The London School of Economics and Political Science

Essays in planning policy and urban economics

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Declaration

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Statement of conjoint work

Paper I "The politics of conservation planning: a comparative study of urban heritage making" is joint work with Dr. Nancy Holman. My contribution to this research includes work relating to: framing the research question; review of institutional frameworks, theories and existing literature; review of legislative documentation; carrying out interviews and related fieldwork, data analysis; write up of paper. I presented the research at the AESOP Annual Conference 2017 and the LSE Urbanisation, Planning and Development Seminar 2017.

This statement is to confirm I contributed a minimum of 50% of this work as agreed by the undersigned.

Nancy Holman

Paper III "The economic effects of density: a synthesis" is joint work with Dr. Gabriel Ahlfeldt. Paper III was based on work on the effects of compact urban form done for the OECD (Organisation for Economic Co-operation and Development) and the WRI (World Resources Institute). Our subsequent research paper significantly developed on the original report both theoretically and empirically. My contribution to this research includes work relating to: structuring the theoretical framework of the research question; review of existing literature; research design; data collection, collation and preparation; statistical analysis; write up of paper. I presented the research at the Urban Economics Association 7th European Meeting 2017 and the LSE Work-in-Progress Seminar 2018.

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Abstract

This thesis consists of four independent chapters. Although the chapters are distinct works, they are related by their focus on urban policy and aim to contribute to the understanding of how planning policies and urban development affect specific outcomes in space. The chapters can be divided into two distinct parts. The first part comprises two studies on conservation planning. The first chapter investigates the complexities at play between conservation planning systems, their applications and how these vary between contexts. Based on a survey of conservation planning systems in 5 countries, focusing on 5 city case-studies, it considers how conservation compares between planning systems of the Global North and Global South and what this suggest about heritage value. The second chapter exploits the Italian context to examine to what extent non-compliance undermines conservation effects given that despite stringent planning regulation, the conditions of the urban environment vary widely throughout Italy, including within protected areas. This study is closely linked to the urban economics literature through an explicit consideration of housing markets and spatial issues.

The second part of this thesis comprises two further chapters that focus on the effects of two distinctly urban occurrences: economic and morphological density. The third chapter investigates the costs and benefits of a widely supported policy paradigm: ‘compact urban form’. It asks to what extent even higher densities within cities are desirable by assessing the effects of density on a broad range of outcomes ranging from wages, innovation, rents, various amenities, the cost of providing public services, transport- and environment-related outcomes to health and wellbeing.

The final chapter focuses on deregulated planning using Beirut, Lebanon as a case-study given the city’s conspicuous transformations which have dramatically altered the city’s landscape, housing stock, and people-space relations. This chapter specifically investigates how morphological densification affects values residents attach to both their physical urban environments and intangible urban amenities such as neighbourhood belonging. The unifying theme of the thesis is to bring fresh evidence to policy-relevant issues in planning and urban economics by the generation of new datasets for all contexts and the application of multi-disciplinary techniques.

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As is customary, all errors and omissions remain my own.

1 Introduction

If we agree, like many scholars do (Boyko & Cooper 2011; Smith 1978; Storper & Manville 2006; OECD 2010), that living in urban areas provides something valuable to an increasing number of people across the globe, then understanding issues that impact cities becomes paramount.[1] The question then is one of perspective. Many different disciplines tackle urban questions, each using its own viewpoint. This thesis approaches the topic from the theoretical underpinnings of both urban planning and urban economics, to support the contention that interlacing both disciplines provides a fuller picture of urban processes and can improve the implementation and adaptation of urban policies.

Urban planning has been advocated as '*critical thinking* about *space and place* as the basis for *action or intervention*' (RTPI 2004). Urban planning is argued to ground knowledge in sociospatial processes, and cement critical thinking about these processes (Friedmann 1998). Making contributions about spatial interrelationships is, however, common to many geographic disciplines. What is often, if not exclusively, characteristic of planners is specifically seeking to connect sociospatial knowledge to forms of action in order to bring about change in the public domain (Davoudi & Pendlebury 2010; Friedmann 1987). It is this interventionist nature of planning which underlines its normative dimension and brings the issues of values to the foreground.

Urban economics also tackles urban questions, using economic theory and applied economic methods to study cities and their development. In an urban economic model, individuals and firms are assumed to behave rationally, choosing locations based on costs and benefits. Urban economic models assume that markets – in which agents interact – are in spatial equilibrium, where prices adjust to ensure that supply equals demand for each location. Such models are then used to predict how urban areas function, and in many cases reveal what individuals consider valuable within their cities. Data on factors such as house prices, wages and firm performance[2] are analysed to understand differences in urban economic performance and the potential effects of urban policy. Housing and land markets are key as they reveal differences across

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[1] Today, more than 50% of the world's population live in urban areas (United Nations 2014). This share is expected to reach 70% globally by 2050, with 86% in OECD countries (OECD 2010) and more than 90% of new urbanities located in low-income countries (United Nations Population Fund 2007).

[2] These are the prices of the factors of land production and labour

locations. Real wages inversely mirror amenities, while house prices capture amenity differences at local level after controlling for housing quality and wages. Locations with high levels of amenities, such as transport access, good schools or access to green spaces, will thus have high prices.

Urban planning and urban economics frequently seem to be at odds. Planners often think economists are too narrowly focused on productive cities and prices, while economists often consider planners attach too little importance to real world markets and focus too narrowly on their contexts of study.[3] The role of planners is tied to adding value to the particulars of place, and although place matters to urban economists, it is seldom their area of focus. Divisions are also increasingly marked by the adoption of qualitative analytical methods by urban planners and quantitative statistical approaches by urban economists, often argued as antagonistic by one discipline or the other.[4] These divisions are more widely present in wider geography, and have stimulated debate on the epistemological values geography should achieve (Overman 2004; Brooks et al. 2012; Rodríguez-Pose 2001). Such methodological and epistemological debate is not unique to geography. Disciplines such as political science have experienced long-running debates about the trade-offs between statistical 'large-N' analyses and in-depth 'small-N' approaches (Lieberman 2005).

Brooks et al.'s (2012) *Handbook of urban economics and planning* attempted to underscore the fruitfulness and importance of opening pathways of communication between economists and planners. This thesis contributes to this call. Although these disciplines differ in their approach in terms of methods and sometimes in terms of philosophy, this thesis supports the consideration of their mutual interests as their objectives are in many ways complementary. While economists often talk about cause and effect (*what is* – positive economics), many applied urban economists also express normative judgements following their evaluations in an effort to advance policy (*what ought to be* – normative economics). The latter ties into planning's normative dimension, supporting spatial policies or urban interventions to better urban living. Both urban economists and planners thus work towards an improved implementation of urban policy and both are often interested in socio-economic and environmental

[3] Although it must be noted that planning education has made considerable efforts to incorporate understanding of economic trends in city growth and sharper appraisal of competitive urban land uses, starting with Harvard in the 1930s (Davoudi & Pendlebury 2010).
[4] One of the greatest challenges within my PhD 'process' has been understanding both disciplines and arguing for their compatibility, firstly to myself, and then to colleagues.

goals. While urban economists assess general patterns (large-N) and the essential economic logic of a situation, planners are usually concerned with place-making issues in one or a few case-studies (small-N). Planning can therefore offer an important substantive contribution to urban economics analysis, while urban economics is necessary to provide a reality check on the claims planners make about the overall effects of urban policies and development.

In an effort to help overcome methodological and epistemological deadlocks, this thesis also calls for the mixed use of both quantitative and qualitative research methods. While the chapters within it are distinct works, they use quantitative, qualitative and mixed methods to contribute to the understanding of how planning policies and urban development affect specific outcomes in space. This thesis rejects the view that qualitative and quantitative research techniques are incompatible and instead follows methodological pluralism – that is, the use of different techniques to uncover different facets of the same social phenomenon (Johnson et al. 2007; Greene 2007; Elwood 2010).[5] The interdisciplinary approach of this work presents an opportunity to help achieve a more complete picture, since it incorporates elements that might not be taken into account if one were to adopt a conceptual lens which relied entirely on one discipline. It predominantly traverses the disciplines of urban planning and urban economics but is also tied to other fields of study, including planning law, development studies, conservation studies and environmental psychology.

The remainder of the introduction is organized as follows. Section 1.1 presents an overview of the thesis. Section 1.2 discusses the methods and data used in the thesis papers. Section 1.3 presents the common themes running through the different papers while sections 1.4 and 1.5 give an overview of limitations and policy implications.

[5] Despite the significant divisions described, Elwood (2010) argues how social scientists have been conducting mixed-methods research for decades.

1.1 Overview of Thesis

1.1.1 Structure of the thesis

This thesis consists of four independent papers.

Paper I: The politics of conservation planning: a comparative study of urban heritage making

Paper II: Conservation planning and informal institutions: heterogenous patterns in Italian cities

Paper III: The economic effects of density: a synthesis

Paper IV: A permanent (re)construction site? Changing urban form and resident value of urban amenities

Although the chapters are distinct works, they are related through their focus on urban policy and their aim of contributing to the understanding of how planning policies and urban development affect specific outcomes in space. The papers investigate urban policy from a legislative standpoint, through meta-analytic research, and test theoretical predictions in empirical settings by examining data on individuals and spatial market prices. The chapters can be divided into two distinct parts. The first part comprises two studies on conservation planning, while the second part encompasses two further chapters focusing on the effects of two distinctly urban occurrences: economic and morphological densification. In the following I provide brief summaries of each paper's context, contribution, method and results.

Part I

Paper I: The politics of conservation planning: a comparative study of urban heritage making

My first paper, co-authored with Nancy Holman and currently under review in *Progress in Planning*, investigates the complexities at play between conservation planning structures, their applications and how these vary between contexts. Urban heritage is the category of heritage that most directly concerns the environment of every individual. Conservation, or the integration of the built historic environment, is typically viewed as a desirable undertaking in city planning, and policies to this effect are established as an integral element of planning in many countries. This paper asks: how does conservation compare between planning systems of the Global North and Global South and what does this suggest about heritage value?

Although some studies have compared conservation planning in neighbouring countries, as far as we are aware a comparative survey of the progress of conservation planning systems has not to date been undertaken. Based on a survey of conservation planning systems in five countries (England, France, Italy, Brazil and Lebanon) and focusing on five city case studies (London, Paris, Milan, Rio-de-Janeiro and Beirut), this paper contributes to the literature by examining the position of conservation within planning in current urban policy in different contexts. The paper analyses how different planning systems have adopted and integrated definitions of urban heritage and, accordingly, how zoning techniques, governance levels and planning constraints have resulted in quite varied conservation planning outcomes, not only between the North and South but between European examples alone. In examining contexts where the desirability of conserving and enhancing the historic environment is overlooked, overturned or simply ignored, despite the existence of conservation policies, this paper also explores the limitations of regulation in pinning down heritage values (Ashworth & Tunbridge 1996; Lowenthal 1985).

This paper takes an interpretive approach, addressing the question through textual analysis of official documents, semi-structured in-depth interviews and mapping of both North and South cities (Hamin 2003; Bevir & Rhodes 2006; Holman 2014). This method, following Bevir and Rhodes (2006, p. 89), was chosen in order to come to terms with complexity, as it rests on a philosophical analysis of meaning – value – in formalized actions – legislation. The paper limits itself to these formalized processes to facilitate an effective comparative exercise, bearing in mind that legislation is often known to follow some way behind public or societal attitudes (Larkham 1992, p. 96).

The paper shows that there is no simple conservation planning model that is particularly Northern or Southern. All of the cases considered began their journeys from similar points of departure, but each then proceeded in slightly different directions based on local contexts. This is perhaps not unexpected, but it lends further weight to studies challenging the concept of *patrimonialization* as a European ideal merely applied in colonial contexts (Choay 1992). This paper argues that the embedded histories of urbanism, planning regulation and the invention of a conceptualization of heritage develop both separately and in parallel in each nation state. Whether the practice of urban planning links itself to the destruction of urban heritage ensembles or attempts to preserve them, the concept of heritage emerges as a factor in opposition to prevailing urban development models.

Paper II: The politics of conservation planning: a comparative study of urban heritage making

Following from Paper I, the second paper investigates urban heritage value taking a different methodological approach, although continuing thematically by analysing how conservation planning plays out in practice. Conservation planning solves an economic coordination problem by internalizing positive externalities i.e. preserving urban heritage. Non-compliance compromises conservation effects, but little is known about how much harm it actually does.

This paper exploits a novel data set of property prices for 55 Italian cities. Despite the stringent planning regulations in this context, the conditions of the urban environment vary widely throughout the country, including within protected areas. I concentrate on property prices as an outcome measure of economic value, following a long tradition of research using hedonic methods to estimate capitalization effects of a wide range of local public goods or policies (Cellini et al. 2010; Eriksen & Rosenthal 2010; Gibbons & Machin 2008; Gibbons et al. 2013). *Abusivism* (AB) – illegal or informal building – is used as a measure of non-compliance. AB is widespread in Italy to such an extent that it has assumed social and political importance (Biffi, Ciafani, Dodaro & Muroni 2014; Trentini 2016), and can be described as a type of informal institution, given that it goes beyond simply ad hoc informal building behaviour, and refers to practices which are widely followed and embedded within Italian societies.

To estimate the effects of non-compliance on the hypothesized capitalization effects of conservation, this paper uses a two-step econometric strategy. The first step explores the variation in price premiums across 933 Landscape Areas (LAs) and 236 Historic Centres (HCs) using a boundary discontinuity design. The second step uses an instrumental strategy to substantiate estimates and confirm that, at least partially, AB rates reduce heritage price premiums. In line with model predictions, heterogeneous patterns in premiums are found across Italian cities, with trends according to region and geographical location. By examining discontinuities at the boundary, I find a capitalization effect of about 6.5% (€160 extra per square metre) for LAs, and an estimated average premium of 3.5% (€86 extra per square metre) for HCs. The second step of the analysis reveals that a 1% increase in AB is associated with an expected depreciation effect of 0.64 percentage points in HC price premiums, while a 1% increase in AB is associated with an expected depreciation effect of 0.14 percentage points in LA price premiums.

The results thus suggest that, at least partially, places with higher AB are less compliant with conservation planning and consequently experience lower external benefits. The important implication from these findings is that planning policies capable of solving the free-market coordination problem related to architectural externalities are undermined in the Italian context by illegal practices. This underlines the necessity to either re-address policies limiting AB or, and perhaps jointly, to remove some of the administrative burdens ('red tape') within conservation areas.

Part II

The following two papers in the thesis address urban densification. While the third paper takes a large-scale approach in examining the effects of population and economic density on 16 distinct outcome variables across multiple countries, the fourth paper focuses on a single case study to assess how living in areas with different rates of morphological densification affects the value residents place on their urban environment. Although these two papers have different foci and thematic approaches, they both aim towards a better understanding of possible outcomes of densification. Density is closely tied to the 'compact city' paradigm, which originates from the critique of modernist planning approaches (Jacobs 1961), supporting both density and mixed use in line with a European discourse of inner-city spaces for a more efficient use of urban resources (Dantzig & Saatay 1973). The concept supports the idea of a city that is distinctively urban in general terms of density, but also in more specific terms such as a contiguous building structure, interconnected streets, mixed land uses, and the way people travel within the city. As discussed in Ahlfeldt & Pietrostefani (2017),[6] it is characterized by economic density, morphological density and mixed use. While the third paper of this thesis focuses on economic density, the fourth and last paper discusses outcomes of morphological density when it is not integrated in wider sustainable city objectives (World Bank 2010; OECD 2010).

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[6] Ahlfeldt & Pietrostefani (2017) is a companion paper to Paper III of this thesis.

Paper III: The economic effects of density: a synthesis

The third paper, co-authored with Gabriel Ahlfeldt and recently published in the *Journal of Urban Economics,* synthesizes the state of knowledge on the economic effects of density. The first contribution of this paper is to provide a unique summary of the quantitative literature on the economic effects of density. We consider 347 estimates from 180 studies of density elasticities of a broad range of outcomes ranging from wages, innovation, rents, various amenities, the cost of providing public services, transport- and environment-related outcomes to health and well-being. More than 100 of these estimates have not been previously published and have been provided by authors on request or inferred from published results in auxiliary analyses. We also attempt to identify differences in density elasticities between non-high-income and high-income countries.

The paper then contributes original estimates of density elasticities of 16 distinct outcome variables that belong to categories where the evidence base is thin, inconsistent or non-existent. This analysis uses data from the OECD functional urban area and regional statistics database. Along with a critical discussion of the quality and quantity of the evidence base, we then present a set of recommended elasticities. Our aim is to provide a compact and accessible comparison of density effects across categories and, where possible, we acknowledge cross-country differences. However, the quality and quantity of the evidence base are highly heterogeneous, and the baseline results are best understood as referring to high-income countries.

Applying the recommended elasticity estimates to a scenario that roughly corresponds to an average high-income city, we find that in per-capita present value terms (at a 5% discount rate) a 1% increase in density implies an increase in wage and rent of $280 and $347 respectively. The decrease in real wage net of taxes of $156 is partially compensated for by an aggregate amenity effect of $100 and there is a positive external welfare effect of $60. We therefore conclude that density seems to be a net amenity; however, although densification policies may be welfare enhancing, the distributional effects may be regressive, especially if residents are immobile and housing supply is inelastic.

Paper IV: A permanent (re)construction site? Changing urban form and resident value of urban amenities

Through the urban renewal process driven by a well-resourced Lebanese diaspora and foreign investment, Beirut has undergone conspicuous morphological densification, characterized by parcel aggregation and increasing building height. The state and planning agencies have contributed to these transformations, involving deliberate temporary suspensions of the law and contributing to deregulated and unplanned urban development. As argued by Fawaz (2017), although 'exceptions' cannot amount to a lack of planning, they are one of Beirut's principal planning strategies, originating in continuities between the realms of the legal and the illegal, given the entanglement of the political elite and the real-estate industry. These dynamics have dramatically altered the city's landscape, housing stock, and people-space relations (Gebara et al. 2016).

The fourth paper of this thesis asks whether morphological densification affects the values residents attach to their urban environments using Beirut as a case study. Although recent work has considerably furthered our understanding of deregulated planning in Beirut (Krijnen & Fawaz 2010; Fawaz 2017; Bou Akar 2018; Krijnen 2010), little is known of the preferences of local residents in regard to the urban development process. The paper focuses on both physical and immaterial amenities, as morphological change may influence both objective (visual, aesthetic) and subjective (social or symbolic) dimensions of neighbourhood satisfaction (Young et al. 2004). Specifically, this paper investigates how changing urban form affects how residents value architectural amenities, open space (specifically sidewalks) and neighbourhood belonging.

This study uses a novel data set and a mixed-methods strategy of qualitative and quantitative research techniques. Mixed methods were chosen as a triangulation methodology (Greene et al. 1989; Greene 2007; Johnson et al. 2007) to obtain a comprehensive appreciation of the complex relationship between changing urban form and how residents value their urban environments in Beirut. In line with predictions, we find contradictions between resident satisfaction with the city's morphological evolution and their preferences in preserving more traditional, vernacular forms of architecture, or in stopping excessive building. I observe higher willingness to pay to stop changes in urban form in areas that have undergone less building change, but much higher willingness to pay to improve open spaces, which suggests that spaces with both infrastructural and social uses present a higher local value. I also find no evidence that morphological change affects neighbourhood belonging, which instead is positively correlated with years lived in a given area, and with locations showcasing better building conditions, confirming a role for the built environment.

1.2 Methods and Data

1.2.1 Methodology

Empirical research has the potential to inform policymakers, public officials, private sector producers, community-based organizations and other actors involved in urban transformations. This can be done in various ways: describing problems, comparing policy definitions and outcomes, evaluating costs and benefits or revealing unintended effects of urban changes. Different research methodologies have been shown to be more adept at tackling different approaches.

Both qualitative and quantitative researchers have to overcome a number of different barriers to achieve their objectives. Qualitative methodologies often face difficulties in gaining access to relevant stakeholders or actors, developing rapport, maintaining boundaries, following ethical practices, and then leaving the field (Clifford et al. 2010; Dickson-Swift et al. 2007). Quantitative methodologies face challenges such as overcoming identification concerns and sourcing data at a small enough geographical level as well as generating findings which are relevant beyond a specific study (Gibbons et al. 2014). An interdisciplinary approach, using the contributions of both planners and urban economists to shed light on different aspects of urban policy, presents an opportunity to help create a more complete picture by incorporating elements usually ignored by purely quantitative or qualitative methodologies. The papers presented in this thesis not only use different methods to understand how planning policies and urban development affect specific outcomes in space, but attempt to bridge the qualitative-quantitative 'divide' by adopting this multiple-methods approach to urban research (Philip 1998).

An eclectic approach certainly entails challenges. Theoretical and terminological variation between planning and urban economics often hampers the discussion of research results. As argued by Brooks (2012), planners and urban economists often do not realize broad overlaps in their disciplines 'for a lack of common foundation in microeconomics' but more generally because of differences in language and vocabulary.[7] The different underlying theories of these disciplines result in diverging views of the relationships between theory and empirical evidence, leading to different approaches in research design. Differences in methodological approaches can make it difficult to interpret empirical results in a way that is understood and accepted across disciplines. Moreover, specific concepts are often associated with diverse meanings according to discipline – potentially undermining the clarity of an eclectic framework. While acknowledging these challenges, the decision to adopt a multidisciplinary approach for this thesis is grounded in the conviction that the benefits associated with the added insights gained from several disciplines outweigh the potential 'costs'.

Following McKendrick (1996), this thesis follows methodological pluralism by adopting both *mixed* and *multiple* methods*.* Mixed methods refer to a study where two or more methods are used to address a research question 'at the same stage in the research process, in the same place, and with the same research subjects' (McKendrick 1996). Mixed methods are adopted in Papers I, III and IV in different ways. Multiple methods are understood as a number of complementary methods employed to address different facets of a research question, or to address the same question from different perspectives. In this thesis, Papers I and II address different facets of related research questions addressing conservation planning, while Paper IV touches on some of the problematics brought forth in the second part of Paper I. Papers III and IV, moreover, address different facets of related research problems.

The first and second papers are rooted in the understanding of the outcomes of conservation planning. The first paper uses the analysis of legal texts, elite semi-structured interviews and visual analysis of geolocalized data to survey conservation planning systems in five countries. The analysis of case studies, where in some cases conserving the historic environment was undermined by urban actors, motivated the research question of the second paper: to what extent does non-compliance undermine conservation effects? In order to accurately identify the overall patterns of such a question, the second paper takes advantage of an econometric strategy carried out on a data set covering 55 Italian cities between 2011 and 2018. A complete understanding of the Italian context, leading to an acceptable identification strategy of the second paper would not have been possible, however, without the contextual nuance gained from the interviews of the first paper (Brooks et al. 2012). The third paper relies on

[7] Brooks (2012) advocates the understanding of microeconomic foundations as a key step for planners to gain insights that can lead to effective policies.

multiple research methods including meta-analytic analysis, regression analysis and monetary evaluation. Although the paper's strategies may appeal more to urban economists than to planners, the outcomes of density analysed in this paper include both traditional economic areas of interest, such as productivity and innovation, and areas closer to planners' interests, such as green spaces and well-being. This paper also presents the overall effects not just in terms of the magnitude of their net benefit, but also in terms of the distribution of the losses, in many ways following Brooks et al.'s (2012) call for such approaches. Finally, the fourth paper features a mixed methodology. It draws on the regression analysis of a household survey and, in the absence of panel or other cross-section comparisons with the variables of interest to control for endogeneity, the triangulation of quantitative and qualitative data is used to complement, validate and develop the results obtained from that analysis (Lieberman 2005; Greene 2007). In fact, given the limitation of data availability in Beirut, the fourth paper partly involved making use of a single method of data collection to generate both quantitative and qualitative data (Philip 1998).

1.2.2 Data and context

Another contribution made by this thesis has been to collect, construct and bring forward new data. The resulting data sets represent a considerable research effort that not only brings forward the findings of these papers but provides valuable new sources of information for future research. The papers in this thesis, while taking different data-collection approaches, attempt to bring fresh evidence to policy-relevant issues in planning by generating new data sets for different contexts. Indeed, rather than focusing on one specific place, this PhD thesis combines empirical analyses drawing on data from both Global North and South case studies.

Within the scope of the first paper, interviews were conducted and geolocalized data (shapefiles) was collected or created according to availability for five cities (London, Paris, Milan, Rio-de-Janeiro and Beirut) for visual analysis. Paper II collected over 60,000 geolocalized property prices with a wide range of attributes through online scraping techniques from *Immobiliare.it,* the largest online portal for real-estate services in Italy. Geolocalized policy boundaries and a long list of locational controls were also obtained from Italian ministries, national geoportals and open street map and, in cases where they were unavailable, drawn on ArcGIS. Paper III collates an evidence base of density elasticity estimates from 180 studies, resulting in 347 estimates. To further the analysis, numbers of citations, adjusted for the years since publication, were also collected for each study in order to generate a citation index. For the final paper, a household survey was conducted in Beirut (Lebanon), targeting 4,900 households and resulting in over 1,000 household observations. Interviews and open-ended questions were also conducted for this last paper.

By using data sets from a variety of contexts, this thesis seeks to uncover complementary insights into the potential effects of urban policy in a world characterized by interdependencies. By covering different parts of the world, this thesis aims to broaden understanding of its core themes (discussed in more detail below). Although Papers I and III present comparative elements, the design of the thesis as a whole does not follow the structure of a comparative study. Accordingly, the approach chosen here does not aim to provide a basis for an in-depth comparison of the role of a specific factor in different contexts. Instead, this thesis examines two main topics, conservation planning and densification, using different data sets and methodologies. By doing so, it hopes to provide a more comprehensive view of the challenges and dynamics to be considered by scholars and policymakers when addressing these topics.

A related question concerns the weight attributed to contextual factors in this thesis. In geography and related disciplines, there is a debate about the extent to which an emphasis on universalizing logics, or in-depth understanding of context-specific distinctions, should dominate the conduct of research. The papers in this thesis are characterized by scepticism towards both extremes. Although this thesis underlines the importance of context-specific factors, rather than assuming 'it is all different everywhere', it assumes that findings based on data from a city or a set of cities can be carefully used to improve our understanding of situations in places with similar characteristics, e.g. regarding recent economic history, urban policy evolution, real-estate markets. The degree of transferability of paper findings depends on the precise research question and the type of empirical finding under consideration. The papers in this thesis discuss context in order to understand policy differences, further identification strategies and understand urban residents' reactions to urban transformations. This is most easily witnessed in Papers II and IV as they present applied presentations of local context, both papers concentrating on precise locations. Papers I and III acknowledge contextual importance in different ways. The first paper utilizes a comparative policy approach, following a line of research that critiques planning that seeks out policy models to apply interchangeably in different contexts. Instead, the first paper pursues a comparative urbanism of *all* urban national contexts as distinct units, explaining similarities and differences between them. The third paper, although recommending density elasticity estimates across multiple outcome categories, cautions against using estimates beyond high-income countries and presents some geographical heterogeneity in estimates when possible. The nuanced discussion of the results in the third paper is meant to help the reader assess the extent to which the findings may have implications for specific places.

1.3 Themes and Overall Contributions

While the papers in this thesis are independent and should be read as such, to varying degrees, cross-cutting themes run through them. The themes correspond to the areas to which this thesis seeks to make a contribution.

1.3.1 Shaping cities: outcomes of urban planning

Planning can take different forms and appear in many different ways (Rydin 2011). Urban planning, as both a technical and a political process (URBAN@IT 2018), helps shape the cities we live in both in conjunction and in opposition to free urban markets. Planning policy consequently affects a long list of economic, physical and subjective outcomes in urban life.

The papers address this broad theme in different ways. Paper III presents the effects of density on a large range of outcomes: productivity, innovation, value of space, job accessibility, service access, efficiency of public services, social equity, safety, open space, pollution reduction, energy efficiency, traffic flow, modal choice, health and well-being. The paper appeals to different disciplines in the understanding of how cities are shaped, from urban economics in its consideration of how urban development increases productivity (Henderson 2003; Rosenthal & Strange 2001)[8] to environmental psychology through its examination of the subjective effects of density on outcomes such as well-being (Young et al. 2004). Paper I looks at the physical outcomes of conservation planning, analysing how similar policies can have very different outcomes in space, relating back to planning's parent profession of architecture and design, while Paper II examines the capitalization effects of conservation planning through house prices, closely tied to urban economic studies investigating policy effects on the value of usable space (Alonso-Mills-Muth model; Rosen-Roback). Paper IV, on the other hand, looks at both physical and subjective outcomes of deregulated planning by focusing on

[8] Going back to the theory of knowledge spill-overs (Marshall 1920).

residents' stated preferences, tying into emphases on the involvement of communities and stakeholders for a better understanding of planning outcomes (Rydin 2011).

1.3.2 Undermining planning policy?

Regulation and the market are frequently described as mutually exclusive realities where, as described by Ahlfeldt and Holman (2015), 'an increase in performance of one necessarily implies an underperformance of the other'. However, in many contexts, the interplay of regulation, markets and other forces are far more complex. Informal or illegal building practices occur in conjunction with more generalized urban trends. Three papers in this thesis directly or indirectly address ways in which planning policy is undermined by different forms of urban illegality.

The second paper looks at *abusivism* – illegal building and construction – and the extent to which it undermines positive heritage externalities preserved by conservation planning. This study thus adresses on how non-state actors, residents or local tactical groups – from landlords to *mafiosi* – can affect planning policy outcomes. The first and last papers of this thesis, on the other hand, address contexts where state policies and market forces converge to make profit-driven real estate a pillar of the neoliberal economy. In these cases, state authorities and planning agencies are often deliberately involved in the production of illegality (Fawaz 2017; Roy 2005), contributing to deregulated urban development and often leading to negative externalities, such as the exclusion of local stakeholders and communities. In investigating whether rates of morphological change affect the value residents place on urban environments, the last paper accounts for confidence in local government given the recognized overlap between real-estate and political practices in the Lebanese context. This thesis thereby contributes to different understandings of urban illegalities, both when they attempt to evade stringent planning policies and when they are embedded in the planning process.

1.3.3 Resident value

In tackling issues of space and place, planners and urban geographers often bring issues of local value to the fore (Davoudi & Pendlebury 2010; Friedmann 1998). Planning is never far from a discussion of how to balance the many different impacts of new development, ensuring that new development meets the needs and expectations of local communities (Rydin 2013; Rydin 2011). This thesis explores different aspects of local value, both by studying the limitations of regulation and planning policy in pinning down local values (Paper I) and by assessing how urban environments are valued locally (Papers II, III and IV).

The first paper compares planning systems of the North and South to discuss what they suggest about heritage value. It navigates the complex relationships between regulations and values, starting from the argument that regulation is a way of pinning down local values (Holman et al. 2018; Bevir et al. 2003). The second paper adopts a revealed preferences methodology grounded in urban economic theory which shows that, at the local level, price differences reveal amenity differences, in this case preferences for heritage areas. In evaluating a wide range of outcomes, and revealing which density outcomes are positive, the third paper also indirectly addresses value. In light of the absence of price micro-data for Lebanon, the final paper uses stated preferences to investigate how the value attached by residents to their urban environments changes according to rates of morphological change.

1.4 Limitations and Extensions to the Research

As with all research, there is a series of limitations to this thesis, which offer a number of areas for future explorations. The limits of the first paper are closely tied to the limitations of its scope. Indeed the paper does not address civil society as a part of the governance system directly, in order to make the cases more easily comparable. This presents a limitation especially in contexts where state governance is lacking and is therefore often taken over by alternative entities such as community-based or non-governmental organizations. A possible extension to this research would be to consider the link between heritage value and non-formalized planning systems in future investigations. The third paper presents different challenges, including the difficulty of separating the effects of density from unobserved factors that determine density. Moreover, compared to wages and modal choice, the evidence base for the other density outcomes is generally underdeveloped. While high-quality contributions are available for some outcome categories, the nature of the evidence is at best preliminary for others, warranting a cautious interpretation of certain elasticity estimates but also presenting opportunities for further research into the effects of density on urban green, income inequality, health and well-being.

A word of caution is also due regarding the difficulty of delineating urban economies and other trends in empirical analyses. Various literatures have underlined the conceptual and empirical challenges of the discretization of continuous space

(Overman 2010; Murphy 1991). In an ideal world, empirical researchers would have access to data that allows them to track variables across time and space indefinitely, thus being able to observe key variables (e.g. house prices) at multiple spatial scales and different points in time. This would allow for far more accurate identification of spatial boundaries, proving especially useful in quantitative strategies. In practice, however, the availability of key variables is limited in many countries.

Although this thesis has made considerable research efforts to develop new data sets as illustrated in section 1.2.2, it was conditioned by time and resources constraints, as is most research. For example, although the spatial precision of the constructed hedonic Italian data set allowed for the boundary discontinuity design used in Paper II, the time-period constraint limited the scope of the study which was not able to disentangle policy and heritage effects as done in Ahlfeldt & Holman (2017). However, the constructed data set presents opportunities for the evaluation of other recent urban policies in the Italian context. Moreover, although the household survey data collected in two Beirut neighbourhoods only allowed for cross-section descriptive analysis in Paper IV in regard to questions of urban value of urban amenities, the survey also replicated questions that had been run in the same areas regarding confidence in government and sociopolitical activism. The data collected will thus be used beyond the work within this thesis towards other studies.

1.5 Policy Implications

This thesis has shed light on different aspects of urban policy by exploring four research questions related to conservation planning and urban densification in both Global North and Global South countries. Each of the findings of this thesis has implications for policymakers. While sensitivity to place-specific factors is important, the policy relevance of the empirical results presented in the second and fourth papers go beyond the specific context discussed in the individual papers. Without attempting to identify universally applicable regularities, one can carefully consider potential implications with respect to places which share similar contextual characteristics. For example, the empirical analysis of the Italian data (Paper II) would be relevant to policymakers in emerging economies that are experiencing similar non-compliance trends with spatial policies, whether related to conservation policy or other stringent urban policies. Similarly, the empirical analysis of the Lebanese data (Paper IV) would be relevant to both policymakers and non-state actors in other deregulated planning contexts where unrestrained morphological densification may be resulting in negative externalities for its residents of origin.

Although using very different methodologies, the first and third papers' multi-contextual approaches aim to make it easy for policymakers to interpret the relevant findings. This is an area this thesis seeks to improve on, to better inform policy making. When the ultimate scope of the first paper was explained to interviewees, many indicated that the final comparative output would be useful to inform the limits and advantages of their own conservation planning practices. Although the third paper finds that density seems to be a net amenity associated with positive external welfare effects in average high-income cities, it also cautions that densification policies may not benefit everyone. Renters may be net losers because of rent effects that exceed amenity benefits. Failure to account for these unintended effects could overstate welfare estimates. An insight from these analyses is that policies often have unintended consequences, benefitting certain groups at the expense of others or achieving policy objectives by incurring some costs. Moreover, by revealing assumptions and limits of planning systems, Papers I and III support the formulation of new lines of inquiry and more situated accounts, ultimately encouraging systems to learn from one another.

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Paper I

2 The politics of conservation planning: a comparative study of urban heritage making

2.1 Introduction

> *'Parmi le fonds immense et hétérogène du patrimoine historique, j'ai choisi comme catégorie exemplaire celle qui concerne le plus directement le cadre de vie de tous et de chacun, le patrimoine bâti. On eût dit hier les monuments historiques, mais les deux expressions ne sont plus synonymes'.* Choay (1988, 10)[9]

Why do we value urban heritage – the more everyday historic environment that makes up parts of our cities? As this quote from Choay (1988) reflects it is precisely this type of space, which most directly impacts the lives of urban dwellers. Historic monuments and single buildings have their importance, but it is these more quotidian areas of cities, which permeate and help to create unique senses of place and identity. A city's physical character, therefore, is at the genesis of place-based identity, making conservation a rationale often integrated into housing and local economic development strategies (Bandarin, 2015; Licciardi & Amirtahmasebi, 2012; Listokin, Listokin, & Lahr, 1998). Conservation or the integration of the built historic environment in city planning is then, typically viewed as a desirable undertaking, and policies to this effect are established as an integral element of planning in most countries in the Global North (Larkham, 1992; Pendlebury, 2009). The act of conservation thus establishes value, however 'value' is defined, for, in theory, societies only attempt to conserve things to which they attach meaning and importance (Pendlebury, 2009; Smith, 2006).

The catch in our story, is that although the aesthetic and physical setting of cities has been identified as an amenity that contributes to quality of life, it is understandably secondary to other primary urban needs (Tweed & Sutherland, 2007; Watson, 2015). Conservation planning is often considered a luxury rather than a necessity. And although regulation has found its footing in many Southern contexts, urban heritage often

[9] "Within the immense and heterogeneous stock of historical heritage, I have chosen as the exemplary category that which is most directly concerned with the environment of each and every one, built heritage. Formerly, this category would have been defined as historical monuments, but the two expressions are no longer synonyms". Choay (1988, 10) (Translated by the authors)

remains an under-employed asset and the desirability of conserving and enhancing the historic environment is often overlooked, overturned or simply ignored (Ashworth & Tunbridge, 1996; Lowenthal, 1985). One of the gaps in our understanding of urban heritage value is thus tied to the complexities at play between land use policy structures, its applications and how these vary between contexts (Watt et al. 2014; Vernières 2011; Holman & Ahlfeldt 2015).

The objective of our paper is to untangle how conservation planning systems and the local value of urban heritage, whether civic or residential, are linked across several different planning contexts in the Global North and the Global South. We use this juxtaposition to challenge the idea that the broad categorisation of planning systems into models or types is particularly helpful in our understanding of policy as it is practiced. As regulation has been argued to be a way of enforcing collectively rational behaviour and pinning down local values (Ahlfeldt & Holman, 2015; Bevir, Rhodes, & Weller, 2003; Holman, Mossa, & Pani, 2018) we see this as a good way of examining how heritage is valued in these diverse contexts. Through 30 in-depth interviews and a comparative analysis of the ways in which heritage is regulated through the planning system in five case-study cities our paper will address our objective through an examination of three key questions. I) How has heritage been regulated in each city? II) How has this regulation evolved over time? III) How do planners interpret and enact this regulation? In so doing, we illustrate how various regulations and definitions of heritage reveal the way societies value the historic environment; how challenges to these values are addressed and in turn how localised and variegated these values are in practice.

2.1.1 Heritage, methods, meanings and approach

The term 'urban heritage' refers here to an 'immoveable' subset of cultural heritage assets which includes not only a part of a city's building stock but also comprises some of its landscapes and public spaces. This includes buildings of historical and architectural significance, harmonious urban fabric, areas such as parks, squares and other public or semi-public spaces that are considered historically or architecturally consequential (Cornu, Negri, Bady, & Leniaud, 2013; Licciardi & Amirtahmasebi, 2012; Tweed & Sutherland, 2007). This paper is not concerned either with 'moveable' heritage or archaeological complexes and sites that are not part of a city's urban fabric, as they are not as directly associated with everyday urban environments, and as a result are not as interlinked with question of placed based identity (Anderson & Gale, 1992; Ashworth & Tunbridge, 1996).

This paper will take an interpretive approach, addressing the question through textual analysis of official documents, semi-structured in-depth interviews and mapping of both North and South cities (Bevir & Rhodes, 2006; Hamin, 2003; Holman, 2014). This method, following Bevir and Rhodes (2006, 89), was chosen as it allows us to analyse the influence of regulation on value, given that 'people adopt beliefs and perform actions against the backdrop of an inherited tradition that influences them'. Traditions in this case are those formalised by conservation planning. The underlying challenge is that, in order to grasp how urban heritage is valued differently between countries, we must start by considering the legislative framework in order to gain a better understanding of how value emerges (Ahlfeldt & Holman, 2015; Holman et al., 2018; Pani, 2017).

Our approach was chosen in order to come to terms with complexity. It rests on a philosophical analysis of meaning – in our case value – in formalised actions: the actions being legislation or the written plan and its applications through government (Bevir & Rhodes, 2006; Thomas, 2005). An interpretative approach distinguishes itself through theoretical views, that allow us to make sense of the governance of conservation planning in various contexts (Bevir et al., 2003). The approach undercuts the idea that there is one set of tools to be used to understand governance: 'if governance is constructed differently, contingently, and continuously' a single tool for managing it would be ineffective (Bevir et al., 2003, 199). It will allow us to make some initial deductions on how conservation planning plays out in various cities, and to interpret what these actions suggest about value. This of course takes into account that our analysis of meanings can grasp meaning only as part of a wider web of beliefs – the other elements of urban planning – knowing that heritage is only a small portion of them (Bevir & Rhodes, 2006, 15).

The finer points of the analysis are rooted in a series of elite semi-structured in-depth interviews carried out between June 2016 and January 2017 in London, Paris, Milan, Beirut and Rio de Janeiro. The interviewees were selected by integrating purposive and chain sampling techniques. First, officers occupying positions at different levels of government in handling the designation and management of conservation areas were contacted. They were asked to provide further contacts, which enabled access to representatives at all levels of government (state, regional, local). The interview strategy thus included combined elements of maximal variation and snowball sampling of interviewees nested into the initial purposive sampling (Creswell, 2009; Flyvbjerg, 2006). Interviewees included architects, planners, politicians, and association or NGO members and activists. Interviewees were encouraged to discuss the appropriateness of conservation planning in their local contexts given other urban pressures. The final sample includes 30 interviews, approximately six for each analysed city. Interviews were kept to under one hour and recorded, and interviewees were guaranteed anonymity (Creswell, 2009). This design allowed the participants to express diverse ideas and allowed us to react and follow up on emerging viewpoints.

In Section 2, our paper proceeds with a review both of urban heritage definitions in the theoretical literature and its different values. A clear theoretical sense of the units of analysis is necessary before initiating comparative analysis. This section also rationalises the use of an interpretative approach to compare conservation planning systems and explains why it is appropriate in bridging the gap between the formalised – urban law – and the intrinsic – value. Given the complexity of these issues, the goal of this paper is not to provide a thorough description of each national conservation planning system (for which references will be provided), but to disentangle the elements, which will be most likely to influence how urban heritage is valued beyond its policy. Specific cities for each chosen case-study will be used to illustrate these elements. These have been arranged into two sections (3 and 4) based on their 'geographic' location (i.e. Global North and Global South) and their legal planning families with four Napoleonic cases (Paris, Milan, Beirut and Rio de Janeiro) and one British case (London) used as a control. We have chosen to present them in this way to better illustrate the complexities of conceptualising cities and their regulation and to illustrate that there is no simple binary or model of planning as variegation always exists.

Section 3 will compare conservation planning in England (London), France (Paris) and Italy (Milan), highlighting the differences between systems that have been considered best practice examples of conservation planning (Albrecht & Magrin, 2015; Cornu et al., 2013). Our chosen interpretative approach assists us in asking a series of sub-questions, which shed light on both the production of heritage values and the implementation of these values through policy. For example, i) how have theoretical and spatial constructs of urban heritage been translated into conservation planning systems? ii) And in turn, how then does local history and culture influence the evolution of these systems? iii) At what level of government is urban heritage designated and to what extent are locals consulted? iv) And, once implemented, to what extent are conservation policies binding? Our European case-studies will reveal that although conservation planning originates in associated legal families, it is influenced by planning cultures and national frameworks, specifically the opportunities and constraints of national planning systems, which vary greatly (Clarke, 2012; Keller, Koch, & Selle, 1996; Nadin & Stead, 2008). In practice, conservation planning thus assumes many different meanings, and seems to be more closely linked to context than the authors would originally have thought, even in neighbouring European settings (Friedmann, 2011; Newman & Thornley, 1996). Our survey of case-studies suggests that local urban heritage value differs widely according to geographical location and historical context (Albrecht & Magrin, 2015; Balbo, 2012; Batista & Macedo, 2010; Cornu et al., 2013). If this is so, value systems are linked to the evolution of policy, which reacts to both location and history.

The appreciation that heritage is historically and geographically constructed inevitably makes it a political enterprise and is at the origin of our title; this is reinforced in the consideration of specifically *urban* heritage, as the city is a political actor in itself (Palermo & Ponzini, 2010; Poulot, 2006). Thus, this historic and geographic construction establishes the *un-designation* or disregard for heritage as an equally political choice, which confirms that undesignated heritage is not necessarily without value. We build up these arguments in section 4, which details the conservation planning systems in two Southern contexts: Lebanon (Beirut) and Brazil (Rio de Janeiro).

Finally, we discuss our understanding of the place of conservation within planning in current urban policy and what our findings suggest about how urban heritage is valued throughout different contexts. In concluding, we bring out more of the parallels between our northern and southern case-studies, to suggest there is no simple model that is particularly Northern or Southern.

2.1.2 'Heritage creation' and its link to value

At least in the European context, the conversion of the material city into an object of historic knowledge was provoked by the extensive and rapid transformation of urban space after the industrial revolution. This radical moment in the evolution of cities provoked the investigation and interrogation of the 'old city' creating a context in which the 'monument', the 'listed building' or the 'building of architectural value' became the starting point for conservation efforts. Definitions, speed of development and political appetite naturally varied across countries but the underlining principle of the retention of a sense of cultural and architectural inheritance remains the same (Cornu et al., 2012; Cornu et al., 2013; Earl, 2015).

As heritage preservation became more embedded in policy it moved beyond the ambit of antiquaries and architects and took on a broader scope, encompassing building ensembles, public spaces such as streets, stairs, green and open spaces and even entire neighbourhoods (Bernier, Dormaels, & Le Fur, 2012; Choay, 1992; Habitat III, 2015; Tunbridge, 1984). In part, this was a recognition that it is the area and the setting that often creates social, cultural economic and environmental value in a city (Dalmas, Geronimi, Noël, & Tsang King Sang, 2015; Larkham, 1992; Licciardi & Amirtahmasebi, 2012; Lowenthal, 1985; Pendlebury, 2009; Smith, 2006). This is because urban fabric often characterises an historic urban example, a unique population density, street pattern or other important urban morphological or cultural features (Tweed & Sutherland, 2007). This paper will analyse planning policy focussing on urban heritage areas (UHAs), given that urban landscapes, and as a result conservation areas, should not be treated as a mere context for individual monuments.

The question then turns to the identification of urban heritage, or 'heritage creation' as defined by Pendlebury (2009, 7). This typically results in a legal recognition or technical obligation to conserve urban heritage. As we shall see, the buildings, districts and other spaces designated by national, regional or local government will conceive spatial constructs in diverse ways. Some will be in line with the latest academic conceptualisations of urban heritage, while others will not. This will ultimately result in the diverse physical evolution of cities. The preservation of this stock includes stabilisation, rehabilitation, restoration, and other supportive activities, which vary greatly. In contexts where 'heritage creation' is effectively integrated into planning systems, conservation policy helps to underpin value by legally establishing protection for UHAs. It is therefore possible to unpick what is valued by the interpretation of policy documents.

Bearing in mind that legislation is known to follow some way behind public or societal attitudes (Larkham, 1992, 96), there is a broader conceptualisation of what is meant by the historic environment, which goes beyond what is designated by a governmental body. As noted by Rautenberg (2003), heritage specification is predicated on two processes; the first is founded in heritage legislation, which creates 'nationally legitimate' and 'legally binding' specifications with the second linked to socio-cultural factors emanating from what 'counts' as heritage to the population. For Rautenberg (2003), it is the social process of valuing that precedes the creation of legally binding designation. Therefore, before *designation* occurs, a form of *appropriation* materialises through actors such as non-governmental organisations (NGOs) and community based organisations (CBOs) in the planning policy process (Balbo 2014, 272). In certain

Southern contexts, these actors have increasingly filled the role of legislative agencies in light of a wide-range of government limitations. To facilitate an effective comparative exercise, however, this paper will limit itself to formalised processes, as it is within these moments of codification that societal preferences and values are formally underpinned.

We accept the limits of our study – it will not address civil society as a part of the governance system directly, in order to make the cases more easily comparable. We will, however, identify in which cases actors are more significant than others in terms of their formal and informal roles and powers (Minnery, Storey, & Setyono, 2012). As suggested by Balbo (2014, 282), we need to be aware in our reflection, of who is leading the governance of conservation within each of our reviewed planning systems. In cases where state governance is lacking, it may have been taken over by alternative entities.

The underlining factor is that urban heritage is an active process of identification (Smith, 2006). As this paper will show, although the starting point for conservation planning is the same in most case-studies presented, the evolution is perhaps not so surprisingly, quite different. This is natural as the process of identification is necessarily linked to cultural, political and economic principles, which affect the intrinsic values of urban heritage. If these principles change or evolve, as argued by Pendlebury (2009, 7) "… not only can heritage identification change but it can also be contested".[10] The process becomes more complex when you consider the multitude of factors linked to conservation planning. For example, who is actually identifying urban heritage? And how does this change how value is determined? Is it central government, local government or communities? Moreover, how is value justified? For example, although urban heritage was traditionally linked to cultural concerns, (Pendlebury, 2009) this has changed as culture has been overtaken by issues like economic development or even sustainability. Here we see the frame of heritage subtly mutate in order to take on the dominant concerns of the day so that it remains relevant and maintains a certain *gravitas* (Gayego, 2014).

As this paper looks at both Northern and Southern examples of conservation planning, it is particularly important to appreciate that urban heritage is also geographically and historically specific (Pendlebury, 2009; Poulot, 2006). Values will unavoidably vary according to local historical and geographical frameworks. Given the past dominance of the North in shaping planning theory and practice (Watson, 2015), a comparison with the

[10] By intrinsic values we mean all intangible values associated with a given urban heritage, whether they be cultural, historical, social, or environmental.

South can be useful in unpicking taken-for-granted assumptions about how planning addresses certain issues and re-questions differences between the North and South (McFarlane, 2010; Roy, 2009).

Cities of the South are often conceptualised as a less-developed, which frequently implies an underdevelopment of their regulatory and governance systems (Roy, 2009). Comparative analysis between the North and South has therefore often been a question of policy transfer – where the adaptation of a Northern model to a Southern context is assessed. This vision is stressed within a heritage discourse, where the notion of *patrimonialisation* is repeatedly said to be a European one (Choay, 1992). Although the notion was certainly born in Europe, it seems unfair to presuppose that every effort to embed heritage conservation in the planning regimes of Southern cities derives from a European notion of patrimonial consciousness and an attempt to adapt this to a non-European context. As discussed, 'heritage creation' is an *active* process. It may certainly start as an exogenous concept coming from colonial compulsions, but the development of heritage in the planning paradigm deserves the benefit of doubt when considering national policies (Hanna, 2010). Moreover, it will allow us to assess the adoption of economic and culturally specific planning tools for every given city through the same lens: a view supported by many (Dolowitz and Marsh 2000; James and Lodge 2003; Balbo 2014, 270).

As we shall see, because every example is different, one cannot even identify a specific 'Northern' model that would apply to every Northern example, as there will always be variegation. Therefore, if we are to examine Northern cases through this lens expecting variation there is no reason not to apply this logic to Southern cases as well. In fact by proceeding in this manner we may more easily form an iterative loop whereby Southern case studies might offer insights into the re-theorisation of planning in the North (McFarlane, 2010; Roy, 2011). The lens will also help us to avoid problems linked with post-colonial theorisation and explore new theoretical possibilities (McFarlane, 2010). Comparative thinking is a well-suited strategy for revealing the distinctiveness and limits of particular theoretical claims, and also for formulating new lines of inquiry (Clarke, 2012; McFarlane, 2010; Sanyal, 2005). Only through such comparisons can an understanding of the place of conservation within planning in current urban policy be teased out, in order to speculate on future progression and possible responses (Balbo 2014, 270; Minnery et al. 2012).

2.1.3 Market and non-market values

In our arguments above we have made the case that there are clear linkages between planning, heritage identification and certain intrinsic cultural values that help to bring about and further embed regulation. We have also alluded to the role that heritage may play in local economic development. In this section of the paper we move to consider urban heritage's use values. As has been well established, markets and regulation interact in cities (Holman and Ahlfeldt 2015; Balbo 2014), making it necessary to analyse the relationships between planning systems and urban heritage's use values as well as its non-use values.

2.1.3.1 Opposing values

Stemming from capital theory, Throsby (2006) describes heritage as an asset. The notions of 'capital' and 'heritage' present a number of similarities, they are both stocks of material assets, or of wealth, which can offer a source of income (Vernieres et al., 2012). Moreover, heritage as capital requires investment to maintain it (Ost, 2009). And conservation can, although this is not always the case, facilitate an investment process of allocating resources over time. For example, heritage buildings are re-used for contemporary activities or develop a framework for tourism. Investment, however, also highlights the opposition between economic and intrinsic values of heritage and how they evolve at different rates (Throsby, 2010; Vecco, 2007). If we consider only the economic value, through revenue extraction and tourism exploitation of heritage, its other values will decrease slowly every year as we can see from Figure 1 (left side); the more urban heritage is exploited, the greater the loss of its intrinsic values (Zouain, 2002, 221). The search for an equilibrium, that maximises economic contribution while respecting the patrimonial aspects – the junction point of the two curves – is thus necessary for a 'living' urban heritage, and in practice proves difficult. The paradox of urban heritage in the economy of any given city is that it is precisely the recognition intrinsic heritage values that allows for economic exploitation (Ost, 2009).[11]

In reality the relation between intrinsic and economic value of heritage is not as linear as depicted on the left side of Figure 1. Economists have elaborated more realistic theoretical relationships. As we see in Figure 1 (right side) after a subjective growth of intrinsic value, there is a corresponding rise in economic use-value[12] (accessibility, use of

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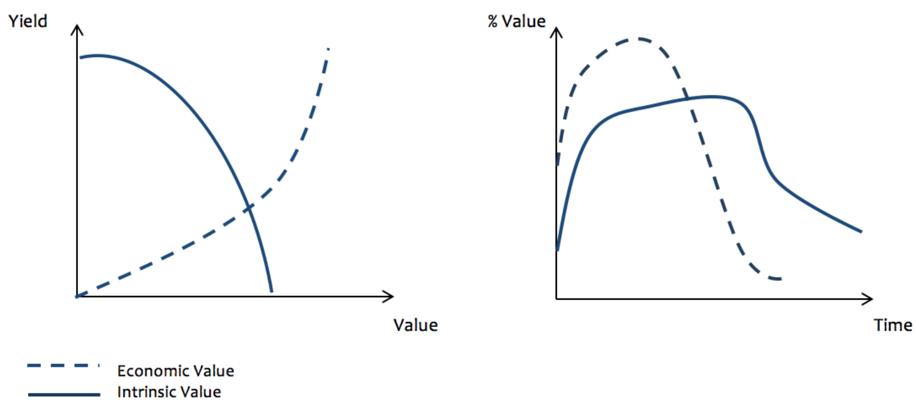
[11] Non-use values are a pre-requisite to use values in heritage cases; without non-use values market transactions would not be generated and additional economic value would not be created.

[12] Here we are speaking specifically of use value in its economic sense taken from environmental economics, rather than 'use-value' from the perspective of Marxian political economy.

the good) of urban heritage. The pursuit of this economic value begins to diminish the intrinsic value through its consumption (Zouain 2002) causing its shrinkage. Despite this the economic value is partially retained, as cities are still able to use structures even if the building stock loses its heritage related values. Given that conservation planning necessarily influences the determination of value through its identification process, it is important to consider these relationships. In fact, as we shall see, distinct conservation planning systems will give weight to one value over another determined in large part by societal desires. The stability of an urban ecosystem that integrates heritage into development decisions will therefore require a system of planning, be it state or non-state led, to manage this process.

Figure 1 Intrinsic and economic values

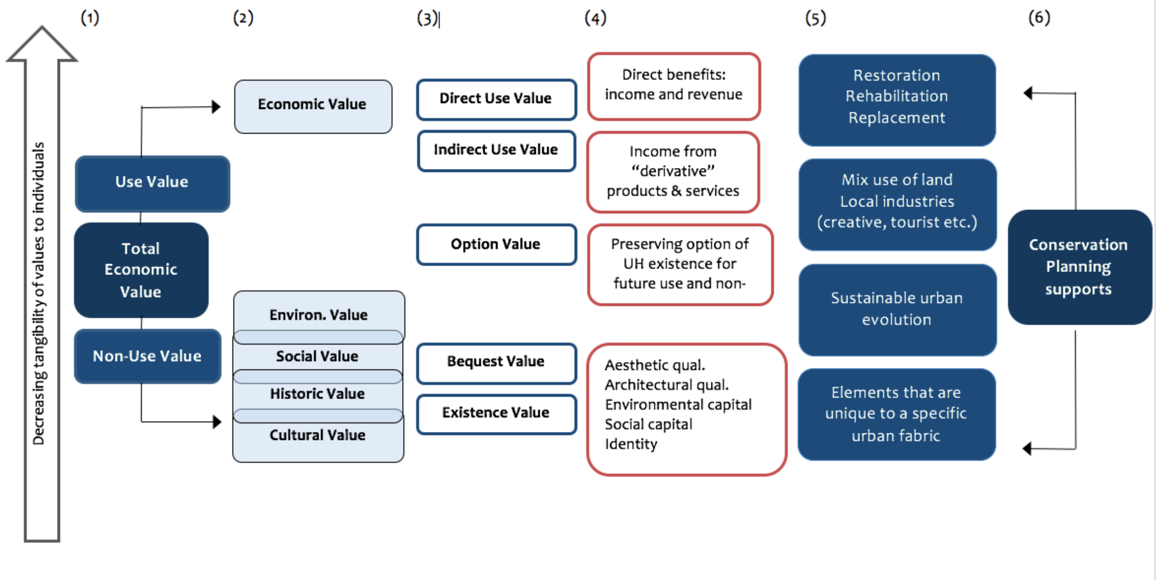


Note: Figure 1 is adapted from Zouain (2002)

2.1.3.2 Total Economic Value

Although we have established that urban heritage values sometimes work in opposition, we need to delimit their multidimensional character (Navrud & Ready, 2002; Vernieres et al., 2012). If we considered only the use-value of heritage buildings, their value would often be lower than that of new builds and the restoration of urban heritage would always be considered an expenditure of resources that could be better used in other ways (Provins et al., 2005; Tuan & Navrud, 2007). Urban heritage values are most simply understood through the well-known delineation of Total Economic Value (TEV) adapted from environmental economic theory where forms of value are monetary but also social, cultural/aesthetic, environmental and historical (Provins et al., 2005; Serageldin, 1999; Vernieres et al., 2012). Scholars have arranged TEV's diagram in several ways in its adaptation to heritage. Figure 2 is our attempt to delimit the TEV of urban heritage and link it to conservation planning. It naturally cannot delineate all the elements (column 5) that conservation planning could support that would influence urban heritage values, and has therefore summarised them in 4 overarching categories.

Figure 2 Total Economic Value



Note: Figure was altered and expanded by the authors following Vernières et al. (2012) and Serageldin (1999). UH refers to 'Urban Heritage' in this Figure.

As we can see from Figure 2, TEV considers both use and non-use values of urban heritage, appealing to the marketable and non-marketable sides of the equation (Pagiola, 1996). The use values of a heritage asset are the direct economic benefits that derive from it such as revenues or service transactions that increase in value because of their presence in heritage buildings (Vernieres et al., 2012). Lack of accommodation and supply of goods and services in an urban heritage environment can result in missed opportunities for induced growth, development and welfare. Non-use values, which we have divided between environmental, cultural, social and historic are often interlinked and refer to the assets people attach intrinsic socio-cultural values to (existence value), or that are closely associated with a way of life and its legacy (bequest value) (Serageldin, 1999; Smith, 2006). Existence value can be defined as the value placed upon the knowledge that a heritage asset exists. For a good to have existence value there are two necessary conditions: uniqueness and irreversibility. If these conditions are not present, then the good in question probably has a small or zero existence value.

As Figure 2 denotes, these values are often tied to identity, aesthetic or architectural qualities, social structures and community values but also to more general urban atmospheres that are typical of specific urban environments. Finally, option value is heritage's 'insurance policy', referring to a heritage asset's possible future value or the value of the information we can derive from it (OECD, 2007). It supposes that even if there is no imminent plan for a heritage asset, its destruction will result in an irreversible impact and loss; there is a high value associated with not making irreversible decisions. Although TEV considers the values of urban heritage holistically, it cannot reflect them all nor explain all the relationships. Especially as, all cases are different; certain examples of urban heritage may present greater social values while others greater cultural ones.

Conservation planning systems and how restrictive they are will vary according to which urban heritage values they stress. Few planning systems will enforce regulations preserving all values, for if they did we would be left with static historic cities not responding to contemporary urban needs. Indeed, the identification of all these values does not imply their use in practice (Vernieres et al., 2012, 72). TEV does, however, help to identify the different values that contribute to decision-making, these decisions are typically informed by conservation planning or the lack of such a system. For an overview of the relationship between TEV and decision-making see Provins et al. (2008). Conservation planning is made complex as each value ascribed to urban heritage is contested by a variety of stakeholders participating in the 'heritage creation' process. This appeals to one of the old tales of planning: given a reality, can planning powers intervene to shift the balance of forces toward social goals in the ongoing processes of urban restructuring and, if so, with what tools? (Friedmann 2008, 250; Palermo and Ponzini 2012). In order to bridge conservation planning with the construct of value, we must attempt to explain the complex way in which value links back to the planning paradigm.

2.2 Conservation planning in the North: England (London), France (Paris) and Italy (Milan)

2.2.1 European comparative planning

There is a long and rich history of comparative planning studies in Europe driven by propinquity, common historical antecedents (e.g. industrialisation and the Second World War) and more recently Europeanisation (Newman & Thornley, 1996; Watson, 2009). We are therefore limiting our comparison of conservation planning in the Global North as it relates to urban heritage in England, France and Italy using London, Paris and Milan to work through specific examples of how heritage is valued in these local contexts. However, this should not be read as an endorsement of a belief in any particular common approach to European planning for as Nadin and Stead (2008) remind us, each planning system has its own peculiar starting point borne out of specific societal conditions and social models. In part this is what makes comparative planning lead by an interpretive approach (Bevir & Rhodes, 2006) that takes value seriously (Ahlfeldt & Holman, 2015; Holman et al., 2018; Pani, 2017), such a fascinating window into how societies value particular aspects of physical and social infrastructure as it is these 'soft cultural' aspects of what is and is not valued that have for a large part produced differences in very similar planning systems (Ernste, 2012). Our goal therefore in this section is to build a picture of the various regulations and definitions of heritage in each urban context in order to reveal how societies value heritage, how they address challenges to these values and how systems, challenges and values are variegated across local contexts.

2.2.2 Heritage creation

2.2.2.1 Identification and the evolution of legislative systems

The state of conservation of buildings and spaces can reflect many things: level of income, education, social and behavioural habits, ultimately the stratification of factors that contribute to defining the unique characteristics of a community. All these aspects are, however, in most cases, heavily influenced by the planning systems that underline the realities of conservation in a given country. The market has not proven to be a reliable institution for allocating present and future consumption; urban heritage is therefore strongly dependent upon regulation to pin down value and help determine supply (Ahlfeldt & Holman, 2015; Rizzo & Towse, 2002).

In the cases of England, France and Italy, the first examples of urban heritage legislation appeared over a century ago. Each system started with listed building designation and then evolved to include its own unique interpretation of UHAs. In England the process began with the 1882 Ancient Monument's Protection Act, updated in 1953 with the Historic Buildings and Monuments Act (Historic England, 2015a; UK Parliament, 1967). In France a first law was introduced in 1887 and updated in 1913 with amendments that made provisions to classify buildings of historic or artistic value to the public without the owner's consent, public or private, and entailing the obligation to not modify the building, or any section of it without obtaining permission from local government (Cornu et al., 2013; Devernois, Muller, & Le Bihan, 2014). In Italy the *Legge Nasi* (n. 185/1902) first established a list of national monuments and was further developed by the *Legge Bottai* (n. 1089/1939) which addressed the needed protection of structures of artistic or historic interest (Carughi, 2012). From 2004, all Italian public buildings constructed 70 or more years ago were automatically listed to avoid the loss of cultural values provided by civic architecture (Ministero dei beni culturali e delle attività culturali e del turismo, 2017). In each case, the legislative framework started with punctual architectural inscriptions within a heritage legislative framework that valued punctual inscriptions, where individual buildings are classified or listed in the French case, given a Grade I, II or II* in the English case, or classified as being of 'great cultural interest' (monumenti) or of minor architectural value or 'other interest' (beni architettoici) in the Italian case (Ministero dei beni e delle attività culturali e del turismo, 2016). In all these case-studies, urban heritage was first 'created' through the recognition of individual architectural examples and frequently tied to notions of nationhood and culture (Choay, 1992; Pendlebury, 2009) . The non-use values of urban heritage, notably the cultural, social and historic values making the continued existence of these buildings important, were thus the first to be emphasised by conservation planning. The differentiation of the various levels of importance of these buildings highlighted the idea that even structures of humble origins may also carry significance.

From their inception, up and to the introduction of modern town planning systems in Italy (1942), England (1947) and France (1954), conservation policy grew slowly but progressively (Mehl-Schouder, Driard, & Ibanez, 2015; Newman & Thornley, 1996; Scattoni & Falco, 2011). During this period, the notion of heritage areas slowly took shape. In England, this came in the shape of the 1931 Ancient Monuments Act, which introduced the idea of preservation schemes and extended this to the area directly surrounding an ancient monument controlling development nearby. In the cases of France and Italy, although UHAs were not identified within urban codes, they were identified from an environmental perspective, including adding UHAs into valued natural environments. In Italy the law (n.1497/1939) refers to 'natural goods' including 'beautiful ensembles'[13] which are 'complexes of immobile things (buildings) that hold aesthetic or traditional values' (Carughi, 2012; Giannini, 1976).

In France, a similar definition relating to the idea of a 'heritage ensemble' is inscribed through the 1906 *lois des sites* (updated in 1930). This law complemented the 1913 historic monuments law by extending protection to historic sites (Assemblée Nationale, 2017). By definition, it protected areas presenting landscape value, both rural and urban – it is the oldest indication of value being attributed to landscape addressing another layer of urban heritage non-use values (Ministère de la Culture et de la Communication - Direction Générale des Patrimoines, 2012). This law is part of the French environmental code, and although, as specified, it isn't directly addressed at UHAs it has resulted in the protection of many equivalent areas. One of the most famous is in Paris (Figure 4) and

[13] Denominated in Italian legislation as 'bellezze d'insieme'.

was inscribed in 1975. It covers 4400 ha (42% of the surface area of Paris) including almost all of the 11 first *arrondissements* and parts of the 16th and 17th (APUR, 2004; IAU-IDF, 2013). Both these initial Italian and French laws indicate that although urban heritage areas are conceptually separate from natural preserved areas, they have links that should not be overlooked. Indeed, the reason why techniques for the economic valuation of natural amenities have been successfully transposed to the historic environment lies in their many similarities (Provins et al., 2008).

The shift in the conception of UHAs as an integral part of cities happened at a later date and varies within our three northern case-studies. In England, the 1967 Civic Amenities Act (updated in 1990) marked this transition by establishing conservation areas (CA) having 'special architectural or historic interest, the character or appearance of which is desirable to preserve or enhance' (UK Parliament, 1967, 1). This transition is closely tied to England's post-war demolition and rebuilding, which spurred many communities to take action. As we shall see this is reflected in the local nature of where power lies in the designation process.

Since their creation in 1967, CAs in England have evolved through different policy documents. Until recently, central government set the stage for the planning system through Planning Policy Statements and Guidance (PPG and PPS) (DCLG, 1994, 2010). PPG15 first laid out government policies for the identification and protection of historic buildings and conservation areas (DCLG, 1994). It explained how development and conservation generally needed to be considered together and broke down the links between the planning system and conservation policy (DCLG, 1994). It was replaced by PPS5, which highlighted planning's central role in conserving heritage assets in the perspective of using them in creating sustainable cities and preserving quality of life (DCLG, 2010). These policies, among others, were replaced in 2012 by the National Planning Policy Framework (NPPF) (DCLG, 2012). The NPPF sets out core principles that should underpin plan making, and includes the historic environment under the umbrella of the environmental role of the three dimensions of sustainable development (DCLG 2012, 2). It aimed at simplifying the national planning framework and was often described by interviewees as similar to the PPS5 but much less detailed. Whilst the borough policy officers we interviewed were concerned with the loss of detail between PPS5 and the NPPF there is striking evidence to suggest how powerful the heritage lobby was in securing a good outcome for conservation policy within the NPPF as the framework went through various stages of drafting (GLA2 and Historic England Interview) (Lennox, 2013).

In France, the legislative jump is not as clear-cut, the structure for the protection of UHAs has been characterised as a *millefeuilles*, a culinary metaphor that reflects the multiple (and many argue redundant) layers of regulation that result in numerous legislative tools protecting urban areas (Bleyon, 1981). Interviewees described it as extensive, binding and containing wide-ranging constrictive measures (STAP Paris Interview). The French attempt at solving this was the creation of the *Code du Patrimoine* in 2004, which brought together all the scattered texts on the protection of heritage (Negri & Cornu, 2010).

The 1943 act extended state control by establishing an easement to protect a 500m perimeter around all historical monuments (Devernois et al., 2014). This measure is part of the heritage code and can be considered a French forerunner to the conservation area, but more importantly, it is a measure still implemented today. As emphasised by Planchet (2009), addressing the outskirts of historic buildings through an administrative constraint is far from linking monument legislation to town planning law. The technique strengthens the singularity of monuments and is based on the misleading assumption that conservation in the immediate vicinity of a monument remains bound to the historic monument (Choay, 1992; Le Louarn, 2011). None of our other northern examples apply such a restrictive measure. The concept of curtilage exists around listed buildings in England but, as recommended by Historic England, no line is ever drawn and the boundaries of the spatially protected area are up for interpretation (Historic England, 2015b). In fact, as written, the policy relating to curtilage and which structures may or may not be protected within it is rather vague and, like much of England's town planning regulation, has been further specified by case law rather than codification (Moore, 1987).

The 1943 law also restricts urban areas by adding sight line restrictions to the field of vision around the monument: within these areas any action changing the appearance of both buildings as outdoor spaces, cannot take place without the prior authorisation of the Architect of the Buildings of France (ABF) (Devernois et al., 2014). This role is one of the few remaining positions that permits individuals to hold sovereign power, a power superior with respect to local mayors or prefects. This power is called the *avis conforme* and denotes the ABF's power to accept or decline any proposal to change or demolish buildings in curtailed areas around monuments (Art. 7. R425-18) (Devernois et al., 2014).

Given the large number of historical monuments in France (about 40,000 across the country), this measure results in the ABF being in control of nearly 3 million hectares of land, which is roughly 5% of France (Ministère de la Culture et de la Communication, 2013). The law's most recent evolution (7 July 2016), finally limited the *avis conforme*[14] to a smaller sector delimited around the monument by the ABF, leaving him with a *avis simple* in the rest of the area (Figure 3) (Ministère de la Culture et de la Communication, 2016) . The reality of this amendment in the law is, however, as discussed with interviewees, that the state does not have the means to draw new individual specified perimeters for each of its 40,000 monuments (STAP Paris Interview). A coordination problem will thus arise between ABFs and local mayors, who will now need to take responsibility for all modifications in the newly created 'simplified sightlines' (*avis simple* areas). It is worth noting that a similar regulation exists in the UK context but applies only in London where specific sightlines are controlled to create viewing corridors to key monuments in the capital (GLA, 2012) .

The French legislative system specifies an astonishing three other ways to designate UHAs. *Secteurs Sauvegardés*[15] were introduced as an instrument in 1962 in a period in which heritage conservation was far from being at the top of the political agenda. Now part of the French urbanism code, they are part of the *Plan de sauvegarde et de mise en valeur* (PSMV)[16] which replaces the local urban plan. With the decentralisation of the state in 1983 came the creation of protection zones for architectural and urban heritage and landscapes (ZPPAUP), now part of the heritage code (Cornu, 2003). Although the ZPPAUP aimed at designating UHAs, it did not entirely break from the pattern of protecting neighbourhoods around historic monuments. Although areas were now designated, they were not conceived as holistic landscapes in their own right but were an attempt to improve the 1943 law.

