are many channels through which HQB can have positive impacts on various outcomes. In total, we identify 46 characteristic-outcome pairs in Table 4. For only four, i.e. less than a tenth, the expected effect is negative (in a normative sense). These negative effects are incurred in the form of greater construction cost and a more limited supply-responsiveness, both of which can lead to supply-driven increases in house prices. For eight, the theoretical effect is ambiguous. For the remaining 34, the expected effect is unambiguously positive.

Fig. 1. Theoretically expected effect by mechanism



Notes: This figure summarizes the theoretically expected direction of effects described in more detail in Table 4.

3 The evidence base

In this section, we describe how we collect and encode the evidence base and provide some descriptive statistics on the origins of the collected evidence.

3.1 Collection

We aim at collecting an evidence base that covers, as broadly as possible, the theoretically relevant links between HQB characteristics and the outcomes discussed in Sections 2.4.1 and 2.4.2. In collecting 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 that were published as edited book chapters, in refereed journals or in academic working paper series (we were also open to other types of publications).

In searching for an evidence base, 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 allow for a transparent and theory-consistent literature search, the selection of keywords is guided by our theory matrix as summarized in Table 5. We run searches that are specific to mechanisms that govern the causal effects of characteristics on outcomes. Notice that the effect of an outcome on a characteristic can operate through multiple mechanisms. In several instances, we run more than one search for an outcome-characteristics combination to cover different empirically observed variables and, thus, maximize the evidence base. In each case, we use combinations of keywords that relate to the outcome (where appropriate, we use empirically observed variables listed in Table 5), HQB characteristic, and, if applicable, a mechanism. For example, in searching for papers on the effect of building functionality on 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 both the terms *form*, *design* and *heritage* for the form category in order to search both for both built heritage, contemporary design and iconic architectural examples. We use the term *urban design* as defined in our characteristics of HQB.

In general, we focus on the direct effects of governance on identified characteristics. We do not search for papers on the indirect effects of governance through function, form, and urban design because, although these are important to consider from a policy perspective, the empirical literature typically abstracts from the origins of these characteristics when establishing their effects. We note that we do not include the term *Baukultur* in our systematic keyword searches since this would narrow down the evidence base. We conduct a separate generic search to cover the small literature using this term. For the same reason, we conduct one generic literature search for a literature concerned with how good governance shapes awareness of *Baukultur*. We do not impose any geographical restrictions, to the extent that they exist. We also run some separate generic searches in German, French, Italian and Spanish to cover literature generated in these languages as reported in Table A1 in the Appendix. However, these searchers returned limited evidence and virtually no studies that were not picked up by the English equivalents. Therefore, we restrict the systematic keyword search to English keywords. In total, we consider the 88 keyword combinations (for 40 theoretically relevant outcome-characteristic combinations summarized in Table 5) which we apply to three databases, resulting in a total of 264 keyword searches (step 1). We note 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 (2017; 2019), and in an attempt to keep the literature search efficient, we generally did not consider documents beyond this threshold. This search delivered 7,000 papers for initial screening. Upon inspection of the collected papers (excluding empirically irrelevant work, duplications of working papers, and journal articles, etc.) we were left with 340 studies. Further inspection resulted in the inclusion of 127 studies from the keyword searches in our database (see Table A2 in the Appendix).

In a limited number of (18) cases (step 2), we reassign a paper returned in a search for a specific outcome category to another category if the fit is evidently better. In multiple cases, especially for internal and external value of space a *paper* contains evidence that is relevant to more than one category in which case it is assigned to multiple categories. We generally refer to such distinct pieces of evidence within one paper as *analyses*. We do not double count any publication when reporting the total number of *analyses* throughout the paper.

Based on the evidence collected in step 1, we then conduct an analysis of citation trees (also step 2) of our literature search. In particular, we select studies that review the related literature and cross check their references with papers picked up 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 no 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 16 studies were added to the database from the citation tree analysis.

In the final step 3 of the evidence collection, we add all relevant empirical studies (38) known to us before the evidence collection (including those we came across in the search for theoretical literature) (Table A2 in the Appendix). This systematic literature search resulted in 197 studies and 382 analyses.

3.2 Encoding

As with most quantitative literature reviews we use statistical approaches to test whether existing empirical findings vary systematically in the selected attributes of the studies, such as the context, the data or the methods used. In line with the standard approach in meta-analytic research (Stanley 2001) we encode the results as well as the attributes the reviewed studies into variables that can be analysed using statistical methods.

3.2.1 Qualitative result score and index

To facilitate a systematic analysis of such a heterogenous evidence base, we follow Ahlfeldt & Pietrostefani (2017) and categorize the results into three discrete classes. The empirical result is classified as *positive* if a compact city characteristic is associated with increases in the outcome. Note that we have defined the outcomes in a way that ensures that positive changes imply positive effects in a normative sense. The empirical result is classified as *negative* if it points in the opposite direction and is statistically significant. The remaining cases are classified as *insignificant*. This metric is qualitative in the sense that we are unable to infer the magnitude of the effects on outcomes. Yet, it allows a summarizing of the entire body of evidence in transparent and accessible form. The metric is comparable within and across outcome categories and can also be compared to the theoretical expectations. To facilitate further analyses, we assign the numeric values 1 / 0 / -1 to *positive*/*insignificant*/*negative* – *the qualitative result score* – which, by taking the mean, allows us to summarize the evidence into a *qualitative result index* that can range from -1 to 1, where positive values imply positive effects on average. For consistency with the theory expectations derived in Section 3, we generally maintain the labelling *negative*/*ambiguous*/*positive* but wish to highlight that the empirical qualitative results scale is a continuous index.

3.2.2 Quantitative results

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 HQB is captured empirically via explanatory variables. The most popular approach is to define HQB via a 0,1 indicator (dummy) variable (e.g. to describe if a building has been certified). This conventional semi-log specification delivers the following premium associated with HQB on an outcome *Y*:

$$E(\ln Y \mid HQB = 1, X) - E(\ln Y \mid HQB = 0, X) = \hat{b},$$

where HQB is the indicator for HQB 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 *PC* following Halverson 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:

$$\frac{\partial \ln Y}{\partial \widetilde{HQB}} = \hat{\beta},$$

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

$$\hat{b} = \hat{\beta} \times \Delta\widetilde{HQB},$$

where $\Delta\widetilde{HQB}$ is the change in the employed metric that corresponds to a change from an ordinary design to one that stratifies criteria of HQB.

3.2.3 Other attributes

Along with the qualitative and quantitative results, we encode, for each analysis in the evidence base, the following attributes:

i) The outcome category, one for the 16 outcomes defined in section 2.4.2
ii) The HQB characteristic, i.e., function, form, urban design and governance
iii) The stage (1–2) at which an analysis is added to the evidence base
iv) The publication venue, e.g., academic journal, working paper, book chapter, report
v) The disciplinary background, e.g., economics, urban planning, energy etc.
vi) The dependent variable, e.g., property prices, rent, construction costs etc.
vii) The study area, including the continent and the country
viii) The period of analysis
ix) The property type, e.g. residential, commercial, or public
x) The number of google citations and the quality of evidence as defined by the Scientific Maryland Scale (SMS) used by the What Works Centre for Local Economic Growth (2016)
The quality can take the following values:
0. Exploratory analyses (e.g., charts). This score is not part of the original SMS
1. Unconditional correlations and OLS with limited controls
2. Cross-sectional analysis with appropriate controls
3. Good use of spatiotemporal variation controlling for period and individual effects, e.g., difference-in-differences or panel methods
4. Exploiting plausibly exogenous variation, e.g., by use of instrumental variables, discontinuity designs or natural experiments
5. Reserved to randomized control trials (not in the evidence base)

Tab. 5. Keyword searches

	HQB Outcomes Characteristic	*HQB* characteristics Function	Form	Urban Design	Governance
1	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
2	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
3	Construction costs	building; function*; "construction cost"	building; design AND form OR heritage; "construction cost"	-	building, planning, policy OR regulation, "construction cost"
4	Operating costs	building; function*; "maintenance cost"	-	-	-
5	Durability	building; function*; durability OR longevity	building; design AND form OR heritage; durability	-	building; planning; regulation; material; durability
6	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
7	Spatial inclusion	-	building; design AND form OR heritage; segregation OR "spatial inclusion" OR gentrification	building; "urban design"; segregation OR gentrification	building: planning; policy; "affordable housing" OR "social housing" OR "spatial segregation"
8	Sense of Place	-	building; design AND form OR heritage; "sense of place" OR belonging	building; "urban design"; "sense of place" OR belonging OR "social interaction"	-
9	Safety	-	-	building; "urban design"; crime OR safety	-
10	Subjective well-being	building; function*; well-being OR health	building; design AND form OR heritage; well-being OR health	building; "urban design"; well-being OR health	-

	HQB Outcomes Characteristic	*HQB* characteristics Function	Form	Urban Design	Governance
11	Housing supply elasticity	building; function*; “land development”	building; design AND form OR heritage; “land development”	building; “urban design”; “land development”	planning; policy; "housing supply" OR "morphological density"
12	Tourism	-	building; design AND form OR heritage; tourism	building; “urban design”; tourism	-
13	Existence value	-	building; design AND form OR heritage; “existence value”	building; “urban design”; “existence value”	planning; policy; existence; awareness
14	Open space preservation	-	-	-	land border; space; urban OR land use; efficient; "open space"
15	Sustainability	building; function*; “carbon footprint” OR “energy efficiency” OR “green labels”	-	-	building; policy; governance; “energy efficiency” OR “carbon footprint”
16	Biodiversity	-	building; design AND form OR heritage; biodiversity	building; “urban design”; biodiversity	-

3.3 Distribution

In this section, we tabulate the evidence base by selected features of the analyses. In Table 6, we tabulate the number of analyses by outcome-characteristics cells. This allows for a quick assessment of the dimensions of HQB that have received the greatest attention in the literature. Perhaps not surprisingly, the evidence base is much more developed for certain outcomes and characteristics than others. As an example, there is a fairly large number of studies analyzing the effects of function and form, on commercial and residential property prices. There is also a sizable number of studies analyzing the external effects of architectural form on property value, revealing recent progress in this research area. For many other outcomes, however, the evidence base is much thinner.

In Table 7, we tabulate the evidence base by geographic and academic origin. Consistent with our geographically unbiased approach, our search recovers studies from a broad range of countries from different world regions with different spoken languages. The evidence base is less dominated by North America than the literature on compact urban form (Ahlfeldt and Pietrostefani 2017), but it is similarly skewed towards analyses from academic publication venues and the economics discipline. To some extent the latter might be attributable to economics simply being a large field within social sciences. To some extent, this may also reveal a growing awareness for the economic relevance of HQB.

Figure 2 reveals that the evidence is generally very recent, with most studies having been published within the last 15 years, reflecting growing interest in HQB. Consistent with the relatively recent publication dates, most studies use data from the 1980s onwards. A clear majority of studies score two or more on the Maryland Scientific Methods Scale (SMS), which means there is usually a serious attempt to disentangle effects related to HQB from other factors, often including unobserved fixed effects and period effects. This is important, because it is likely that buildings exhibiting HQB are located in more attractive locations. Distinguishing between studies published before or after 2010 reveals a progression toward more rigorous methods that score three or four on the SMS. For a more detailed discussion of the SMS metric, we refer to What Works Centre for Local Economic Growth (2016).

Tab. 6. Distribution of analyses by outcome and characteristic

		Characteristic				
Outcome		A	B	C	D	Sum
1	Internal value of space: residential	36	74	10	3	123
2	Internal value of space: commercial	34	20	7	0	61
3	Construction cost reduction	20	6	0	1	27
4	Operating cost reduction	10	0	0	0	10
5	Durability	1	0	0	1	2
6	External value of space	0	53	4	0	57
7	Spatial inclusion	0	3	0	3	6
8	Sense of place	0	10	2	0	12
9	Safety	0	0	9	0	9
10	Subjective wellbeing	17	1	5	0	23
11	Housing supply elasticity	0	4	0	0	4
12	Tourism	0	3	0	0	3
13	Existence value	0	12	0	0	12
14	Open space preservation	0	0	0	4	4
15	Sustainability	18	0	0	6	24
16	Biodiversity	0	3	2	0	5
	Sum	136	189	39	18	382

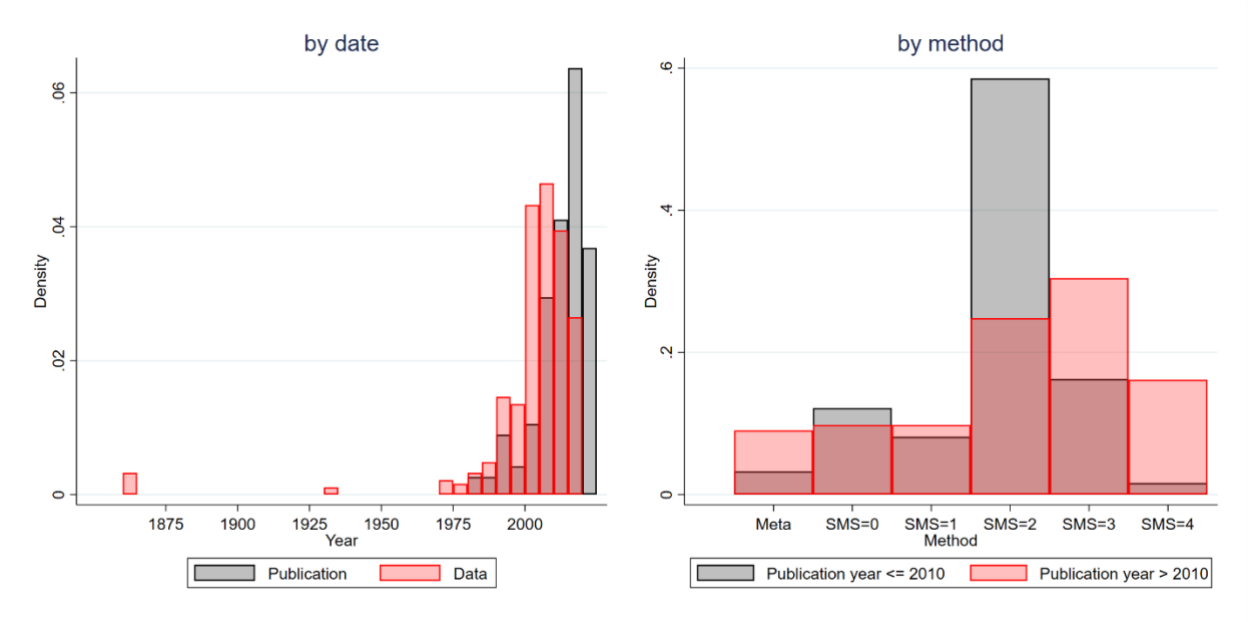
Notes: Note: A = Function, B = Form, C = Urban Design, D = Government

Tab. 7. Distribution of analyses by geographic and academic origin

World region	N	Publication venue	N	Discipline	N
USA	119	Academic Journal	343	Economics	191
UK	27	Working Paper	20	Urban Planning	79
Netherlands	26	Report	9	Environment	39
Unknown	23	Book	7	Cultural Heritage	20
Australia	21	Dissertation	2	Architecture	16
China	20	Book Chapter	1	Social Science	9
Japan	14	-	-	Regional Studies	6
Italy	13	-	-	Engineering	6
New Zealand	13	-	-	Management	6
Singapore	10	-	-	Public Health	4
Latvia	9	-	-	Geography	4
Switzerland	8	-	-	Other	2
Canada	8	-	-	-	-
Germany	7	-	-	-	-
Northern Ireland	6	-	-	-	-
Iran	5	-	-	-	-
Sweden	5	-	-	-	-
Chile	4	-	-	-	-
Portugal	4	-	-	-	-
India	4	-	-	-	-
South Africa	3	-	-	-	-
Iran and India	3	-	-	-	-
Greece	2	-	-	-	-
Canada and USA	2	-	-	-	-
Vietnam	2	-	-	-	-
Malaysia	2	-	-	-	-
Israel	2	-	-	-	-
Armenia	2	-	-	-	-
Sri Lanka	2	-	-	-	-
Brazil	2	-	-	-	-
Turkey	2	-	-	-	-
Lebanon	1	-	-	-	-
Spain	1	-	-	-	-
Romania	1	-	-	-	-
Egypt	1	-	-	-	-
Mauritius	1	-	-	-	-
Tanzania	1	-	-	-	-
Indonesia	1	-	-	-	-
Germany and Sweden	1	-	-	-	-
Taiwan	1	-	-	-	-
Ireland	1	-	-	-	-
Cape Verde	1	-	-	-	-
South Korea	1	-	-	-	-
Sum	382		382		382

Notes: N = Number of analysis in group. Assignment to disciplines based on publication venues.

Fig. 2. Distribution of analyses by date and method



Notes: Date of the data is the mean of the start date and the end data of the study period covered in an analysis.