By 2010 policy had evolved and the ZPPAUP were replaced by the *aires de valorisation de l'architecture et du patrimoine* (AVAP)[17] (Negri & Cornu, 2010). The biggest marker of this evolution was the inclusion of concepts of well-being within a sustainable development framework. AVAP also required a management plan only partially subsidised by the state, which takes the form either of a *Plan de Sauvegarde et de Mise en Valeur* (PSMV)

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[14] The *avis confrome* is the French administrative action of giving assent and represents the irrefutable power to accept or decline any proposal to modify buildings. The *avis simple* is simply on the other hand closer to giving advice.

[15] Preserved sectors (Translated by the authors)

[16] Protection and enhancement plan (Translated by the authors)

[17] Areas of enhancement of architecture and heritage (Translated by the authors)

or of a heritage PLU (Rouillon, 2014). An attempt to simplify the urban heritage designation system was finally made in 2016 with a legislative amendment that regroups the *secteurs sauvegardés*, ZPPAUP and AVAP into one category: the Site Patrimoniales Remarquables (SPR)[18] (Ministère de la Culture et de la Communication, 2016). Although the details of the implementation of this most recent amendment to the legislation are still unclear, interviewees confirmed that if certain areas were prone to more than one UHAs legislation in the past, the most restrictive one would be applied (Ministry of Culture France Interviews).

Article 9 of the Italian Constitution states the need to protect and enhance both the landscape, historical and artistic heritage of the nation (Cosi, 2008). Conservation planning has a unique place in the Italian context, so much so, that some have argued that the principles and practises of conservation planning are one of Italian urbanism's contributions to the field (Balducci & Gaeta, 2015). The Italian architect Gustavo Giovannoni coined the term 'urban heritage' in the 1930s as obtaining its value not as an individual and autonomous object but as part of the overall character of urbanism (Choay, 1992).

Interestingly, the Italian system did not develop an UHAs designation strategy that resembles the English conservation areas or French ZPPAUP. The *vincoli paesaggistico*[19] are derived solely from the 1939 environmental law mentioned earlier, which later received modifications in the 1980s (n. 431/1985 "Aree tutelate per legge") and in 1999 (n. 490/99 'Testo Unico') (Ministero dei Beni e della Attività Culturali e del Turismo, 2016). The Cultural Heritage and Landscape code later (22 January 2004 n. 42) integrated these previous norms in an attempt to simplify legislation. Within this code, Article 136 and Article 142 apply to landscapes. Article 136 identifies buildings and areas of significant public interest[20] while Article 142 identifies the areas having natural interest. Even though this construct is tied initially to environmental rather than socio-cultural historical values, it includes restrictions linked to heritage more holistically. For Example, the neighbourhood of Brera, one of Milan's historic quarters, is protected by a *vincoli paesaggistico* and within its specifications it considers the preservation of its historic character by controlling things like the appearance and décor of buildings (MiBAC Interview) (Gazzetta Ufficiale, 2009). Therefore, even though this legislative feature

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[18] Remarkable heritage sites (Translated by the authors)
[19] Landscape protection (Translated by the authors)
[20] These include a. good of specific administrative use b. 'immovable things', 'villas and gardens', 'parks' c. and d. 'complex of properties', 'areas of scenic beauty'

does not classify the area as a culturally valuable one, it identifies it as being significant to people's identity and in so doing, as noted by our interviewees, the area's character and form can be protected through the imposition of measures to protect "…historicism, décor, view and perspective" (MiBAC and conservation legislation specialist Interviews).

What is unique about urban heritage 'creation' in Italy, however, is the conception of the historic centre – *centro storico* – as *the* area retaining urban heritage value. Although this is true in other countries where UHAs are clustered in the centre of a city such as London (see Fig. 5) Italy is the only country that institutionally defines these areas. The *Commissione Franceschini* in 1964 undertook a census of cultural property and underlined the value of the *centri storici* as settled urban structures that constitute cultural ensembles and the original and authentic part of settlements (Cosi, 2008; Olivetti et al., 2008). ANCSA (*Associazione Nazionale Centri Storici Artistici*), on the other hand, appealed the need to classify historical centres as a whole as unique examples of history where the phases of development could be clearly identified in light of a low number of modern replacements (Bonfantini 2015). In fact, the concept of Italian historic centres was thought of as a way to preserve both the physical and social body of historic centres in order for these to remain interlinked (Albrecht & Magrin, 2015).

The 1967 *Legge Ponte* (Law n. 765) officially included historic centres as part of overall city planning, delimiting them by the notation 'Zone A' in Italian Master plans or PRGs which delimits zoning areas, buildable exploitation and the areas to be allocated to public services (Venuti & Oliva, 1993).[21] Although this has evolved today, as historic centres are now defined on a case by case basis through their urban plans and with more complex zoning techniques, it underlines the significant value accorded to them in the Italian case. Various authors and interviewees (Politecnico Interview) (Bonfantini, 2012, 2013; Mioni & Pedrazzini, 2005) stressed how historic centres are in no way replaceable, differing visually and perceptively from the rest of Italian settlements, because of their display of unmistakable patterns, underscoring the traits of strong spatial cohesion that is immediately morphologically recognisable. Italian conservation planning is thus emphasising historic centres' option value. Several interviewees stressed how the conception of Italian conservation planning is deeply seeded in the country's history and geography: the historic centre being a distinctive urban characteristic of the Italian urban landscape (UNESCO/ANCSA and CE Interview). Similar arguments could be made

[21] PRGs (Piano Regolatore Generale) are general regulatory plans for the city.

about certain historic centres in England or France, but they are not legislatively recognised in the same manner: in Italy, the temporal threshold is given much more weight.

There is, moreover, a clear distinction to be made between the *vincoli paessagistici* and historic centres. While the former presents elements both of valorisation and safeguarding, the latter are almost solely about promotion and valorisation (Art. 117, comma 3, of the Italian Constitution) (Fantini, 2014). In practice, many historic centres are partially superimposed by *vincoli paessagistici* (Figure 5). The dangers of Italian historic centres are linked to the possible isolation and transformation of this central area, for in designating these central islands of land, there is a risk that the intangible values are gradually lost as they become areas for tourism and not for everyday people, referring back to the opposition of economic and intrinsic values as illustrated in Figure 1. When the *vincoli paesaggistici* cover the whole of historic centres, the risk of this isolation happening is high, as argued by several interviewees in the case of cities like Florence and Venice (UNESCO/ANCSA and CLS Interviews). As Bandarin (2015) argues, there is no purpose in maintaining architectural appearance If you turn the city into an empty shell. Instead of going towards inclusiveness and the living nature of heritage, 'the historic centre creates insularisation' (Lombardy Region Interview) as a result of constraints tied to it and 'dangerously transforms the area into a theme park' (Italian historic centre specialist). This essentially describes the tipping point of the right hand side of Figure 1, where the pursuit of this economic value (through tourism) begins to diminish the intrinsic value of UHAs through its consumption.

It is clear from this analysis of the evolution of urban heritage legislation in England, France and Italy that context plays a substantial role in how urban heritage is 'created'. Even though the beginning of conservation planning is very similar between these neighbours, planning cultures and historical geography influence national definitions of urban heritage, meaning that these built forms are somehow valued differently.

2.2.2.2 From cultural to holistic non-use values

As we have seen in the previous section, the reasons behind why monuments and UHAs are designated is tied to different types of value associated with these different heritage forms. While single heritage designations appear to be tied to historic and cultural values, UHAs are first conceived from an environmental value perspective in Italy (*vincoli paesaggistici*) and France (*sites inscrits*) and from the perspective of cultural-historical value in England. These initial values, however, have evolved both through the conceptual evolution of these first designations and also through the creation of new regulatory tools.

Our review of multiple policy documents for this paper suggests that the policy trend altered from being concerned primarily with cultural and historic urban heritage values to having a more holistic understanding of what urban heritage might be. The joint consideration of socio-cultural, historical, environmental, and economic values becomes predominant and inscribes heritage into the sustainable development discourse (Council of European Union, 2014; Gayego, 2014; Vernieres et al., 2012) . This suggests at least a partial incorporation of urban heritage values as understood through TEV delineation into national policies.

In England, the NPPF is now the key document linking urban heritage to sustainability. It highlights 'the wider social, cultural, economic and environmental benefits that conservation of the historic environment can bring' (DCLG, 2012, 126). It also states that local planning authorities should take into account the positive contribution that conservation of heritage assets can make to sustainable communities including their economic vitality (DCLG, 2012, 131), clearly appealing to both use and non-use values of urban heritage. The NPPF also included the historic environment under the environmental umbrella within the three dimensions of sustainable development, associating urban heritage with environmental values when initially conservation areas were underpinned and valued for their historical and architectural interests (DCLG 2012, 2). This illustrates the evolution of heritage policy in England, which has, over the years been able to shift itself with the leitmotif of the day going from the promotion of conservation for its own sake, to the promotion of heritage based on its value as a tool for economic and placed based regeneration to now as a promoter of sustainable growth.

In France, the biggest change in the evolution of urban heritage came with the progression from the ZPPAUP to the AVAP in 2010. The Loi de Grenelle (2010) introduced sustainable development notions through the AVAP that were not previously present, establishing a national engagement to the environment and altering the underlining values of UHAs in France (ICOMOS France, 2010). The AVAP also included well-being into its conceptualisation, introducing the notion that the value of UHAs is linked to urban emotional perceptions (Negri & Cornu, 2010). The evolutions in English and French conservation planning thus present similarities in repositioning themselves closer to discourses of sustainability and emphasizing the multidimensionality of values. It seems governments were keen to streamline conservation planning by linking it to sustainability and making it part of a more popular and accessible discourse.

In Italy, the theoretical jump in legislation is less specified but still present. Art 143 of the updated Cultural Heritage and Landscape code mentions the necessity to find 'correct ways to insert modern elements in landscape areas' in order to 'sustainably develop these areas' (Carughi, 2012). Moreover, although the historic centre is a concept linked to the history of a given city, it has been argued that it also supports notions of sustainability through its links to the UNESCO 2011 Recommendations on the historic urban landscape (Bonfantini, 2015). Therefore, although Italian conservation planning doesn't specify sustainability's role in related legislative documents, or in practice, as commented by one of our interviewees (CLS Interview) it has subtly attempted to include it within the conservation discourse.

These evolutions suggest two things. First that the international push to include urban heritage into the sustainable cities discourse was successful given that national policies rephrased urban heritage in this perspective. Agenda 21 for Culture's Fourth Pillar of Sustainable Development (by United Cities and Local Governments) exemplifies this movement, followed by the inclusion of heritage in the sustainable cities discourse of the Sustainable Development Goals 's (SDG) and its inclusion in the recent United Nations Conference on Housing and Sustainable Urban Development (Habitat III 2015; UCLG 2005). The evolution of conservation planning in our case-studies suggests that the concepts of these movements have effectively trickled down to national policies.

Secondly, it can be argued that as conservation is a 'luxury' of planning, its inclusion into a sustainability discourse might therefore have been orchestrated to give it more gravitas, not unlike earlier shifts toward more economic language. The restoration and maintenance of urban heritage is often considered an expenditure of resources that could better be used in other ways. Conservation is thus intricately tied with the cost of an alternative that must be forgone in order to preserve heritage buildings (Provins et al., 2005; Serageldin, 1999; Tuan & Navrud, 2007). If a high proportion of a city's economy is linked to construction and/or real-estate development, net income sacrificed to conservation will be high and cities in urgent need of economic growth will not be willing to make the sacrifice (Barton, Blumentrath, Bernasconi, Pinto, & Tobar, 2013). This is especially true in places where weak governance systems do not enforce planning as we shall see in the second part of this paper. We cannot forget that there is often a prevalent political rhetoric favouring economic maximisation over other social constructions of value, which occurs in both the Global North and the Global South (Ahlfeldt & Holman, 2015; R. Lee, 2011).

Perhaps in order to overcome this rhetoric, conservation has often gained importance not as a cultural variable within planning but as one inserted into the sustainable development discourse, thus attracting more attention by modifying how it is included in policy. This could also be why heritage is often classified as an urban amenity, as a way of boosting attractiveness (Finco & Nijkamp, 2001; Glaeser, Kolko, & Saiz, 2001). Even organisms like UNESCO have somehow compromised, adjusting their interpretations of historic landscapes to be much more inclusive, to use the words of Bandarin (2015, 14) a 'much more flexible, open-ended and people driven approach to conservation'.

2.2.3 Heritage in space

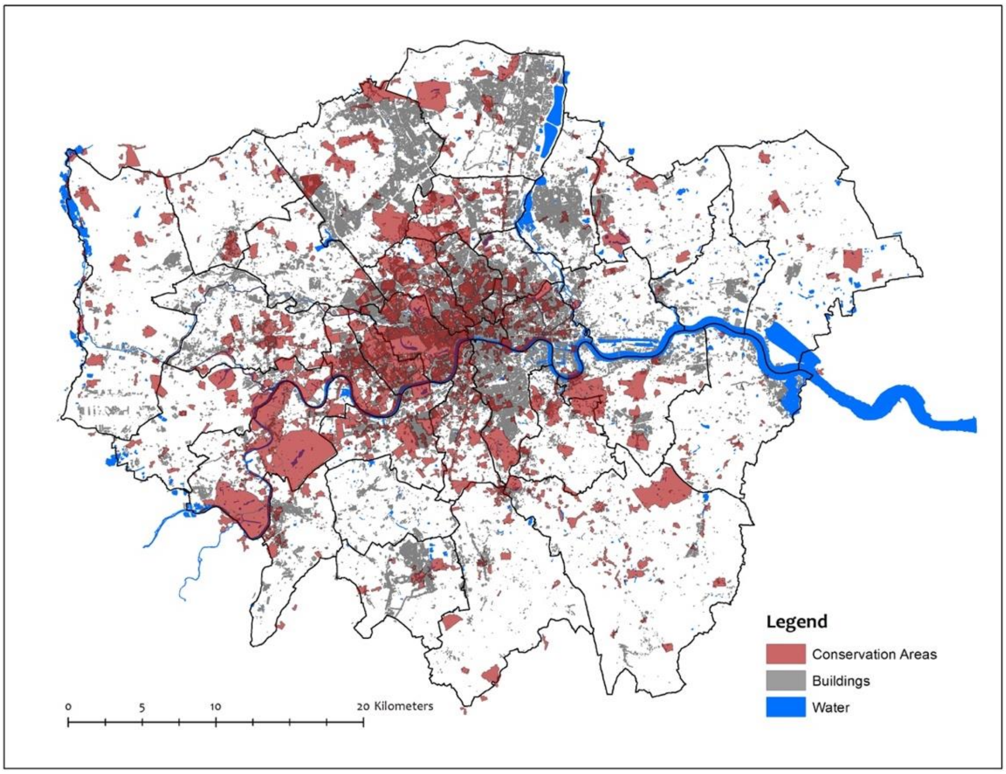
2.2.3.1 Heritage Counts

Spatially we see these regulations impacting on our case study cities in the following ways. Listed buildings in both London (16,420) and Paris (3,842) are great in number and were designated over an extended period of time going back as far as the 1850s. Milan counts 1677 listed buildings however data on their year of designations is unfortunately not readily available. UHAs in Paris (22) and Milan (31) only reach a maximum of 6 designated areas a year, while London (965) sees high number of designations from the 1970s. However, despite London's large number of UHAs this does not mean that London in necessarily more constrained than Paris. Not only are UHAs in Paris more spatially extensive, English CA policy can, in many cases, be less restrictive given it is locally arbitrated and locally enforced.

2.2.3.2 UHAs as a spatial construct

Figure 3,Figure 4Figure 5 demonstrate how the size UHAs and the details of their spatial demarcations vary in light of the evolution of legislations discussed above. CAs in England are relatively small, delimited areas, they usually do not map full city centres but several, even many specific areas within them. In large cities, such as London, they are clustered in the centre of the city, marking its most historic part despite the absence of other regulations, with the exception of strategic protected views in London, which are designated by the Mayor. These strategic views are focused on St Paul's Cathedral, the Palace of Westminster and the Tower of London and are broken into the categories of: Panorama; River Prospects and Townscape. In practice, these views are protected from development that may obscure them. This does not mean that new development is not possible, only that any development should be sensitive to these sightlines. Historical centres usually count several CA's such as a range of houses or a square and its surrounding buildings. The delimitations are particularly specific, presenting an attempted reconciliation between conservation planning and mainstream modern town planning. They allow the construction of new builds both within and between them and they are not integrated into local urban plans (Rodwell 2007). Some areas like South West London do have contiguous CAs that create larger designated areas, but these are locally controlled and managed meaning that the rigidity of policy is, to some extent, locally varied.

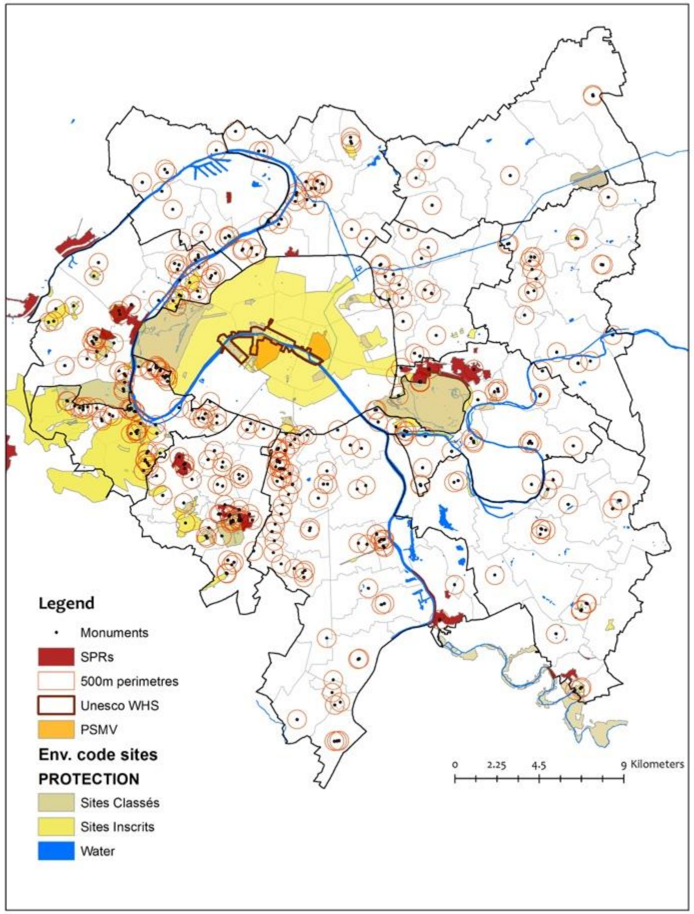
Figure 3 London

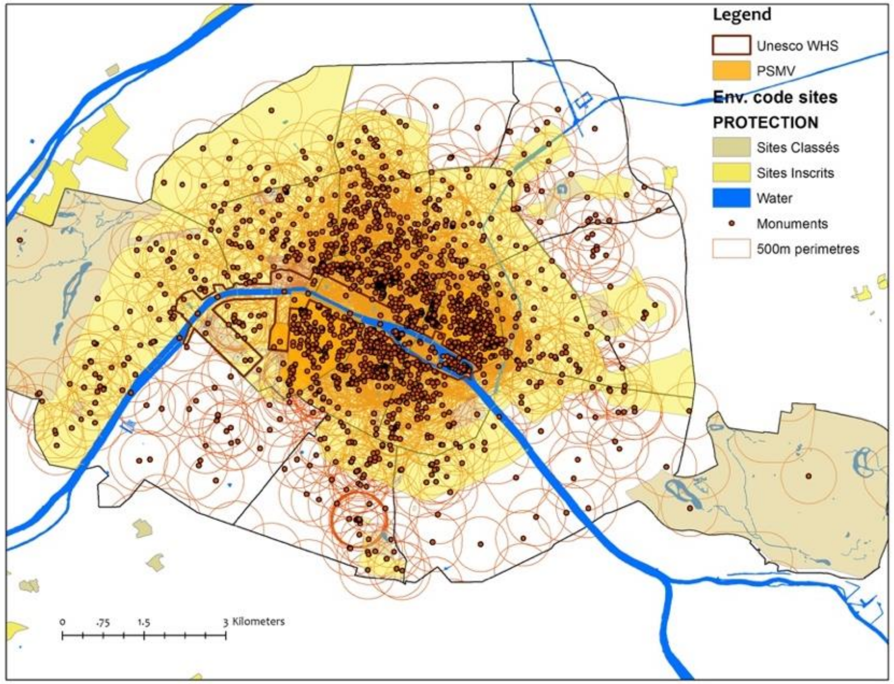


The superposition of French conservation areas results in 93,5% of Paris being subject to some form of regulation. The *Secteurs Sauvgardés* are typically neighbourhoods, in Paris the 7th arrondissement and the Marais. What used to be the SPR range from the size of small neighbourhood to half a city. None are found in Paris itself but there are over 40 in the Ile-de-France area, many of which are show in the 'Grand Paris' areas in Figure 4. Paris not only has an extensive *site inscrit,* as mentioned earlier, it also has a series of *sites classes* which include all the parks in Paris as well as some of the most important perspectives in the city such as the Invalides esplanade. When asked why Paris does not have ZPPAUP/AVAP, interviewees responded that the wide range of conservation planning present within the inner walls of Paris made it unnecessary (STAP Ile-de-France

Interview). In fact, throughout the whole *site inscrit* the ABF has an *avis confome* on all demolition. Moreover, the superposition of 2000 historic monuments, an inscribed site, and two *secteurs sauvegardés* and various smaller *site classes* there is very little that needs further conservation. As an interviewee said: there are 2150 conservation constraints on 1950 buildings (Paris Municipality Interview).

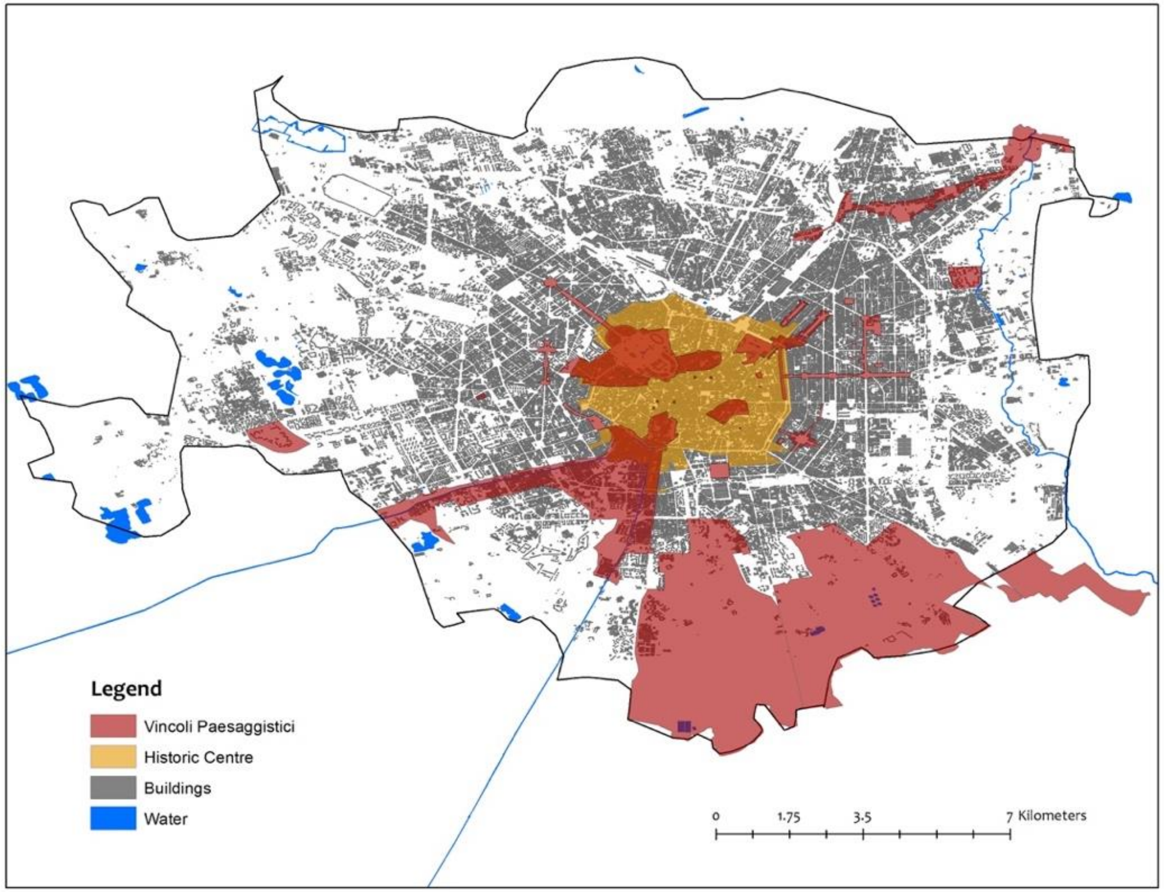
Figure 4 'Grand Paris' and Central Paris





Note: SPRs are the *Sites Patrimoniales Remarquables*, PSMV are the *Secteurs Sauvegardés*. The second image zooms in on central Paris and illustrates the 500m perimeters which have been omitted in the left image for clarity.

Figure 5 Milan



Vincoli paesaggistici have similar spatial delimitations to English conservation areas. For example, Milan has 31 *vincoli paessagistici* including the neighbourhood of Brera, the area around the Castello Sforzesco and the area di via Francesco Sforza e Largo Richini. The greatest difference in the Italian demarcation of urban heritage can be observed through the historic centre. It is characterised by its insularity, which is quite striking as we can see in Figure 5 (Bonfantini 2013). This has led, in recent urban plans, to the transition from the notion of historic centre to that of historic city as colourfully argued by Bonfantini (2012, 2). The difficulty arises, however, with the recognition of the historic environment, which is not part of the historic centre in a given context. Conservation planning cannot simply equate to the widening of cartographic boundaries of a historic centre based on the extension of a temporal threshold as has sometimes been done (Bonfantini 2012). In Naples the local authority (LA) decided to extend the historic centre perimeter from the 19th century to the early 20th century, bringing the historic centre beyond its traditional definition or pre-industrial urban fabric (Argan 1990). The danger of this simple extension is the creation of static museum cities, which have been highly criticised by heritage specialists (Bandarin, 2015; Bonfantini, 2012).

It is clear that there is not one way of defining and thus 'creating' UHAs even between countries with similar planning origins such as France and Italy. Although common delimitations of UHAs exist in different planning systems, the extent of their specification and the details of their spatial demarcations vary greatly. Urban fabric is thus valued differently according to geographical context and suggests that policies need to be interpreted within their own context and not through policy transfer.

Our hyper-factual approach has helped us demonstrate that heritage is morphologically valued differently in London, Paris and Milan (Ridley in Rhodes 1997). While historic centres and large neighbourhoods are valued in Milan, smaller concentrated UHAs allowing for greater building flexibility are appreciated in London and numerous layers of conservation systems are applied in Paris resulting in almost no flexibility. Upon reflection, not only are these differences observable to the naked eye in these cities, but they result in some urban fabrics being more coherent that others in light of the dissimilar spatial protections. This suggests that although the planning system is not the only element, which will determine heritage value, it will implicitly change how urban heritage is viewed by the population. Valuing urban heritage is therefore necessarily rooted in the analysis of country planning systems where zoning plays a major role as it results in different integrations of urban heritage in the city.

Urban heritage is thus engrained in local history both conceptually and spatially and this inevitably modifies its construction within planning. As such, heritage is a social construction dependent upon spatial and temporal interpretations of the past: this implies that its meaning is likely to change through time and across space, adding to its complexity.

2.2.4 'Quanto é vincolato?'[22]: reflections on conservation planning constraints

The extent of the constraints these various conservation planning systems present, together with the degree to which they are enforced, also speaks to how urban heritage is valued within a given context. The principal actors defining and enforcing the systems are necessarily involved. Values alter depending on the level of government deciding heritage constructs, shapes and restrictions. In other words, who decides what is valuable? Does the mayor, the local authority, the residents or central government decide? And if different actors are involved does this lead to coordination problems? As argued by Rhodes (2007), not only do patterned, interdependent, and bargained behaviours of government vary between contexts but so does their configuration, building different policy networks.

English conservation planning is underlined by notions of compromise and balance. The tendency to use the word 'significance' in previous planning documents such as PPS5 and PPG15 changed to the predominant use of the word 'interest' in the NPPF, as an interviewee argued, implicitly altering the weight given to urban heritage assets (Historic England Interview). As noted by Historic England (2015b, 3) conservation is not a stand-alone exercise, it must be negotiated and balanced with other local and national priorities. Although the NPPF states that 'local planning authorities should set out a strategy for the conservation and enjoyment of the historic environment' in their Local Plan (Paragraph. 126 DCLG 2012, 15) and should recognise it as irreplaceable, the document also clearly addresses a negotiation between conservation of heritage assets and necessary developments (Paragraph. 61 DCLG 2012, 15). A scale with existence value on one side and direct use values of land on the other is thus established. A compromise is immediately put forward between the protection of urban heritage and the evolution

[22] Common question in Italian conservation planning that asks to what extent a good is bound/restricted.

of the modern city. As with most elements in the English system, which is based on case-law, this leaves a great amount of space for interpretation. Local Planning Authorities (LPAs), which hold planning control, are given the option of permitting partial loss of heritage in CAs according to their judgement. LPAs must, however, 'not permit loss of the whole or part of a heritage asset without taking all reasonable steps to ensure the new development will proceed after the loss has occurred' (Paragraph. 136, DCLG 2012, 15). Loss of existence value is thus only justified if direct use values of land are exploited.

Despite the NPPF stating that the planning system is to contribute to the achievement of sustainable development through its economic, social and environmental dimensions, many authors consider English planning to be fixed on a growth-imperative model wishing to limit further planning power (DCLG, 2012; R. Lee, 2011; Rydin, 2013). Centring on economic profit has made social constructs of the built environment such as urban heritage preservation unpopular, criticised as mechanisms hampering the market by restricting land supply and leading to rising house prices (Cheshire & Hilber, 2008; Hilber, 2015). This 'negotiation' between conservation planning and development, is much rarer in the French or Italian systems, where the possibility of compromise especially in terms of new builds within UHAs is much more restricted. In fact, in comparing the three systems, the strong tensions between conservation and growth, especially noted in London, seem disproportionate (Cheshire & Dericks, 2014). Demolition and new build are controlled in the English context, but their local determination, available local resources and local values and attitudes create far more variation in the ultimate outcome of their conservation (Bottrill, 2005). As we will see in the next section, negotiation between conservation and development is much more widely found in our Global South case-studies

The English system must be applauded for making this negotiation local. The NPPF eliminated the regional planning apparatus (except for London) and introduced neighbourhood planning providing, a set of tools for local people to ensure the developments in their areas reflect community motivations (Paragraph. 184 DCLG 2012). LPAs are responsible for the designation and supervision of CAs, making urban heritage designation in England a locally defined system. If urban heritage is ultimately for people, especially those who live in and around an UHA, power residing with local governments seems appropriate. In fact, criteria for selection of CAs varies from region to region, making the value attached to heritage interpreted through specific sites and places (Lee, 2006). The designation process in England thus reflects the interests of local society; locally defined places are then provided protection under national planning legislation (Ahlfeldt & Holman, 2015, p. 174). This underlines the complexities of valuing urban heritage across one country, and touches on the complexities of values that will arise in analysing examples from wide-ranging contexts in this paper (Pendlebury, 2009). In fact, interviewees who dealt with heritage at a national level found it difficult to generalise what aspects of CAs were valued with many local choices viewed as peculiar or unexpected in terms of designation (Historic England Interview) .

In practice, LPAs have only limited resources in terms of enforcement and typically the system is reactive rather than proactive with officers only checking work where complaints are made (Harris, 2013). This makes CA integrity incredibly reliant on collaboration between communities and local planners (Ahlfeldt & Holman, 2015). Interviewees commented that the control of conservation areas is not what it should be (GLA 1 and Hackney Borough Interviews). The loss of front gardens, replacement of windows and doors are a common feature when private houses do not demolish but radically change a building's appearance without asking for permission. Interviewees commented that this ties to a political idea in England that an individual's house is their castle, and therefore unless the CA has an Article 4 Directive (a legal proviso, which extends and strengthens planning control) the council is not able to enforce higher standards. LPAs have the right to withdraw permitted developments under Article 4 directives, which compromised in 2009 about 13% of all CAs in England (Ahlfeldt & Holman, 2015). This demonstrates the inherent role LPAs have in the protection, or not, of UHAs and the criticality local attitudes and values as support within the process. In France, the opposite was noted by interviewees: owners might lay claim to the right to dispose of their good as they see fit but the concept of public good is so engrained in the law and in society that the 'existence value' of the heritage for the public will almost always succeed (STAP Paris Interview).

As discussed earlier in this paper, French conservation planning is characterised by heavy restrictions and the layering and juxtaposition of legislation, resulting in a building often being subject to more than one regulation. It is difficult to ascertain where heritage 'creation' lies in French conservation planning. Each of the multiple UHA designations is tied to an authority. Listed buildings are linked to the *conservateurs des monuments historiques;* what were the 500m perimeters, the ZPPAUP and *secteurs sauvegardés,* are the responsibility of the Architect of the Buildings of France (ABFs);

while the management of the *sites* is a matter handled by the Minister of the Environment. The ABF's power certainly encompasses the most land. In Paris the ABF holds absolute planning control over 90% of the territory as well as an *avis simple* for all building permits and urban planning certificates etc. This power denotes the importance of history in the conception of conservation planning, for it comes out of a post-war concern to preserve areas that had not been damaged during the war (STAP Ile-de-France Interview). As an interviewee noted, such a measure would never be allowed today, as it evokes regal institutionalism, but remains as a result of history (STAP Paris Interview). In some ways, therefore, the French conservation planning system has opted to 'maintain such power with heritage experts and (make it in a way undemocratic) to protect it' (STAP Ile-de-France Interview).

The system has often been criticised as presenting an arrangement characterised by too many checks and balances. The 2016 legislative amendment finally simplified and clarified things by eliminating the simultaneous imposition of codes (Ministère de la Culture et de la Communication, 2016). From 2016 onwards areas where two codes existed would be subject to the most restrictive only. For example, if a building is in a *site inscrit* and in the perimeter of a historic monument, it will only be subject to restrictions by the historic monument, because it is the most restrictive (Heritage code) (Figure 3). On the other hand, if the building is a *site inscrit* but not in the perimeter of a monument it will be subject to the environmental code. Other simplifications to the system are also occurring, not only with the limitation of the 500m perimeter, as discussed in section 3.2.1. of this paper, but with the first de-designation of an urban heritage asset in Paris. For example, a public consultation is currently underway to de-designate the entrance to the Bois de Boulogne in proximity of the Suresnes bridge (Prefet de la Région d'Ile de France, 2017). Interviewees confirmed that there is little reason for this listing, designated in 1922, to exist (MSD France Interview). The cast iron bridge, built between 1873 and 1874, was destroyed and replaced by a reinforced concrete bridge in 1951. In addition, this area of the city has been profoundly transformed, to the point that the epicentre of the perimeter of protection turns out to be a major road. This consultation on de-designation has been made possible by recent changes to the environmental code as it relates to the total or partial de-designation of a monument of a *site classé.*

Just like the French system is characterised by the power held by the ABF, the Italian system is characterised by the role of the *soprintendeza*. This body decides all detail related to *vincoli architettonici* and buildings surrounding them in an ad-hoc perimeter. In practice, they decide many elements of the décor of urban areas, vastly limiting the freedom to build or modify in designated areas. These include binding procedures related to building work, with restoration only carried out by qualified staff – disputes have arisen between the state and the region on the training such staff should have received (MiBAC interview). Restrictions in Italy also vary whether a building is public or private. When the building is private there is an obligation to conserve it and the *soprintendeza* can impose works to be carried out on buildings (Ministero dei Beni e le Attività Culturali, 2016). The restrictions and confinements of *vincoli paesaggistici* are not much less invasive (Politecnico Interview). The *vincoli paesaggistici* are nominated by the region, who identifies and starts the designation process, establishes specific guidelines which are then delegated to municipalities after the approval of the *soprintendeze*. Restrictions are detailed in the plan and are controlled by regional government. The danger in the Italian system thus lies in too much restriction, suggesting too high a price is legislatively placed on the existence value of all urban heritage. Owners usually prefer their buildings not to be within UHAs and work on properties within UHAs is often done without permission to avoid extra costs (ISTAT, 2015). Fiscal advantages did exist but are now only reflected in a 50% discount on ownership tax and a 19% reimbursement of works carried out on buildings from one's taxes.

The Italian system is also characterised by institutional regional disparity, both in terms of amount of designations and in enforcement of regulation in practice. ISTAT (2013) statistics suggest how the country's regional division and disparate economic possibilities result in different conditions of the urban historical environment. Regions such as Tuscany and Umbria have 3 out of 4 historic buildings in an excellent or good condition where in Campania, Calabria and Sicilia fewer than half of all heritage assets are in a good state (ISTAT, 2015). The *Commissione Franceschini* (1964) was the first governmental body to denounce the degradation, the state of abandonment and the lack of development of urban heritage in Italy in the 1960s. Today, while some regions adhere to the restrictive regulations, others, especially in southern regions are characterised by a laxer application of these and thus a deterioration of the historic environment. There are many reasons why southern regions are characterised by degradation, amongst these are: lack of political will to enforce regulation, lack of compliance resulting in resident-led illegal amendments and construction and/or a lack of local investment in UHAs (Bonfantini 2012) (For a larger discussion, see Pietrostefani (2019)). Interviewees remarked that some regional governments have worked much more than others with regard to their historical urban environments. Clearly, there is a lack of geographical consistency within the system (MIBAC and UNESCO/ANCSA Interviews). In some regions, the Italian case presents an over estimation of intrinsic values of heritage which results in a very limited usage of its use values. While in others, lack of enforcement as well as residents and developers disrespecting regulation results in illegal amendments and modifications to historic properties and built environments.

This trend introduces a theme that will surface further in the Global South section of this paper. The opportunities and constraints linked to planning will not only depend on how regulations are set up, but in what context and to what degree they are implemented. The formality of policy and value are not immediately tied, the difficult reality of political activity and governance intervenes between them. When regulation is not enforced, conservation is in many ways a political decision, tied to the value of actors within cities with regulation enforced or ignored based on the values of these actors (Tunbridge, 1984). As Bevir, Rhodes, and Weller (2003, 193) argue 'we cannot properly understand a political practice solely by its legal character', and so we must attempt to consider how it actually plays out. In analysing how conservation planning compares between northern and southern cities, we must attempt to unpick the element of governance that follows regulation in the hierarchy of political will. As suggested by Balbo (2014, 282), we need to be aware in our reflection, of the reassessment of the government versus urban governance; in cases where state governance is lacking, it may have been taken over by independent entities.

2.2.5 Conclusion Northern case-studies

Reflecting on our three northern cases we see an English system of urban heritage areas that are very much locally driven and typified like all of English planning by discretion and broad principles rather than codification. Heritage in terms of value has often been adapted to the leitmotiv of the day and in this way has maintained momentum in a political culture that is often hostile to planning. This flexibility has allowed for areas to develop and retain their cultural dynamism but has also meant that many conservation areas have become so degraded as to no longer hold the values that once gained them designation.

The French system with its precise codification and overlapping designations is particularly byzantine in its approach. In terms of historic buildings, the main difference with the English and Italian system are the de-facto (500m) protected areas around heritage buildings, in the other two systems there are case-by-case boundaries. Although the system has been simplified over the years, it remains strict in terms of the constraints it inscribes. It has been streamlined by linking it to urban sustainability and well-being, but generally has received little opposition. In Paris urban heritage is engrained in the city and national heritage, architectural change has taken place more in terms of punctual occurrences than changing buildings or transforming areas. The newly conceived skyscrapers in Paris (not yet built) have received heavy opposition. In terms of enforcement, the power held by a single entity – the ABF – suggests a system where the confidence lies in educated expertise rather than local opinion/impressions.

Like France the Italian system is also typified by precise codification, which is heavily enforced and does not leave room for interpretation. Italy presents, however, a simpler system, its idiosyncrasies are that all public buildings constructed 70 or more years ago are designated, and that both rural and urban conservation areas are inscribed through the same policy. Like the French system it has attempted to simplify its codification system over the years, but constraints remain stringent. It is also characterised by advocating for the protection of its historic centres specifically more than England or France. Its other main difference is in scale of governance. In Italy policies are regionally enforced and as Italy presents great administrative disparities between north and south, this brings very different outcomes both in terms of scale and type of area designations.

2.3 Conservation planning in the South: Lebanon (Beirut) and Brazil (Rio de Janeiro)

2.3.1 Comparative planning in the Global South

Studies comparing planning systems in the Global South have grown steadily in recent years, addressing issues ranging widely - from urban growth (Minnery et al., 2012) to equity (Sotomayor & Daniere, 2018).

In addressing questions of conservation planning in the Global South, two difficulties become immediately apparent. The first is linked to the rapid urbanisation and development pressures that have been a prominent characteristic of many cities of the Global South in the last 100 years (Marchettini, Brebbia, Pulselli, & Bastianoni, 2014). The benefits of urban heritage are often overrun by more pressing needs tied to urban growth, resulting in conservation being a loosely integrated variable in planning – a luxury not necessarily being advocated as an intrinsic part of contemporary urban fabric

(Tweed & Sutherland, 2007; Watson, 2015). The second difficulty is a theoretical one: to avoid post-colonial discourses in addressing conservation in the Global South given that conservation is most often first formalised through legislation backed by colonial governments or similar. As we shall see, however, although the starting point for conservation planning in our southern case-studies is often adopted from western discourses, the systems evolve differently in light of contextual parameters, similar to our northern cases. Because every example is different, we are able to continue our exercise by adopting the same lens to our southern case-studies as we did our northern cases (Dolowitz and Marsh 2000; James and Lodge 2003; Balbo 2014, 270). Via this comparative analysis (Clarke, 2012; Sanyal, 2005), we denote relationships across and between 'northern' and 'southern' models allowing us to develop new theoretical models that avoid valorising western perspectives of planning (McFarlane, 2010).

In the same manner as our Global North section, we are limiting our comparison of conservation planning in the Global South as it relates to urban heritage in Lebanon and Brazil, using Beirut and Rio de Janeiro to work through two examples of how heritage is valued in these two different southern contexts. We have chosen case-studies from the Napoleonic planning model from different regions of the world as it is often argued that Latin America has appropriated the conservation planning discourse much further than other southern contexts, while the Arab World have few examples of countries that have truly attempted integrating heritage within their planning systems (Balbo, 2012) (UNESCO/ANCSA and IAUV interviews). Although we will not be able to evaluate this, as a much more extensive study of solely southern conservation planning systems would have to be undertaken, we will argue that in the cases of Rio de Janeiro and Beirut, even though the former presents a more developed formalised conservation system than the latter, the outcomes 'on the ground' are in some ways comparable. Both conservation systems present similar hurdles, namely real-estate pressure and exploitation of land values – a factor also present in our English case-study; a point we will return to later. Accordingly, the underlying question of this section is: what does it mean for urban heritage value when societies formalise the physical and social infrastructure of urban heritage at very different rates, but despite the differences in formalisation (legislations), outcomes appear to be so similar?

2.3.2 Heritage creation

2.3.2.1 First identifications of urban heritage

Similar to our European cases, the legislative framework in Brazil and Lebanon started with punctual architectural inscriptions. In both cases, the first examples of urban heritage legislation appeared in the 1930s (Table A1 in Appendix). The first conservation law in Lebanon dates back to the French mandate (1920–1942) and stipulates the protection of urban heritage within all artefacts dating before 1700 through the *Antiquities Law* (166/LR - 7/11/1933) (Audrerie, 2000; Tyan, 2012). It also declared that immoveable objects dated after 1700 may be preserved if special public interest of historic or artistic value can be ascertained (Toubekias & Dentzer, 2009, 16). Despite the vagueness of this initial legislation, 20 years after the monuments law in France, Lebanon had introduced a law that recognised the diverse values of stand-alone buildings, both historic and artistic. Similar to its northern counterparts, the legislation specified two ways of inscription. In Lebanon a building could either be inscribed by ministerial decree or classified by the Head of State (Article 26) on an inventory of historic monuments managed by the General Directorate of Antiquities, a part of the Ministry of Culture (Hanna, 2010; Tyan, 2012).

The first reference to immoveable heritage in Brazil is in the Constitution of 1934. It states that 'it is the responsibility of the Union and the States to protect natural beauties and monuments of artistic and historical value' (Castriota, 2008; Silva, 2012, 120) The 1937 Constitution then transmitted the responsibility to protect historic monuments to municipalities and swiftly recognised the natural value of landscapes (F. F. da Silva, 2012, 120). Decree-Law 25/1937 created the four *Livros de tombo* (Inscription books), which interestingly divided heritage assets both by category and type of values between Archaeology, Ethnography and Landscape, History, Fine Arts and applied arts (Batista & Macedo, 2010; Camara dos Deputados, 2010; Dos Santos & Telles, 2017). Heritage buildings or monuments could thus, in theory, be listed in one or more of these registers. This is different from other formaliations of value we have analysed, as the division of the books underlined the importance of identifying the principle type of value recognised in a building. According to the legislation, an asset recognised for its historical value needs to be inscribed in appropriate book and not in another one, at the risk of invalidating the inscription (F. F. da Silva, 2012, 124).

In both our southern case-studies urban heritage was thus first 'created' through the recognition of the intrinsic values of individual architectural examples. According to both Brazilian and Lebanese legislation, assets must be legally preserved and their owners should maintain their original features. In the Lebanese case, no alternations should be carried out without the approval of the General Directorate of Antiquities. In Brazil, there are different categories of building listing, similar to our northern case-studies. The first, called *tombamento* stipulates the conservation of all original elements of the building, interior or exterior. The second, *bem preservato*, only protects exterior elements of the building (facades, roofs, etc). The third category, *bem tutelado*, are buildings only semi-protected, demolition or changes are permitted, however new construction needs to follow the general aesthetics of the surrounding (R. C. M. Da Silva, 2012). As in the European cases, social concerns are thus formalised through the recognition of non-use values of urban heritage making the continued existence of these buildings important.

There is, however, a divergence in the values being recognised and the elaboration of the legislation. While the Lebanese law remains vague, specifying solely historic and artistic values, its Brazilian counterpart includes all the modern values, even at this early stage, of urban heritage conservation: economic, cultural, historic and natural (Dalmas et al., 2015). As Canani (2005) explains the 25/1937 law specifies that when verifying each building or monument, it is necessary to question what values it represents, which attributes justify its existence, and what kind of relationship it fosters with the local people, thus addressing the existence, bequest and option values of urban heritage. Decree-Law 25/1937 also made a first allusion to the concept of historical areas, neighbourhoods, sub-cities or city-centres (*tombamento do conjunto urbano*) to be inscribed in any of the four books. Article 17 of 25/37 specifies that in the neighbourhood of the listed building 'it is not possible to … make a construction that prevents or reduces visibility' (Presidência da Republica Brasil, 1937). Similar to the English and Italian cases, this perimeter around listed buildings exists but remains ad-hoc. The 25/37 Law has been commended by many (Batista & Macedo, 2010; F. F. da Silva, 2012). Despite its age, its concepts, regulations and purpose are clear, remaining relevant even now. On the other hand, the Lebanese law, which has only been partially updated since its inception in 1933 presents many limitations. While heritage is logically included in its mandate, it is not specifically addressed making the protection it lends the historic environment debateable.

2.3.2.2 The evolution of legislative systems

Conservation planning evolved very differently in our two southern contexts. While notions of heritage areas in Brazil developed similarly to our northern case-studies, in Lebanon the political will towards conservation was sporadic and rarely followed through.

Following the 1937 law, Brazilian municipalities started pursuing conservation at the local level in the 1970s. In Rio, Lucio Costa lobbied to change the concept of urban conservation from isolated buildings to urban heritage areas. Contemporaneously Rodrigo Mello Franco was active within the National Institute of the Historical and Artistic Heritage (IPHAN) based in Rio, and advocated the concept of urban fabric and buildings as homogenous ensembles (Batista & Macedo, 2010; R. C. M. Da Silva, 2012). Efforts were then made to advance conservation planning through urban law. Similar to the French and Italian systems, Brazil inserted conservation within its zoning policies. Brazilian zoning delimited areas of historic, artistic or environmental value (Afonso da Silva, 1968). Law 3.289/1983 created zoning for the protection of urban areas of cultural or landscape value and demarcated them as undevelopable. Law 10.829/1987 outlined that all urban master plans should have four areas. The most relevant for our study was the monumental zone, the area featuring the main characteristics of the city's urban design (F. F. da Silva, 2012). In many ways this is very similar to Italian historic centres, however, it does not receive as much attention in the literature.

In Lebanon, similar efforts were made to advance conservation planning, partly through laws of urbanism and construction. Beirut's Urban Master Plan (1964) initiated a concern for conservation of historic areas. During Amin Gemayel's (1982-88) mandate as president, two decree-laws were issued. The law of urbanism 9/9/1983 n°69 required the delimitation of archaeological areas and other historic zones presenting aesthetics, historic or ecological value (Hamdan, Lamy-Willing, & Yazigi, 2012). The law of construction 16/9/1983 n° 148 subjects buildings of historical importance to construction permits to be evaluated by the General Directorate of Antiquities (Fischfisch, 2011). Other attempts in Lebanon were through decentralisation efforts. Article 74 of the municipal law of 1977 stipulates that the mayor has the obligation to protect historic monuments. The municipality was given responsibility to financially participate in the conservation of both public and private buildings in their municipal perimeters (Hamdan et al., 2012; Hanna, 2010).

Although our case-studies present similarities, while historical zoning was incorporated in many city plans in Brazil, the zoning of Lebanon today covers only 16% of the territory (UN-Habitat, 2011). The non-regulated parts are entirely developable, and policies applied to regulated sections are commonly disregarded (whether addressing conservation or other urban concerns) (CDR Interview) (Tyan, 2012). This lack of regulation gives way to high exploitation coefficients, parcel amalgamation and the construction of large highways through historic urban areas (SBH and APLH Interviews). Beirut's Master Plan has not been updated since 1964, and most efforts to amend it or to introduce a new Master Plan have been hindered by political pressure (Ashkar, 2018). Examples of municipalities who conceptualise urban heritage's touristic economic potential are rare (Akl & Davie, 1999). Very few municipalities comply with the 1983 policy and countless road routes that disrupt the historic urban fabric have been approved by local authorities (CHUD Interview).

During the Lebanese civil war (1975-1990) the centre of Beirut was gravely damaged. Many buildings, such as those constructed under the French mandate, were perceived as symbols of a blamed political order rather than as part of the nation's identity and were the target of hostile factions (Tabet, 2001). Beirut as a whole, however, maintained a certain coherence, with only an estimated 10% of buildings destroyed (Tabet, 2001). It is in fact often argued that although the destruction of Lebanon's urban heritage began during the war, it only really boomed during its reconstruction (Akl & Davie, 1999; Davie, 2001, 2004). This is in contrast to Europe, where the urban destruction of the Second World War led to the development of modern town planning with conservation as part of the conversation, suggesting different outcomes for conservation planning depending on the nature of war (civil or between nations). This echoes the work of Bevir and Rhodes (2006, 89) who note how inherited traditions can be disrupted by crises of identity making it difficult to formalise these values.

The shift in the conception of UHAs as an integral part of cities was attempted after the war with little successes. It was not until 2008 that a new law was established to enlarge the conservation of urban fabric (Hanna, 2010). This legislative project was led by Ghassan Salamé, Minister of Culture (2000-2003) with the aim of recognising the notion of architectural value and urban ensemble to be protected and developed with a master plan for cities adapted to the Lebanese case (LOCE and UNESCO-LB Interviews). Article 2 of the 2008 N.37 law on cultural goods enlarged the heritage sector to cover urban fabric, it recognised the 'historical, scientific, aesthetic, architectural or symbolic value, whether religious or secular' of many immoveable properties including 'structures, landmarks, edifices, buildings, or part thereof' (International Foundation for Art Research (IFAR), 2014). Although a more inclusive definition of urban heritage was now ratified, underlining the different intrinsic values of immoveable objects, bylaws were never issued to provide a framework for its operation and management (SBH Interview). As yet no precedent has been set for its application, making it very difficult to be used to protect UHAs. This is one of many examples that characterises the evolution of conservation planning in Lebanon, although societal desires are present, as seen in NGO activism (SBH and APLH interviews), political will is rare, and most often lacks follow through mainly because of the aggressiveness of real estate as Lebanon's biggest economic driver (Hanna, 2010; Krijnen, 2010; Krijnen & Fawaz, 2010). The economic and intrinsic values of urban heritage are secondary to economic exploitation of land and financial speculation (Figure 1) and the potential of urban heritage to create prestige or revenue is not taken into account, as the culture and local values of the market do not support this.

The shift in the conception of UHA's in Brazil has been more successful. Article 215 and 216 of the Constitution of 1988 departed from the use of the word monument to refer to 'urban complexes and sites manifesting artistic-cultural value' (F. F. da Silva, 2012). It also expanded the definition of value by stating that heritage is all things 'bearing reference to identity, action, memory of Brazilian society' (Batista & Macedo, 2010). It further designated all sites retaining historic references to quilombos communities (slaves) (F. F. da Silva, 2012), reflecting the incorporation of diversity into the values that underpin conservation in Brazil (PROURB Interview). The 1988 Constitution also laid the groundwork for the 2001 evolution of conservation planning. Although Brazil does not place urban heritage within the remit of environmental, as does Italy and France, Article 225 of the 1988 Constitution underlined the right of everyone to an ecologically balanced environment, requiring federal entities or municipalities to include environmental analysis in their creation of conservation areas (Castriota, 2008).

The 10.237/2001 *Estatuto da Cidade* - City Statute law builds on the 1988 Constitution to create a new legal urban order to provide land access and equity in large urban cities. The main concept behind many of the instruments of the City Statute is that all property has a social function and in that manner, land is seen as much as a public good as a marketable one, recognizing the existence and bequest values of areas (R. C. M. Da Silva, 2012; F. F. da Silva, 2012). Special Interest Districts (SID) can be registered within this law with different foci: social, environmental, cultural or functional. Cultural Special Districts are most often the ones more closely tied to urban heritage, and include specifications of the types of preservation for each building within them (R. C. M. Da Silva, 2012). Districts inscribed for cultural values are known as APAC in the city of Rio de Janeiro and are most often established by the Rio General Department of Cultural Heritage (DGPC) which is part of the Municipal Secretary of Cultures (R. C. M. Da Silva, 2012). Article 123 of the City Statute specifies that urban areas can also be inscribed for their environmental value, for example, in Rio de Janeiro, vegetation plays an important role in the memory and identity of the city (Batista & Macedo, 2010). Article 123 therefore promotes and respects locally derived values of preservation.

In Lebanon other attempts were made to further conservation at a city level. In 1995 in Lebanon, the Council for Development and Reconstruction (CDR), at the request of the Minister of Culture Michel Eddé and with the assistance of the Lebanese Association for the Protection of Sites and Historic Monuments (APSAD), inventoried 1,016 houses built between 1860 and 1943 in the peri-central area of Beirut and proposed classification (Tyan, 2012). The list formed the first reference of a census of heritage buildings in Beirut, and the basis on which the Ministry of Culture requested the Governor of the city to take temporary measures to freeze demolition. This measure led to a massive campaign organised by the owners, in which they demanded that the state either overturn its decision or provide compensation for the injustice and subsequent economic damage caused by the freeze (CDR Interview) (Akl & Davie, 1999). Giving way to socio-political pressure, and the values of private property and highest and best use, the CDR restricted the inventory, whereby 592 properties were freed from registration and only 459 buildings divided into five categories (A, B, C, D & E) remained (Resolution No. 97/12 on 2/6/1997) (Table 3 Appendix).

In 1999, after continuing pressure, D and E were also eliminated from the list by official decree (No. 32 on 3/3/1999). This was done by claiming that the buildings lacked a cultural component, thus limiting urban heritage's definition and thereby its embedded value to a cultural one (Council of Ministers Lebanese Republic, 2010). A decree was also later signed that closed this inventory, meaning that no institutional entity could add buildings to be protected (SBH and APLH Interviews). In 2010, the Council of Ministers commissioned the CDR to conduct a comprehensive study of the buildings under frozen demolition, recommending the release of buildings not having a cultural component. This progression reflected negatively on the unity of the few remaining traditional neighbourhoods in the city of Beirut. As interviewees lamented (CDR, UNESCO-LB, SBH Interviews), in Beirut, conservation planning never really took on a broader scope and has mostly failed in recognizing the value of urban heritage fabric, with some successes for isolated buildings. Some ad-hoc conservation measures succeeded in providing protection for some small contiguous areas of urban fabric. For example, the Director of the DGU, Joseph Abdel Ahad, succeeded in establishing the perimeter of Gemmayze before he retired (2010) thus limiting the coefficient of exploitation for the area (APLH Interview).

Most recently, a cleverly-contextual legal attempt was made to protect the few remaining heritage buildings by utilising the nation's tendency towards land exploitation. This approach is closely tied to the TCE (Total Coefficient of Exploitation) of the city, which determines how high one can build on a parcel of land. In 1971 Beirut changed the TCE of its city centre to 6, approximately 160-180m high, equivalent to the buildings of *La Défense* in Paris (Ashkar, 2018; Hanna, 2010). This very high coefficient was later suppressed and planning law accorded no coefficients or formal height restrictions: the sky was the limit. This law approved on 12/10/2017, allows for the Transfer of Development Rights (TDR), meaning that an owner may sell the undevelopable portion of their protected parcel (air rights) to someone else who is then allowed to build the same quanta of development elsewhere in the city (Hilton, 2017; Saade, 2017). This allows owners to keep their heritage building while benefiting from the development value of their land. In return, selling the TDR gives owners the necessary revenue to engage in renovating their building (Beirut Municipality Interview) (Saade, 2017). Although this approach in no way attempts to preserve the few remaining heritage areas as a whole, it is a last resort to protect individual buildings. We cannot comment on the implementation of this legislation, as the government has yet to ratify it, similar mechanisms have been successful in contexts presenting similar land exploitation difficulties. In Brazil, the City Statue includes clauses regarding the purchase and transfer of property rights for buildings having to maintain their original form (R. C. M. Da Silva, 2012). The TDR makes possible to transfer or sell the unused portion of a building to a site in another area defined by the city's urban master plan (R. C. M. Da Silva, 2012). An Interviewee commented that such mechanisms should be further developed in contexts like Rio de Janeiro to create a better balance between those who profit from urban development and heritage building owners, for a more equal city paradigm (Rio Municipality Interview). This regulation offers an excellent window into locally derived values that seek to both preserve heritage as a living memory in the city, but also acknowledge the financial costs of doing so.

2.3.3 Heritage in space

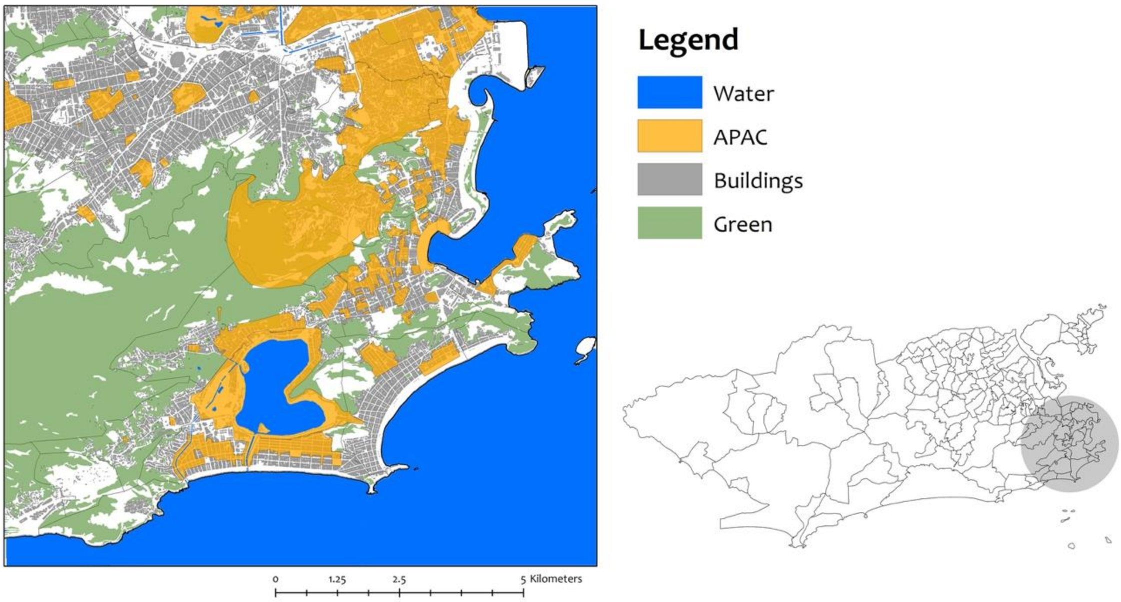
2.3.3.1 Heritage counts

Spatially, conservation planning in our two southern contexts plays out very differently. Lebanon's attempts at classifying historic buildings is very sporadic, with only 37 monuments and architectural elements classified through decree on the General Inventory of Historical Monuments between 1934 and 2002, and 1,367 listed through orders for the entire country (DGA Interview) (Toubekias & Dentzer, 2009). Data on the number of nationally listed buildings in Beirut is unavailable and just over 200 buildings from categories A, B, C of Resolution No. 97/12 on 2/6/1997 have escaped demolition (APLH Interview). There are no formally inscribed UHA's areas in Beirut, a few streets were identified as part of the only real attempt to further UHA legislation in the 1990s, but the only result was the Municipality's marking of roads in question with signs saying '*Rue à caractère traditionnel*' (road with traditional character). Rio de Janeiro on the other hand, presents numbers much closer to our European examples. The General Department of Cultural Heritages (DGPC), part of the Municipal Secretary of Cultures, is Responsible for preservation of over 2,000 listed buildings (*bens tombados*), 10,000 minor listed buildings (*bens preservados*), and over 90 UHAs (APAC), numbers close to the amount of listed buildings in London (IRPH, 2018).

2.3.3.2 Spatial Construct

Figure 6 and Figure 7 demonstrate the great differences in size and extent of UHAs in Beirut and Rio de Janeiro determined by the evolution of legislation. APACs in Rio de Janeiro are concentrated in the Central and Southern districts of the city, with a few recently inscribed in suburban neighbourhoods such as the APAC de Marechal Hermes (N° 37.069/2013) (IRPH, 2018). UHAs range from small delimited areas, similar to London, to much larger areas such as the APAC of Santa Teresa (L.495 - 09/01/1984 N° 5.050/1985), which not only covers Rio's Montmarte typical 19th century and belle-époque buildings, but also part of the mountain going up to Cristo Redentor (IRPH, 2018). Part of the Santa Teresa APAC was also inscribed as a Cultural Landscape on the World Heritage List in 2012 (UNESCO, 2012). In the central areas of the city, many of the APAC have contiguous borders, resulting in larger designated areas, for example the *Corredor Cultural* neighbours the Cruz Vermelha APAC and the Arcos de Lapa (Borde & Sampaio, 2012). Unlike our European case-studies (with the exception to some extent of England and the mezzogiorno in Italy), despite the considerable spatial extent of UHAs within Rio, the enforcement of the regulation varies greatly, this often depends on the local population's support of the preservation of their neighbourhood and is not helped by the lack of management plans for any of the Rio UHAs (PROURB and Rio Municipality interviews).

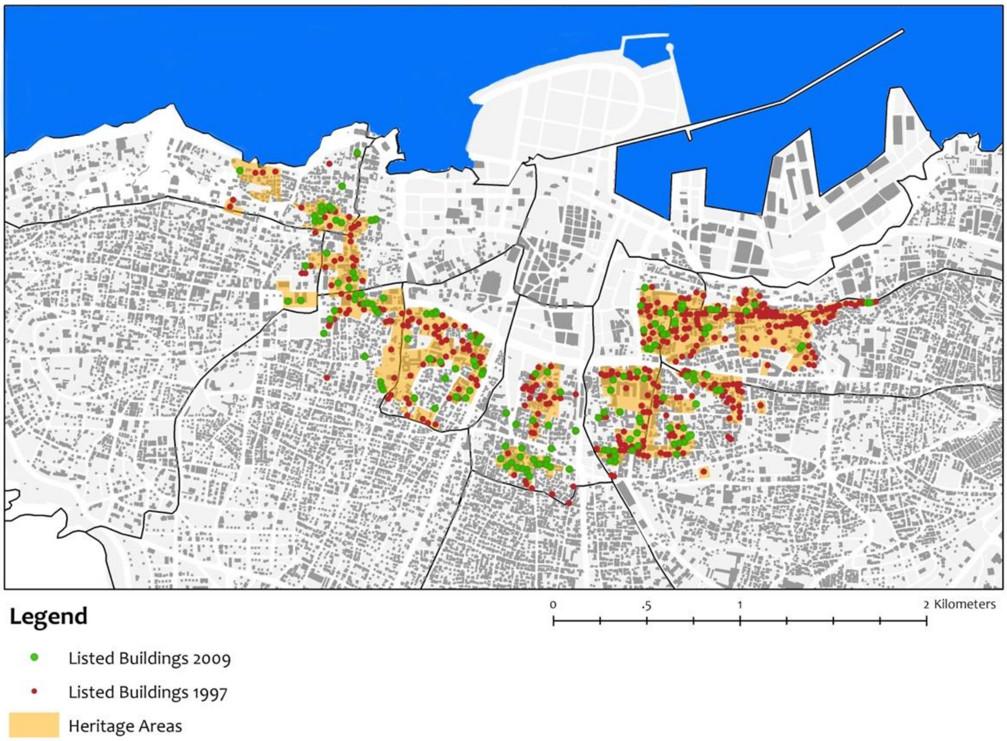
Figure 6 Rio de Janeiro



Note: Data from *Prefeitura do Rio de Janeiro*

Between all our case studies, Beirut presents the weakest example in terms of the spatial extent of its conservation planning. As illustrated in Figure 7, of the individual buildings locally listed in 1997 (Resolution No. 97/12 on 2/6/1997) few remained in 2009 and even fewer today (Pietrostefani, 2015). The UHA clearly identified around these clusters of heritage buildings are marked by signs denoting 'roads with traditional character' but remain mostly as nostalgic reminders of a historic urban fabric which is no longer intact, and their protection is in no way enforced (CDR and APLH Interviews).

Figure 7 Beirut



Note: Data from Majal – Academic Urban Observatory. Academie Libanaise des Beaux Arts. Red points mark buildings identified and listed in 1997 that are now demolished. Green points mark buildings identified and listed in 1997 that were still existing in 2009, few of which still remain today.

We observe clear differences in the spatial demarcations of UHAs in our two southern examples. While UHAs in Rio are well-defined and spatially extensive, in Beirut although an effort at defining UHAs was attempted, its formalisation through legislation was not followed-through. Heritage is morphologically valued differently in Beirut and Rio.

Despite different evolutions of conservation between Rio and Beirut, in practice, as we shall see in section 4.4, the planning issues at stake present many parallels. In Rio, even though spatially preservation is extensive, in practice regulation is not necessarily respected and conservation of heritage buildings is in many cases more closely tied to local will and real-estate pressure than legislative presence (PROURB Interview). Borde & Sampaio (2012) observe discontinuity within the Rio's urban fabric, typified by significant morphological contrasts: narrow lanes of the original neighbourhoods cut by wide avenues of the twentieth century; heritage houses preserved as a backdrop of recent skyscrapers driven by densification (Guimaraens, 2002); urban voids and buildings in an accelerated state of degradation driven by the densification of the centre of Rio (Guimaraens, 2002). The extensive legislative mapping is thus not necessarily what can be observed with the naked eye and is not representative of conservation planning in practice, highlighting the paradoxes of the Carioca urban planning process. Similar tensions are also wide-spread in Beirut's urban fabric.

2.3.4 The value of land vs. urban heritage value

While for our northern case-studies, systems are characterised by the extent of conservation planning constraints and differences in designation according to the level of government involved. In our southern case-studies, we become more aware of the luxury of conservation in light of the greater need for urban development in fast-growing cities (Cheng, Yu, & Li, 2017; S. L. Lee, 1996). We are also continuously reminded of the pronounced economic and political choice to value land and economic speculation, over valuing urban heritage. Therefore, conservation planning in our southern cities is characterised by a pitched conflict between the value of land for redevelopment and the value of heritage practiced through regulation. This is of course, a struggle that exists in our northern cities as well, as previously illustrated in the case of London (section 3.4) but is more muted in this case. Having discussed the extent of the constraints of northern conservation planning, we now find ourselves unpicking the degree to which an absence of constraints illustrate how urban heritage is valued within our southern contexts.

2.3.4.1 The role of public officials

Despite the advancement of conservation planning in Brazil, a series of institutional and economic complications make its implementation difficult. Castriota (2008) argues a disarticulation of the various bodies responsible for the preservation and administration of Brazilian cities. In the case of Rio, the federal (IPHAN), state (INEPAC (State Institute of Cultural Heritage)), and municipal (of DGPC (Municipal Council - General Department for Cultural Heritage) authorities often do not successfully collaborate. Interviewees (IRPH and PROURB) argued that this dis-articulation has generated a large number of un-registered buildings and limited the efficient implementation of legislation in practice. They noted that land division has contributed not only to changing the spatial configuration of Rio but has created difficulties that go far beyond conservation. This suggests a conflict between the urban heritage values recognised in legislation and how value recognition plays out in practice.

Beirut is characterised by the opposite tendency. While Rio presents too many actors and the lack of coordination between them, Beirut reveals a system where the decision to value UHA can be overturned by one person. The Lebanese Council of Ministers pass legislation, but its implementation falls to the Ministry for Culture. Proceedings of conservation planning therefore depend greatly on the minister in charge and so are intimately tied to personal agendas and changing political will (Hamdan et al., 2012). The formality of policy and value are thus not immediately intertwined, the difficult and capricious reality of politics, especially when tied to an individual, can therefore disrupt this relationship. When regulation is not enforced, conservation is often rendered an even more political decision, especially in cities which are ultimately political actors (Tunbridge, 1984). Actors may comply with a policy that is inconsistent with, even opposed to, their beliefs, or they may sidestep the implementation of policy because of their convictions (Bevir, Rhodes, and Weller 2003, 193). The opportunities and constraints linked to conservation planning not only depend on how regulations are set up, but in what context and to what degree they are implemented. As Bevir, Rhodes, and Weller (2003, 193) argue 'we cannot properly understand a political practice solely by its legal character', and so we must attempt to consider how it actually plays out. Although regulation is often a key first step: it is difficult for conservation, unlike some other urban concerns, to be effected through informal means.

2.3.4.2 A tendency towards demolition

As conservation often entails keeping exploitation rates low, maintaining conservation areas in highly dense cities is another challenge for public officials. This marks a difficulty in integrating heritage in urban policies in practice (Batista & Macedo, 2010; Castriota, 2008).

In the 1940s, the creation of the Avenida Presidente Vargas in Rio, justified the demolition of hundreds of townhouses, entire blocks of colonial fabric, a ninety-meter strip of one of Rio's parks (Campo de Santana), and the dismantling of two churches (Borde & Sampaio, 2012; Ribeiro & Simao, 2014). Praça Onze, another space of great symbolic value for Carioca urban culture, a site of carnival parades and a public space for immigrants and newly freed slaves, was also eliminated. The decision was controversial as it prioritised urban redevelopment and modern aesthetics over an urban fabric with evident sociocultural value (Borde and Sampaio, 2011). This was the beginning of a trend, which flourished in the 1970s, where high-rise buildings became symbols of progress and modernity (R. C. M. Da Silva, 2012). As a consequence many important historical buildings were demolished and substituted for modern ones (Rojas, 1999). Accounts from the Monroe Palace demolition in 1975 frame it as an effort to remove decay and abandonment from the city, placing these values above the historic importance of the site (Paraizo, 2004). However, an interviewee (PROURB) argued that this, as many other examples, was just a justification for clearance, which concealed more speculative and political ambitions. Moreover, damage was not limited to buildings. In 8/18/2009 Judge Herman Benjamin in the Brazilian Superior Court of Justice stressed how damage is not limited to structural harm, but includes mores systemic damage to the environment as a whole (Miranda, 2017). These comments were being applied to the irregular conduct of a real-estate company in Rio de Janeiro who had damaged the vegetation of an UHA, affecting the environmental value of the location.

This tendency to demolish, indicating how land and its exploitation is valued more than urban heritage value, is also present in Beirut. Recent work by Gebara, Khechen, & Marot (2016) maps Beirut's demolition-based urban restructuring where approximately 78% of authorised construction was based on redevelopment, much of this on plots that contained heritage buildings. This figure rises in the neighbourhoods of Mazraa (90% of urban reconstruction is demolition-based) and in the historic quarter of Zokak-El-Blat (85% demolition). This is also illustrated in Figure 7 in section 4.3.2. Owners of heritage buildings in Beirut often see no point in renovating in the absence of subsidies and given they are unable to increase ground rent from these buildings, they often engage in legal or illegal demolition (Krijnen, 2018b). This tendency towards demolition suggests that in many cases, land value and the economic benefits to be made from it trumps the preservation of urban heritage values.

In the introduction of this paper we proposed that the more urban heritage is exploited, the greater the loss of its intrinsic value (Zouain, 2002, 221). Thus, to support a 'living' urban heritage, there is a constant search for equilibrium between the two curves that allows for economic benefit to occur and patrimony to be respected. However, while the over-regulation of urban heritage or 'museumifying' UHA may be argued for the cases of northern Italy and France (Choay, 1992), in our southern case-studies, economic exploitation does not come from the building itself but from the land it is built on (Ost, 2009). The greater the exploitation of land, the greater the loss of all heritage values, both intrinsic and economic, where a heritage asset's possible future value is lost (OECD, 2007).

2.3.4.3 Dissonance between legislation and practical urbanism

In the 2000s legislation for new building construction became more flexible in Rio, stimulating the construction business. Real-estate developers wanted to maximize legally permitted land use (R. C. M. Da Silva, 2012). Since 2005, the central area of Rio de

Janeiro has therefore seen increasing real estate projects. State led infrastructure projects have also contributed to accelerating the processes of urban transformation (Borde & Sampaio, 2012). Although many buildings escaped demolition through regulation, many others, especially in economically challenged UHAs suffered from deterioration and obsolescence. Townhouses in these areas are often internally demolished to respond to the expanding demand for parking, and given the growing demand for housing, old buildings in degraded conditions are often occupied (IPHAN Interview).

The port zone of Rio (APA SAGAS) for example retains significant historic references to quilombos communities (ex-slaves). However, it has undergone great transformation. Substandard and informal housing predominates in much of this area, with heritage buildings abandoned and degraded (PROURB Interview). The Municipality of Rio then pushed for rehabilitation of the district in an effort to reintegrate it in the more dynamic sections of the city through the Projeto Porto do Rio published in 2001 (Soares & Moreira, 2007). The plan has been implemented very slowly and it is argued that the area's urban heritage is de-naturalised and under-protected because of Olympic investments (Borde & Sampaio, 2012) (PROUB Interview). Moreover, the lack of public resources for social housing represent a great threat to the permanence of local families and heritage streets such as Rua São Francisco da Prainha.

In fact, although many neighbourhoods in Rio welcomed APACs for the protection they afford built heritage, in some areas there was fierce opposition. The elected mayor in 2001, Cesar Maia, promised a suspension of licensing of new buildings in his campaign, and once elected as he could not change legislation he declared an APAC though mayoral decree (R. C. M. Da Silva, 2012). The neighbourhood of Leblon was thus designated. This started a power struggle between local NGOs and pressure-groups and construction firms who argued this suffocated the real estate market and would bring unemployment and economic losses. Much of the local population was also not happy, as APAC prevented modifications to their properties and hindered them from selling (Rio Municipality Interview).

Similar examples exist in the Beiruti context. Real-estate promoters able to operate with impunity have destroyed many buildings with high heritage value (Akl & Davie, 1999). In 2004, the Lebanese building law (Law 646/2004) allowed for more intensive land exploitation (El-Achkar, 2011; Krijnen & Fawaz, 2010), increasing potential ground rents, especially in areas of the city characterised by low-rise rent-controlled (often heritage) buildings (Krijnen, 2018a; Krijnen & Fawaz, 2010). Real estate developers started acquiring multiple plots, merging these in order to create larger ones to circumvent maximum building heights (Krijnen, 2018a; Krijnen & Fawaz, 2010). The economic logic of land thus became much stronger than the recognition of patrimonial value; urban heritage is in fact rarely exploited in a commercial logic through boutique hotels and restaurants in Beirut (Ziad El Samad, 2016; Zouain, Liatard, & Fournier, 2011). As argued by Barton et el (2013), if a high proportion of a city's economy is linked to construction, net income sacrificed to conservation will be high and cities in urgent need of economic growth will not be willing to make the sacrifice. In 2017, the real estate sector made nearly 15 % of the Lebanese GDP with no capital investment in infrastructure and transport (CEIC, 2017; Fransabank, 2017).

As in the case of Leblon in Rio, local NGOs, neighbourhood associations and academics have put pressure on the local government in Beirut in an attempt to halt new developments in neighbourhoods considered to have heritage value, even those not formally inscribed. So too in Mar Mikhael, heritage based activism was widespread (Ashkarian, 2012; Fawaz, Krijnen, & El Samad, 2018). However, given the lack of legislation or municipal will to limit high-rise development the neighbourhood's morphology has changed significantly (APLH Interview), as evidenced by the Laziza factory complex, the first brewery of the middle east, which was demolished in (2017) to construct high-end condos (Ghorayeb, 2017). In both Rio and Beirut, non-governmental and community based organisations have thus increasingly filled the role of government agencies in light of questionable enforcement or lack of legislation (R. C. M. Da Silva, 2012; Hanna, 2010). The necessity for civil action in both cases is warranted and again suggests that it is not possible to determine value purely through legislation (Rojas, 2002). In many ways, NGOs are leading the governance of conservation planning Balbo (2014, 282). Huybrechts & Verdeil (2005) have argued that Lebanon is a weak state with a strong society: value is present but a pattern of appropriation not designation shows more about urban heritage value (Rautenberg, 2003). Heritage *appropriation* is key to survival of Lebanese urban heritage, despite this method's obvious limitations of being easily halted by government (CDR and CHUD Interviews).

2.3.5 Conclusion southern case studies

Reflecting on our southern case-studies we see two conservations systems that despite diverging greatly in terms of the development of their formalisations (legislations), present many comparable outcomes on the ground. The Brazilian conservation planning system is comparable in detail and geographical extent to some of its European counterparts, presenting a system of consistent inscription mentioning all intrinsic values. Indeed, from the first instance, Brazilian legislation envisions conservation planning as an integral part of urban planning. The Lebanese system, on the other hand, is characterised by outdated and un-enforced legislation. Even recently proposed laws lack the related bylaws to provide a framework for the operation of urban heritage areas, or indeed the protection of single heritage buildings. Despite these differences, in practice, both contexts present cases where exploitation of land values often precedes the integration of conservation planning in city dynamics. The development of new cities trumps conservation and land value and the economic benefits to be made from it outplay valuing urban heritage.

Some could argue that the reason why this imbalance is more pronounced in our southern examples than our northern ones may be linked to the historicism of conservation in our European examples. Did conservation planning not develop fast enough in the Global South? Given the advanced development of the Brazilian system, we suspect this is not the case. The imbalance is more likely driven by questions of economic growth rather than legislative development. The question of the preservation of our cities is more political than legal in these cases and determining value solely through legislation is difficult. Non-governmental bodies or social movements often advocate for conservation more than formal planning bodies and are very significant in our understanding of value of UHAs (Krijnen & Fawaz, 2010; Minnery et al., 2012). As defined by Rautenberg (2003), before *designation* occurs, a form of *appropriation* materialises through non-governmental actors. In cases where the state is weak or lacking, urban governance, including when it comes to questions of urban heritage value, may have been taken over by independent entities (Balbo, 2014; Mitlin & Satterthwaite, 2013). This does not mean legislation should be overlooked as a tool that identifies value altogether. Interviewees maintained that the degree of articulation of urban and patrimonial policies remains fundamental to the viability and success of its management, mainly because non-governmental bodies could not guarantee continuity (LOCE and PROURB Interviews) (Borde & Sampaio, 2012). The greater number of successes found in Rio compared to Beirut were certainly aided by the viability of the conservation system.

2.4 Conclusion

Our paper illustrates the complexities of heritage conservation, its integration into planning regulation, the implementation of these regulations and ultimately what this tells us about how society defines value in the context of conservation. We did this through an analysis of five case studies located in both Global North and Global South cities so that the complexities of regulation and context could better emerge. As we have shown there is no simple model that is particularly Northern or Southern, as variegation always exists. All of our cases began their journeys from similar points of departure, but each then proceeded in slightly different directions based on local contexts, producing different results. This is perhaps not unexpected, but it lends further weight to the work that eschews ideas that *patrimonialisation* is a European ideal merely applied in colonial contexts (Choay, 1992). While it may be true that 'heritage creation' emerged first in Europe, the development of regulations, the implementation of these rules and the histories and communities surrounding them are very much local and therefore produce place specific outcomes. We contend that the embedded histories of urbanism, planning regulation and the invention of a conceptualisation of what heritage means develop both separately and in parallel in each nation state. Whether urban planning and its practice links itself to the destruction of urban heritage ensembles or whether it attempts to preserve them, the concept of heritage emerges as a factor in opposition to dominant real estate models by becoming either an obstacle to the production of highest value or an element that needs to be factored into urban development.

In most of our case studies we can see to a greater or lesser extent how the exploitation of land values can create pressures to limit the importance of heritage. This is perhaps most pronounced in the Global South because there is greater dissonance between existing regulation and implementation of the policies in question. But there are also cultural and historical differences. In our European cases, UHA regulations gained significantly in prominence after the destruction of World War II (Mehl-Schouder et al., 2015; Scattoni & Falco, 2011). The reality of bomb damage and loss of patrimony helped to reinforce and solidify conservation, at least in part challenging a reification of highest and best use. France and Italy pursued stringent policies where UHAs became overlapping webs of protection or museumifying *historic centres*. In England UHAs were predominantly developed as a reaction against the destruction caused by the movement for housing modernisation after the war, which saw slum clearance layered with bomb damage. War brought different results in Lebanon, here buildings of the past were imagined as undervalued assets of a previous era and thus society valorised development more fully than it did heritage. These issues indicate the importance of context and history in the production of heritage value.

We therefore must take notions of context very seriously as it plays a substantial role in how urban heritage is 'created' and how it actively evolves (Smith, 2006). Planning cultures and historical geography influence national definitions of urban heritage privileging some built forms over others thus valuing them differently. In practice, conservation planning assumes many different meanings, bound in local context and the operation of the planning systems more broadly. Societal values impact planning decisions and in turn the outcomes of these decisions, further embed societal values until these values are disrupted through internal or external events.

Whilst historic monuments appear to be valued in all our contexts more heavily despite the evolution of legislation, the same cannot be said for UHA, where across the case studies, varying levels of valuation are apparent. This might be the expectation in our southern case studies, however what is interesting here is that adequate protection is not always or necessarily tied to an elision between the planning system and conservation regulations. For example, in our Northern cases contextual factors like corruption, lagging local economies and issues with enforcement have seen in some cases, considerable levels of heritage decline. As we see, the split between northern Italy with its more rigid application of existing regulations and the south where views are laxer has resulted in the abandonment and degradation of listed buildings in the mezzogiorno. In England, where UHAs are inscribed more locally and where planning enforcement is often a case of spotting an infraction with a fairly under-resourced team; conservation areas can often quickly degrade leading them to be put on the *Conservation Areas at Risk* register (in 2018 roughly 5% of all CAs were considered to be at risk).

As noted by McFarlane (2010), there is a tendency in certain strands of urban planning to seek out models and apply them in different contexts. Most dangerously following on a rhetoric of northern policy models, being applied and often failing in southern contexts. Our paper has continued in the line of research attempting a critique of such trajectories, towards a comparative urbanism of *all* urban national contexts as distinct units, explaining similarities and differences between them. By revealing 'assumptions, limits and distinctiveness' (McFarlane, 2010) of conservation systems, we support the formulation of new lines of inquiry and more situated accounts, ultimately encouraging systems to learn from each other. When explaining the ultimate scope of this paper to interviewees, many indicated the final comparative output would be useful to inform the limits and advantages of their own conservation planning practices.

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2.6 Appendix: The politics of conservation planning

Table A1 List of Interviews

#	Institution or Organisation	Ref. within text	Country	City
1	Historic England	Historic England	UK	London
2	Greater London Authority	GLA 1	UK	London
3	Greater London Authority	GLA 2	UK	London
4	Hackney Borough - London	Hackney Borough	UK	London
5	Ministry of Cultural- National Directorate of Heritage and Architecture	Ministry of Culture France	France	Paris
6	Territorial services of architecture and heritage (Services Territoriaux de l'Architecture et du Patrimoine STAP) Paris	STAP Paris	France	Paris
7	Territorial services of architecture and heritage Services Territoriaux de l'Architecture et du Patrimoine STAP) Ile-de-France	STAP Ile-de-France	France	Ile-de-France
8	Paris Town Hall (Mairie de Paris)	Paris Municipality	France	Paris
9	Ministry of Sustainable Development (Ministère de l'Écologie et du Développement durable)	MSD France	France	Ile-de-France
10	IAUV (Academic)	IAUV	Italy	GN/GS
11	MiBAC Milano (Regional Ministry of Culture)	MiBAC	Italy	Milano
12	Lombary Regional Government	Lombardy Region	Italy	Milano
13	Urban heritage legislation expert	CLS	Italy	Milano
14	Constitutional and urban heritage law expert	CE	Italy	Milano
15	Politecnico di Milano expert	Politecnico	Italy	Milano
16	Representative of UNESCO and ANCSA	UNESCO/ANCSA	Italy/France	Paris
18	Cultural Heritage and Urban Development in Lebanon Project	CHUD	Lebanon	Beirut
19	Representative Permanent Delegation of Lebanon to UNESCO	UNESCO-LB	Lebanon	Paris
20	Representative of the Association for the protection of Lebanese Heritage NGO	APLH	Lebanon	Beirut
21	General Directorate of Antiquities, Lebanese Ministry of	DGA	Lebanon	Beirut
23	Project Manager at Council for Development and Reconstruction	CDR	Lebanon	Beirut
24	Beirut Municipality Council	Beirut Municipality	Lebanon	Beirut
25	Save Beirut Heritage NGO	SBH	Lebanon	Beirut
26	Lebanese Order of Civil Engineers	LOCE		
27	Rio Heritage Institute (Instituto Rio Patrimonio da Humanidade)	IRPH	Brazil	Rio
28	National Historical and Artistic Heritage Institute Brazil	IPHAN	Brazil	Rio
29	PROURB - Universidade Federal do Rio de Janeiro	PROURB	Brazil	Rio
30	Municipality of Rio	Rio Municipality	Brazil	Rio

Paper II

3 Conservation Planning and Informal Institutions

3.1 A story of heterogeneity

Architectural beauty, whether historic or modern, can be considered a local public good and amenity. Urban heritage is the category of heritage that most directly concerns the environment of every person. Living within or in close proximity to urban heritage areas is thought to provide a number of welfare benefits. Similarly to other planning policies addressing local public goods, heritage preservation policies solve an economic coordination problem. Conservation planning corrects for market failures and internalizes positive externalities, by preserving spaces of particular heritage value or architectural beauty which might otherwise be subject to considerable urban change because of market pressures to exploit land in attractive places.

Italy is famously known for the richness of its urban heritage, which has been argued to be a valuable public asset throughout the country by countless experts (Albrecht & Magrin 2015; Bonfantini 2012; Bandarin & Oers 2012). Italy presents a longstanding conservation planning system, with well-developed policies and strict regulations. Article 9 of the Italian Constitution states the need to protect and enhance both the landscape and the historical and artistic heritage of the nation (Cosi 2008; Trentini 2016). Conservation policy takes three main forms in this context: individual architectural designations (Nasi Law n. 185/1902), Landscape Areas (LAs) (Law n.1497/1939) protecting landscapes in both natural and urban settings, and Historic Centres (HCs) embedded in Italian urban policy through zoning (Bonfantini 2012). These regulations impose considerable limitations on how the urban environment can be modified within these areas, in order to preserve the sociocultural and historic values of urban fabrics. It has in fact been argued that conservation planning is one of the contributions to have been made by Italian urbanism (Balducci & Gaeta 2015).[23]

Non-compliance with planning policy undermines its effects. Little is known, however, as to how much harm non-compliance actually does. Italy presents a context where,

[23] 'The Italian modern movement not only saw the historic city as unreplaceable part of the city to be preserved, but as a model of inspiration for the design of the modern city' Giuseppa Fera in Ernesti et al. (2015).

despite stringent planning regulation, the conditions of the urban environment vary widely throughout the country, including within protected areas (ISTAT 2015). The presence of such heterogeneity in conservation areas has not, to this author's knowledge, been empirically explored to date, and neither have hypotheses that this variation could stem from non-compliance embedded in informal institutions. *Abusivismo* (AB) – illegal or unauthorized building and construction – is often argued to be behind heterogeneity in urban environmental conditions (Zanfi 2013), potentially undermining planners' efforts to preserve heritage externalities. This paper will explore the heterogeneity in urban heritage effects, delimited through conservation planning, and attempt to show how, at least partially, AB levels explain this heterogeneity. Is *abusivismo* putting one of the major urban amenities of Italian cities at risk?

Illegal or informal building is present in many countries; however, the precise phenomenon of AB is quite specific to Italy. AB is widespread, to the extent that it has assumed social and political importance (Biffi, Ciafani, Dodaro & Muroni 2014; Trentini 2016). AB can be described as a type of informal institution, given that it goes beyond simply ad hoc informal building behaviour and refers to practices which are widely followed and embedded within Italian societies. This follows Helmke & Levitsky (2004) who define informal institutions as socially shared rules, usually unwritten, that are created, communicated and enforced outside of officially sanctioned channels.[24] Specifically, this paper identifies AB as a competing informal institution, as defined by Helmke & Levitsky (2004), given its coexistence with ineffective formal institutions and divergent outcomes. Competing informal institutions structure incentives which are incompatible with formal rules, creating alternative norms (Della Porta & Vannucci 1999).

As an outcome measure of economic value, I concentrate on property prices which reflect the value buyers attach to all property characteristics, including the architectural or heritage value of a property itself and the area. By using the economic value embedded in property prices as an outcome variable, this hedonic approach has the advantage of building on a tradition of research estimating the capitalization effect of a wide range of local public goods or policies (Cellini et al. 2010; Eriksen & Rosenthal 2010; Gibbons & Machin 2008; Gibbons et al. 2013). The paper is divided into two subsequent analyses. I first investigate whether heterogenous price premiums can be

[24] This definition borrows from Brinks (2003) and is consistent with Carey (2000), Lauth (2000) and Christiansen & Neuhold (2012).

observed across the 55 cities and the 296 neighbourhoods under investigation, the underlying question being what this suggests about how urban heritage is valued across Italian regions. Robust evidence on potential benefits of conservation planning is scarce, and crucial for the economic justification of such planning policies. I then examine what drives the heterogeneity of heritage price premiums across cities, and attempt to assess whether heritage price premiums are reduced by rates of AB. This hypothesis can be substantiated empirically, the underlying premise being that places with higher AB are less compliant with urban policy and consequently experience lower external benefits. Conservation planning is a good example to examine because of the stringency of the policies attached to it. I hope this analysis will motivate other investigations of the relationship between restrictive zoning systems and citizen compliance. Despite recent efforts and the political will to fight AB and other forms of widespread illegal attitudes in Italy over the last 20 years, AB rates, among other outcomes, have not substantially dropped (ISTAT 2015).

To assess the heterogeneity of heritage price premiums and thereafter the reasons behind such variation, I make use of a two-step strategy which recovers price premiums by city in the first step and regresses the recovered premiums on AB rates in the second step. This methodology can in theory be applied to other contexts with stringent policies and which present similar heterogeneities. To collect price premiums by city for both Italian conservation policies (LAs and HCs), I exploit the fine spatial nature of a novel Italian data set of house prices and draw on the regression discontinuity design literature, in particular work that has exploited discontinuous changes at spatial boundaries (Gibbons et al. 2013; Ahlfeldt & Holman 2017). I establish a boundary discontinuity-inspired design (BDD) which allows me to account for unobserved location characteristics that could confound the heritage effect. In the second step, I explore how AB and other covariates affect both LA and HC price premiums.

I face two possible estimation challenges in this city-level second step. On the one hand, returns to abusive behaviour could be larger in highly valued areas, presenting a possible reverse causality issue and a negative bias in the results. On the other hand, possible omitted variables could be affecting both the heritage premium and abusive behaviour: AB is likely correlated with unobserved city characteristics. I address these endogeneity concerns using an instrumental variable approach. The main instrument used is a legal attitudes index (LAI) created by Tabellini (JEEA 2010) in his longstanding work on informal institutions. This index incorporates measures of trust, respect, control and obedience. The instrument mechanically gets around a possible reverse causality problem since it is unlikely to be affected by price premiums. It also addresses the omitted variable problem as it measures a range of attitudes which are good predictors of AB but not of price premiums. As predicted, results using the LAI as an instrument have slightly larger magnitudes than the OLS estimates. The estimates are, however, consistent overall, suggesting that the OLS results are quite robust. Accordingly, I re-run the entire analysis at neighbourhood level, using an alternative measure of AB that I am able to construct at a smaller spatial scale using census data. This alternative measure of AB is an index of urban law compliance, constructed by exploiting differences in numbers of pre-1919 buildings between 2011 and 2001, which are strictly protected by law. Re-rerunning my analysis at neighbourhood level allows me to identify the effect of interest from a comparable source of variation at a finer spatial scale (within cities), and to include city fixed effects to confirm that heritage price premiums are, at least partially, significantly reduced by non-compliance.

Comparing the discontinuities in property prices at the boundaries of both HCs and LAs, I find an average capitalization of about 6.5% (€160 extra per square metre) for LAs, and an estimated average premium of 3.5% (€86 extra per square metre) for HCs. Results show significant variation in heritage price premiums across Italian cities, with some trends according to geographical location. The analysis also reveals different effects in terms of magnitude for HCs and LAs. LA premiums tend to be significant and positive at larger magnitudes in northern cities, and significant and negative at smaller magnitudes in central and southern cities, while HC premiums tend to be significant and positive in northern and central cities, but significant and negative at smaller magnitudes in southern cities and island cities. There are, however, many exceptions within these geographical trends. The second step of the analysis reveals that premiums are on average lower in regions with higher rates of AB, suggesting that places with higher *AB* are less compliant with conservation planning and consequently experience lower external benefits. More specifically, a 1% increase in AB is associated with an expected depreciation effect of 0.64 percentage points in HC price premiums, while a 1% increase in AB is associated with an expected depreciation effect of 0.14 percentage points in LA price premiums. The results therefore confirm that, at least partially, illegal building and construction levels explain this heterogeneity. The important implication from these findings is that planning policies capable of solving the free-market coordination problem related to the architectural externalities are undermined in the Italian context by illegal attitudes. This underlines the necessity to either re-address policies limiting AB or, and perhaps jointly, re-address cutting red tape to remove some of the administrative burdens within conservation areas. These findings can also have external policy implications in suggesting the magnitudes at which illegal attitudes can undermine urban policy effects.

This study generally follows two strands of literature. It contributes to literature that has assessed the amenity value of cities (Glaeser et al. 2005; Gyourko & Tracy 1999; Albouy 2009) and neighbourhoods within cities (Cheshire & Sheppard 2005; Coulson 2008). The study more specifically contributes to literature evaluating urban heritage and architectural amenity capitalization effects on property prices (Noonan 2007; van Duijn & Rouwendal 2015; van Duijn et al. 2016; Ahlfeldt & Holman 2017; Ahlfeldt et al. 2017; Hilber et al. 2017). In comparison with these studies, this analysis explores the heterogeneity of urban heritage effects across two conservation policies – 933 LAs and 236 HCs. The analysis is unique in terms of the number of cities compared, and in the spatial detail of the data set for the Italian territory. Lack of previous evidence for the Italian context can be attributed to the challenge of compiling large micro data sets for this territory. The analysis of capitalization effects of conservation policies is in itself interesting in the Italian context because of the particular stringency of the planning system, especially compared to other European systems such as the English one (Pietrostefani & Holman 2017).

Exploiting the Italian context also allows this study to investigate the relationship between a restrictive zoning system and informal institutions, creating a link between two literature strands. The paper generally inserts itself in a growing body of evidence suggesting that illegal behaviour within both formal and informal institutions is one of the major causes of the degradation of natural and built environments, diluting policy effects (Wilson & Damania 2005). Traditionally, economists have been reluctant to consider informal practices as possible determinants of economic outcomes. More recently, however, a growing body of empirical work has measured how socially shared rules and attitudes – sometimes denominated as 'culture' – matter for a variety of economic outcomes (Alesina & Giuliano 2015; Tabellini 2010; Guiso et al. 2006; Bisin & Verdier 2001). This paper specifically contributes to this literature, as well as building on empirical studies that have investigated the role of other illegal activities on house prices (Roy 2005; Krijnen & Fawaz 2010). Studies have found considerable discounts on homes in high crime areas (Pope & Pope 2012; Buonanno et al. 2013; Gibbons 2004;

Lynch & Rasmussen 2001) and historical crime rates have also been shown to have persistent effects on the price of real estate (Frischtak & Mandel 2012). Studies have also only very recently analysed the effect of organized crime on choice of living location and house price behaviour (Maggio 2018).

The remainder of this paper is structured as follows. Section 2 presents the unique data set and its various sources as well as the institutional and policy setting of our analysis by giving a short overview of conservation planning and illegal building and construction in the Italian context. Section 3 presents the empirical strategy and econometric specifications for the analysis, followed by Section 4 which reveals and discusses the results. The final section present the conclusions.

3.2 Data and Institutional Setting

3.2.1 Property and Location Data

The empirical analysis relies on a novel data set constructed from a wide-range of sources. Over 60,000 geo-localised house sales advertisements with a wide range of attributes spanning from 2011 to 2018 were collected from *Immobiliare.it,* the largest online portal for real-estate services in Italy. Data sampling focused on residential units for sale monitored from the time they were created up to the time they were removed from the database.[25]

This paper is among the first to exploit this database, which presents various advantages to the data provided by the real estate market observatory of the Italian Tax Office (OMI data). The OMI data is aggregated at neighbourhood level and is therefore insufficient for the study of localized phenomena. Moreover, it has limited information about the physical characteristics of the transacted housing units. The collected *Immobiliare* data has the advantage of including a long list of structural attributes including floor space (m2), date posted on website, year, month, type (building, villa, house, apartment, loft, attic, box), number of rooms and bathrooms, type of kitchen, floor, garage of parking facilities, presence of a lift, year built, state of property, type of heating, AC facilities, energy classification, presence of a balcony/terrace and optic fibre facilities. Loberto, Luciani and Pangallo (2018)'s recent comparison between the OMI zone data and the *Immobiliare.it* database found the

[25] In 2016 the number of housing transactions in provincial capitals on *Immobiliare.it* was 183,000 units (about one-third of all housing transactions in Italy). The majority of transactions in these cities is brokered by real estate agents – who are more likely to upload adds on Immobiliare.it than private citizens –, whereas in small towns sales are less likely to need brokerage and so representativeness is potentially a problem.

latter broadly consistent with official sources with an approximate 12% discount to be interpreted between the *Immobiliare* data and the OMI data. The use of house price data from advertisements – as opposed to data from actual sales – is not problematic in this case given the paper's focus on large cities (the 3 most population capitals in each region). I do not need to worry about large quantities of properties not advertised on *Immobaliare.it* which is the case in smaller Italian cities. As demonstrated by Loberto et al (2018), who use a similar data-set, the advertised price is close to an unbiased forecast of actual sales prices that does not vary across the cities under consideration (and includes a constant premium). Details on the compilation of the hedonic data and city selection are illustrated in section 3 of the appendix.

A long list of locational controls in order to diminish omitted variable bias in the baseline regressions were collected from the Italian census (2011), the Italian National Geoportal of the Environment, various Italian open data regional geo-portals (when available), the Ministry of Education, the Ministry of Culture and Open Street Map. They include geo-localised micro-data such as building height and average typology of buildings on the street, a range of natural and commercial amenities, parking and transport controls, as well as the locations of schools. These were all matched to the hedonic data through GIS. The mid-point of the main commercial street of each city was also recorded to act as a proxy for the CBD of each city. The main road construct applies well to medium Italian cities and for larger cities such as Milan, Rome and Naples two or more points were recorded (Borruso & Porceddu 2009). Socio-economic variables such as population density, migrant percentages and level of education were obtained and joined to the hedonic data from the 2011 Italian census (please see section 3 of the appendix for a full list of covariates and further clarifications).

3.2.2 A very short summary of conservation planning in Italy

Conservation planning in Italy is made up of three highly restrictive legislative strands: individual architectural designations[26] and their relative perimeters, Landscape Areas (LAs)[27] and Historic Centres (HCs) (Carughi 2012; Bonfantini 2012; Olivetti et al. 2008; Giannini 1976). Conservation planning has a unique place in Italian urban policy; some have even argued that the principles and practises of conservation planning are one of Italian urbanism's few contributions in the field (Balducci & Gaeta 2015).

[26] Known in Italian as *vincoli architettonici*.
[27] Known in Italian as *vincoli paesaggistici*.

Individual architectural amenities are the most restrictive of the three legislative strands (Nasi Law n. 185/1902) (Carughi 2012). The Italian system differentiates between monuments – buildings with high levels of architectural significance – and buildings of 'minor' architectural value which nonetheless carry historic or socio-cultural significance (Ricci 2007).[28] In 2004, public buildings constructed before 1919 were also all automatically listed to avoid the loss of urban cultural values (Ministero dei beni culturali e delle attività culturali e del turismo 2017). This paper exploits the nature of this binding law and the availability of data from the Italian building census, to construct an index of urban law compliance $\Delta UBL_c = LB_{ct_2} - LB_{ct_1}$ by calculating the difference in pre-1919 buildings in a good or excellent state between 2011 (LB_{ct_2}) and 2001 (LB_{ct_1}) per 100 buildings by census tract, accounting for changes in census unit boundaries. The constructed index thus measures the respect of the law protecting all buildings built before 1919 and is indicative of places where changes have occurred in the historic urban environment at a very fine spatial level despite the national law. The index presents an alternative measure to the AB rates primarily used in this paper. Census data also allows me to construct an index estimating positive or negative variations of housing stock by census tract in the same manner ($\Delta Hstock_c = Hstock_{ct_2} - Hstock_{ct_1}$) to control for the development tendencies of each area (Cortese 2013).

Landscape Areas (LAs) (Law n.1497/1939) protect landscapes in both natural and urban settings, in the latter specifically 'complexes of immobile things (buildings) that hold aesthetic or traditional values' (Giannini 1976; Carughi 2012). This aspect of Italian conservation planning is included in the Cultural Heritage and Landscape Code (22 January 2004 n. 42) as Article 136, identifying buildings and areas of significant public interest[29] (Ministero dei Beni e della Attività Culturali e del Turismo 2016). Most LAs were designated between 1950 and 1970, with fewer but constant inscriptions in the last 20 years, as well as boundary and extension updates of many of the earlier inscriptions (Pietrostefani & Holman 2017) (see section 2 in the appendix). There are over 6000 LAs of various sizes in the Italian territory, many of which are situated in urban areas. LAs go

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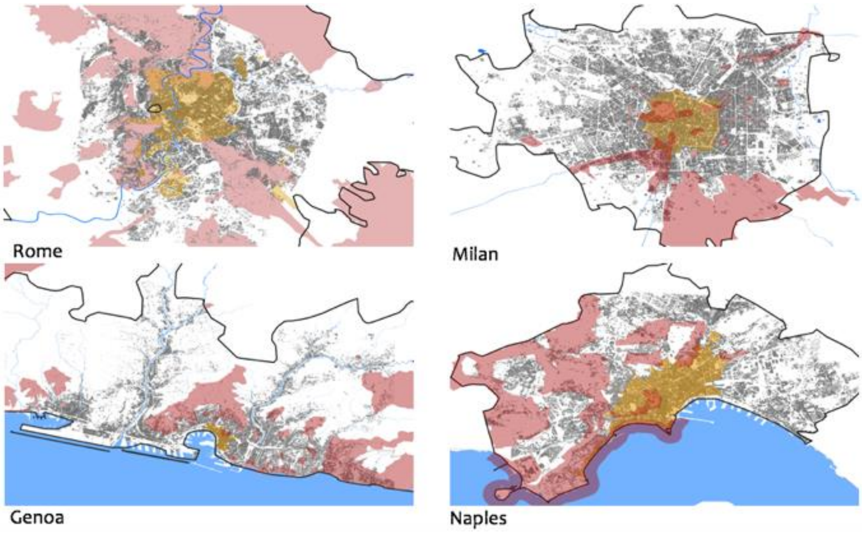
[28] The data-set used distinguishes between monuments, palaces, houses, portals, walls, courtyards and other types of architectural amenities (Ministero dei beni e delle attività culturali e del turismo 2016). The dataset also specifies whether the cultural value of the architectural good has been verified by the relevant governing body – in many cases, because of the limited resources, it has not been verified.

[29] These include a. good of specific administrative use b. 'immovable things', 'villas and gardens', 'parks' c. and d. 'complex of properties', 'areas of scenic beauty'.

beyond the protection of built form, they designate and attribute value to streets, sidewalks, piazzas and minor elements of the urban fabric.

Figure 1 Examples of the Italian conservation planning system



Note: Historic Centres (HCs) are in denoted in orange. Landscape Areas (LAs) are in pink/red.

Historic Centres (HCs) are the third strand of Italian conservation planning and are imbedded in Italian urban policy through zoning (Bonfantini 2012). The 1967 *Legge Ponte* (Law n. 765) included historic centres as part of overall city planning, delimiting them by the Zone A in Italian Master plans which demarcates zoning areas, buildable exploitation and areas to be allocated to public services (Campus-Venuti & Oliva 1993).[30] The regulatory plans of each city protect HCs and impose a series of restrictions on them. HCs are delimited in a logic of historical consistency where there is a clear differentiation in building age between buildings inside Zone A and outside Zone A. As shown in Figure 1, in practice many historic centres are partially superimposed by LAs. Given fragmented historical geography of Italy, there are over 8,000 Italian cities, most of which, both large and small, have at least one historic centre (Ricci 2007). HCs often spatially overlap with the city centres of Italian metropolitan areas, thus hosting the large part of economic activity, however, larger cities have often switched to a more polycentric nature by adopting a second economic hub.

This paper explores 55 provincial capitals which include 933 Landscape Areas, more than 236 Historic Centres and over 43,000 individual architectural designations. Geo-localised data on listed architectural amenities was provided by the *Istituto Superiore per la*

[30] PRCs (*Piano Regolatore Comunale*) or PRGs (*Piano Regolatore Generale*) are general regulatory plans for the city.

conservazione ed il restauro in the Ministry of Culture. The Landscape Area shapes were traced through the *Direzione generale archeologia, belle art e paesaggio* WMS services on ArcGIS. This last data is known to present a series of spatial errors and in order to avoid the definition of incorrect boundaries, the data was checked with regional datasets when available. The Historic Centres for each of the 55 cities were drawn from the metropolitan zoning plans on ArcGIS by geo-referencing each zoning plan.

The restrictions imposed on these areas are characterised by the role played by the *soprintendenza* – the regional cultural heritage authority. The *soprintendenza,* with recommendations from the regional authority, have absolute control over individual architectural amenities and their ad-hoc perimeters. They approve building modifications, reserve the right to order suspension of works and can impose work on private buildings. They also generally determine many elements of urban design, and in practice new developments and building modifications are heavily controlled. The regional authority also leads the enforcement of restrictions related to LAs. Constraints are itemised in the plan attached to each designated area and are subject to inspection by the *soprintendenza*. Local municipalities cannot grant building permits without the approval of the *soprintendenza*. Permits are typically difficult to obtain in light of extensive red-tape and are a source of common complaint among citizens. It is well-known that residents often opt to illegally modify their homes or buildings instead of facing the administrative labyrinth of gaining permission for possible alterations as this comes with monetary costs and long delays (Grignetti 2017). The Italian conservation planning system is thus characterised by a top-down approach and too much restriction, typically associated with the role of the *soprintendenza*. Recent research (Pietrostefani & Holman, 2017) has remarked on the system's traditionalist nature, where the potential of both urban heritage areas and buildings is not exploited because too much restriction is imposed.

3.2.3 Informal attitudes and behaviours

Despite the presence of identical policies and similar budgets and human resources available between Italian regions, the conditions of the urban environment vary widely throughout the country, including within protected areas (ISTAT 2015). Several important strands of social science research suggest that real world institutions seldom function according to formal institutional rules alone, but are shaped by powerful informal rules and norms (Beers 2010; Ostrom 2005; North 1991). Pioneered by Friedman (1975), the legal culture literature clearly acknowledges the role of informal rules and norms—both within legal institutions ("internal" legal culture) and in the broader society ("external" legal culture). Informal building practices are present in many contexts, and in Italy *abusivism* is engrained in society to the extent that it has assumed considerable social and political importance (Zanfi 2013; Biffi et al. 2014). It is often argued that AB is behind this heterogeneity in urban environment conditions (Zanfi 2013), potentially undermining planners' efforts to preserve positive heritage externalities.

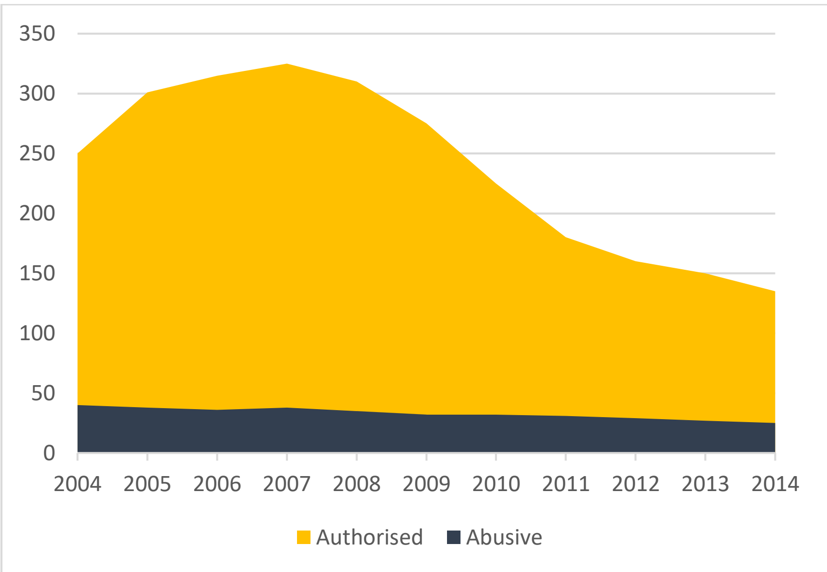
The term informal institutions has been applied to wide-ranging phenomena. This paper follows Helmke and Levitsky (2004) in delimiting informal institutions as capturing as much of the universe of informal rules as possible, but narrow enough to distinguish informal rules from other, non-institutional informal phenomena (Christiansen & Neuhold 2012; Brinks 2003). By contrast, formal institutions are rules and procedures that are created, communicated, and enforced through channels widely accepted as official. Within Helmke and Levitsky's (2004) typology of informal institutions, AB most closely identifies with what are defined as competing informal institutions. In such cases, formal rules and procedures are not systematically enforced, which enables actors to ignore or violate them. Competing informal institution structures coexist but are incompatible with formal rules, creating alternative norms (Della Porta & Vannucci 1999). Clientelism, clan politics, and corruption are a few examples of such informal institutions.

3.2.3.1 Widespread self-building practices and policies responding to *AB*

Approximately a quarter of the buildings constructed in Italy between the 1960s and the 1980s were unauthorised (CER & Ministero dei Lavori Pubblici 1986). Since 2008, Italy has witnessed a sharp downsizing of construction as illustrated in Figure 2. However, while legal construction shrank by over 60%, the illegal component did so by less than 30% (ISTAT 2016b). This pattern continued and since 2014 the number of authorized new constructions dropped by 16.3% with unauthorized construction falling by only by 6.1%. The recession also created a favourable climate for AB, leading the number of illegal buildings to rise in specific years, for example from 15.2% to 17.6% in 2014 (ANAC 2013; Grignetti 2017). These numbers suggest a lack of control over the process of urbanisation, aggravated by informal development both in the form of building extensions and new constructions. Furthermore, this is taking place not only in buildable areas but also in areas subject to protective regulations, including landscape and archaeological areas (ISTAT 2014).

Before the reinforcement of the landscape area law (Galasso law 1985), there were on average 437 buildings per square kilometre along coastlines. Twenty years later, building density reached 540 per square kilometre (+23,6%) (ISTAT 2015; Legambiente 2014), with particularly large increases in the regions of Calabria, Sicily and Marche. The stringent urban planning system is thus opposed in many cases by a tacit laissez faire attitude where individuals work on their own solutions taking advantage of weak formal institutions despite strict national policies. This suggests that the heterogeneity in the conditions of the urban environment in both Landscape and Historic Areas across the Italian territory may be inversely correlated with AB. The principle measure of AB used in this paper are the *abusivism* rates created by CRESME – the Italian Centre for Social and Economic Research of the Construction and Real-estate market, which measure number of illegal dwellings constructed for every 100 dwellings in a given year. Estimates are available from 2004 to 2017. Cities with high scores on the CRESME index sometimes present values as high as 70 percent of buildings constructed abusively in a given year, while cities with low values range at approximately 5 percent of buildings constructed illegally in a given year.

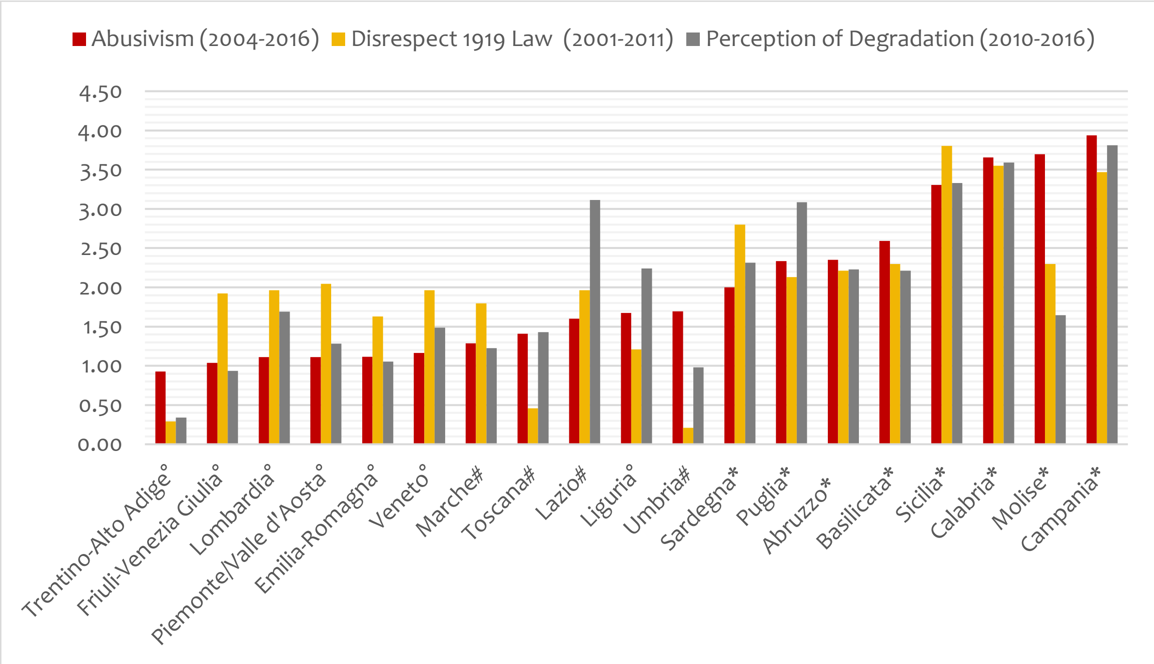
Figure 2 Evolution of un-authorised vs. authorised building



Note: Authorised and abusive constructions in Italy, thousands of new construction for residential use. Years 2004-2014.

There has been a general North-South polarization in AB trends as shown in Figure 3. AB has maintained higher levels in southern regions compared to the rest of the Italy. In Calabria, unauthorised construction accounted for no less than 70 percent of total buildings in the 1970s (Zanfi 2013). Although these estimates have dropped since, AB indices are still very high: 45-60% of authorised buildings between 2012-2014 in Molise, Campania, Calabria and Sicily. In the same period, the average values of AB also doubled compared to the previous three years in the central regions of Umbria and Marche (from 9 to 17.6% and from 5.1 to 10.6% respectively). Significant increases were also recorded in Tuscany (from 7.9% to 11.5%), Lazio (from 9.7% to 15.1%) and Liguria (from 12.4% to 15.6%) (ISTAT 2013). Figure 3 also illustrates similar trends in people's perception of degradation of the urban environment. There is more perceived degradation in regions with high rates of AB, and higher disrespect of the 1919 historic building law (UBL index) in regions also exhibiting higher values of AB (ISTAT 2013). Section 2.2 of the appendix provides further information on the evolution of illegal building trends.

Figure 3 North-South divide in non-compliance



Note: Data standardized for comparability – x* = (x-m)/sd + 2. °Northern Regions #Central Regions *Southern and Island Regions. Abusiveness: Average rate of *abusivism 2004-2016* – number of new abusive constructions of residential use for every 100 legal constructions. Perception of Degradation: Average 2010-2016 – Individuals of 14 or more years that consider the urban environment in the place which they live in to be affected by evident degradation (for every 100 people). Disrespect of 1919 Law (2001-2011) – difference in pre-1919 buildings in good or excellent state between 2011 and 2001 per 100 buildings. Figure A3 in appendix shows how abusiveness does not substantially diminish over recent years. Source: author's elaboration of CRESME and ISTAT Data.

Informal and illegal building practices in Italy are principally motivated by local necessity driven by the will to bypass administrative red-tape and difficulties obtaining permission to build or modify structures (Zanfi 2013). It is also more generally part of a Do It Yourself (DIY) culture aimed at avoiding monetary and time costs (Schneider & Williams 2013). The literature thus principally ties AB to local attitudes and preferences. Studies have, however, also linked AB to local building collusion both to provide work to unemployed and unskilled population, and to consolidate the power base of local mafia groups. Out of the 19.1 billion euros part of the Italian eco-mafia market in 2016, 16.4% were linked to illegal building (Legambiente 2017).[31] In addition to marking the landscape, AB feeds the illegal cement industry (from quarries, to concrete plants, to construction companies). I construct a mafia-crime index as a covariate for the second step of the empirical strategy to account for this. The index is constructed from ISTAT province capitals crime data and accounts for rates of mass casualty crimes (usually linked to bombs or similar), voluntary mafia homicides and kidnappings.

The best deterrent to AB has been argued to be the restoration of legality through the demolition of outlawed buildings. Recurrent building amnesties, 1985, 1994 and 2003 have, however, not helped metropolitan administrations to remember that demolishing illegal buildings is not optional, but an obligation according to Presidential Decree 380/2001 (Biffi et al. 2014). A more recent Law 68/2018 on environmental crimes has seen better outcomes with an increase of arrests by 20% and a decrease in illegality by 7% (Marra 2017). AB continues, however, given the ineffectiveness of demolitions. Of the 46,700 demolitions ordered by the state judiciary in 2012, only 14% have been carried out to date (see section 2 of the appendix for a breakdown). Between 2004-2018, Campania only followed through on 496 (2.9%) of its 16,596 demolition injunctions, while other regions with much lower rates have carried out much higher numbers of demolitions, Lombardy and Piedmont 37% and 30% of their 4,895 and 3,456 injunctions respectively (Biffi et al. 2018). Moreover, even though lack of funds for demolition costs is used to justify the inaction of the public administration, the law clearly states that costs associated with demolitions are the responsibility of building owners.

3.3 Empirical Framework

The starting point of my empirical strategy is the assumption that in spatial equilibrium all costs and benefits associated with residing in a property of a certain type and at a certain location capitalise into property prices. This assumption follows a long tradition of hedonic research, which assumes that residents are fully mobile and there is perfect spatial competition (Rosen 1974; Tolley & Diamond 1982). As argued by Ahlfeldt & Holman (2017), Cheshire et al. (2017) and Levkovich et al. (2018) among others, this assumption is plausible when identifying spatial variation at a very fine scale which our novel Italian data-set allows. Market price P_i is fully described by vectors of structural S', locational L' components and regulatory components H' making a property more of

[31] The term eco-mafia, in the Italian language, is a neologism coined by the environmental association Legambiente (2014) to indicate the illegal activities of criminal organizations, mostly mafia, which cause damage to the environment.

less attractive (zoning, height restriction or other). In this case, the regulatory components are Historic Centres and Landscape Areas. When denoting whether a property *i* is sold within the boundaries of a historic centre HC, or within the boundaries of Landscape Area LA, the respective coefficients indicate the different effects of the heritage areas. Following exploratory regressions (see section 5.1 of the appendix), estimates suggest there is enough variation between LAs and HCs to separately identify the effects of these two policies.

My first fundamental identification problem arises because of possible unobserved amenities inside or near HCs or LAs. I draw on the regression discontinuity design literature, in particular recent literature utilising property price discontinuities at spatial boundaries (BDD), a special case of the more general RDD (Gibbons et al. 2013; Ahlfeldt & Holman 2017). This allows me to account for unobserved location characteristics that could confound the heritage effect. I exploit the precise knowledge of the rules determining treatment of two border zones $z = (1, 2)$ across the boundaries of HCs and LAs, where the border x_0 is the known cut-off, and where $z = 1$ and $z = 2$ are geographically close, whilst ensuring they are on different sides of the regulation boundary (Angrist & Pischke 2009). The difference in prices between $z = 1$ and $z = 2$ is fully described by the differences in structural and locational attributes, as well as regulatory features. I further assume that the two areas immediately inside and outside of LAs and HCs are the same in terms of locational attributes such as accessibility to the city centre, transport infrastructures, natural amenities, schools or other unobserved variables, i.e. $L_{z=1} = L_{z=2}$. I therefore assume that the variation in the areas immediately inside and outside of LAs and HCs is primarily related to heritage or architectural characteristics, and that the areas at both sides of the boundary are similar in most other respects. As stipulated in Ahlfeldt & Holman (2017) this assumption is easily accurate at the boundary that separates two zones.

Given the precise policy intervention, where areas are purposefully drawn to protect coherent areas of urban fabric presenting valued architectural styles, we can expect abrupt changes between $z = 1$ and $z = 2$. The critical restrictive differences between buildings inside and outside urban heritage areas, as described in section 2.2, further supports this argument. It is therefore sensible to expect, as argued by Ahlfeldt & Holman (2017), a sharp discontinuity in the appearance of buildings at the boundary of LAs and HCs in cities presenting low levels of AB where I anticipate conservation planning to be respected. A smaller or lack-of discontinuity is on the other hand expected in cities presenting high levels of AB, given that policy restrictions would not necessarily be followed. It is fair to acknowledge, however, that there could also be very localised spill-over effects from heritage areas to nearby areas.

The empirical strategy relies on the estimation of two econometric specifications. In the first step, I use the spatial nature of the policies under investigation to graphically explore discontinuities at the boundaries of both Landscape Areas and Historic Centres. I then estimate average boundary price premiums across the 55 cities in my sample controlling as comprehensively as possible for other factors. This allows me to explore the heterogeneity of heritage effects. Throughout the econometric specifications, my approach to control for unobserved locational factors is inspired by the spatial boundary discontinuity design (BDD). In the second step, I explore variables driving the heterogeneity in price premiums and regress the recovered premiums on a series of city-level controls, notably *abusivism* rates. I address endogeneity concerns in the second step by using an instrumental variable approach. As a robustness test, I then re-run the entire analysis at neighbourhood level using an alternative measure of AB.

3.3.1 Price premiums at the boundary

In identifying heritage capitalisation effects by city, I concentrate on property prices that fall within a 200-metre buffer inside and outside LA and HC boundaries. I create dummies of the buffer areas around LA and HC borders, specifically $LAbuffer_{ia}$ takes the value of one if $DIST\_LA_i > -200$ & $DIST\_LA_i < 200$, and $HCbuffer_{ia}$ takes the value of one if $DIST\_HC_i > -200$ & $DIST\_HC_i < 200$. I also create dummies of the area immediately inside both LA and HC borders, specifically $LAin_{ia}$ takes the value of one if $DIST\_LA_i < 0$ and $DIST\_LA_i > -200$, and $HCin_{ia}$ takes the value of one if $DIST\_HC_i < 0$ & $DIST\_HC_i > -200$. The inclusion of both these dummies within my equation allows me to recover the coefficients of $LAin_{ia}$ and $HCin_{ia}$ as the boundary effects.[32] I thus mitigate the problem of unobserved area effects by differencing the data between close-neighbouring properties to eliminate area-specific unobservable. By interacting $LAin_{ia}$ and $HCin_{ia}$ with city dummies, I then easily collect average boundary effects by city. This strategy achieves the collection of lower bound estimate price premiums given it considers small areas on each side of the policy border: estimates are thus less-likely to be influenced by locational spill-over which might be present if wider areas on each side of the boundary were considered (Koster & Rouwendal 2017; Koster et al. 2012).

[32] This is equivalent to taking the difference of coefficients $HCin_{ia}$ and $HCout_{ia}$ if $HCout_{ia}$ took the value of one if $DIST\_HC_i$ > 0 & $DIST\_HC_i < 200$.

For example, if considering wider areas on each side of the policy demarcation, a greater variety of heritage amenities would in many cases be present within inner areas of the spatial policies, possibly inflating the estimates.

To estimate the boundary effect first step, I therefore use the following specification:

$$lnP_{iat} = \alpha_t + \beta HCin_{ia} \times City_a + \rho LAin_{ia} \times City_a + \lambda HCbuffer_{ia} \times City_a + \gamma LAbuffer_{ia} \times City_a + \delta S_{ia} + \theta L_{ia} + \epsilon_{iat} \tag{1}$$

, where P_{iat} is the price per square metre of floor space of a property *i* advertised in year *t* in city *a*. S_i and L_i are typical structural and locational amenities controls and α_t are year effects. *a* can be substituted by *n* for neighbourhoods in an alternative version of the model. $HCin_{ia}$ and $LAin_{ia}$ are the boundary effect dummies and my two key variables of interest, with $HCbuffer_{ia}$ and $LAbuffer_{ia}$ are limited areas on both side of the boundary respectively controlling for un-observables. The model thus accounts for unobserved amenities and heterogeneity of preferences among households. For convenience, I assume a semi-log relationship as it infers a premium in percentage terms and has proven to suit data in many hedonic house price studies (Halvorsen & Palmquist 1980).

3.3.2 How does *abusivisim* affect both LA and HC price premiums?

The second step concentrates on how city variation influences border price premiums. It specifically focuses on how *abusivism* affects both LA and HC heritage premiums as hypothesised in section 2 of the paper. The specification takes the following form:

$$\hat{\beta}_a = AB_a\delta + B_a f + \epsilon_a \tag{2a}$$

$$\hat{\rho}_a = AB_a\theta + B_a g + \kappa_a \tag{2b}$$

, where $\hat{\beta}_a$ and $\hat{\rho}_a$ are the boundary effects for city *a* recovered in (1). $AB_a\delta$ and $AB_a\theta$ are measures of *abusivism* and $B_a f$ and $B_a g$ are other city *a* characteristics which could be theoretical influencing price premiums. The latter include covariates such as level of education, number of buildings in bad condition, building height, new building growth and an environmental degradation index focusing on natural amenities such as water and air quality. A mafia-crime index is also tested as a covariate (as defined in section 2.3.1) given the theoretical basis that *AB* might be partially motivated by informal organizations (Helmke & Levitsky 2004). A number of variations of the equation are run to arrive to a preferred model. These equations allow me to assess whether heritage price premiums are reduced by *AB* rates, the underlining premise being that places with higher *AB* are less-compliant to urban policy and consequently experience lower external benefits.

3.3.2.1 Instrumental variable (IV) estimation

I face two possible estimation challenges in this city-level second step. To address these issues, I use an instrumental variable approach to substantiate my results.

On one hand, returns to abusive behaviour could be larger in highly valued areas, presenting a possible reverse causality issue. Developers might want to build in high premium areas, because the larger the premium the more the motivation to extend development for larger gains. Higher heritage premiums could thus cause more abusiveness. If this is the case, a negative bias in the results would be expected, and a suitable instrument would slightly increase the magnitude of relative coefficients. On the other hand, an omitted variable problem is also possible, affecting both the heritage premium and abusive behaviour. There may well be unobserved factors determining both preference for heritage (heritage appreciation) (a) and preference for abusive behaviour (legal attitudes) (b), resulting in the effect of unknown attitudes influencing both price premiums and abusive behaviour. In this case, a negative bias in the results would also be expected, and a suitable instrument is needed to separate out (a) from (a)+(b).

Both sources of endogeneity can be addressed through instrumental variables. The main instrument used to address these challenges is a legal attitudes index (LAI) conceptually created by Tabellini (JEEA, 2010). Drawing on a large sociological (Bisin & Verdier 2001; Benabou & Tirole 2006) and economic (North 1991) literature that addresses informal institutional questions, Tabellini (2010) refers to this measure as a 'cultural' index. However, the index actually focuses on four related but distinct measures of preference and attitudes where measurable counterparts can be found: trust, respect, control and obedience. Trust and respect encourage welfare-enhancing social interactions such as participation in the provision of public goods and are likely to improve the functioning of government institutions. Both trust and respect thus motivate strong negative relationships with *abusivism*, given how AB is linked to mis-trust in local administration and is essentially a form of illegality (marking lack of respect). Control and obedience measure confidence in the virtues of individualism and are symptomatic of an entrepreneurial environment where individuals seek to take advantage of economic opportunities. They also strongly influence AB given its rootedness in 'Do it Yourself' culture (Tabellini 2010, p.683). The selection of the traits which compose LAI has some unavoidable arbitrariness, but hopefully it does not matter too much. The traits are all highly relevant to AB given they measure factors which necessarily influence attitudes towards law enforcement.

The instrument thus mechanically gets around a possible reverse causality problem since it is unlikely to be affected by price premiums. In measuring a range of attitudes which are good predictors of AB, but probably less so of price premiums (heritage preferences), LAI also addresses the omitted variable problem. Indeed, preferences for urban heritage are traditionally highly correlated with education, income-level and place of origin (Dalmas et al. 2015), and not with attitudes influencing illegal practices. Measures of trust, respect, control and obedience very similar to the ones used by Tabellini (JEEA, 2010) are obtained from the Aspects of Daily Life Survey (2013-2016) at province level. This survey is chosen, instead of the World Value Surveys as it has much larger sampling for the Italian territory (20,000 observations per year) and data at province level is available. I also report an alternative, notably an instrument measuring early political institutions in 15-17th century Italy in the spirit of Guiso, Sapienza and Zingales (2016). Such instruments have been argued to be effective predictors of tendency towards illegal attitudes as they embody the institutional cultural transmitted from generation to generation, and are in this case, evidently not correlated with price premiums (Alesina & Giuliano 2015; Putnam et al. 1993).

3.3.2.2 Robustness Checks and Neighbourhood Level Analysis

Given estimates using the LAI instrument suggest the OLS results are quite conservative and robust, I re-run equation (1) substituting *a* by *n* for neighbourhoods to recover price premiums at neighbourhood level. Equations (2a) and (2b) are then estimated at neighbourhood level using the urban compliance (UBL) index, described in section 2.2 of this paper, as an alternative measure of *abusivism*. This approach allows me to include city fixed effects to my analysis and confirm my results at neighbourhood level. I also discuss a range of supplementary estimations, notably how other more disaggregated neighbourhood level characteristics across LA and HC borders could be affecting price premiums at a smaller spatial level.

3.4 Estimation Results

3.4.1 Descriptive statistics and overall average effects

Table 1 presents some key descriptive statistics. The first four columns summarise key variables of the full data set, while the four following columns summarise the sample within HC and LA boundaries. The average price per square meter of the full data is

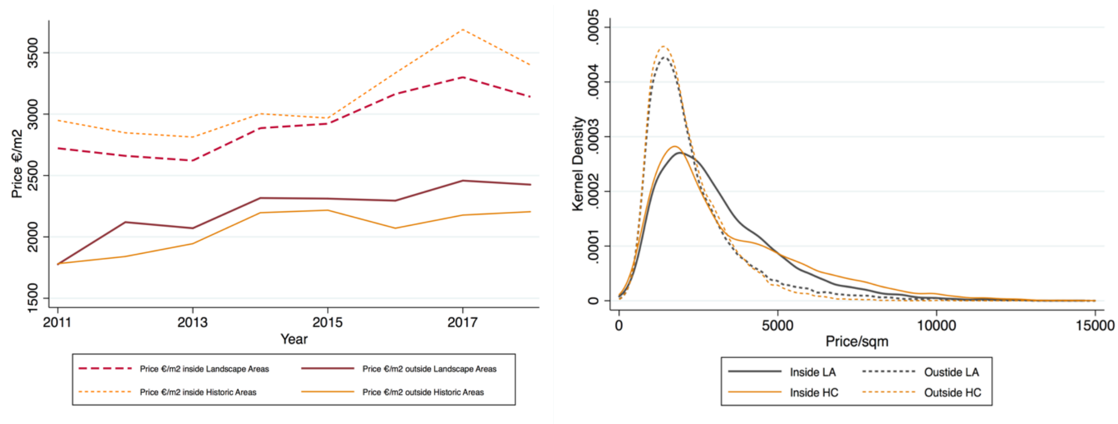
€2,463, inside HC and LA the mean price is respectively about €950 (38%) and €690 (28%) higher. Table A2 in section 3.3 of the appendix provides a full overview of the descriptive statistics of the data-set. Panel 1 of Figure 4 presents an easy comparison of house sales advertisements between control groups (outside Landscape and Historic Areas) and treatment groups (inside Landscape and Historic Areas). In line with previous research on conservation areas (Ahlfeldt et al. 2012) the price trends reveal a relative premium for properties inside both HCs and LAs compared to the control groups. I observe rather stable trends in mean prices per square metre for both LAs and HCs, which corresponds to Italian real-estate trends during the considered period (Banca D'Italia 2017). More specific comparisons of variables between treatment and control areas are analysed in Table A3 of the appendix. Panel 2 of Figure 4 compares the distribution of transactions by price per square metres for properties located inside and outside LAs and HCs. The figure indicates a larger proportion of relatively more valuable properties inside LAs and HCs compared to the control groups, and this is slightly more pronounced for LAs than HCs.

Table 1 Descriptive Statistics

	First Step							
	Full data set				Inside HC		Inside LA	
	mean	sd	min	max	mean	sd	mean	sd
Price	315,420	500,869	1,000	3.00e+07	475,898	796,277	463,857	693,100
Price SQM	2,463	1,726	.54	20,000	3,414	2,444	3,158	2,002
Ln price SQM	7.61	0.63	-.60	9.90	7.89	0.73	7.87	0.65
Year built [a]	3.85	0.99	1	5	3.15	1.17	3.55	1.15
Height building [b]	14.04	8.04	1	89.3	16.60	7.61	13.12	7.18
Distance to Arch[c]	346	734	.10	42,276.65	90	199	245	547
Distance to CBD[d]	2,338	2,026	1.94	45,821.32	1,121	982	2,377	2,135
N	53,572				14,334		8,320	
	Second Step							
	mean	sd	min	max	N			
AB rate [e]	20.08	15.56	3.68	52.52	55			
ΔUBL [f]	-2.32	2.38	-11.84	3.79	296			

Note: N refers to the number of observations, in the First step these refer to property prices, in the Second step to 55 Cities and 296 neighbourhoods within these cities. [a] Year built is defined as follows: 1 -1700 and before, 2 – 1700 to 1919, 3 – 1920 to 1950, 4 – 1951-1980, 5 1980 to now. [b] Building height is in metres. [c] Distance to architectural designations is in metres [d] Distance to CBD is in metres. [e] *Abusivism* rates (AB) created by CRESME - number of illegal dwellings constructed for every 100 dwellings in a given year, average of estimates between 2004 and 2017. [f] UBL Index - the difference in pre-1919 buildings in good or excellent state between 2011 and 2001 per 100 buildings by census tract.

Figure 4 Distribution of house prices offers by price



Note: Kernel density estimates. To improve visibility, the figure focuses on the price segment below €15,000/sqm.

I begin by evaluating differences in price premiums by simply denoting properties inside HCs and LAs with a dummy. These exploratory regressions, which can be found in section 5.1 of the appendix, suggest there is enough variation between HCs and LAs to separately identify effects. I then more precisely identify differences in premium between LAs and HC. In Table 2 I report estimates of a simplified version of equation 1 where I do not interact inside and buffer variables by city *a,* in order to estimate the average effect across all 55 Italian cities for each type of heritage area. Dummies of the buffer areas around LA and HC borders, as well as dummies of the area immediately inside both LA and HC borders are created as explained in section 3.1.1. The inclusion of both these dummies within my equation allows me to recover the coefficients of $LAin_{ia}$ and $HCin_{ia}$ as the boundary effects.

Results are consistent in columns 1-4, where I progressively add neighbourhood fixed effects, building and amenity controls. Overall, the regression results suggest a positive effect of being within a heritage area. The different magnitudes of the coefficients suggest slightly different premiums for properties depending on the type of policy. Results also suggest that policy effects do not substantially influence each other as coefficients maintain similar magnitudes whether I include them together or separately in the equation (columns 7 and 8). I also observe that areas inscribed for a longer number of years have higher premiums as explored in Table A5 of the appendix. I test the sensitivity of my sample by limiting observations to 1km and 2km from LA and HC boundaries to ensure I am getting relevant local estimates. As expected, I observe very minor changes in my results, the trends observed hold throughout the estimations. On average for the whole of Italy, properties just inside a Landscape Area are about 6.5%

(€160 extra per square metre) more expensive than properties just outside, while the estimated premium for Historic Centre is on average 3.5% (€86 extra per square metre).

Table 2 Overall average effects

Ln price m2	(1) FULL	(2) FULL	(3) FULL	(4) FULL	(5) 2km	(6) 1km	(7) FULL	(8) FULL
L in 200m	0.0868**	0.0705***	0.0688***	0.0660***	0.0646***	0.0624***		0.0669***
	(0.0421)	(0.0215)	(0.0214)	(0.0202)	(0.0198)	(0.0192)		(0.0214)
H in 200m	0.0619†	0.0440***	0.0429***	0.0355**	0.0339**	0.0327**	0.0406*	
	(0.0323)	(0.0164)	(0.0165)	(0.0163)	(0.0163)	(0.0104)	(0.0188)	
Observations	53,572	53,572	53,572	53,572	50,259	44,493	53,572	53,572
R-squared	0.378	0.703	0.704	0.707	0.710	0.713	0.705	0.706
S controls[a]	YES	YES	YES	YES	YES	YES	YES	YES
B controls[b]	NO	NO	YES	YES	YES	YES	YES	YES
A controls[c]	NO	NO	NO	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
N FE	NO	YES	YES	YES	YES	YES	YES	YES

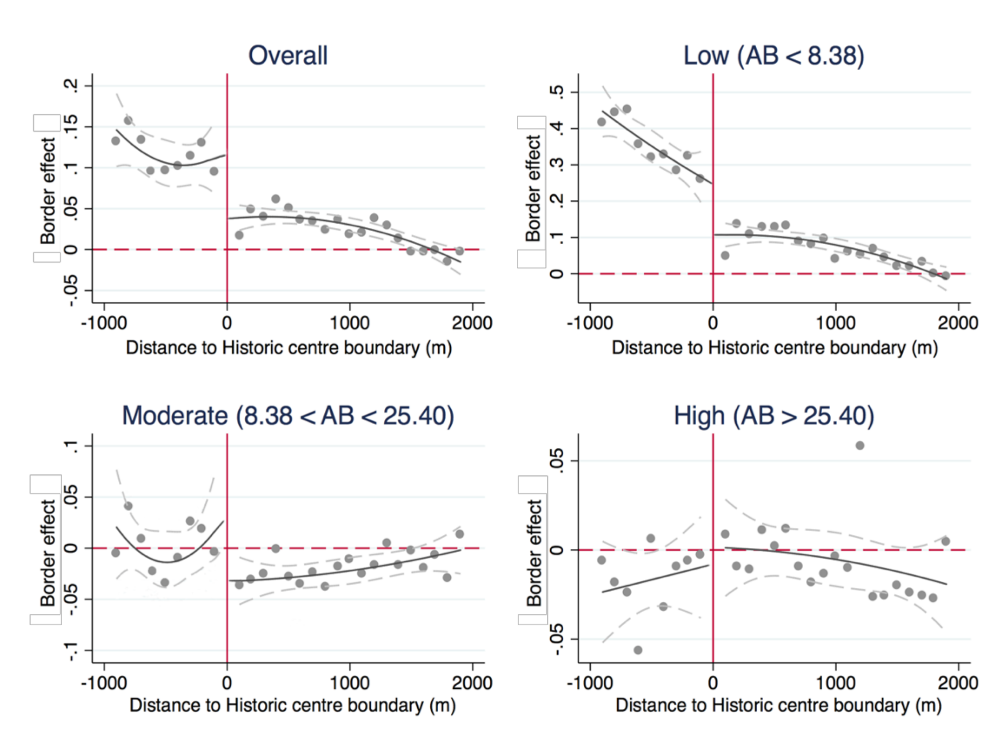
Note: [a] Structural controls [b] Building controls [c] Amenity Controls. Outliers in the sample were dropped. Standard errors clustered at neighbourhood level for all regression. Columns (5) and (6) kept observations 2km and 1km from the border respectively. Neighbourhoods are defined as the sub-municipal areas identified by the Italian Census (sub-municipal areas or neighbourhoods) (ISTAT 2016a). Neighbourhood Fixed effects (N FE) affect Landscape Area estimates less because these areas are usually much smaller than neighbourhood within cities, whereas Historic Centres can in some cases comprise more than one Neighbourhood. *** p<0.01, ** p<0.05, * p<0.1, † p < 0.15

3.4.2 Boundary discontinuities: Graphical Illustrations

By exploiting discontinuous variation in property prices at the boundaries of LAs and HC, where the architectural character of the area changes abruptly, I am able to control for unobserved locational characteristics and achieve a robust identification of the heritage effect. Figure 5 and Figure 6 illustrate the variation in prices and boundary discontinuities for Historic Centres and Landscape Areas respectively. The four panels plot coefficients which control for observable structural and locational characteristics, against distance from the HC and LA boundaries and differentiating between trends inside and outside policy boundaries. The grey dots plot the point estimates of 50-metre-bin effects. The dashed lines show 95% confidence intervals based on standard errors clustered at neighbourhood level. The plots are restricted to 1km inside and 2km outside heritage areas for clarity. I allow for quadratic distance trends and semi-non-parametric specifications in an attempt to find the best fit for the distance bin effects. The equation is estimated for all cities, and then subsequently between cities with high, medium and low levels of AB scores.

Figure 5 andFigure 6 quickly show that although discontinuities are observed at distance zero for both HCs and LAs, the distance price decays present different trends. The key insight that emerges from Figure 5 is the existence of a much larger jump (price discontinuity) at the boundary of cities with low AB rates, with the jump becoming progressively smaller in average and high AB rate cities. While the overall estimated boundary effect is 5%, it is close to zero for cities where the reported *AB* rates are large (AB rate > 25.40). The boundary effect is 4% for cities with moderate AB rates (8.38 < AB rate < 25.40) but increases to 10% for cities with low AB rates (AB rate < 8.38). Given the fluctuation of the price premium according to type of city, and as hypothesized, Figure 5 suggests there is negative relationship between differences in prices across HC boundaries and respective AB rates. It also more generally suggests, that in cities where *abusiveness* is high I observe no jump because high AB entails that urban heritage amenities are either badly preserved, severely modified or may no longer exist, resulting in a lack of or even a negative price premium effect.