4 Analysing the evidence base: Qualitative effects

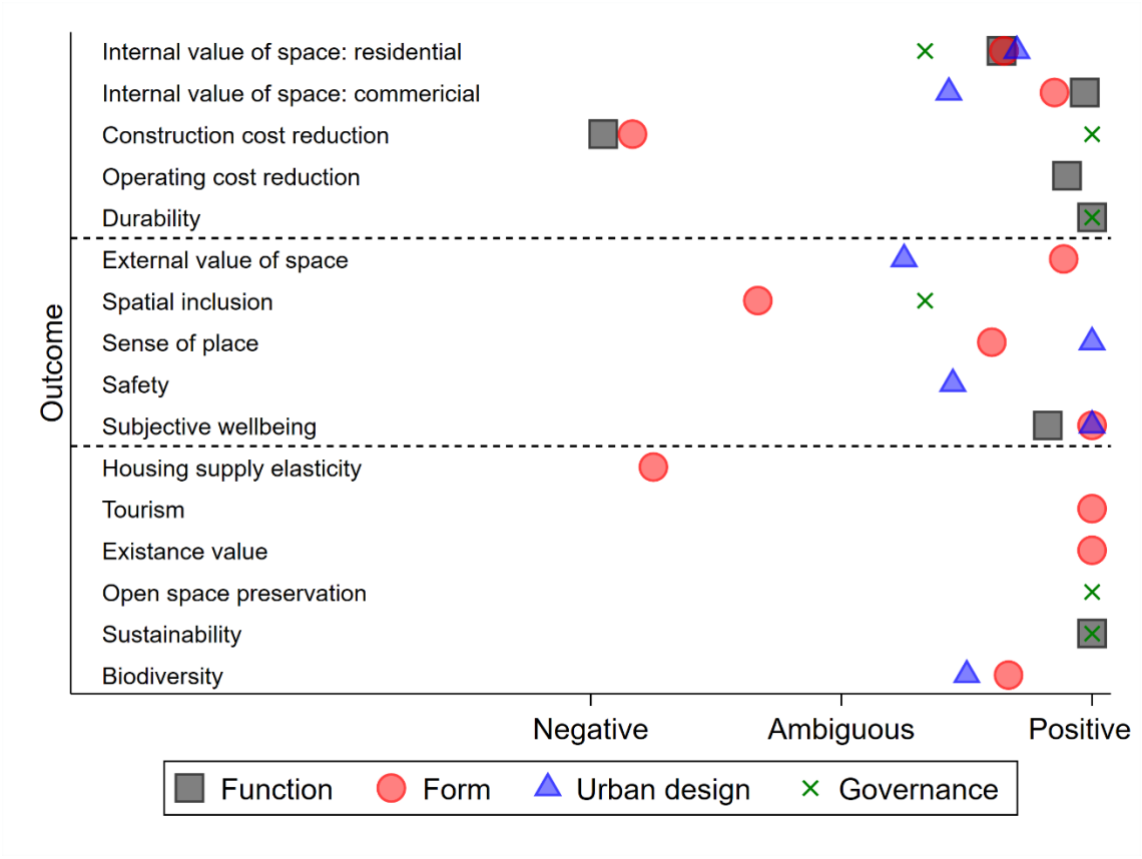
The evidence base collected is very broad in the sense that it relates to different outcomes and characteristics and is based on different empirical approaches. Therefore, the evidence collected is often not directly comparable across studies, not even within outcome categories. Any quantitative interpretation will inevitably be limited to a narrower set of studies that explore similar mechanisms using similar empirical approaches. Before we turn our attention to the specific mechanisms that are key to a quantitative evaluation of the "quality sells hypothesis", we wish to provide a snapshot of the entire evidence base in this section.

4.1 Theory vs. evidence

In Figure 3, we illustrate the distribution of qualitative result scores (see Section 3.2.1) by mechanism. Consistent with theoretical expectations, the evidence base on the effects of HQB is generally positive. Indeed, Figure 4 reveals that the evidence is mostly positive where theoretical expectations are positive. Likewise, there is a strong concurrence between theoretical expectations and empirical evidence regarding normatively negative effects on outcomes, mostly in the form of greater construction cost and lower housing supply elasticities. One disconnect between theoretical expectation and evidence, is that the latter fails to substantiate the positive spill over effects of urban design policies on property prices (see marker 6C in Figure 4). However, it should be noted that this result is driven by one study on a particular heritage-preservation policy in Quebec, Canada, which may have limited external validity (Devaux, Berthold, and Dubé 2018). It also turns out that the evidence points to negative effects of architectural form on spatial inclusion, although the evidence base is small (see marker 7B in Figure 4). No such effect would be expected if good architectural form was abundant (hence, theoretically ambiguous expectations). It appears, however, that attractive form remains scarce and associated with high willingness to pay among wealthier households. The other result that jumps out of Figure 4 is that – while theoretically ambitious – the effect of HQB on subjective wellbeing via function, form, and urban design (see markers 10A, 10B, 10C in Figure

4) tends to be generally positive. This suggests that increasing rents and prices do not offset for the utility individuals derive from HQB.[6]

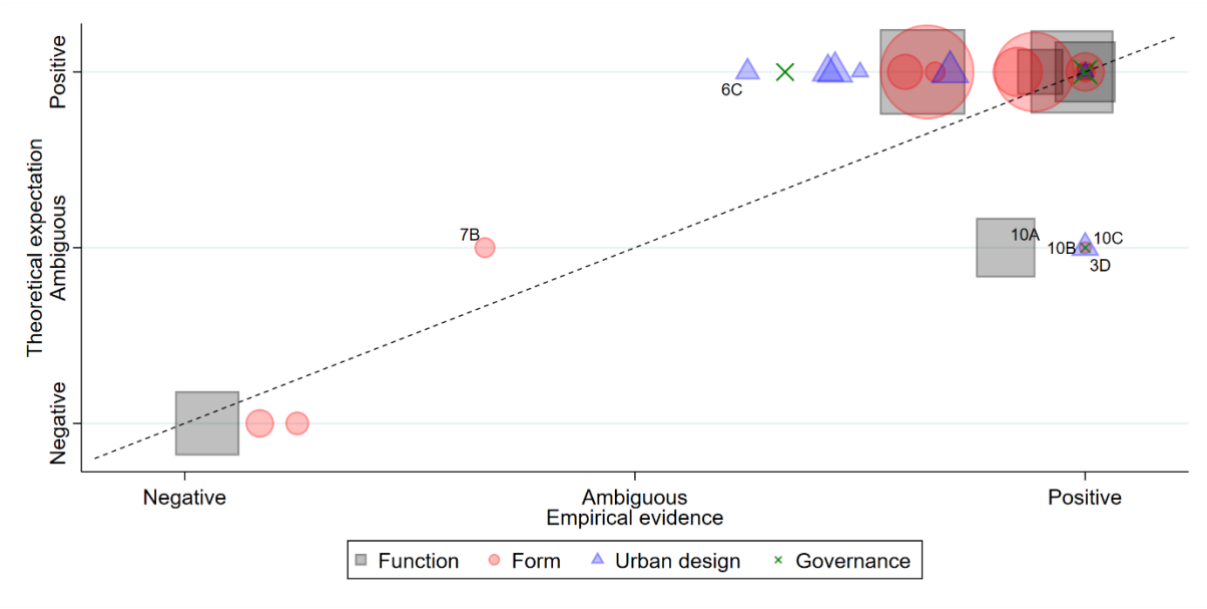
Fig. 3. Qualitative result index by mechanism



Notes: We assign the numeric values 1 / 0 / -1 to *positive*/*insignificant*/*negative*, which, by taking the mean, allows us to summarise the evidence into a qualitative result *index* that can range from -1 to 1, where positive values imply positive effects on average.

[6] The evidence base does not allow for a comprehensive evaluation of the effects of architectural spill overs (from other than the inhabited development) on subjective wellbeing; therefore, this result may or may not generalize to areas that are indirectly affected by HQB.

Fig. 4. Qualitative result index by mechanism



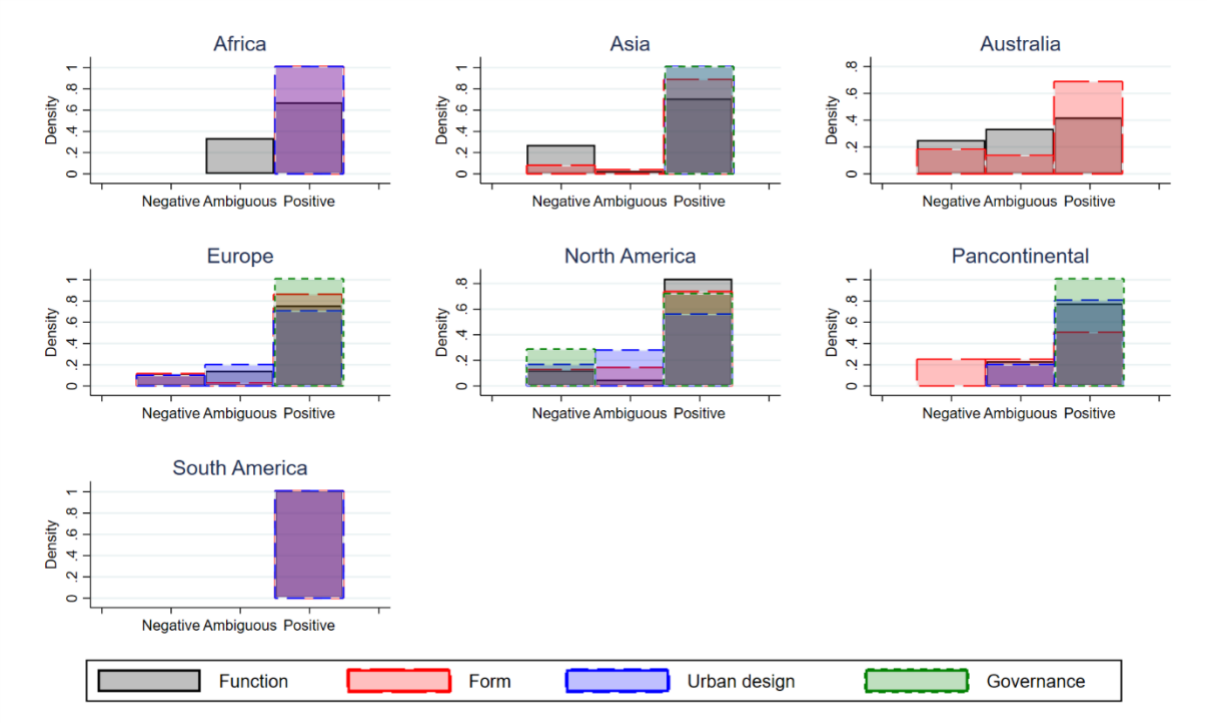
Notes: This figure correlates theoretical expectation and qualitative empirical evidence by outcome-characteristics cells (see Table 3). Theoretical expectations are those listed in Figure 1. Empirical evidence is measured by the qualitative results index illustrated in Figure 3. Marker size is proportionate to number of studies by characteristics. Dashed line is the 45-degree line. Marker labels give combinations of outcomes (numbers) and characteristics (letters).

For the interested reader, we illustrate the full distribution of analyses that find negative, insignificant, and positive results of each characteristic on each outcome in histograms in Figure 5. This presentation provides more details at the expense of being somewhat less accessible than the summary in Figure 3 and will be of relevance for readers interested in the effect of a specific mechanism on a specific outcome. In Figure 6, we present similar histograms by world region to illustrate that the generally positive evidence base, is not driven by a particular geography.

Fig. 5. Qualitative evidence by outcome and characteristics

Notes: This figure presents shares of analyses that find negative, insignificant, and positive results for each characteristic on each outcome.

Fig. 6. Qualitative result score by mechanism



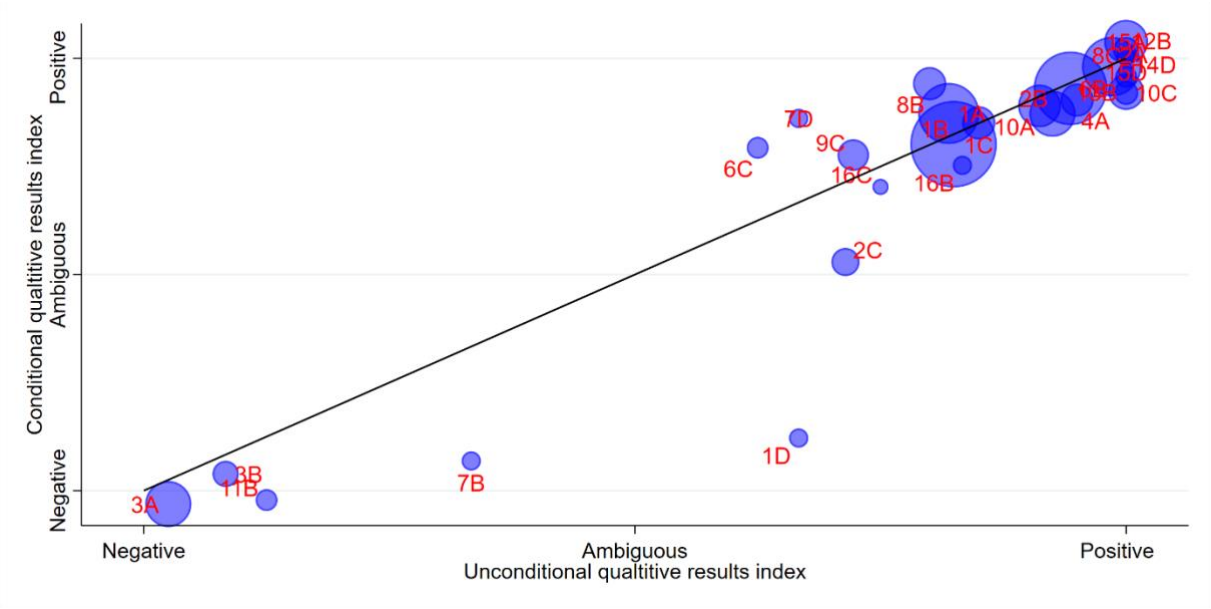
Notes: This figure presents shares of analyses that find negative, insignificant, and positive results by characteristics for different world regions.

4.2 Meta-regressions

A standard approach in meta-analytic research is to run meta-regressions to adjust for features of the study design that might affect results and give higher weights to more reliable estimates. We follow this canonical practice and generate a mix-adjusted conditional qualitative result index by regressing the qualitative result score against method fixed effects (see Section 3 for a discussion of method categories), discipline fixed effects, a year-of-publication trend rescaled to zero for 2022, and outcome-characteristics fixed effects. Given the heterogeneity of the evidence base with respect to outcomes and empirical designs, we follow Ahlfeldt & Pietrostefani (2019) and weigh studies by the number of Google citations. Since studies accumulate citations over time, we residualize the number of citations in a regression against a time trend so that the adjusted citation score reflects how heavily cited a study is relative to others published at the same time. With this approach, we delegate the judgement of the scientific quality of a study to the academic community, in the expectation that more credible studies are more impactful. We then recover the outcome-characteristics fixed effects as our conditional qualitative results index, adjusted for the composition of the underlying evidence base with respect to methods, disciplinary background and year of publication.

In Figure 7, we compare the conditional and unconditional qualitative result indices. For most outcome-characteristics cells, both indices are closely aligned, substantiating our interpretations of the descriptive evidence above. The one notable exception concerns the effect of governance on the internal value of space (see marker 1D in Figure 7), which leans towards positive in the unconditional index, but towards negative in the conditional index. The implication is that the positive result is driven by study characteristics (e.g. specific methods or disciplinary background) that tend to produce more positive results.

Fig. 7. Conditional vs. unconditional qualitative result indices



Notes: We assign the numeric values 1 / 0 / -1 to *positive*/*insignificant*/*negative*, which, by taking the mean, allows us to summarise the evidence into a qualitative result *index* that can range from -1 to 1, where positive values imply normatively positive effects on average. The unconditional index is simply the average across the evidence base by outcome-characteristics cells. The conditional index is adjusted for rigour of methods, discipline, time trend and weighted by adjusted (for publication year) citations. These adjustments are made in auxiliary regressions of the qualitative result score against outcome-characteristics fixed effects and covariates. Marker size is proportionate to the number of studies. Marker labels give combinations of outcomes (numbers) and characteristics (letters).

4.3 Rankings

To facilitate a quick assessment of the most consensual mechanisms through which HQB has an impact, we provide a ranking of characteristics-outcome cells by the qualitative results index in Table 8. For the sake of transparency, we add the number of analyses that enter the index since a larger evidence base can generally be considered more reliable. It seems fair to conclude that form and function are found to increase the value of real estate. Various mechanisms can be viewed as a moderator of this effect. For example, functional buildings have lower operation costs and increase wellbeing; benefits that are expected to capitalize in property rents and prices. Social benefits that originate from HQB arise from sustainability, existence value, sense of place, and biodiversity. However, the evidence base also fairly-consistently points to HQB increasing construction costs. This result is specific to new constructions and, based on the evidence collected, it is not possible to infer whether this result extends to redevelopments and extensions. By appealing to wealthier income groups, HQB can lead to spatial segregation and reduce spatial inclusion unless it becomes a universal feature of the built environment. A reduced housing supply elasticity is likely to lead to greater appreciation of house prices and rents, potentially leading to affordability problems in the long run.

Tab. 8. Ranking of mechanisms by qualitative result score

Rank	Characteristic	Outcome	Index	N
1	Function	Sustainability	1.00	18
2	Form	Existence value	1.00	12
3	Governance	Sustainability	1.00	6
4	Urban Design	Subjective wellbeing	1.00	5
5	Governance	Open space preservation	1.00	4
6	Form	Tourism	1.00	3
7	Urban Design	Sense of place	1.00	2
8	Function	Internal value of space: commercial	0.97	34
9	Function	Operating cost reduction	0.90	10
10	Form	External value of space	0.89	53
11	Form	Internal value of space: commercial	0.85	20
12	Function	Subjective wellbeing	0.82	17
13	Urban Design	Internal value of space: residential	0.70	10
14	Form	Biodiversity	0.67	3
15	Form	Internal value of space: residential	0.65	74
16	Function	Internal value of space: residential	0.64	36
17	Form	Sense of place	0.60	10
18	Urban Design	Biodiversity	0.50	2
19	Urban Design	Safety	0.44	9
20	Urban Design	Internal value of space: commercial	0.43	7
21	Governance	Spatial inclusion	0.33	3
22	Governance	Internal value of space: residential	0.33	3
23	Urban Design	External value of space	0.25	4
24	Form	Spatial inclusion	-0.33	3
25	Form	Housing supply elasticity	-0.75	4
26	Form	Construction cost reduction	-0.83	6
27	Function	Construction cost reduction	-0.95	20

Notes: We assign the numeric values 1 / 0 / -1 to *positive*/*insignificant*/*negative*, which, by taking the mean, allows us to summarise the evidence into a qualitative result *index* that can range from -1 to 1, where positive values imply normatively positive effects on average.

4.4 Summary

The qualitative results in this section substantiate positive theoretical expectations regarding the effects of various characteristics of HQB on various outcomes. In general, HQB leads to a more attractive built environment and correspondingly higher market values. This is partially because better designed buildings increase the utility and productivity of users, resulting in higher market rents, and partially because they reduce operation costs and are more durable. There is also evidence of a positive impact on the environment due to a lower carbon footprint and a positive effect on biodiversity. HQB can also add to sense of place and subjective wellbeing. The latter is an interesting result because the higher market rents resulting from more attractive spaces can put a burden on household budgets, in particular of those facing tighter budget constraints. Yet, there is evidence that HQB leads to increasing spatial segregation, which is

consistent with the phenomenon of gentrification according to which affluent residents tend to displace low-income residents in more desirable locations. It is worth noting that this displacement effect becomes less of a concern when HQB is a universal feature of the built environment. Concerning the supply side of real estate markets, our results confirm the theoretical expectations that HQB adds to construction costs and the associated regulations implemented to promote HQB often lead to less elastic property markets, leading to greater house price growth in the long run.

5 Analysing the evidence base: Quantitative effects

Having established a comprehensive summary of the qualitative nature of the evidence for all outcome-characteristics cells, we now zoom into selected cells for a quantification of the effects. We focus on cells where the evidence is a) amenable to quantification because the literature is sufficiently well developed and consistent in its empirical approaches and b) of first-order relevance to the research question, i.e. whether HQB "sells". Hence, we are primarily interested in effects on outcomes that have a direct effect on return on investment (ROI).

5.1 Effects of function on internal value

From the perspective of an investor seeking to enhance ROI, the effect investing into the functionality of a building has on market rents and sales prices is of obvious first-order relevance. While there are many dimensions of functionality, few of them are directly observable in the typical data sets researchers have access to. Therefore, the quantitative evidence base is relatively thin and not as comprehensive as one may wish. Below, we discuss evidence that nevertheless helps putting bounds on the effects of functionality on internal property value.

Our search for the effect of the HQB characteristic function (A) on the outcomes residential and commercial internal value of space (1 and 2) uncovered a sizable literature estimating the effects of energy efficiency. In particular, the most widely analyzed research question is whether energy efficient buildings add to property value. While some of the studies consider the "greenness" of buildings more broadly defined (by green labels and certificates), overall, the majority focuses on energy efficiency primarily. In this context, it is worth noting that there is evidence suggesting that the rent effect of green certification primarily originates from lower energy and water bills (Yoshida, Yamazaki, and Lee 2008). To summarize the evidence base, we build on the meta-analysis by Ankamah-Yeboah and Rehdanz (2014). We use the mean values and standard deviations of the various study characteristics reported in their Table 3 and their point estimates and estimated standard errors from their Table 4, Column (3) to generate various distributions of "energy efficiency" capitalization effects. To this end, we conduct a sensitivity analysis in a series of $i \in I$ Monte Carlo runs. In each run we combine a value of a study feature $m \in M$ (e.g. if a studied green label is categorical), X_i^m, with the associated the marginal effect b_i^m, to generate a "energy efficiency premium" g_i:

$$g_i = \sum_m b_i^m X_i^m$$

We draw all parameter values of all M features from normal distributions $b_i^m \sim N(\hat{b}^m, \hat{s}^m)$, where $\hat{b}^m$ is the estimated point estimate and $\hat{s}^m$ is the associated standard error estimated by Ankamah-Yeboah and Rehdanz (2014).[7] For selected features (the use and the continents evaluated below), we fix the value of X_i^m to a value of interest (e.g. we set the attribute value residential to one when we evaluate the residential green effect). For all other features, we draw

[7] The exception is the estimate of the effect of the study year. Since Ankamah-Yeboah and Rehdanz (2014) do not demean this variable before including it in the meta regression, the predicted green effect is extremely sensitive variation in the parameter value. Therefore, we fix the value to the point estimate in all Monte Carlo experiments.

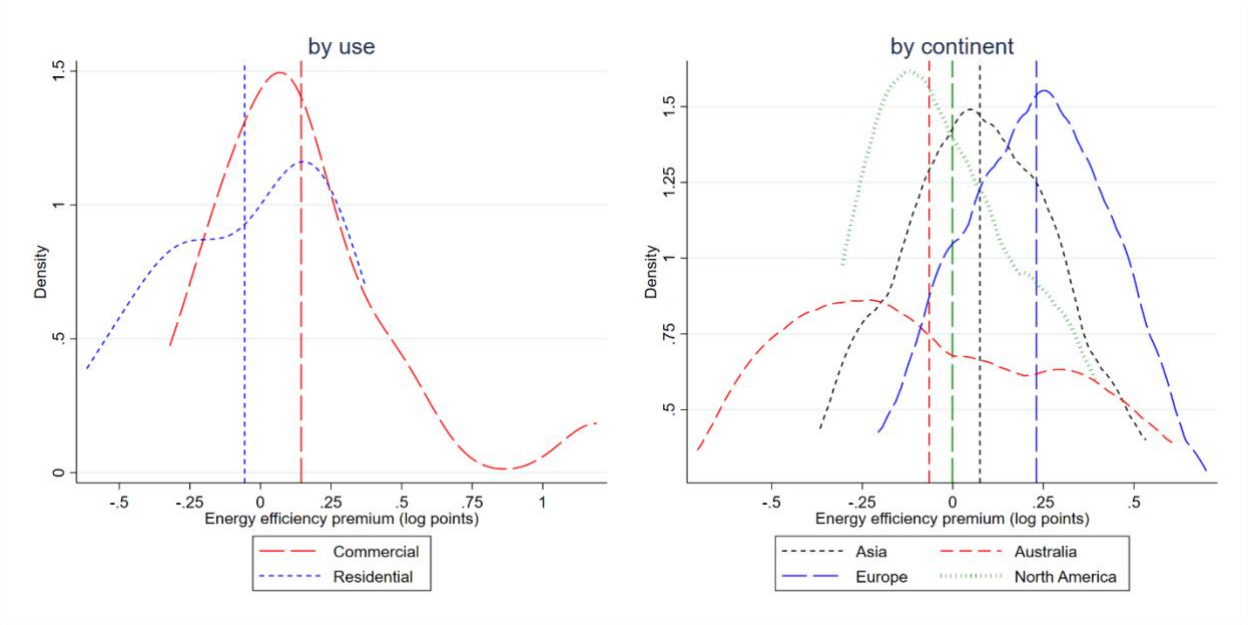
the feature values from normal distributions $X_i^m \sim N(\mu^m, \sigma^m)$, where μ^m is the mean σ^m is the standard deviation of the distribution of feature values. With this approach, we generate distributions of energy efficiency premia that incorporate the uncertainty in the parameter value, as well as the heterogeneity in feature characteristics observed across studies.

The unconditional mean premium across all studies covered by Ankamah-Yeboah and Rehdanz (2014) is 0.076, which implies that buildings that comply with energy efficiency standards see at $(\exp(0.076) - 1) = 7.8\%$ higher prices. This is a sizable effect, but it masks significant heterogeneity as revealed by the results of our sensitivity analysis in Figure 1. It turns out that the positive effect is driven by commercial property. This is consistent with lower energy costs that capitalize in commercial rents or a positive signaling effect that firms value in a sensitive environment. In contrast, the premium for residential property is near zero. Possible explanations include lower energy savings for residential buildings, limited awareness of labels and certificates among residential users, greater bargaining power of residential landlords, or rental regulation that prevents energy savings from capitalizing into higher rents.

There is also significant heterogeneity across continents. European countries are an outlier as extant studies point to commercial energy efficiency premiums of 25% on average. The same premia are much closer to zero in other continents and are, on average, even negative in Australia. Ankamah-Yeboah and Rehdanz (2014) assume that the commercial-residential premium gap is constant across continents. Under this assumption, one can derive the residential premium simply by subtracting the commercial premium from the continental premium, e.g. 25%-7.8%=17.2% for Europe.[8] Against the background of the information asymmetry problem in Section 2.2, one could think of differences in the quality of the certification schemes or differences in the awareness as plausible explanations for the cross-continent variation. It is important to note, however, that the premium analyzed here does not capture the pure certification value of a label, exclusively. At least to some extent, the premium also captures the present value of increased revenues and reduced operating costs that caused certification (Yoshida, Yamazaki, and Lee 2008). As an example, higher energy efficiency is associated with lower costs for heating and air conditioning, leading to higher market rents and prices. Therefore, variation in climate conditions and energy costs may also rationalize cross-country heterogeneity in the premium. Intuitively, we expect a greater premium where summers are hot or winters are cold and, at the same time, energy prices are high.

[8] Ankamah-Yeboah and Rehdanz (2014) estimate the continental effect conditional on a variable that differentiates between residential and commercial markets, hence, the gap in the premia is assumed to be constant across markets. If, in reality, the gap varies across continents, this will bias the reported continent premia.

Fig. 8. "Energy efficiency premia" in property values

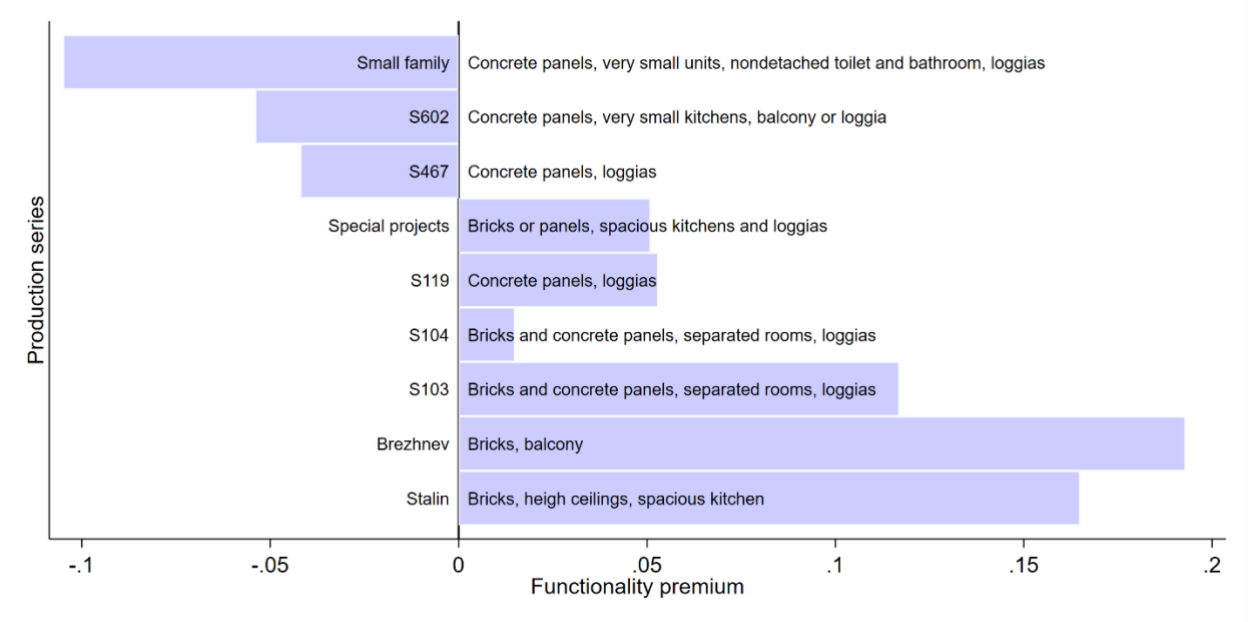


Notes: This figure illustrates the distribution of energy efficiency premia (log points increases in property price associated with energy efficiency certification) generated in a sensitivity analysis based on the meta-analysis of Ankamah-Yeboah and Rehdanz (2014). Each vertical line represents the mean of a distribution.

Of course, the function of a building comprises many more features than the energy efficiency of a building or even the "greenness" of a building, broadly defined. The challenge the literature faces with estimating the effect of other features of a building function is twofold. For one thing, features other than conventional hedonic characteristics (e.g. floor space or number of bedrooms) are generally difficult to observe. Researchers usually have no information about features like ceiling heights, ground plans, window sizes, just to name a few. And even if they were observable, they would be likely correlated with many unobserved characteristics, hindering a causal interpretation. Therefore, the evidence base on the price effects of many dimensions of function is generally thin. Yet, the work by Plaut and Uzulena (2006) provides a good indication of the price effects that can be associated with otherwise comparable buildings that differ in their functionality. The authors analyze the housing market in Riga, Latvia, which consists largely of mass-produced housing of a limited number of production series. With a conventional hedonic model, they control for variation in the attractiveness of location via neighborhood fixed effects as well as for the canonical housing features like size or number of bedrooms. Via dummy variables for different production series, the authors estimate the *ceteris paribus* effect associated with the different production series that can be interpreted as a functionality premium. Of course, the architectural form is a potential confounder. But given the character of mass produced about five-to-ten storey block developments, it is at least likely that the functionality effect dominates any form effect.

It is naturally difficult to specify exactly the level of functionality that each of production series offers. But based on the description by the authors, it appears uncontroversial that the "single family" series is inferior to the "special projects series (including the "Sxxx"), which are in turn inferior to "Brezhnev" and "Stalin" series. The price effects in Figure 9 confirm this notion. There is even a clear differentiation within the "Sxxx" series between those built from panels which command a lower premium and those built from bricks that command a higher premium. This pattern substantiates the hypothesis that buildings that are better designed in terms of their function, achieve higher market values.

Fig. 9. Price effects of housing production series in Riga



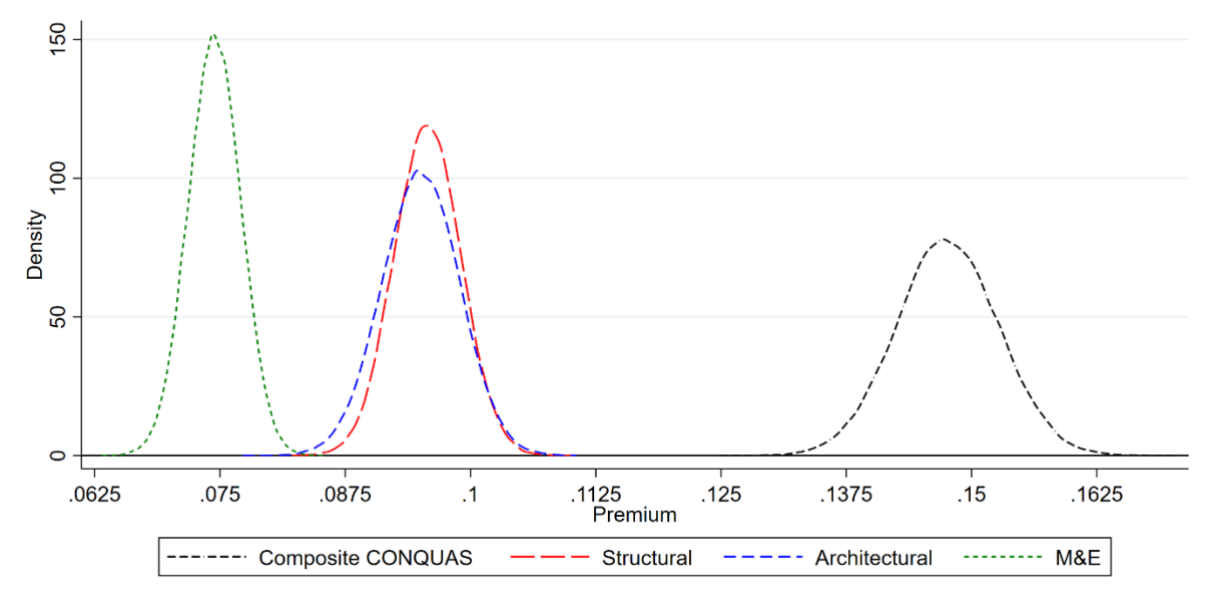
Notes: Point estimates are from Plaut and Uzulena (2006). The functionality premium is given in log points.