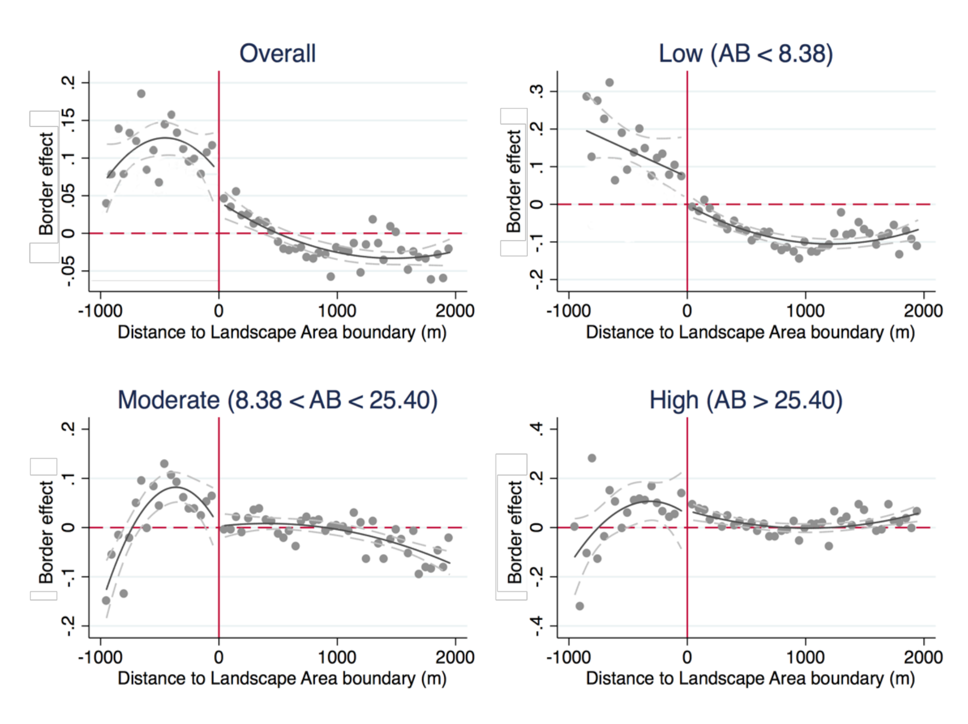
Figure 5 Discontinuities in Prices at Historic Centres boundaries by AB rates



Note: Coefficients are from regression (1) - natural log of price per square metre against structural and locational controls, year fixed effects and neighbourhood-fixed effects. Grey dots plot the point estimates of '100 metre bins from the boundary' effects. The solid lines are illustrations of the parametric estimates and the dashed lines show 95% confidence intervals based on standard errors clustered at neighbourhood level. a) represents overall equation estimated b), c) and d) are the same equation estimated for cities with Low, Average and High AB *rates*. AB rates range from 3.24 abusive buildings per 100 buildings (on average for a city) to 52.52 abusive buildings per 100 buildings (on average for a city). Cities are equally divided between cities with low AB rates (AB < 8.38), moderate AB rates (8.38 < AB < 25.40) and high AB rates (AB > 25.40).

Figure 6 suggests that discontinuities in prices at LA boundaries also decrease as AB rates increase. A capitalisation effect at the boundary of cities with low AB rates is about 9%, this effect becomes much smaller already for cities with moderate AB rates at 1.5%, and close to zero for cities with high AB rates. Overall, Figure 5 and Figure 6 show that the benefits from designation decay smoothly across heritage area boundaries, as expected, since these are based on the preservation of a visual amenity. In the overall panels of Figures 5 and 6 (top-left), the designation effect becomes zero after about 1.5 kilometres for HCs owing to the large size of these areas, and becomes zero after about 500 metres for LAs, which is close to existing evidence relative to the decay in heritage externalities (Lazrak et al. 2014). In cities with low AB rate (top-right of both Figure 5 and 6), I am also able to detect positive effects of greater magnitude towards the centre of LAs and HCs suggesting greater urban heritage densities, which is also in line with existing evidence (Ahlfeldt et al. 2017).

Figure 6 Discontinuities in Prices at Landscape Area boundaries

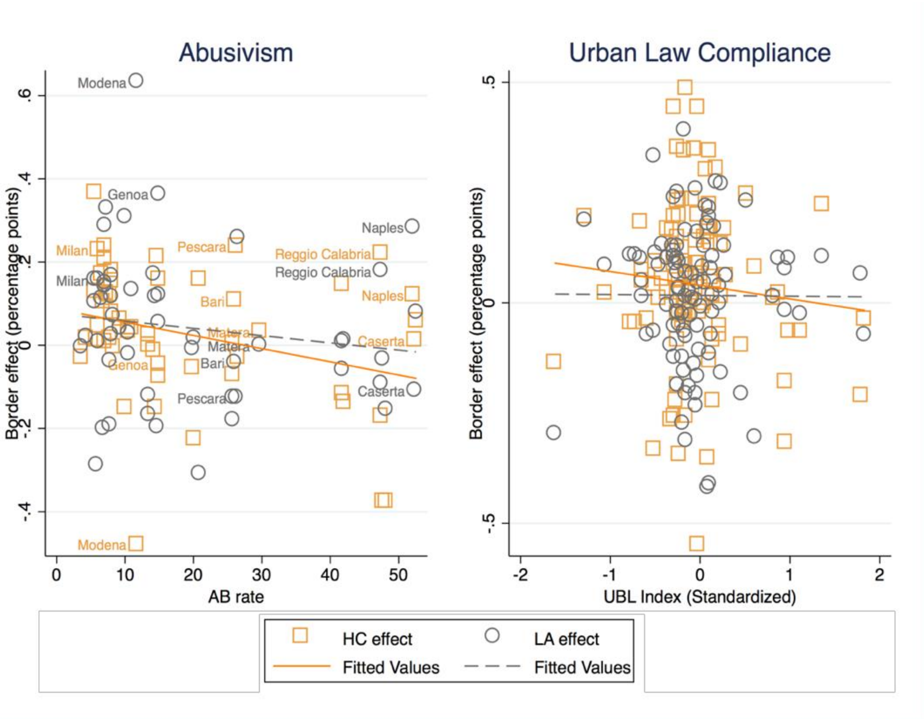


Note: Coefficients are from regression (1) - natural log of price per square metre against structural and locational controls, year fixed effects and neighbourhood-fixed effects. Grey dots plot the point estimates of '50 metre bins from the boundary' effects. The solid lines are illustrations of the parametric estimates and the dashed lines show 95% confidence intervals based on standard errors clustered at neighbourhood level. a) represents overall equation estimated b), c) and d) are the same equation estimated for cities with Low, Average and High AB *rates*. AB rates range from 3.24 abusive buildings per 100 buildings (on average for a city) to 52.52 abusive buildings per 100 buildings (on average for a city). Cities are equally divided between cities with low AB rates (AB < 8.38), moderate AB rates (8.38 < AB < 25.40) and high AB rates (AB > 25.40).

In the left panel of Figure 7, I specifically plot the negative relationship between differences in prices across HC and LA boundaries and respective AB rates by city. This corresponds to using estimates of the border effects by city from specification (1) and plotting them against AB rates. Despite a few outliers, notably Naples and Reggio

Calabria, the negative correlation, although moderate, is reasonably defined. In the right panel of Figure 7, I plot the similar negative relationship between differences in prices across HC and LA boundaries and respective UBL rates by neighbourhood used as an alternative measure to AB in the last section of this paper. While more robust estimates are discussed in section 4.4 of this paper following specifications (2a) and (2b), these simple and transparent scatterplots provide some interesting insights. There is a positive intercept, implicating that in cities with the lowest rates of non-compliance heritage areas appreciate the value of a property by about 8.7% or €27.4k and by about 7.5% or €23.8k for HCs and LAs respectively. A 10-percentage point increase in AB, so from having no AB to 10% of abusive buildings, all else equal, decreases heritage price premiums by about 3.2 and 1.7 percentage points for HCs and LAs respectively. In standard deviation terms, a one unit increase in AB decreases prices by about 4.9 and 2.7 percentage points for HCs and LAs respectively.

Figure 7 Border Price Premium versus Non-Compliance Measures



Note: Left Panel - Unit of observation is city. Border effect (unweighted) is obtained by regressing log of price against structural and location controls, dummies delineating limited areas on both side of the boundary, boundary effect dummies and year effects (specification 2). Standard errors clustered at neighbourhood level. Right Panel – Unit of observation is neighbourhood. Same approach is employed to calculate border effects but at neighbourhood level.

There is a similar positive intercept in the right panel, plotting the relationship with UBL, implicating that in neighbourhoods with the lowest UBL rates heritage areas appreciate the value of a property by about 3.9% or €12.5k for HCs and 1.6% or €5.3k for LAs. A one standard deviation in the UBL index is associated with a depreciation effect of about 3.1

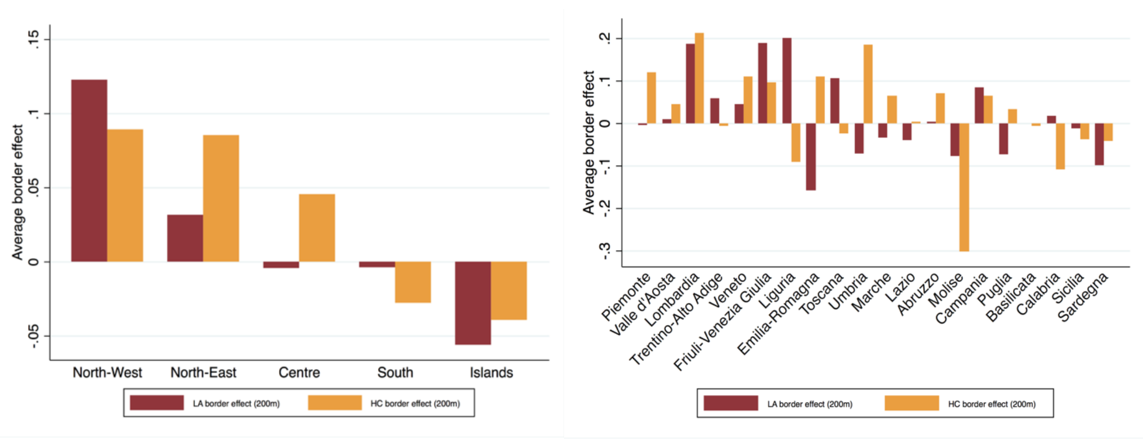
and 0.18 percentage points for HCs and LAs respectively. The negative effect increases when weighting the border effects although I do not report this in Figure 7 to improve clarity.

3.4.3 Heterogeneous heritage effects

Before further analysing the relationship between price premiums and non-compliance measures, I explore the variation in differences in prices across LA and HC boundaries in more depth, estimated according to specification (1) by city. 37 out of 55 cities achieve a positive premium for Historic Centres, 18 of which are significant estimates, while 18 out of 55 cities achieve a negative premium, 11 of which are significant estimates. 30 out of 55 cities achieve a positive premium for Landscape Areas, 18 of which are significant estimates, while 22 out of 55 cities achieve a negative premium, 8 of which are significant estimates. There is therefore significant variation in the price premiums of the two conservation policies under consideration, with a noteworthy variation in premium magnitudes. The comprehensive list of estimates by city are reported in Table A7 of the appendix. I can tentatively suggest that the price effect is at least partially driven by architectural externalities, but the estimates also suggests there are contextual differences between both landscape and historic areas resulting in negative or positive price premiums.

Taking the average of coefficients by region and geographical area reveals some trends. The left panel of Figure 8 illustrates how per geographical area (north-west, north-east, centre, south and islands) LA premiums are on average consistently significant and positive at larger magnitudes in northern cities than in central and southern cities. It also illustrates how HC premiums are on average consistently significant and positive in northern and central cities but on average significant and negative in southern and island cities. The right panel of Figure 8 breaks these trends down, revealing that at regional level there are many exceptions within these trends. Although the effects suggest that less value is attributed to heritage areas in southern rather than in northern regions, cities such as Savona and Livorno present negative significant estimates in the north (Table A7 in the appendix) while cities such as Bari and Messina present positive and significant estimates in the south (Table A7 in the appendix). I hypothesise that these differences stem from informal building behaviour, which although generally more present in southern regions, has risen in other cities over Italy.

Figure 8 Summary of border effects



Note: The left panel of Figure 8 illustrates the mean by geographical area of coefficients of specification (2) at city level. The right panel of Figure 8 repeats the same exercise but illustrates the mean by the 20 Italian regions, going from the most northern regions on the left side to the more southern at the right side, and the islands of Sardinia and Sicily at the end.

3.4.4 Does *abusivism* drive heritage price premiums ?

Once recovered, the boundary coefficients are then run in the two second steps regressions (2a) and (2b) to evaluate the forces driving the heterogeneity in price premiums. Price premiums are weighted by the inverse of their relative standard errors to account for the significance of estimated effects. In Table 3 I report estimates of specification (2a) and (2b) in columns (1) – (7) and (8) – (14) respectively. The first 7 columns show a consistent and significant negative effect of AB on price premiums for HCs. A 1% increase in AB is associated with an expected depreciation effect of 0.510-0.68 percentage points in HC price premiums, given the average premium is 3.5% this is a considerable depreciation. The OLS results remain relatively consistent after controlling for education, population density, building height and environmental quality, which progressively increase the magnitude of the effect. Given that AB, as motivated earlier in the paper, is influenced both by informal institutions and mafia influences, I control for mafia from column (4), which allows me to isolate the effect that runs from AB to heritage premiums because of informal institutions and not because of mafia. The addition of a mafia-crime index contributes to increasing the magnitude of the effect of AB but is not in itself significant.

In columns (5) to (7), I address endogeneity. To repeat, I expect the main sources of endogeneity to be reverse causality, returns to abusive behaviour could be larger in highly valued areas, or an omitted variable problem affecting both the heritage premium and abusive behaviour thus decreasing the magnitude of my coefficients.

Column 5 duplicates column 4 but uses an instrument for AB exploiting the legal attitudes index (LAI) conceptually created by Tabellini (JEEA, 2010) as explained earlier in the paper. This allows me to isolate attitudes affecting abusive behaviour from ones affecting price premiums. The results for the IV estimation in column (5) increases the magnitude of the coefficient of AB but does not appear to affect the rest of the regression, suggesting the presence of a slight negative bias in the OLS results, likely driven by the possible reverse causality where higher heritage premiums could cause more abusiveness. An instrument measuring early political institutions in 15-17th century Italy in the spirit of Guiso, Sapienza and Zingales (2016), is used in column 6 yielding similar results. Finally, column 7 uses both LAI and historical instruments to estimate a coefficient of 0.59 percentage points, further confirming the relative magnitude of the results. I test for weak-instruments using the Kleibergen-Paap rk Wald F statistic. In all cases, the F-statics imply that our instruments are strongly correlated with the variable of interest.   To test for overidentification, I report Hansen's J-statistic in column 7, the null-Hypothesis is not rejected indicating that the instruments are valid and therefore uncorrelated with the error term. Overall, the results indicate that the OLS estimates are quite conservative and robust.

Columns (8) – (14) show a consistent negative effect of AB on price premiums in Landscape Areas, however, not only is AB weakly associated with premiums in this case, the association is only very weakly significant. The results remain consistent after controlling for education, population density, building height and environmental quality, but the identification is only improved after AB is instrumented suggested some omitted variable bias most likely linked to the specific nature of LAs which comprehend areas of both natural and architectural value. The effect remains just shy of significance in the OLS estimations. Unlike in the HC results, the mafia index variable is negative and significant. This is driven by the mafia-led *abusivism* happening in costal LAs present in my sample, as the significance of the effect disappears when coastal cities are dropped. My preferred estimate in the case of LAs is that a 1% increase in AB is associated with an expected depreciation effect of 0.25-0.63 percentage points in LA price premiums. Although this is a slightly smaller effect than the effect of AB on HC premiums, it is still a considerable depreciation given the average premium is 6.5% .

Table 3 AB effect on price premiums

	Historic Centre price premiums (weighted)						
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) IV LAI	(6) IV HIST	(7) IV
AB rate [a]	-0.00273**	-0.00236*	-0.00445***	-0.00505***	-0.00689***	-0.00580**	-0.00596***
	(0.00126)	(0.00132)	(0.00155)	(0.00164)	(0.00180)	(0.00205)	(0.00158)
Mafia Index [b]				-9.10e-05	-8.77e-05	-9.41e-05	-9.08e-05*
				(5.68e-05)	(5.77e-05)	(5.91e-05)	(5.39e-05)
First-stage	–	–	–	–	46.35	41.80	45.26
Hansen J p-value	–	–	–	–	–	–	0.88
Observations	55	55	55	55	55	55	55
R-squared	0.364	0.367	0.437	0.438	–	–	–
Education [c]	YES	YES	YES	YES	YES	YES	YES
Pop density [d]	YES	YES	YES	YES	YES	YES	YES
Build. Height [e]	–	YES	YES	YES	YES	YES	YES
Env. Qual. [f]	–	–	YES	YES	YES	YES	YES
	Landscape Areas price premiums (weighted)						
	(8) OLS	(9) OLS	(10) OLS	(11) OLS	(12) IV LAI	(13) IV HIST	(14) IV
AB rate	-0.00122	-0.00144	-0.00142	-0.00257†	-0.00635**	-0.00427*	-0.00535**
	(0.00116)	(0.00132)	(0.00197)	(0.00112)	(0.00270)	(0.00234)	(0.00220)
Mafia Index				-0.000162	-0.000231**	-0.000193*	-0.000213**
				(0.000108)	(0.000104)	(9.96e-05)	(9.91e-05)
First-stage	–	–	–	–	42.87	35.25	45.7
Hansen J p-value	–	–	–	–	–	–	0.43
Observations	52	52	52	52	52	52	52
R-squared	0.304	0.307	0.307	0.345	–	–	–
Education	YES	YES	YES	YES	YES	YES	YES
Pop density	YES	YES	YES	YES	YES	YES	YES
Build. Height	–	YES	YES	YES	YES	YES	YES
Env. Qual.	–	–	YES	YES	YES	YES	YES

Note: Price premiums are obtained by regressing log of price against structural and location controls, dummies delineating limited areas on both side of the boundary, boundary effect dummies and year effects (specification 2). The coefficients are then weighted by the inverse of their relative standard errors to account for the significance of estimated effects. [a] AB rates range from 3.24 abusive buildings per 100 buildings (on average for a city) to 52.52 abusive buildings per 100 buildings (on average for a city). [b] The index is constructed from ISTAT province capitals crime data and accounts for rates of mass casualty crimes (usually linked to bombs or similar), voluntary mafia homicides and kidnappings. [c] Share of population holding a university degree. [d] Population density by neighbourhood. [e] Building height is in metres. [f] Quality of the environment index evaluating air, water and other natural variables (mean=2.83 std=.16, higher numbers indicate better environmental quality). The first-stage statistics is the Kleibergen-Paap rk Wald F. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 † p < 0.15

Collateral findings to my analysis include observations about the effect of education and population density on price premiums. Share of population holding a university degree has a consistent positive effect on price premiums in HC, which is consistent with other findings that more educated people value heritage amenities more and confirms amenity-based sorting (Ahlfeldt & Holman 2017). This effect is on the other hand insignificant for LAs. Population density also has a small but significantly positive effect on both HC and LA price premiums, suggesting that heritage price premiums are positively associated with the presence of higher densities, possibly alluding to the importance of intangible heritage present in such areas. Building height also has a consistently negative effect on HC price premiums suggesting that taller buildings are not valued in historic centres. See Table A8 in the appendix for a full tabulation of estimates.

3.4.5 Neighbourhood Level Analysis and Robustness Checks

Given estimates using the LAI instrument suggest the OLS results are quite conservative and robust, I re-run the entire analysis at neighbourhood level according to specification (1), and subsequently (2a) and (2b) using the urban compliance (UBL) index as an alternative measure of illegal and informal building behaviour, as described in section 2.2 of this paper. This approach allows me to include city fixed effects to my analysis and confirm my results at neighbourhood level. It also allows me to focus on how other neighbourhood level characteristics across LA and HC borders could be affecting price premiums.

Results in Table 4 confirm a consistent and significant negative effect of non-compliance (in this case ΔUBL) on price premiums for Historic Centres, and a negative and weakly significant effect of ΔUBL on price premiums in Landscape Areas. The magnitudes of the coefficients are, given the smaller neighbourhoods under consideration, larger but generally in line with city estimates in Table 3. The addition of city fixed effects in columns (3) increase the magnitude of the effect of ΔUBL on HC price premiums, similarly to the city level regressions including instruments, while in column (6) fixed effects bring the effect of ΔUBL on LA price premiums to significance. Overall, the results support the estimates in Table 3, confirming a consistent negative effect of non-compliance especially in the case of HCs. A one standard deviation in UBL is associated with a depreciation effect of up to 7 percentage points for HCs price premiums. The insignificant effect on LA price premiums, is most likely linked to the nature of the UBL index (change in number of pre-1919 buildings which by law should not be demolished). LA policy (Law n.1497/1939) protects landscapes in both urban and natural settings, specifically complexes of immobile things with aesthetic or traditional values, it is therefore consistent with the nature of the policy that a change in the historicism of buildings would affect LAs less than HCs, given the former policy is not as tied to historical buildings specifically, but to the value of urban and natural settings as a whole.

Table 4 Neighbourhood Level estimates

Price premium	(1) HC	(2) HC	(3) HC	(4) LA	(5) LA	(6) LA
ΔUBL [a]	-0.0519**	-0.0508**	-0.0795***	-0.0106	-0.0211	-0.0377*
	(0.0202)	(0.0207)	(0.0277)	(0.0224)	(0.0211)	(0.0175)
Arch. density [b]		0.00938	0.0119		0.0273**	0.0412**
		(0.0108)	(0.0290)		(0.0134)	(0.0197)
Higher Edu [c]	0.0212	0.0561	0.0180	0.0319	0.226	0.256
	(0.140)	(0.149)	(0.226)	(0.178)	(0.210)	(0.288)
Pop Density [d]	4.30e-06	4.50e-06	3.36e-06	2.45e-06	1.02e-06	1.31e-07
	(3.41e-06)	(3.50e-06)	(5.08e-06)	(3.19e-06)	(3.42e-06)	(3.44e-06)
Build. Bad [e]	-0.241*	-0.226*	- 0.0179†	-0.0642	-0.0928	-0.287
	(0.123)	(0.115)	(0.0187)	(0.148)	(0.143)	(0.206)
Build. Height [f]	-0.00403	-0.00355	-0.0103	-0.00303	-0.00294	-0.00126
	(0.00654)	(0.00647)	(0.0119)	(0.00617)	(0.00625)	(0.00736)
Δ NBG [g]	-0.000872	-0.00278	-0.00123	-0.00818***	-0.00568*	-0.00650†
	(0.00650)	(0.00690)	(0.0136)	(0.00306)	(0.00308)	(0.00424)
Δ empty build [h]	-0.00163	-0.00181*	-0.00315	-0.000488	-0.000283	-0.00360***
	(0.00102)	(0.000965)	(0.00254)	(0.00106)	(0.00105)	(0.00135)
Year Built [i]	0.0250	0.0231	0.00734	-0.0142	-0.00499	0.0391
	(0.0220)	(0.0220)	(0.0424)	(0.0195)	(0.0199)	(0.0284)
Observations	311	311	311	311	311	311
R-squared	0.098	0.102	0.479	0.035	0.055	0.526
City FE	NO	NO	YES	NO	NO	YES
Cities	55	55	55	55	55	55

Note: Price Premiums are obtained by regressing log of price against structural and location controls, dummies delineating limited areas on both side of the boundary, boundary effect dummies and year effects (specification 2). The coefficients are weighted by the inverse of their relative standard errors to account for the significance of estimated effects. [a]UBL Index (standardized) - the difference in pre-1919 buildings in good or excellent state between 2011 and 2001 per 100 buildings by census tract. [b]K-density (quantiles) of buildings with recognised architectural value. [c]Share of population holding a university degree. [d]Population density by neighbourhood. [e]Percentage of buildings in fair or bad state. [f]Building height is in metres. [g]New Build Growth - change in number of residential buildings after 1991. [h]Change in number of empty units. [i]Year built is defined as follows: 1 -1700 and before, 2 – 1700 to 1919, 3 – 1920 to 1950, 4 – 1951-1980, 5 1980 to now. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 † p < 0.15

The neighbourhood level analysis also allows me to explore other variables driving heterogeneity at a smaller spatial scale. In Italy, buildings inscribed for their architectural value are not just historical monuments, but all buildings of architectural significance, often referred to as 'minor architectural goods' (Cosi 2008). My results show, as anticipated, that density of these architectural goods positively and significantly influence price premiums across LA borders. The disaggregated results also confirm that higher levels of education positively affect HC premiums, as suggested in the city-level results, although the effect is insignificant. Buildings in bad condition negatively affect both HC and LA price premiums, and while building height is negative, as in the city-level results, coefficients remain insignificant throughout. The same is observed for population density, although coefficients are positive, they remain insignificant in all estimation unlike the city-level regressions. New building growth has a small negative effect on price premiums, which is significant for LAs, which is in line with the spatial nature of the policy as LA are much smaller than HC, and new building growth would thus much more significantly affect their appreciation.

3.5 Conclusion

Italy is famously known for the richness of its urban heritage, which is a valuable public asset throughout the country. This paper exploits the Italian context to examine the heterogeneity of urban heritage value through two conservation policies - Landscape Areas and Historic Centres. To then examine the extent to which non-compliance undermines conservation effects.

This paper presented a two-step strategy which recovers price premiums by city or neighbourhood in the first step and regresses the recovered premiums on AB among other variables in the second step. Comparing the differences in property prices along the boundaries of both HCs and LAs, I find an overall average capitalisation of about 6.5% (€160 extra per metre square) for Landscape Areas, and as estimated average premium of 3.5% (€86 extra per metre square) for Historic Centres. Results also indicate substantial heterogeneity in heritage price premiums, suggesting that despite nationally imposed stringent planning regulations there are other forces driving a disparity in values. In the second step and by using an instrumental strategy to substantiate estimates, results confirm that at least partially *abusivism* levels explain the heterogeneity of price premiums, limiting the capitalisation of architectural public goods and putting one of the major urban amenities of Italian cities at risk. A one percent increase in AB is associated with an expected depreciation effect of 0.50-0.68 percentage points in HC price premiums, which is considerable given the magnitude of the capitalisation effect. Furthermore, a one percent increase in AB is associated with a depreciation of 0.25-0.63 percentage points in LA price premiums. Within my analysis, I further control for mafia effects, which allows me to separate out the effect that runs from AB to heritage premiums because of informal institutions from the effect that runs from AB to heritage premiums because of mafia.

Results imply that informal institutions tied to illegal attitudes and behaviour undermine the positive economic outcomes of these heritage areas, and places with higher AB thus experience lower external benefits of urban heritage. The evidence we provide is particularly relevant for internal policy. The results suggest an impoverishment of the physical appearance of heritage areas in many cities, which in turn assumes other negative outcomes such as fewer economic benefits from tourist industries in locations with high AB, or losses of intangible socio-cultural customs and values which are often tied to the preservation of historic areas (Tweed & Sutherland 2007; Lazrak et al. 2014). Results are also relevant to the recent governmental push to limit *abusivism*. The evidence suggests that given past building amnesties, people still rely on the possibility of future measures granting legal status to unauthorised buildings, and implies efforts limiting AB have evidently not been localised enough. This underlines the necessity to re-address policies limiting AB, in order to provide stronger motivations towards the compliance of construction regulations, and to re-address red-tape and high-costs to obtain permissions within conservation areas, in order to better protect areas where public goods such as heritage buildings and landscapes are found. Without administrative burden reduction policies the costs from greater compliance will most likely be too high for average residents. This paper contributes more generally to furthering understanding of urban illegalities , which exist in many contexts, and how they can affect the urban policy outcomes. I hope this study will motivate other investigations of the relationship between restrictive zoning systems and citizen compliance.

3.6 References

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3.7 Appendix : Conservation Planning and Informal Institutions

3.7.1 Introduction Appendix

This appendix complements the main paper by providing additional detail not included in the main paper for brevity. To facilitate comprehension, it partially duplicates parts of the prose in the main text. Section 2 provides further details regarding the institutional setting presented in the main paper. Section 3 comprises additional material on data collection and collation as well as the presentation of some descriptive statistics. Section 4 includes additional detail on the empirical strategy, with the presentation of maps that illustrate the spatial setting of the study. Section 5 presents complementary results that are not essential for the message of the main paper but may be of interest to some readers, as well as several robustness checks. The appendix is designed to complement arguments and specifications in the main paper, it is not designed to stand alone or replace the reading of the main paper.

3.7.2 Institutional Setting

3.7.2.1 The evolution of the Italian conservation planning system

Conservation planning in Italy is made up of three highly restrictive legislative strands: individual architectural designations[33] and their relative perimeters, Landscape Areas (LAs)[34] and historic centres (HCs) (Bonfantini, 2012; Carughi, 2012; Giannini, 1976; Olivetti et al., 2008). There are almost 200,000 architectural restrictions in Italy, the listed buildings are divided between verified buildings, others that are under consideration, and others that are not yet verified (Ministero dei beni e delle attività culturali e del turismo, 2016). There are over 6000 *vincoli paesaggistici* of various sizes many of which are situated in urban areas (Ministero dei Beni e della Attività Culturali e del Turismo, 2016). Given fragmented historical geography of Italy, there are over 8,000 Italian cities, 90% of which have fewer than 15,000 inhabitants; just about all of them, both large and small, have a least one historic centre (Ricci, 2007). This results in a phenomenal 22,698 historic centres (Ministero dei Beni e le Attività Culturali, 2016).

Conservation planning has a unique place in Italian urban policy; some have even argued that the principles and practises of conservation planning are one of Italian urbanism's main contributions in the field (Balducci & Gaeta, 2015). The Italian architect Gustavo Giovannoni coined the term 'urban heritage' in the 1930s as obtaining its value not as an individual and autonomous object but as part of the overall character of urbanism

[33] Known in Italian as *vincoli architettonici*.
[34] Known in Italian as *vincoli paesaggistici*.

(Choay, 1992). Article 9 of the Italian Constitution states the need to protect and enhance both the landscape, historical and artistic heritage of the nation (Cosi, 2008).

From its inception, up and to the introduction of modern town planning in Italy (1942), conservation policy grew slowly but progressively. Although urban heritage areas were not identified within urban codes, they were recognised from an environmental perspective. Indeed, the Landscape Areas are derived solely from the 1939 environmental law, which later received modifications in the 1980s (n. 431/1985 "Aree tutelate per legge") and in 1999 (n. 490/99 'Testo Unico') (Ministero dei Beni e della Attività Culturali e del Turismo, 2016). This law (n.1497/1939) refers to 'natural goods' including 'beautiful ensembles'[35] which are 'complexes of immobile things (buildings) that hold aesthetic or traditional values (Carughi, 2012; Giannini, 1976). The Cultural Heritage and Landscape code later (22 January 2004 n. 42) integrated these previous norms in an attempt to simplify legislation. Within this code, Article 136 and Article 142 apply to landscapes. Article 136 identifies buildings and areas of significant public interest[36] while Article 142 identifies the areas having natural interest. Even though this construct is tied initially to environmental rather than socio-cultural historical values, it includes restrictions linked to heritage more holistically. For example, the neighbourhood of Brera, one of Milan's historic quarters, is protected by a *vincoli paesaggistico* and within its specifications it considers the preservation of its historic character by controlling things like the appearance and décor of buildings (Gazzetta Ufficiale, 2009).

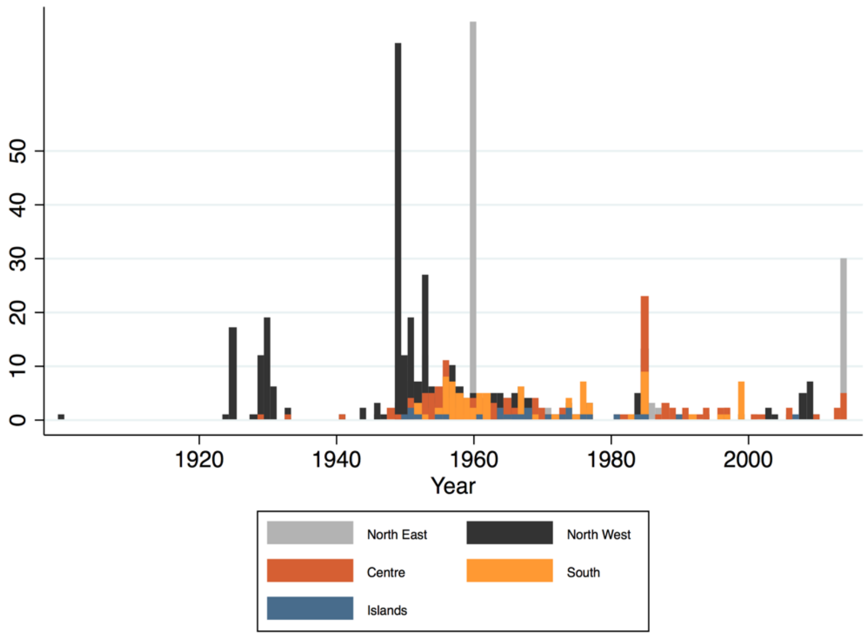
There is, moreover, a clear distinction to be made between the *vincoli paessagistici* and historic centres. While the former presents elements both of valorisation and safeguarding, the latter are almost solely about promotion and valorisation (art. 117, comma 3, of the Italian Constitution) (Fantini, 2014). The 1967 *Legge Ponte* (Law n. 765) included historic centres as part of overall city planning, delimiting them by the Zone A in Italian Master plans which demarcates zoning areas, buildable exploitation and areas to be allocated to public services (Venuti & Oliva, 1993).[37] The regulatory plans of each city protect HCs and impose a series of restrictions on them. HCs are delimited in a logic of historical consistency where there is a clear differentiation in building age between

[35] Denominated in Italian legislation as 'bellezze d'insieme'.
[36] These include a. good of specific administrative use b. 'immovable things', 'villas and gardens', 'parks' c. and d. 'complex of properties', 'areas of scenic beauty'
[37] PRCs (*Piano Regolatore Comunale*) or PRGs (*Piano Regolatore Generale*) are general regulatory plans for the city.

buildings inside Zone A and outside Zone A. In practice, many historic centres are partially superimposed by *vincoli paessagistici* (Figure 1 of main paper).

Figure A1 shows the evolution of LA listings throughout Italy by geographical area. I observe a peak of designations after the introduction of modern town planning, and notably after the end of the Second World War. As noted, by Pietrostefani & Holman (2017) this is closely tied to post-war demolition and rebuilding, which spurred communities and nations to strengthen conservation planning. There is an overall decreasing trend in designations after 1960, with a few peaks just before the 1990s and in recent years. Figure A1 thus demarcates the historicism of the LA system in Italy. In some exploratory regressions, presented in Table A5 of the appendix, we consider how the years since designation of a LA affect price premiums.

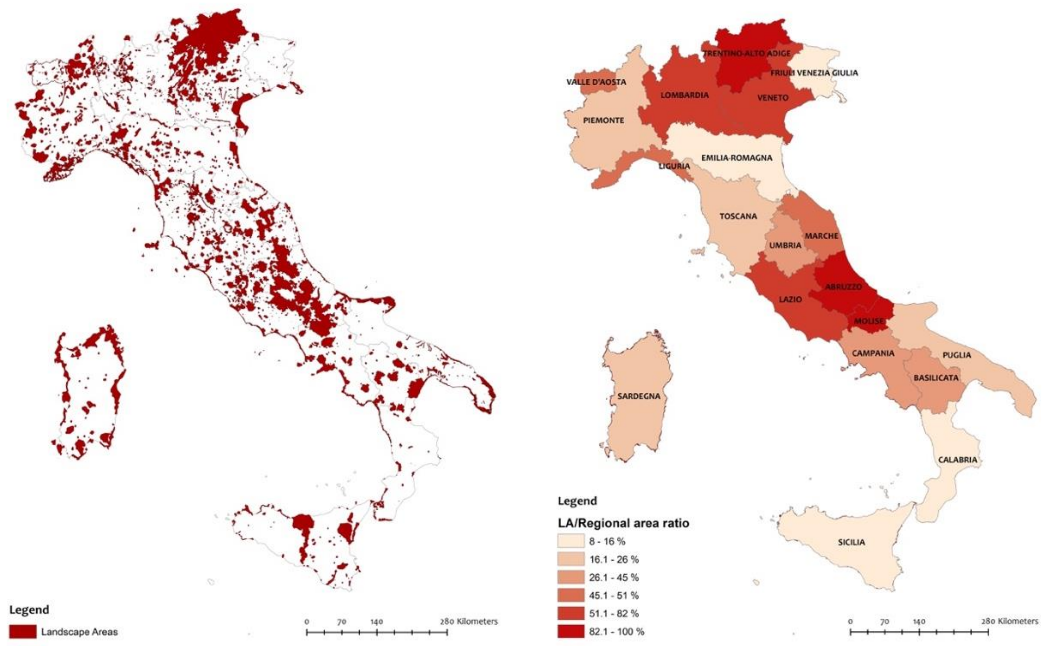
Figure A1 Evolution of Landscape Area designation by year



Notes: Presents the distribution of conservation areas by year of designation by geographical area of Italy.

Figure A2 presents the geographical distribution of Landscape Areas per region and percentage of area LA cover per total regional area. I observe some heterogeneity in terms of percentage of land covered by LAs, however there is no distinct pattern by geographical location.

Figure A2 Landscape areas per Region



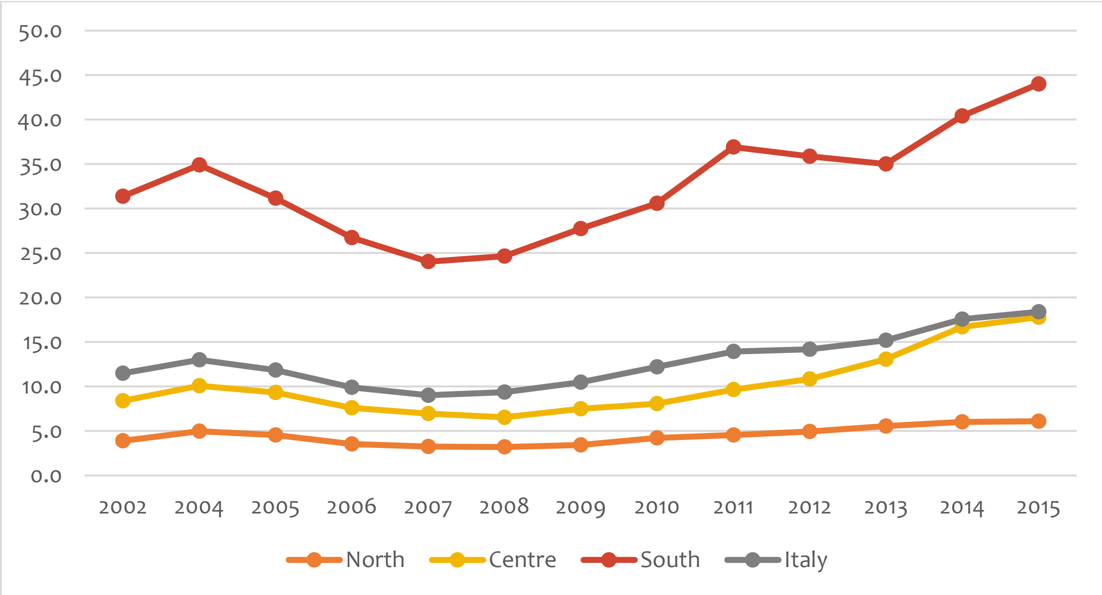
3.7.2.2 *Abusivism* and policies addressing it

There is, on the other hand, a clear North-South polarization in AB trends as shown in Figure 3 in the main paper. Figure A3 further illustrates the rates of AB in southern regions, and much lower rates in Central and Northern regions. From 2008, as shown in Figure 2 there is a sharp reduction in building production, but a much more contained decline in *abusive* construction, in line with a slight rise of AB not only in southern regions but central ones as well as shown in Figure A3. The rise is particularly marked in the south, specifically in Campania, Calabria and Sicily (where between 2012-2014 the number of illegally constructed buildings was estimated as varying from 45 and 60% of authorized ones). A worrying trend characterises Umbria, where average AB rates have doubled compared to the previous three-year period and, in 2015, reached more than 28% (+3.8 points). Significant increases are also recorded in Lazio (from 19.6% to 22.4%) and in Liguria (from 16.5% to 18.5%).

The best deterrent to *AB* has been argued to be the restoration of legality through the demolition of outlawed buildings. *AB* continues, however, given the ineffectiveness of demolitions in many regions. Figure A4 illustrates the percentage of demolitions per region which have yet to be carried out. These numbers are especially high in Campania and Calabria at 97% and 94% respectively. Throughout Italy, of the 46,700 demolitions ordered by the state judiciary in 2012, only 14% have been carried out to date (see section 2 of the appendix for breakdown). Between 2004-2018, Campania only carried out 496

(2.9%) of its 16.596 demolition injunctions, while other regions with much lower *AB* rates have carried out much higher numbers of demolitions, Lombardy and Piedmont 37% and 30% of their 4.895 and 3456 injunctions respectively (Biffi, Dodaro, Morabito, & Pergolizzi, 2018).

Figure A3 Evolution of Illegal Building by Geographical location



Notes: Index of abusiveness by geographical region. Years 2002-2015. Number of new abusive constructions of residential use for every 100 legal constructions. Source: Author's elaboration of CRESME data

Figure A4 *Abusivism* Policy map and comments

Region	Demolitions Ordered	Demolitions Done
Valle d'Aosta/Vallée d'Aoste	140	42
Molise	441	148
Friuli-Venezia Giulia	823	536
Marche	896	234
Basilicata	946	224
Abruzzo	983	259
Trentino-Alto Adige/Südtirol	1919	238
Puglia	2252	366
Sardegna	2538	491
Umbria	2538	774
Calabria	2816	168
Liguria	2863	888
Emilia-Romagna	3360	1076
Piemonte	3465	1060
Lombardia	4895	1827
Toscana	5098	1262
Lazio	5604	689
Sicilia	6637	1089
Veneto	6820	2151
Campania	16596	496

Notes: Source: Author's elaboration of Legambiente (2017) data

3.8 Data and Descriptive Statistics

This section of the appendix provides detail on data collection and collation not included in the main paper.

3.8.1 Examples of Posts and Location

The empirical analysis relies on a novel data set constructed from a wide-range of sources. Over 60,000 geo-localised house sales advertisements with a wide range of attributes spanning from 2011 to 2018 were collected from *Immobiliare.it,* the largest online portal for real-estate services in Italy. Data sampling focused on residential units for sale monitored from the time they were created up to the time they were removed from the database. In 2016 the number of housing transactions in provincial capitals on *Immobiliare.it* was 183,000 units (about one-third of all housing transactions in Italy). The majority of transactions in these cities is brokered by real estate agents, who are more likely to upload adds on *Immobiliare.it* than private citizens, whereas in small towns sales are less likely to need brokerage and so representativeness is potentially a problem.

Given this website's coverage and the paper's focus on large cities (the 3 most capitals with largest populations in each region), I do not need to worry about representativeness of the sample of properties advertised on *Immobaliare.it*. Figure A5 presents examples of posts from *Immobiliare.it* and the attributes scraped from the HTML code of these adds.

Figure A6 presents an example of the geo-localisation of an advert on the *Immobiliare.it* website. Figure A7 presents two examples of post locations, Milan on the left panel and Naples on the right panel. As we can see properties are evenly spread out across space.

Figure A5 Examples of posts

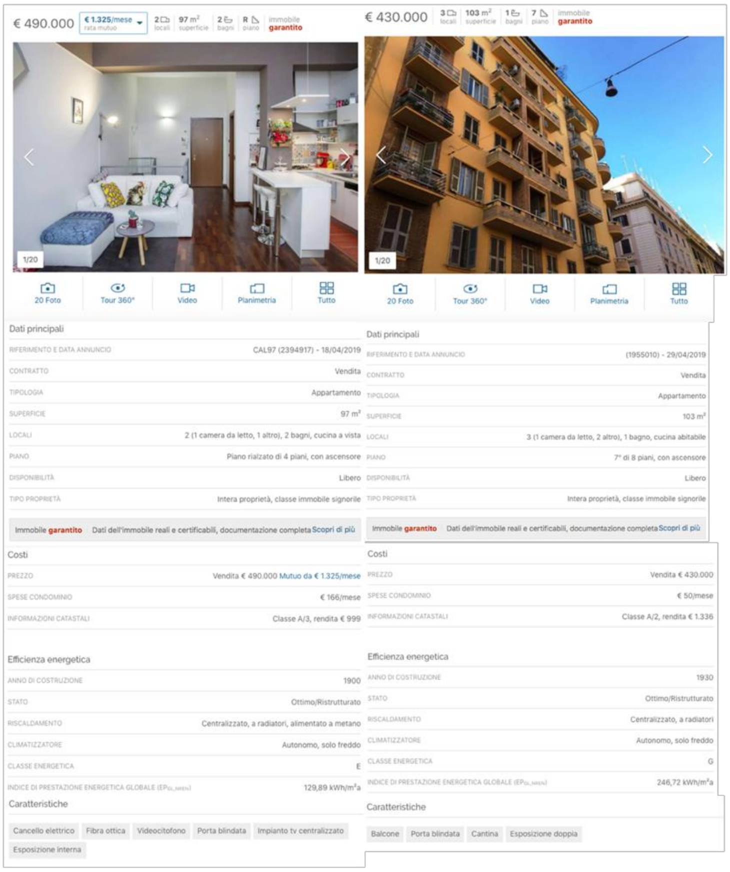


Figure A6 Example of geo-localised location of one advert

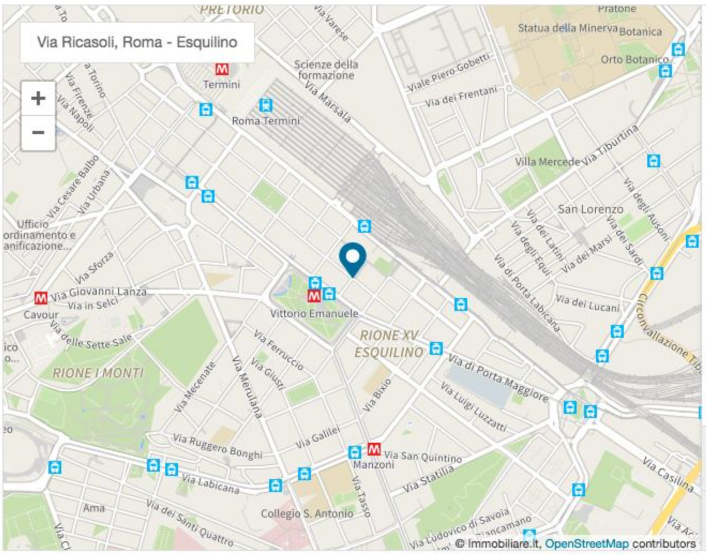
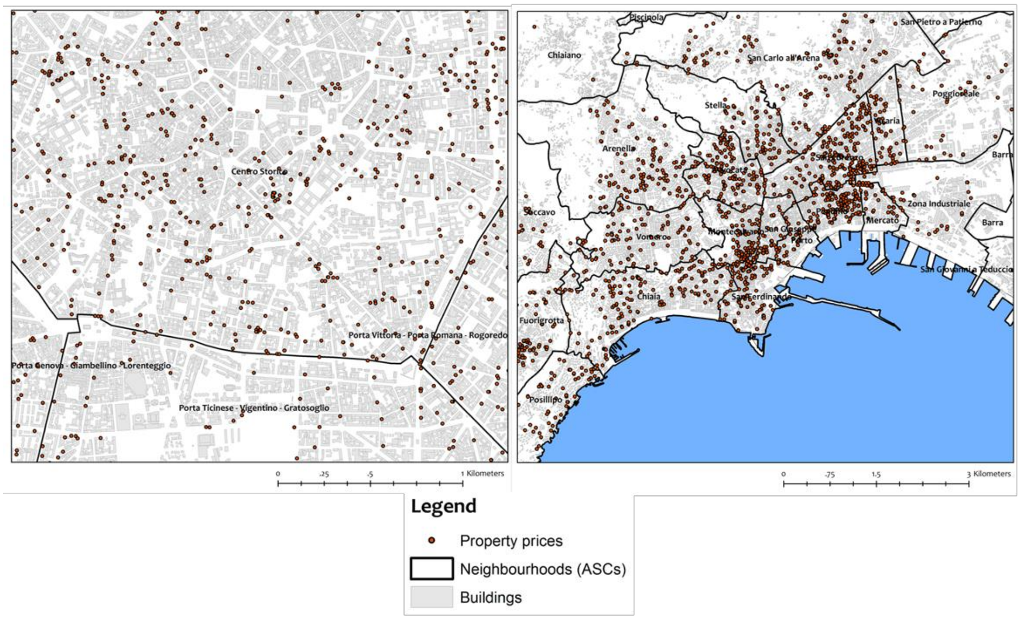


Figure A7 Insert Image of location of posts



3.8.2 Property data collection and description

Until recently, micro-geo-localised house price data was not available for the Italian territory. *Immobiliare.it* was used given it is the largest online portal for real-estate services in Italy to get access to the biggest source of geo-localised sale advert data. Each post has a unique identifier, a short text describing the sale and various standardized tables presenting the most important characteristics of each property. A first table presents the principle characteristic of each property, the surface area, the number of rooms, the price, the floor number and type of building (Figure A5). A second table presents the price and cadastral information and a third lists year of construction, general state of property, type of heating, availability of air conditioning as well as energy class (Figure A5). The next section presents internal amenities the property has been tagged with, which can be used as key words in order to find additional information such as the presence of a balcony or terrace, WIFI, window exposure among other facilities. Finally, the geo-localisation of the property is shown on a map enabled by OpenStreetMap (Figure A6).

To get the data from the website, I use Python to create programs that mimic a web browser request. First, I randomly select URL's of posts by city, to the extract Hypertext Markup Language (HTML) of each page from the server, including the coordinates of the property in order to later geo-localise it on ArcGIS. The data is immediately collected into an excel file with set columns, however, a great deal of cleaning and restructuring is still needed to get an analysable format for each post. The source data obtained from

Immobiliare.it is contained in yearly files. The database is then saved and imported into STATA. Overall the scraping operation takes between an hour and a day depending on the period of time and the internet connection. Initially the process was carried out with a google plug-in called *Webscraper* twice a year from 2013 to 2015, and then using the Python from 2015 to 2018 every 3 months.

The files were then compiled, cleaned and checked for duplicates through the website's unique identifier for each add. When a change of price was tracked, the final most conservative price was recorded. A recent paper by Loberto, Luciani and Pangallo (2018) which focused on the comparison between *Immobiliare* data and the OMI data provided by the real estate market observatory of the Italian Tax Office, found the *Immobiliare* data providing a picture of the housing market broadly consistent with official sources, with an approximate 12% discount to be interpreted between the *Immobiliare* data and the OMI data. Although this paper uses a different sample from the same source, both datasets overlap in timing and in the methodology followed for their collection. I am thus confident that the advertised price data is close to an unbiased forecast of actual sales prices that does not vary across the cities under consideration and includes a constant premium.

Table A1 provides an overview of the variables, some of the missing values were filled by using the textual description of the ads. For example, over 1,000 properties were geo-localised from their addresses given latitudes and longitudes were missing.

Table A1 Content of the ads dataset

Type of data	Variables
Identifiers	Unique ad identifier, date in which the ad was created in the database, date in which the ad was removed from the database, date in which one of the characteristics of the ad was modified for the last time
Numerical	Price, floor area, *rooms, bathrooms*, year built
Categorical	Property type, kitchen type, heating type, *maintenance status, floor,* air conditioning, energy class
Type of building	*Elevator, garage/parking spot,* building category
Geographical	*Longitude, Latitude*, address
Temporal	Ad posted, ad removed, ad modified
Contractual	Foreclosure auction
Textual	Description

Notes: Variables in italic are complemented using semantic analysis on the textual description of the ad.

3.8.3 Choice of 55 cities

This paper focuses on a subset of the Italian province capitals. Within the 118 provincial capitals, the 3 most populated capitals in each region were selected, always including the regional capital, resulting in 55 cities. Better data is available within this list of cities, which is not to be overlooked as data availability in Italy is extremely heterogeneous and there are over 8000 urban areas (Ricci, 2007). For Umbria, Trentino-AltoAdige, Valle d'Aosta, Basilicata and Molise there were less than 3 provincial capitals, they were thus all selected. In Lombardia, the city of Monza was only recently separated from Milan as a provincial capital (declared in 2004, in practice in 2009), and was therefore added as a 4^{th} urban area for the region. Figure A8 illustrates the 55 selected urban areas. The geographical area of study is the municipal area, rather than the whole province territory.

Figure A8 55 provincial capitals

3.8.4 Creating an exhaustive set of controls

Before using instruments or relying on the temporal dimension of the data, my first strategy is to collect and consider an exhaustive set of control variables, which has not been done as such a fine spatial scale for such a large part of cities in the Italian territory. A long list of locational controls in order to diminish omitted variable bias in the baseline regressions were collected from the Italian census (2011), the Italian National Geoportal of the Environment, various Italian open data regional geo-portals (when available), the Ministry of Education, the Ministry of Culture and Open Street Map. They include geo-localised micro-data such as building height and typology of buildings on the street, a range of natural and commercial amenities, parking and transport controls, as well as the locations of schools. These were all matched to the hedonic data in ArcGIS.

The mid-point of the main commercial street of each city was also recorded to act as a proxy for the CBD of each city. The main road construct applies well to medium Italian cities and for larger cities such as Milan, Rome and Naples two or more points were recorded (Borruso & Porceddu, 2009). Socio-economic variables such as population density, migrant percentages and level of education were obtained and joined to the hedonic data from the 2011 Italian census. Table A2 presents the summary statistics for all the main structural and location variables used as controls.

Table A3 presents summary statistics of property prices, structural, social and urban environment variables inside and outside HCs and LAs (mean, standard deviation [S.D.], min. and max.), to compare the two groups. Table A4 compares prices between different areas of Italy and illustrates a gap between average prices between the north and south of Italy. Largest standard deviations are exhibited in the Central regions, for example for transactions outside LAs the average price is €5,900 with a standard deviation of €81,737. This is most likely because of the presence of the capital city, Rome, has much higher prices than the other provincial capitals of the area.

3.8.5 Matching census data

To assess whether urban heritage areas attract certain types of households more than others and to partially control for the effects associated with such sorting, I spatially match neighbourhood characteristics to the hedonic data. This data refers to census spatial statistical units whose boundaries are typically much smaller than LAs or HC and are also smaller than city neighbourhoods. Figure A9 illustrates how LA and HC boundaries are much larger than the census units, I can therefore expect than even the smaller LAs comprise at least a few census areas and am therefore able to test differences across boundaries. To merge the data, I spatially match the hedonic data to the census unit it falls within.

Figure A9 LAs, HCs and Census Unit Boundaries

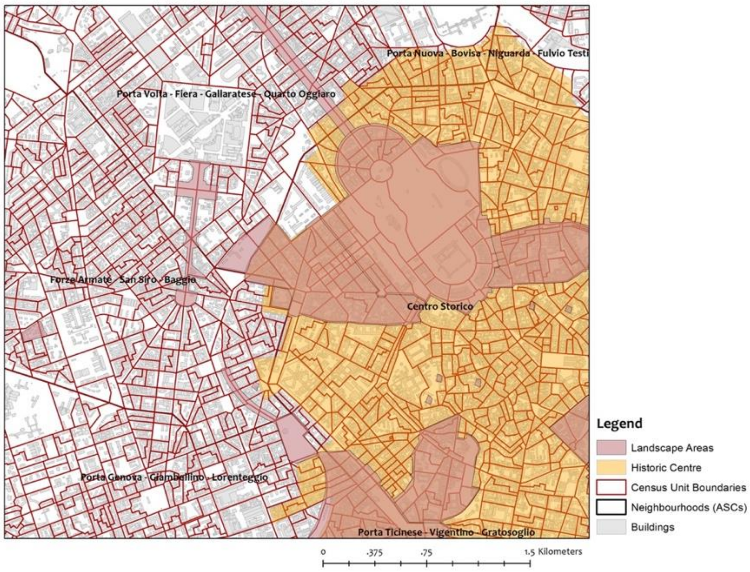


Table A2 Summary Statistics

Variable	mean	sd	min	max
Price €	320,049	760,617	1,000	130,000,000
Price SQM	3,543	52,030	1	7,200,000
Ln Price	12.25	0.85	6.91	18.68
Ln Price SQM	7.62	0.67	-0.60	15.79
Year	2016	1.81	2011	2018
SQM	123.18	136.35	1.00	7,344.00
Property type	4.02	0.71	1	7
# of rooms	2.80	1.30	1	5
# of bathrooms	1.51	0.69	0	3
Kitchen type	1.46	0.70	0	2
Floor	2.01	2.61	-1.00	12.00
Parking dummy	0.33	0.47	0	1
Lift Dummy	0.41	0.49	0	1
Property condition	2.19	1.08	0	4
Heating type	0.93	0.73	0	2
AC dummy	0.27	0.44	0	1
Energy band	0.87	0.83	0	3
Year built	2.49	2.01	0	5
Height building	14.52	8.36	1.00	89.30
HC dummy	0.27	0.44	0.00	1.00
LA dummy	0.16	0.36	0.00	1.00
Distance to HC	968	1,674	-2,893	44,986
Distance to LA	1,338	4,457	-4,791	53,794
Distance to Arch.	346	734	0	42,277
K-density arch.	0.00007	0.00019	0.00000	0.00649
Island	0.01	0.10	0	1
Distance to Green	4,305	6,647	0	46,513
Distance to Water	1,537	1,865	0	12,928
Distance to Beach	334,734	172,189	13	659,975
Distance to View	10,812	19,965	3	114,766
distance to Uni.	27,782	50,316	7	204,310
Distance to transport	756	3,082	1	48,682
Distance to out. Trans.	1,751	6,018	1	65,272
Distance to Airport	17,174	17,594	0	84,399
Distance to CC	14,489	25,858	0	137,379
Distance to Churches	407	730	0	38,624
Distance to public schools	994	6,897	0	76,705
Motorway buffer dummy	0.06	0.23	0	1
Industrial area dummy	0.03	0.16	0	1
Distance to construction	9,126	19,821	0	94,979
K-density car amenities	0.00000	0.00001	0.00000	0.00007
K-density financial amenities	0.00000	0.00001	0.00000	0.00005
K-density bars & rest.	0.00003	0.00005	0.00000	0.00060
K-density health amenities	0.00000	0.00001	0.00000	0.00006
Distance to CBD	2,340	2,027	2	45,821
N	**53,728**			

Notes: 1. Box, 2. Attic, 3. Loft 4. Apartment, 5. House, 6. Villa, 7. Building. 1. Needs refurbishment, 2. Good, 3. Refurbished. 4. New. 1. 700 and before, 2. 800 until 1919, 3. 1920-1950, 4. 1951-1980, 5. 1980-Now. Distances are in metres.

Table A3 Summary of variables by LA and HC: price, structural, social and urban environment tendencies.

Transaction	mean	sd	min	max	Transaction	mean	sd	min	max	T-test diff.	
Price SQM	5,745	93,871	1	6,500,000	Price SQM	3,138	39,784	3	7,200,000	-2607.5***	(-4.21)
Property type	4.07	0.78	1	7	Property type	4.01	0.70	1	7	-0.0607***	(-7.17)
# of rooms	3.00	1.37	0	5	# of rooms	2.76	1.28	0	5	-0.238***	(-15.45)
# of bathrooms	1.67	0.77	0	3	# of bathrooms	1.49	0.68	0	3	-0.186***	(-22.63)
Year built	2.28	1.94	0	5	Year built	2.53	2.02	0	5	0.251***	-10.51
Height building	13.72	7.70	1	57.8	Height building	14.65	8.46	1	89.3	0.939***	-8.68
Distance to	246	548	0	10,081	Distance to	364	761	0	42,277	118.8***	-13.62
Parking dummy	0.33	0.47	0	1	Parking dummy	0.33	0.47	0	1	0.00103	-0.18
Δ empty build	3.78	24.07	-470	226	Δ empty build	3.55	20.21	-476	351	-0.228	(-0.87)
Δ new build	1.14	5.61	-54	172	Δ new build	1.24	6.21	-56	158	0.104	-1.35
Pop. density	10,258	9,422	0	114,381	Pop. density	15,351	14,464	0	643,273	5092.9***	-30.79
Migrants	0.08	0.09	0	1	Migrants	0.10	0.11	0	1	0.0140***	-10.59
Build. Bad	0.11	0.18	0	1	Build. Bad	0.12	0.20	0	1	0.0121***	-5.11
Higher Edu.	0.57	0.14	0	1	Higher Edu.	0.51	0.15	0	1	-0.0641***	(-34.74)
inside HC	mean	sd	min	max	outside HC	mean	sd	min	max	diff.	
Price SQM	5,842	87,850	3	7,200,000	Price SQM	2,702	29,514	1	4,700,000	-3140.7***	(-6.20)
Property type	3.94	0.63	1	7	Property type	4.05	0.74	1	7	0.111***	-16.01
# of rooms	2.76	1.32	0	5	# of rooms	2.81	1.29	0	5	0.0499***	-3.95
# of bathrooms	1.56	0.72	0	3	# of bathrooms	1.50	0.68	0	3	-0.0632***	(-9.34)
Year built	1.93	1.79	0	5	Year built	2.70	2.04	0	5	0.770***	-39.94
Height building	16.92	7.64	1	61.6	Height building	13.56	8.45	1	89.3	-3.360***	(-40.47)
Distance to	90	199	0	7,799	Distance to	440	829	0	42,277	349.2***	-50
Parking dummy	0.18	0.39	0	1	Parking dummy	0.39	0.49	0	1	0.207***	-45.93
Δ empty build	3.71	21.20	-470	210	Δ empty build	3.54	20.69	-476	351	-0.168	(-0.80)
Δ new build	0.39	3.19	-40	62	Δ new build	1.54	6.89	-56	172	1.150***	-18.76
Pop. density	17,636	17,114	0	643,273	Pop. density	13,445	12,383	0	148,424	-4191.0***	(-30.93)
Migrants	0.10	0.11	0	1	Migrants	0.09	0.11	0	1	0.00697***	(-6.43)
Build. Bad	0.15	0.24	0	1	Build. Bad	0.11	0.18	0	1	-0.0489***	(-25.45)
Higher Edu.	0.57	0.17	0	1	Higher Edu.	0.50	0.14	0	1	-0.0745***	(-49.80)

Notes: T statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A4 Comparison of mean sales between by urban heritage areas and geographical location

Transaction inside LA	count	%	Price (€/m2) Mean	S.D	Min	Max	Transaction outside LA	count	%	Price (€/m2) Mean	S.D	Min	Max	Difference €/m2	%
Centre	2490	19.66	7,551	109,080	1	4,700,000	Centre	10176	80.34	5,900	81,737	5	7,200,000	1650	21.86
Islands	646	11.03	1,853	883	88	12,957	Islands	5212	88.97	1,588	1,521	55	59,800	264	14.27
North-east	1390	14.25	9,755	176,264	100	6,500,000	North-east	8364	85.75	2,156	3,319	3	283,333	7599	77.90
Nord-west	2754	18.57	3,915	5,798	125	230,000	Nord-west	12077	81.43	3,150	16,052	5	1,050,000	765	19.54
South	1069	10.08	3,403	24,836	4	812,500	South	9532	89.92	1,884	7,328	3	690,000	1519	44.62

Transaction inside HC	count	%	Price (€/m2) Mean	S.D	Min	Max	Transaction outside HC	count	%	Price (€/m2) Mean	S.D	Min	Max	Difference €/m2	%
Centre	3,961	31.27	9,878	128,146	4.76	7,200,000	Centre	8,707	68.73	4,561	61,092	0.54	4,700,000	5318	53.83
Islands	608	10.36	1,641	1,208	234.63	19,666	Islands	5,260	89.64	1,614	1,492	55.15	59,800	27	1.64
North-east	2,613	26.79	6,441	128,587	2.66	6,500,000	North-east	7,142	73.21	2,066	3,558	6.21	283,333	4375	67.92
Nord-west	3,208	21.63	5,492	25,247	125	1,050,000	Nord-west	11,625	78.37	2,684	9,909	5.38	700,000	2809	51.13
South	4,004	37.76	2,375	13,144	3.33	812,500	South	6,600	62.24	1,832	8,532	3.73	690,000	544	22.88

3.9 Empirical Strategy

Section 4 includes additional detail on the empirical strategy, with the presentation of maps that illustrate the spatial setting of the study.

3.9.1 Spatial illustrations of data

In identifying heritage capitalisation effects by city, I then concentrate on property prices that fall within a 200-metre buffer inside and outside LA and HC boundaries as specified in section 3.2.2 of the main paper. I create dummies of the buffer areas around LA and HC borders, specifically $LAbuffer_{ia}$ takes the value of one if $DIST\_LA_i > -200$ & $DIST\_LA_i < 200$, and $HCbuffer_{ia}$ takes the value of one if $DIST\_HC_i > -200$ & $DIST\_HC_i < 200$. I also create dummies of the area immediately inside both LA and HC borders, specifically $LAin_{ia}$ takes the value of one if $DIST\_LA_i < 0$ and $DIST\_LA_i > -200$, and $HCin_{ia}$ takes the value of one if $DIST\_HC_i < 0$ & $DIST\_HC_i > -200$. These buffers and inside variables are illustrated in Figure A10, showing that a 200m distance from the boundary typically does not include more than three to five aligned buildings from HC or LA border and therefore indicates a small restricted area, which is suitable to Regression Discontinuity Design strategies.

Figure A10 Visualising border discontinuities

Notes: LA and HC borders mark the delimitations of Landscape and Historic Areas. LA and HC inside 200m denote the areas 200m inside the border, and LA and HC buffers denotes 200m both inside and outside the borders.

3.10 Estimation Results

This section of the appendix presents complementary results that are not essential for the message of the main paper but may be of interest to some readers, as well as several robustness checks.

3.10.1 Baseline regression – just dummies

Before establishing establish a boundary discontinuity inspired design (BDD), I first explore if there is enough variation between LA and HC premiums to suggest that these effects are separately identifiable. In Table A5 I present results of exploratory regressions where I simply create dummies (LA=1 and HC=1) when property prices are inside each of these heritage areas. I then include a large set of control variables including structural and amenity variables, characteristics of the built environment and socio-economics variables. Neighbourhood and city fixed effect are added in alternative version of the specification to account for unobserved across-neighbourhood or across-city differences.

A variable accounting for LA years since inscription is also included in the specification to evaluate the effect of time passed since designation given the historicism of the policy as illustrated in Figure A1. Although the results are not significant before the inclusion of neighbourhood fixed effect, results in columns (9) to (11) of Table A5 suggest that it is in fact years since inscription which are driving the positive price premium in LAs when accounting for unobserved across-place differences. Older LAs are characterised by higher price mark ups, suggesting that the effect of inscription may be almost null at first inscription and rises with time. These findings are consistent with the logic of cumulative effect of designation over time (Ahlfeldt, Holman, & Wendland, 2012).

Table A5 Baseline results

Ln price m2	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS	(8) OLS	(9) OLS	(10) OLS	(11) OLS
Inside LA	0.223***	0.212***	0.361***	0.257***	0.237***	0.243***	0.245***	0.193***	-0.0140	-0.0429*	-0.0179
	(0.0500)	(0.0484)	(0.110)	(0.0827)	(0.0797)	(0.0797)	(0.0766)	(0.0696)	(0.0308)	(0.0349)	(0.0293)
Inside HC	0.253***	0.290***	0.286***	0.234***	0.211***	0.190***	0.199***	0.182***	0.0430***	0.102***	0.0433***
	(0.0740)	(0.0730)	(0.0715)	(0.0706)	(0.0677)	(0.0732)	(0.0713)	(0.0633)	(0.0137)	(0.0285)	(0.0134)
K-density arch.	0.0118	0.0234**	0.0240**	0.0118	0.00147	-0.000342	0.00184	-0.00216	0.00966***	0.0133***	0.00949***
	(0.00997)	(0.0113)	(0.0113)	(0.00842)	(0.00831)	(0.00792)	(0.00800)	(0.00772)	(0.00237)	(0.00270)	(0.00235)
LA years since inscription			-0.00311	-0.00251	-0.00179	-0.00189	-0.00209	-0.00217	0.00172***	0.00323***	0.00173***
			(0.00195)	(0.00154)	(0.00151)	(0.00151)	(0.00147)	(0.00138)	(0.000639)	(0.000888)	(0.000613)
UNESCO site [a]						0.209	0.240	0.273*	-0.0236	0.0558	-0.0259
						(0.192)	(0.182)	(0.161)	(0.0335)	(0.0695)	(0.0327)
Build. Bad [b]							-0.326***	-0.195***	-0.0873***	-0.122***	-0.0852***
							(0.0495)	(0.0398)	(0.0131)	(0.0195)	(0.0131)
Δ empty build [c]							-0.000742**	-0.000742**	-9.03e-05	-0.000315**	-8.99e-05
							(0.000346)	(0.000332)	(0.000130)	(0.000159)	(0.000128)
NBG [d]							-7.07e-05	-0.00105	0.000530	0.000210	0.000487
							(0.000729)	(0.000665)	(0.000347)	(0.000361)	(0.000343)
Higher Edu. [e]								0.693***	0.326***	0.509***	0.322***
								(0.0596)	(0.0252)	(0.0341)	(0.0251)
Migrant % [f]								-0.310***	-0.341***	-0.449***	-0.338***
								(0.0829)	(0.0410)	(0.0386)	(0.0404)
Pop. Density [g]								-2.89e-06***	-2.42e-06***	-3.13e-06***	-2.35e-06***
								(6.09e-07)	(4.23e-07)	(5.25e-07)	(4.11e-07)
Observations	53,572	53,572	53,572	53,572	53,572	53,572	53,572	53,572	53,572	53,572	53,572
R-squared	0.335	0.348	0.350	0.480	0.492	0.496	0.507	0.543	0.720	0.682	0.723
CBD control	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
S controls	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
A controls	NO	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES
Amenity densities	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES	YES
Year FE	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES
City FE	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO
N FE	NO	NO	NO	NO	NO	NO	NO	NO	YES	NO	YES

Notes: Inside LA and HC are simply dummies if a property is found within the respective heritage areas. [a] UNESCO site is a dummy if a property is found within a UNESCO heritage site. [b]Percentage of buildings in fair or bad state. [c]Change in number of empty units. [d]New Build Growth - change in number of residential buildings after 1991. [e]Share of population holding a university degree. [f] Share of migrant population . [g] Population density by neighbourhood. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 † p < 0.15

Table A6 reports the estimates of distance from HCs and LAs boundaries both separately and jointly, results also include second and third order polynomials to evaluate the linearity of best fit lines. I simply estimate distance trends allowing for quadratic and semi-non-parametric specifications. The equation is estimated including both LA and HC distances variables first, then evaluating the distance trends for each policy separately, and then including them jointly with quadratic specifications. Only modest differences are found that do not significantly alter the results.