Singapore constitutes another, more contemporary, context to gain insights into the functionality premium. A unique feature of the Singapore housing market is that new residential projects are assessed independently on the quality of construction under the Construction Quality Assessment System (CONQUAS). The scoring metric was introduced in 1989 and comprises three main components: *Structural works* cover the quality of the structural works (e.g. type and quality of the concrete). *Architectural works* cover the quality of finishes and components (e.g. the quality internal finishes or watertightness of windows). *Mechanical and Electrical works* (M&E) cover ventilation (including air-conditioning), wiring, plumbing, among other related features. For each component a separate score on a scale of 0-100 is awarded based on comprehensive onsite and laboratory tests. The assessment system is generally considered reliable and objective (Ling 2005) and has been adapted in the UK and Hong Kong. Ooi et al. (2014) take advantage of this unique functionality score and a comprehensive transactions data set to estimate how a higher CONQUAS score increases the market price of residential units in a hedonic analysis that holds other factors constant (i.e. they control for location and size and other observable features of the transacted units). Based on the point estimates, t-statistics, and descriptive statistics reported in their paper, we illustrate the functionality premium in Figure 10. Concretely, we illustrate the premium of a property with the highest CONQUAS score (96.2) compared to an otherwise comparable property (in terms of location and size) with the lowest score (62.5) in the sample. While going from the lowest to the highest score might seem like a large spread, the housing market in Singapore is one of relatively high quality, on average. Moreover, there is sample selection. For one thing, the CONQUAS assessment is only compulsory for larger, more ambitious developments. For another developers are more likely to voluntarily opt into the scheme, are if they expect a relatively high score. Thus, the comparison should be broadly consistent with that between an ordinary building and one that complies with HQB. In fact, a causal inspection of the three developments with the lowest CONQUAS score in the sample (The Trumps, Hilltop Grove Starville) suggests that minimum standards in the sample are fairly high. Hence, the approximate 15% functionality premium we find in Figure 10 might be considered a lower-bound estimate.

It is also worth pointing out that the authors find positive effects of each of the sub-indices that enter the composite CONQUAS scores. This suggests that structural quality, the interior and exterior finishing, as well as the quality of mechanical and electrical work all matter in their own

right. An exact decomposition of their contributions to the functionality premium, however, is not possible since their effects have not been estimated conditional on each other and the variation in the sub-indices is not reported. Therefore, the premia associated with those subindices in Figure 10 should be interpreted as rough ballpark figures that do not necessarily have to add up to the overall functionality premium.

Fig. 10. Functionality premium in Singapore



Notes: Own illustration based on Ooi et al. (2014). We use the point estimates and t-statistics from Table 3, Column (1) and Table 5, Columns (1-3) based on which we generate the normal distributions depicted here. The illustrated premium compares an otherwise comparable building with the lowest (62.5) to the highest (96.2) CONQUAS score. Since the variation in the CONQUAS score is not reported for the sub-indices, we apply the same range in all four cases. M&E = Mechanical and Electrical.

To sum up, the quantification of the effect of architectural function is challenging because many of the relevant features are often not observable. Buildings of better function likely offer various positive features at the same time, making it difficult to disentangle the effects of individual features. As an example, a building that offers a high energy efficiency may be built from materials that make it more durable. The strong evidence for a positive price premium associated with the "greenness" of commercial buildings, given the likely correlated unobserved features, is perhaps best interpreted as a general functionality premium. While the evidence on functionality dimensions other than "greenness" is less conclusive, there is evidence that substantiates the hypothesis that residential buildings using better materials, more attractive floorplans, and greater ceiling heights, command a premium. From the evidence reviewed, it appears that a functionality premium can realistically reach 20% of property value, but we wish to highlight that this is a rule-of-thumb surrounded by much uncertainty and that it cannot be ruled out that part of this premium is attributable to an architectural form effect since more functional buildings may have a more attractive form.

5.2 Effects of form on internal value

Just like with the functionality of a building, an investor has some control over the architectural form of a building. Whether architectural form has a positive effect on market rents and sale prices is, therefore, of immediate interest to an investor seeking to maximize ROI. That said, the evaluation of the effects of architectural form on property value is a relatively new field of research. The challenge the literature has long faced is to find criteria for good architectural form that are objective in the sense of being independent of the author's subjective assessment.

Over time, a couple of popular approaches have emerged to deal with this challenge. Typically, the judgement is delegated to committees that decide on architectural awards (e.g. Hough and Kratz 1983; Cheshire and Dericks 2020; Liao, Jing, and Lee 2022) or certifications of historical significance (e.g. Asabere, Huffman, and Mehdian 1994; Ahlfeldt and Maennig 2010; Pietrostefani 2019).[9] Occasionally, authors have asked either experts (e.g. Vandell and Lane 1989) or local residents (e.g. Ahlfeldt and Holman 2018) to rate the distinctiveness or beauty of architectural form.[10] Yet, despite an evidence base that has been building up, there is no systematic summary of this emerging literature. We fill this gap by providing the first meta-analysis of architectural form on property value.

The literature has used various terms to describe buildings of appealing urban form (e.g. designer buildings, trophy buildings, etc.) and as such there are many ways to name the premium attached to such a form. We follow Ahlfeldt and Holman (2018) and refer to distinctive form and a distinctiveness premium for convenience. There is 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.[11] Hence the distinctiveness premium can be interpreted as a semi-log effect, just like the "functionality" premium in the previous section. Again, the percentage effect (pc) can be derived from the estimated semi-log premium (b) as $pc = \exp(b)$-1.

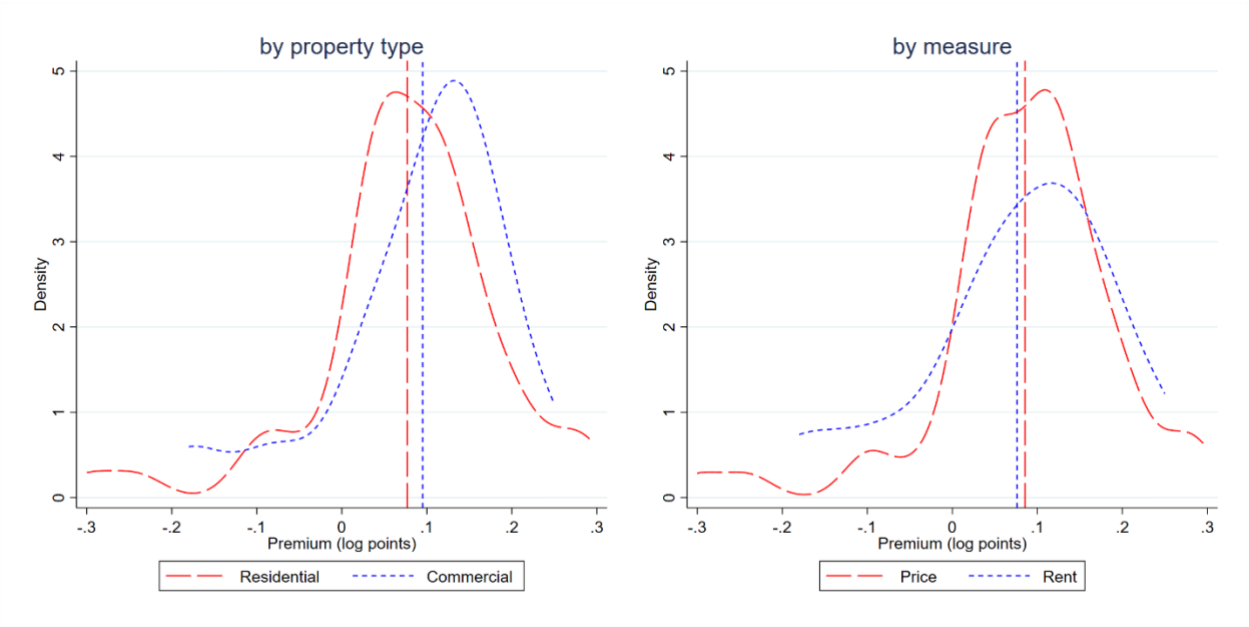
We begin by illustrating the distribution of distinctiveness premia by property type and property value measure in Figure 11. The first insight is that, while there is significant variation, the premium is positive, on average. On average, distinctive commercial buildings command a premium of nearly 10%. This supports the hypothesis that a distinctive form provides benefits to firms, be it because of signaling effects that translate into greater revenues or a workplace amenity effect that allows attracting qualified workers at lower cost. For residential property, the premium is about 8%, which suggest that residential users derive utility from living in a building of distinctive architectural form. At close to 9%, we find a very similar average premium on property prices and rents, which is consistent with the canonical view that any effect on rental income capitalizes in property prices on competitive markets.

[9] A related idea is to use buildings that have been listed in architectural city guides (Ahlfeldt, 2013).

[10] A related idea is to use the number of photos taken near a building to measure its distinctiveness (Ahlfeldt, 2013).

[11] To this end, we multiply the estimated marginal effect by a change in the design score that corresponds to the difference between the scores of an ordinary and a highly distinctive building.

Fig. 11. Distinctiveness premium by property type and capitalization measure



Notes: This figure illustrates distribution of architectural form premiums (log points increases in property price associated with distinctive form) in our evidence base. Each vertical line represents a mean of the distribution.

A natural question to ask is whether the distinctiveness premium depends on the way the distinctiveness of form is measured, or the style of the building is denoted. We illustrate the distinctiveness premium distinguishing between measures of form and the design era of the analyzed buildings in Figure 12. The premium estimated for buildings that won architectural awards or were designed by award-winning architects and the premium found for buildings that were top-rated by expert juries, are close to 12%. Notice that the "pure" award premium has a different interpretation. The standard approach in the literature is to compare the market values of properties that won and did not win architectural awards. Therefore, awards generally capture the combined effect of distinctive design that caused a prize to be awarded *and* the certification value attached to 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 sizable, suggesting that there is a willingness to pay for a certification of good design, consistent with imperfect information that can cause adverse selection (see Section 2). Indirectly, the fact that the gross award premium exceeds the pure award premium reveals that there is a sizable willingness to pay for distinctive design, irrespectively of the certification by an award.

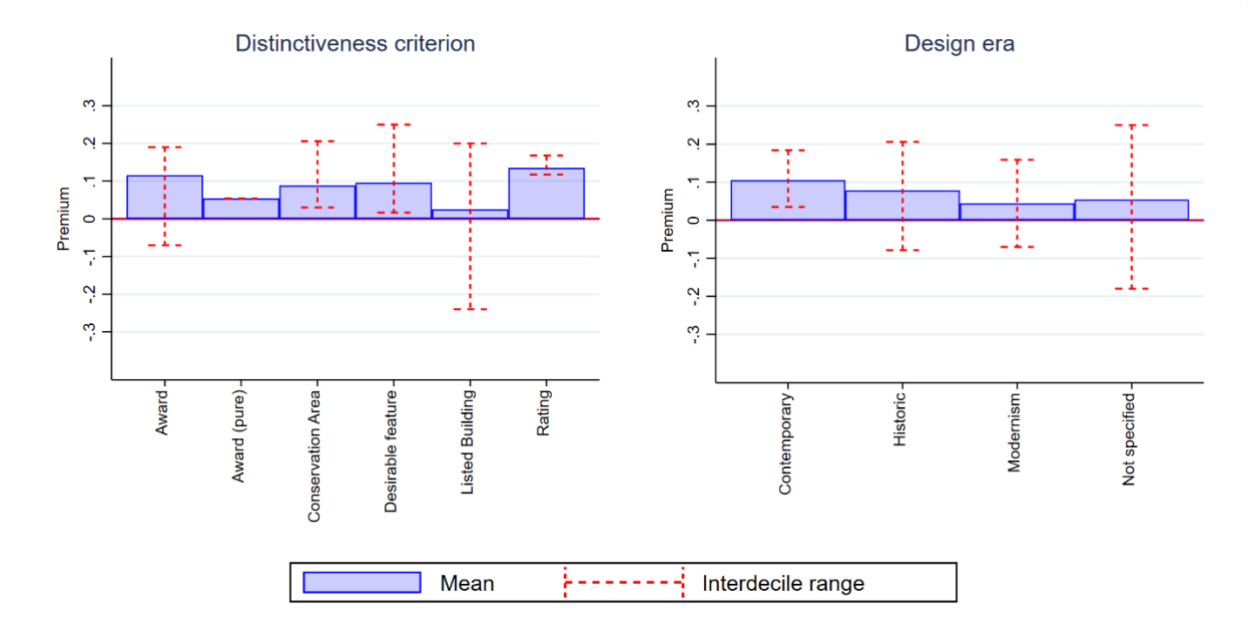
Buildings in conservation areas and listed buildings which are deemed to stand out relative to their respective cohorts, command lower distinctiveness premia, on average. In particular, the effect for listed buildings is close to zero. However, it is important to acknowledge that historic designation is not just 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 form and function. These restrictions can add to the cost of maintenance and modernization and even prevent the owner from amending a building in a desired fashion, which can reduce the market value of a listed building. Note that 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 not just in how these policies are referred to locally, but also in the way heritage is understood

and protected. Moreover, owners are compensated for these restrictions by favorable tax laws in some countries, which can increase the market value of listed buildings. Therefore, premia estimated for conservation areas and listed buildings capture the net effect of the pure distinctive form effect and the positive and negative effects associated with the legal status. Because the way planning systems treat designated buildings varies across countries, it is no surprise that there is great 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, therefore not necessarily imply that owners and renters do not value the distinctive form. It is entirely conceivable that a positive distinctiveness premium is negatively compensated by legal constraints.

Another obvious question is whether the distinctiveness premium captures the effects of particular architectural styles or a genuine architectural form effect that distinguishes a well-designed building from an ordinary building of the same style. It appears that historic architectural styles are more consensual than contemporary styles. This can have many reasons, on which to speculate is beyond the scope of this research. What matters is that a polarization of tastes toward a particular style does not necessarily have to result in a lower distinctiveness premium because the price of a property on a competitive market is determined by the marginal buyer and not the average buyer. Intuitively, it only takes two bidders with a high willingness to pay for a distinctive form of a building to result in a high distinctiveness premium. If all other potential buyers searching for a property on the market do not value the distinctiveness of the design, this will not affect the market price. Therefore, it is entirely conceivable that distinctive buildings that are criticized by many, but loved by few, command a higher premium than buildings that are more consensual.

Indeed, the right panel of Figure 12 reveals generally high distinctiveness premia found for distinctive buildings of contemporary style (1970s onward). In contrast, the evidence is less conclusive for the distinctive design of historical styles that make more intense use of ornamentation as popular until the transition from the 19th to the 20th century. This can have different reasons. Appealing historic buildings may be relatively abundant. Less polarized tastes may imply that there are few potential buyers who strongly dislike historic styles, but also fewer true admirers who are willing to pay a very high design premium. Most importantly, distinctive historic buildings have a high chance of being subject to historic preservation laws, which may be detrimental to value as discussed above. As we found for listed buildings, the variation in the results across studies is large and, therefore, the average premium is less meaningful.

Fig. 12. Distinctiveness premium by measure and style



Notes: 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 prices 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 cases 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 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. The inter-decile range gives the range between the first and the ninth deciles, i.e. 80% of all observations fall into this range.

In Table 9, we follow the standard practice in meta-analytic research and regress the point estimates of the distinctiveness premia encoded from the literature against selected study criteria. We begin with a parsimonious model in which we solely add two dummies indicating either commercial or residential use in Column (1). Since these indicators add to one, we omit the constant. Echoing Figure 11, the architectural form effect, at about 10%, exceeds the distinctiveness premiums for commercial properties by about a fourth.

To evaluate whether the difference is attributable to a composition effect, we add a set of indicator variables in Table 9, Column (2). Conservation area and listed building indicators account control for constraints associated with historic preservation laws that can be detrimental to value. The pure award indicator is added because the pure award effect only captures the certification value of the award and not the effect of the distinctive design that justifies the award. We also control for an indicator of historic architectural style because there is arguably less polarization and scarcity of distinctive historic architectural form. Controlling for composition, indeed, closes the gap in the premia.

In Table 9, 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 weigh observations by the inverse of the standard error. Since our evidence base is highly heterogenous with respect to the empirical approaches used, we follow Ahlfeldt and Pietrostefani (2019) and weigh studies by the citation-based quality indicator. With this approach, we assume that more rigorous analyses are more impactful and will be cited more often. Since citations naturally increase in the years that have passed since publication, we residualize the Google citation count in an auxiliary regression

of the log number of citations (adding a unit) against a year trend. One of the concerns with the identification of distinctiveness premia is that they may not only capture quality of the architectural form, but also a correlated cohort effect. An obvious example are conservation areas or listed buildings. While historic preservation aims to preserve buildings that stand out in terms of design quality and historic significance relative to their respective cohorts, it is possible that there is a positive (or negative) willingness to pay for the style per se, in addition to a particular manifestation of that style. The ideal empirical comparison is, therefore, one between a distinctive building of a particular cohort and an ordinary building of the same cohort. Unfortunately, not all studies control for cohort effects. Therefore, in addition to the weighting, we focus on a subset of studies that do so and may be regarded as particularly robust in in Table 9, 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%. However, as we already noted in the context of architectural form, it is possible that part of the effect is attributable to architectural function if more functional buildings have a more attractive form. We also wish to highlight that measuring distinctiveness has been one empirically feasible approach to quantifying the positive effects of ambitious architectural form. By no means this implies that to have positive effects on value, good architectural form must be distinctive in the sense that the form must be unique or even spectacular. In fact, the distinctive character of central Paris originates partially from the coherence created by relatively homogenous Haussmann apartment buildings. For almost a century, Mies van der Rohe's aphorism "*less is more*" has been a very successful design principle. Measuring the quality of homogeneous or minimalist architectural styles, however, is empirically challenging. Lindenthal (2020) provides evidence that real estate markets value "shape homogeneity" using the volumes of row houses in Rotterdam as a case in point. Developing algorithms that can quantitatively account for more nuanced features of architectural form, however, remains a priority for future research.

Tab. 9. Multivariate analysis of distinctiveness premium

	(1) Premium		(2) Premium		(3) 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 (dummy) on property price or rent from the literature in log points. All explanatory variables are dummy variables. Baseline distinctiveness measure is listed building (see left panel of Figure 12). Modern covers the style groups contemporary, modernism, and transitional from Figure 12 (right panel). Quality weights are proportionate to Google citation counts adjusted for publication years. To this end we run an auxiliary regression of the log of the citation count. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5.3 Life cycle cost

The life cycle cost of a building covers the cost associated with building design and construction, operation and maintenance, and its eventual disposal (Moussavi Nadoushani and Akbarnezhad 2015; Liu et al. 2014). For our purposes, we are primarily interested in how HQB affects these different cost items. Due to the limited evidence and the low weight in a discounted cashflow

analysis (given that they incur after a typically long lifetime), we abstract from effects on the disposal. We cover the effects on construction cost (including design cost) in Section 5.3.1 and the effects on operating (including maintenance costs) and depreciation in Section 5.3.2.