Table A6 Distances

Ln price m2	(1)	(2)	(3)	(4)
Distance HC	-2.88e-05*		-6.40e-	-5.96e-
	(1.66e-05)		(1.88e-05)	(1.85e-05)
Distance LA	-1.52e-05*	-3.35e-05***		-2.45e-05**
	(8.59e-06)	(1.12e-05)		(1.12e-05)
LA 2nd order poly		2.71e-09**		5.34e-10
		(1.17e-09)		(1.22e-09)
LA 3rd order poly		-2.76e-14		8.55e-16*
		(2.28e-14)		(2.21e-14)
HC 2nd order poly			6.45e-09***	6.77e-09***
			(1.24e-09)	(1.39e-09)
HC 3rd order poly			-1.30e-13***	--1.25e-13***
			(2.64e-14)	(2.74e-14)
Observations	53,572	53,572	53,572	53,572
R-squared	0.705	0.705	0.706	0.706
S controls	YES	YES	YES	YES
A controls	YES	YES	YES	YES
Amenity densities	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
N FE	YES	YES	YES	YES

Notes: Standard Errors clustered at Neighbourhood level. *** p<0.01, ** p<0.05, * p<0.1

Table A7 First Step full estimates

	TORINO	Novara	Alessandria	AOSTA	Savona	GENOVA	La Spezia	MILANO	Bergamo	Brescia	Bolzano
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
HC 200m in	0.172***	0.177***	0.012	0.045	-0.149***	-0.045	-0.077**	0.230***	0.124***	0.128***	-0.029
LA 200m in	0.111***	0.166***	-0.287***	0.009	0.116**	0.364***	0.122***	0.156***	0.328***	0.158***	-0.003

	TRENTO	Verona	VENEZIA	Padova	Udine	TRIESTE	Parma	Modena	BOLOGNA	Pesaro	ANCONA
	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
HC 200m in	0.017	0.207***	0.017	0.106	0.009	0.042	0.152***	0.117***	0.062**	0.078	-0.005
LA 200m in	0.019	0.142***	-0.039	-0.200	0.149	0.134***	0.117	-0.632***	0.042	0.024	0.069**

	Ascoli	FIRENZE	Livorno	PERUGIA	Terni	Viterbo	ROMA	Latina	Caserta	NAPOLI	Salerno
	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)
HC 200m in	0.119***	0.040	-0.149***	0.159***	0.211***	0.001	0.023	-0.015	0.011	0.121***	0.059
LA 200m in	-0.193***	-0.021	0.307***	0.054**	-0.197**	-0.165***	-0.122***	0.169**	-0.109	0.285***	0.078

	L'AQUILA	Teramo	Pescara	CAMPOBAS	Foggia	BARI	Taranto	POTENZA	Matera	Cosenza	CATANZAR
	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)	(42)	(43)	(44)
HC 200m in	0.006	-0.031	0.239***	-0.325***	0.061	0.106***	-0.071**	-0.045	0.033	-0.376***	-0.173***
LA 200m in	-0.126	0.260	-0.126***	-0.154***	x	-0.042	-0.179	x	-0.001	-0.033	-0.092

	Reggio	PALERMO	Messina	Catania	Sassari	Nuoro	CAGLIARI	Pordenone	Isernia	Prato	Monza
	(45)	(46)	(47)	(48)	(49)	(50)	(51)	(52)	(53)	(54)	(55)
HC 200m in	0.221***	-0.118***	0.144**	-0.139***	-0.227***	0.156	-0.053	0.238**	-0.278***	0.035	0.365***
LA 200m in	0.178***	0.007	-0.059	0.014	0.015	-0.307*	-0.008	0.286***	x	0.030	0.104**

HC 500m in		LA 100m in			
Lin100m	0.101*** (0.0066)	Hin500m	0.054*** (0.0071)	Outside boundary controls	YES
Observations	50409	Observations	50409	Year FE	YES
R-squared	0.677	R-squared	0.665	Structural, Amenity and Amenity density controls	YES
				Robust st. errors. *** p<0.01, ** p<0.05, * p<0.1	

3.10.2 City-level additional estimates

Table A8 *Abusivism*'s effect on price premiums – full regression unweighted

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Price premiums	HC	HC	HC	HC	HC	LA	LA	LA	LA	LA
AB rate	-0.00403**	-0.00409***	-0.00358**	-0.00594***	-0.00644***	-0.000961	-0.000981	-0.000930	-0.000436	-0.000859†
	(0.00157)	(0.00141)	(0.00150)	(0.00157)	(0.00165)	(0.000972)	(0.00110)	(0.00119)	(0.00163)	(0.00072)
Education	0.404	0.450*	0.383*	0.436*	0.572*	0.0990	0.0361	0.0429	0.0541	0.0598
	(0.290)	(0.243)	(0.147)	(0.248)	(0.292)	(0.414)	(0.366)	(0.358)	(0.359)	(0.417)
Pop. density		2.53e-05***	3.05e-05***	2.68e-05***	3.80e-05***		3.45e-05***	3.51e-05***	3.58e-05***	4.53e-05***
		(8.04e-06)	(8.73e-06)	(8.58e-06)	(1.18e-05)		(9.57e-06)	(1.06e-05)	(1.08e-05)	(1.68e-05)
Build. Height			-0.00871	-0.0171***	-0.0145**			-0.000889	-0.000860	-0.00302
			(0.00611)	(0.00613)	(0.00618)			(0.00847)	(0.00865)	(0.00933)
Env. Qual.				-0.427***	-0.511***				0.0892	0.0178
				(0.118)	(0.133)				(0.151)	(0.170)
Mafia Index					-0.000100					-8.48e-05
					(6.37e-05)					(9.39e-05)
Constant	-0.0910	-0.156	-0.0283	1.312***	1.475***	0.0850	-0.00362	0.00941	-0.271	-0.132
	(0.149)	(0.130)	(0.149)	(0.427)	(0.431)	(0.213)	(0.198)	(0.213)	(0.507)	(0.516)
Observations	55	55	55	55	55	55	55	55	55	55
R-squared	0.194	0.277	0.296	0.405	0.419	0.008	0.114	0.114	0.117	0.124

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Paper III

4 The economic effects of density: A synthesis

4.1 Introduction

The degree of concentration of economic activity in urban areas is striking as they host more than 50% of the world's population (United Nations 2014) on only an approximate 2.7% of the world's land (GRUMP 2010; Liu et al. 2014).[38] There is a consensus among planners and policymakers, however, that even higher densities within cities and urban areas are desirable, at least on average (Boyko & Cooper 2011; OECD 2012). Most countries pursue policies that implicitly or explicitly aim at promoting "compact urban form", reflecting the concern that unregulated economic markets will fail to deliver allocations of uses and infrastructure that are efficient and equitable (IAU-IDF 2012; Holman et al. 2014). It is difficult to ascertain, however, to what extent this normative statement prevailing in the policy debate can be substantiated by evidence (Neuman 2005).

To our knowledge, no attempt has been made to synthesise the evidence on the economic effects of density and to compare the variety of costs and benefits across a comprehensive range of outcome categories. It seems fair to state that the dominating "compact city" policy paradigm, which aims at shaping the habitat of the urban population over the decades to come, is not well-grounded in evidence. We make four contributions to address this notable gap in the literature.

Our first contribution is to provide a unique summary of the quantitative literature on the economic effects of density. Our evidence base contains 347 estimates (from 180 studies) of the effects of density on a wide range of outcomes including accessibility (job accessibility, accessibility of private and public services), various economic outcomes (productivity, innovation, value of space), various environmental outcomes (open space preservation and biodiversity, pollution reduction, energy efficiency), efficiency of public service delivery, health, safety, social equity, transport (ease of traffic flow, sustainable mode choice), and self-reported well-being.

[38] The estimates of the global urban land reported in the literature vary widely, from less than 0.3 to 3% primarily because of the different definitions of urban land and data used (night light data, Landsat data etc.) (Angel et al. 2005; GRUMP 2010; Liu et al. 2014). In 2010, the global urban land was close to 3%, while the global built-up area was approximately 0.65%.

While the evidence base is shared with a companion paper (Ahlfeldt & Pietrostefani 2017), the results presented in the two papers are mutually exclusive. In the companion paper, we analyse the effects of a variety of compact city characteristics (including morphological features and land use mix), restricting the interpretation to qualitative results in order to explore the full evidence base. In this paper, we focus on a quantitative comparison, and, therefore, restrict the analysis to results that can be expressed as density elasticity estimates. For more than 100 cases, we conduct back-of-the-envelope calculations to convert the results into a comparable metric or obtain results that had not previously been published from the relevant authors. Borrowing techniques from meta-analytic research, we analyse within-category heterogeneity with respect to characteristics such as the methods used, the citations adjusted for years since publication, or the geographic setting of the analysis. In some instances, we make admittedly ambitious assumptions to translate results published in fields such as engineering and medical research into a format that is compatible with the conventions in economics and related disciplines.

Our second contribution is to provide original elasticity estimates where the evidence base is thin or inconsistent. We provide transparent density elasticity estimates based on a consistent econometric framework and OECD data that refer to 16 distinct outcome variables (from 10 outcome categories). For some outcomes, such as the density elasticity of preserved green space, our estimates are without precedent. We provide an estimate of the elasticity of density with respect to city size, which facilitates a better comparison of the results from studies analysing the effects of density and city size. To reconcile the evidence on the effects of density on wages, rents, and various (dis)amenities, we also provide novel estimates of the density elasticity of construction costs.

Our third contribution is to condense this broad evidence base into a set of 15 category-specific density elasticity estimates. Specific to each category, we either recommend the weighted (by adjusted citations) mean across the elasticity estimates in our evidence base, an estimate from a high-quality original research paper or one of our original estimates. Along with the recommended elasticities, we provide a critical discussion of the quality and the quantity of the evidence base, highlighting priority areas for further research. The compact presentation of a variety of density elasticity estimates in a consistent format is unique in terms of accessibility and coverage and represents a convenient source for research engaging with the quantitative interpretation of density effects.

Our fourth contribution is to monetise the economic effects of density. For each of the 15 outcome categories, we compute the per capita present value (PV, at a 5% discount rate) of the effect of a 1% increase in density for a scenario that roughly corresponds to an average metropolitan area in a developed country. For this purpose, we combine our recommended density elasticity estimates with several valuations of non-marketed goods such as time, crime and mortality risk, or pollution, among many others. The monetary equivalents allow for a novel accounting of the costs and benefits of density and how the net effect of density across a broad range of amenity and dis-amenity categories aligns with estimates of quality of life based on cost-earning differentials.[39]

Our analysis reveals sizeable benefits and costs of density. A log-point increase in density leads to (log-point effects in parenthesis) higher wages (0.04), higher rent (0.15) and lower average vehicle mileage (0.06), but also higher pollution concentration (0.13) and lower average speed (0.12). For other outcomes, existing estimates are better interpreted as associations in the data since the causal interpretation would rest on the strong assumption that differences in density are historically determined by factors that have no contemporaneous effects on outcomes. A log-point increase in density is associated with (log-point effects in parenthesis) higher patent activity (0.21), consumption variety value (0.12), preservation of green spaces (0.28), as well as lower car use (0.05), energy consumption (0.07), crime (0.085), and costs of providing local public services (0.17). Density, however, is also associated with higher construction costs (0.55), skill wage gaps (0.035), mortality risk (0.09) as well as lower self-reported well-being (0.004).

Studies that are more frequently cited, or use more rigorous methods, find less positive density effects (in a normative sense). The estimates also become less positive over time, possibly reflecting a trend towards the application of more rigorous methods. Although more evidence would be desirable to substantiate our findings, our analysis reveals some insights into geographic heterogeneity in density elasticity estimates. For non-high-income countries, the estimated density elasticity of wages, at 0.08, is twice as large for high-income countries, on average. Mode choice is less likely to change with

[39] The indirect inference of quality of life from relative wages goes back to the work pioneered by Rosen (1979) and Roback (1982) which has spurred a growing literature (see Albouy & Lue 2015 for a review).

density, whereas the gains from density in terms of domestic energy consumption appear to be larger. Compared to other developed countries, density in the US is associated with larger skill wage gaps and higher rather than lower crime rates. Our review of the literature also suggests that the effect of density on rents may not be log-linear. Estimates of the density elasticity of rent increase by 0.063 for every increase in population density by 1000 inhabitants per square kilometre. We do not find a similar non-linearity in the estimated effects of density on wages, suggesting that convex costs lead to a bell-shaped net-agglomeration benefits curve (Henderson 1974).

In our illustrative scenario, a 1% increase in density leads to an increase in the per capita present value (infinite horizon, 5% discount rate) of wages and rents of \$280 (\$190 after taxes) and \$347. Summing up the monetary equivalents of all amenity and dis-amenity categories we find a clearly positive value, which is, however, not as large as the "compensating differential" (rent effect – after-tax wage effect). While density seems to be a net amenity, our admittedly imperfect accounting also suggests that part of the rent increase may be attributable to the higher cost of providing space in addition to enjoyable amenities. Policy-induced densification may lead to aggregate welfare gains. However, there may be a collateral net-cost to renters and first-time buyers.[40] This effect adds to a potentially regressive distributional impact due to a widening skill wage gap.

Our analysis unifies important strands in the economics literature on the spatial organisation of economic activity. We provide an explicit comparison of the magnitude of agglomeration benefits on the production (e.g. Combes et al. 2012) and consumption side (e.g. Couture 2016), the effects of urban form on innovation (e.g. Carlino et al. 2007), housing rent (e.g. Combes et al. 2018), quality of life (e.g. Albouy & Lue 2015), driving distances (Duranton & Turner 2018), road speeds (Couture et al. 2018), public spending reduction (e.g. Hortas-Rico & Sole-Olle 2010), energy consumption (Glaeser & Kahn 2010), skill-wage gaps (Baum-Snow & Pavan 2012) and self-reported well-being (Glaeser et al. 2016), in addition to a range of density effects on outcomes that have remained under-researched in the economics literature. Our findings also have important policy implications as they suggest that densification policies are likely efficient but not necessarily equitable.

Some words are due on the limitations of this ambitious synthesis. The fundamental challenge the literature faces is to separate the effects of density from unobserved

[40] To be theoretically consistent this interpretation requires that residents are not fully mobile (e.g. because they have location-specific preferences).

factors that determine density. As mentioned above, a causal interpretation often requires the strong identifying assumption that contemporary density is not endogenous to factors that have direct effects on outcomes. Moreover, for individual-, firm-, and unit-based outcomes (e.g. wages, innovation, rent, wellbeing), the collected density elasticity estimates often capture composition effects. In general, the quantitative results are best suited for an evaluation of the effects of densification policies applied to individual cities (as opposed to all cities in a country) in the long run. Compared to wages and mode choice, the evidence base for the other outcomes is generally underdeveloped. While for some categories selected high-quality contributions are available, the nature of the evidence is at best preliminary for others. Significant uncertainty surrounds any quantitative interpretation in the categories urban green, income inequality, health, and well-being. We view these outcomes as priority areas for further research into the effects of density. In general, the extant evidence base consists of point estimates, so that heterogeneity in density effects across contexts and the density distribution remains a key subject for future original research and reviews.

The remainder of this paper is organised as follows. In section 2, we provide an introduction into the origins of density and some ancillary estimates that help with the interpretation of density effects. In section 3, we lay out how the evidence base was collected and classified. Section 4 summarises the evidence by outcomes and attributes. Section 5 presents a discussion of our original density elasticity estimates. Section 6 condenses the evidence (including our original estimates) to 15 outcome-specific density elasticity estimates. Section 7 discusses the monetary equivalents of an increase in density. The final section (8) concludes. We also provide an extensive technical appendix with additional results and explanations, which is essential reading for those wishing to use our quantitative results in further research (recommended elasticities and monetary equivalents).

4.2 Background

In this section, we provide some theoretical background and ancillary empirical analyses that will guide the interpretation of the evidence base.

4.2.1 Origins of density

The first columns of Table 1 summarise the distribution of population density by OECD functional urban areas (FUA), comparing the US to the rest of the world. While, on average, density in US cities is relatively low, the variation, at a coefficient of variation of about one, is similarly striking in both samples. Another notable insight from 0 is that the variation in density within US FUAs is about two and a half times the variation across FUAs.

Table 1 Variation in density

	(1) FUA, Non-US		(2) FUA, US		(3) FUA, US		(4) Census tract, US	
	OECD data		OECD data		Census data		Census data	
	Pop. Density		Pop. density		Pop. Density (PD)		Tract PD - FUA mean	
	Level	Ln	Level	Ln	Level	Ln	Level	Ln
Min	36	3.58	27	3.29	34	3.54	-1,947	-10.99
p1	55	4.01	27	3.29	34	3.54	-1,201	-3.18
p25	330	5.80	100	4.60	163	5.10	369	0.57
p50	580	6.36	179	5.19	371	5.92	1,295	1.44
p75	994	6.90	386	5.96	648	6.47	2,831	2.37
p99	4,652	8.44	1,661	7.42	1,947	7.57	31,388	4.28
Max	4,851	8.49	1,661	7.42	1,947	7.57	209,187	5.87
Mean	814	6.33	274	5.23	451	5.76	2,907	1.36
SD[1]	798	0.90	268	0.89	370	0.90	5,890	1.49
CV[2]	98.03%	-	97.81%	-	82.06%	-	202.58%	-
N	211		70		70		34,123	

Note: Population density in inhabitants per square kilometre. Functional urban area (FUA) data from OECD (Columns 1 and 2). Census data matched to FUA shapefiles on GIS, aggregated to FUA (Columns 3 and 4) – data includes only core FUA, excluding the commuting zones around them. City cores are defined using the population grid from the global dataset Landscan (2000). [1] Standard Deviation. [2] Coefficient of variation.

Economic theory offers a range of explanations for this large variation in density. In a world without internal or external scale economies, density naturally results from the fundamental productivity and amenity value of a location. Exogenous geographic features such as fertile soil, moderate climate, or access to navigable rivers attract economic activity, leading to growing cities. Classic urban economics models predict that larger cities will be denser since positive within-city transport costs limit horizontal urban expansion (Brueckner 1987). Urban growth, therefore, drives up the average rent in a city, leading to lower use of space and a substitution effect on the consumption side. Since building taller becomes profitable, higher rents lead to densification due to a more intense use of land and a substitution effect on the supply side. Within cities, densities are higher close to desirable locations (such as the CBD) where rents are particularly high to offset for transport cost. Transport innovations (e.g. mass-produced cars) allow for horizontal expansion and, ceteris paribus, reduce urban density.

Reflecting the shift towards knowledge-based urban economies (Michaels et al. 2018), recent models feature agglomeration externalities (Lucas & Rossi-Hansberg 2002; Ahlfeldt et al. 2015) making density a cause and an effect of productivity and utility. This class of models features multiple equilibria so that cities may be dense and monocentric or polycentric and dispersed. Yet, due to agglomeration-induced path dependency, contemporary economic geography often follows features that were important in the past, e.g. agricultural land suitability (Henderson et al. 2018) or portage sites (Bleakley & Lin 2012). Similarly, the compact monocentric city structure that is characteristic for historic cities has been argued to be more resilient to shocks (e.g. natural disasters, or transport innovations) in cities that were already large about a century ago, the time when external returns and mass-produced cars presumably started to become increasingly important (Ahlfeldt & Wendland 2013).

In practice, and at the heart of the policy dimension of this paper, density is also determined by various land use regulations, such as urban growth boundaries, preservation policies, as well as height, floor area ratio, and lot size regulations, which often have their origins in history (McMillen & McDonald 2002; Siodla 2015). For a comprehensive review of the role of history in urban economics research, see Hanlon & Heblich (2018).

Given the endogeneity of density, separating the effects of density on an economic outcome from the effects of location fundamentals represents an identification challenge. Natural experiments such as the division of a city due to exogenous political reasons (Ahlfeldt et al. 2015) are rare. Plausible instruments for density are often difficult to find, although some researchers have exploited geology as a factor that likely impacts on the distribution of economic activity, but not on an economic outcome of interest (Combes et al. 2010). Our reading is that, for the most part, the literature implicitly exploits the idea that much of the spatial variation in density is rooted in history. Many of the results summarised below are informative to the extent that density is determined by factors that were relevant in the past and have a limited direct effect on economic outcomes today.

4.2.2 Density and city size

The relationship between city size and density is critical to the interpretation of our evidence base. Given the theoretical link discussed above, it is perhaps not surprising that the literature refers to actual density, the population normalised by the geographic size of a city, and city size, the total population, interchangeably.

Some researchers have attempted to disentangle the effects of density and city size (Cheshire & Magrini 2009). At the heart of such a separation is the idea that different types of agglomeration economies operate at different spatial resolutions (Rosenthal &

Strange 2001). Separating the effects of city size and density corresponds to separating the effects of different agglomeration economies (and diseconomies), some of which operate over large distances (such that city size matters), while others are more localised (such that density matters). While separating the effects of density and city size is interesting, it is also challenging because the geographic size of an integrated urban area cannot grow infinitely, which implies that density and city size cannot vary independently.

Our reading of the literature is that in most studies identifying density effects from between-city (as opposed to within-city) comparisons, city population implicitly changes as city density changes (and vice versa). The evidence from between-city comparisons reviewed here should be interpreted in that light, since compact-city policies aiming at changing density while keeping population constant may result in smaller effects, if there is a genuine city-size effect that is independent from density. As an example, if productivity gains from labour market pooling operated at the city scale over relatively large commuting distances without spatial decay, increasing density while holding population constant would not increase productivity. Reassuringly, the estimates from between-city and within-city studies (which hold population constant) tend to be quite similar conditional on us making the following adjustment.

To translate estimated city size elasticities from the literature into density elasticity estimates, we use an estimate of the elasticity of (population) density with respect to city size (population) derived from a multi-country FUA-level data set (OECD 2016) and the following empirical specification:

$$\ln\left(A_{i,c}\right) = a \ln(P_i) + \mu_c + \varepsilon_{i,c}, \qquad (1)$$

where $A_{i,c}$ is the geographic area of FUA *i* in country *c*, P_i is the land area of the FUA, and μ_c is a country fixed effect. The city size elasticity of density is implicitly determined as $d\ln(P_i/A_i)\,/d\ln(P_i) = \alpha = 1 - a$. Compared to using the log of density as dependent variable, this estimation strategy avoids the mechanical endogeneity problem that arises if population shows up on both sides of the equation. Our preferred estimate of *a* is 0.57, which implies a city size elasticity of density of $\alpha = 0.43$. Therefore, we expect density elasticity estimates to be slightly more than twice as large as population elasticity estimates if the underlying economic mechanisms are the same. We note that our estimate of *a* is broadly consistent with the 0.7 estimate for French cities by Combes et al (2018). Details related to the estimation of equation (1), the estimation results, and the various transformations used to standardise the results reported in the literature are reported in section 2 of the appendix.

4.2.3 Density and the supply side

As discussed above, the positive city size elasticity of density results from an interplay of the demand side and the supply side of the urban economy. Higher rents in larger cities lead to higher densities. Higher densities, in turn, imply that it is more expensive to provide space, pushing rents up. Larger cities are therefore theoretically expected to be denser and have higher rents, with the latter being the cause and effect of higher construction costs. The empirical evidence is generally in line with these expectations. Helsley and Strange (2008) provide anecdotal evidence of larger cities having taller buildings. Gyourko and Saiz (2006) show that constructing a standard home is more expensive in denser areas, even after controlling for differences in geography (high hills and mountains), regulatory regimes (housing permits, regulatory chatter), and labour market conditions (e.g. wages, unionisation). According to Ellis (2004), midrise stacked flats are twice as expensive to construct as single-family detached housing. Ahlfeldt & McMillen (2018) estimate a height elasticity of construction cost of 0.25 for small structures (five stories and below), and even higher elasticities for taller structures. However, estimates of the effect of density on construction cost that capture the changes in the composition of building types (a structure effect) as well as changes in the cost of building equivalent units (a location effect) to our knowledge do not exist to date.

To substantiate the interpretation of our evidence base, we therefore provide novel estimates of the density elasticity of (per-unit) construction costs. We combine a micro-data set on building constructions from Emporis with census tract level population and area data from the 2010 US Census and the American Community Survey (ACS). In an alternative approach, we create a construction cost index using structure-type-specific construction cost estimates from Ellis (2004) and information on the structure-type composition from the ACS (Ruggles et al. 2017). This index exclusively captures variation in construction costs due to the composition of structure types (the structure effect). The estimated density elasticity of this index can be combined with the estimated density elasticity of the cost of a standard home (the location effect) from Gyourko and Saiz (2006) to give an estimate of the gross density effect.

From the results of both analyses, we conclude that 0.04–0.07 represent a conservative range for the density elasticity of construction cost in the US. This estimate is a gross estimate that includes all structure effects and location effects that are associated with density (including differences in regulation, geology and labour market conditions that may be cause or effects of density). A detailed discussion of the effects of density on construction cost is in appendix 2.2. We will return to this parameter when reviewing the evidence on the effects of density on rents, wages and amenities.

4.3 The evidence base

4.3.1 Collection

In line with standard best-practice approaches of meta-analytic research, as reviewed by Stanley (2001), our literature search is carried out in several stages.[41] We do not impose any geographical restrictions (with respect to the study area) and consider various geographic layers (from micro-geographic scale to cross-region comparisons).

First, we conduct 260 separate searches for various combinations of category-specific keywords (combinations of outcomes and empirically observed variables) in academic databases (EconLit, Web of Science, and Google Scholar) and specialist research institute working paper series (NBER, CEPR, CESIfo, and IZA). Second, we expand on relevant research strands by conducting an analysis of citation trees. Third, we ask colleagues in our research networks to recommend relevant research (by personal mail and a call circulated in social media) and add studies that were previously known to us or came up in discretionary searches.[42] We keep track of the stage at which the evidence is added to control for a bias due to a potentially selective research network. To prevent publication bias, we explicitly consider studies that were published as edited book chapters, PhD theses, reports, in refereed journals or in academic working paper series (we were also open to other types of publications). This process, which is described in more detail in the appendix to this paper and in Ahlfeldt & Pietrostefani (2017), results in 268 relevant studies, which include 473 conceptually distinct analyses. We typically keep multiple estimates (analyses) from the same study if they refer to different dependent variables or geographic areas.

A restriction to elasticity estimates that are explicitly reported in publications shrinks the sample by about 50% to 242 analyses in 127 studies. We make some effort, however, to increase the evidence base. We infer density elasticity estimates from reported city size

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[41] Recent examples of classic meta-analyses in economics include studies by Eckel and Füllbrunn (2015), Melo et al. (2009), and Nitsch (2005).

[42] At this stage, we were pointed to a literature on urban scaling in which city size is related to a variety of outcomes. This literature is not part of this review, because unlike with the bulk of the evidence base, the analysis is purely descriptive and not concerned with density (Bettencourt & Lobo 2016; Batty 2008; Bettencourt 2013).

elasticity estimates using the estimated elasticity of city size with respect to density discussed above. Similarly, we conduct back-of-the-envelope calculations to approximate density elasticity estimates if results are reported as estimated marginal effects in levels, semi-elasticities, or in graphical illustrations. We also make some adjustments to allow for a consistent interpretation within categories. As an example, we convert estimates of the density elasticity of land price into estimates of the density elasticity of housing rent assuming a Cobb-Douglas housing production function (Epple et al. 2010) and a land share of 0.25 (Combes et al. 2018; Ahlfeldt et al. 2015). Finally, some authors kindly provided density elasticity estimates on request, which were not reported in their papers (e.g. Couture 2016; Tang 2015; Albouy 2008). This way, we increase the quantitative evidence base by more than 100 estimates to 347 analyses in 180 studies. The final quantitative sample is comparable to the full sample (473 analyses from 268 studies) across a range of characteristics that we introduce in the next subsections (see appendix section 2).

A more complete discussion of the various adjustments made to ensure comparability of the evidence is in appendix section 2. A complete list of studies along with the encoded attributes introduced in the following sections is provided in a separate appendix to this paper.

4.3.2 Attributes

We choose a quantitative approach to synthesise our broad and diverse evidence base. 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 geographic context, the data or the methods used. Therefore, we encode the results and the various attributes of the reviewed studies into variables that can be analysed using statistical methods.

The typical approach in meta-analytic research is to analyse the findings in a very specific literature strand. The results that are subjected to a meta-analysis are often parameters that have been estimated in relatively similar econometric analyses. In such instances, it is useful to collect specific information concerning the econometric setup. In contrast, the scope of our analysis is much broader. Our aim is to synthesise the evidence on the economic effects of density across a range of outcome categories. We consider studies from separate literature strands that naturally use very different empirical approaches. The information we collect is, therefore, somewhat more generic and includes the following attributes:

i) The outcome category, one for the 15 categories (see Table A1 for details, appendix section 1)
ii) The dependent variable, e.g. wages, land value, crime rate
iii) The study area, including the continent and the country
iv) The publication venue, e.g. academic journal, working paper, book chapter, report
v) The disciplinary background, e.g. economics, regional sciences, planning, etc.
vi) The stage (1–3) at which an analysis is added to the evidence base (see Table A2)
vii) The period of analysis
viii) The spatial scale of the analysis, i.e. within-city vs. between-city
ix) The methodological approach as defined by the Scientific Maryland Scale (SMS) used by the What Works Centre for Local Economic Growth (2016)
The variable 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 comprehensive 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 randomised control trials (not in the evidence base)
x) The cumulated number of citations, adjusted for the years since publication, which we generate using yearly citations counts per study from Scopus. For non-journal publications, we impute the citation index using data from Google Scholar. Expectedly, our study-based index is closely correlated with journal quality as measured by the SNIP (Source Normalised Impact per Paper) score (Scopus 2016) and the SCImago Journal Rank (Scimago 2017). A detailed discussion is in appendix 1.2.

It is worth pointing out that, in the present context, a higher SMS score does not necessarily imply a higher quality of the evidence. While exploiting plausibly exogenous variation (SMS 4) is certainly desirable to separate the effects of density from unobserved location fundamentals, it is less clear that having a greater set of covariates (SMS 2) improves the analysis if the controls are potentially endogenous. One example frequently found in the literature that gives cause for concerns is the inclusion of multiple variables that capture different shades of urban compactness such as population density, building density and job centrality. Similarly, the inclusion of spatial fixed effects (SMS 3) does not improve the identification if the fraction of the variation in density that is most likely exogenous is cross-sectional, because it is determined by history (see discussion in section 2.1). Given these ambiguities, our preferred measure for weighting the elasticities in the evidence base is the citation index, which captures the impact an analysis has had within the research community.

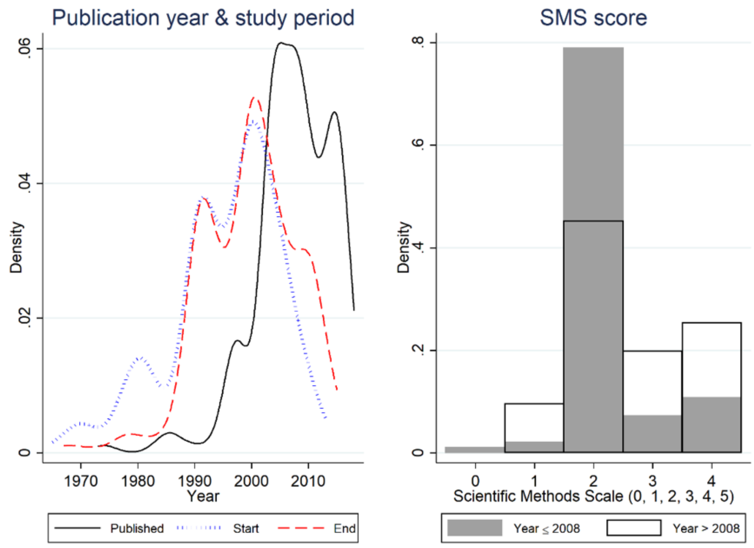
In Table 2 we tabulate the distribution of analyses included in this review by selected attributes (as discussed above, one study can include several analyses). While our evidence base to some extent covers most world regions, including the global south, there is a strong concentration of studies from high-income countries and, in particular, from North America. The clear majority of studies have been published in academic journals. The evidence base is diverse with respect to disciplinary background, with economics as the most frequent discipline, accounting for a share of about 30%.

Table 2 Distribution of analyses by attributes I

World region		Publication		Discipline	
North America	208	Academic Journal	266	Economics	100
Europe	86	Working Paper	62	Transport	72
Asia	34	Report	14	Planning	48
South America	7	PhD	4	Urban Studies	42
World	4	Book chapter	1	Other	34
OECD	3	-	-	Regional Studies	24
non-OECD	3	-	-	Health	14
Oceania	1	-	-	Economic Geography	9
Africa	1	-	-	Energy	4

Note: Assignment to disciplines based on publication venues. Studies contain multiple analyses if density effects refer to multiple outcomes.

Figure 1 Distribution of study period and quality of evidence



Note: Kernel in the left panel is Gaussian. 2008 is the median year of publication. Scientific Methods Scale (SMS) defined above (higher values indicate more rigorous methods).

In Figure 1, we illustrate the distribution of publication years, the study period, and the type of methods used, according to the SMS. The evidence, overall, is very recent, with the great majority of studies having been published within the last 15 years, reflecting the growing academic interest in the topic. Most studies use data from the 1980s onwards. A clear majority of studies score two or more on the SMS, which means there is usually at least some attempt to disentangle density effects from other effects, often including unobserved fixed effects and period effects. Distinguishing between studies published before or after the median year of publication (2008) reveals a progression towards more rigorous methods that score three or four on the SMS.

4.4 Density elasticity estimates in the literature

4.4.1 Results by outcome category

In Table 3 we summarise the quantitative results in our evidence base. We made an effort to condense the elasticity estimates into a limited number of outcome groups. Because of the great variety of outcomes in the evidence base we frequently report more than one elasticity per outcome category to which we will refer to in the remainder of the paper (indicated by ID). Throughout this paper, all outcomes are expressed such that positive values imply economic effects that are typically considered to be positive in a normative sense in the relevant literatures.

Given the variety of outcomes we do not discuss each result here but leave it to the interested reader to pick their finding of relevance. We note, however, that there is significant variation in the quantity of the evidence base (N) and the quality of the underlying evidence (as well as other attributes) and we urge these differences to be taken into account when considering the evidence. Caution is warranted, not only when the evidence base is quantitatively small (small N), but also when it is inconsistent. A useful indicator is a standard deviation (SD) that is large compared to the mean, like, for example, pollution reduction. We also note that the results summarized in Table 3 cannot generally be interpreted as causal estimates since the estimated density effects, in many cases, may capture the effects of correlated location fundamentals. For a selected set of outcome groups (one per category) we provide a critical discussion of the quantity and the quality of the evidence in section 4 of the appendix. We report the mean elasticity weighted by our citation index in Table 3. The interested reader will find results using alternative weighting schemes in section 2 of the appendix.

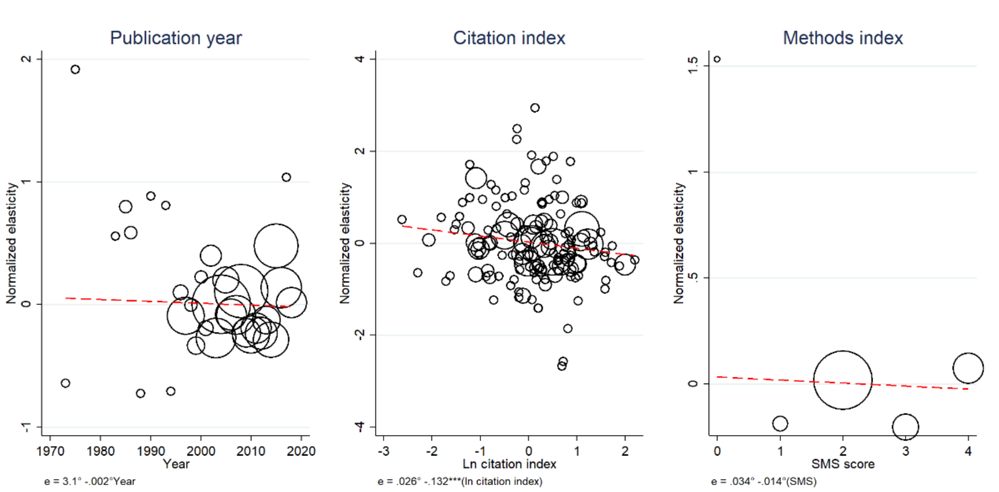
4.4.2 Results by attributes

For a pooled analysis of the sources of heterogeneity in the evidence base, we normalise category-specific elasticity estimates so that they have a zero mean and a unit standard deviation within the outcome groups listed in Table 3. Figure 2 reveals that density elasticity estimates tend to decline in the year of publication, the citation index, and the

SMS score. This pattern is in line with the increasing popularity of more rigorous methods displayed in Figure 1.

In Figure 3, we illustrate how the distribution of normalised elasticity estimates varies in selected attributes. At the bottom of each panel we report (two-sided) Kolmogorov-Smirnov test statistics and significance levels. We find a statistically significant difference in the distributions with respect to publication venue (less positive elasticities in journals) and citation index (less positive elasticities for higher index values), which may reflect publication bias or quality of peer review. Estimated elasticities from higher-density contexts are larger, on average.

Figure 2 Normalised elasticity estimates vs. publication year and quality of evidence



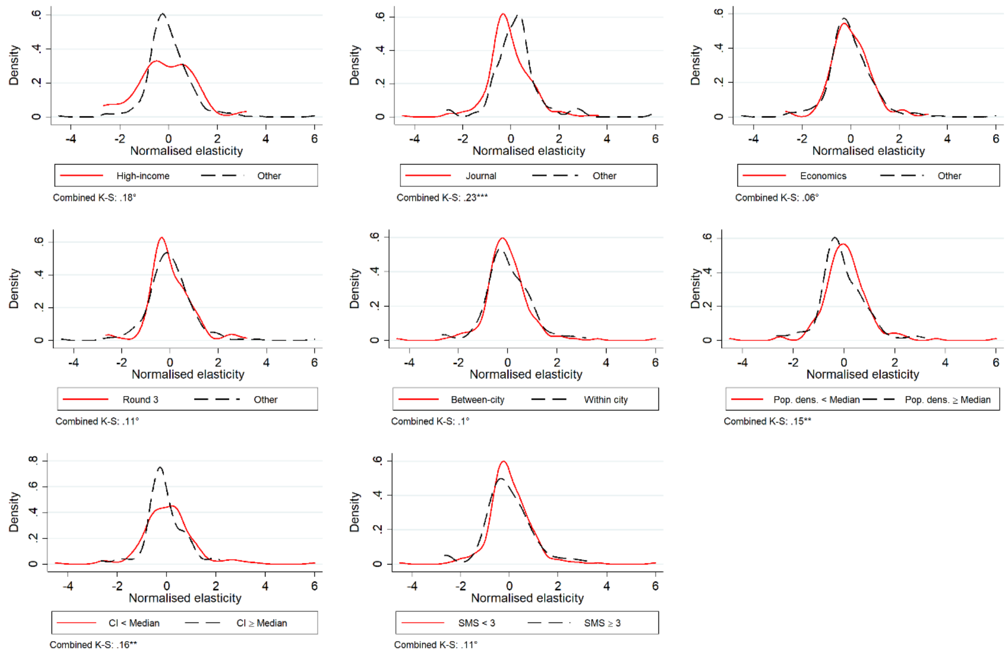
Note: Elasticity estimates (e) are normalised within outcome elasticity groups (listed in Table 3) to have a mean of zero and a standard deviation of one. Citation index defined in section 2.2. Marker size proportionate to number of observations. Linear fits (dashed lines, parametric results at the bottom) are frequency weighted by observations. °/*/**/*** indicates insignificant/significant at the 10%/5%/1% level (robust standard errors).

Table 3 Density elasticity estimates in the literature

ID	Elasticity of outcome with respect to density	N	Proportion Poor[a]	Ac.[b]	Econ.[c]	With[d]	Med. Year[e]	Mean SMS[f]	Elasticity[g] Mean	S.D.
1	Labour productivity	47	0.19	0.79	0.74	0.06	2007	3.02	0.04	0.04
1	Total factor productivity	15	0.13	0.87	0.80	0.20	2004	2.80	0.06	0.03
2	Patents p.c.	7	0.00	1.00	0.14	0.00	2006	2.86	0.21	0.11
3	Rent	13	0.00	0.69	0.62	0.62	2013	3.00	0.15	0.13
4	Commuting reduction	36	0.03	0.56	0.08	0.56	2005	2.17	0.06	0.12
4	Non-work trip reduction	7	0.00	0.71	0.00	0.86	2005	2.00	-0.20	0.44
5	Metro rail density	3	0.00	1.00	0.00	1.00	2010	3.33	0.01	0.02
5	Quality of life	8	0.38	0.88	1.00	0.13	2014	3.00	0.03	0.07
5	Consumption amenities	1	0.00	1.00	0.00	0.00	2015	4.00	0.19	-
5	Variety price reduction	2	0.00	0.00	1.00	1.00	2016	4.00	0.12	0.06
6	Public spending red.	20	0.00	1.00	0.05	0.00	2007	2.00	0.17	0.25
7	90th-10th pct. wage gap reduction	1	0.00	1.00	0.00	0.00	2004	4.00	0.17	-
7	Black-white wage gap reduction	1	0.00	0.00	1.00	0.00	2013	2.00	0.00	-
7	Diss. index reduction	3	0.00	1.00	0.33	0.00	2009	3.33	0.66	0.94
7	Gini coef. reduction	1	0.00	1.00	0.00	0.00	2010	4.00	4.56	-
7	High-low skill wage gap reduction	3	0.00	0.67	1.00	0.00	2013	4.00	-0.13	0.07
8	Crime rate reduction	13	0.00	0.69	0.15	0.92	2014	2.54	0.24	0.47
9	Foliage projection cover	1	0.00	1.00	0.00	1.00	2015	1.00	-0.06	-
10	Noise reduction	1	0.00	1.00	0.00	0.00	2012	1.00	0.04	-
10	Pollution reduction	18	0.44	0.33	0.33	0.39	2014	2.83	0.04	0.47
11	Energy reduction:	21	0.10	0.90	0.38	0.24	2010	1.81	0.07	0.10
11	Energy reduction: Public	1	0.00	1.00	1.00	0.00	2010	1.00	-0.37	-
12	Speed	2	0.00	0.00	1.00	0.00	2016	4.00	-0.12	0.01
13	Car usage reduction	22	0.00	0.95	0.00	0.95	2004	2.00	0.05	0.07
13	Non-car use	76	0.05	0.79	0.00	0.86	2006	2.03	0.16	0.24
14	Cancer & other disease reduction	5	0.00	1.00	0.00	0.60	2000	2.40	-0.33	0.20
14	KSI & casualty reduction	4	0.00	1.00	0.00	0.00	2003	2.00	0.01	0.61
14	Mental-health	1	0.00	1.00	0.00	1.00	2015	2.00	0.01	-
14	Mortality reduction	3	0.00	1.00	0.00	0.00	2010	2.00	-0.36	0.17
15	Reported health	3	0.00	1.00	0.00	0.00	2013	1.00	-0.27	0.11
15	Reported safety	1	0.00	1.00	0.00	1.00	2015	2.00	0.07	-
15	Reported social interaction	6	0.00	0.17	0.83	0.00	2007	3.50	-0.13	0.19
15	Reported wellbeing	1	0.00	1.00	1.00	0.00	2016	3.00	0.00	-
	Sum	347								

Note: [a] Poor countries include low-income and median-income countries according to the World Bank definition. [b] Published in academic journal. [c] Belongs to the economics discipline. [d] Exploits within-city variation. [e] Year of publication. [f] Scientific Methods Scale (SMS) defined in section 3.2 (higher values indicate more robust methods). [g] Weighted by the citation index introduced in section 3.2 and appendix section 1.2. Outcome categories correspond to ID as follows: 1: Productivity; 2: Innovation: 3: Value of space; 4: Job accessibility; 5: Services access; 6: Efficiency of public services delivery; 7: Social equity; 8: Safety; 9: Open space preservation and biodiversity; 10: Pollution reduction; 11: Energy efficiency: Domestic & driving; 12: Traffic flow: 13: Sustainable mode choice; 14: Health; 15: Well-being.

Figure 3 Distribution of normalised elasticity estimates by attributes



Note: Elasticity estimates normalised within outcome elasticity groups (listed in Table 3) to have a mean of zero and a standard deviation of one. Non-high-income include low-income and median-income countries according to the World Bank definition. The citation index (CI) defined in section 2.2. °/*/**/*** indicates insignificant/significant at the 10%/5%/1% level based on a two-sample Kolmogorov-Smirnov test for equality of distribution functions.

Table 4 presents the results of a multivariate analysis simultaneously controlling for all attributes considered in Figure 3. We first run a pooled regression using the normalised estimated density elasticity as an outcome. Being published in an academic journal decreases the estimated elasticity by a 0.4 standard deviation. In addition, a one standard-deviation increase in the citation index results in a 0.09 standard deviation reduction in the estimated elasticity. The conditional effect of a high SMS score is insignificant, but the point estimate is negative. So, in line with Figure 2 and Figure 3, the overall impression is that higher quality is associated with less positive density elasticity estimates.

In the remaining columns of Table 4, we perform meta-analyses (Stanley & Jarrell 1989; Melo et al. 2009) of the raw elasticity estimates in some of the more populated outcome categories. The first interesting finding is that once we control for study fixed effects, we find that the estimated density elasticity of wages in non-high-income countries is about twice as large as for high-income countries (column 3). It is worth noting that this effect is identified from one multi-country study covering Brazil, China, and India, in addition to the US (Chauvin et al. 2016), which is why we do not add further controls to save degrees of freedom. However, the unconditional citation-weighted mean in the evidence base is 0.08 for non-high-income countries (from 9 analyses), confirming the 100% premium over high-income countries (see Table A11 in the appendix for a tabulation of mean elasticity estimates by high-income and non-high-income countries).

The important second insight is that if the population density in the studied area increases by 1000 inhabitants per square kilometre, the estimated density elasticity of rent increases by 0.063, on average. This effect is qualitatively and quantitatively consistent with recent evidence from French cities. Combes et al. (2018) show that the estimated elasticity can vary from 0.205 for a small urban area to 0.378 for an urban area of the size of Paris. Applying the 0.063-estimate from Table 4, column (4), this corresponds to an increase in density by 2,750 inhabitants per square kilometre, which in turn corresponds to going from cities like Grenoble or Lens (1000/km^2) to a city like Paris (3,700/km^2) (Demographia 2018). In line with Glaeser & Gottlieb (2008), we do not find a similar effect of density on the estimated density elasticity of wages. So it appears that increasing cost of density rather than decreasing productivity gains curb agglomeration benefits, leading to a bell-shaped net-agglomeration benefits curve (Henderson 1974).

The third relevant finding is that the density elasticity estimates of sustainable mode choice are significantly lower for non-high-income countries. A potential explanation that is consistent with the large estimated density elasticity of wages in developing countries is an indirect income effect that works in the opposite direction of the direct density effect. While a compact urban form ceteris paribus may favour alternative modes, higher incomes in more urbanised areas increase the affordability of car trips. Fourth, the mean estimated density elasticity of energy consumption reduction is much larger when identified from studies exploring *within-city variation.* In this context, it is worth noting that the citation-weighted unconditional mean density elasticity of energy consumption reduction, at 0.16, is much larger for non-high-income countries than for high-income countries. Given the small numbers (two estimates from non-high-income countries), it is difficult to separate the *within-city* and *non-high-income country* effects. It may be that within cities, population density is generally more strongly correlated with the share of multi-family houses, which tend to be more energy efficient. This relationship might be particularly strong in developing countries where often high densities imply formal housing as opposed to informal housing (Henderson et al. 2016).

Table 4 Meta-analysis of density elasticity estimates

	(1) Normalised density elasticity estimate	(2) Estimated density elasticity of wages	(3) Estimated density elasticity of wages	(4) Estimated density elasticity of rent	(5) Estimated density elasticity of commuting reduction	(6) Estimated density elasticity of energy use reduction	(7) Estimated density elasticity of sustainable mode choice
Category ID	All	1	1	3	4	11	13
Non-high-income country	-0.111 (0.25)	0.025 (0.02)	0.050*** (0.00)	-	-0.247 (0.21)	-0.195 (0.26)	-0.162*** (0.04)
Not published in academic journal	0.401** (0.19)	0.004 (0.02)		-0.021 (0.07)	0.150 (0.13)	0.364*** (0.10)	0.164 (0.16)
Non-economics discipline	0.043 (0.18)	0.007 (0.02)		-0.081 (0.07)	0.041 (0.07)	0.003 (0.06)	-
Round 3 [a]	0.077 (0.18)	0.022* (0.01)		-0.109+ (0.06)	0.003 (0.06)	0.101* (0.05)	-0.178** (0.07)
Within-city variation	-0.136 (0.18)	-0.020+ (0.01)		-0.146 (0.10)	-0.071 (0.07)	0.187** (0.07)	-0.085 (0.11)
Citation index normalised by s.d.	-0.091* (0.05)	-0.005+ (0.00)		0.307+ (0.18)	0.058 (0.05)	-0.010 (0.01)	0.030 (0.04)
SMS >=3	-0.203 (0.16)	-0.014 (0.01)		-0.040 (0.08)	-0.025 (0.05)	0.070 (0.07)	-0.007 (0.09)
Pop. density in study area (1000/km²)	-0.008 (0.01)	-0.005 (0.00)		0.063** (0.03)	0.011 (0.07)	0.017 (0.04)	-0.001 (0.00)
Constant	0.000 (0.05)	0.048*** (0.01)	0.048*** (0.00)	0.131*** (0.02)	0.051** (0.02)	0.115*** (0.02)	0.183*** (0.04)
Study effects	-	-	Yes	-	-	-	-
N	337	47	47	13	36	21	76
r2	0.043	0.126	0.846	0.805	0.306	0.763	0.131

Note: Normalised elasticity estimates in (1) are normalised within outcome groups (those listed in Table 3) to have a zero mean and a unity standard deviation. Citation index normalised by the global standard deviation. All explanatory variables are normalised to have a zero mean within outcome groups. 10 observations drop out in (1) due to normalisation within categories with singular observations. Non-high-income countries include low-income and median-income countries according to the World Bank definition. Population density in study area is from Demographia World Urban Areas (2018). [a] Round 3 consists of previously known evidence and recommendations by colleagues. Standard errors (in parentheses) are clustered on studies (one study can contain multiple analyses, the unit of observation). + $p < 0.15$, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.5 Original density elasticity estimates

While the evidence base on the quantitative effects of density summarised above is rich and reasonably consistent for outcomes like productivity or mode choice, it is thinner and less consistent for many other outcomes. To enrich the evidence base in some of the less-developed categories, we contribute some transparent elasticity estimates using data from the OECD functional urban area and regional statistics database and the following regression model:

$$\ln\left(Y_{i,c}\right) = \beta \ln\left(\frac{P_i}{A_i}\right) + \tau \ln\left(\frac{G_i}{P_i}\right) + \mu_c + \epsilon_{i,c}, \qquad (2)$$

where $Y_{i,c}$ is an outcome in city *i* in country c, P_i, A_i, μ_c are population, geographic area, and country fixed effects as in equation (1), and G_i is GDP. The coefficient of interest is β, which gives the estimated density elasticity of an outcome controlling for GDP per capita and unobserved cross-country heterogeneity. Where either population or area forms part of the dependent variable, we instrument population density using the (ln) rank within the national population density distribution as an instrument. Table 5 summarises the key results. Full estimation results, in each case for a greater variety of model specifications, are in the appendix (section 3).

We find a negative association between well-being and density, which seems to be more pronounced across countries than within. Still, the results support the singular comparable result found in the literature (Glaeser et al. 2016). Our results further support the average findings in the evidence base, in that innovation (number of patents) increases in density and crime rates, energy use (carbon emissions), and average road speeds decrease in density.

Conflicting with the mean elasticities in the evidence base reported in Table 3, we find that pollution concentrations are higher in denser cities. At the local level, the effect of concentrating sources of pollution in space dominates the effect of reduced aggregate emissions (due to shorter car trips and more energy-efficient housing). Our estimate has been confirmed by two recent studies (Carozzi & Roth 2018; Borck & Schrauth 2018). Furthermore, our results consistently suggest that income inequality increases in density. Our results are qualitatively and quantitatively (see the results for US cities reported in section 3.3 in the appendix) consistent with Baum-Snow et al. (2017). But there is some contrast to the reviewed literature that has found mixed results, with many studies pointing to lower inequalities at higher levels of economic density. To reconcile the evidence, we note that the evidence base contains several case studies on a within-city scale, but our comparison is across economic areas. It seems plausible that the mechanisms affecting equity dimensions are different on a within-city (segregation) and a between-city (skill complementarity) scale, but further research is required to substantiate this intuition. We note that the statistically insignificant effect of density on crime (conditional on country fixed effects), masks heterogeneity across US and non-US cities. In line with Glaeser and Sacerdote (1999), we find that crime rates increase in density for US cities, whereas the opposite is true for other OECD countries (see appendix 3.4).

Table 5 Original elasticity estimates

	Ln patents p.c.[a]		Ln broadband p.c.[b]		Ln income quintile		Ln Gini coefficient [b]	
Ln dens.	0.349***	0.129*	0.034***	0.01	0.024	0.035**	-0.007	0.025***
FE	-	Yes	-	Yes	-	Yes	-	Yes
IV	-	Yes	-	Yes	-	-	-	-
	Ln poverty rate[b] Ln poverty rate[b]		Ln homicides p.c.[b]		Ln green density[b] (administrative)		Ln urban green density[a] (functional economic)	
Ln dens.	-0.013	0.032	-0.166***	-0.048	-0.267***	-0.245***	0.283**	0.761*
FE	-	Yes	-	Yes	-	Yes	-	Yes
IV	-	Yes	-	Yes	-	Yes	-	Yes
							Ln speed[a,d]	
	Ln green p.c.[c]		Ln pollution (PM2.5)[b]		Ln CO_2 p.c.[b]		freeway	arterial
Ln dens.	-0.717***	-0.239	0.220***	0.124***	-0.224***	-0.173***	-0.008	-0.063***
FE	-	Yes	-	Yes	-	Yes	-	-
IV	-	Yes	-	-	-	Yes	-	-
	Ln mortality rate[b]		Ln mortality rate: transport[b]		Ln life expectancy at birth[b]		Ln self-reported well-being[b]	
Ln dens.	-0.046***	-0.017	-0.150***	-0.099***	0.013***	0.007*	-0.023***	-0.007**
FE	-	Yes	-	Yes	-	Yes	-	Yes
IV	-	Yes	-	Yes	-	-	-	-

Note: Density (dens.) is population density (population / area). All models control for ln GDP p.c. Fixed effects (FE) are by country. IV is rank of a city in the population density distribution within a country.[a] Data from OECD.Stat functional economic areas.[b] Data from OECD.Stat administrative boundaries (large regions).[c] Data from OECD.Stat administrative boundaries (small regions, excluding GDP control due to unavailability of data for the US) [d] Speed data from Lomax et al (2010). Poverty line is 60% of the national median income. Speeds are measured during peak time. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, with standard errors clustered on FE where applicable.

Our estimates of the relationship between green coverage and population density are without precedent. The elasticity of green density with respect to population density qualitatively depends on the spatial layer of analysis. At regional level (administrative boundaries) the spatial units cover both urban and rural areas. The negative elasticity estimate likely reflects that an increase in population implies a larger share of urban, at the expense of non-urban land. Functional economic areas are designed to cover exclusively urban areas. The positive elasticity estimate likely reflects that within an urbanised area, increasing population density preserves space for urban parks and suburban forests. Because we focus on the effects of urban form in this paper, the latter is our preferred estimate. We note that the relatively large elasticity estimated conditional on country fixed effects is driven by a suspiciously large elasticity estimated across US cities (>1.4), whereas the within-country elasticity estimate for the rest of the world is in line with the baseline elasticity estimate from the cross-sectional model excluding fixed effects. Therefore, in this case we prefer the conservative non-fixed effects model. The estimated elasticity of per capita green area with respect to population is negative, as expected. Our preferred elasticity estimate (-0.283) is of roughly the same magnitude as the estimated elasticity of green space value with respect to population density of 0.3 (Brander & Koetse 2011) suggesting that congestion (number of users) and the value of green space increase at roughly the same rate.

4.6 Recommended elasticity estimates

In Table 6 we condense the quantitative evidence, including our original estimates, into recommended density elasticity estimates which we provide for each outcome category. Specific to each category, we either recommend a citation-weighted mean across the elasticity estimates in our evidence base as reported in Table 3, an estimate from a high-quality original research paper or one of our original estimates. The selected dedicated analyses use comprehensive data and make sensible choices in the research design, i.e. they avoid excessive "overcontrolling" for endogenous variables and exploit plausibly exogenous variation. In general, we prefer the citation-weighted mean in the evidence base as well as estimates from dedicated high-quality original research papers over our original estimates. We also prefer estimates from dedicated high-quality papers over the weighted means in the evidence base if the evidence base is thin or inconsistent, in particular if the recommended elasticity estimate is in line with our original analysis of OECD data.

Our aim is to provide a compact and accessible comparison of density effects across categories. The baseline results are best understood as referring to high-income countries. Where possible, we acknowledge cross-country differences in Table 6. Nevertheless, we wish to remind the reader that we likely miss substantial context-specific heterogeneity. Moreover, the quality and quantity of the evidence base is highly heterogeneous across categories. We strongly advise to consult section 4 in the appendix, which provides a discussion of the origin of each of the recommended elasticity estimate against the quality and quantity of the evidence base, before applying any of the elasticity estimates reported in Table 6 in further research. In a nutshell, we see sufficient evidence that seriously engages with separating the effects of density from the effects of correlated unobserved fundamentals to allow for a causal interpretation in the following categories: 1: Wage and productivity; 3: Rent, 4: Vehicle miles travelled; 10: Pollution reduction; 12: Average speed. For the other categories, the estimated elasticities are better interpreted as associations in the data. We stress that significant uncertainty surrounds the effects of density on income inequality, urban green, health, and self-reported well-being. In general, the recommended elasticities are best understood as describing area-based effects that include composition effects.

There is an important additional elasticity estimate that is implicitly determined by the elasticity estimates reported in Table 6. Assuming perfect mobility and competition in all markets, all benefits and costs in urban area offers must be compensated by wages and rents (Rosen 1979; Roback 1982). The relative quality of life of a place can be inferred from the relative real wage (income after taxes and housing expenditures) residents are willing to give up to enjoy living there, i.e. $\mathrm{dln}\,Q = \rho\,\mathrm{dln}\,r - T\,\mathrm{dln}\,w$, where $\mathrm{dln}\,Q$, $\mathrm{dln}\,r$,and $\mathrm{dln}\,w$ are differentials in quality of life, rents, and wages (in natural logs), ρ is the housing expenditure share and T is one minus the tax rate. The elasticity of quality of life with respect to density can be expressed as: $\frac{\mathrm{dln}\,Q}{\mathrm{dln}(P/A)} = \rho\frac{\mathrm{dln}\,r}{\mathrm{dln}(P/A)} - T\frac{\mathrm{dln}\,w}{\mathrm{dln}(P/A)}$.

Applying conventional values of $\rho = 1/3$ and $T = 0.66$ (Albouy & Lue 2015) and the elasticity estimates reported in Table 6, the resulting quality-of-life elasticity estimate at 0.04 is close to the citation-weighted mean from the evidence base (0.03). However, we must note that there is considerable variation in the collected quality-of-life elasticity estimates including both negative (Chauvin et al. 2016) and positive effects (Albouy & Lue 2015).

Table 6 Recommended elasticity estimates by category

ID	Elasticity	Value	Comment
1	Wage	0.04	Citation-weighted mean in review, roughly in line with Melo et al. (2009). 0.08 for non-high-income countries. Net of selection effects, elasticity estimates about halve (Combes & Gobillon 2015).
2	Patent intensity	0.21	Citation-weighed mean in review, in line with original analysis of OECD data.
3	Rent	0.15	Citation-weighed mean in review. In line with evidence from the US (dedicated analysis based on Albouy & Lue, 2015 data). Estimated elasticity increases in density (original meta-analysis) and is 0.21 for France (Combes et al. 2018).
4	Vehicle miles travelled (VMT) reduction	0.06	Citation-weighted mean in review, roughly in line with Duranton & Turner (2018) and Ewing & Cervero (2010).
5	Variety value (price index reduction)	0.12	Dedicated analysis on request using data from Couture (2016), in line with Ahlfeldt et al. (2015).
6	Local public spending	0.17	Citation-weighted mean in review, roughly in line with dedicated high-quality paper (Carruthers & Ulfarsson 2003).
7	Inter-quintile wage gap reduction	-0.035	Original analysis of OECD data[a]. -0.057 for the US. US estimate in line with dedicated high-quality paper (Baum-Snow et al. 2017) (section 3 in appendix).
8	Crime rate reduction	0.085	Dedicated analysis on request (Tang 2015), in line with original analysis of OECD non-US city data. Dedicated high-quality paper (Glaeser & Sacardote) and original analysis suggest a negative value for the US.
9	Green density	0.28	Original analysis of OECD data (evidence base non-existent)
10	Pollution reduction	-0.13	Dedicated high-quality paper (Carozzi & Roth 2018). In line with Borck & Schrauth (2018) and original analysis of OECD data
11	Energy use reduction	0.07	Citation-weighted mean in review
12	Average speed	-0.12	Citation-weighted mean of two (no further evidence) high-quality papers (Duranton & Turner 2018; Couture et al. 2018)
13	Car use reduction	0.05	Citation-weighted mean in review
14	Mortality rate reduction	-0.09	Dedicated paper (Reijneveld et al. 1999)
15	Self-reported well-being	-0.0037	Only direct estimate in literature (Glaeser et al. 2016). In line with original analysis of OECD data

Note: Density elasticity estimates are best understood as referring to large cities in high-income countries. In general, they represent correlations and not necessarily causal estimates. If our recommended elasticities differ between US and non-US cities, we report the former as the baseline and mention the latter in the comments, because, as shown in Table 1, the density distribution of US cities is not representative. [a] Original analysis uses the wage gap between 80th and the. 20th percentile. 1: Productivity; 2: Innovation: 3: Value of space; 4: Job accessibility; 5: Services access; 6: Efficiency of public services delivery; 7: Social equity; 8: Safety; 9: Open space preservation and biodiversity; 10: Pollution reduction; 11: Energy efficiency; 12: Traffic flow: 13: Sustainable mode choice; 14: Health; 15: Well-being. See appendix section 4 for a critical discussion of the evidence base by category.

4.7 Monetary equivalents

For a quantitative comparison of density effects across categories, we conduct a series of back-of-the-envelope calculations to express the effects that would result from a 1% increase in density as per capita PV dollar effects, assuming an infinite horizon and a conventional 5% discount rate (de Rus 2010). We summarise the results in Table 7. As most of the parameters used in the back-of-the envelope calculations are context-dependent, the table is designed to allow for straightforward adjustments. The monetary effect in the last column (8) is simply the product over the elasticity (3), the base value (5), the unit value (7), a 1% increase in density and the inverse of the 5% discount rate (e.g. 0.04 × $35,000 × 1 × 1%/5% for the wage effect). By changing any of the factors a context-specific monetary equivalent can be calculated.

The exercise summarised in Table 7 is ambitious and there are some limitations. First, the monetary equivalents are estimates that most closely refer to large metropolitan areas in high-income countries. In drawing conclusions for a specific institutional context, we strongly advise that the assumptions made in appendix section 5 are evaluated with respect to their applicability. Second, the results in Table 7 do not necessarily correspond to the short-run effect of a policy-induced change in density. As an example, an increase in population holding the developed area constant will increase population density, but not necessarily the green density. However, the green density will be higher than in a counterfactual where the population growth was achieved holding density constant. Third, the effects implied by the elasticities apply to marginal changes only, i.e. they should not be used to evaluate the likely effects of extreme changes (e.g. a 100% increase in density) in particular settings. Fourth, while for the not genuinely area-based outcomes we would ideally apply density effects that come net of selection effects, the literature only offers such estimates in the productivity category. So, for consistency across categories, we strictly apply the baseline elasticities capturing area-based effects from Table 6. Section 5 in the appendix provides a more detailed discussion of the evidence base that should be consulted before there is any further use of the suggested monetary equivalents in Table 7.

Despite these limitations, Table 7 offers novel insights into the direction and the relative importance of density effects. The density effect on wages, which has been thoroughly investigated in the agglomeration literature, is large, but not as large as the effect on rents, on average.[43] Density generates costs in the form of higher congestion and lower average road speeds, which are, however, more than compensated for by the cost reductions due to shorter trips. Agglomeration benefits on the consumption side due to larger and more accessible consumption variety are quantitatively important and amount to more than one-third of agglomeration benefits on the production side (wages). Other quantitatively relevant benefits arising from density include cost savings in the provision of local public services, preserved green spaces, lower crime rates

[43] The results by Combes at al. (2018) suggest that this result may not apply to small cities as the rent elasticity increases in city size.

(outside the US), and reduced energy use, which creates a sizeable social benefit (reduced carbon emissions) in addition to private cost savings. Besides the aforementioned congestion effects, the cost of density comes in the form of increased pollution concentration, inequality, adverse health effects and reduced well-being.

Table 7 Present value[a] of a 1% increase in density I: Category-specific effects

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Category			Quantity, p.c., year		Unit value		PV of 1%
ID	Outcome	Elast.	Variable	Value	Unit	Value	dens. incr.
1	Wage	0.04	Income ($)	35,000	-	1	280
2	Patent intensity	0.21	Patents (#)	2.06E-04	Patent value ($/#)	793K	7
3	Rent	0.15	Income ($)	35,000	Expenditure share	0.33	347
4	VMT[b] reduction	0.06	VMT[b] (mile)	10,658	Priv. cost $/mile	0.83	107
5	Variety value[c]	0.12[b]	Income ($)	35,000	Expenditure share[d]	0.14	115
6	Local public spending	0.17	Total spending ($)	1,463	-	1	50
7	Wage gap[e] reduction	-0.035	Income ($)	35,000	Inequality premium	0.048	-12
8	Crime rate[f] reduction	0.085	Crimes (#)	0.29	Full cost ($/#)	3,224	16
9	Green density	0.28	Green area (p.c., m^2)	540	Park value ($/$m^2$)	0.3	100
10	Pollution reduction	-0.13	Rent ($)	11,550	Rent-poll. elasticity	0.3	-90
11	Energy use reduction	0.07	Energy (1M BTU)	121.85	Cost ($/1M BTU)	18.7	32
	(private and social	0.07	CO_2 emissions (t)	25	Social cost ($/t)	43	15
12	Average speed	-0.12	Driving time (h)	274	VOT ($/h)	10.75	-71
13	Car use reduction	0.05	VMT[b]	10,658	Social cost ($/mile)[g]	0.016	2
14	Health	-0.09	Mortality risk (#)	5.08E-04	Value of life ($/#)[h]	7M	-64
15	Self-reported well-being[j]	-0.004	Income ($)	35,000	Inc.-happ. elasticity	2	-52

Note: Monetary equivalents represent area-based effects, including selection effects. [a] The per-capita present value for an infinite horizon and a 5% discount rate. [b]Vehicle miles travelled. [c]Reduction in price index of consumption varieties. [d] Local non-tradeables: home, entertainment, and apparel and services. [e] Assuming a wage gap of high-skilled vs. low-skilled that corresponds to the 80th vs. 20th percentiles in the wage distribution. [f]All crimes against individual and households, [g]Emissions externality [h]Statistical value of life. [i]Pre-mature (> 70) mortality rate. [j] Self-reported well-being. See appendix section 5 for a discussion of the assumptions on quantities and unit values by category.

Given that we have gone a long way in computing category-specific estimates of costs and benefits that are comparable across categories, a natural question arises: Do the benefits of density exceed the costs and, if so, by how much? To address this question, we conduct a simple accounting exercise in Table 8. We distinguish between private (columns 1–5) and external (column 6) costs and benefits, which residents do not directly experience and likely do not pay for via rents (such as reductions in carbon emissions that have global rather than local effects). To avoid double-counting, we exclude gasoline costs in computing the benefits of shorter average trips (category 4) as this cost-saving is already accounted for by reduced energy consumption (category 11). Also, we correct consumption benefits (category 5) to reflect the pure gains from variety and not savings due to shorter car trips, which are already itemised in category (4). Since health effects are itemised in 14, we use an estimate of the health cost arising from density-related pollution from Carozzi & Roth (2018) to restrict the pollution effect to an amenity channel. The external effect from sustainable mode choice (13) is already itemised in the external benefit of reduced energy use (11) and is thus not counted separately. In the baseline scenario (*Sum* row), we assume that public services are nationally funded. In an alternative accounting (indicated in the bottom of the table), we assume that public services are locally funded, so that density-induced cost savings fully capitalise into rents (via lower taxes).

The standard urban economics framework builds on the spatial equilibrium assumption, which implies that individuals are fully mobile and competition in all markets is perfect. In this framework, rents reflect the capitalised values of productivity and utility so that the sum over rents and wages (column 1) amounting $627, p.c. can be interpreted as a welfare gain to which the external welfare effects of $60 in column (6) can be added. The spatial equilibrium framework is also the theoretical fundament for the economic quality-of-life literature mentioned above, which infers place-specific amenity values from compensating differentials. With perfectly elastic demand, an increase in rent that exceeds an increase in disposable income necessarily reflects a positive quality-of-life effect.

If mobility is not perfect and/or there is heterogeneity in the preference for locations, rents will not only reflect demand-side conditions (here, amenities), but also supply-side conditions, because local demand is downward-sloping (Arnott & Stiglitz 1979). Increases in density – or the policies that enforce increased density – may then also increase rents because the cost of supplying space is higher. By implication, observed rent increases do not necessarily reflect demand-driven capitalization effects exclusively, but potentially to some extent spatial differences in the slope of the supply curve (Hilber & Vermeulen 2016; Hilber 2017). Distinguishing these scenarios is notoriously difficult, but it is informative to compare the quality-of-life effect inferred from wages and rents to the aggregate amenity effects across categories. If the accounting was precise and complete and demand was perfectly elastic, we would expect the aggregate amenity effect to equal the quality-of-life effect.

The amenity effect reported in column (3) with an PV of $100 per capita, is substantial, but smaller than the after-tax compensating differential ($156) in column (2), suggesting a role for the supply side (as long as demand is locally downward-sloping). The role of self-reported well-being is controversial as it is regarded either as a proxy for individual utility (Layard et al. 2008) or as a component in the utility function that is traded against the consumption of goods and amenities (Glaeser et al. 2016). Indeed, the amenity effect and the quality-of-life effect are closer if we exclude the well-being effect as a (dis)amenity category. Similarly, the gap shrinks if we treat local public services as fully locally financed, which implies that the savings are passed on to individuals and are capitalised into rents.

To assess the potential relevance of density effects on rents that originate from the supply side, we assume a share of structural value in housing of 75% (Ahlfeldt et al. 2015; Combes et al. 2018) and compute a range for the monetary equivalent of the effect of a 1% density increase on construction cost as 0.04–0.07 (estimated density elasticity of construction cost, see section 2.3) x $35k (income) x 75% (share of structure value) x 33% (expenditure share on housing) x 1% (change in density) / 5% (discount rate) = $70–120. Thus, density-induced increases in the cost of housing supply are a plausible explanation for the gap between the estimated amenity and quality-of-life effects if demand is locally downward sloping. A complementary channel that strengthens the supply-side argument is a scarcity land rent that results from policies that restrict the amount of usable land to increase density (Gyourko et al. 2008; Mayer & Somerville 2000). A detailed discussion of the effects of density on construction costs is in appendix section 2.2.

In columns (4) and (5) we change the perspective and ask how a policy-induced marginal increase in the density of a city would affect residents. Because costs and benefits of density capitalise into rents, the individual net-benefit depends on housing tenure. Given the positive amenity affect from column (5), it is immediate that homeowners gain, on average, as they receive an amenity benefit without having to pay a higher rent. If they were moving to another area, they would leave the amenity gain behind, but would benefit from a higher housing value. Renters would be negatively compensated for the amenity gain by higher rents, making the implications more ambiguous (Ahlfeldt & Maennig 2015). The net benefit to homeowners is positive with a combined amenity and wage effect of $291 or more (if there are tax savings or we abstract from the well-being effect). There is a net cost to renters of up to $56 if we include well-being effects and assume that there are no tax effects due to savings in public services. If we exclude the well-being effect and allow for cost savings in public services to be passed on to renters via lower taxes, the net benefit remains negative, but is close to zero. Of course, the flipside is that there is a positive external benefit to land owners and given the non-linearity in the density effect on rent documented in Section 4.2 the effect on renters may be positive in supply-elastic markets.