5.3.1 Effects of function and form on construction cost

An investor concerned with maximizing ROI will naturally not only be interested in the effects of HQB on revenues, but also on costs. While the evidence base on the effects of HQB on construction cost is relatively small, the results are fairly consistent. In keeping with theoretical expectations discussed in Section 2 the evidence points to HQB increasing construction cost of new developments. This is intuitive, given that departures form the least-cost configuration that improve function and form are typically associated with additional costs for materials, statics, architects, etc. (Vandell and Lane 1989). Indeed, the USA's national building cost manual illustrates the higher construction costs of increased ceiling height, larger windows, and more durable choice of flooring (Moselle 2017). Related evidence has shown that flexible more complex ceiling height designs are more expensive (Martani, Cattarinussi, and Adey 2018)and that in the 2.5-3 meter interval a 10cm reduction in height entails saving of about 1% in construction costs (Technion 1958). Other studies have also documented higher costs of energy-efficient windows (Raimundo et al. 2021; Saadatian, Simões, and Freire 2021).

We tabulate results from our evidence base in Table 10. The naive average across studies that have analyzed the effects of improved energy efficiency and greenness on construction costs suggests that functional buildings are about 8% more expensive to construct. The added cost for distinctive form appears to be more sizable. Vandell and Lane (1989), in their review of the earlier literature, conclude that there is an additional cost in the range of 10-30%, including both the actual construction cost and the design cost. In their own analysis, they also find a positive correlation between the rating of the architectural design and the construction cost. Moving from the bottom to the top of the list of the design ranking is associated with an increase in construction cost of more than 60%. In contrast, Cheshire and Dericks (2020), at 13%, find an extra cost that are towards the lower end of the range. So, based on the evidence, it appears sensible to view the 10-30% (0.11-0.35 in log points) reported by Vandell and Lane (1989) as consensual.

The notorious problem this literature faces is that comprehensive data sets covering larger sets of constructions and the associated costs are not readily available. This problem is even more severe for projects that do not concern new constructions, but renovations or extensions of existing buildings. Thus, one limitation of the relatively small literature reviewed here is that it focuses on new constructions, exclusively. It is entirely conceivable that the effect of HQB on the costs of redevelopments or extensions differs. Another limitation of the literature is that the evidence base is not suitable to infer a potential non-linearity in the construction cost effect. At moderate levels, the marginal cost of investments into HQB may be lower than for some of the more ambitious projects analysed by the literature summarized in Table 10. It is even possible that within a band of intermediate construction costs the marginal cost of HQB is zero.

Tab. 10. Estimates of construction cost inflators

Author	Ch.	Approach	Inflator
Ade and Rehm (2020)	A	Original analysis wrt. energy efficiency	.11
Bradshaw et al (2005)	A	Original analysis wrt. energy efficiency	.02
Gabay et al (2014)	A	Original analysis wrt. greenness	.08
Glossner et al (2015)	A	Original analysis wrt. energy efficiency	.04
Hwang et al (2017)	A	Original analysis wrt. greenness	.06
Kats (2003)	A	Original analysis wrt. greenness	.07
Kim et al (2014)	A	Original analysis wrt. greenness	.11
Mapp et al (2011)	A	Original analysis wrt. greenness	.03
Zhang et al (2011)	A	Original analysis wrt. greenness	.14
Zhang et al (2011)	A	Original analysis wrt. greenness	.1
Cheshire and Dericks (2020)	B	Consultation with developer	.13
Vandell and Lane (1989)	B	Original analysis wrt. highly rated architecture	.56
Vandell and Lane (1989)	B	Summary of previous literature	.11-.35

Notes: Notes: Ch. = Characteristic. Inflator is a parameter that expresses by how much (in log scale) the construction cost (of a new building) increase relative to a comparable ordinary building.

5.3.2 Operating costs and depreciation

Over the entire lifecycle, operating costs and depreciation add to the cost of construction and are, thus, equivalently important in an investment evaluation. The evidence on the effects of HQB on operating costs and depreciation, however, is extremely thin, with not even a hand full of studies exploring very specific aspects. Therefore, we take an indirect approach to inferring theory-consistent effects of HQB on operating costs and depreciation.

Since real estate represents a durable form of capital, we can approximate the present value, p, of the cash flows of a property assuming an infinite annuity.

$$P^B = \frac{NCF^B}{i^B},$$

where NCF is a measure of net cashflow that discounts gross rental revenues, r, in the rates of operating expenses, m, and depreciation, δ, and i is the internal rate of return required by an investor.

$$NCF^B = r^B \exp\left(-o^B \times \delta^B\right)$$

We use the superscript $B \in \{LQB, HQB\}$ to index a high-quality (HQB) and low-quality (LQB) *Baukultur*. Combining both equations, taking logs and differences, we obtain:

$$\Delta \ln P = \Delta \ln r - \Delta(o\delta) - \Delta \ln(i),$$

where Δ indicates differences between HQB and LQB (HQB-LQB) in each variable. Assuming that the investor requires the same rate of return from HQB and LQB real estate so that $\Delta \ln(i)$=0, we obtain:

$$\Delta \ln P - \Delta \ln r = -\Delta(o\delta)$$

Notice that $\Delta \ln P$ corresponds to the estimated HQB premium on transaction prices while $\Delta \ln r$ corresponds to the estimated HQB premium on rents. Intuitively, a greater HQB premium on

prices than rents implies that the net cost associated with operation and depreciation is lower for HQB real estate.

Indeed, the meta-analysis by Ankamah-Yeboah and Rehdanz (2014) points to $\Delta \ln P - \Delta \ln r \approx 0.09$, implying that over the entire lifecycle, investments into the energy efficiency buildings can be associated with cost savings on the investor side that amount to the equivalent of about 9% of rental revenues. Our own analysis of form on prices and rents in Section 5.2 reveals no such difference, suggesting that, unlike for function, any effects on operating costs and depreciation associated with form, if they exist, cancel out each other.

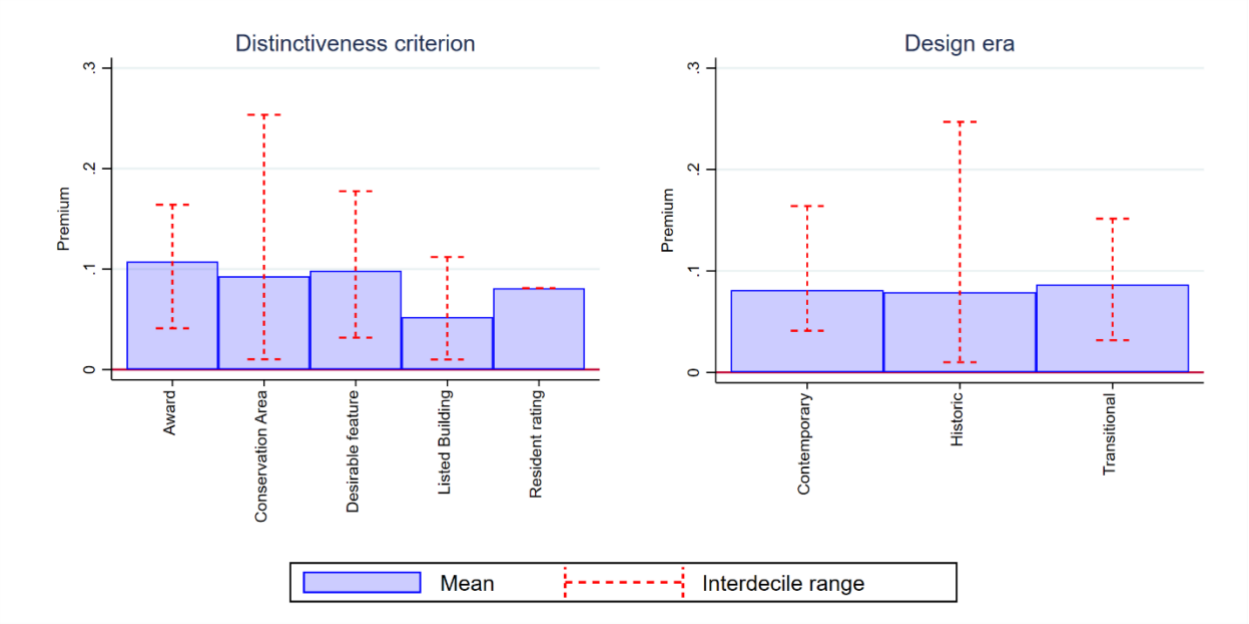
5.4 Effects of form on external value

While an investor may have no direct control over the investments into HQB at nearby parcels, there is the possibility that investors can coordinate their investments, if only with the help of the planning system. Intuitively, distinctive form not only generates a value to those who use a building, but also to those who view the building. Thus, we expect a positive effect of buildings of distinctive form on nearby properties. We illustrate the estimates of such design spill overs in Figure 13 in the same way we illustrate the internal form effect in Figure 12.

On average, we find positive spill over effects irrespectively of how distinctive design is measured and of the style of the distinctive design. There is large variation across studies, because the analyzed buildings in the evidence base differ remarkably 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 hypothesis that the relatively low average internal distinctiveness premia for preserved buildings found in Figure 12 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 neighborhood of about 9%, irrespectively of weather we weigh observations by adjusted (for year of publication) citations, SMS methods score, or not at all.

As already discussed in Section 5.2, the focus on distinctive design in the literature does not imply that architectural form must be distinctive to generate value. If anything, coherence will be even more important for external value as it emerges from the designs of all surrounding buildings and how they complement each other. The fact that we do not report a premium for the coherence of the design in a neighborhood, hence, is to be viewed as a limitation of the literature and not as indicative of the absence of such a premium.

Fig. 13. External architectural form premium by measure and style



Notes: 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 prices 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 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. The inter-decile range gives the range between the first and the ninth deciles, i.e. 80% of all observations fall into this range.

6 Returns on investment into HQB

We now turn to an evaluation of the impact of HQB on the expected ROI, which is our central research question. We first introduce a simple framework in the spirit of standard discounted cashflow analysis that allows us to express the effect of HQB on ROI through a set of parameters that govern the effect of HQB on selected outcomes. We then discuss how we set these parameter values based on the quantitative evidence we review in Section 5. Finally, we evaluate the effect of HQB on ROI for various scenarios, each of which incorporates uncertainty in parameter choice, to answer the question if, and by how much, investments into HQB can be expected to pay off.

6.1 Framework

Let's assume that an investor who already owns a parcel of land invests an amount I out of equity into a real estate development. A fraction of β is spent on construction costs, with the remaining fraction being spent on land. We start from a simple measure of return on investments (ROI) defined as follows:

$$\mathcal{R}^B = \frac{P^B - I^B}{I^B},$$

which simply states by what profit margin the present value of net cashflows defined in Section 5.4 exceeds the total investment. In other words, $\mathcal{R}$ gives the expected profit for each invested unit in an arbitrary currency (e.g. 15 Cent for each invested Euro). As before, we use the superscript $B \in \{LQB, HQB\}$ to index a high-quality (HQB) and low-quality (LQB) *Baukultur*. The profit margin can be rewritten as

$$\mathcal{R}^B = \frac{P^B}{\frac{1}{\beta} C^B} - 1$$

To link the return on investment to construction cost (instead of total investments). We can express the present value of net cashflows as a function of the present value of a LQB project and a set of HQB premia indexed by $\mathbb{P}$:

$$P^{HQB} = P^{LQB} \prod\nolimits_{\mathbb{P}} \exp\left(d^{\mathbb{P}}\right),$$

where $d^{\mathbb{P}}$ is a log HQB premium in the same metric that we use in Section 5. Likewise, we can express the construction cost of a HQB project as a function of the construction cost of a LQB project and a set of construction cost inflators indexed by $\mathbb{C}$:

$$C^{HQB} = C^{LQB} \prod\nolimits_{\mathbb{C}} \exp\left(d^{\mathbb{C}}\right),$$

where $d^{\mathbb{C}}$ is a construction cost inflator in the same metric that we use in Section 5. Using P^{HQB} and C^{HQB} in $\mathcal{R}^B$ allows us to express the ROI for a HQB project as follows:

$$\mathcal{R}^{HQB} = \beta \frac{P^{LQB} \prod_{\mathbb{P}} \exp\left(d^{\mathbb{P}}\right)}{C^{LQB} \prod_{\mathbb{C}} \exp(d^{\mathbb{C}})} - 1$$

Of course, the ROI can vary across space and time for a variety of reasons. Here, we are interested in the effect of HQB holding other factors constant. Thus, we take the ROI for a LQB project as exogenously given:

$$\mathcal{R}^{LQB} = \beta \frac{P^{LQB}}{C^{LQB}} - 1$$

Combining $\mathcal{R}^{LQB}$ and $\mathcal{R}^{HQB}$, we obtain the following relative premium of HQB on ROI:

$$\frac{\mathcal{R}^{HQB} - \mathcal{R}^{LQB}}{1 + \mathcal{R}^{LQB}} = \tilde{\mathcal{R}} = \frac{\prod_{\mathbb{P}} \exp\left(d^{\mathbb{P}}\right)}{\prod_{\mathbb{C}} \exp(d^{\mathbb{C}})} - 1$$

The advantage of this measure is that it is unit free and can be applied to arbitrary institutional contexts. Intuitively, the absolute difference in ROI between a HQB and a LQB project can be easily computed as the product of the relative premium, $\tilde{\mathcal{R}}$, and the baseline return on investment, $\mathcal{R}^{LQB}$:

$$\mathcal{R}^{HQB} - \mathcal{R}^{LQB} = (1 + \mathcal{R}^{LQB})\tilde{\mathcal{R}}$$

6.2 Parametrization

Evaluating the ROI of HQB comes down to identifying the appropriate set of parameters that inflate net cashflows and construction costs. In doing so, it is important to acknowledge the uncertainty in the parametrization. For one thing, any estimate of any parameter comes with a positive standard error. For another, point estimates vary across studies. Therefore, we evaluate the relative premium in a Monte-Carlo analysis in which we draw all relevant parameters from normal distributions: $d_i^{\mathbb{P}} \sim N(\hat{d}^{\mathbb{P}}, \sigma^{\mathbb{P}})$, $d_i^{\mathbb{C}} \sim N(\hat{d}^{\mathbb{C}}, \sigma^{\mathbb{C}})$.

Table 11 itemizes the net cashflow and cost inflators that we index by $\mathbb{P}$ and $\mathbb{C}$. We provide a rationale for our choices of parameter in the last column. In general, our choices are relatively straightforward given the evidence reviewed in the previous section. Two choices, however, deserve being highlighted in the interest of transparency.

While, qualitatively, the evidence base clearly supports that HQB increases the value of a property through better functionality, there is significant uncertainty in quantitative terms because the evidence is limited to selected aspects of functionality. As discussed in Section 5.1, descriptive evidence suggests that high functionality can increase the market value of a property by up to 20%. Since, as derived in Section 5.4, nearly half of this premium can be ascribed to a discount in operation cost and depreciation, we set the residual rent premium to 0.11. To capture the uncertainty that surrounds this parameter value, we select half the size for the standard error, which implies that we are 95% confident that the premium is positive (consistent with the unambiguous qualitative evidence base).

We find a HQB premium on rent that operates through distinctive form of about 0.16. Typically, this premium is estimated for buildings that won architectural awards, are certified by local authorities (e.g. in case of historic preservation) or were highly rated by knowledgeable experts. Recent evidence suggests that that the market value of properties increases by 5.4% once the design quality is certified by experts (Liao, Jing, and Lee 2022). Since the 0.16 internal form premium includes this certification value, we subtract the 0.054 pure award premium from the internal form premium to avoid double counting.

Tab. 11. Net revenue and cost inflators

Net cashflow	$\hat{d}^{\mathbb{P}}$	$\sigma^{\mathbb{P}}$	Notes
Function: Rent premium	0.11	0.055[a]	Rule-of-thumb premium of about 20% based on descriptive evidence in Section 5.1, net of operation cost and depreciation discount to avoid double counting.
Function: Operation cost and durability discount	0.09	0.027	Point estimate and standard error from Ankamah-Yeboah & Rehdanz (2014), interpreted as discussed in Section 5.3.2.
Form: Certification premium	0.054	0.013	Point estimate and standard error from Liao et al. (2022)
Form: Rent premium	0.106	0.04	Weighted (by adj. citations) regression of form premium against constant, net of pure award premium to avoid double counting
Form: Operation cost and durability discount	0	0.04	No difference in function price and rent premia found in Section 5.3.2. Standard error from a regression of form premium against a "rent" dummy.
Form: External premium	0.093	0.018	Weighted (by adj. citations) regression of form premium against constant.
Construction cost	$\hat{d}^{\mathbb{C}}$	$\sigma^{\mathbb{C}}$	**Notes**
Function: Cost inflator	0.076	0.039	Mean and standard deviation across parameters related to energy efficiency in Table 9
Form: Cost inflator	0.22	0.11[a]	Point estimate is the middle of the range reported by Vandell and Lane (1989) based on previous studies.

Notes: [a] Standard error chosen so that point estimate is statistically different from zero with 95% confidence. This choice is motivated by an evidence base too small to estimate the standard error. This choice reflects that there is high certainty regarding the qualitative direction of the effect.