Table 8 Present value[a] effects of a 1% increase in density II: Accounting

ID	Outcome Category	(1) Factor Incomes	(2) Quality of life	(3) Amenity value	(4) Effect on Owner	(5) Effect on Renter	(6) External welfare
1	Wage	280	-190[b]	0	190[c]	190[c]	0
2	Innovation	0	0	0	0	0	6
3	Value of space	347	347	0	0	-347	0
4	Job accessibility	0	0	87[d]	87[d]	87[d]	0
5	Services access	0	0	99[e]	99[e]	99[e]	0
6	Eff. of pub. services delivery	0	0	0	0	0	50
7	Social equity	0	0	0	0	0	-12
8	Safety	0	0	16	16	16	0
9	Urban green	0	0	100	100	100	0
10	Pollution reduction	0	0	-47[f]	-47[f]	-47[f]	0
11	Energy efficiency	0	0	32	32	32	15
12	Traffic flow	0	0	-71	-71	-71	0
13	Car use reduction	0	0	0	0	0	0[g]
14	Health	0	0	-64	-64	-64	0
15	Self-reported well-being	0	0	-52	-52	-52	0
	Sum	627	152	100	291	-56	60
	Excl. subj. well-being	-	-	152	342	-4	60
	Locally financed pubic	-	106		340	-6	
	Factor incomes and	686	-	-	-	-	-
	Locally financed pubic	637	-	-	-	-	-

Note: [a] The present value per capita for an infinite horizon and a 5% discount rate. All values in $. [b]Amenity equivalent of after-tax wage increase assuming a marginal tax rate of 32% as in Albouy and Lue (2015). [c]After-tax wage increase as discussed in [b]. [d] Excludes $19.18 of driving energy cost ($0.15/mile gasoline cost) discounted at 5%, which are itemised in 11 [e] Assumes a 10.2% elasticity to avoid double-counting of road trips already included in 4. [f] Amenity effect, excludes health effect itemised in 14. [g] Set to zero to avoid double counting with 11. Numbers reported in the "Locally financed pubic services" row assume that cost savings in local public services are fully passed on to residents via lower taxes.

Overall, the evidence suggests that density is a net amenity. This does not imply, however, that everybody necessarily benefits from densification policies. Renters may be net losers of densification because of rent effects that exceed amenity benefits. The negative net-effect is consistent with a negative density effect on well-being if individuals are attached to some areas more than others. If one is willing to believe that there are strong forces that prevent renters from moving, a supply constraining effect of density can shift renters to a lower utility level, consistent with a negative effect on well-being (or happiness). This is, however, an ambitious interpretation of the evidence as it is impossible to claim full coverage and perfect measurement of amenity effects. It is important to acknowledge that the difference between the amenity effect (in column 3) and the quality-of-life effect (in column 2) of density could simply be due to measurement error (e.g. missing items column 3). Research into the well-being effects of density differentiated by tenure would be informative, but to our knowledge, has yet to be conducted.

4.8 Conclusion

We provide the first quantitative evidence review of the effects of density on a broad range of outcomes. Synthesising the reviewed evidence and a range of original estimates, we report recommended density elasticity estimates for 15 distinct outcome categories along with monetised values of density effects for application in research and policy analysis. While there are sizeable benefits and costs associated with increases in density, the former exceed the latter for a typical large city in the developed world.

In general, much work lies ahead of the related research fields to consistently bring the evidence base to the quantity and quality levels of the most developed outcome categories productivity and mode choice. For all other categories, more research is required – even if selected high-quality evidence exists – to substantiate the recommended elasticities. At this stage, significant uncertainty surrounds any quantitative interpretation in the categories urban green, income inequality, health, and well-being.

As research progresses and the quantity of the evidence base increases, evidence reviews and meta-analyses become a more important aspect of knowledge generation. Regrettably, the scope of this review was constrained because it was frequently not possible to translate results into a comparable metric. To increase the scope of future reviews and meta-analyses, we encourage researchers to complement the presentation of their preferred results by density elasticity estimates that are comparable to those collected here. Minimally, complete summary statistics need to be provided to allow for a conversion of reported marginal effects. Another feature that hinders comparisons across studies is the common practice of analysing more than one aspect of urban form at once, i.e. simultaneously using multiple spatial variables such as population density, building density and job centrality. Disentangling the sources of the effects of compact urban form is important. But it is difficult to compare such conditional marginal effects estimated under the ceteris paribus condition across studies if the measures of urban form co-vary in reality because they are simultaneously determined. To facilitate future reviews and meta-analyses we encourage researchers to complement their differentiated analyses with simple models that exclusively consider the most conventional measure of urban form, which is density.

We provide suggestive evidence that the costs and benefits of agglomeration may be larger in developing-country cities. However, because the evidence from non-high-income countries is scarce, it is not possible to property evaluate whether our key result that density is a net-amenity generalises to non-high-income countries. An important challenge that lies ahead of the research community is to generate a deeper understanding of heterogeneity in density effects across contexts and the density distribution itself, a necessary condition for inference on optimal levels of density.

4.9 References

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4.10 Appendix : The economic effects of density: A synthesis

4.10.1 Introduction to appendix

This appendix complements the main paper by providing additional detail not reported in the main paper for brevity. To improve the flow of the presentation it partially duplicates discussions in the main text. The appendix, however, is designed to complement, not replace the reading of the main paper.

4.10.2 Evidence base

4.10.2.1 Collecting the evidence

In order to determine the selection of keywords to collect our evidence base we developed a theory matrix through a transparent and theory-consistent literature search which can be found in a companion paper (Ahlfeldt & Pietrostefani 2017). The theory matrix establishes the economic channels connecting 15 outcome categories to three compact city characteristics. We use combinations of keywords that relate to each outcome and compact city characteristic. Where appropriate, we use empirically observed variables specified in the companion paper (Ahlfeldt & Pietrostefani 2017).

Table A1 Organisation of keyword search

	Compact city effects	Compact city characteristics		
#	Outcome category	Residential and employment Density	Morphological Density	Mixed use
1	Productivity	density; productivity; wages; urban	-	-
		density; productivity; rent; urban	-	-
2	Innovation	density; innovation; patent; urban	-	-
		density; innovation; peer effects, urban	-	-
3	Value of space	density; land value; urban	building height; land value; urban	-
		density; rent; urban	building height; rent; urban	-
		density; prices; urban	building height; prices; urban	-
4	Job accessibility	density; commuting; urban	land border; commuting; urban	-
5	Services access	density; amenity; distance; urban	street; amenity; distance; urban	mixed use; amenity; distance; urban
		density; amenity; consumption; urban	street; amenity; consumption; urban	mixed use; amenity; consumption;
6	Eff. of public services	density; public transport delivery; urban	building height; public transport delivery; urban	-
		density; waste; urban	street; waste; urban	-
7	Social equity	density; real wages; urban	building height; real wages; urban	-
		density; segregation; urban	building height; segregation; urban	-
		density; "social mobility"; urban	street; "social mobility"; urban	-
8	Safety	density; crime; rate; urban	building height; crime; urban	-
		density; open; green; space; urban	land border; open; green; space; urban	-
9	Open space	density; green; space; biodiversity; urban	land border; green; space; biodiversity; urban	-
10	Pollution reduction	density; pollution; carbon; urban	building height; pollution; carbon; urban	mixed use; pollution; carbon; urban
		density; pollution; noise; urban	building height; pollution; noise; urban	mixed use; pollution; noise; urban
11	Energy efficiency	-	building height; energy; consumption; urban	mixed use; energy; consumption; urban
12	Traffic flow	density; congestion; road; urban	Street layout; congestion; road; urban	mixed use; congestion; road; urban
13	Mode choice	density; mode; walking; cycling; urban	street; mode; walking; cycling; urban	mixed use; mode; walking; cycling;
14	Health	density; health; risk; mortality; urban	-	-
15	Well-being	density; well-being; happiness; perception;	space; well-being; perception; urban	mixed use; well-being; perception;

Note: Each outcome- characteristics cell contains one or more (if several rows) combinations of keywords each used in a separate search. In each cell we use a combination of keywords based on effects (related to the outcome category or typically observed variables) and characteristics (related to residential and employment density, morphological density or mixed use). Outcome-characteristics cells map directly to Table A1.

We usually use the term density in reference to economic density and a more specific term to capture the relevant aspect of morphological density. In several instances, we run more than one search for an outcome-characteristics combination to cover different empirically observed variables and, thus, maximise the evidence base. We note that because this way our search focuses directly on specific features that make cities "compact," we exclude the phrase 'compact city' itself in all searches. Adding related keywords did not improve the search outcome in several trials, which is intuitive given that, by itself, "compactness" is not an empirically observable variable. In total, we consider the 52 keyword combinations (for 32 theoretically relevant outcome-characteristic combinations) summarised in Table A1 which we apply to five databases, resulting in a total of 260 keyword searches. 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 probability of a paper being relevant for our purposes was marginal after the 50^{th} entry. Therefore, in an attempt to keep the literature search efficient, we generally did not consider documents beyond this threshold.

In a limited number of cases we reassign a paper returned in a search for a specific outcome category to another category if the fit is evidently better. Studies referring to economic density may thus have sometimes been found through searches focused on other compact city characteristics. Occasionally, a study 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 our study as *analyses*. We do not double count any publication when reporting the total number of *studies* throughout the paper and the appendix.

Based on the evidence collected in step one, we then conduct an analysis of citation trees in the second step of our literature search. An important number of papers were added to the *productivity*, *innovation*, *job accessibility* and *mode choice* categories through the citation tree analysis (Table A2). For papers that were not accessible through online resources, we reached out to citing and cited authors. In a hand full of cases, we did not receive a response, the studies therefore remain excluded. Upon inspection (excluding empirically irrelevant work, duplications of working papers, and journal articles, etc.) this systematic literature search resulted in 195 studies and 313 analyses.

Up to this point, our evidence collection is unbiased in the sense that it mechanically follows from the theory matrix (Ahlfeldt & Pietrostefani 2017) and is not driven by our possibly selective knowledge of the literature, nor that of our research networks. For an admittedly imperfect approximation of the coverage we achieve with this approach we exploit the fact that the search for theoretical literature already revealed a number of empirically relevant studies that were not used in the compilation of the theory matrix unless they contained significant theoretical thought. From 19 empirically relevant papers known before the actual evidence collection, we find that step one (keyword search) and two (analysis of citation trees) identified six, i.e., 31%.

In the final step 3 of the evidence collection we add all relevant empirical studies known to us before the evidence collection as well as studies that were recommended to us by colleagues working in related fields. To collect recommendations, we reached out by circulating a call via social media (Twitter) and email (to researchers within and outside LSE). 22 colleagues contributed by suggesting relevant literature. Further studies were suggested to us during presentations of this paper and following our submission of this paper for publication. This step increases the evidence base to 268 studies and 473 analyses (160 additional observations). The evidence included at this stage may be selective due to particular views that prevail in our research community. However, recording the stage at which a study is added to the evidence base allows us to test for a potential selection effect.

Panel 1 of Table A2 summarises the collection process of the evidence base. We present the number of studies found by category and the stage at which they were added to the evidence base. Panel 2 of Table A2 summarises the distribution of analyses collected by outcome categories and compact city characteristics. The large majority of 353 out of 473 analyses are concerned with the effects of economic density, on which we focus in this paper. After restricting the sample to analyses for which we are able to infer density elasticity estimates, this number is reduced to 347. Table A3 compares the subsample of analyses for which we were able to compute outcome elasticity estimates with respect to density to the universe of analyses, revealing only moderate differences. The analyses in the elasticity subsample have a slightly higher propensity of being added in the third evidence collection stage, a slightly higher mean SMS score (proxy for evidence quality), and a somewhat higher propensity of showing positive (qualitatively) results.

Table A2 Evidence base by collection stage and research topic

Panel 1

#	Outcome	Google Scholar	Web of Science	EconLit	CesIfo	Step 2	Step 3	Total
1	Productivity	9	3	3	0	25	17	57
2	Innovation	3	1	2	1	5	1	13
3	Value of space	6	1	6	1	2	10	26
4	Job accessibility	3	1	3	0	19	5	31
5	Services access	2	0	1	0	0	8	11
6	Efficiency of public services delivery	2	0	1	0	0	4	7
7	Social equity	3	1	0	0	4	3	11
8	Safety	2	3	0	0	3	3	11
9	Open space preservation and biodiversity	4	1	0	0	0	0	5
10	Pollution reduction	2	1	1	0	2	4	10
11	Energy efficiency	5	2	2	0	7	6	22
12	Traffic flow	2	0	0	0	1	1	4
13	Sustainable mode choice	7	3	1	0	27	5	43
14	Health	2	1	0	0	5	1	9
15	Well-being	2	0	1	0	0	5	8
	Total	54	18	21	2	100	73	268

Panel 2

	Compact city effects	Compact city characteristics			
#	Outcome category	Economic	Morph.	Mixed	Total
1	Productivity	67	-	-	67
2	Innovation	14	1	-	15
3	Value of space	18	8	2	28
4	Job accessibility	32	15	11	58
5	Services access	16	2	**0**	18
6	Efficiency of public services delivery	21	2	-	23
7	Social equity	13	**0**	-	13
8	Safety	19	4	-	23
9	Open space preservation and biodiversity	2	5	-	7
10	Pollution reduction	18	3	**0**	21
11	Energy efficiency	26	8	1	35
12	Traffic flow	4	2	1	7
13	Sustainable mode choice	76	33	17	126
14	Health	13	3	-	16
15	Well-being	14	2	**0**	16
	Total	353	88	32	473

Note: Panel 1: Google Scholar, Web of Science, EconLit, CesIfo searches all part of evidence collection step one. Step 2 contains results from 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, and studies from citation trees. Step 3 consists of previously known evidence and recommendations by colleagues. Evidence base by outcome category and compact city characteristic. Panel 2: All numbers indicate the number of analyses collected within an outcome-characteristics cell. "**0**" indicates missing evidence in theoretically relevant outcome characteristic cell. "-" indicates missing evidence in theoretically irrelevant relevant outcome characteristic cell.

Table A3 All analyses vs. elasticity estimates sample

	All analyses		Elasticity estimates sample	
	Mean	S.D.	Mean	S.D.
Non-high-income country [a]	0.11	0.31	0.084	0.28
Academic journal	0.79	0.41	0.77	0.42
Economics	0.26	0.44	0.29	0.45
Within-city	0.47	0.5	0.47	0.5
Round 3 [d]	0.34	0.47	0.4	0.49
Year of publication	2007	8.4	2008	6.9
Citation index	1.7	1.7	1.7	1.4
SMS (methods score)	2.2	1	2.4	0.86
Positive & significant [b]	0.67	0.47	0.69	0.46
Insignificant [b]	0.14	0.34	0.15	0.36
Negative & significant [b]	0.19	0.4	0.16	0.37
Qualitative result score [c]	0.48	0.8	0.53	0.76
N	473		347	

Note: Elasticity estimates sample is the sample of analyses from which a density elasticity estimate could be inferred. [a] Non-high-income include low-income and median-income countries according to the World Bank definition. [b] Qualitative results (positive, insignificant, negative) is a category-characteristics specific and defined in Table A4. [c] Qualitative results scale takes the values of 1 / 0 / -1 for positive / insignificant / negative. [d] Round 3 consists of previously known evidence and recommendations by colleagues.

4.10.3 Citation weights

For the SMS-based quality measure, we use a mapping of methods to quality ranks. Although we closely follow an existing approach (What Works Centre for Local Economic Growth (WWC) 2016), the assignment of methods to quality scores involves individual judgement that is potentially controversial. Moreover, the method used is at best an imperfect measure of the quality of a research piece. Given these limitations, we develop, as an alternative, a citation-based quality measure that is objective in the sense that it avoids individual judgements. With this approach, we delegate the quality judgement to the wider research community, assuming that better papers receive more attention. Still, to obtain a measure that is comparable across papers we need to account for the obvious time trend in the probability of being cited. For this purpose, we recover a paper's cumulated citation count adjusted for the years since publication as the fixed effect component μ_p from the following regression:

$$\ln C_{pt} = f\left(YSP_p\right) + \mu_p + \varepsilon_{pt}$$

, where $C_{pt} = \sum_{z \le t} c_{ptz}$, c_{ptz} is the number of citations of a paper p in year t, ε_{pt} is an idiosyncratic component, and $f\left(YSP_{pt}\right)$ is a function that describes how a paper's cumulative citation count increases in the years a paper has been out.

To allow for non-linearities, given the lack of theoretical priors identifying the functional form, we use a linear spline specification:

$$f(YSP_{pt}) = \alpha_1 YSP_{pt} + \sum\nolimits_{n=2,5,10,20} \alpha_2 (YSP_{pt} - n) \times (YSP_{pt} - n > 0)$$

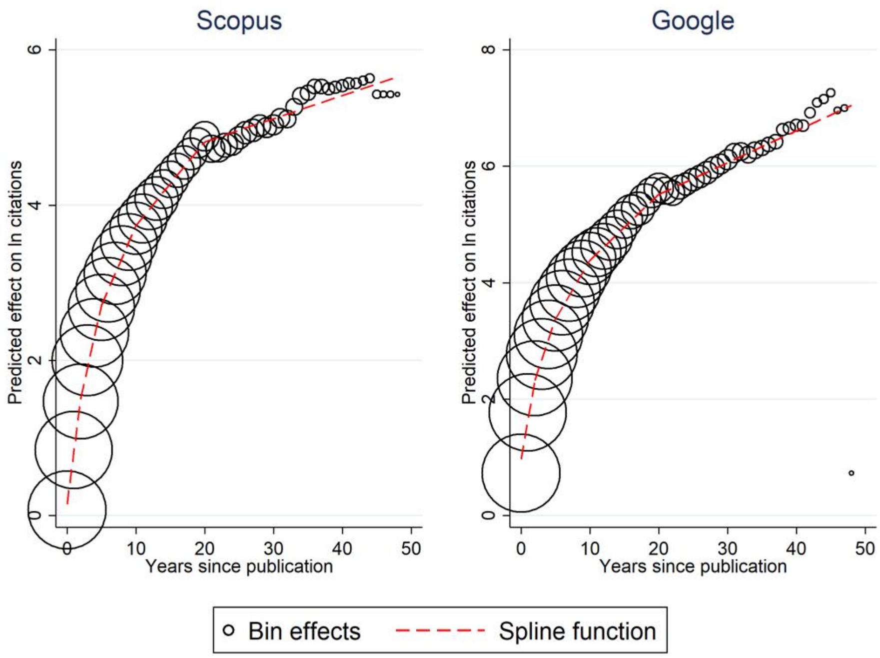
, where $(YSP_{pt} - n > 0)$ is a dummy variable that takes the value of one if the condition is true and zero otherwise. In the figure below, we compare the fit provided by a linear spline function allowing for changes in the marginal effect after 2, 5, 10, and 20 years since publications (dashed lines) to a more flexible semi-non-parametric function (black circles). In this alternative specification, we estimate a bin effect α_m for every group of papers with the same number of years since publication:

$$f(YSP_{pt}) = \sum\nolimits_{m>0} \alpha_m (YSP_{pt} = m)$$

, where $(YSP_{pt} = m)$ is a dummy variable that is one if the condition is true, and zero otherwise. Figure A1 suggests that the spline function overall provides a reasonable fit to the data generating process. The bin effects are somewhat noisier for larger values of the year since publication because only a fraction of papers in our data base have been out for such a long time, introducing some selection effects. For this reason, we prefer the parametric spline function as a control for year-since-publication effects.

We collect citation counts from Google Scholar and Scopus. The data was collected from the summary tables of citation counts that both Google Scholar and Scopus provide starting from the year of publication to today. Total number of citations for each source was also collected. Figure A1 suggests that the rate at which citation counts increase in both data bases is roughly comparable, although Google counts tend to be larger on average and increase a bit faster over time for papers that have been out for a while.

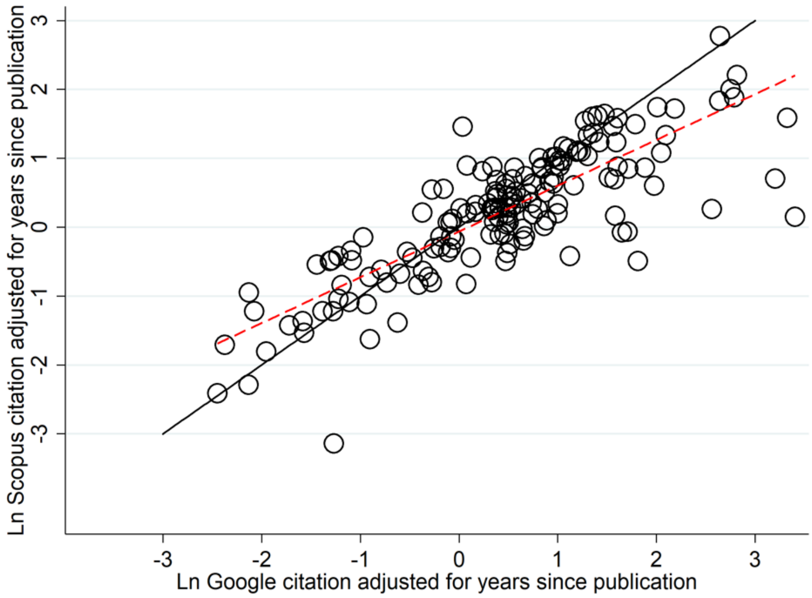
Figure A1 Cumulated citation counts vs. years since publication (within-paper effects)



Note: Predicted values (excluding fixed effects) from regressions of the cumulated citation count of a paper against bin effects and a spline function controlling for paper fixed effects. Dot size proportionate to the number of papers in a bin.

In Figure A1, we compare the fixed effects components recovered from the Google Scholar and the Scopus citation count regressions. The adjusted citation measures are highly correlated, which is reassuring given neither data base provides full citations coverage. We select Scopus as a baseline source because their counts are considered more reliable for a variety of reasons. Scopus only indexes articles published in journals affiliated with its databases, but is the largest abstract and citations database of peer-reviewed literature including research from science, social sciences, humanities and other fields (Guide 2016). It not only includes citations counts for journal articles but also trade publications, books and conference papers. Although Google Scholar is increasingly used as a tool to collect citation impact, it has been shown to inflate numbers of citations, be prone to double counting and does not have a clear indexing policy (Moed et al. 2016; Harzing & Alakangas 2016). To achieve full coverage, we impute 26 missing values in our Scopus-based adjusted citation measure using the Google-based adjusted citation measure. In particular, we use predicted values from regressions of the Scopus measure against the Google measure (corresponding to the dashed line in Figure A2).

Figure A2 Google Scholar vs. Scopus adjusted citation indices



Note: Solid line is the 45-degree line. Dashed line is the linear fit. Sample restricted to observations with positive Google Scholar and Scopus citation counts.

In Table A4 , we correlate our adjusted citation index with the Source Normalised Impact per Paper (SNIP) published by Scopus. This is a citation-based journal quality measure and it should be positively correlated with our paper-based quality measure to the extent that our year-since-publication adjustment results in a sensible approximation of the long-run impact of a paper. Indeed, we find such a positive and statistically significant correlation. We also find that the there is a significant trend in our (adjusted) citation count measure. Controlling for year-since-publication effects, a paper published one year later attracts approximately 5% more citations.

The effects of the SNIP score and the publication year seem to be independent as the marginal effects remain within close range across columns (1-3). The effects also remain within close range if we control for differences in average number of citations across disciplines (4). Our adjusted citation index is also positively correlated with the SCImago Journal Rank (5-6)

Table A4 Adjusted citations by paper vs. Scopus journal measures

	(1) Ln Scopus citation adjusted for years since publication	(2) Ln Scopus citation adjusted for years since publication	(3) Ln Scopus citation adjusted for years since publication	(4) Ln Scopus citation adjusted for years since publication	(5) Ln Scopus citation adjusted for years since publication	(6) Ln Scopus citation adjusted for years since publication
Ln SNIP score	0.798***		0.834***	1.001***		
	(0.17)		(0.14)	(0.14)		
Year – 2000		0.051***	0.052***	0.054***		0.055***
		(0.01)	(0.01)	(0.01)		(0.01)
Ln SJR score					0.360***	0.523***
					(0.08)	(0.10)
Constant	-0.332***	-0.186**	-0.654***	-0.759***	-0.063	-0.462***
	(0.12)	(0.09)	(0.12)	(0.07)	(0.08)	(0.05)
Discipline effects	-	-	-	Yes	-	Yes
r2	0.112	0.203	0.325	0.398	0.072	0.371
N	225	225	225	225	225	225

Note: Sample includes a subset of studies for which Scopus journal quality measures are available. Citation scores adjusted for years since publications (in columns 1 and 3) are the study fixed effects recovered from regressions of study-year Google citation counts against years since publication (a spline function) and study fixed effects. A small number of observations is imputed using an auxiliary regression of the Google-based citation measure against a similarly constructed Scopus-based measure. Citation scores adjusted for year of publication and discipline are the residuals from a regression of the measures used in columns (1) and (3) against discipline fixed effects and a yearly trend variable with a zero value in 2000. Disciplines are defined based on outlets (journals and working paper series). SNIP is the Source Normalised Impact per Paper and SJR is the SCImago Journal Rank, both published by Scopus. Scopus scores are averaged over 2011-2015. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

In Table A5 , we compare our adjusted citation index to the SMS methods score. A one step increase on the SMS, on average, is associated with an increase in adjusted citations by some notable 14% (1). The effect becomes insignificant once we control for discipline fixed effects, but the point estimate increases (2). Once we control for the publication year trend, the positive association disappears (3), suggesting that the positive correlation in (1) is driven by a common time trend and that the two alternative quality measures are orthogonal to each other (in the cross-section). Similarly, the journal-based SNIP is unrelated to the methods that prevail in the published literature once we control for discipline effects (5-6).

Table A5 Citation measures vs. scientific methods scale

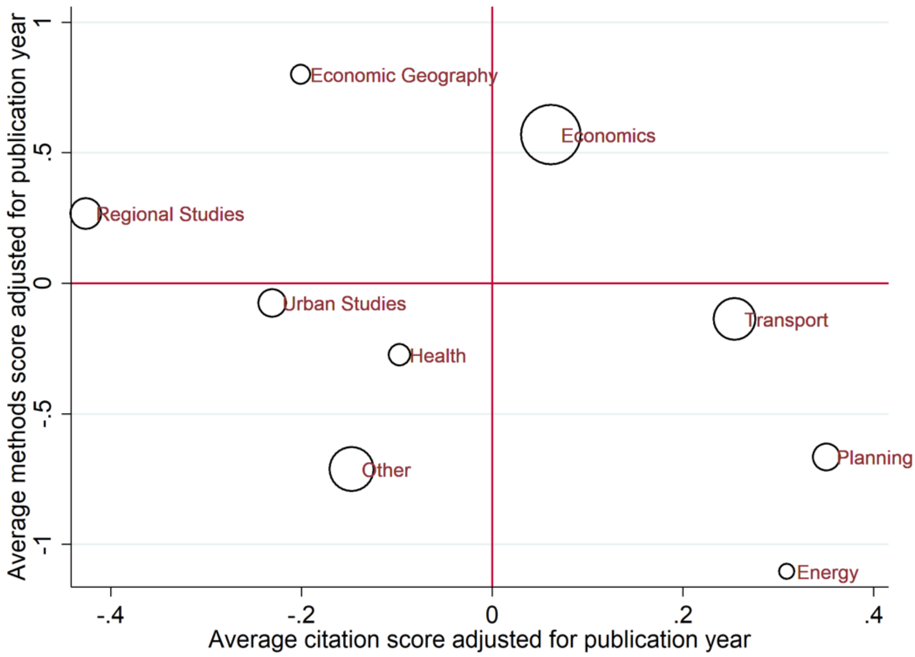
	(1) Ln Scopus citation adjusted for years since publication	(2) Ln Scopus citation adjusted for years since publication	(3) Ln Scopus citation adjusted for years since publication	(4) Ln SNIP score	(5) Ln SNIP score	(6) Ln SNIP score
Scientific methods scale score	0.160**	0.234	0.074	0.074***	0.020	0.024
	(0.06)	(0.14)	(0.12)	(0.03)	(0.04)	(0.04)
Year – 2000			0.048***			-0.001
			(0.01)			(0.01)
Constant	-0.292*	-0.456	-0.394	0.386***	0.507***	0.506***
	(0.17)	(0.31)	(0.24)	(0.06)	(0.09)	(0.09)
Discipline effects	-	Yes	Yes	-	Yes	Yes
r2	0.027	0.081	0.234	0.031	0.181	0.182
N	258	258	258	228	228	228

Note: Sample in columns (4-6) includes a subset of studies for which Scopus journal quality measures are available. Citation scores adjusted for years since publications are the study fixed effects recovered from regressions of study-year Google citation counts against years since publication (a spline function) and study fixed effects. A small number of observations is imputed using an auxiliary regression of the Google-based citation measure against a similarly constructed Scopus-based measure. Disciplines are defined based on outlets (journals and working paper series). SNIP is the 2011-2015 average over the Source Normalised Impact per Paper and SJR published by Scopus. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

In Figure A3, we compare adjusted citation scores to the SMS scores by discipline. The values plotted on the x-axis are the discipline fixed effects recovered from a regression of the Scopus citation count adjusted for years since publication effects against discipline effects and a publication year trend (the model from Table A5 , column 3). The values on the y-axis are the discipline fixed effects from similar regressions using our SMS scores as a dependent variable. The figure suggests significant heterogeneity in the methods used as well as in the citation probabilities across disciplines, but no significant correlation between the two.

It is possible that differences in the average citation counts across disciplines reflect a tendency for researchers in some disciplines to cite relatively more frequently. This brings up the question of whether such differences should be controlled for in a citation-based quality measure. Controlling for discipline effects would impose the assumption that the average quality within disciplines is the same across disciplines. This is a strong assumption; especially given that we cover a potentially selective set of papers within each discipline. The high variation in the SMS score across disciplines is certainly not suggestive of a constant average quality. We, therefore, prefer not to control for cross-discipline differences in citation counts and, instead, assume that such differences are driven by differences in the quality of the papers.

Figure A3 Quality measures: Methods-based vs. citation-based by discipline



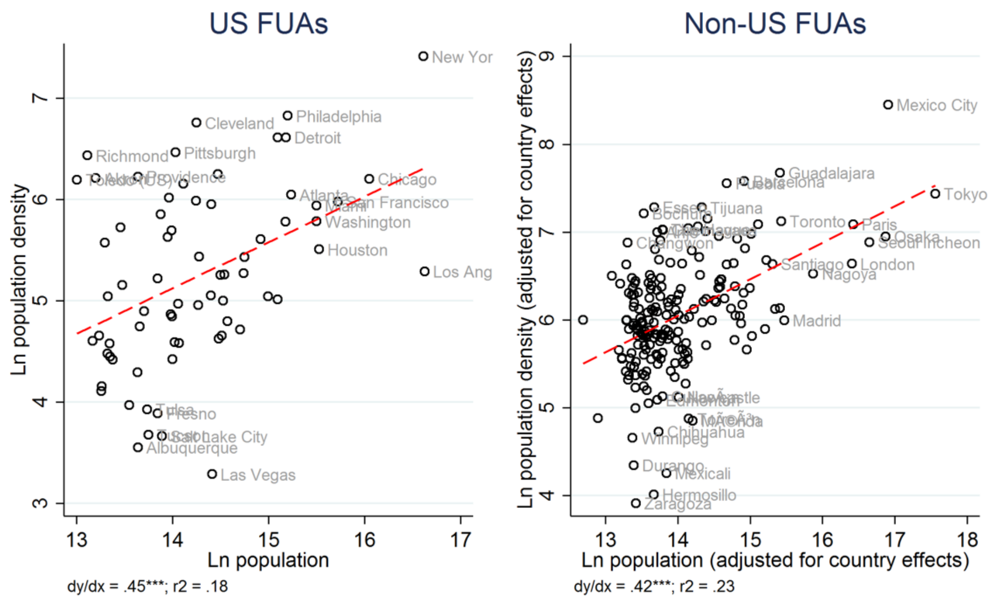
Note: The values plotted on the x-axis are the discipline fixed effects recovered from regressions of the Google citation count adjusted for years since designation effects against discipline effects and a publication year trend (the model from TableA5, column 3). The values on the y-axis are the discipline fixed effects from similar regressions using our SMS scores as dependent variable.

4.11 Density elasticity estimates in the literature

4.11.1 Estimating the elasticity of density with respect to city size

In Figure A4, we correlate city size proxied by population and density (population/area) across a sample of functional urban areas (FUA) as defined by the OECD. In keeping with theoretical predictions from standard models, there is a positive relationship between the two variables. The correlation is reasonably well defined and similar with the sub-samples of US and non-US FUAs.

Figure A4 Population vs. population density



Note: Dotted lines are the fitted lines from linear regressions. Non-US panel shows the partial correlation controlling for country effects. Afunctional urban area (FUA) is labelled if the population is among the ten largest or if it is an outlier. Outlies are below the 10th/5th or above the 90th/95th percentile in the US/Non-US residual distribution. *** indicates significance at the 1% level.

We estimate the elasticity of density with respect to population using the following straightforward econometric specification.

$$\ln\left(\frac{P_i}{A_i}\right) = \alpha \ln(P_i) + \mu_c + \varepsilon_{ic}$$

, where P_i is the population of city i, A_i is the respective land area, and μ_c is a country fixed effect. While the data theoretically allows us to estimate the elasticity from within-city variation over time, we are concerned about the very limited within-city variation in land area in the data. An imperfect measurement of changes in land area over time will lead to an upward bias in the elasticity estimate. In the extreme case, where land area does not change at all over time, the elasticity estimate would be mechanically one as the only variation on the left-hand side and the right-hand side originates from population. To mitigate this problem, we prefer to estimate the elasticity from cross-sectional between-city variation. Yet, there is still a potential mechanical endogeneity as population (left-hand side) is also a component of density (right-hand side) so that any measurement error in population will upward bias the elasticity estimate. To address this problem, we exploit that, mechanically, there is a negative relationship between the population of a city and its rank in the population distribution within a city system. This negative relationship has been analysed in a vast literature on city size distributions (Nitsch 2005). The rank of a city in the distribution of a country city-size distribution is naturally a strong instrument. It is also a valid instrument in this particular context because it effectively removes the population level from the right-hand side of the estimation equation.

We note that it is straightforward to solve $\ln(P_i/A_i) = \alpha \ln(P_i)$ for $\ln(A_i) = (1-\alpha)\ln(P_i)$. Thus, the elasticity estimate of density with respect to city size can also be estimated from a regression of the log of land area against the log of population, which avoids the mechanical endogeneity problem.

Our estimates of the elasticity of density with respect to city size are reported in Table A6. The elasticity estimate increases significantly as the country fixed effects are added to the equation (from 1 to 2). As expected given the presumed absence of measurement error in population, using an IV for population hardly affects the results (3). The results from the alternative specification reported in the main paper, which uses the city log of area and log of population, are identical to the baseline, as expected (4 and 5 vs. 1 and 2, resp. 3). Our preferred estimate of the elasticity of density with respect to city size is 0.43. The distribution of country-specific elasticities estimated by country using the same model as in Table A6 , column (3) (excluding country fixed effects), is illustrated in Figure A5and Table A7 .

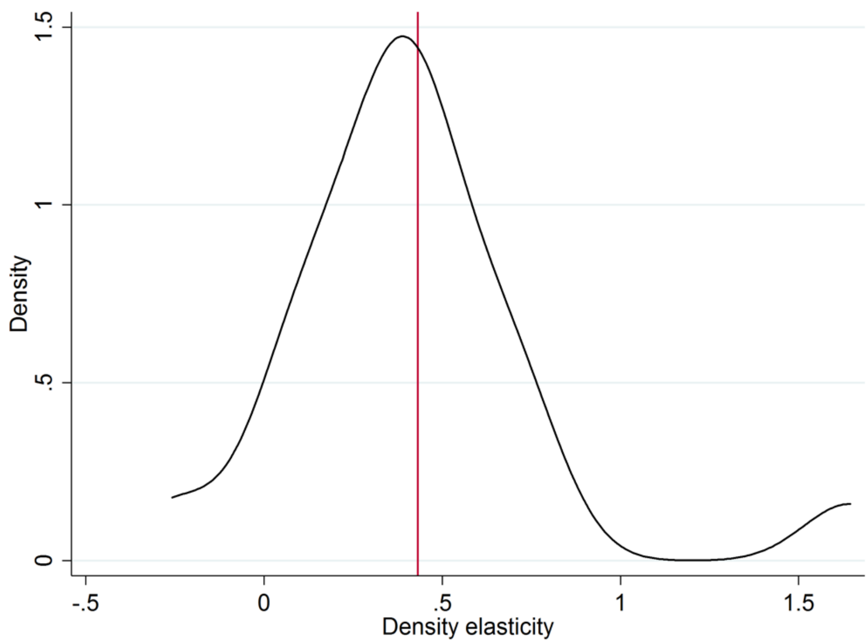
We note that our preferred estimate of the elasticity of density with respect to city size is within close range of Combes et al. (2018), who report an estimate of the elasticity of land area with respect to population of approximately 0.7 for French cities, implying an estimate of the elasticity of density with respect to city size of 0.3. Our results are also close to Rappaport (2008) who estimates an elasticity of 0.34 across US metropolitan areas.

Table A6 Estimates of the elasticity of density with respect to population

	(1) Ln population density	(2) Ln population density	(3) Ln population density	(4) Ln geographic area	(5) Ln geographic area
Ln population	0.304***	0.427***	0.431***	0.696***	0.573***
	(0.07)	(0.05)	(0.04)	(0.07)	(0.05)
Country effects	-	Yes	Yes	-	Yes
IV	-	-	Yes	-	-
Density elasticity	0.3	0.43	0.43	0.3	0.43
N	281	281	281	281	281
r2	0.057	0.614		0.239	0.689

Note: Standard errors in parentheses. Population density and population are averages over the 2000–2014. IV is rank of a city in the population distribution within a country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure A5 Elasticity of density with respect to population: Distribution of estimates across countries



Note: The vertical line represents the elasticity estimated in Table A6, column 2 model. The black curved line is the kernel density distribution across 19 countries with sufficient metropolitan areas estimated using Table A6, column 1 model by country.

Table A7 Estimates of the elasticity of density with respect to population by country

Country code	N	Elasticity of density with respect to population	Standard error
AT	3	0.27	0.07
AU	6	0.06	0.15
BE	4	0.30	0.16
CA	9	0.74	0.39
CH	3	1.65	0.17
CL	3	0.55	0.15
CZ	3	-0.26	0.56
DE	24	0.08	0.18
ES	8	0.65	0.62
FR	15	0.39	0.17
IT	11	0.40	0.17
JP	36	0.40	0.10
KR	10	0.50	0.18
ME	33	0.71	0.25
NL	5	0.19	0.57
PL	8	0.43	0.28
SE	3	0.35	0.06
UK	15	0.11	0.17
US	70	0.43	0.13

Note: Elasticity estimated for 19 countries with sufficient metropolitan areas estimated using Table A1, column 1 model by country.

4.11.2 Estimating the elasticity of construction cost with respect to density

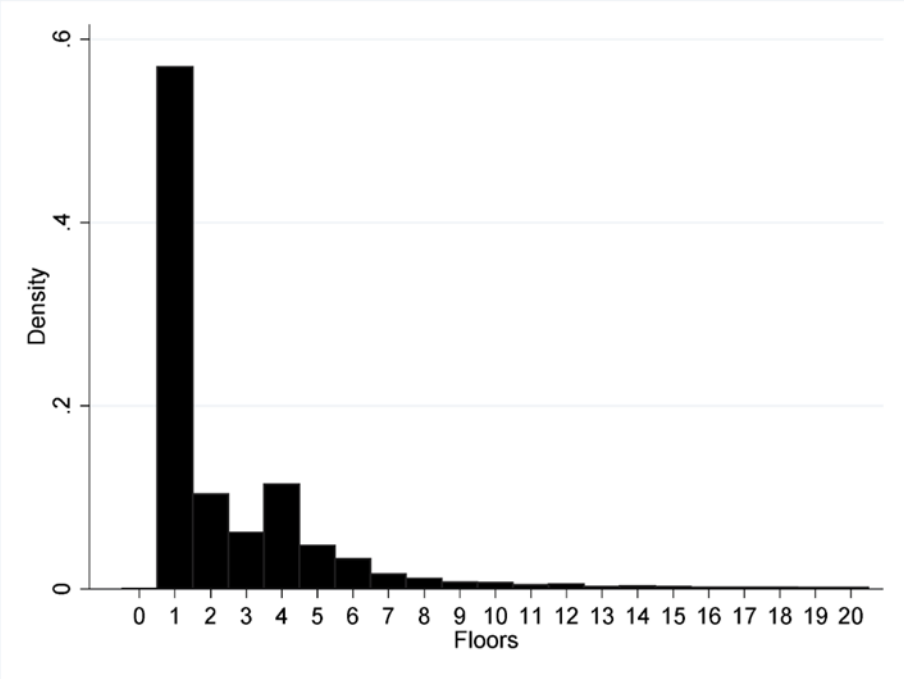
We assume that density impacts on construction costs through two principle channels. On the one hand, constructing a dwelling unit with exactly the same specification is likely more expensive in denser places because such places are usually more congested (higher cost of moving materials, less space for construction), have higher construction worker wages, and are more regulated (a location effect). On the other hand, while density can be achieved by reducing housing consumption and increasing building density, it at least in the limit also requires taller buildings, which are more expensive to construct (a structure effect). We are interested in the gross effect of density on construction cost and, thus, in an estimate of the density elasticity of construction cost that captures both location and the structure effects. To our knowledge, such an estimate does not exist to date. However, Gyourko and Saiz (2006) provide estimates of the density elasticity of construction cost using a construction cost index for a same-specification home, which reflects on the effects of location exclusively. Ellis (2004), in contrast, provides a construction cost index by dwelling type (various types of single-family and multifamily structures) that holds all locational effects constant. In the remainder of this section we provide two novel approaches to estimating the density elasticity of construction cost.

Frist, we make use of a micro-data set to compare how observed construction costs (excluding costs for land acquisition) vary in density within and across cities. This approach directly yields an estimate of the combined location and structure effect. Second, we create a construction cost index that captures variation in the average construction cost across locations due to differences in the structure composition, i.e. the structure effect. We then combine the estimated density elasticity of this index with density elasticity estimates inferred from Gyourko and Saiz (2006), which capture the locational effect, to obtain an estimate of the overall effect of density on construction cost.

4.11.2.1 Estimates using micro-data

To our knowledge, no estimates of the effect of density on construction costs using actual construction cost data exist to date. To fill this gap, we make use of a commercial data set compiled by Emporis that has previously been used by Ahlfeldt & McMillen (2018). The data set contains information on the date of construction, the height, and the number of floors for a large number of buildings worldwide. Geo-information is provided in form of geographic coordinates so that the location can be merged with other spatial data in GIS. The data set contains additional building information, such as construction costs, use, or total floor space, however missing values are present for a substantial fraction of constructions. While the data set is a unique source of information on construction costs, its representativeness with respect to location and structure type is not guaranteed. The intuition is that taller buildings at denser places will be overrepresented in the data set as Emporis claims a nearly comprehensive coverage of tall buildings such as skyscrapers. Against this background, it is reassuring to see that within the US-sub-sample we use (containing information on construction cost and floor space, among other characteristics), a large share of observations refers to small structures which account for the majority of the building stock in US metropolitan areas (see also Figure A7). However, it is still notable from Figure A6 that low-density census tracts are underrepresented in the data set we analyse, suggesting that we obtain local elasticity estimates representative for above-average density areas. Within tracts with at least one Emporis observation, constructions are also more concentrated than population, as revealed by a more than twice as large Herfindahl index (0.0205% vs. 0.0097%).

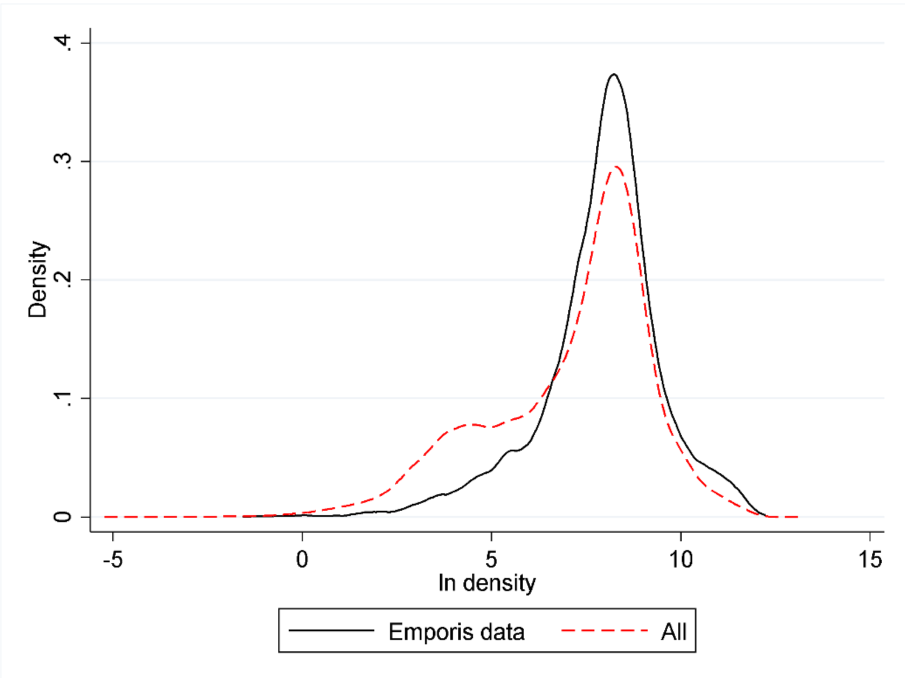
Figure A6 Distribution of buildings in micro-data by number of floor



Note: Data from Emporis. Sample restricted to observations in the US with information on location, construction year, construction cost, building area, building height and the number of floors. Constructions exceeding 20 floors excluded in the graph to improve the presentation.

Census tract population density distribution: Emporis sample vs. all tracts

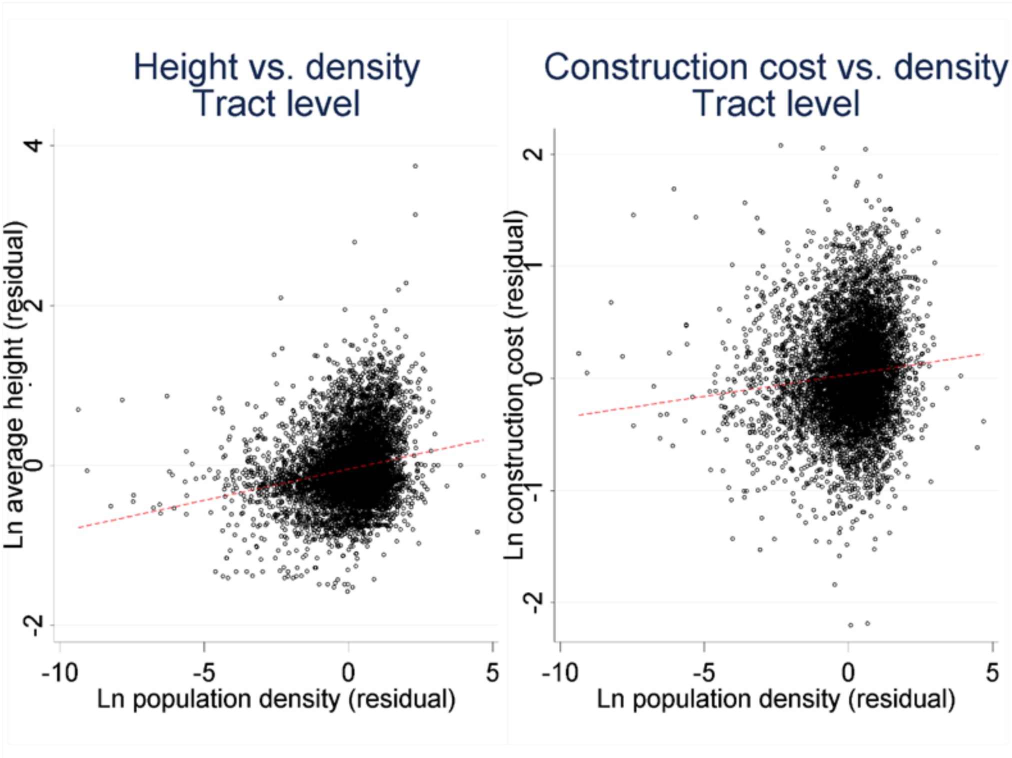
Note: Population density computed using census tract population from the US 2010 Census and tract



perimeter data from the US 2010 Census with areas calculated on ARCGIS (US Census Bureau 2010). "Emporis data" is a subsample of "all" US census tracts that contain construction observations in the Emporis data set (observation with complete information used in Figure A5.

In keeping with intuition, 0shows a positive correlation between average building height and population density across census tracts, i.e. density is achieved at least to some extent by building taller (the other margins of adjustment being building density and per-capital consumption of floor space). Given that taller buildings are generally more expensive to construct (Ahlfeldt & McMillen 2018) and that the same building is more difficult to construct where density is higher (Gyourko & Saiz 2006), it is no surprise that floor space construction costs are also higher at denser places.

Figure A7 Height, construction cost, and density within metropolitan areas



Note: Residuals are from regressions of each variable against MSA x year effects. Building data from Emporis. Population density computed using population data and area data from the US 2010 Census.

In Table A8 , column (1), we estimate the density elasticity of construction cost using variation within and across metropolitan areas. Because density is measured at the census-tract level we cluster standard errors at the same level. We exclude any control except for year effects, which control for the time trend in nominal construction costs. Our estimate of the density elasticity of construction cost is 0.07. This estimate captures the effects of structure height due to expensive materials and engineering as well as locational effects originating from congestion (transport cost, space for construction), regulation (ease of obtaining planning permission), and labour market conditions (construction wages, unionisation) that vary within and across metropolitan areas. Besides the potential sample selection implying a local estimate that is likely valid for denser-than-average places, the main concern with this estimate is that density is correlated with structure quality conditional on height. As an example, renters and buyers in markets with different densities may demand buildings of more sophisticated materials and designs due to differences in tastes and incomes.

In column (2) we replace year effects with metro-year effects, which control for all such effects at the metropolitan level (core-based statistical areas) and also capture time trends that potentially vary across metropolitan areas. In column (3), in addition, we add a set of variables capturing non-height related features of the structure that are likely correlated with quality. Among these variables is the ratio of building height over the number of floors, which captures the effects of differences in ceiling height and decorative elements of the roof that primarily serve aesthetic purposes. The controls also include two sets of variables capturing the architectural design (e.g. modernism, postmodernism) and the structural material (e.g. wood, masonry). The density elasticity estimate is reduced to 0.43 conditional on these feature controls and metro-year effects. With respect to the gross-density effect we aim to estimate, there is a concern of over-controlling (bad control problem (Angrist & Pischke 2009)). For one thing, metro-year effects could absorb effects related to density that vary primarily across metropolitan areas, such as labour market conditions and regulation. For another, design and, in particular, materials (e.g. concrete and steel) to some extent are endogenous to building height as taller buildings require different approaches to structural engineering. In light of these concerns (omitted variable bias vs. over-controlling) our preferred interpretation of the density elasticity estimates reported in (1) and (3) is that of a range between an upper-bound and a lower-bound estimate.

The remaining columns in Table A8 are added to connect to the extant literature. In column (4), we estimate a (gross) height elasticity of construction cost of 0.25 for the US, which is close to the respective elasticity estimated by Ahlfeldt & McMillen (2018) from a global sample of small structures (up to five floors). In keeping with intuition, this elasticity estimate decreases considerably to approximately 0.14 when controlling for metro-year effects and the building features introduced in column (3).

To our knowledge, Gyourko and Saiz (2006) provide the only explicit estimate of density effects on construction costs that exist thus far. The estimates of the specification they use, which is quadratic in density, imply a density elasticity of 0.02 at the mean of the density distribution across US metropolitan areas. As noted above, their estimate, by construction, excludes the structure effect as they use a construction cost index as dependent variable that refers to a same-specification home. Their estimate also excludes various locational effects because they control for labour market conditions and the regulatory environment. The bounds of the density effect reported in Table A8, columns (1) and (3), thus, expectedly exceed their estimates. In column (6), we expand the baseline model from column (1) by the feature controls from column (3) and a large set of 310 indicator variables capturing various aspects of the building, such as the type and the use of a building (e.g. single-family detached housing, mid-rise apartment building). We also control for building height. With this specification, we aim to control for the structure effect as comprehensively as the Emporis data allows to obtain a density effect on construction cost that approximates the location effect. The resulting 0.023 density elasticity estimates is slightly larger than the implied 0.02 elasticity at the mean from Gyourko and Saiz (2006). This is the expected result, because unlike Gyourko and Saiz (2006) we estimate the gross location effect without controlling for regulation and labour market conditions. In the last column, we further add metro-year effects, which controls for regulation and labour market conditions as these vary mostly between metropolitan areas. Of course, metro-year effects also control for any other density effect originating from variation between metropolitan areas. Even conditional on these demanding controls, we still estimate a density elasticity of approximately 0.01, which is highly statistically significant. It is no surprise that this estimate which captures only a fraction of the location effect of density is smaller than the estimates by Gyourko and Saiz (2006). We thus conclude that our estimate of the density effect on construction cost is novel, but consistent with the existing literature.

Table A8 Estimates of the density elasticity of construction costs I

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Ln floor space construction cost						
Ln census tract population density	0.070*** (0.003)	0.053*** (0.004)	0.043*** (0.004)			0.023*** (0.002)	0.009*** (0.002)
Ln Building height				0.250*** (0.006)	0.137*** (0.008)	0.140*** (0.008)	0.094*** (0.008)
Year effects	Yes	-	-	Yes	-	Yes	-
Metro-year effects	-	Yes	Yes	-	Yes	-	Yes
Feature controls	-	-	Yes	-	Yes	Yes	Yes
Building type controls	-	-	-	-	-	Yes	Yes
N	30,048	30,048	30,048	30,048	30,048	30,048	30,048
r2	.202	.379	.435	.245	.438	.607	.699

Note: Unit of analysis is construction. Construction data from Emporis. Census tract population density data from the US 2010 Census. Feature controls include the ratio of building height over the number of floors, a set of 18 dummy variables indicating architectural styles and a set of 19 dummy variables indicating structural materials. Building type controls are a set of 310 dummy variables indicating building types and uses. Standard errors clustered on census tracts. Standard errors (in parentheses) are robust or clustered on metro-year effects where applicable. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Since the unit of observation in Table A8 is a construction, the models are implicitly weighted by the number of constructions per tracts. This weighting scheme attaches greater importance to census tracts for which we have more construction cost information. In Table A9 , we consider alternative weighting schemes. First, we re-estimate the models from columns (1) and (3) in Table A8 , weighting each observation by the ratio of the population over the number of per-tract observations to instead obtain a density elasticity estimate that is more representative for an average household (columns 1-2). Then, we repeat the exercise using the inverse of the observation count (same weight to all tracts, columns 3-4) and the tract-population (lager weights to tracts with many constructions and large population) as weights. The density elasticity estimates reported in Table A8 , columns (1) and (3) are roughly at the centre of the range of estimates we find in this sensitivity analysis.

Table A9 Estimates of the density elasticity of construction costs II

	(1)	(2)	(3)	(4)	(5)	(6)
	Ln floor space construction cost					
Ln census tract population density	0.088*** (0.009)	0.057*** (0.008)	0.046*** (0.003)	0.025*** (0.004)	0.073*** (0.004)	0.044*** (0.004)
Year effects	Yes	-	Yes	-	Yes	-
Metro year effects	-	Yes	-	Yes	-	Yes
Feature controls	-	Yes	-	Yes	-	Yes
Building type controls	-	-	-	-	-	-
Weights	Tract population / Emporis count		1 / Emporis count		Tract population	
N	30,048	30,048	30,048	30,048	30,048	30,048
r2	.211	.441	.172	.443	.179	.412

Note: Unit of analysis is construction. Construction data from Emporis. Census tract population density data from the US 2010 Census. Feature controls include the ratio of building height over the number of floors, a set of 18 dummy variables indicating architectural styles and a set of 19 dummy variables indicating structural materials. Building type controls are a set of 310 dummy variables indicating building types and uses. Standard errors clustered on census tracts. Standard errors (in parentheses) are robust or clustered on metro-year effects where applicable. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.11.2.2 Index-based estimates

As noted, our primary concerns with the estimation of density effects using the Emporis data are the selectivity of the sample and an imperfect control for structural quality. These concerns motivate a complementary analysis in which we rely on engineering estimates of construction costs. This approach does not involve the arguably attractive use of actual micro data, but it largely avoids the aforementioned problems.

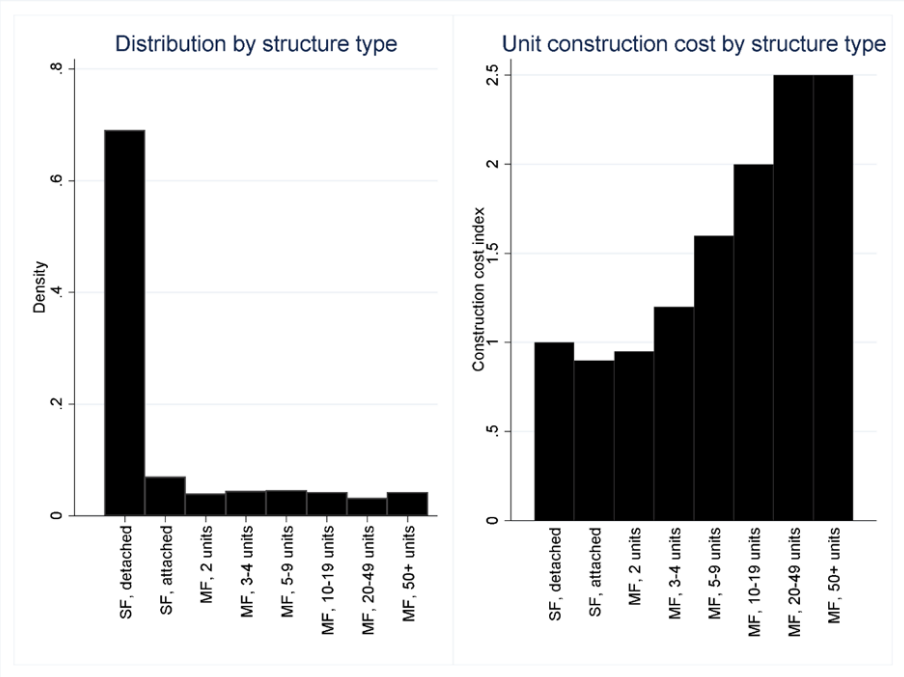
In what follows, our aim is to estimate the cost of providing a mix of structures required to accommodate higher density (essentially greater average building height), holding non-height related structure features constant. While the use of an engineering cost index as dependent variable is analogical to Gyourko and Saiz (2006), the density effect we estimate is not. Gyourko and Saiz (2006) estimate the density effect on the cost of a same-specification home, i.e. they hold the structure effect constant and estimate a location effect. In contrast, we focus exclusively on the effect of having taller same-quality structures at denser places, i.e. we hold the location effect constant and estimate the structure effect. We argue that combining both estimates yields a reasonable approximation of the gross density effect that can be compared to our micro-data estimates of the density elasticity.

For this exercise, we require the composition of dwelling units by structure type at a geographically disaggregated level. To approximate the shares of various structure types we make use of the American Community Survey (ACS). The data contains relatively rich information on the type structure a household lives in for a 1% sample of the total US population. To increase the number of observations we pool the 2010-2015 survey waves, weighting each observation by the sample weight reported in the data.

As expected, the left panel of Figure A8reveals that the great majority of households live in single-family homes (left panel). To explore the relationship between construction cost and density, we merge a structure-type specific per-unit construction cost index to the data. Ellis (2004) provides same-quality per-dwelling-unit engineering estimates of relative construction cost for eight structure types, which roughly correspond to the eight structure types in the ACS data. According to the Ellis (2004) index illustrated in the right panel of Figure A8, same-quality-same-size units in large multi-family structures are more than twice as expensive to build as single-family homes because they require more expensive materials (e.g. brick), more sophisticated structural engineering (e.g. concrete frames), and facilities (e.g. elevators).

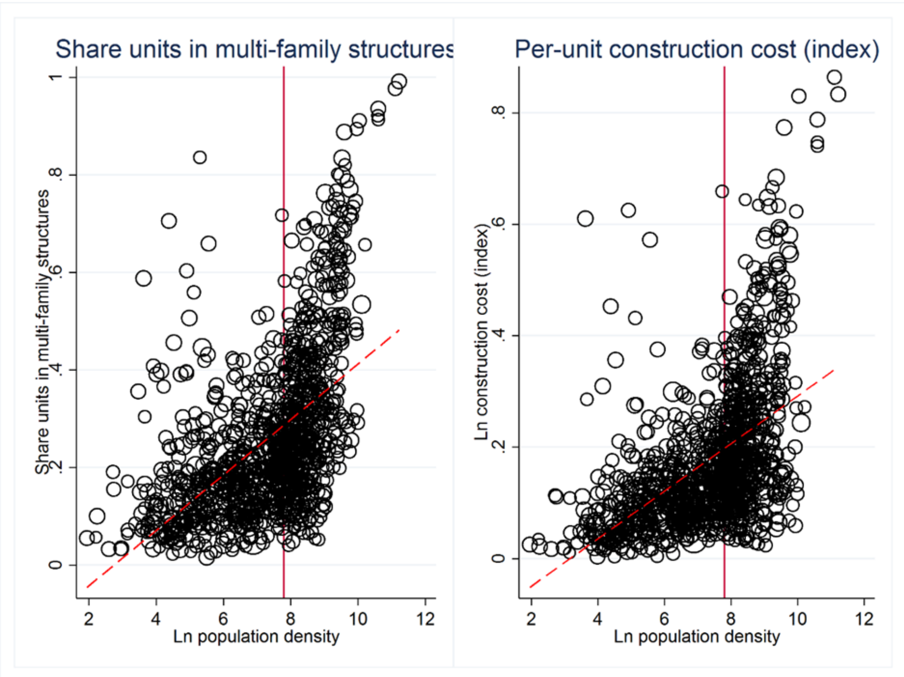
Having merged the Ellis index to the ACS data by structure type, it is straightforward to compute the weighted (by the household weight) mean structure replacement value within a public use microdata area (PUMA) – the smallest geographic identifier in the ACS data set – to which we refer to as construction cost for simplicity. To this PUMA level data set we merge population data from the ACS and the geographic area from the US Census to compute density (US Census Bureau 2010).

Figure A8 Household accommodation by structure



Note: Left panel uses household-level data from American Community Survey (ACS), weighted by household weights. SF = single family house, MF = multi-family house (Ruggles et al. 2017). Right panel illustrates the construction cost index by Ellis (2004), mapping the closest of the eight categories in Ellis to each of the eight categories in IPUMS.

Figure A9 Density, dwelling type, and the cost of construction



Note: Unit of analysis is PUMA. Ln population density rescaled to have a zero mean. Area-based construction cost index and share of dwelling in multi-family structures is computed as the mean over the construction cost by dwelling type provided by Ellis (2004), weighted by the dwelling-type shares in the IPUMS data (incorporating sample weights). Population density computed using population data and area data from the American Community Survey (ACS).

In the left panel of Figure A9, we examine the relationship between structure composition and density. In keeping with intuition, higher densities are associated with larger shares of units in multi-family buildings, i.e. density is correlated with height as already evident from Figure A7. The relationship seems to be non-linear. One interpretation is that at low levels of density, increases in density can be achieved by building single-family homes more densely. Beyond a certain level, however, higher densities require the construction of tall multi-family buildings. Expectedly, the positive non-linear correlation also exists between density and the mean construction cost (right panel).

In the table below, we provide estimates of the density elasticity of our construction cost index at the PUMA level. To account for the non-linearity suggested by Figure A9, we experiment with a quadratic specification. We also add metro effects in some specifications and weight observations by PUMA population in others. The elasticity estimates (at the mean) range from 0.043-0.056. As discussed above, these estimates capture the structure effect of density exclusively. Adding the 0.02 location effect estimated by Gyourko and Saiz (2006) (at the mean of the density distribution), we obtain a combined effect in the range of 0.06 to 0.75, which is close to the upper bound of the density elasticity estimated from the micro-data. The quadratic specification from column (2) implies a spread of the marginal density effect of 0.038-0.066 from the 5^{th} to the 95^{th} percentile in the density distribution across PUMAs.

Table A10 Estimates of the density elasticity of construction costs (index-based models) III

	(1)	(2)	(3)	(4)	(5)	(6)
	Ln construction cost index					
Ln population density	0.043^{***}	0.055^{***}	0.043^{***}	0.056^{***}	0.043^{***}	0.056^{***}
	(0.003)	(0.004)	(0.005)	(0.006)	(0.003)	(0.005)
Ln population density squared		0.011^{***}		0.012^{***}		0.012^{***}
		(0.002)		(0.003)		(0.002)
CBSA effects	-	-	Yes	Yes	-	Yes
Weighted	-	-	-	-	By pop.	By pop.
N	1158	1158	1158	1158	1158	1158
r2	.259	.323	.357	.41	.263	.417

Note: Unit of analysis is PUMA. Ln population density rescaled to have a zero mean. Area-based construction cost index is computed as the mean over the construction cost by dwelling type provided by Ellis (2004), weighted by the dwelling-type shares in the ACS data (incorporating sample weights). Population density computed using population data from ACS data and area data from US Census Bureau. Standard errors are robust or clustered on CBSAs where included. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.11.2.3 Summary

The micro-data analysis presented in this section yields and estimate of the density elasticity of construction cost that is a composite of all structural effects (costs of building taller structures to achieve density) and locational effects (costs of building similar structures at denser locations). However, because of the potential selectivity of the Emporis data, the density estimate is potentially local and representative for above-average density locations. The estimates may also confound the effects of non-height-related structural characteristics (quality of design and materials) that are correlated with density. Our index-based estimates are likely robust to these problems because the composition of dwelling types in the ACS data is likely representative and the engineering cost index we use refers to constant-quality units. However, these estimates capture exclusively the structure effect of density, and not the location effect, for which we refer to Gyourko and Saiz (2006).

The combined structural and locational effect that results from summing our engineering estimate and Gyourko and Saiz (2006)'s estimate of the density elasticity still differs conceptually from the elasticity estimate that results from the analysis of the micro-data. Gyourko and Saiz (2006) control for several locational attributes that are likely correlated with and potentially endogenous to density. If regulation was tighter in denser areas and had a positive effect on construction cost (Green et al. 2005; Saiz 2010; Gyourko & Saiz 2006), one would expect the density elasticity estimated from the micro-data to exceed the index-based elasticity (our engineering estimate, plus Gyourko and Saiz (2006) estimate). However, the index-based estimate is close to the upper-bound estimate from the micro-data, even though we suspect, if anything, an upward bias of the latter due to selection. This is consistent with a weakly negative correlation between the Wharton Regulatory Index and population density, which suggests that achieving density is not the primary motivation for more intense regulation in the US (Gyourko et al. 2007)

Based on the evidence presented in this section, we conclude that 0.04-0.07 is a conservative estimated range for the density elasticity of construction cost. This estimate is a gross estimate that includes all structure effects and location effects that are associated with density (including differences in regulation, geology and labour market conditions may be cause or effects of density).

4.11.3 Converting estimated marginal effects into elasticity estimates

Where possible, we convert reported marginal effects in levels or reported semi-elasticities into density elasticity estimates (at the mean of a distribution) using descriptive statistics reported in the studies. Where necessary, we conduct auxiliary research into the institutional setting to facilitate such conversions (e.g. to infer mean density). For studies from disciplines that are remote to economics (e.g. engineering and medical research), additional steps are often required to infer density elasticity estimates because the results are reported not as marginal density effects but as predicted values by density category (e.g. energy consumption or adjusted premature mortality rates). In such instances, we extract the predicted values (if necessary, by the visual inspection of graphs) and approximate an implied density elasticity estimate by regressing the natural logarithm of an outcome value against the natural logarithm of the midpoint of the density interval.

In this subsection we discuss how we adjust the density effects reported in the literature into a consistent format. Our aim is to express as many as possible estimates in terms of an elasticity of an outcome measure *Y* with respect to density *P/A*:

$$\beta = \frac{\frac{dY}{Y}}{\frac{d(P/A)}{(P/A)}}$$

, where *P* (population) and *A* (area) are defined as in the previous sub-section. Authors of the studies included in the evidence base frequently report marginal effects of the following forms:

Marginal effects in levels:

$$\gamma = \frac{dY}{d(P/A)}$$

Log-lin semi-elasticities estimated using log-lin models:

$$\delta = \frac{\frac{dY}{Y}}{d(P/A)}$$

Lin-log semi-elasticities estimated using lin-log models:

$$\vartheta = \frac{dY}{\frac{d\left(\frac{P}{A}\right)}{(P/A)}}$$

Hence, we can compute β at the mean of the distributions of *Y* and *P* (denoted by bars) from reported estimates of γ or δ or ϑ as follows:

$$\beta = \delta\left(\overline{P/A}\right)$$

$$\beta = \gamma \frac{\left(\overline{P/A}\right)}{\bar{Y}}$$

$$\beta = \vartheta \frac{1}{\bar{\bar{Y}}}$$

We note that in some instances, a conversion into an elasticity estimate requires further auxiliary steps such as removing a standardisation (normalisation by standard deviations) or the auxiliary estimation of elasticities based on results reported for discrete categories. In some cases, we infer a marginal effect from graphical illustrations (in particular in the health category).

4.11.4 Converting city size elasticities into density elasticities

In several instances the authors of the considered analyses use city population as a proxy of density. The estimated elasticity of an outcome with respect to population (city size proxy) takes the following form (after the transformations described 2.2, if necessary):

$$\theta = \frac{\frac{dY}{Y}}{\frac{d(P)}{(P)}}$$

As we have shown in 2.1, our estimated elasticity of density with respect to city size is not unity. It is therefore necessary to adjust the estimates in order to make them comparable to density elasticity estimates. Given that we have an estimate of the elasticity of density with respect to city size

$$\alpha = \frac{\frac{d(P/A)}{(P/A)}}{\frac{dP}{P}}$$

we can easily compute the elasticity of an outcome with respect to density as:

$$\beta = \frac{\theta}{\alpha}$$

4.11.5 Converting density elasticities of land price into density elasticities of rent

Density effects on the value of real estate are often reported in terms of house price capitalisation, which is linearly related to rent capitalisation (assuming a constant discount factor). Sometimes, authors report the effects in terms of land price capitalisation. Land price elasticity estimates are not directly comparable to house price elasticity estimates because house prices generally move less than land prices due to factor substitution (developers substitute away from land as land prices increase).

To allow for a simple micro-founded translation of land price capitalisation effects into house price capitalisation effects, it is useful to assume a Cobb-Douglas housing production function and a competitive construction sector. Assume that housing services *H* are produced using the inputs capital *K* and land *L* as follows: $H = K^{\beth}L^{1-\beth}$. Housing space is rented out at bid-rent ψ while land is acquired at land rent Ω. From the first-order condition $K/L = \beth/(1-\beth)\ \Omega$ (the price of capital is the numeraire) and the non-profit condition $\psi H = K + \Omega L$, it is immediate that $\log(\psi) = (1-\beth)\log(\Omega) + c$, where *c* is a constant that cancels out in differences, i.e., $d\ln(\psi) = (1-\beth)d\ln(\Omega)$.

It is, therefore, possible to translate an estimate of the density elasticity of land price with respect to density into an estimate of the density elasticity of rent (house price) with respect to density as follows:

$$\frac{d\ln\psi}{d\ln\left(\frac{P}{A}\right)} = (1-\beth)\frac{d\ln\Omega}{d\ln\left(\frac{P}{A}\right)}$$

, where we set $(1-\beth) = 0.25$, following Ahlfeldt et al. (2015).

4.11.6 Density elasticity estimates: High-income vs. non-high-income

In the table below, we compare citation-weighted median and mean elasticity estimates between high-income countries and non-high-income countries. The table complements Table 3 in the main paper. Evidently, the evidence base from non-high-income countries is limited. Notably we observe that mean elasticity estimates differ between high-income and non-high-income countries in outcome categories where we are able to observe this. For productivity, the unconditional citation-weighted mean in the evidence base is 0.08 for non-high-income countries, while 0.04 for high income countries. Within the quality of life category, we also observe that while density has an average positive effect on quality of life in high-income places, it has an average negative effect in non-high-income countries. Another relevant finding is that estimates of the density elasticity of non-car use are significantly lower for non-high-income countries.

Table A11 Average density elasticity estimates by high-income and non-high-income

ID	Elasticity of outcome with respect to density	High-income [a] N	Median	Mean	S.D.	Non-High-income [a] N	Median	Mean	S.D.
1	Labour productivity	38	0.04	0.04	0.03	9	0.08	0.06	0.07
1	Total factor productivity	13	0.05	0.05	0.03	2	0.10	0.06	0.06
2	Patents p.c.	7	0.20	0.21	0.11	0	-	-	-
3	Rent	13	0.16	0.15	0.13	0	-	-	-
4	Commuting reduction	35	0.06	0.07	0.11	1	-0.21	-0.21	-
4	Non-work trip reduction	7	-0.06	-0.20	0.44	0	-	-	-
5	Metro rail density	3	0.00	0.01	0.02	0	-	-	-
5	Quality of life	5	0.02	0.05	0.06	3	-0.05	-0.04	0.03
5	Variety (consumption amenities)	1	0.19	0.19	-	0	-	-	-
5	Variety price reduction	2	0.12	0.12	0.06	0	-	-	-
6	Public spending reduction	20	0.11	0.17	0.25	0	-	-	-
7	90th-10th pct. wage gap reduction	1	0.17	0.17	-	0	-	-	-
7	Black-white wage gap reduction	1	-0.00	0.00	-	0	-	-	-
7	Diss. index reduction	3	0.33	0.66	0.94	0	-	-	-
7	Gini coef. reduction	1	4.56	4.56	-	0	-	-	-
7	High-low skill wage gap reduction	3	-0.12	-0.13	0.07	0	-	-	-
8	Crime rate reduction	13	0.36	0.24	0.47	0	-	-	-
9	Foliage projection cover	1	-0.06	-0.06	-	0	-	-	-
10	Noise reduction	1	0.04	0.04	-	0	-	-	-
10	Pollution reduction	10	-0.12	0.02	0.43	8	0.33	0.07	0.54
11	Energy consumption reduction	19	0.07	0.07	0.10	2	0.04	0.08	0.13
11	Energy consumption reduction: Public transit	1	-0.37	-0.37	-	0	-	-	-
12	Speed	2	-0.13	-0.12	0.01	0	-	-	-
13	Car usage (incl. shared) reduction	22	0.04	0.05	0.07	0	-	-	-
13	Non-car use	72	0.14	0.17	0.24	4	0.02	0.04	0.06
14	Cancer & other serious disease reduction	5	-0.30	-0.33	0.20	0	-	-	-
14	KSI & casualty reduction	4	0.17	0.01	0.61	0	-	-	-
14	Mental-health	1	0.01	0.01	-	0	-	-	-
14	Mortality reduction	3	-0.29	-0.36	0.17	0	-	-	-
15	Reported health	3	-0.32	-0.27	0.11	0	-	-	-
15	Reported safety	1	0.07	0.07	-	0	-	-	-
15	Reported social interaction	6	-0.04	-0.13	0.19	0	-	-	-
15	Reported wellbeing	1	-0.00	0.00	-	0	-	-	-

Note: [a] Weighted by the citation index introduced in section 3.2 and appendix section 1.2. Outcome categories correspond to ID as follows: 1: Productivity; 2: Innovation: 3: Value of space; 4: Job accessibility; 5: Services access; 6: Efficiency of public services delivery; 7: Social equity; 8: Safety; 9: Open space preservation and biodiversity; 10: Pollution reduction; 11: Energy efficiency; 12: Traffic flow: 13: Sustainable mode choice; 14: Health; 15: Well-being.

4.12 Original density elasticity estimates

In this section we complement the existing literature on the effect of density using OECD.Stat functional economic areas or regional statistics data and the following regression model:

$$\ln(Y_i) = \beta \ln\left(\frac{P_i}{A_i}\right) + \tau \ln\left(\frac{G_i}{P_i}\right) + \mu_c + \epsilon_{ic}$$

, where i indexes cities, Y_i is an outcome as defined in the table below, P_i, A_i, μ_c are population, geographic area, and country fixed effects, and G_i is GDP per capita. The coefficient of interest is β, which gives the elasticity of an outcome with respect to population density controlling for local GDP p.c. and unobserved cross-country heterogeneity. Where either population or area forms part of the dependent variable we instrument population density using the rank within the national population density distribution as an instrument. In the following subsections, we present estimates of this model including and excluding the GDP control and fixed effects, as well as with and without using the instrumental variable. Because the interpretation of the parameter on population density as an elasticity is straightforward, we generally present the results without further discussion. The exception is our estimate of the elasticity of speed with respect to density, which follows a slightly different structure.

4.12.1 Innovation

Table A12 Elasticity estimates of patents per capita with respect to population density

	(1) Ln patents per capita	(2) Ln patents per capita	(3) Ln patents per capita	(4) Ln patents per capita	(5) Ln patents per capita	(6) Ln patents per capita
Ln population density	0.170	0.349***	0.122**	0.129*	0.164*	0.036
	(0.11)	(0.06)	(0.06)	(0.07)	(0.09)	(0.10)
Ln GDP per capita		2.953***	1.426***	1.425***	2.028***	1.053***
		(0.11)	(0.21)	(0.39)	(0.34)	(0.35)
Country effects	-	-	Yes	Yes	-	Yes
Sample	Non-US	Non-US	Non-US	Non-US	US	Non-US
IV	-	-	-	Yes	Yes	Yes
N	218	218	218	218	70	148
r2	0.010	0.723	0.894		0.408	

Note: Standard errors in parentheses. Unit of observation is functional economic area. All variables are averaged over 2000–2014. IV is rank of a city in the population density (and population where included) distribution within a country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.12.2 Services access (broadband)

Table A13 Elasticity estimates of broadband per capita with respect to population density

	(1) Ln broadband per capita	(2) Ln broadband per capita	(3) Ln broadband per capita	(4) Ln broadband per capita	(5) Ln broadband per capita	(6) Ln broadband per capita
Ln population density	0.033***	0.034***	0.011	0.010	-0.000	0.013
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)
Ln GDP per capita		0.474***	0.305***	0.306***	0.119	0.327***
		(0.04)	(0.06)	(0.06)	(0.07)	(0.06)
Country effects	-	-	Yes	Yes	-	Yes
IV	-	-	-	Yes	Yes	Yes
N	343	343	343	343	51	292
Sample	All	All	All	All	US	Non-US
r2	0.020	0.576	0.862		0.186	

Note: Standard errors in parentheses. Unit of observation is large regions (OECD definition). All variables are averaged over 2000–2014. IV is rank of a city in the population density distribution within a country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.12.3 Social equity

Table A14 Elasticity estimates of income quintile ratio with respect to population density

	(1) Ln disposable income quintile ratio (pct. 80 vs 20)	(2) Ln disposable income quintile ratio (pct. 80 vs 20)	(3) Ln disposable income quintile ratio (pct. 80 vs 20)	(4) Ln disposable income quintile ratio (pct. 80 vs 20)	(5) Ln disposable income quintile ratio (pct. 80 vs 20)
Ln population density	0.023	0.024	0.035**	0.057***	0.032**
	(0.02)	(0.03)	(0.01)	(0.02)	(0.01)
Ln GDP per capita		-0.233***	0.469	0.197*	0.503
		(0.09)	(0.29)	(0.11)	(0.32)
Country effects	-	-	Yes	-	Yes
IV	-	-	-	-	-
N	275	269	269	51	218
Sample	All	All	All	US	Non-US
r2	0.004	0.042	0.734	0.352	0.718

Note: Standard errors in parentheses. Unit of observation is large regions (OECD definition). All variables are averaged over 2000–2014. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A15 Elasticity estimates of Gini coefficient with respect to population density

	(1) Ln Gini coefficient	(2) Ln Gini coefficient	(3) Ln Gini coefficient	(4) Ln Gini coefficient	(5) Ln Gini coefficient
Ln population density	-0.007	-0.007	0.025***	0.020***	0.026***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Ln GDP per capita		-0.133***	0.026	0.025	0.028
		(0.03)	(0.02)	(0.04)	(0.03)
Country effects	-	-	Yes	-	Yes
IV	-	-	-	-	-
N	275	269	269	51	218.
Sample	All	All	All	US	Non-US
r2	0.003	0.118	0.880	0.237	0.880

Note: Unit of observation is large regions (OECD definition). Standard errors in parentheses. Unit of observation is large regions (OECD definition). All variables are averaged over 2000–2014. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A16 Elasticity estimates of poverty rate with respect to population density

	(1) Ln poverty rate (poverty line 60%)	(2) Ln poverty rate (poverty line 60%)	(3) Ln poverty rate (poverty line 60%)	(4) Ln poverty rate (poverty line 60%)	(5) Ln poverty rate (poverty line 60%)
Ln population density	-0.014	-0.013	0.032	0.034**	0.027
	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)
Ln GDP per capita		-0.280***	-0.590***	-0.396**	-0.617***
		(0.05)	(0.11)	(0.18)	(0.13)
Country effects	-	-	Yes	-	Yes
IV	-	-	-	-	-
N	275	269	269	51	218
Sample	All	All	All	US	Non-US
r2	0.004	0.148	0.547	0.156	0.549

Note: Standard errors in parentheses. Unit of observation is large regions (OECD definition). All variables are averaged over 2000–2014. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4.12.4 Safety

Table A17 Elasticity estimates of homicides p.c. with respect to population density

	(1) Ln homicides p.c.	(2) Ln homicides p.c.	(3) Ln homicides p.c.	(4) Ln homicides p.c.	(5) Ln homicides p.c.	(6) Ln homicides p.c.
Ln population density	-0.204***	-0.166***	-0.033	-0.048	0.105**	-0.076**
	(0.03)	(0.03)	(0.04)	(0.04)	(0.05)	(0.04)
Ln GDP per capita		-0.918***	0.086	0.086	0.312	0.058
		(0.07)	(0.06)	(0.07)	(0.48)	(0.07)
Country effects	-	-	Yes	Yes	-	Yes
IV	-	-	-	Yes	Yes	Yes
N	481	474	474	474	51	423
Sample	All	All	All	All	US	Non-US
r2	0.088	0.393	0.879		0.139	

Note: Standard errors in parentheses. Unit of observation is large regions (OECD definition). All variables are averaged over 2000–2014. IV is rank of a city in the population density distribution within a country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4.12.5 Urban green

Table A18 Elasticity estimates of vegetation density with respect to population density

	(1) Ln vegetation density	(2) Ln vegetation density	(3) Ln vegetation density	(4) Ln vegetation density	(5) Ln vegetation density	(6) Ln vegetation density
Ln population density	-0.199***	-0.267***	-0.257***	-0.245***	0.034	-0.261***
	(0.02)	(0.02)	(0.04)	(0.05)	(0.10)	(0.05)
Ln GDP per capita		0.388***				
		(0.06)				
Country effects	-	-	Yes	Yes	-	Yes
IV	-	-	-	Yes	Yes	Yes
N	583	410	583	583	45	538
Sample	All	Non-US	All	All	US	Non-US
r2	0.142	0.262	0.381			

Note: Standard errors in parentheses. Unit of observation is small regions (urban and intermediate, OECD definition). US GDP data not available at this scale. All variables are averaged over 2000–2014. IV is rank of a city in the population density distribution within a country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A19 Elasticity estimates of green area density with respect to population density

	(1) Ln green area density	(2) Ln green area density	(3) Ln green area density	(4) Ln green area density	(5) Ln green area density	(6) Ln green area density
Ln population density		0.283^{**}	0.683^{**}	0.761^{*}	1.446^{***}	0.197
		(0.14)	(0.31)	(0.40)	(0.38)	(0.43)
Ln GDP per capita		0.496^{**}	0.035	0.022	1.178	-0.857
		(0.23)	(0.94)	(0.86)	(0.96)	(0.69)
Country effects	-	-	Yes	Yes	-	Yes
IV	-	-	-	Yes	Yes	Yes
N	280	280	280	280	70	210
Sample	All	All	All	All	US	Non-US
r2	0.021	0.040	0.283		0.246	

Note: Standard errors in parentheses. Unit of observation is functional economic area. All variables are averaged over 2000–2014. IV is rank of a city in the population density (and population where included) distribution within a country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A20 Elasticity estimates of green area per capita with respect to population density

	(1) Ln green area per capita	(2) Ln green area per capita	(3) Ln green area per capita	(4) Ln green area per capita	(5) Ln green area per capita	(6) Ln green area per capita
Ln population density	-0.754^{***}	-0.717^{***}	-0.317	-0.239	0.446	-0.803^{*}
	(0.14)	(0.14)	(0.31)	(0.40)	(0.38)	(0.43)
Ln GDP per capita		0.496^{**}	0.035	0.022	1.178	-0.857
		(0.23)	(0.94)	(0.86)	(0.96)	(0.69)
Country effects	-	-	Yes	Yes	-	Yes
IV	-	-	-	Yes	Yes	Yes
N	280	280	280	280	70	210
Sample	All	All	All	All	US	Non-US
r2	0.170	0.186	0.392		0.027	

Note: Standard errors in parentheses. Unit of observation is functional economic area. All variables are averaged over 2000–2014. IV is rank of a city in the population density (and population where included) distribution within a country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.12.6 Pollution concentration

Table A21 Elasticity estimates of air pollution concentration with respect to population density

	(1) Ln air pollution (level PM2.5)	(2) Ln air pollution (level PM2.5)	(3) Ln air pollution (level PM2.5)	(4) Ln air pollution (level PM2.5)	(5) Ln air pollution (level PM2.5)
Ln population density	0.221***	0.220***	0.124***	0.111***	0.128***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Ln GDP per capita		-0.208***	0.020	0.053	0.018
		(0.04)	(0.19)	(0.14)	(0.21)
Country effects	-	-	Yes	-	Yes
IV	-	-	-	-	-
N	343	343	343	51	292
Sample	All	All	All	US	Non-US
r2	0.407	0.456	0.708	0.247	0.720

Note: Standard errors in parentheses. Unit of observation is large regions (OECD definition). All variables are averaged over 2000–2014. IV is rank of a city in the population density distribution within a country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.12.7 Energy

Table A22 Elasticity estimates of ln CO2 emissions p.c. with respect to population density

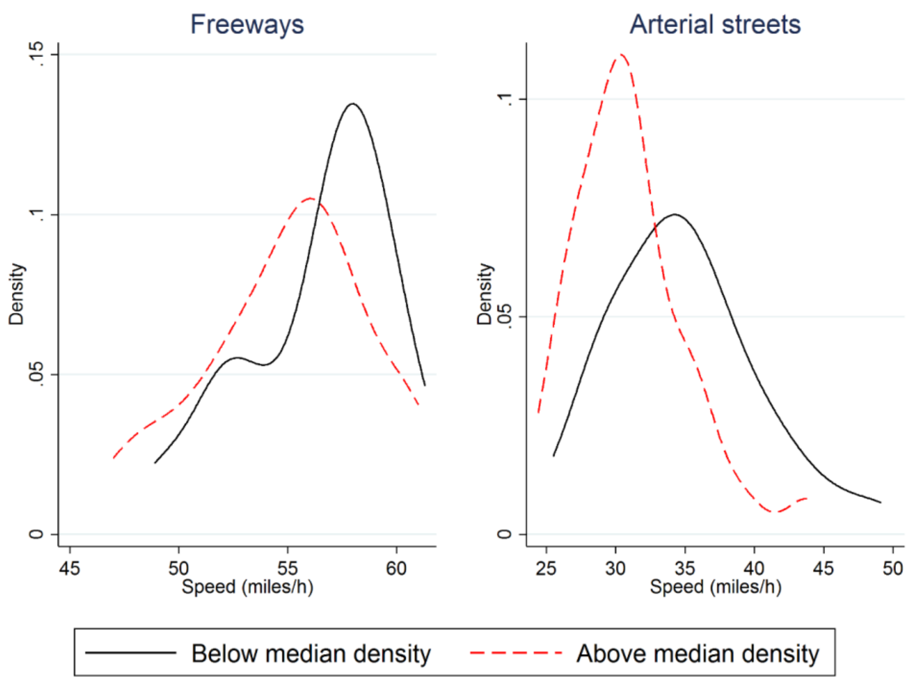
	(1) Ln CO2 emissions p.c.	(2) Ln CO2 emissions p.c.	(3) Ln CO2 emissions p.c.	(4) Ln CO2 emissions p.c.	(5) Ln CO2 emissions p.c.	(6) Ln CO2 emissions p.c.
Ln population density	-0.225***	-0.224***	-0.189***	-0.173***	-0.190***	-0.170***
	(0.02)	(0.02)	(0.04)	(0.04)	(0.05)	(0.05)
Ln GDP per capita		0.503***	0.283***	0.282***	0.354	0.280***
		(0.04)	(0.08)	(0.07)	(0.27)	(0.07)
Country effects	-	-	Yes	Yes	-	Yes
IV	-	-	-	Yes	Yes	Yes
N	570	562	562	562	51	511
Sample	All	All	All	All	US	Non-US
r2	0.176	0.358	0.597		0.300	

Note: Standard errors in parentheses. Unit of observation is large urban regions (OECD definition). All variables are averaged over 2000–2014. IV is rank of a city in the population density distribution within a country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.12.8 Traffic flow

In the figure below we compare the peak time (with congestion) speeds on freeways and arterial roads across metros that are above and below the median population density. Both distributions seem to suggest that metros with a higher population density have lower average speeds, which is in line with more congestion in denser cities.

Figure A10 Distribution of peak time speeds by population density



Note: Data from OECD (population density) and Lomax (2010).

However, regressing the freeway speed against population density does not yield a significant relationship during peak time (with congestion) or off-peak time (free flow). There is also no population density effect on congestion, i.e., on peak time speeds controlling for free-flow speeds. There is, however, a significantly negative effect of population size on congestion, suggesting that freeway congestion is determined by the size of the city and not its density.

Table A23 Elasticity estimate of speed with respect to population density: Freeways

	(1) Ln freeway speed (miles/h): Peak time	(2) Ln freeway speed (miles/h): Peak time	(3) Ln freeway speed (miles/h): Free flow	(4) Ln freeway speed (miles/h): Free flow	(5) Ln freeway speed (miles/h): Peak time	(6) Ln freeway speed (miles/h): Peak time
Ln population density	-0.008	0.003	0.001	0.003	-0.001	0.011
	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)
Ln GDP p.c.		-0.097***		-0.015	-0.078**	-0.037
		(0.03)		(0.02)	(0.03)	(0.03)
Ln freeway speed (miles/h): Free flow					1.312***	1.315***
					(0.18)	(0.16)
Ln population						-0.042***
						(0.01)
N	62	62	62	62	62	62
r2	0.012	0.113	0.001	0.013	0.420	0.630

Note: Standard errors in parentheses. Data from OECD and Lomax (2010). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

For arterial streets, in contrast we estimate a significant elasticity of peak time speed with respect to population density of -0.063. Interestingly, we estimate an elasticity within the same range for free-flow speeds. This suggests that the lower speed is primarily a morphological density effect. Street layouts in denser cities result in a generally lower speed, but not higher congestion. This effect is confirmed by the model controlling for free-flow speeds, which yields no significant congestion effect (on peak time speeds). As with freeway speeds, there is a significant population size effect, although it is relatively smaller.

Table A24 Elasticity estimate of speed with respect to population density: Arterial streets

	(1) Ln arterial streets speed (miles/h): Peak time	(2) Ln arterial streets speed (miles/h): Peak time	(3) Ln arterial streets speed (miles/h): Free flow	(4) Ln arterial streets speed (miles/h): Free flow	(5) Ln arterial streets speed (miles/h): Peak time	(6) Ln arterial streets speed (miles/h): Peak time
Ln population density	-0.063***	-0.041**	-0.050***	-0.034**	-0.001	0.003
	(0.02)	(0.02)	(0.02)	(0.02)	(0.00)	(0.00)
Ln GDP p.c.		-0.192***		-0.139***	-0.029	-0.018
		(0.06)		(0.05)	(0.02)	(0.02)
Ln arterial streets speed (miles/h): Free flow					1.182***	1.142***
					(0.03)	(0.03)
Ln population						-0.017***
						(0.00)
N	62	62	62	62	62	62
r2	0.138	0.217	0.130	0.192	0.966	0.972

Note: Standard errors in parentheses. Data from OECD and Lomax et al. (2010). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.12.9 Health

Table A25 Elasticity estimate of standardised mortality rate with respect to population density

	(1) Ln standardised mortality rate	(2) Ln standardised mortality rate	(3) Ln standardised mortality rate	(4) Ln standardised mortality rate	(5) Ln standardised mortality rate	(6) Ln standardised mortality rate
Ln population density	-0.056***	-0.046***	-0.015	-0.017	-0.005	-0.019
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Ln GDP per capita		-0.140***	0.039	0.039*	-0.017	0.040
		(0.02)	(0.02)	(0.02)	(0.12)	(0.02)
Country effects	-	-	Yes	Yes	-	Yes
IV	-	-	-	Yes	Yes	Yes
N	528	528	528	528	51	477
Sample	All	All	All	All	US	Non-US
r2	0.107	0.223	0.882		.	

Note: Standard errors in parentheses. Unit of observation is large regions (OECD definition). All variables are averaged over 2000–2014. IV is rank of a city in the population density distribution within a country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A26 Elasticity estimate of life expectancy at birth with respect to population density

	(1) Ln life expectancy at birth	(2) Ln life expectancy at birth	(3) Ln life expectancy at birth	(4) Ln life expectancy at birth	(5) Ln life expectancy at birth
Ln population density	0.016***	0.013***	0.007**	-0.001	0.008***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ln GDP per capita		0.055***	0.002	0.023	0.002
		(0.00)	(0.00)	(0.02)	(0.00)
Country effects	-	-	Yes	-	Yes
IV	-	-	-	-	-
N	496	496	496	51	445
Sample	All	All	All	US	Non-US
r2	0.157	0.496	0.922	0.065	0.931

Note: Standard errors in parentheses. Unit of observation is large regions (OECD definition). All variables are averaged over 2000–2014. IV is rank of a city in the population density distribution within a country. * *p* < 0.1, ** *p* < 0.05, *** *p* < 0.01

Table A27 Elasticity estimate of mortality in transport p.c. with respect to population density

	(1) Ln mortality in transport p.c.	(2) Ln mortality in transport p.c.	(3) Ln mortality in transport p.c.	(4) Ln mortality in transport p.c.	(5) Ln mortality in transport p.c.	(6) Ln mortality in transport p.c.
Ln population density	-0.162***	-0.150***	-0.103***	-0.099***	-0.119***	-0.093***
	(0.02)	(0.01)	(0.03)	(0.03)	(0.02)	(0.03)
Ln GDP per capita		-0.278***	-0.111**	-0.110***	-0.484*	-0.087**
		(0.04)	(0.04)	(0.04)	(0.25)	(0.04)
Country effects	-	-	Yes	Yes	-	Yes
IV	-	-	-	Yes	Yes	Yes
N	420	414	414	414	51	363
Sample	All	All	All	All	US	Non-US
r2	0.260	0.375	0.819		0.534	

Note: Standard errors in parentheses. Unit of observation is large regions (OECD definition). All variables are averaged over 2000–2014. IV is rank of a city in the population density distribution within a country. * *p* < 0.1, ** *p* < 0.05, *** *p* < 0.01

4.12.10 Well-being

Table A28 Elasticity estimate of subjective well-being with respect to population density

	(1) Ln subjective life satisfaction	(2) Ln subjective life satisfactio n	(3) Ln subjective life satisfactio n	(4) Ln subjective life satisfactio n	(5) Ln subjective life satisfactio n
Ln population density	-0.021***	-0.023***	-0.007**	-0.001	-0.008**
	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)
Ln GDP per capita		0.114***	0.069***	0.012	0.074***
		(0.01)	(0.01)	(0.04)	(0.01)
Country effects	-	-	Yes	-	Yes
IV	-	-	-	-	-
N	339	339	339	51	288
Sample	All	All	All	US	Non-US
r2	0.073	0.410	0.850	0.003	0.859

Note: Standard errors in parentheses. All variables are averaged over 2000–2014. IV is rank of a city in the population density distribution within a country. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.13 Recommended elasticity estimates

This section provides a justification of the recommended elasticity estimates reported in Table 5 in the main paper alongside a critical discussion of the quality and the quantity of the evidence base. We strongly advise consulting the relevant subsections below before applying one of the recommended elasticity estimates in further research.

Before we proceed to the discussion of the category-specific density elasticity estimates, we wish to remind the reader, that, as discussed in Section 2.1 in the main paper, there is fundamental problem in identifying density effects because density is endogenous and potentially determined by unobserved location fundamental factors (e.g. a favourable geography). Studies that estimate density effects from plausibly exogenous variation (e.g. by making use of natural experiments or instrumental variables) are the minority. For most estimates, the causal interpretation rests on the assumption that the variation in density within and between cities is largely historically determined by factors that have limited contemporaneous effects on outcomes. For individual-, firm-, and unit-based outcomes (e.g. wages, innovation, rent, wellbeing), the collected density elasticity estimates often capture composition effects. In this case, a density elasticity estimate does not give the effect of an exogenous change in density on an outcome such as the productivity of individuals, the innovative activity of firms, or the value of housing units. For individual- and firm- based outcomes, the density elasticity estimate, in addition, captures the composition effect that usually arises because more productive individuals and firms self-select into more productive areas. The density elasticity of rent captures the effect of a change in the quality of housing stock if developers make choices that depend on rents and incomes, which in turn depend on density.

4.13.1 Wage elasticity

The literature reports both wage and TFP elasticities with respect to density, the former being by far the most frequently reported parameter. While we find a significant difference between the wage and the TFP elasticity in our review, it is notable that high quality papers analysing both wage and TFP within a consistent framework do not report the existence of such a difference (Combes et al. 2010). We choose the citation-weighted average value of the wage elasticities in our sample of 0.04, which is close to the results from recent high-quality work (Combes et al. 2012) and meta-analysis (Melo et al. 2009). The citation-index-weighted mean elasticity is almost identical if we restrict the sample to 19 analyses that disentangle density effects from unobserved location fundamentals using instrumental variables or natural experiments. Therefore, a causal interpretation of our recommended elasticity seems justifiable. While there is some variation in the estimated density elasticities of wage and TFP, the estimates in the literature do not appear to be systematically related to the average density level in the considered study areas. However, it is noteworthy that, within the admittedly smaller sample of studies from non-high-income countries, the citation-weighted average of the density elasticity of wages, at 0.08, is about twice as large. We also note that there is a tendency for within-city analyses (Ahlfeldt et al. 2015) and TFP analyses to yield larger estimated elasticities, but we recommend further work to substantiate this impression. An important qualification is that the recommended 0.04 elasticity is best interpreted as an area-based effect that partially captures a productivity effect on identical workers and partially captures a shift in composition towards more productive workers (a sorting effect). Studies that control for unobserved heterogeneity of workers by identifying from movers across agglomerations tend to find elasticities that are about 50% lower (Combes & Gobillon, 2015). We recommend the 0.04 elasticity as an area-based effect that is consistent with the area-based estimates recommended for the other categories, for which estimates controlling for unobserved micro-level heterogeneity are typically not available.

4.13.2 Patents

While there is a sizeable literature engaged with the effects of urban form on innovation, we only found seven studies that provided estimates that either directly corresponded to or could be converted into estimates of the density elasticity of patents. Some studies report marginal effects that cannot be converted into elasticity estimates due to missing descriptive statistics. We recommend the citation-weighted mean in the evidence base of 0.21, which is in line with Carlino et al. (2007) and Sedgley & Elmslie (2004) who use instruments for density. The recommended elasticity estimate is also in line with our original analysis of US FUAs. While this consistency is reassuring, we are somewhat hesitant to recommending a causal interpretation. In general, we find the evidence provided by Carlino et al. (2007) quite convincing. Actually, we consider it the most credible study on the effects of density on innovation in our evidence base. However, it can be argued that the instruments may not be excludable. As an example, favourable climate may attract high-skilled workers. Lagged density may be endogenous to the same fundamentals as current density, and consumption amenities are likely endogenous to density itself and, thus, the fundamentals that determine density. We acknowledge that the comprehensive set of control variables makes the instruments more likely excludable. Yet, compared to the other categories for which we recommend a causal interpretation, the identifying variation in our view is less plausibly exogenous.

More generally, the evidence base in this category is relatively thin and our original elasticity estimates for the world-wide sample, at 0.13, are somewhat smaller than the recommended elasticity. More work aiming at comparable elasticity estimates from different geographic contexts would be desirable.

4.13.3 Rents

We recommend the citation-weighted mean elasticity from the evidence base of 0.15. This estimate is almost identical to the density elasticity of rent in the data set used by Albouy & Lue, (2015), which was kindly provided by the authors. This estimate is also within the range of other good quality and relevant papers. In particular, the citation-index-weighted mean elasticity, at 0.13, is very close if we restrict the sample to six analyses that disentangle density effects from unobserved location fundamentals using instrumental variables or natural experiments (SMS = 4). Therefore, a causal interpretation of our recommended elasticity seems justifiable and we are thus reasonably confident in recommending the mean elasticity of 0.15 as an average even though the evidence base is not as well developed as it is, for example, for wages. It is important to note, however, that the density elasticity of rent appears to vary in density. Our meta-analysis of the reviewed elasticities suggests that elasticity increases by 0.06 if the population density in the considered study area increases by 1000 inhabitants per square kilometre. This effect is qualitatively and quantitatively consistent with the positive effect of city size on the density elasticity of rent documented by Combes et al (2018) for French cities. The non-log-linearity in the effect of density on rent also explains why Combes et al (2018) find a larger elasticity for French cities than Albouy and Lue (2015) find for US cities. The 0.06 difference in the density elasticity (0.21 for French cities vs. 0.15 for US cities) corresponds to a difference in density of about 1000 inhabitants per square kilometre, almost exactly the difference reported in the Demographia World Urban Areas (2018). So, as a rule of thumb we can recommend the following approximation of a context-specific density elasticity of rent:

$$\beta_c = 0.15 + 0.63 \times \left(\frac{D_c - 1200}{1000}\right),$$

where 0.15 is the average density elasticity applicable to the US average, 0.63 is the marginal effect of an increase in density by 1000 residents per square kilometre, 1200 is the average density of US cities measured in population per square kilometre reported in the Demographia World Urban Areas (2018), and D_c is the density measured in population per square kilometre in a specific context.

4.13.4 Vehicle miles travelled

We recommend the citation-weighted mean elasticity from the evidence base of 0.06. The evidence base, including 36 analyses, is relatively large. There is sizeable variation in the estimated density elasticity across analyses (standard deviation of 0.12). Our recommended elasticity, however, is relatively close to Duranton & Turner (2018), a dedicated high-quality paper, and to the mean elasticity recommended in the meta-analysis (0.04) by Ewing & Cervero (2010). Moreover, the citation-index-weighted mean elasticity is almost identical if we restrict the sample to four analyses from two papers that disentangle density effects from unobserved location fundamentals using instrumental variables or natural experiments (SMS = 4). Therefore, a causal interpretation of our recommended elasticity seems justifiable and we are reasonably confident in recommending this elasticity, even though there is significant heterogeneity that remains to be explored.

4.13.5 Variety benefits

The literature on consumption benefits arising from agglomeration is underdeveloped relative to the production side. However, there are some good papers which suggest a sizeable effect. Victor Couture kindly provided estimates of the elasticity of restaurant price indices with respect to population density not reported in his paper (Couture 2016). Expressed in terms of price reductions (gains from variety) the elasticity estimates take the values of 0.08 for driving and 0.16 for walking. These elasticities roughly generalise when estimated exploiting between-city variation (0.05–0.11 and 0.1–0.22). We recommend the naïve average of two elasticity estimates (0.12), stressing that the exact elasticity will depend on the relative importance of the two modes in a setting. In support of the recommended elasticity we highlight that other good work has pointed to a positive and causal impact of density on consumption variety (Schiff 2015) and that Couture's result is close to the elasticity of urban amenity value with respect to density provided by Ahlfeldt et al. (2015), which is identified from quasi-experimental variation. The recommended elasticity is based on a small sample of high-quality evidence. More research is required to substantiate the findings and to allow for a causal interpretation.

4.13.6 Local public spending

We recommend the citation-weighted mean elasticity estimate from the evidence base of 0.17. This elasticity is within reasonable close range of Carruthers & Ulfarsson (2003) who find an 0.144 elasticity of total spending. Overall, the evidence base is relatively thin as most estimates come from a hand full of studies providing multiple estimates of density elasticities for distinct spending categories. More research is required in this area. There is significant heterogeneity that remains to be explored. Disentangling the effects of density from correlated unobserved fundamental effects to establish causality remains a challenge in this category.

4.13.7 Income inequality

The literature on the effects of density on inequality is relatively inconsistent in the sense that a small number of studies use different inequality measures (e.g., dissimilarity index, wage gaps, Gini coefficient), different geographic scales (within-city, between-city) and different density measures (e.g., population density, relative centralisation, clustering). The results are, therefore hard to compare and are also qualitatively inconsistent. Our analysis of OECD regional data suggests that inequality increases in density, irrespective of the inequality measure we use (Gini, poverty ratio, interquartile wage gap). This finding is consistent with broader evidence in urban economics suggesting that the highly skilled (high-wage earners) benefit relatively more from agglomeration (Baum-Snow et al. 2017). We acknowledge that we may be capturing different phenomena than studies that find a negative association between density and inequality at a within-city scale (Galster & Cutsinger 2007). We believe, however, that our original estimates are closer to the thought experiment conducted here, which refers to an increase in overall urban density. Our original analysis of OECD data suggests a -0.035 elasticity estimate of the income quintile wage gap reduction with respect to density (Table 5 in the main paper). Reassuringly, our -0.057 elasticity estimate for the US is within close range of Baum-Snow et al (2017). However, a sizeable evidence base with comparable results has yet to be developed. Disentangling the effects of density from correlated unobserved fundamentals to establish causality remains a challenge in this category.

4.13.8 Crime rate reduction

The literature of the effects of urban form on crime rates is small, but mostly points to a normatively positive effect of density on crime rates (crimes, p.c. as opposed to crimes per area) of sizeable magnitudes. The interpretation of the results is somewhat complicated as authors typically consider various dimensions of compact urban forms at the same time. While separating the effects of different shades of compactness is interesting, it also complicates the evaluation of an overall density effect as any dimension can only be varied under the ceteris paribus condition (while most measures effectively change at the same time). Our recommended elasticity estimate, therefore, is from Cheng Keat Tang, who kindly provided estimates of the elasticity of crime rates with respect to population density (without controlling for other dimensions of urban form) not reported in his paper (Tang 2015). Reassuringly, his estimates (level-level model) are almost identical for crimes against persons and property. Moreover, Tang's estimate is close to our original estimate of the density elasticity of crime rate reduction for non-US cities (setion 3.4 of this appendix). Importantly, however, we stress, that our original analysis reveals that the elasticity is negative for US cities, i.e. higher densities tend to be associated with higher crime levels in the US. This is in line with Glaeser & Sacerdote (1999). Therefore, we consider the recommended elasticity estimate to be suitable for non-US countries exclusively. More comparable evidence is required to substantiate our recommended elasticity for non-US countries and to allow for a more comprehensive analysis of heterogeneity. Disentangling the effects of density from correlated unobserved fundamentals to establish causality remains a challenge in this category.

4.13.9 Urban green

As discussed in the context of the presentation of our original results in the main paper quantitative evidence suitable for our purposes is essentially non-existent. We are thus left with no choice but to recommend our original elasticity estimate of green space density with respect to population density of 0.0283. Of course, we must stress that this estimate should be considered preliminary as a sizeable evidence base with comparable results has yet to be developed. Disentangling the effects of density from correlated unobserved fundamentals to establish causality remains a challenge in this category.

4.13.10 Pollution reduction

The literature on the effects of density on pollution concentrations is relatively small. Moreover, the quantitative results prevailing in the literature are highly inconsistent as reflected by a standard deviation of 0.47 relative to a weighted mean elasticity of pollution reduction with respect to a density of 0.04. Our original cross-sectional estimate of approximately -0.12 (using OECD data) is close to the elasticity reported by Albouy & Stuart (2014). Moreover, this elasticity has been substantiated by a recent working paper by Carozzi and Roth (2018) who provide an elasticity estimate of -0.13 and shortly after, by Borck & Schraut (2018), who provide very similar estimates. In our view, Carozzi & Roth (2018) and Borck & Schraut (2018) are the most credible estimates in the evidence base. Given the consistency of their independent estimates for the US (Carozzi & Roth) and Germany (Borck & Schraut) as well as the consistency with our original estimates from a sample of OECD cities, we are confident in recommending the -0.13 elasticity from Carozzi and Roth (2018). Given that both Carozzi & Roth (2018) and Borck & Schraut (2018) use instrumental variable strategies to disentangle density effects from correlated fundamental effects, a causal interpretation seems justifiable. A larger evidence base, however, would be desirable to substantiate findings.

4.13.11 Energy consumption

We interpret CO_2 emissions as reflecting energy usage, assuming that the elasticity of energy mix with respect to density is zero. CO_2's social cost is primarily incurred through global warming. This is different from the pollutants considered in category 10, which have much more localised effects. The literature on the effects of density on energy consumption is relatively well developed and reasonably consistent, both qualitatively and quantitatively. We therefore choose the weighted mean elasticity estimate of energy use reduction with respect to density across the reviewed analyses of 0.07 as a recommended elasticity estimate. We note that the respective elasticity of public transport seems to be negative (meaning more energy is consumed) and large (-0.37), which is consistent with higher transit usage in denser cities (see category 13). Given the relatively small proportion of overall energy consumption, the effects on aggregate outcomes are limited. Since few studies seek to disentangle the effects of density from correlated unobserved fundamentals, establishing causality remains a challenge in this category.

4.13.12 Traffic flow

The quantitative literature on the effects of density on average speed is surprisingly small. Most related analyses focus on the effects of road usage on speed on individual road segments. We found only two studies providing estimates of the elasticity of speed with respect to density, both of which, however, are of high quality (Couture et al. 2018; Duranton & Turner 2018). They yield very similar elasticities with a mean of -0.12. Because the evidence base is quantitatively thin we contribute an original analysis using OECD functional urban area (density) and speed data from Lomax et al. (2010). We find no effect of urban density on speeds on highways where the metropolitan population is the more important predictor. This is intuitive because highways represent a transport system which is used to overcome relatively large distances, and which is separate from the local street network. As long as the length of the highway network grows with the population in the metro area, flows on highways are not necessarily determined by population density. In contrast, for the arterial road network, density is predicted to be a more explicit determinant of flow as more people per area are expected to congest local roads as it is more difficult to increase the overall road density proportionately in population density. In line with these expectations, we find an elasticity of speed with respect to population density of -0.63%, which is at least roughly in line with Couture et al. (2016). Given the consistency of the estimates, we are reasonably confident in recommending the -0.12 elasticity from the small literature. Since both studies (Couture et al. 2018; Duranton & Turner 2018) use plausible instrumental variables to disentangle density effects from correlated unobserved fundamental effects, a causal interpretation seems justifiable. More research, however, is required to substantiate the evidence and to allow for us to differentiate by road types and geographies. In particular, evidence from outside the US is desirable.

4.13.13 Mode choice

The literature on the effects of urban form on mode choice is quantitatively well developed, although there is significant variability in the methodological approaches, which complicates the comparability of results across studies. Our recommended estimate of the density elasticity of car use reduction of 0.05 is the quality-weighted average from the evidence base. Ewing & Cervero (2010), in a dedicated meta-analysis, report estimates of the density elasticity of walking and public transit use of 0.07. We note that this elasticity of non-car usage with respect to density is consistent with the recommended elasticity of car usage reduction of 0.05 since car trips typically account for roughly 50% of overall trips. We note that the estimated elasticity of non-car use with respect to density of 0.16 in our evidence base is driven by outliers since the median value is 0.1. We further note that Ewing & Cervero (2010) discuss a range of elasticities with respect to other dimensions of compact urban form such as diversity or design, which may well be more appropriate in particular contexts and are worth considering. Since few studies seek to disentangle the effects of density from correlated unobserved fundamentals, establishing causality, despite a large evidence base, remains a challenge in this category.

4.13.14 Health

The evidence base on the effects of density on health is small and difficult to interpret. The results are mostly published in the field of medicine with a presentation that differs significantly from social sciences. None of the considered studies estimates marginal effects with respect to density. Instead, adjusted (by individual characteristics) rates (e.g., pre-mature mortality or mortality by disease) are reported by density categories. In some instances, such categories refer to density terciles or quintiles, which are not specified further so that admittedly heroic assumptions have to be made regarding density distributions in a study setting. In other instances, rates are only reported graphically, and numeric values must be entered after a visual inspection. We conduct ambitious back-of-the-envelope calculations to compute marginal effects, which can be converted into density elasticity estimates as otherwise we would virtually be left without any evidence base. The nature of this evidence base needs to be critically acknowledged when working with the results. In particular, because the relatively large negative effects of density on health are not confirmed by our original analysis of OECD regional data. In our preferred specification, we do not find a significant effect of density on overall mortality rates. If anything, the effect is negative (meaning, positive health effects) as we find significantly negative effects in simpler specifications that do not control for cross-country heterogeneity. Moreover, there is a robust negative effect of density on mortality in transport rates and a robust positive association between density and life expectancy at birth. Following our rule, that we generally prefer evidence from the literature over our original estimates – unless the evidence is highly inconsistent or inconclusive – we use an estimated of the elasticity of mortality rate reduction with respect to density, derived from Reijneveld et al.'s (1999) in the further calculations: their research focuses specifically on density and the overall mortality rate is particularly amenable to back-of-the-envelope calculations using the statistical value of life (see next section). We note however, that the evidence base is not sufficiently developed to allow for a confident recommendation of a consensus estimate. More research is required, ideally research using methods that are closer to the conventions in economics to allow for a more immediate cross-category comparison. Since few studies seek to disentangle the effects of density from correlated unobserved fundamentals, establishing causality remains a challenge in this category.

4.13.15 Well-being

Except for reported safety (in line with the evidence reviewed in category 8), the literature finds a negative association between reported satisfaction indicators and density, including reported satisfaction with social contacts, health (consistent with 14) and healthy environment (inconsistent with 9, but consistent with 10). Our evidence base contains surprisingly few analyses of the relationship between life satisfaction (subjective well-being or happiness) and density. For one of the few analyses in the evidence base, we were not able to convert the presented results into an estimate of the elasticity of well-being with respect to happiness (Brown et al. 2015). We found one estimate which we were able to convert (from a lin-log semi-elasticity) in Glaeser et al. (2016). This estimate referred to city size instead of density and we converted it using the estimate of the elasticity of density with respect to city size presented in section 2.1. The resulting elasticity estimate of reported life satisfaction with respect to density is -0.0037, which is roughly within the range of our original analysis of OECD data (-0.007). While we proceed using the -0.0037 elasticity estimate implied by Glaeser et al.'s (2016) analysis, we caution against uncritical application of this elasticity unless further research substantiates our quantitative interpretation. Since few studies seek to disentangle the effects of density from correlated unobserved fundamentals, establishing causality remains a challenge in this category.

4.14 Monetary equivalents

This section lays out the assumptions on quantities and unit values on which we base the calculation of monetary equivalents of density increases reported in Table 7 in the main paper. We strongly advise to consider the relevant subsection before applying the monetary equivalents to specific contexts as the assumptions may not be transferrable. All monetary equivalents are expressed in per capita and year Dollar terms. Some of the quantities and unit values borrowed from the literature are in other currencies. To convert Pound and Euro values into Dollar values we apply the average exchange rates over the 2000–2016 (October) period (1.64 and 1.22).

4.14.1 Productivity

A value of $35,000 is set as the worker wage, which is slightly below the US real disposable household income during 2010 (US Bureau of Economic Analysis 2016), but above the level of most high-income countries.

4.14.2 Innovation

We use the mean number of patents per year and 10,000 of population over 1990–1999 (2.057) as reported by Carlino et al. (2007). Valuing patents is difficult because prices are not usually directly observed. To analyse the distribution of patent values, the literature uses patent renewal data (Pakes 1986), event studies (Austin 1993), inventor surveys (Giuri et al. 2007), and census data (Balasubramanian & Sivadasan 2010), typically facing a trade-off between representativeness and identification. Recent estimates of an average patent value range from a simple average of transaction prices of patents of $288K ($233K median) to well-identified but much more specific estimates of $20M–30M inferred from the economic success of start-ups (Gaulé 2016). A common theme emerging from the literature is that the distribution of patent values is skewed, i.e., the majority of patents have low values, while a small number of patents achieve extremely high values. Given these challenges, our preferred approximation of the value of a representative patent is a reservation price (the price at which inventors report being willing to sell their patent) of $793,000 (€650,000) from Giuri et al. (2007). This value is in the middle of the median category (300K–1M) of reported patent reservation prices and the broader distribution of patent value estimates in the literature. We prefer self-reported reservation prices to observed transaction prices because the latter subsample is likely prone to adverse selection due to severe information asymmetries.

4.14.3 Value of space

We assume that the expenditure share on housing is one-third, which is in line with empirical evidence (Combes et al. 2018) and conventional assumptions made in urban economics (Chauvin et al. 2016; Albouy & Lue 2015). The total rent paid per year thus corresponds to one-fourth of the disposable income. This expenditure share is an average and seems to increase in city size (Combes et al. 2018).

4.14.4 Job accessibility

Total vehicle miles p.c. are taken from the American Driving Survey (Triplett et al. 2015). The total (private) per mile driving costs are from the American Automobile Association (2015).

4.14.5 Amenity access

Assuming that similar gains from variety arise in the consumption of other non-tradeables, we apply the estimate of the density elasticity of the restaurant variety price index to household expenditures (see 5.5 for a discussion) in food away from home, entertainment, and apparel and services (based on shares reported in the 2015 Consumer Expenditure Survey) (Bureau of Labour Statistics 2015). In Table 6 in the main paper we use an adjusted elasticity estimate to avoid a double counting of reduced costs of road trips that are already itemised in category 4. Couture reports that approximately 56% from the gains are pure gains from variety, with the remaining share result from travel cost reductions. Since the overall reduction in vehicle miles travelled is already accounted for in 4, we multiply the car elasticity by 0.56 to capture purely the gains from variety, resulting in an elasticity of 0.045. Assuming that each of the modes accounts for half of the restaurant trips made, we use the naïve average over the adjusted car and the walking elasticity estimates in our calculations.

4.14.6 Efficiency of public services

The per capita expenditures on local public services are from Carruthers & Ulfarsson (2003).

4.14.7 Social equity

Valuing income inequality is even more challenging than measuring income inequality. To value income equality as it arises from density we compute the premium an individual would be willing to pay to insure themselves against uncertain realisations of incomes. In doing so we assume a concave relationship between utility and income that implies certain outcomes are preferred over uncertain outcomes, which is in line with risk-aversion. We compute the difference between the expected income E and the certainty equivalent (which a risk-averse individual would accept to avoid uncertainty) across the 20th (I^{20pct}) vs. the 80th (I^{80pct}) percentiles in the income distribution after taxes. The expected income is simply the mean across the two potential outcomes.

$$E = \frac{1}{2} I^{20pct} + \frac{1}{2} I^{80pct}$$

The certainty equivalent is computed as,

$$CE = U^{-1}\left[\frac{1}{2} U(I^{20pct}) + \frac{1}{2} U(I^{20pct})\right]$$

where $U(I) = I^{\aleph}$ is the utility function in which $\aleph$ determines the degree of concavity. We set $\aleph = 0.5$, which is in the middle of the range of the elasticity estimates of happiness (viewed as a proxy for utility) with respect to income estimates reported by Layard, Mayraz, & Nickell (2008). We use the distribution of incomes after taxes of the UK, a country that is arguably neither among the most equal nor unequal countries in the world (HM Revenue & Customs 2016). In dollar terms, the resulting inequality premium corresponds to $CE - E = \$1{,}793$ or $(E - CE)/CE = 4.8\%$. To analyse the effects of density on inequality we apply the estimate of the elasticity of the interquartile wage gap with respect to density to the product of the percentage uncertainty premium and the disposable income in our scenario.

4.14.8 Safety

The average crime rate (p.c.) as well as the estimated cost of crime are from Brand & Price (2000).

4.14.9 Urban green

The green area p.c. of 540 m² we use is the mean across functional economic areas in the OECD.Stat data. The value of a m² green area per year is based the meta-analysis of contingent valuation estimates by Brander & Koetse (2011). Based on the reported meta-analysis coefficients we compute the average per m² and year value of a park in a functional economic area with a population density and a per capita GDP that corresponds to the mean in the OECD.Stat data.

4.14.10 Pollution concentration

We use an elasticity of rent with respect to density of 0.25, which is in the middle of the range of estimates reported by Chay & Greenstone (2005) with respect to the total suspended particles (TSPs). We note that with this approach we presumably capture dis-amenity effects and health effects, both of which should be associated with a negative willingness to pay. Carozzi & Roth (2018) compute the pure health effect using estimates of the pollution effect on death risk and the statistical value of live. Accordingly, a log-point increase in density leads to an annualised per capita effect of -$370. It follows that a percentage point increase in density is associated with -$.215 which, at a 5% discount rate over an infinite horizon, gives a per capita present value of -$43. This is about half of the -$90 per capita present value gross effect we compute. To avoid double counting with the health effect discussed in 5.14, we subtract the -$43 health effect from the -$90 gross effect in the accounting reported in Table 8 in the main paper.

4.14.11 Energy reduction

The total energy consumption per year is from the US Energy Information Administration (2012). We consider residential and transport energy consumption, which corresponds to 40% of all energy consumed according to Glaeser & Kahn (2010). To compute the p.c., annual consumption, we normalise by the total US population (320M). This results in a p.c. energy consumption of 121M BTU. We use an average over the price of all individual energy sources of $18.7 per 1M BTU from the U.S. Energy Information Administration (2012). To compute the corresponding CO2 emissions, we first convert p.c. energy consumption into KWH, to which we apply a factor of 25T/KWH and a social cost of $43/T (Glaeser & Kahn 2010).

4.14.12 Traffic flow

We obtain the total travel time p.c. per year by multiplying the average daily car trip length of 45 minutes (Triplett et al. 2015) by 365. The value of time is set to 50% of the average hourly wage of $21.5 as in Anderson (2014).

4.14.13 Sustainable mode choice

In computing the economic benefits of changes in mode we operate under the assumption that the marginal user is indifferent between modes, thus, there are no private costs and benefits to be considered above and beyond those already considered in categories 4, 5, and 12. However, a switch in mode may be associated with external benefits. Since the effects on congestion are already captured by the outcome category 12, we focus exclusively on the emission externalities. To compute the average emissions economised by switches away from car trips we proceed as follows. First, we compute the average energy consumed per passenger km by mode across the US, EU, high-income Asian, and Latin American countries. Weighted by the average modal split the average energy consumed per passenger km corresponds 0.49 MJ/km for non-car trips and 3.73 MJ/km for a car trip (Bohler-Baedeker & Huging 2012). These figures can be converted into KWH/mile, CO2/mile, and eventually $/mile using the same conversation rates as in 11.

4.14.14 Health

The premature mortality risk refers to OECD countries and is taken from OECD (2011). The statistical value of life is to $7,000,000 according to Viscusi & Aldy (2003) and confirmed in later studies (Hammitt & Haninger 2010; Viscusi 2010). We note that the per capita present monetised pollution effect on health we infer from Carozzi & Roth (2018) of -$43 (see 5.10) corresponds to about two-thirds of the health effect of -$64 we compute with our approach.

4.14.15 Wellbeing

We use an estimate of the elasticity of self-reported well-being with respect to income of 0.5, which is in the middle of the range reported by Layard et al. (2008) who estimate this elasticity through survey data on both happiness and life satisfaction from a wide range of geographical locations (US, Europe, and worldwide). Due to the concavity of the happiness function in income a 2% change in income is required to trigger a 1% change in happiness.

4.15 Appendix references

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Studies reviewed : The economic effects of density

ID	Author	Year	Cause	Cat.	Outcome	Density	Country	Model	SMS	CI	Elasticity
P1	Abel et al.	2012	a	1	Labour productivity	PD	US	OLS IV	4	2.10	0.0300
P2	Aberg	1973	a	1	Productivity	PD	Sweden	OLS	2	0.10	0.0170
P3	Ahlfeldt & Feddersen	2015	a	1	Labour productivity	ED	Germany	DID IV	4	4.92	0.0380
P4	Ahlfeldt & Wendland	2013	a	1	Total factor productivity	SPP	Germany	Panel FE	3	1.01	0.0590
P5	Ahlfeldt, Redding, et al.	2015	a	1	Total factor productivity	ED	Germany	DID, GMM	4	2.01	0.0620
P6	Albouy & Lue	2015	a	1	Wages	PD	US	OLS CONTR	2	1.07	0.0680
P8	Andersson et al.	2014	a	1	Wages	ED	Sweden	Panel FE	3	1.18	0.0100
P9	Andersson et al.	2016	a	1	Wages	ED	Sweden	Panel	3	1.83	0.0300
P10	Au & Henderson	2006	a	1	Productivity	ED	China	OLS IV	4	2.40	0.0130
P11	Baldwin et al.	2010	a	1	Labour productivity	ED	Canada	FD, GMM, IV	3	1.32	0.0200
P12	Baldwin et al.	2007	a	1	Labour productivity	PD	Canada	CrossSec FE	2	0.23	0.0674
P13	Barde	2010	a	1	Wages	ED	France	CrossSec, IV	4	0.58	0.0350
P14	Barufi et al.	2016	a	1	Wages	ED	Brazil	Panel IV	3	0.61	0.0730
P16	Baum-Snow & Pavan	2012	a	1	Log hourly wage	PD	US	Panel, IV	4	2.94	0.0870
P17	Brülhart & Mathys	2008	a	1	Labour productivity	ED	Europe	Panel GMM	3	2.00	-0.0800
P18	Chauvin et al.	2016	a	1	Wages	PD	China	Panel IV	3	0.61	0.2000
P19	Chauvin et al.	2016	a	1	Wages	PD	India	Panel IV	3	0.61	0.0750
P20	Chauvin et al.	2016	a	1	Wages	PD	US	Panel IV	3	0.61	0.0500
P21	Chauvin et al.	2016	a	1	Wages	PD	Brazil	Panel IV	3	0.61	0.0260

ID	Author	Year	Cause	Cat.	Outcome	Density	Country	Model	SMS	CI	Elasticity
P23	Ciccone	2002	a	1	Labour productivity	ED	Europe	FE, IV	4	3.79	0.0450
P24	Ciccone & Hall	1996	a	1	Total factor productivity	ED	US	OLS IV	3	5.58	0.0530
P25	Cingano & Schivardi	2004	a	1	Total factor productivity	PD	Italy	CrossSec	2	1.82	0.0540
P26	Combes et al.	2012	a	1	Total factor productivity	ED	France	Panel IV	4	4.88	0.0320
P27	Combes et al.	2008	a	1	Wages	ED	France	Panel IV	4	9.07	0.0300
P28	Combes et al.	2017	a	1	Total earning	ED	China	Panel OLS	3	1.72	0.0970
P29	Combes et al.	2015	a	1	Total earnings	ED	China	OLS IV	4	0.93	0.1100
P30	Combes et al.	2008	a	1	Total factor productivity	ED	France	Panel IV	4	2.29	0.0400
P31	Combes et al.	2008	a	1	Wages	ED	France	Panel IV	4	2.29	0.0500
P32	Combes & Li	2018	a	1	Earnings per hour	ED	China	OLS IV	4	1.06	0.1000
P33	Davis & Weinstein	2001	a	1	Productivity	ED	Japan	OLS	2	0.52	0.0628
P34	Dekle & Eaton	1999	a	1	Wages	ED	Japan	Panel FE	3	0.74	0.0100
P35	Dericks & Koster	2018	a	1	Total factor productivity	ED	UK	Panel, IV	4	1.06	0.0720
P37	Echeverri-Carroll & Ayala	2011	a	1	Wages	PD	US	OLS IV	4	0.43	0.0305
P38	Faberman & Freedman	2016	a	1	Wages	PD	US	Panel IV	3	0.61	0.0698
P39	Fingleton	2003	a	1	Wages	ED	UK	OLS	2	1.12	0.0170
P40	Fingleton	2006	a	1	Wages	ED	UK	OLS	2	1.67	0.0250
P41	Fu	2007	a	1	Wages	ED	US	CrossSec FE	2	2.07	0.0370
P44	Graham	2007	a	1	Labour productivity	ED	UK	GLS CONTR	2	2.44	0.0402
P45	Graham	2000	a	1	Labour productivity	ED	UK	OLS	2	0.18	0.0080
P46	Graham	2007	a	1	Labour productivity	ED	UK	Panel OLS	3	0.83	0.0200
P47	Graham	2005	a	1	Labour productivity	ED	UK	Panel OLS	3	0.29	0.1290

ID	Author	Year	Cause	Cat.	Outcome	Density	Country	Model	SMS	CI	Elasticity
P48	Graham & Kim	2008	a	1	Labour productivity	ED	UK	Panel OLS	3	0.91	0.0790
P49	Graham et al.	2010	a	1	Labour productivity	ED	UK	Panel GMM	3	1.33	0.0905
P50	Henderson	2003	a	1	Labour productivity	ED	US	Panel IV	3	6.58	0.0240
P52	Henderson	1986	a	1	Total factor productivity	ED	Brazil	CrossSec, IV	4	1.31	0.1000
P53	Kanemoto et al.	1996	a	1	Total factor productivity	PD	Japan	CrossSec	2	0.24	0.0890
P54	Lall et al.	2004	a	1	Industry productivity	ED	India	OLS	2	1.22	0.0170
P55	Larsson	2014	a	1	Wages	ED	Sweden	Panel IV	3	1.41	0.0100
P56	Mion & Naticchioni	2005	a	1	Wages	ED	Italy	Panel OLS	3	0.83	0.0340
P57	Monkkonen et al.	2018	a	1	Labour productivity	ED	Mexico	Panel	3	1.06	-0.0800
P58	Moomaw	1985	a	1	Labour productivity	PD	US	OLS	2	0.39	0.0930
P59	Moomaw	1983	a	1	Total factor productivity	PD	US	CrossSec	2	0.16	0.0884
P60	Morikawa	2011	a	1	Total factor productivity	PD	Japan	Panel	2	0.92	0.1100
P61	Nakamura	1985	a	1	Labour productivity	PD	Japan	CrossSec	2	0.64	0.0781
P62	Rappaport	2008	a	1	Total factor productivity	PD	US	CGEM	1	0.78	0.1500
P63	Rice et al.	2006	a	1	Labour productivity	PD	UK	OLS IV	4	2.37	0.0350
P64	Rosenthal & Strange	2008	a	1	Wages	ED	US	OLS, GMM, IV	4	5.69	0.0450
P65	Sveikauskas	1975	a	1	Labour productivity	PD	US	CrossSec	2	1.07	0.1391
P66	Sveikauskas et al.	1988	a	1	Labour productivity	PD	US	CrossSec	2	0.41	0.0130
P67	Tabuchi	1986	a	1	Labour productivity	PD	Japan	CrossSec IV	4	0.21	0.0615
P68	Wheeler	2001	a	1	Total factor productivity	ED	US	CrossSec	2	1.21	0.0170
P69	Eckert et al.	2018	a	1	Wages	PD	Denmark	OLS FE	3	0.35	0.0539
I1	Andersson et al.	2005	a	2	Patents/capita	ED	Sweden	Poisson	2	0.82	0.0190

ID	Author	Year	Cause	Cat.	Outcome	Density	Country	Model	SMS	CI	Elasticity
I3	Bettencourt et al.	2007	a	2	Patents/capita	PD	US	FGLS	2	2.99	0.2900
I4	Carlino et al.	2007	a	2	Patents/capita	ED	US	OLS IV	4	4.45	0.2000
I5	Echeverri-Carroll & Ayala	2011	a	2	Patents/capita	PD	US	OLS IV	1	0.43	0.0504
I8	Knudsen et al.	2008	a	2	Patents per 100,000 pop	PD	US	OLS	2	1.54	0.3000
I11	Ó hUallacháin	1999	a	2	Patents/capita	PD	US	OLS	2	0.71	0.3100
I13	Sedgley & Elmslie	2004	a	2	Average patents	PD	US	GMM IV	4	0.82	0.0020
VS2	Ahlfeldt, Redding, et al.	2015	a	3	House prices	PD	Germany	SPVAR IV	4	1.07	0.0465
VS3	Albouy & Lue	2015	a	3	House prices	PD	US	OLS CONTR	2	1.07	0.1560
VS9	Combes et al.	2018	a	3	House prices	PD	France	OLS IV	4	1.06	0.2080
VS10	Dericks & Koster	2018	a	3	Rent	ED	UK	Panel, IV	4	1.06	0.2873
VS13	Kholodilin & Ulbricht	2015	a	3	House prices	PD	Europe	OLS QR	2	0.62	0.2500
VS15	Koster et al.	2014	a	3	Rent	ED	Netherlands	Panel, IV	4	0.82	0.0820
VS16	Liu et al.	2016	a	3	Rent	ED	US	OLS FE	2	0.71	0.1000
VS17	Lynch & Rasmussen	2004	a	3	House prices	PD	US	OLS CONTR	2	0.48	-0.0179
VS21	Palm et al.	2014	a	3	Rent	PD	US	OLS FE	2	0.54	0.0450
VS23	Song & Knaap	2004	a	3	House prices	PD	US	OLS IV	4	1.07	-0.0170
VS26	Cheshire & Dericks	2018	a	3	Rent	ED	UK	QUASI-EXP	4	1.06	0.1840
VS21	Palm et al.	2014	a	3	Rent	PD	US	OLS FE	2	0.54	0.0450
JA1	Albouy & Lue	2015	a	4	Commuting cost red.	PD	US	LPROB	2	1.07	-0.0230
JA3	Bento et al.	2005	c	4	VMT per household	EPD	US	LOGIT	2	2.41	0.0600
JA5	Bhat et al.	2009	b	4	VMT per household	BS	US	LOGIT	2	4.85	0.0100
JA8	Brownstone & Thomas	2013	a	4	Red. total vehicle mileage/year	HD	US	OLS	2	1.16	0.1222

ID	Author	Year	Cause	Cat.	Outcome	Density	Country	Model	SMS	CI	Elasticity
JA9	Cervero & Kockelman	1997	a	4	VMT per household	ED	US	LOGIT	2	3.43	0.2470
JA10	Cervero & Kockelman	1997	a	4	VMT per household	LU	US	LOGIT	2	3.43	0.0000
JA11	Cervero & Kockelman	1997	b	4	VMT per household	SC	US	LOGIT	2	3.43	0.0000
JA12	Cervero & Kockelman	1997	b	4	VMT per household	BS	US	LOGIT	2	3.43	0.1900
JA13	Champman et al.	2004	b	4	VMT per person	SC	US	LOGIT	2	0.13	0.0800
JA14	Chapman & Frank	2004	c	4	VMT per person	LU	US	LOGIT	2	0.13	0.0400
JA15	Chatman	2003	a	4	Commercial trip length red.	ED	US	LOGIT, TOBIT	2	0.45	0.2327
JA16	Chatman	2003	a	4	VMT commercial trips	PD	US	LOGIT, TOBIT	2	0.45	-0.5800
JA19	Duranton & Turner	2015	a	4	VKT per person	PD	US	Panel IV	4	1.30	0.0850
JA21	Fan	2007	b	4	Miles travelled per person	PCD	US	OLS	2	1.06	0.0700
JA22	Fan	2007	b	4	Miles travelled per person	SC	US	OLS	2	1.06	0.1100
JA23	Frank & Bradley	2009	b	4	VMT per household	SC	US	OLS	2	0.33	0.1100
JA24	Frank	2009	c	4	VMT per household	LU	US	OLS	2	0.33	0.0400
JA27	Holtzclaw et al.	2002	a	4	VMT per household	HD	US	OLS	2	1.94	0.1400
JA28	Cervero & Kockelman	1997	c	4	VKT per household	LU	US	OLS	2	0.87	0.1000
JA29	Cervero & Kockelman	1997	a	4	VMT per household	ED	US	OLS	2	0.87	0.0000
JA30	Cervero & Kockelman	1997	a	4	VMT per household	PD	US	OLS	2	0.87	0.0000
JA31	Kuzmyak et al	2006	c	4	VMT per household	LU	US	OLS	2	0.43	0.0900
JA34	Mashall	2008	a	4	Vehicle Km travelled	PD	US	COR	0	1.43	0.3000
JA36	Pouyanne	2004	a	4	Commuting length reduction	ED	France	OLS, LOGIT	2	0.34	0.1104
JA37	Pouyanne	2004	a	4	Commuting length reduction	PD	France	OLS, LOGIT	2	0.34	0.2065
JA38	Pickrell & Schimek	1996	a	4	VMT per household	PD	US	OLS	2	0.69	0.0700

ID	Author	Year	Cause	Cat.	Outcome	Density	Country	Model	SMS	CI	Elasticity
JA40	Sun et al	1998	a	4	VMT per household	ED	US	OLS - ANOVA	2	0.45	0.0000
JA41	Sun et al	1998	c	4	VMT per household	LU	US	OLS - ANOVA	2	0.45	0.1000
JA43	Vance & Hedel	2007	a	4	VKT per person	ED	Germany	PROBIT IV	4	1.51	0.0100
JA44	Vance & Hedel	2007	b	4	VKT per person	SDI	Germany	PROBIT IV	4	1.51	0.0400
JA45	Vance & Hedel	2007	c	4	VKT per person	LU	Germany	PROBIT IV	4	1.51	0.0600
JA46	Veneri	2010	a	4	Av. Commuting time	PD	Italy	OLS, ML	2	1.02	-0.0212
JA47	Fan	2007	b	4	Daily transit travel time	PCD	US	OLS	2	1.06	0.0000
JA48	Frank et al.	2008	b	4	transit trips per household	SC	US	LOGIT	2	1.06	0.1200
JA49	Zhou & Kockelman	2008	a	4	VMT per household	ED	US	OLS -PROBIT	2	1.44	0.0200
JA50	Zhou & Kockelman	2008	a	4	VMT per household	PD	US	OLS -PROBIT	2	1.44	0.1200
JA51	Yang et al.	2012	a	4	Commuting time reduction	PD	China	OLS CONTR	2	2.25	-0.2085
JA52	Boarnet et al.	2004	a	4	Non-work VMT per person	ED	US	OLS	2	0.28	0.0300
JA53	Boarnet et al	2004	a	4	Non-work VMT per person	PD	US	OLS	2	0.28	-0.0400
JA54	Chatman	2008	a	4	Non Work VMT per person	ED	US	LOGIT	2	1.74	-0.1900
JA55	Chatman	2008	a	4	Non Work VMT per person	PD	US	LOGIT	2	1.74	-1.0500
JA56	Chatman	2008	b	4	Non Work VMT per person	SC	US	LOGIT	2	1.74	-0.0600
JA58	Cervero & Kockelman	1997	a	4	VMT	ED	US	LOGIT	2	3.43	0.0630
SA1	Ahlfeldt & Maennig	2015	a	5	Quality of life	ED	Germany	DID, GMM	4	2.01	0.1500
SA2	Ahlfeldt, Moeller, et al.	2015	a	5	Underground station density	PD	Germany	SPVAR IV	4	1.07	0.0350
SA3	Albouy	2008	a	5	Quality of life	PD	US	OLS FE	2	2.15	0.0200
SA4	Albouy & Lue	2015	a	5	Quality of life	PD	US	OLS CONTR	2	1.07	0.0150
SA8	Chauvin et al.	2016	a	5	Real wages	PD	China	Panel IV	3	0.61	-0.0520

ID	Author	Year	Cause	Cat.	Outcome	Density	Country	Model	SMS	CI	Elasticity
SA9	Chauvin et al.	2016	a	5	Real wages	PD	India	Panel IV	3	0.61	-0.0690
SA10	Chauvin et al.	2016	a	5	Real wages	PD	US	Panel IV	3	0.61	-0.0200
SA11	Chauvin et al.	2016	a	5	Real wages	PD	Brazil	Panel IV	3	0.61	-0.0100
SA12	Couture	2016	a	5	Restaurant prices	PD	US	OLS LOGIT IV	4	3.61	0.0800
SA13	Couture	2016	a	5	Restaurant prices	PD	US	OLS LOGIT IV	4	3.61	0.1600
SA14	Levinson	2008	a	5	Rail station density	PD	UK	Panel	3	1.28	0.0023
SA15	Levinson	2008	a	5	Underground station density	PD	UK	Panel	3	1.28	0.0027
SA17	Schiff	2015	a	5	Cuisine variety	PD	US	OLS IV	4	0.92	0.1850
SA18	Baum-Snow & Pavan	2012	a	5	Real wages	PD	US	Panel, IV	4	2.94	0.0160
PS2	Carruthers & Ulfarsson	2003	a	6	Red. spending capital	PD	US	CrossSec FE	2	0.98	0.1440
PS3	Carruthers & Ulfarsson	2003	a	6	Red. spending education	PD	US	CrossSec FE	2	0.98	0.1920
PS4	Carruthers & Ulfarsson	2003	a	6	Red. spending police	PD	US	CrossSec FE	2	0.98	0.0960
PS5	Carruthers & Ulfarsson	2003	a	6	Red. spending roadways	PD	US	CrossSec FE	2	0.98	0.2880
PS6	Carruthers & Ulfarsson	2003	a	6	Red. spending sewerage	PD	US	CrossSec FE	2	0.98	-0.1440
PS7	Carruthers & Ulfarsson	2003	a	6	Red. total spending	PD	US	CrossSec FE	2	0.98	0.1440
PS8	Carruthers & Ulfarsson	2003	b	6	Red. total spending	GAR	US	CrossSec FE	2	0.98	0.0195
PS9	Carruthers & Ulfarsson	2003	a	6	Red. spending transport	PD	US	CrossSec FE	2	0.98	-0.4800
PS10	Carruthers & Ulfarsson	2003	a	6	Red. spending trash	PD	US	CrossSec FE	2	0.98	0.0960
PS11	Hortas-Rico & Sole-Olle	2010	a	6	Admin spending per capita	UL	Spain	OLS CONTR	2	1.39	0.1075
PS12	Hortas-Rico & Sole-Olle	2010	a	6	Red. community facilities	UL	Spain	OLS CONTR	2	1.39	0.1069
PS13	Hortas-Rico & Sole-Olle	2010	a	6	Red. culture and sports	UL	Spain	OLS CONTR	2	1.39	0.1509
PS14	Hortas-Rico & Sole-Olle	2010	a	6	Red. housing and community development per capita	UL	Spain	OLS CONTR	2	1.39	0.0753

ID	Author	Year	Cause	Cat.	Outcome	Density	Country	Model	SMS	CI	Elasticity
PS15	Hortas-Rico & Sole-Olle	2010	a	6	Red. spending police	UL	Spain	OLS CONTR	2	1.39	0.0920
PS16	Hortas-Rico & Sole-Olle	2010	a	6	Red. total spending	UL	Spain	OLS CONTR	2	1.39	0.1058
PS17	Hortas-Rico & Sole-Olle	2010	a	6	Red. spending trash	UL	Spain	OLS CONTR	2	1.39	0.3058
PS19	Ladd	1994	a	6	Change per capita spending	PD	US	CrossSec FE	2	0.19	-0.0302
PS20	Prieto et al.	2015	a	6	Paving cost per capita	PD	Spain	LOGIT	2	1.23	0.8120
PS21	Prieto et al.	2015	a	6	Sewage cost per capita	PD	Spain	LOGIT	2	1.23	0.5070
PS22	Prieto et al.	2015	a	6	Water supply cost per capita	PD	Spain	LOGIT	2	1.23	0.3970
SE1	Ananat et al.	2013	a	7	Red. in black-white wage gap	ED	US	OLS FE	2	0.92	-0.0033
SE2	Baum-Snow et al.	2016	a	7	High-low skill wage gap red.	PD	US	Panel IV	4	2.69	-0.0674
SE5	Galster & Cutsinger	2007	a	7	Dissimilarity index	PD	US	OLS CONTR	2	0.51	2.5675
SE8	Rothwell	2011	a	7	Dissimilarity index	PD	US	CrossSec IV	4	1.25	0.3920
SE9	Rothwell & Massey	2009	a	7	Dissimilarity index	PD	US	CrossSec IV	4	1.88	0.3261
SE10	Rothwell & Massey	2010	a	7	Red. Gini coefficient	PD	US	CrossSec IV	4	1.33	4.5635
SE11	Wheeler	2004	a	7	Red. 90th vs. 10th decile	PD	US	GLS IV	4	0.35	0.1700
SE12	Baum-Snow & Pavan	2012	a	7	Skill wage gap	PD	US	Panel, IV	4	2.94	-0.2093
SE13	Baum-Snow & Pavan	2012	a	7	Skill wage gap	PD	US	Panel, IV	4	2.94	-0.1163
SF6	Glaeser & Sacerdote	1999	a	8	Crime per capita	PD	US	OLS IV	3	2.04	-0.5581
SF10	Raleigh & Galster	2015	a	8	Red. assault	PD	US	OLS CONTR	2	0.66	0.3562
SF11	Raleigh & Galster	2015	a	8	Red. burglary	PD	US	OLS CONTR	2	0.66	0.3417
SF13	Raleigh & Galster	2015	a	8	Red. narcotics	PD	US	OLS CONTR	2	0.66	0.8142
SF14	Raleigh & Galster	2015	a	8	Property theft	PD	US	OLS CONTR	2	0.66	0.4580
SF15	Raleigh & Galster	2015	a	8	Red. robbery	PD	US	OLS CONTR	2	0.66	0.8288