6.3 Scenario analysis

The evidence-based parameter choices listed in Table 11 can be used in the framework laid out in Section 6.1 to evaluate the effect of HQB on expected ROI. As already discussed in Section 2, we take a Monte Carlo approach that accounts for a distribution in all parameter values.

Therefore, we also obtain a distribution of expected effects on ROI that accounts for the distribution of estimates in the entire quantitative evidence base.

We consider four different scenarios. The first scenario (S1) assumes that no certification of design is available, and that the investor does not coordinate with landlords of nearby properties, thus there is no externality. This scenario is perhaps closest to the situation faced by a small-scale developer of an individual parcel. In the second scenario (S2), the investment is made under a credible and ambitious design certification scheme that reduces the uncertainty regarding the wider perception and longevity of design. Since such a scheme does not yet exist, this is a hypothetical scenario that illustrates the potential of a certification scheme that replicates the idea of popular energy performance certificates in the context of architectural design. In the third scenario (S3), we abstract from a certification scheme, but assume that investments into architectural form are coordinated. This scenario corresponds to a situation in which a large-scale developer develops a group of adjacent parcels or an entire neighborhood and consistently invests in architectural form to generate positive spill overs between parcels. It might also be viewed as a situation in which the freeriding problem discussed in Section 2 is solved by local authorities by means of incentives (subsidized investments into design) or regulation (enforcement of design standards). In the last scenario (S4), we combine Scenarios S2 and S3 and assume that there is certification of design quality and internalization of design spill overs. We illustrate how the items defined in Table 11 map to these scenarios in Table 12.

Tab. 12. Net cashflow and construction cost inflators by scenario

Parameter	S1	S2	S3	S4
Function: Rent premium	X	X	X	X
Function: Operation cost and durability discount	X	X	X	X
Form: Certification premium	-	X	-	X
Form: Rent premium	X	X	X	X
Form: Operation cost and durability discount	X	X	X	X
Form: External premium	-	-	X	X
Function: Cost inflator	X	X	X	X
Form: Cost inflator	X	X	X	X

Notes: Notes: See Table 11 for the chosen parameter values.

For each scenario, we draw 10,000 values for all parameters which we use to compute 10,000 values of HQB premiums on investment returns $\tilde{\mathcal{R}}$. We plot the resulting distributions by scenario in Figure 14.

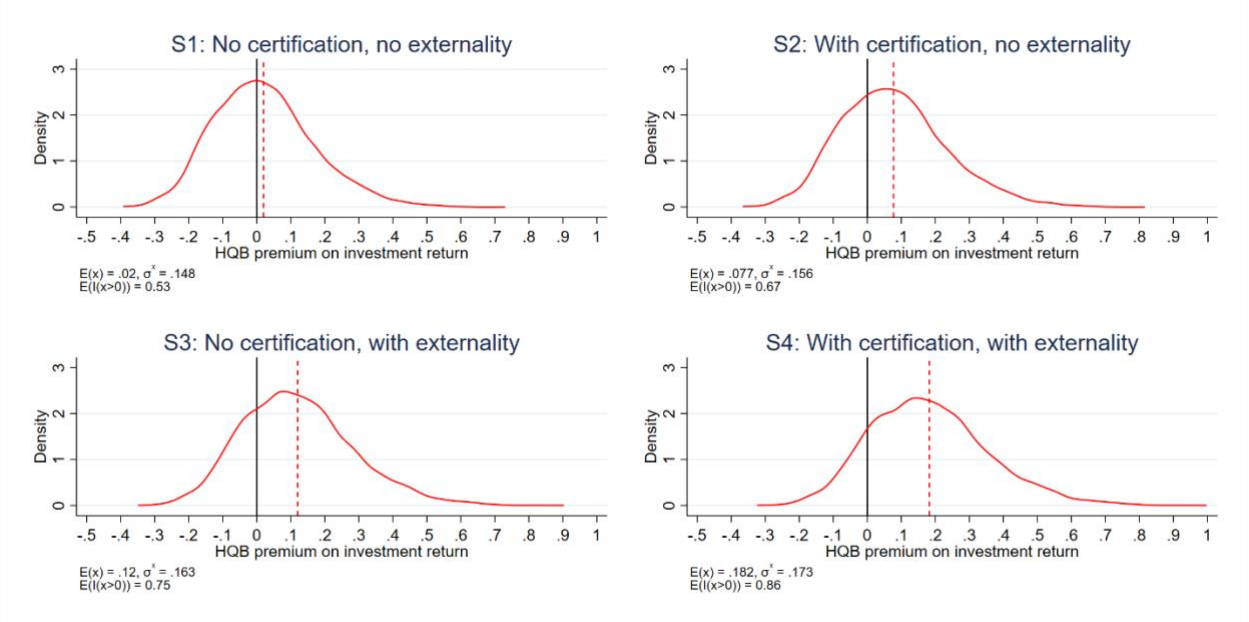
The first insight is that even in the most conservative scenario S1, there is a positive investment premium associated with HQB. Notice that mean premium of 0.02 is not an absolute ROI, but a relative premium that indicates by how much the ROI increases if the investor decides to invest in HQB. If we assume a ROI in the absence of HQB of $\mathcal{R}^{LQB} = 0.1$, the ROI under HQB exceeds the ROI under LQB by $\mathcal{R}^{HQB} - \mathcal{R}^{LQB} = 0.02$, i.e. by some sizable 20%. Moreover, the ROI under HQB exceeds the ROI under LQB in 53% of the cases. So, more often than not, investments into HQB pay off. Yet, there is significant uncertainty regarding the outcome, reflected in the large standard deviation of 0.148 and in 47% of the cases, the simulated return to investments into HQB is negative. This may explain why, despite a positive effect on expected returns, some risk-averse investors choose to limit their investment into HQB.

The second scenario, S2, reveals that a credible design certification scheme can increase incentives to invest into HQB. The HQB investment premium increases by a factor of more than three. Since the standard deviation hardly changes, the risk-return trade-off improves significantly and returns to HQB investments are now positive in 67% of cases. As revealed by scenario S3, internalizing externalities, and solving the freerider problem can have even larger effects. The HQB investment premium, compared to scenario S1, increases by a factor of six and returns to HQB investments become positive in 75% of cases. Combining the certification

scheme with an internalization of design externalities in scenario S4, expectedly, result in an even clearer case for investments in HQB as the HQB investment premium is now positive with an 86% probability.

Thus, while risk-neutral profit-maximizing investors should decide to invest into HQB even in the most conservative scenario, the incentives to invest in and the expected returns to investments into HQB increase significantly when the market failures discussed in Section 2 are addressed.

Fig. 14. Return in investment of HQB



Notes: ROI = Return on investment. HQB = High-quality *Baukultur*. Figure shows the distribution of simulated relative premia on returns on investment associated with HQB, $\widetilde{\mathcal{R}}$. E(x) and σ given the mean and the standard deviations of the distribution. E(I(x>0)) gives the probability of a positive outcome. For example, E(x) = 0.027 implies that a with HQB the ROI is 2.7 percentage point higher, on average. E(I(x>0))=0.55 implies that with HQB, the ROI will be larger than without in 55% of all cases.

7 Conclusion

Based on 382 empirical analyses, we conclude that HQB can result in a variety of social returns such as in the form of higher quality of life and a more sustainable use of land. HQB not only yields social dividends but also tangible returns on investments because real estate markets value buildings and urban spaces that are functional and aesthetically appealing. In fact, evidence suggests that returns to investments into HQB exceed the costs. Hence, developers who invest in HQB can do well by doing good. Yet, it is unlikely that if left to themselves, markets will deliver the socially optimal investment into HQB.

For one thing, there is an information problem because users may find it difficult to assess whether a building complies with all criteria of HQB. Users, therefore, discount their willingness to pay for HQB, which reduces the incentives for developers to invest in HQB. This market failure could be overcome with a credible certification scheme akin to increasingly popular energy performance certificates. An Alliance of developers where membership entails a credible commitment to complying with the criteria of HQB could serve a similar purpose. For another, there is a *freeriding* problem because those who invest in HQB generate a positive design spill over for which they are not financially compensated. This creates an incentive to limit investments into architectural design and to freeride on the efforts of others, which results in

suboptimal investments in HQB. This market failure could be overcome by a planning system that encourages, facilitates, or even enforces investments into HQB via hard and soft governance. A hard measure would be to increase the legally allowed floor area ratios in return for credible and binding design competitions. A soft measure would be a reflexive governance approach that establishes multi-stakeholder fora at the neighborhood level to facilitate coordination of investments into HQB, thus mitigating the *freeriding* problem.

More generally, there are an array of soft governance approaches that may help bring investments into HQB closer to the social optimum. Options underlined in the governance literature include events and exhibitions to raise awareness nationally and promote and explore international engagement and funding opportunities, as well as attracting support from funders to translate learning resources and research. Making HQB literature more accessible to architecture, engineering, and other relevant specialists in multiple languages represents a complementary avenue. Another possible approach is supporting HQB professionals: government supporting international posts in related organizations to gain knowledge from other contexts about HQB, travel bursaries to help promote people exchanges, visa exemptions for accredited professionals as remuneration within the architecture and conservation sectors often does not reflect the skills and education of the workforce.

Compared to hard governance measures that operate through regulation, such soft measures are less prone to the concern that unintended consequences generate social costs that exceed the benefits. The main challenge is to promote investments into HQB without making the supply of space less responsive to changes in market prices, which can lead to affordability problems. To avoid collateral social cost, any hard measure intended to solve a market failure in the context of HQB must, therefore, be transparent and rule-based, so that decisions on planning permissions are predictable.

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9 Appendix

This paper presents additional tables that complement the main paper.

Tab. A1. *Keywords* in French, Italian, German and Spanish

	HQB Outcomes Characteristic	*HQB* characteristics French	Italian	German	Spanish
1	Internal value of space: residential	Bâtiment; "patrimoine culture*" OR forme AND architecturel; prix immobilier	edifici, "beni culturali" OR architettura, "prezzi immobiliari"	Gebäude, Baudenkmal OR Form AND Architektur,, Immobilienpreise	edificios, "patrimonio cultural" OR "arquitectura", precios inmobiliarios
2	Internal value of space: commercial	bâtiment, "patrimoine culture*" OR forme AND architecturel, prix commerc*	edifici, "beni culturali" OR architettura, prezzi commerciali	Gebäude, Baudenkmal OR Form AND Architektur, Immobilienpreise, Gewerbe	edificios, "patrimonio cultural" OR "arquitectura", precio comercial*
3	Construction costs	bâtiment, "patrimoine culture*" OR forme AND architecturel, coûts de construction	edifici, "beni culturali" OR architettura, costi di costruzione	Gebäude, Baudenkmal OR Form AND Architektur, Baukosten	edificios, "patrimonio cultural" OR arquitectura, costos de construcción

Tab. A2. Evidence collection: Distribution of studies

#	Outcome	Google Scholar	Web of Science	EconLit	Step 2	Step 3	Total
1	Internal value of space: residential	21	5	9	4	18	57
2	Internal value of space: commercial	11	3	2	6	3	25
3	Construction costs	8	1	0	8	0	17
4	Operating costs	3	0	0	0	0	3
5	Durability	1	0	0	0	0	1
6	External value of space	12	3	3	5	11	34
7	Spatial inclusion	4	0	0	0	0	4
8	Sense of Place	6	1	0	1	0	8
9	Safety	4	0	1	0	3	8
10	Subjective well-being	5	0	0	3	1	9
11	Housing supply elasticity	1	0	0	0	0	2
12	Tourism	2	1	0	0	0	3
13	Existence value	2	0	0	4	1	7
14	Open space preservation	3	0	0	0	1	4
15	Sustainability	9	3	1	0	0	13
16	Biodiversity	1	0	0	1	0	2
	Total	94	17	16	32	38	197

Notes: Google Scholar, Web of Science, EconLit searches all part of evidence collection step one. Step 2 contains results from the analysis of evidence from step 1 and studies which were collected during step one but corresponded to a different outcome to the one suggested by the keyword search they were found with. Step 3 consists of previously known evidence and recommendations by colleagues. See section 3 in the main paper for details.

Gabriel M. Ahlfeldt[♣], Elisabetta Pietrostefani[♠]

Studies reviewed in "Quality sells" - High-quality *Baukultur* as a success factor for the construction and real estate industry

Version: July 2022

Summary of study attributes

ID	Author	Year	C[1]	O[2]	Outcome Long	Country	Model	SMS	QRS[3]	Premium[4]
A1	Kok & Jennen	2012	A	2	rent	Netherlands	OLS FE	3	1	0.0650
A2	Ankamah-Yeboah & Rendanz	2014	A	1	property price	World	Meta	Meta	0	
A3	Ankamah-Yeboah & Rendanz	2014	A	2	property price	World	Meta	Meta	1	
A4	Plaut & Uzulena	2006	A	1	property price	Latvia	OLS FE	3	1	0.1650
A5	Plaut & Uzulena	2006	A	1	property price	Latvia	OLS FE	3	1	0.1930
A6	Plaut & Uzulena	2006	A	1	property price	Latvia	OLS FE	3	1	0.1170
A7	Plaut & Uzulena	2006	A	1	property price	Latvia	OLS FE	3	1	0.0150

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1 Characteristics as itemized in Table 2: A – Function, B – Form, C – Urban design, C - Governance

2 Outcomes as itemized in Table 3: 1 - Internal value of space: residential, 2 - Internal value of space: commercial, 3 - Construction costs, 4 - Operating costs, 5 – Durability, 6 - External value of space, 7 - Spatial inclusion, 8 Sense of Place, 9 – Safety, 10 – Subjetive well-being, 11 – Housing supply elasticity, 12 – Tourism, 13 – Existence value, 14 – Open space preservation, 15 – Sustainability, 16 – Biodiversity

3 Qualitative result score, see Section 3.2.1 in the main paper for details.

4 Log-point effect associated with the HQB. Missing values where results are not quantifiable.

ID	Author	Year	C[1]	O[2]	Outcome Long	Country	Model	SMS	QRS[3]	Premium[4]
A8	Plaut & Uzulena	2006	A	1	property price	Latvia	OLS FE	3	0	0.0530
A9	Plaut & Uzulena	2006	A	1	property price	Latvia	OLS FE	3	1	0.0510
A10	Plaut & Uzulena	2006	A	1	property price	Latvia	OLS FE	3	0	-0.0420
A11	Plaut & Uzulena	2006	A	1	property price	Latvia	OLS FE	3	0	-0.0540
A12	Plaut & Uzulena	2006	A	1	property price	Latvia	OLS FE	3	1	-0.1050
A13	Yoshida et al.	2008	A	1	property price	Japan	OLS	2	0	-0.0754
A14	Yoshida et al.	2008	A	1	property price	Japan	OLS	2	1	0.1258
A15	Yoshida et al.	2008	A	1	property price	Japan	OLS	2	1	0.0307
A16	Yoshida et al.	2008	A	2	property price	Japan	OLS	2	1	0.0674
A17	Yoshida et al.	2008	A	1	property price	Japan	OLS	2	1	0.1444
A18	Yoshida et al.	2008	A	1	property price	Japan	OLS	2	1	0.1655
A19	Yoshida et al.	2008	A	1	property price	Japan	OLS	2	1	0.0525
A20	Yoshida et al.	2008	A	2	property price	Japan	OLS	2	1	0.0776
A21	Yoshida et al.	2008	A	2	property price	Japan	OLS	2	1	0.0450
A22	Thatcher & Milner	2014	A	2	self-reported productivity	South Africa	Descriptives	1	1	
A23	Thatcher & Milner	2014	A	10	psychological wellbeing	South Africa	Descriptives	1	0	
A24	Thatcher & Milner	2014	A	10	reported health	South Africa	Descriptives	1	1	
A25	Newsham et al.	2019	A	2	self-reported productivity	World	Descriptives	0	1	
A26	Newsham et al.	2019	A	10	reported health	World	Descriptives	0	1	
A27	Liu et al.	2014	A	5	building lifespan	China	OLS	2	1	

ID	Author	Year	C[1]	O[2]	Outcome Long	Country	Model	SMS	QRS[3]	Premium[4]
A28	Peng & Chen	2015	A	1	property price	Australia	OLS	2	0	
A29	Peng & Chen	2015	A	1	property price	Australia	OLS	2	0	
A30	Mapp, et al	2011	A	3	construction costs	USA	Descriptives	0	-1	-0.0250
A31	Gabay et al.	2014	A	3	construction costs	Israel	Descriptives	0	-1	-0.0800
A32	Ade & Rehm	2013	A	3	construction costs	New Zealand	Descriptives	0	0	
A33	Kats	2003	A	3	construction costs	USA	Descriptives	0	-1	-0.0650
A34	Kim et al.	2014	A	3	construction costs	USA	Descriptives	0	-1	-0.1077
A35	Zhang, Platten, & Shen	2011	A	3	construction costs	China	Descriptives	0	-1	-0.1390
A36	Zhang et al.	2011	A	3	construction costs	China	Descriptives	0	-1	-0.1030
A37	Bartlett & Howard	2000	A	3	construction costs	UK	Descriptives	0	-1	
A38	Bartlett & Howard	2000	A	3	construction costs	UK	Descriptives	0	-1	
A39	Bartlett & Howard	2000	A	4	construction costs	UK	Descriptives	0	1	
A40	Weerasinghe & Ramachandra	2018	A	3	construction costs	Sri Lanka	Descriptives	0	-1	
A41	Weerasinghe & Ramachandra	2018	A	4	operating costs	Sri Lanka	Descriptives	0	1	
A42	Jafarzadeh et al.	2015	A	3	construction costs	Iran	OLS	2	-1	
A43	Jafarzadeh et al.	2015	A	3	construction costs	Iran	OLS	2	-1	
A44	Jafarzadeh et al.	2015	A	3	construction costs	Iran	OLS	2	-1	
A45	Sun et al.	2019	A	3	construction costs	Taiwan	Graph	1	-1	
A46	Sirmans et al.	2006	A	1	property price	USA	Meta	Meta	1	0.1200
A47	Sirmans et al.	2006	A	1	property price	USA	Meta	Meta	0	
A48	Reichardt	2014	A	4	operating costs	USA	OLS propensity-weighted	3	1	0.0540
A49	Reichardt	2014	A	4	operating costs	USA	OLS propensity-weighted	3	1	-0.0390

ID	Author	Year	C[1]	O[2]	Outcome Long	Country	Model	SMS	QRS[3]	Premium[4]
A50	Reichardt	2014	A	4	operating costs	USA	OLS propensity-weighted	3	1	0.0590
A51	Reichardt	2014	A	2	rent	USA	OLS propensity-weighted	3	1	0.0700
A52	Reichardt	2014	A	2	rent	USA	OLS propensity-weighted	3	1	0.0310
A53	Reichardt	2014	A	2	rent	USA	OLS propensity-weighted	3	1	0.1020
A54	Pivo and Fisher	2020	A	4	operating costs	USA	OLS	2	0	
A55	Pivo & Fisher	2020	A	4	operating costs	USA	OLS	2	1	0.1290
A56	Deng et al.	2020	A	2	rent	Japan	OLS FE	3	1	0.0439
A57	Stanley and Wang	2017	A	2	rent	USA	OLS	1	1	0.0650
A58	Yoshida, Yamazaki, & Lee	2017	A	15	water consumption	Japan	OLS FE	3	1	0.1890
A59	Yoshida et al.	2017	A	15	electricity consumption	Japan	OLS FE	3	1	0.1010
A60	Yoshida et al.	2017	A	2	rent	Japan	OLS FE	3	1	0.1010
A61	Asensio and Delmas	2017	A	15	carbon	USA	OLS propensity-weighted	3	1	
A62	Asensio & Delmas	2017	A	15	carbon	USA	OLS propensity-weighted	3	1	
A63	Asensio & Delmas	2017	A	15	carbon	USA	OLS propensity-weighted	3	1	
A64	Shimizu	2013	A	2	rent	Japan	OLS	2	1	0.0470
A65	Fang et al.	2018	A	2	property price	China	OLS	2	1	0.1290
A66	Devine & Kok	2015	A	15	water consumption	Canada and USA	OLS	2	1	
A67	Devine & Kok	2015	A	15	embodied energy	Canada and USA	OLS	2	1	
A68	Laurent et al.	2018	A	15	carbon	Canada	Descriptives	1	1	
A69	Yang et al.	2018	A	15	carbon	China	Descriptives	1	1	
A70	Yang et al.	2018	A	15	carbon	China	Descriptives	1	1	

ID	Author	Year	C[1]	O[2]	Outcome Long	Country	Model	SMS	QRS[3]	Premium[4]
A71	Nadoushani & Akbarnezhad	2015	A	15	carbon	USA	Descriptives	1	1	
A72	Nadoushani & Akbarnezhad	2015	A	15	carbon	USA	Descriptives	1	1	
A73	Pivo & Fisher	2010	A	15	operating costs	USA	OLS	2	1	
A74	Pivo & Fisher	2010	A	2	rent	USA	OLS	2	1	0.0520
A75	Pivo & Fisher	2010	A	2	property price	USA	OLS	2	1	0.0850
A76	(Novaes Pires Leite et al. 2019)	2019	A	2	IRR	Brazil	cross-section	1	1	
A77	Novaes Pires Leite et al.	2019	A	2	IRR	Brazil	cross-section	1	1	
A78	Fuerst & Warren-Myers	2018	A	1	property price	Australia	quantile regression	3	1	0.0936
A79	Fuerst & Warren-Myers	2018	A	1	property price	Australia	quantile regression	3	0	0.0100
A80	Fuerst & Warren-Myers	2018	A	1	property price	Australia	quantile regression	3	-1	-0.0150
A81	Fuerst & Warren-Myers	2018	A	1	property price	Australia	quantile regression	3	-1	-0.0453
A82	Fuerst & Warren-Myers	2018	A	1	property price	Australia	quantile regression	3	1	0.1000
A83	Fuerst & Warren-Myers	2018	A	1	property price	Australia	quantile regression	3	1	0.0304
A84	Fuerst & Warren-Myers	2018	A	1	rent	Australia	quantile regression	3	1	0.0263
A85	Banfi et al.	2008	A	1	willingness to pay	Switzerland	logit FE	3	1	0.0300
A86	Banfi et al.	2008	A	1	willingness to pay	Switzerland	logit FE	3	1	0.0800
A87	Ho et al.	2005	A	2	rent	Australia	Descriptives	1	1	
A88	Miller et al	2008	A	2	property price	USA	OLS	2	1	0.0576
A89	Miller et al.	2008	A	2	property price	USA	OLS	2	1	0.0940
A90	Miller et al.	2008	A	4	operating costs	USA	OLS	2	1	
A91	Miller et al.	2008	A	15	operating costs	USA	OLS	2	1	

ID	Author	Year	C[1]	O[2]	Outcome Long	Country	Model	SMS	QRS[3]	Premium[4]
A92	Miller et al.	2009	A	2	self-reported productivity	USA	Descriptives	0	1	
A93	Feige et al.	2013	A	10	reported health	Switzerland	Descriptives	1	1	
A94	Feige et al.	2013	A	2	self-reported productivity	Switzerland	Descriptives	1	0	
A95	Newton et al	2006	A	4	operating costs	Canada	Descriptives	1	1	
A96	Lowe et al.	2006	A	3	construction costs	UK	Descriptives	0	-1	
A97	Ade & Rehm	2020	A	3	construction costs	New Zealand	OLS	2	-1	-0.1070
A98	Hwang et al.	2017	A	3	construction costs	Singapore	Descriptives	0	-1	-0.0575
A99	Glossner et al.	2015	A	3	construction costs	USA	Descriptives	0	-1	-0.0400
A100	Glossner et al.	2015	A	4	operating costs	USA	Descriptives	0	1	
A101	Bradshaw et al.	2005	A	3	construction costs	USA	Descriptives	0	-1	-0.0242
A102	Ooi et al.	2014	A	1	property price	Singapore	OLS FE	3	1	0.0049
A103	Ooi et al.	2014	A	1	property price	Singapore	OLS FE	3	1	0.0028
A104	Ooi et al.	2014	A	1	property price	Singapore	OLS FE	3	1	0.0022
A105	Steemers & Manchanda	2010	A	10	subjective well-being	India	Descriptives	0	1	
A106	Steemers & Machanda	2010	A	10	subjective well-being	India	Descriptives	0	1	
A107	Steemers & Machanda	2010	A	10	subjective well-being	UK	Descriptives	0	1	
A108	Steemers & Machanda	2010	A	10	subjective well-being	UK	Descriptives	0	1	
A109	Menzies et al.	1997	A	2	self-reported productivity	Canada	Descriptives	0	1	
A110	Seppänen, et al.	1999	A	10	reported health	World	Meta	Meta	1	
B1	Filazzola et al.	2018	B	16	biodiversity	World	Meta	Meta	1	

ID	Author	Year	C[1]	O[2]	Outcome Long	Country	Model	SMS	QRS[3]	Premium[4]
B2	Filazzola et al.	2018	B	16	biodiversity	World	Meta	Meta	0	
C1	Filazzola et al.	2018	C	16	biodiversity	World	Meta	Meta	0	
C2	Filazzola et al.	2018	C	16	biodiversity	World	Meta	Meta	1	
A111	Maidment et al.	2014	A	10	reported health	World	Meta	Meta	1	
A112	Minunno et al.	2021	A	15	embodied energy	World	Meta	Meta	1	
A113	Minunno et al.	2021	A	15	carbon	World	Meta	Meta	1	
A114	Minunno et al.	2021	A	15	embodied energy	World	Meta	Meta	1	
A115	Minunno et al.	2021	A	15	carbon	World	Meta	Meta	1	
A116	Colenberg, et al.	2020	A	10	reported health	World	Meta	Meta	0	
A117	Colenger et al.	2020	A	10	psychological wellbeing	World	Meta	Meta	0	
A118	Colenger et al.	2020	A	10	psychological wellbeing	World	Meta	Meta	1	
A119	Singh et al.	2010	A	2	self-reported productivity	USA	Descriptives	0	1	
A120	Singh et al.	2010	A	10	psychological wellbeing	USA	Descriptives	0	1	
A121	Singh et al.	2010	A	10	reported health	USA	Descriptives	0	1	
A122	Palacios et al.	2020	A	2	work dissatisfaction	Netherlands	DD	4	1	
A123	Palacios et al.	2020	A	2	work hindrance	Netherlands	DD	4	1	
A124	Palacios et al.	2020	A	2	work dissatisfaction	Netherlands	DD	4	1	
A125	Palacios et al.	2020	A	2	work hindrance	Netherlands	DD	4	1	
A126	Palacios et al.	2020	A	2	work dissatisfaction	Netherlands	DD	4	1	
A127	Palacios et al.	2020	A	2	work hindrance	Netherlands	DD	4	1	

ID	Author	Year	C[1]	O[2]	Outcome Long	Country	Model	SMS	QRS[3]	Premium[4]
A128	Palacios et al.	2020	A	2	self-reported productivity	Netherlands	DD	4	1	
A129	Palacios et al.	2020	A	10	sick leave	Netherlands	DD	4	1	
A130	Jafarzadeh et al.	2015	A	3	construction costs	Iran	OLS	2	-1	
A131	Öven & Pekdemir	2006	A	2	rent	Turkey	OLS	2	1	
A132	Rossi-Hansberg et al.	2010	A	1	property price	USA	OLS	2	1	0.1690
A133	Rossi-Hansberg et al.	2010	A	1	property price	USA	OLS	2	1	0.1220
A134	Rossi-Hansberg et al.	2010	A	1	property price	USA	OLS	2	1	0.0410
A135	Ooi, Le, & Lee	2014	A	1	property price	Singapore	OLS FE	3	1	0.0028
B3	Barreca	2022	B	1	property price	Italy	spatial model	2	1	0.0800
B4	Ahlfeldt & McMillen	2018	B	3	construction costs	World	OLS FE	3	-1	
B5	Ahlfeldt & McMillen	2018	B	3	construction costs	USA	OLS FE	3	-1	
B6	Poursafar et al.	2019	B	2	self-reported productivity	Iran and India	SEM	1	1	
B7	Poursafar et al.	2019	B	2	self-reported productivity	Iran and India	SEM	1	1	
B8	Poursafar et al.	2019	B	2	self-reported productivity	Iran and India	SEM	1	1	
B9	Cheshire and Dericks	2020	B	2	property price	UK	panel FE	3	1	0.1670
B10	Cheshire & Dericks	2020	B	2	property price	UK	panel FE	3	1	0.1250
B11	Cheshire & Dericks	2020	B	6	property price	UK	panel FE	3	1	0.0890
B12	Cheshire & Dericks	2020	B	3	construction costs	UK	panel FE	3	-1	-0.1300
B13	Fuerst & Warren-Myers	2018	B	1	property price	Australia	quantile regression	3	-1	
B14	Fuerst & Warren-Myers	2018	B	1	property price	Australia	quantile regression	3	0	

ID	Author	Year	C[1]	O[2]	Outcome Long	Country	Model	SMS	QRS[3]	Premium[4]
B15	Fuerst & Warren-Myers	2018	B	1	property price	Australia	quantile regression	3	1	
B16	Fuerst & Warren-Myers	2018	B	1	property price	Australia	quantile regression	3	1	
B17	Fuerst & Warren-Myers	2018	B	1	property price	Australia	quantile regression	3	1	
B18	Fuerst & Warren-Myers	2018	B	1	property price	Australia	quantile regression	3	0	
B19	Fuerst & Warren-Myers	2018	B	1	rent	Australia	quantile regression	3	-1	
B20	Fuerst & Warren-Myers	2018	B	1	rent	Australia	quantile regression	3	0	
B21	Fuerst & Warren-Myers	2018	B	1	rent	Australia	quantile regression	3	1	
B22	Fuerst & Warren-Myers	2018	B	1	rent	Australia	quantile regression	3	1	
B23	van Duijn et al.	2016	B	1	property price	Netherlands	DD	4	0	
B22	Zhang, Zhang, & Guo	2021	B	6	attitudes	China	Descriptives	1	1	
B24	Pietrostefani	2019	B	1	property price	Italy	BDD	4	1	0.0300
B25	Pietrostefani	2019	B	1	property price	Italy	BDD	4	1	0.0600
B26	Pietrostefani	2019	B	7	property price	Italy	BDD	4	-1	0.0600
B27	Franco & Macdonald	2018	B	1	property price	Portugal	spatial error model	3	1	0.0410
B28	Franco & Macdonald	2018	B	6	property price	Portugal	spatial error model	3	1	0.0330
B29	Franco & Macdonald	2018	B	1	property price	Portugal	spatial error model	3	1	0.0071
B30	Ahlfeldt & Maennig	2010	B	1	property price	Germany	OLS FE	3	-1	-0.0400
B31	Ahlfeldt & Maennig	2010	B	1	property price	Germany	OLS FE	3	1	0.0280
B32	Ahlfeldt & Maennig	2010	B	6	property price	Germany	OLS FE	3	1	0.0100
B33	Coulson & Leichenko	2001	B	6	property price	USA	OLS	2	1	0.0140
B34	Coulson & Leichenko	2001	B	1	property price	USA	OLS	2	1	0.1760
B35	Koster & Rouwendal	2017	B	6	property price	Netherlands	OLS IV	4	1	0.0225

ID	Author	Year	C[1]	O[2]	Outcome Long	Country	Model	SMS	QRS[3]	Premium[4]
B36	Rosato et al.	2008	B	1	property price	Italy	OLS	2	1	
B37	Lazrak et al.	2014	B	1	property price	Netherlands	OLS	2	1	0.2790
B38	Lazrak et al.	2014	B	6	property price	Netherlands	OLS	2	1	0.2800
B39	Lazrak et al.	2014	B	1	property price	Netherlands	OLS	2	1	0.2950
B40	Zahirovic-Herbert & Chatterjee	2012	B	1	property price	USA	quantile regression	3	1	0.0940
B41	Zahirovic-Herbert & Chatterjee	2012	B	6	property price	USA	quantile regression	3	1	0.0380
B42	Moro et al.	2013	B	6	property price	Ireland	OLS FE	3	1	0.1120
B43	Shing Cheung & Yim Yiu	2022	B	6	property price	New Zealand	OLS FE	3	1	0.3390
B44	Shing Cheung & Yim Yiu	2022	B	6	property price	New Zealand	OLS FE	3	1	0.3550
B45	Shing Cheung & Yim Yiu	2022	B	6	property price	New Zealand	OLS FE	3	1	0.0930
B46	Nilsson	2011	B	1	property price	Sweden	OLS	2	1	0.0800
B47	Nilsson	2011	B	1	property price	Sweden	OLS	2	1	0.0450
B48	Nunns	2015	B	6	property price	New Zealand	OLS	2	1	0.0030
B49	Jayantha & Yung	2018	B	2	rent	China	OLS	2	1	0.1500
B50	Ahlfeldt & Maennig	2010	B	6	land value	Germany	OLS FE	3	1	0.0732
B51	Ahlfeldt & Maennig	2010	B	6	land value	Germany	OLS FE	3	1	0.0411
B52	Coulson & Lahr	2005	B	1	property price	USA	OLS FD	3	1	0.1300
B53	Vandell & Lane	1989	B	2	rent	USA	OLS IV	4	1	0.1173
B54	Vandell & Lane	1989	B	3	construction costs	USA	OLS IV	4	0	-0.5622
B55	Vandell & Lane	1989	B	3	construction costs	USA	OLS IV	Meta	-1	-0.2000
B56	Noonan	2007	B	1	property price	USA	OLS FE	3	1	0.1060

ID	Author	Year	C[1]	O[2]	Outcome Long	Country	Model	SMS	QRS[3]	Premium[4]
B57	Noonan	2007	B	1	property price	USA	OLS FE	3	1	0.0400
B58	Noonan	2007	B	6	external property prices	USA	OLS FE	3	1	
B59	Hough & Kratz	1983	B	2	rent	USA	OLS	2	1	0.1588
B60	Hough & Kratz	1983	B	2	rent	USA	OLS	2	0	-0.0787
B61	Asabere & Huffman	1994	B	6	property price	USA	OLS	2	1	0.2600
B62	Asabere & Huffman	1994	B	1	property price	USA	OLS	2	-1	-0.3000
B63	Asabere et al.	1994	B	1	property price	USA	OLS	2	-1	-0.2400
B64	Asabere et al.	1994	B	1	property price	USA	OLS	2	0	0.0000
B65	Moorhouse & Smith	1994	B	1	property price	USA	OLS	2	1	0.2644
B66	Moorhouse & Smith	1994	B	1	property price	USA	OLS	2	1	0.1077
B67	Moorhouse & Smith	1994	B	1	property price	USA	OLS	2	1	0.1756
B68	Moorhouse & Smith	1994	B	1	property price	USA	OLS	2	1	0.1173
B69	Moorhouse & Smith	1994	B	1	property price	USA	OLS	2	1	0.1478
B70	Moorhouse & Smith	1994	B	1	property price	USA	OLS	2	1	0.1229
B71	Gat	1998	B	2	rent	Israel	OLS	2	1	0.1207
B72	Ahlfeldt & Mastro	2012	B	6	land value	USA	OLS FE	3	1	0.0850
B73	Ahlfeldt & Kavetsos	2014	B	6	property price	UK	DD	4	1	0.1640
B74	Ahlfeldt & Kavestos	2014	B	6	property price	UK	DD	4	1	
B75	Liao, Jing, and Lee	2022	B	1	property price	Singapore	DD	4	1	0.0540
B76	Been et al.	2016	B	6	property price	USA	DD	4	1	0.1192
B77	Been et al.	2016	B	1	property price	USA	DD	4	1	0.2219

ID	Author	Year	C[1]	O[2]	Outcome Long	Country	Model	SMS	QRS[3]	Premium[4]
B78	Moon & Ahn	2022	B	11	new buildings	USA	OLS FE	3	0	
B79	Ding	2013	B	11	output per unit land	China	OLS	2	-1	
B80	Been et al.	2016	B	11	new housing construction	USA	DD	4	-1	
B81	Buitelaar & Schilder	2017	B	1	property price	Netherlands	OLS FE	3	1	0.1480
B82	Buitelaar & Schilder	2017	B	1	property price	Netherlands	OLS FE	3	1	0.0480
B83	Buitelaar & Schilder	2017	B	3	construction costs	Netherlands	OLS FE	3	-1	
B84	Fuerst et al.	2011	B	2	rent	USA	OLS FE	3	1	0.0500
B85	Fuerst et al.	2011	B	1	property price	USA	OLS FE	3	1	0.1200
B86	Koster et al.	2016	B	1	property price	Netherlands	RDD	4	1	0.0350
B87	Koster et al.	2016	B	6	property price	Netherlands	RDD	4	1	0.0204
B88	Koster et al.	2016	B	7	property price	Netherlands	RDD	4	-1	
B89	Ahlfeldt & Holman	2018	B	1	property price	UK	BDD	4	1	0.1680
B90	Ahlfeldt & Holman	2018	B	6	property price	UK	BDD	4	1	0.0810
B91	Lindenthal	2020	B	1	property price	Netherlands	OLS FE	3	1	0.0350
B92	Auckland Council	2018	B	6	property price	New Zealand	OLS	2	1	0.0140
B93	Auckland Council	2018	B	1	property price	New Zealand	OLS	2	1	0.0430
B94	Auckland Council	2018	B	1	property price	New Zealand	OLS	2	-1	-0.1010
B95	Deodhar	2004	B	1	property price	Australia	OLS	2	1	0.1120
B96	Sharpe	2006	B	1	property price	Canada	Descriptives	1	0	
B97	Gale	1991	B	1	property price	USA	Descriptives	1	0	
B98	Benson & Klein	1988	B	1	property price	USA	Descriptives	1	1	

ID	Author	Year	C[1]	O[2]	Outcome Long	Country	Model	SMS	QRS[3]	Premium[4]
B99	Benson & Klein	1988	B	11	new housing construction	USA	Descriptives	1	-1	
B100	Asabere & Huffman	1991	B	1	lot price	USA	OLS	1	1	
B101	Leichenko, el al.	2001	B	1	property price	USA	OLS	2	1	0.1363
B102	Schaeffer & Millerick	1991	B	1	property price	USA	OLS	2	1	
B103	Clark & Herrin	1997	B	1	property price	USA	OLS	2	1	0.1367
B104	Clark & Herrin	1997	B	6	property price	USA	OLS	2	-1	
B105	Narwold	2008	B	6	property price	USA	OLS	2	1	0.0370
B106	Lindenthal & Johnson	2021	B	1	property price	UK	OLS FE	3	1	
B107	Lindenthal & Johnson	2021	B	1	property price	UK	OLS FE	3	1	
B108	Rong et al.	2020	B	2	rent	USA	OLS	2	1	0.0200
B109	Rong et al.	2020	B	2	rent	USA	OLS	2	1	0.1840
B110	Rong et al.	2020	B	2	rent	USA	OLS	2	1	0.0350
B111	Rong et al.	2020	B	2	property price	USA	OLS	2	1	0.1240
B112	Rong et al.	2020	B	2	property price	USA	OLS	2	1	0.1900
B113	Rong et al.	2020	B	2	property price	USA	OLS	2	1	0.0970
B114	Zheng et al.	2020	B	6	property price	China	DD	4	1	0.0634
B115	Tan and Ti	2020	B	6	property price	Singapore	OLS FE	3	1	
B116	Bade et al.	2020	B	1	property price	New Zealand	OLS FE	3	-1	-0.0960
B117	Bade et al.	2020	B	6	property price	New Zealand	OLS FE	3	1	0.0170
B118	Bade et al.	2020	B	1	property price	New Zealand	OLS FE	3	1	0.0430
B119	Fernandez & Martin	2020	B	1	property price	New Zealand	OLS FE	3	1	0.0790

ID	Author	Year	C[1]	O[2]	Outcome Long	Country	Model	SMS	QRS[3]	Premium[4]
B120	Andersson et al.	2018	B	1	property price	Sweden	OLS FE	3	1	0.2000
B121	Andersson et al.	2018	B	6	property price	Sweden	OLS FE	3	1	0.0100
B122	Kee	2018	B	6	property price	China	OLS FD	3	1	0.2100
B123	Kee	2018	B	6	property price	China	OLS FD	3	1	0.1200
B124	Kee	2018	B	6	property price	China	OLS FD	3	1	0.1515
B125	Lee	2021	B	6	property price	Singapore	OLS FE	3	0	
B126	Liu & Liu	2022	B	6	property price	Netherlands	DD	4	1	0.0217
B127	Nase et al.	2013	B	2	rent	Northern Ireland	OLS	2	1	0.2500
B128	Nase et al.	2013	B	2	rent	Northern Ireland	OLS	2	-1	-0.1800
B129	Nase et al.	2013	B	2	rent	Northern Ireland	OLS	2	1	0.0860
B130	Shilton & Zaccar	1994	B	6	property price	USA	OLS	2	1	
B131	Oba & Noonan	2017	B	1	property price	USA	DD	4	1	0.1011
B132	Oba & Noonan	2017	B	1	property price	USA	DD	4	0	
B133	Oba & Noonan	2017	B	6	property price	USA	DD	4	0	0.0000
B134	Oba & Noonan	2017	B	6	property price	USA	DD	4	0	
B135	Angjellari-Dajci & Cebula	2016	B	1	property price	USA	OLS	2	1	
B136	Heintzelman & Altieri	2013	B	1	property price	USA	DD	4	1	0.2060
B137	Heintzelman & Altieri	2013	B	6	property price	USA	DD	4	1	0.0725
B138	Ahlfeldt & Holman	2015	B	1	property price	UK	BDD	4	1	0.0950
B139	Ahlfeldt & Holman	2015	B	6	property price	UK	BDD	4	1	0.0500
B142	Ruijgrok	2006	B	1	property price	Netherlands	OLS	2	1	0.1321
B143	Ruijgrok	2006	B	1	property price	Netherlands	OLS	2	1	0.0164

ID	Author	Year	C[1]	O[2]	Outcome Long	Country	Model	SMS	QRS[3]	Premium[4]
B144	Ruijgrok	2006	B	13	bequest (per year per household)	Netherlands	CVM	2	1	
B145	Ruijgrok	2006	B	8	recreation (per visit)	Netherlands	CVM	2	1	
B146	Noonan & Krupka	2011	B	1	property price	USA	OLS IV	4	1	0.0520
B147	Noonan & Krupka	2011	B	6	property price	USA	OLS IV	4	1	0.2470
B148	Ahlfeldt	2009	B	1		Germany	OLS	2	1	0.0770
B149	Ahlfeldt	2009	B	1		Germany	OLS	2	-1	-0.0700
B150	Salazar Miranda	2020	B	7	dissimilarity	Spain	OLS	3	1	
B151	Pietrostefani	2022	B	8	willingness to pay	Lebanon	CVM	2	-1	
B152	Garrod et al.	1996	B	13	willingness to pay	UK	CVM	2	1	
B153	Dutta et al.	2007	B	6	willingness to pay	India	CVM	2	1	
B154	Kling et al.	2004	B	6	willingness to pay	USA	CVM	2	1	
B155	Chambers, Chambers & Whitehead	1998	B	13	willingness to pay	USA	CVM	2	1	
B156	Alberini & Longo	2009	B	13	willingness to pay	Armenia	CVM	2	1	
B157	Bertacchini and Sultan	2020	B	13	willingness to pay	Mauritius	CVM	2	1	
B158	Giannakopoulou et al.	2011	B	6	willingness to pay	Greece	CVM	2	1	
B159	Giannakopoulou et al.	2011	B	13	willingness to pay	Greece	CVM	2	1	
B160	Báez and Herrero	2012	B	6	willingness to pay	Chile	CVM	2	1	
B161	Báez & Herrero	2012	B	13	willingness to pay	Chile	CVM	2	1	
B162	Pollicino & Maddison	2001	B	6	willingness to pay	UK	CVM	2	1	
B163	Báez-Montenegro et al. 2	2012	B	6	willingness to pay	Chile	CVM	2	1	
B164	Malavasi	2020	B	1	property price	Italy	OLS	2	1	

ID	Author	Year	C[1]	O[2]	Outcome Long	Country	Model	SMS	QRS[3]	Premium[4]
B165	Morpugno	2015	B	1	property price	Italy	OLS	3	1	0.0800
B166	Gabrielli and Farinelli	2017	B	1	property price	Italy	OLS	2	-1	
C3	Alberini et al	2003	C	6	willingness to pay	Northern Ireland	DCE	2	0	
B167	Alberini et al.	2003	B	6	willingness to pay	Northern Ireland	DCE	2	0	
B168	Mattia & Bianchi	1994	B	13	willingness to pay	Italy	CVM	2	1	
B169	Mattia & Bianchi	1994	B	13	willingness to pay	Italy	CVM	2	1	
B170	Sardaro et al.	2021	B	13	willingness to pay	Italy	DCE	2	1	
B171	Merciu et al.	2021	B	6	willingness to pay	Romania	TCM	1	1	
B172	Alberini & Longo	2006	B	6	willingness to pay	Armenia	CVM and TCM	2	1	
B173	Tuan & Navrud	2007	B	6	willingness to pay	Vietnam	CVM and CM	2	1	
B174	Tuan & Navrud	2007	B	13	willingness to pay		CVM and CM	2	1	
B175	Willis	1994	B	13	willingness to pay	UK	CVM	1	1	
B176	Poor & Smith	2004	B	6	willingness to pay	USA	TCM	2	1	
B177	Shamsuddin & Ujang	2008	B	8	attachment	Malaysia	Descriptive	1	1	
C4	Shamsuddin & Ujang	2008	C	8	attachment	Malaysia	Descriptive	1	1	
B178	Dameria et al.	2021	B	8	sense of place	Indonesia	Descriptive	1	1	
B179	Amjad et al.	2021	B	8	sense of belonging	Iran	Descriptive	1	1	
B180	Gokce & Chen	2018	B	8	sense of place	Turkey	Descriptive	1	1	
B181	Hassan et al.	2019	B	8	social interraction	Egypt	Descriptive	0	1	
B182	Hu & Chen	2018	B	8	sense of place	USA	OLS	2	-1	
B183	Hu & Chen	2018	B	8	sense of place	USA	OLS	2	1	
B184	Hu & Chen	2018	B	8	sense of place	USA	OLS	2	1	

ID	Author	Year	C[1]	O[2]	Outcome Long	Country	Model	SMS	QRS[3]	Premium[4]
B185	Lwoga	2018	B	12	tourism	Tanzania	SEM	2	1	
B186	Cuccia, Guccio, & Rizzo	2015	B	12	tourism	Italy	OLS	3	1	
B187	Patuelli et al.	2016	B	12	tourism	Italy	OLS	3	1	0.0400
B188	Wei Wang et al.	2017	B	16	biodiversity	Singapore	Descriptives	0	1	
C5	Chen	2017	C	1	property price	China	OLS	2	1	0.0461
C6	Nase et al.	2013	C	2	rent	Northern Ireland	OLS	2	1	0.1700
C7	Mazzotta et al.	2014	C	1	willingness to pay	USA	Meta	Meta	1	
C8	Mazzotta et al.	2014	C	1	willingness to pay	USA	Meta	Meta	1	
C9	Mazzotta et al.	2014	C	1	willingness to pay	USA	Meta	Meta	1	
C10	Laverne & Winson-Geideman	2003	C	2	rent	USA	OLS	2	1	0.0700
C11	Laverne & Winson-Geideman	2003	C	2	rent	USA	OLS	2	1	0.0700
C12	Laverne & Winson-Geideman	2003	C	2	rent	USA	OLS	2	0	
C13	Laverne & Winson-Geideman	2003	C	2	rent	USA	OLS	2	0	
C14	Laverne & Winson-Geideman	2003	C	2	rent	USA	OLS	2	0	
C15	Laverne & Winson-Geideman	2003	C	2	rent	USA	OLS	2	0	
C16	Ng et al.	2015	C	6	willingness to pay	China	DCE	3	1	
A136	Zhang & Tu	2021	A	10	psychological wellbeing	Singapore	Descriptives	1	1	
B189	Colenger et al.	2020	B	10	wellbeing	World	Meta	Meta	1	
B190	Lawton et al.	2021	B	6	willingness to pay	UK	CVM	2	1	
C17	Anderson et al.	2017	C	8	social interaction	UK	Descriptives	0	1	
C18	Anderson et al.	2017	C	10	engaging in physical activity	UK	Descriptives	0	1	

ID	Author	Year	C[1]	O[2]	Outcome Long	Country	Model	SMS	QRS[3]	Premium[4]
C19	Pitt et al.	2021	C	10	reported health	Canada	Meta	Meta	1	
C20	Pitt et al.	2021	C	10	reported health	Canada	Meta	Meta	1	
C21	Devaux, et al	2018	C	6	property price	Canada	DD	4	-1	
C22	Devaux et al.	2018	C	1	property price	Canada	DD	4	0	
C23	Schläpfer et al.	2015	C	1	rent	Switzerland	OLS controls	2	1	0.0009
C24	Schläpfer et al.	2015	C	1	rent	Switzerland	OLS controls	2	-1	-0.0002
C25	Silva & Li	2020	C	9	burglary rate	Cape Verde	OLS controls	2	1	
C26	Chalfin, Kaplan, & LaForest	2021	C	9	burglary rate	USA	OLS Experiment	4	1	
C27	Hillier & Sahbaz	2008	C	9	crime	UK	LOGIT	2	0	
C28	Sohn	2015	C	9	burglary rate	USA	OLS	2	1	
C29	Navarrete-Hernandez et al.	2021	C	9	perception of safety	UK	OLS Experiment	4	1	
C30	Navarrete-Hernandez et al.	2019	C	10	subjective well-being	Chile	OLS Experiment	4	1	
C31	Chang	2011	C	9	burglary rate	South Korea	CORR	1	1	
C32	Newman & Franck	1982	C	9	crime	USA	CORR	1	-1	
C33	Newman & Franck	1982	C	9	Fear of crime	USA	CORR	1	-1	
C34	Harvey et al.	2015	C	9	Perceived safety	USA	OLS, LOGIT	2	1	
C35	Bockarjova et al.	2020	C	1	property price	World	Meta	Meta	1	
C36	Brander and Koetse	2011	C	1	property price	World	Meta	Meta	1	
C37	Brander & Koetse	2011	C	1	willingness to pay	World	Meta	Meta	1	
C38	Guite, Clark, & Ackrill	2006	C	10	Mental health score	UK	LOGIT	2	1	
C39	Baranzini & Schaerer	2011	C	6	rent	Switzerland	OLS	3	1	0.0740
D1	Noonan & Krupka	2011	D	1	property price	USA	OLS IV	4	-1	

ID	Author	Year	C[1]	O[2]	Outcome Long	Country	Model	SMS	QRS[3]	Premium[4]
D2	Buchel & Hoesli	1995	D	1	property price	Switzerland	cross-section	2	1	
D3	Marks	1984	D	1	rent	USA	cross-section	2	1	
D4	Patel et al.	2018	D	3	construction cost	India	Descriptives	0	1	
D5	Liu et al.	2014	D	5	building lifespan	China	OLS	2	1	
D6	Orfield et al.	2015	D	7	income gap	USA	OLS	2	-1	
D7	Granath Hansson	2019	D	7	affordable housing	Germany and Sweden	Descriptives	0	1	
D8	Mukhija et al.	2010	D	7	affordable housing	USA	OLS	2	1	
D9	Wang, Liu, & Zhang	2020	D	14	urban land expansion	China	SEM	2	1	
D10	Irwin & Bockstael	2004	D	14	open space conservation	USA	OLS	2	1	
D11	Tang & Wong	2008	D	14	open space zoning	China	OLS	2	1	
D12	Lewis et al.	2009	D	14	open space conservation	USA	PROBIT	2	1	
D13	Yu et al.	2021	D	15	energy saving rate	China	Descriptives	1	1	
D14	Fuinhas et al.	2022	D	15	energy consumption	Portugal	OLS	2	1	
D15	Smedby	2016	D	15	energy consumption	Sweden	Descriptives	1	1	
D16	Hou et al.	2016	D	15	energy saving rate	China	Descriptives	0	1	
D17	laband	2020	D	15	energy consumption	World	Meta	Meta	1	
D18	Papineau	2017	D	15	energy consumption	USA	OLS FE	4	1	

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