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SF16	Raleigh & Galster	2015	a	8	Red. vandalism	PD	US	OLS CONTR	2	0.66	0.3562
SF17	Raleigh & Galster	2015	a	8	Vehicle theft	PD	US	OLS CONTR	2	0.66	0.2763
SF18	Raleigh & Galster	2015	a	8	Red. violence	PD	US	OLS CONTR	2	0.66	0.5234
SF20	Tang	2015	a	8	Red. assault	PD	UK	Panel	3	0.45	0.0845
SF21	Tang	2015	a	8	Property theft	PD	UK	Panel	3	0.45	0.0902
SF22	Twinam	2016	a	8	Red. assault	PD	US	Panel IV	4	0.78	0.5314
SF23	Twinam	2016	a	8	Red. robbery	PD	US	Panel IV	4	0.78	0.4679
OG4	Lin et al.	2015	b	9	Foliage Projection Cover	HD	Australia	OLS	1	0.87	-0.0600
PO1	Albouy & Stuart	2014	a	10	Red. Pollution	PD	US	NLLS CONTR	2	1.68	-0.1500
PO3	Hilber & Palmer	2014	a	10	Red. NOx µg/m3	PD	non-OECD	Panel FE	3	0.36	-0.7816
PO4	Hilber & Palmer	2014	a	10	Red. PM10 µg/m3	PD	non-OECD	Panel FE	3	0.36	0.3482
PO5	Hilber & Palmer	2014	a	10	Red. SOx µg/m3	PD	non-OECD	Panel FE	3	0.36	-1.8367
PO6	Hilber & Palmer	2014	a	10	Red. NOx µg/m3	PD	OECD	Panel FE	3	0.36	0.2382
PO7	Hilber & Palmer	2014	a	10	Red. PM10 µg/m3	PD	OECD	Panel FE	3	0.36	-0.4740
PO8	Hilber & Palmer	2014	a	10	Red. SOx µg/m3	PD	OECD	Panel FE	3	0.36	2.0080
PO9	Salomons & Berghauser	2012	a	10	Red. Noise	PD	Netherlands	CORR	1	2.31	0.0400
PO10	Sarzynski	2012	a	10	Red. CO m. metric tons	PD	World	CrossSec	2	1.37	0.2280
PO11	Sarzynski	2012	a	10	Red. Nox m. metric tons	PD	World	CrossSec	2	1.37	0.4380
PO12	Borck & Schrauth	2018	a	10	NO2	PD	Germany	Panel IV	4	1.06	-0.1610
PO13	Sarzynski	2012	a	10	Red. SO2 m. metric tons	PD	World	CrossSec	2	1.37	0.3760
PO14	Sarzynski	2012	a	10	Red. VOCs m. metric tons	PD	World	CrossSec	2	1.37	0.3300
PO15	Stone	2008	a	10	Red. NOx µg/m3	PD	US	Panel	2	2.33	0.1900

ID	Author	Year	Cause	Cat.	Outcome	Density	Country	Model	SMS	CI	Elasticity
PO16	Tang & Wang	2007	b	10	Red. CO2 concentration	HD	China	CORR	1	2.18	-0.2300
PO17	Borck & Schrauth	2018	a	10	CO	PD	Germany	Panel IV	4	1.06	-0.1200
PO18	Borck & Schrauth	2018	a	10	PM10	PD	Germany	Panel IV	4	1.06	-0.1140
PO19	Borck & Schrauth	2018	a	10	O3	PD	Germany	Panel IV	4	1.06	-0.0600
PO20	Carozzi & Roth	2018	a	10	Average residential PM2.5	PD	US	Panel IV	4	1.06	-0.1300
EN3	Barter	2000	a	11	Red. Emission/capita	PD	Eastern Asia	DESC	0	0.46	0.2940
EN5	Brownstone & Thomas	2013	a	11	Red. gasoline consumption	HD	US	OLS	2	1.16	0.1440
EN7	Cirilli & Veneri	2014	a	11	CO2 emissions commutes	PD	Italy	OLS IV	4	1.32	0.2346
EN8	Glaeser & Kahn	2010	a	11	CO2 private driving	PD	US	CORR	1	7.41	0.0821
EN9	Glaeser & Kahn	2010	a	11	CO2 electricity	PD	US	CORR	1	7.41	0.0682
EN10	Glaeser & Kahn	2010	a	11	CO2 heating	PD	US	CORR	1	7.41	-0.0339
EN11	Glaeser & Kahn	2010	a	11	CO2 Total	PD	US	CORR	1	7.41	0.0527
EN12	Glaeser & Kahn	2010	a	11	CO2 public transport	PD	US	CORR	1	7.41	-0.3685
EN13	Glaeser & Kahn	2010	a	11	Red. gasoline consumption	PD	US	CORR	1	7.41	0.0320
EN14	Glaeser & Kahn	2010	a	11	Red. gasoline consumption	PD	US	CORR	1	7.41	0.0974
EN15	Holden & Norland	2005	a	11	Red. domestic energy	HD	Norway	OLS	2	2.28	0.1100
EN16	Hong & Shen	2013	a	11	Red. CO2 transport	PD	US	OLS IV	4	1.79	0.3100
EN19	Larson et al.	2012	b	11	Red. residential energy	FACAP	US	OLS	2	1.16	0.0338
EN20	Larson et al.	2012	b	11	Red. residential energy	FACAP	US	OLS	2	1.16	0.0467
EN23	Muñiz & Galindo	2005	a	11	Red. ecological footprint	PD	Spain	OLS	2	2.38	0.3648
EN25	Norman et al.	2006	b	11	Red. CO2 emissions	HD	Canada	CORR	1	3.92	0.0890
EN26	Osman et al.	2016	a	11	Red. gasoline consumption	PD	Egypt	OLS	1	2.44	0.0354

ID	Author	Year	Cause	Cat.	Outcome	Density	Country	Model	SMS	CI	Elasticity
EN30	Su	2011	a	11	Gasoline consumption	PD	US	OLS CONTR	2	1.41	0.0680
EN31	Su	2011	b	11	Gasoline consumption	FSDI	US	OLS CONTR	2	1.41	-0.0920
EN32	Travisi et al.	2010	b	11	Env. impact reduction	PD	Italy	Pooled WLS	3	2.63	0.0092
EN34	Borck & Tabuchi	2016	a	11	CO2 Reduction	PD	US	Panel	3	0.79	0.4651
EN35	Fragkias et al.	2013	a	11	Red. CO2	PD	US	Panel	2	4.96	0.0017
C2	Couture et al.	2018	a	12	Travel speed	PD	US	OLS IV	4	2.82	-0.1300
C3	Duranton & Turner	2018	a	12	Travel speed	PD	US	Panel IV	4	1.30	-0.1100
MC6	Boarnet et al	2008	a	13	Miles walked per person	ED	US	LOGIT	2	1.57	0.0000
MC7	Boarnet et al	2011	a	13	Walking trips per person	ED	US	LOGIT	2	2.72	0.1400
MC8	Boarnet et al	2011	a	13	Walking trips per person	PD	US	LOGIT	2	2.72	0.5000
MC9	Boarnet et al.	2008	a	13	Miles walked per person	PD	US	LOGIT	2	1.57	0.1300
MC10	Boarnet et al.	2011	b	13	Walking trips per person	SC	US	LOGIT	2	2.72	-0.0900
MC11	Boarnet et al	2011	b	13	Walking trips per person	BS	US	LOGIT	2	2.72	-0.3500
MC12	Boarnet et al	2008	b	13	Miles walked per person	SC	US	LOGIT	2	1.57	0.4500
MC15	Boer et al.	2007	a	13	Miles walked per person	PD	US	LOGIT	2	1.58	0.2100
MC16	Boer et al.	2007	b	13	Miles walked per person	PD	US	LOGIT	2	1.58	0.3900
MC20	Cervero	2002	c	13	Transit mode choice	LU	US	LOGIT	2	2.98	0.5300
MC21	Cervero	2002	c	13	Transit mode choice	PD	US	LOGIT	2	2.98	0.3900
MC24	Cervero & Kockelman	1997	a	13	Non-personal vehicle	ED	US	LOGIT	2	3.43	0.0980
MC25	Cervero & Kockelman	1997	a	13	Non-pers. vehicle	ED	US	LOGIT	2	3.43	0.0840
MC28	Cervero & Kockelman	1997	a	13	Alternative to car (ACU)	LU	US	LOGIT	2	3.43	0.0000
MC29	Cervero & Kockelman	1997	b	13	Alternative to car (ACU)	SC	US	LOGIT	2	3.43	0.0000

ID	Author	Year	Cause	Cat.	Outcome	Density	Country	Model	SMS	CI	Elasticity
MC30	Cervero & Kockelman	1997	b	13	Alternative to car (ACU)	SC	US	LOGIT	2	3.43	0.0000
MC31	Cervero & Kockelman	1997	c	13	Non-person vehicle choice	LU	US	LOGIT	2	3.43	0.0000
MC34	Chao & Qing	2011	a	13	Walking choice	PD	US	OLS CONTR	2	2.14	0.1573
MC35	Chatman	2003	c	13	Driving choice	ED	US	LOGIT TOBIT	2	0.44	0.4373
MC36	Chatman	2009	a	13	Walk/bike trips per person	PD	US	BINOMIAL	2	3.13	0.1600
MC37	Chatman	2009	b	13	Walk/bike trips per person	SC	US	BINOMIAL	2	3.13	0.3000
MC41	de Sa & Ardern	2014	a	13	Walking/cycling choice	PD	Canada	LOGIT	2	0.36	0.1093
MC43	Fan	2007	b	13	Daily walking time per person	PCD	US	OLS	2	1.06	0.0800
MC44	Frank & Bradley	2009	b	13	Walk trips per household	FAR	US	OLS	2	0.33	0.2000
MC45	Frank	2009	c	13	Walk trips per household	LU	US	OLS	2	0.33	0.0800
MC46	Frank et al.	2008	a	13	Cycle choice	PD	US	LOGIT	2	3.03	-0.0800
MC47	Frank et al.	2008	a	13	Cycle choice	PD	US	LOGIT	2	3.03	0.8400
MC48	Frank et al.	2008	a	13	Transit mode choice	PD	US	LOGIT	2	3.03	0.2400
MC49	Frank et al.	2008	a	13	Transit mode choice	PD	US	LOGIT	2	3.03	0.2600
MC50	Frank et al.	2008	b	13	Walk choice	PD	US	LOGIT	2	3.03	0.2800
MC51	Frank et al.	2008	a	13	Walk choice	PD	US	LOGIT	2	3.03	0.4300
MC52	Frank et al.	2008	b	13	Transit mode choice	FAR	US	LOGIT	2	3.03	0.1700
MC53	Frank et al.	2008	b	13	Transit mode choice	SC	US	LOGIT	2	3.03	0.2400
MC54	Frank et al.	2008	c	13	Transit mode choice	LU	US	LOGIT	2	3.03	0.1900
MC56	Frank et al.	2008	b	13	Transit mode choice	FAR	US	LOGIT	2	3.03	0.2100
MC57	Frank et al.	2008	b	13	Transit mode choice	SC	US	LOGIT	2	3.03	0.2000
MC58	Frank et al.	2008	c	13	Transit mode choice	LU	US	LOGIT	2	3.03	0.0900

ID	Author	Year	Cause	Cat.	Outcome	Density	Country	Model	SMS	CI	Elasticity
MC59	Frank et al.	2008	b	13	Walk mode choice	SC	US	LOGIT	2	3.03	0.2800
MC60	Frank et al.	2008	b	13	Walk trips per household	SC	US	LOGIT	2	3.03	0.5500
MC61	Frank et al.	2008	b	13	Walk mode choice	SC	US	LOGIT	2	3.03	0.2100
MC63	Greenwald & Boarnet	2001	a	13	Walk trips per person	PD	US	PROBIT	2	0.07	0.3400
MC64	Joh et al.	2009	a	13	Walk trips per person	ED	US	OLS	2	0.34	0.1900
MC65	Joh et al	2009	b	13	Walk trips per person	SC	US	OLS	2	0.34	-0.2700
MC66	Joh et al	2009	b	13	Walk trips per person	BS	US	OLS	2	0.34	0.0100
MC68	Cervero & Kockelman	1997	a	13	Walk/bike mode choice	ED	US	OLS	2	0.87	0.0000
MC69	Cervero & Kockelman	1997	a	13	Walk/bike mode choice	PD	US	OLS	2	0.87	0.0000
MC70	Cervero & Kockelman	1997	c	13	Walk/bike mode choice	LU	US	OLS	2	0.87	0.2300
MC73	Lund et al.	2004	b	13	Transit mode choice	SC	US	LOGIT	2	1.14	1.0800
MC79	Nielsen et al.	2013	a	13	Cycle distance	PD	Denmark	Heckman	2	1.86	0.0870
MC81	Pouyanne	2004	a	13	Car share rate	PD	France	OLS, LOGIT	2	0.34	-0.0210
MC82	Pouyanne	2004	a	13	Cycling choice	PD	France	OLS, LOGIT	2	0.34	2.0143
MC83	Pouyanne	2004	a	13	Public transport choice	PD	France	OLS, LOGIT	2	0.34	0.4203
MC84	Pouyanne	2004	a	13	Walking choice	PD	France	OLS, LOGIT	2	0.34	0.4390
MC85	Rajamani & Handy	2003	c	13	Transit mode choice	LU	US	LOGIT	2	1.04	-0.0400
MC86	Rajamani et al	2003	a	13	Walk mode choice	PD	US	LOGIT	2	1.04	0.0100
MC87	Rajamani et al	2003	c	13	Walk mode choice	LU	US	LOGIT	2	1.04	0.3600
MC88	Reilly & Landis	2002	a	13	Transit mode choice	PD	US	LOGIT	2	0.36	0.2000
MC89	Reilly	2002	a	13	Walk mode choice	PD	US	LOGIT	2	0.36	0.1600
MC90	Rodríguez & Joo	2004	a	13	Transit mode choice	PD	US	LOGIT	2	2.80	-0.2000

ID	Author	Year	Cause	Cat.	Outcome	Density	Country	Model	SMS	CI	Elasticity
MC93	Targa et al.	2005	a	13	Walk trips per person	PD	US	Poisson	2	0.35	0.0300
MC94	Targa & Clifton	2005	b	13	Walk trips per person	BS	US	Poisson	2	0.35	0.3200
MC95	Targa & Clifton	2005	c	13	Walk trips per person	LU	US	Poisson	2	0.35	0.0800
MC98	Zegras	2007	b	13	Daily automobile use	BD	Chile	OLS -LOGIT	2	0.89	-0.0400
MC99	Zegras	2007	b	13	Automobile use per household	SC	Chile	OLS -LOGIT	2	0.89	-0.1500
MC100	Zegras	2007	c	13	Automobile use per household	LU	Chile	OLS -LOGIT	2	0.89	-0.0100
MC101	Zhang	2004	a	13	Driving choice red.	ED	Hong Kong	LOGIT	2	1.63	0.0700
MC102	Zhang	2004	a	13	Driving choice red.	PD	Hong Kong	LOGIT	2	1.63	0.1100
MC103	Zhang	2004	a	13	Driving choice	ED	Hong Kong	LOGIT	2	1.63	0.0770
MC104	Zhang	2004	a	13	Driving choice	PD	Hong Kong	LOGIT	2	1.63	0.0390
MC105	Zhang	2004	a	13	Taxi red.	ED	Hong Kong	LOGIT	2	1.63	0.0240
MC106	Zhang	2004	a	13	Taxi red.	PD	Hong Kong	LOGIT	2	1.63	0.1280
MC107	Zhang	2004	a	13	Taxi red.	ED	Hong Kong	LOGIT	2	1.63	0.1180
MC108	Zhang	2004	a	13	Taxi red.	PD	Hong Kong	LOGIT	2	1.63	0.0260
MC109	Zhang	2004	a	13	Public transport choice	ED	Hong Kong	LOGIT	2	1.63	0.0060
MC110	Zhang	2004	a	13	Public transport choice	PD	Hong Kong	LOGIT	2	1.63	0.0140
MC111	Zhang	2004	a	13	Transit choice	ED	Hong Kong	LOGIT	2	1.63	0.0110
MC112	Zhang	2004	a	13	Transit choice	PD	Hong Kong	LOGIT	2	1.63	0.0050
MC113	Zhang	2004	a	13	Driving choice red.	ED	US	LOGIT	2	1.63	0.0010
MC114	Zhang	2004	a	13	Driving choice red.	PD	US	LOGIT	2	1.63	0.0400
MC115	Zhang	2004	a	13	Car share red.	ED	US	LOGIT	2	1.63	0.0030
MC116	Zhang	2004	a	13	Car share red.	PD	US	LOGIT	2	1.63	0.0330

ID	Author	Year	Cause	Cat.	Outcome	Density	Country	Model	SMS	CI	Elasticity
MC117	Zhang	2004	a	13	Car share red.	ED	US	LOGIT	2	1.63	0.0440
MC118	Zhang	2004	a	13	Car share	PD	US	LOGIT	2	1.63	0.0710
MC119	Zhang	2004	a	13	Driving choice	ED	US	LOGIT	2	1.63	0.0310
MC120	Zhang	2004	a	13	Driving choice	PD	US	LOGIT	2	1.63	0.0440
MC121	Zhang	2004	a	13	Public transport choice	ED	US	LOGIT	2	1.63	0.0040
MC122	Zhang	2004	a	13	Public transport choice	PD	US	LOGIT	2	1.63	0.1260
MC123	Zhang	2004	a	13	Transit choice	ED	US	LOGIT	2	1.63	0.0900
MC124	Zhang	2004	a	13	Transit choice	PD	US	LOGIT	2	1.63	0.1180
MC125	Zhang	2004	a	13	Walking/cycling choice	ED	US	LOGIT	2	1.63	0.0040
MC126	Zhang	2004	a	13	Walking/cycling choice	PD	US	LOGIT	2	1.63	0.0600
MC127	Zhang	2004	a	13	Walking/cycling	ED	US	LOGIT	2	1.63	0.0260
MC128	Zhang	2004	a	13	Walk choice	PD	US	LOGIT	2	1.63	0.1050
MC129	Zhao	2014	a	13	Cycling choice	ED	China	LOGIT	2	2.78	0.1265
MC130	Zhao	2014	a	13	Cycling choice	PD	China	LOGIT	2	2.78	0.0034
MC133	Zhao	2014	a	13	Walking choice	ED	China	LOGIT	2	2.78	0.0418
MC134	Zhao	2014	a	13	Walking choice	PD	China	LOGIT	2	2.78	0.0013
MC135	Cervero & Kockelman	1997	a	13	Non-pers. vehicle	ED	US	LOGIT	2	3.43	0.1130
H1	Chaix et al.	2006	a	14	IHD risk red.	PD	Sweden	Panel LOGIT	3	2.40	-0.2986
H2	Chaix et al.	2006	a	14	Lung cancer risk red.	PD	Sweden	Panel LOGIT	3	2.40	-0.1949
H3	Chaix et al.	2006	a	14	Pulmonary disease red.	PD	Sweden	Panel LOGIT	3	2.40	-0.5779
H4	Fecht et al.	2016	a	14	Premature mortalities	PD	UK	CrossSec	2	2.40	-0.2900
H5	Fecht et al.	2016	b	14	Premature mortalities	SDI	UK	CrossSec	2	1.22	-0.5000

ID	Author	Year	Cause	Cat.	Outcome	Density	Country	Model	SMS	CI	Elasticity
H6	Graham & Glaister	2003	a	14	KSI reduction	ED	UK	LOGLIN	2	0.88	-0.0510
H7	Graham & Glaister	2003	a	14	KSI reduction	PD	UK	LOGLIN	2	0.88	0.3990
H9	Graham & Glaister	2003	a	14	Pedestrian casualty red.	ED	UK	LOGLIN	2	0.88	-0.8260
H10	Graham & Glaister	2003	a	14	Pedestrian casualty red.	PD	UK	LOGLIN	2	0.88	0.5290
H12	Howe et al.	1993	a	14	Red. all cancer rate	PD	US	COR	1	0.51	-0.0550
H14	Mahoney et al.	1990	a	14	Mortality red. (all cancers)	PD	US	LOGIT	2	2.55	-0.0380
H15	Melis et al.	2015	a	14	Red. metal health prescript.	PD	Italy	OLS, panel	2	1.54	0.0127
H16	Reijneveld et al.	1999	a	14	Mortality red.	PD	Netherlands	LOGLIN	2	0.29	-0.0906
WB3	Brueckner & Largey	2006	a	15	# times attends club meeting	PD	US	PROBIT IV	4	1.10	-0.0796
WB4	Brueckner & Largey	2006	a	15	# people can confide in	PD	US	PROBIT IV	4	1.10	-0.0056
WB5	Brueckner & Largey	2006	a	15	# close friends	PD	US	PROBIT IV	4	1.10	-0.0081
WB6	Brueckner & Largey	2006	a	15	Social contacts	PD	US	PROBIT IV	4	1.10	-0.0159
WB7	Brueckner & Largey	2006	a	15	Visit neighbour/week	PD	US	PROBIT IV	4	1.10	-0.0446
WB8	Fassio et al.	2013	a	15	Self-rep. env. health	PD	Italy	COR	1	1.97	-0.3384
WB9	Fassio et al.	2013	a	15	Self-rep. social satisfaction	PD	Italy	COR	1	1.97	-0.4232
WB10	Fassio et al.	2013	a	15	Self-rep. physical health	PD	Italy	COR	1	1.97	-0.1380
WB11	Fassio et al.	2013	a	15	Self-rep. psychological status	PD	Italy	COR	1	1.97	-0.3189
WB12	Glaeser et al.	2016	a	15	Self-rep. well-being	PD	US	Panel	3	1.30	-0.0037
WB13	Harvey et al.	2015	b	15	Perceived safety	FAR	US	OLS, LOGIT	2	1.07	0.0690
WB10	Fassio et al.	2013	a	15	Self-rep. physical health	PD	Italy	COR	1	1.96	-0.1380

Paper IV

5 A permanent (re)construction site? Changing Urban Form and Resident Value of Urban Amenities

"There is no logic that can be superimposed on the city; people make it, and it is to them, not buildings, that we must fit our plans."
— **Jane Jacobs**

5.1 Introduction

Rapid urban development is a major feature of many less-developed countries.[44] While we generally think of rapid urbanization taking the form of 'informal' or 'illegal' settlements in low- and middle-income countries, notably 'peripheries' (Roy 2005; Roy 2009b) that develop as urban slums, motives for urban illegality often go beyond the production of housing for low-income city dwellers (Fawaz 2009; Heyman 1999; Nientied & van der Linden 1990). The state and planning agencies have been deliberately involved in the production of illegality in various Global South contexts (Fawaz 2017), contributing to deregulated and unplanned urban development which often leads to blatant transformations of urban form.

Beirut is no exception. Through the urban renewal process driven by a well-resourced Lebanese diaspora and foreign investment since the early 2000s, Beirut has become a permanent (re)construction site. Urban planning is characterized by neoliberal tendencies and a public–private overlap which has allowed discourses of real-estate profit to hijack notions of urban amenities (Ashkar 2018). This has been paired with demolition-based urban restructuring for maximum profit. Fawaz (2017, p.94) highlights the prevalence of the practice of issuing 'exceptions' or temporary suspensions of the law in the daily practices of public planning agencies as they manage the production of the built environment in Beirut.

Over the past few decades, most neighbourhoods in municipal Beirut have thus undergone conspicuous alterations, resulting in dramatic changes to the city's

[44] By 2025, more than 90% of new urbanities will locate in low-income countries (United Nations Population Fund 2007), which are already characterized by explosive growth of population, low stages of economic development and poor state of the urban environment (Pugh 2013).

landscape, housing stock and people–space relations (Gebara et al. 2016). The deregulated planning framework has in many cases led to the deterioration of urban environments and to social-cultural instabilities, in many ways opposing the wide-ranging consensus among planners and policymakers of the importance of sustainable urban growth (World Economic Forum 2019; UNDP 2017; Pugh 2013; Knox 1993). Although recent work has considerably furthered our understanding of deregulated planning in Beirut (Krijnen & Fawaz 2010; Fawaz 2017; Bou Akar 2018; Krijnen 2010), little is known of the preferences and responses of local residents in relation to the urban development process.

In order for policy or urban interventions to attempt to enforce collectively rational behaviour and adherence to local values, the latter should be uncovered and analysed. This paper contributes to such an exploration and analysis, building on ongoing research into strategies to protect and enhance Beirut's social and architectural diversity by exposing, as far as that is possible, residents' complex and multiple values in this regard. Specifically, this paper investigates how changing urban form affects how residents value both physical environments and intangible urban amenities, specifically architectural amenities[45], open space (specifically sidewalks) and neighbourhood belonging. The study first explores satisfaction with and preferences attached to these amenities and investigates whether they vary across socio-economic characteristics. The paper then uses stated preference to assess indicative monetary values, and asks: in a context of continual construction with no public consultation, are residents still willing to pay (WTP) to preserve architectural amenities and public space? And given the climate of 'exceptions' present in urban planning in Beirut, does mistrust in local government affect WTP?

This study uses a novel data set and two case-study neighbourhoods as entry points to examine the relationship between construction rates as indicators of building change (BC) and resident value of neighbourhood amenities. The two middle-income neighbourhoods, Ras Beirut and Mar Mikhael, were selected as case studies because the former has undergone substantial change in urban form over the last few decades whereas the latter has only recently seen changes to its urban fabric. These

[45] Architectural amenities in this paper refer to locally valued heritage and modern heritage buildings. I have preferred not to identify them as heritage buildings within the discourse of this paper as most such buildings are not legislatively recognized as heritage in light of the limitations of Lebanese conservation policy system but are instead recognized by local actors and communities.

neighbourhoods were also chosen as both areas present multiple cases of urban illegality linked to the production of housing for profit (Fawaz et al. 2018; Khechen 2018).

This study uses a mixed methods strategy of qualitative and quantitative research techniques in order to provide triangulation of the results (Greene et al. 1989; Greene 2007; Johnson et al. 2007) and to obtain a comprehensive appreciation of the complex relationship between changing urban form and the value residents attach to their urban environments in Beirut. Three principal modes of analysis were used: descriptive statistics, survey-based stated preferences techniques, and textual analysis of discursive survey and interview elements. Survey-based stated preference techniques ask individuals to choose between a number of response options or place a monetary value on a good presented in a hypothetical scenario (see Alberini & Kahn, 2006; Bateman et al., 2002 for comprehensive reviews). While descriptive statistics and contingent valuation (CV) are used to identify underlining patterns of resident preferences according to the BC rates of their location of residence, analysis of open-ended survey responses and interviews allows for a better understanding of the reasons behind resident preferences.

CV has been widely used to elicit citizens' preferences and their WTP for the preservation of architectural amenities or open or green spaces (Provins et al. 2008; Alberini et al. 2003), including in less-developed countries where the quality of the urban environment has been increasingly recognized as a key determinant of quality of life (Whittington 2010). A common aspect of CV studies in these contexts, however, is the occurrence of protest responses, which has attracted growing attention from scholars and practitioners. These are defined as responses in which respondents reject some aspect of the contingent market rather than reveal their true preferences, thus jeopardizing the validity of the WTP estimates (Calia & Strazzera 2000; Szabó 2011). One possible reason associated with protest responses is respondents' distrust of authorities, or in this case, of planning agencies in conjunction with developers responsible for changes in urban environment (Oh & Hong 2012). This paper accounts for this possibility in the Lebanese context by analysing motives for lack of WTP through textual analysis and attempts to account for mistrust in governance through the inclusion of a confidence in government indicator (CGOV) in the WTP regressions.

The paper proceeds as follows. Section 2 first discusses neoliberal planning in the Lebanese context and 'exceptions' as one of Beirut's principal planning strategies, and then explores how changes in urban form can affect the values residents attach to architectural amenities, open spaces and neighbourhood belonging. Section 3 introduces the construction rate and survey data, defines the main variables used and discusses the mixed-methods approach. Section 4 presents findings on overall perceptions of BC, while section 5 presents the different relationships between construction rates and the value residents attach, respectively, to architectural amenities, open space and neighbourhood belonging. In section 6 I discuss the WTP results, revealing a stable negative relationship between WTP to stop new building and rate of BC, and a similar negative relationship between WTP and confidence in local governance. Section 7 sets out the conclusions of the study.

5.2 A permanent construction site

5.2.1 Planning as a political decision versus planning as a technical activity

Heavy construction is widespread across municipal Beirut. It is worth noting, as argued by Ashkar (2018), that unlike most other Middle Eastern countries, Lebanon never developed a social welfare state system, and in many ways Lebanon moved directly from economic liberalism to neoliberalism (Harvey 2005). Neoliberal tendencies facilitate the circulation of capital to the real-estate sector and foster intensive construction practices (Fawaz 2017; Krijnen 2018; Krijnen & Fawaz 2010).

The Lebanese Law of Construction sets out the conditions required to obtain a construction permit. This Law is applied across the Lebanese territory but is restricted by the relevant Master Plan at the local level (Ashkar 2018). Beirut's Master Plan has not been updated since 1954, and most efforts to amend it have been hindered by political pressure. The Master Plan is basic and lacks meaningful restrictions on development or height limits. The Law of Construction is, on the other hand, periodically amended. Article 16 of the Lebanese Construction Law and its 2004 revision (followed by two Enforcement Decrees in 2005 and 2007) enlarged the permissible building envelope and stipulated that land developers could benefit from exemptions to the Total Coefficient of Exploitation (TCE) (Ashkar 2011). This allowed further height exploitation, best viewed in terms of financial profit, as higher floor generate more income than lower ones, with the price of apartments in Beirut typically increases by at least US$100 per square metre per floor (Ashkar 2011). Such projects are transforming both the skyline and the social make-up of Beirut as they are clearly not targeted at the majority of the city's long-term dwellers, but mostly cater to the wealthy or Lebanese expatriates and other nationals investing in multi-million-dollar apartments.

Despite the loose development regulation, the prevalence of the issuance of 'exceptions' or temporary suspensions of the law to bolster profitable development even further is common practice. This is an example of the rise of state-led informal planning practices happening in many Global South cities (Roy 2005; Roy 2009a). Fawaz (2017) argues that 'exceptions' constitute one of Beirut's principal planning strategies, originating in clear continuities between the realms of the legal and the illegal, given the entanglement of the political elite and the real-estate industry. This argument inscribes itself in a body of work that traces the relationship between political gain and tolerance of forms of informality, where legality rests on the power of state actors who determine what is and is not legal to their own advantage (Smart 2001; Roy 2009a). Decisions frequently disguise political motives and rarely reflect the technical planning imperatives in place (Portes et al. 1989; Braverman 2007).

Planning as a government decision and planning as a technical activity are clearly at odds here (Alexander et al. 2012). In this case, it is not 'society collectively deciding what urban change should look like', as Rydin (2013, p.12) asserts, but is quite the opposite. The climate of 'exceptions' reveals a struggle over the right to the city, where low-income dwellers are mostly subject to insecure housing or need to relocate to the city's peripheries and partake in long commutes, while incentives are extended to wealthy developers to enable high-end buildings. It can therefore be assumed that patterns of urban and neighbourhood change are reshaping communities and altering the cohesion of societies.

It comes as no surprise that these dynamics have led to significant morphological densification in the city. Morphological density refers to the density of the built environment and captures aspects such as compact urban land cover, street connectivity, and a high building footprint to parcel size ratio (Neuman 2005; Churchman 1999).[46] Beirut's case is characterized by parcel aggregation and exploitation of building height (Khechen 2018; Verdeil 2002). Unsurprisingly, morphological densification has been paralleled by changes in population.[47] Notably, there have been changes in the demographics and socioeconomic backgrounds of local

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[46] This can also be referred to as the densification of built form: a measure of the intensity of development in relation to available ground-level open space.

[47] The population of Lebanon is unevenly distributed among regions: one third of the population resides in the Greater Beirut Area (GBA), occupying only 233 km^2 (2% of Lebanon's total area). The Greater Beirut Area is subject to pressures arising from population growth and economic expansion (Faour & Mhawej 2014).

populations, not only as a result of internal displacement trends but also of the influx of displaced individuals and families following the Syrian crisis (UNHCR & UNHabitat 2014). Many displaced people reside in costly middle-income neighbourhoods – such as this paper's case studies Ras Beirut and Mar Mikhael – because of close access to services and jobs, inserting themselves as best they can, often in informal or unserviced housing units within these areas (Pietrostefani 2019). Although this paper will not be focusing on the effects of population change on local neighbourhoods, it will be accounting for it in its analysis, given its important impact on this context.

5.2.2 Resident value of urban environments

In considering whether morphological change affects how residents value their urban environments, this paper focuses on three aspects: the value residents attach to architectural amenities, open space (principally sidewalks) and neighbourhood belonging. These three aspects were selected because of their relevance to the Lebanese context. The paper focuses on both physical and immaterial amenities, as morphological change may influence both objective (visual, aesthetic) and subjective (social or symbolic) dimensions of neighbourhood satisfaction (Young et al. 2004). This section gives an overview of the relevant literature, linking it to the central concerns in the chosen context.

Although I am not aware of any studies exploring the relationship between changing urban form and values attached to either physical or intangible urban amenities, there is a large body of work on the effects of changing urban form on various subjective outcomes. Improved access due to morphological density can increase social well-being, as can agreeable dense urban environments (Vorontsova et al. 2016; Churchman 1999). Morphological density can, however, have negative effects on well-being, due to a lower overall sense of community (Wilson & Baldassare 1996), anxiety, stress, social withdrawal, and a feeling of loss of control (Chu et al. 2004; Churchman 1999). It can also negatively affect perceptions of space, and tall, dense structures obstruct views, cause shadowing, reduce open space, and give a visual sense of lack of proportion (Hitchcock 1994).

5.2.2.1 Architectural amenities and open space

Height of buildings and amount and quality of open space have been recognized as being among the most important attributes of urban space in environmental psychology (Stamps & Nasar 1997; Alberini et al. 2003). Both buildings of architectural value and open space (as opposed to built space) have also been recognized as land-based public goods in both urban planning and urban economic discourses (Ahlfeldt & Holman 2018; Brander & Koetse 2011; Ward 2004). Studies thus confirm a demand for well-designed buildings, heritage buildings and new architectural designs, and open space in contemporary urban environments.

The value attached to buildings is particularly relevant in Beirut, given both the urban landscape's extensive transformations and the associations attached to architectural styles and types of building. Connotations of wealth attached to high-rise buildings are easily understood, following the discussion in section 2.1. Urban heritage buildings and older building stock, although valued by practitioners, academics and non-governmental agencies (Hilton 2017; Davie 2004; Saliba 2013), are 'often disregarded or devalued' by much of the Lebanese population, as illustrated by various interviewees, even though these buildings largely represent the remaining part of the city's affordable housing stock (Fawaz et al. 2018).

Urban open space provides a number of valuable services to urban populations, including recreational opportunities, aesthetic enjoyment and environmental functions (Brander & Koetse 2011). Considerable advances have been made in urban open-space research, influenced by a growing concern for the quality of urban environments and the importance of the role of open space in achieving sustainable neighbourhoods (Francis 1987; Al-Hagla 2008). Traditionally, open spaces are identified as parks, green spaces, playgrounds and squares as well as undeveloped land. In Beirut, however, the widespread privatization of public spaces, often associated with the construction of new buildings or private leisure facilities (Fawaz 2014; Saksouk-Sasso 2019), has resulted in sidewalks often performing the role of open spaces. Sidewalks are spaces often appropriated by residents because of a lack of other public spaces (Ghandour & Fawaz 2010; Seidman 2009). As illustrated in Figure A1 of the appendix, most open space in Ras Beirut are private, and numerous gatherings in public spaces are on sidewalks or edges of buildings. Given the different nature of sidewalks from that of parks or squares, residents may also attach a different value to these amenities than to more traditional forms of open space. Brander & Koetse (2011) also underline the important regional differences in preferences for open space, which may constrain the potential for transferring estimated values between places.

5.2.2.2 Neighbourhood Belonging

Understanding the meaningful relationships that people have with place(s) has been of academic interest for several decades. Patterns of urban and neighbourhood change are reshaping communities and altering the cohesion of societies. Neighbourhood is a central element within both social geography and environmental psychology in understanding and explaining people's sense of attachment to places, defined as meaningful locations (Lewicka 2011; Lewicka 2010). Neighbourhood belonging can represent an emotional bond to a place and is usually seen as positive as it can result in local social networks and engagements associated with well-being and building of community identity (Finney & Jivraj 2013). It is important to note, however, that neighbourhood relationships and senses of belonging are not universal, and some residents will always be excluded.

Neighbourhoods have both concrete and symbolic definitions (Blokland-Potters 2003, p.213). As presented by Watt & Smets (2014, p.8), the neighbourhood is characterized by the 'spatial' – it is a locally bounded place; the 'social' – it involves sets of social relations between neighbours; and the 'symbolic' – it has an imaginative, symbolic component. The social and symbolic are meaningful to a neighbourhood's residents, even though there can be a lack of congruence over what that meaning is. Indeed, social and symbolic aspects are frequently linked to the concept of community (Watt & Smets 2014, p.6), where locals, longstanding residents, new comers and ex-residents experience living in places differently, and are often part of separate communities, often resulting in multiple senses of *belonging* (Bailey et al. 2012). Neighbourhood relationships are an important feature of the Lebanese value system, and this paper aims to explore, in the second instance, whether morphological change affects these sociospatial relationships or whether they are driven by socio-economic characteristics.

Recent studies have assessed relationships between population change and neighbourhood belonging, producing somewhat different results (Finney & Jivraj 2013; Clark & Coulter 2015; Bailey et al. 2012). The contrasting results suggest that *type*[48] of local population change matters in relation to feelings of neighbourhood belonging. In addition, the impact of population change on belonging may be experienced differently by different ethnic groups (Finney & Jivraj 2013). To this author's knowledge, however, beyond sociological commentaries (Watt & Smets 2014), there is no available literature on the relationship between change in physical urban form and neighbourhood

[48] The arrival of racialised 'others' in a given neighbourhood can be perceive 'to disrupt the cultural familiarity of place' (Watt 2010, p.154), but the arrival of individuals more similar to longstanding populations may not be seen as disrupting (Laurence & Heath 2008).

belonging. This paper contributes to filling this gap, while accounting for population change given its prevalence to the context.

5.3 Data and Methodology

5.3.1 Measuring building change

Until recently, only a limited number of visual and quantitative records were available documenting the conspicuous construction activities that have taken place in Beirut in the last 20 years. To investigate the relationship between changing urban form and the value residents attach to their urban environments I exploit a recently assembled data set on construction permits between 2000 and 2013 (Gebara et al. 2016). Building permits reflect the intentions of financiers to invest and of builders to launch projects, according to their anticipation of real-estate activity. The data was verified and updated until 2017 for the neighbourhoods of Ras Beirut and Mar Mikhael. Site visits were conducted and only data relating to projects that were actually built was retained.[49] Other limitations linked to the data set are discussed in section 2.2 of the appendix or more thoroughly in Gebara et al. (2016). Construction permits are thus adopted as a key indicator of changing urban form and morphological densification. Other changes in urban form are of course present but difficult to measure. The data was instrumental in the site-selection of this study as it allowed the identification of areas which have experienced different rates of construction (Figures A2 and A3 in the appendix) and it confirmed two main trends in construction patterns throughout the city: the concentration of developments in prime city locations and the domination of a demolition-based form of urban restructuring.

In order to identify whether and how changing urban form affects the value residents attach to urban amenities, areas that had undergone different rates of construction were identified. The selection process was carried out as follows. The city of Beirut was divided in a fishnet grid of 200 metre by 200 metre square cells, as illustrated in Figure 1. The cells were then limited to the squares overlapping the areas of Ras Beirut and Mar Mikhael. Given the great limitation of geolocalized micro-data in Lebanon, these areas were selected for their data availability, as previous geolocalized surveys were run in 2009 (Ras Beirut) (Kaddour et al. 2014) and 2011 (Mar Mikhael) (Buccianti-Barakat et al. 2015) giving me access to indicative measures of population change for both areas. The

[49] It is possible that some building permits have been cancelled or that construction activities have been postponed as construction permits have a six-to-eight-year period of validity.

definition of these areas as cohesive neighbourhoods is presented in section 3.1 of the appendix.

The building permit data was used to construct a simple index of building change BC_c as follows:

$$BC_c = \frac{\sum_{b=1}^{n} BUP_{cb}}{area_c}$$

where BUP_b is the sum of the *super built-up areas*[50] *b* of all new developments within each square *c* and $area_c$ is simply the area of each square *c*, in this case 0.04 square kilometres. Once the building change ratio had been calculated, the squares were divided into quartiles, from areas of high BC to areas of low BC, as distinct treatment and control areas would have been contextually inappropriate.[51] In Figure 1, red areas display high rates of BC (more than 13% of the area of a given square), yellow areas display medium rates of BC (7-13%), light green areas display low rates (5-7%) while dark green areas display almost no change to the urban fabric (<5%). For closer-up illustrations of the classification grid and more details on the BC index please see section 4.1 of the appendix.

Ras Beirut and Mar Mikhael are currently both prime locations, both being middle-income neighbourhoods with main roads, presenting comparable access to and quality of commercial amenities, and with very similar house price trends in the last five years (RAMCO 2015). Moreover, despite the wealth of these neighbourhoods, recent research (Public Works Studio 2016; Public Works Studio 2018; Pietrostefani 2019) has confirmed the presence of a significant number of low-income families in both areas, using abandoned buildings, ad-hoc structures on roofs and in courtyards or renting very small spaces for close access to services and jobs.

Despite their similarities, Figure 1 indicates that Ras Beirut presents higher building change rates than Mar Mikhael. The main reason is that Mar Mikhael only became a prime location in 2010 (Fawaz et al. 2018) whereas Ras Beirut has been one of Beirut's most diverse and cosmopolitan neighbourhoods for many years (Khechen 2018; Kaddour et al. 2014), thus enticing market-led development. The better the location in

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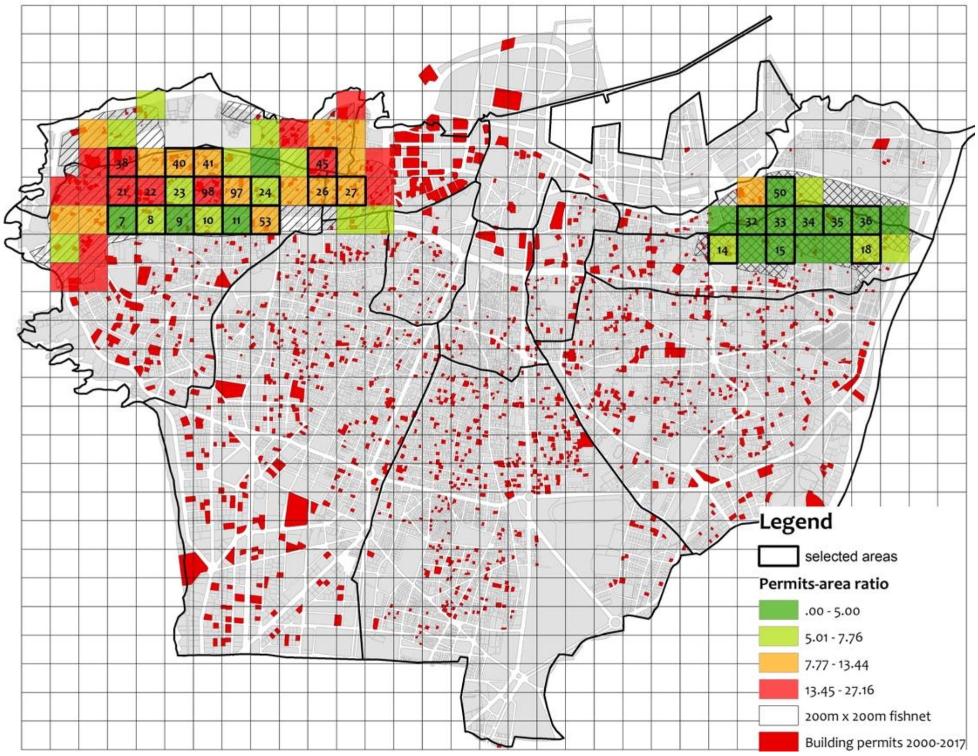
[50] In urban planning, 'super built-up area' refers to the carpet area + wall area + common area.

[51] Quartile classification slightly varies according to whether it is calculated over the whole sampling area or only considering sampled squares. This paper uses the classification as calculated over the whole sampling area; however, the analysis was also run with the alternative and results did not significantly differ.

terms of prestige, historical reputation and open views (including sites with high elevation), the higher the built-up area of new projects is likely to be (Gebara et al. 2016).

Figure 1 Sampling grid



Given its different history, Mar Mikhael has managed to retain a significant proportion of buildings from the 1950s despite recent constructions, while Ras Beirut's buildings date principally from the 1975 onwards. To date, a significant number of new projects in both these prime locations have been given exceptional building permits, allowing their developers to bypass zoning regulations and exceed permissible TCE (Krijnen & Fawaz 2010).[52] Despite the differences in construction rate, both neighbourhoods have been subject to demolition-based construction. Eighty-three percent of authorized construction projects were planned on constructed parcels of land as of the 2004 occupation status in Ras Beirut and eighty-seven percent in Mar Mikhael (Gebara et al. 2016).

5.3.2 Mixed methods : survey and interview data

This study uses a mixed methods strategy of qualitative and quantitative research techniques in order to provide triangulation of the results (Greene et al. 1989; Greene 2007; Johnson et al. 2007). It draws on regression analysis of a household survey to identify patterns and detect the relative magnitudes of resident preferences for the

[52] Total Exploitation Coefficient is 5 in Ras Beirut and 2.5 in most of Mar Mikhael.

urban amenities considered. In the absence of panel or other cross-section comparisons with variables of interest to control for endogeneity, qualitative data is used to complement, validate and develop the results obtained from that analysis (Lieberman 2005; Greene 2007). Primary data collection was the only possible means of obtaining quantitative data on values residents attach to their urban environments at a detailed level. A household survey was consequently designed, and over one thousand households were surveyed in the two selected neighbourhoods. The geo-localized survey observations were then mapped through Geographical Information Systems (GIS), and matched to the new constructions data.[53] Analysis of open-ended survey responses and interviews then allowed for a better understanding of the reasons behind resident preferences. More information on survey design and sampling is detailed in section 3.1 of the appendix.

In the first instance, this paper aims to understand whether the value residents attach to architectural amenities and sidewalks as open spaces is related to the rates of morphological change undergone in the areas they live in. To evaluate these relationships, I use a series of variables evaluating the value residents attach to urban heritage and well-designed modern building and a series of variables on resident satisfaction with open areas and use of sidewalks. I also consider variables assessing resident confidence in legislative or action-led mechanisms to protect the integrity of the urban environment. A wide range of socioeconomic characteristics were also collected, including age, sex, nationality, education, income, housing tenure and religion. Two main sets of CV questions were also presented to respondents to evaluate relationships between rates of BC and WTP a) to stop excessive building and b) to improve sidewalk conditions.

To evaluate the relationship between neighbourhood belonging and rates of morphological densification a series of questions measuring neighbourhood experience, identity, belonging, friendships and relationships and civic participation are compiled to create a *Neighbourhood Belonging* indicator. An assortment of questions is typically used to measure neighbourhood attachment for clarity and simplicity, and to

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[53] The final sample covers 7.7% of the estimated population and 21.5% of total households in the randomly selected 27 squares. Surveys were conducted face-to-face and the sample was drawn so as to cover the principal nationalities resident in these neighbourhoods, with a 95% confidence level and 5% margin of error. The squares selected also ensured that the sample geographically overlapped by 70% with data previously collected in these neighbourhoods so as to be able to control for population change.

directly access perceptions of belonging, without normative assumptions about whether this is positively or negatively experienced (Finney & Jivraj 2013).[54] The overall indicator used in this paper measures the degree to which residents feel attached to their neighbourhood with respect to ties they have with individuals located in their area. It also integrates the likelihood of residents of a certain neighbourhood to stay in their area. The full list of variable descriptions is presented in Table A3 of section 3.4 of the appendix, summary statistics of main variables are presented in Table 1 and complementary variables are itemised in Table A4 section 4.1 of the appendix.

The impact of changing urban form on value of architectural amenities and neighbourhood belonging are analysed using simple logistic models. These models illustrate the relationships between BC rates and our different variables of interest *(Y)*, notably *value of architectural amenities*, *signing a petition objecting a major change in your neighbourhood* and *neighbourhood belonging*, controlling for demographic and socioeconomic characteristics (age, nationality, gender, education, income, etc.), and other relevant variables (housing tenure, length of residence in the neighbourhood)[55] (Lewicka 2011). Both ordinal logistic regression and binary logistic models are used. Weights compensated for unequal sampling rates and for the possibility that certain population elements may not have been included in the frame used for sampling. This was done in an attempt to reduce bias in the survey (Brick & Kalton 1996). The model is then replicated using WTP as the dependant variable to evaluate the effect of BC rates on the expected probability of WTP to stop excessive building and to improve sidewalk conditions. Given the climate of deregulated planning and public-private overlap discussed in section 2.1, in the WTP regressions, I also attempt to account for a possible bias in stated WTP in light of mistrust with developers and governmental institutions by controlling for a confidence in local government.

Although overall questions were multiple choice in the survey, I included selected questions allowing for longer discursive elements to disentangle resident opinions about their neighbourhood environments and allowing for a mixed-methods approach.

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[54] The set of questions selected was adapted from the *Understanding Society* survey (Knies 2014) and resulted in eight questions (Table A1 in appendix) on a 5-point scale from *Strongly agree* to *Strongly disagree* and one asking for the number of neighbours known by name.

[55] This cross-section data allows me to regress controlling for a number of variables (socio-econ and neighbourhood characteristics). These variables control for the potential correlation of place and individual-specific variables on the outcome of interest. As in any cross-sectional paper, I cannot rule out the possibility that other omitted variables may be correlated with the outcome of interest, and therefore I do not claim a causal effect.

For instance, after the WTP questions, debriefing questions were asked with the aim of understanding reasons for non-WTP, followed by attitudinal questions pertaining to potential protest attitudes. In many empirical studies, non-WTP respondents are required to state the reasons for their choices, in order to distinguish protesters from genuine zero responses (Calia & Strazzera 2000). My aim is to detect which percentage of respondents were not WTP because they believed developers 'would build anyway' or because 'there is no way of stopping them'. Public trust in governments has declined significantly over the past decades, and such a declining trend is often more apparent in countries with well-known political unrest like Lebanon (Bou Akar 2018). Qualitative interviews were also conducted with six local community-based organizations, three in each neighbourhood, and with one administrative official in each neighbourhood to unpick some of the subtleties that emerged in the quantitative analysis. At all stages, anonymity was assured, and informed consent gained. More details on the data collection can be found in section 3.3 of the appendix.

Table 1 Summary Statistics

	mean	sd	min	max
Urban Change Ratio				
Urban Change Ratio	7.24861	4.901557	0	19.39
Urban Change Ratio (quartile)	2.441706	1.092568	1	4
Willingness to Pay				
WTP to stop development (image)	2.969668	2.352485	1	9
WTA development (image)	2.548134	2.476267	1	9
WTP to improve sidewalk	2.972947	1.609703	1	8
Control variables				
Age [a]	3.280569	1.246228	1	5
Nationality [b]	1.312796	.6026328	1	3
Gender [c]	1.504265	.5002189	1	2
Education [d]	3.290995	.8786226	1	4
Years lived in N*	21.21048	20.00683	0	78
Income [e]	3.763657	1.94394	1	8
Ownership or Rent [f]	2.136008	.9995567	1	5
Religion [g]	3.745972	3.964013	1	11
Other variables				
Neighbourhood Belonging [h]	3.492987	.9108901	1	5.125
Confidence in Government [i]	2.76412	.7744556	1	5
Sample Size N = 1055				

Note: [a] Age brackets: 1. <21, 2. 22-34, 3. 35-49, 4. 50-64, 5. >65; [b] Nationalities: 1. Lebanese, 2. Syrian or Palestinian, 3. Other; [c] Gender: 1 Man, 2 Woman; [d] Education brackets: 1 None, 2, Elementary, 3 Secondary, 4 University; [e] Income brackets: 1. $450 (minimum wage), 2. $450 – 1,600, 3. $1,601 – 3,000, 4. $3,001 – 5,000, 5. $5,001 – 8,000, 6. $8,001 – 12,000, 7. $12,001 – 16,000, 8. <$16,001; [f] House Tenure: 1. Old Ownership, 2. Old Rent, 3. New Rent, 4. No Rent; [g] Religion brackets: 1. Muslim, 2. Christian, 3. Druze, 4. Atheist, 5. Refused; [h] Average of Neighbourhood Belonging variables (belonging, friendship and associations, advice, borrowing, remaining a resident, talking to people, helping neighbours, trust in neighbours, knowing neighbours by name). [i] Average of Confidence in Government variables (Confidence in Muhtar, Municipality, Political Parties, Parliament, Religious bodies, Media, NGOs, Police).

5.4 Has my neighbourhood changed?

5.4.1 Overall neighbourhood perception

The survey started by asking questions about residents' overall neighbourhood perceptions. It first asked respondents to briefly describe the physical environment of their street, without being biased by detailed questions. While Mar Mikhael was valued for the quality of its environment as a 'village-like' 'old neighbourhood with heritage buildings', but it was also described as 'dirty', 'unkempt' and 'needing renovation'. Ras Beirut was considered as a 'mixed' neighbourhood, which had become 'cleaner after renovations' despite its lack of 'open spaces'.

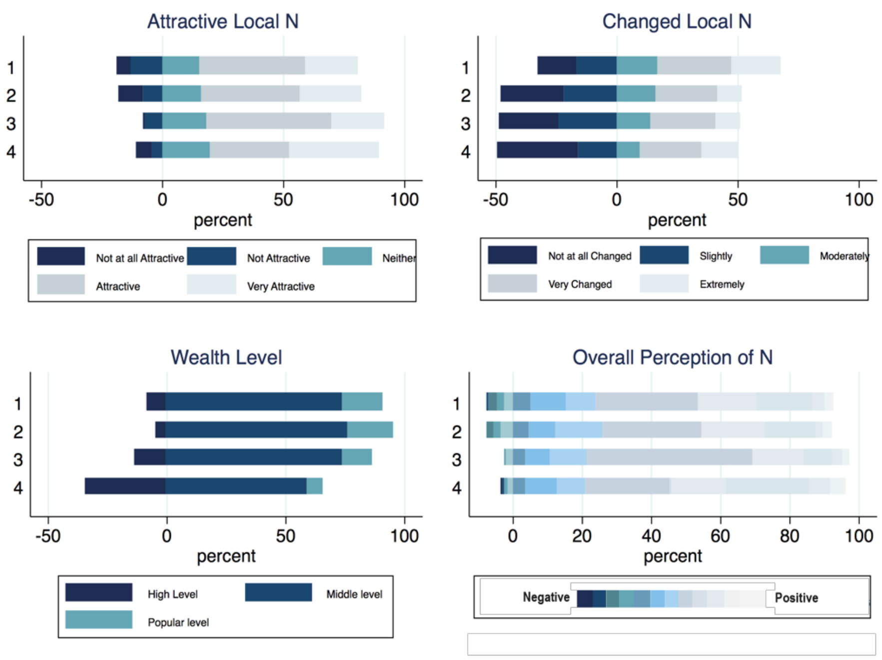
This snapshot of resident quotes immediately underlined the complex nature of the connotations associated with changes in urban form, where, because of their neglected state, areas with historical or well-designed urban fabric are not necessarily valued more highly than areas reconstructed with large numbers of high-rise structures. When respondents were asked what they most valued about their neighbourhood, the core element that emerged across all of the surveyed areas was location in terms of access to services and retail amenities, confirming the similarity in these neighbourhoods in this respect. Community cohesion (or neighbourliness) was also highlighted as a key aspect valued by respondents in both neighbourhoods.

Respondents were then asked to rate the attractiveness of their neighbourhoods on a five-point scale where 1 was not at all attractive and 5 was very attractive. They were also asked to rate how safe, stressed, happy and satisfied they felt with their neighbourhoods to evaluate residents' overall satisfaction. Similarly to Navarrete-Hernandez and Laffan (2019), these variables were used to construct an overall perception of the neighbourhood measure shown in the bottom-right panel of Figure 2. Finally, respondents were asked how much they perceived their local neighbourhood to have changed and to discursively explain why.

Only 20% of Mar Mikhael residents considered their neighbourhood to be very attractive, in contrast to 40% of Ras Beirut residents. Figure 2 suggests a positive correlation between finding your local neighbourhood attractive and BC rates and a small, but also positive correlation between having positive neighbourhood perceptions and BC rates. This suggests not only that areas that have undergone more morphological transformations are seen as more attractive by residents, but they are also perceived as safer and less stressful. Areas that are still composed of older urban fabric, and effectively more open and green spaces, are not necessarily better perceived by their residents, given the ‘degradation’, ‘continual new construction’ and ‘demolishing of old buildings’. They are also considered as being more ‘popular’ which has been show to increase the perception of crime (Burton 2000) (Figure 2).

Moreover, as shown in Figure 2, areas with the lowest rates of building change are actually rated as having changed more in recent years (50% of residents considered areas with low BC rates as ‘very’ or ‘extremely’ changed). This negative correlation is explained by the residents’ comments when asked what had changed: ‘new constructions’ and ‘new developments’ were much more recurrent reasons for residents in areas with low BC rates, suggesting that, although there had actually been less morphological change in these areas in the past decades, residents were currently focusing more on the evolving urban form of their environments. ‘It is no wonder Mar Mikhael residents are more concerned with building change than people in other neighbourhoods,’ commented one interviewee, ‘many parts of this once quiet neighbourhood are now construction sites.’ ‘Newcomers’, ‘Syrians’, ‘new people’ and ‘new neighbours’ were other principal markers of change, underlining the change in populations driven by the refugee crisis across all areas. For an overview of the geographical patterns of new constructions by year see Figure A4 in section 2.2 of the appendix.

Figure 2 Neighbourhood Perception



Note: 1-4 indicate the quartiles of building change, 1 being the least change and 4 being the most change. N stands for Neighbourhood. Overall Perception of Neighbourhood is the average of variables: satisfied, safe, stressed and happy.

5.4.2 Contradictions of morphological change

Respondents were then asked more specifically about their satisfaction with the physical aspects of their urban environments. Figure 3 shows how residents in areas with high rates of BC were on average more satisfied with the physical transformations of their neighbourhoods. Moreover, more residents in high BC rate areas considered the overall condition of the buildings in their neighbourhood 'excellent' and even found the condition of some older buildings 'excellent'.[56] Higher BC rates are therefore paralleled with overall higher satisfaction of local urban environments. And yet, finding newly redeveloped places more attractive does not necessarily imply a lack of resident interest in preserving more traditional urban environments or stopping excessive building.

In fact, contradictions in the survey responses, in many ways reflecting the contradictions of Beiruti (re)construction patterns (Verdeil 2002; Huybrechts & Verdeil 2005), became apparent while plotting different variable relationships, underlining the importance of a mixed-methods approach. For example, while 60% of residents considered new constructions to be 'attractive' or 'very attractive' (0), when asked directly if they preferred Beirut's traditional urban stock or new high-rise buildings, 75% preferred traditional building stock. Other aspects influencing these preferences are not only education and income but also number of years lived in a given location, and type of building lived in as a child, but are not reported here for brevity.

The morphological evolution of a city is problematic because buildings are almost necessarily related to socioeconomic status (Ragette 1980). This is especially relevant in contexts where state policies and market forces converge to make profit-driven real estate a pillar of the neoliberal economy, while offering no housing, social or economic policies to redress its gentrifying effects. Residents therefore associate building change not only with the evolution of urban physical form, but also with changes in local socioeconomic make-up. As interviewees confirmed, socioeconomic status of buildings is typically well-understood by urban citizens, given that the building of new constructions is usually preceded by evictions and pressured displacement (Bekdache 2015; Fawaz et al. 2018). Respondents in Mar Mikhael living in pre-1990 building stock

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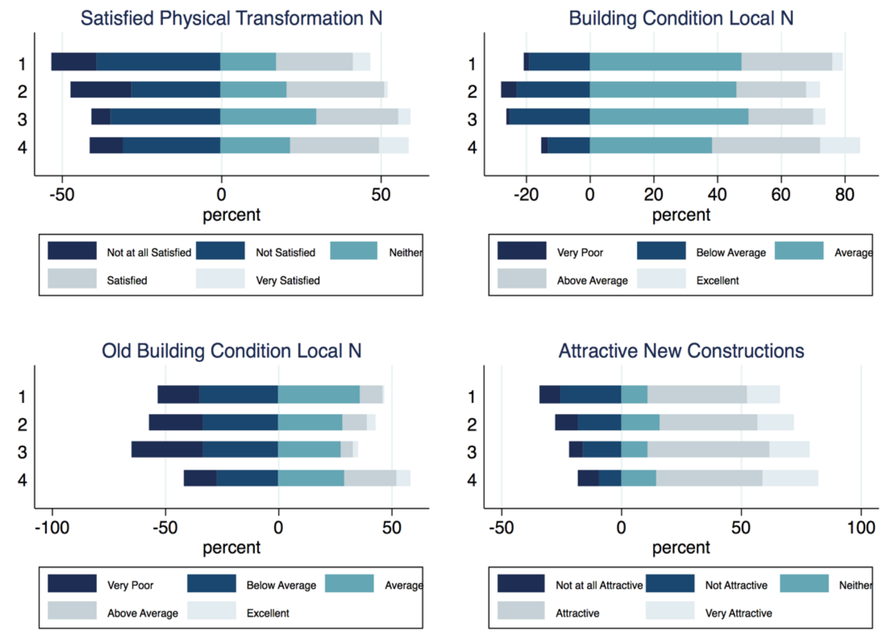
[56] Interviews with local NGOs suggested that more cases of heritage building restoration had recently taken place in Ras Beirut, both for commercial uses and less lucrative purposes with community participation, most probably accounting for the more positive resident accounts in regard to older building stock.

commented that, if a tall building was being built next to them, it would probably result in their forced displacement next.

These relationships are important in explaining the background to the willingness to pay analysis. On the one hand, the responses suggest that the deregulated planning practices ‘making Beirut for its buildings’ are in many ways accepted by society, in contradiction to one of Jane Jacob’s (1961) famous arguments that plans for a city should be made not for its buildings but for its people. In some ways, preferences can therefore be seen to be in opposition to arguments made by widespread discourses in sustainable urban growth (Williams et al. 2000). On the other hand, residents in areas with low BC rates are dissatisfied with the changes occurring in their neighbourhoods.

Figure 3 Building Conditions



Note: 1-4 indicate the quartiles of building change, 1 being the least change and 4 being the most change. N stand for Neighbourhood.

5.5 Values in a changing urban environment

The aspect of ‘neighbourliness’ highlighted in the initial open answers of the survey confirmed the importance of addressing both physical and subjective neighbourhood values, in considering the possible effects of morphological change (Young et al. 2004). This section will now consider more specifically the values residents attach to architectural amenities, open space (principally sidewalks) and neighbourhood belonging and analyse whether these values differ according to building change rates.

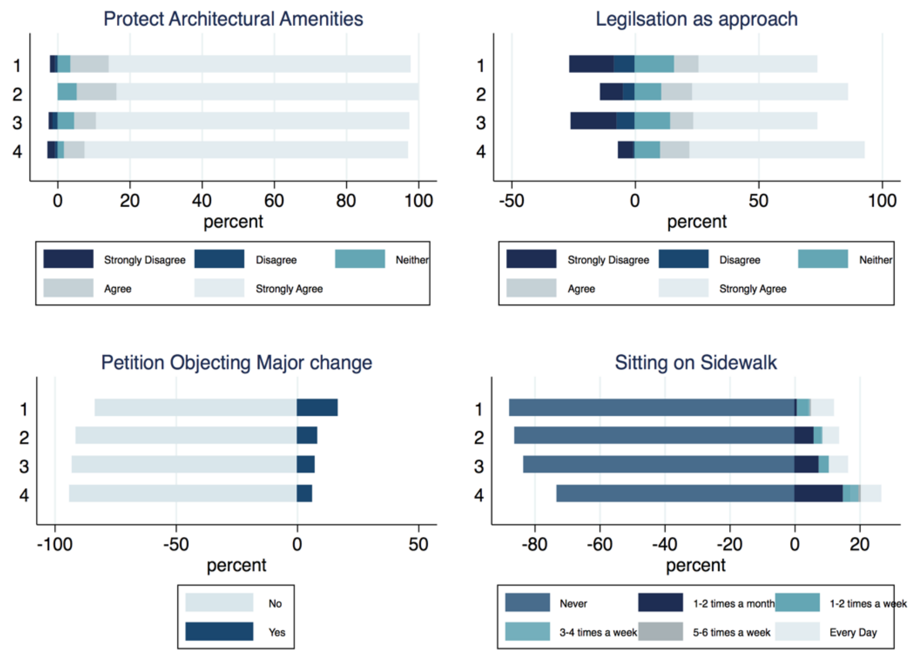
5.5.1 Architectural amenities and open spaces

Architectural amenities, referring to both urban heritage and well-designed modern buildings, were generally valued by respondents, with 85% of respondents strongly agreeing with the importance of preserving both such areas as illustrated in the top-left panel of Figure 4. Residents were more likely to sign a petition opposing a major change in their neighbourhood if they lived in areas with lower BC rates (bottom-left panel of Figure 4). Of the 10% of respondents who had signed a petition in the last year, 65% lived in areas that had undergone low or almost no change to their urban fabric. Findings also show that the probability of signing a petition increases with age and that Lebanese are more likely to sign a petition than Syrians or other nationalities. Higher levels of education also increase the probability of signing a petition. An overview of findings is presented in Table A5 of the appendix.

Interviews with local community-based organizations in Mar Mikhael confirmed that they had received some support from residents publicly opposing recently confirmed construction projects, even though 'most residents have lost hope that sociopolitical activism will make any difference'. I can therefore confirm a discordance between values residents attach to architectural amenities and actual action towards their preservation. Indeed, it is not surprising that these same residents, living in areas with low BC rates, do not believe legislation is the best mechanism with which to protect the integrity of urban environments (Figure 4). Interviewees explained that academics, NGOs and other activists have pushed towards legislative solutions to demolition-based construction with few successes. The Transfer of Development Rights (TDR) Law (12/10/2017) was a small achievement, intended to allow owners to retain their low-rise buildings while letting them benefit from the development value of their land by enabling them to sell their 'air space', thereby gaining revenue to renovate their building. Although this law has passed through parliament, the government has yet to ratify it.

Respondents were generally unsatisfied with the open spaces available in their neighbourhoods and in many cases were not sure what to respond, simply saying that there were no open spaces in their neighbourhoods. There was a clear higher resident satisfaction in open spaces at a 200m radius from Sanayeh park in Ras Beirut and from the Jesuit garden in Mar Mikhael – two of the very few green spaces in Beirut. There was also a higher satisfaction with open spaces in areas with higher BC rates, and clearly higher satisfaction in Ras Beirut than in Mar Mikhael, although the surface area of open spaces is lower in the former than the latter area. Higher satisfaction in Ras Beirut may be connected to the recent public space interventions carried out by the Neighbourhood Initiative and to the existence of some resident access to the American University of Beirut which has many green areas, although they are semi-public at best.

Figure 4 Architectural amenities and sidewalk descriptive analysis



Seventeen percent of respondents affirmed they sat on sidewalks, whether by themselves, with family or friends. The data thus validates the use of sidewalks as an alternative form of open space, although it is not as widespread as initially hypothesized (also refer to Figure A1 in the appendix). Surprisingly, 20% of respondents used sidewalks in this manner in Ras Beirut while only 10% did so in Mar Mikhael, which was hypothesized as the opposite before data collection (lower-right panel 0). This finding parallels other recent research on Street Invitation Quality which was recorded as higher in Ras Beirut areas than in Mar Mikhael areas (Madani, 2018). In fact, respondents noted that neighbours used to sit on sidewalks in Mar Mikhael much more in past years but that the recent construction sites, as well as the opening of more commercial facilities which often use sidewalks for outdoor seating, obstruct these spaces, and have led residents to use sidewalks less for walking, let alone for sitting. It must also be noted that this rate is also influenced by a discrepancy of sidewalks in areas with low BC rates, marking a lack of basic infrastructure in less redeveloped areas. While only 9% of residents living in high BC rate areas confirmed not having a sidewalk at the entrance to their building, 19% stated the same in low BC rate areas.

Greater deficiency in local infrastructure, together with the short-term effects of construction, is thus affecting the use of sidewalks as public spaces in areas that have undergone less morphological change. Other findings include men and less educated residents being far more likely to use sidewalks as open spaces. As observed in other contexts, as housing forms change the practice of sitting on the sidewalk or similar ad-hoc spaces moves from a collective practice to an activity of poorer populations, where highly-educated residents prefer their homes of more formalised forms of public space (Kim 2012; Gehl 2011). The relationship between morphological change and use of sidewalks as open spaces is thus ambiguous. Although we ascertain some value attached to these spaces in Beirut, it is much lower, as expected, than values attached to spaces such as parks which were immediately acknowledged as highly valuable.

5.5.2 Neighbourhood Belonging

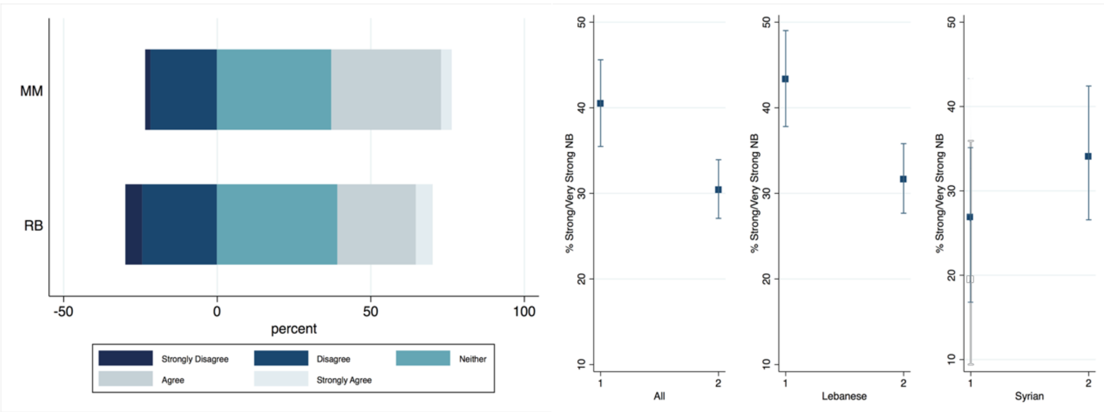
Figure 5 suggests that average neighbourhood belonging is slightly higher in Mar Mikhael than in Ras Beirut. This figure represents the average of the set of neighbourhood belonging variables depicting ties and actions of the respondent in her local neighbourhood. They include belonging, friendships and associations, seeking advice, borrowing things, planning to remain a resident, regularly stopping and talking to people, willingness to help neighbours, trust in neighbours, and knowing neighbours by name. The complete tabulations of all neighbourhood belonging variables can be found in Figure A1 in section 4.2 of the appendix. The data is presented by neighbourhood as it does not reveal specific tendencies by BC rates. This is not surprising given that respondents are being asked about neighbourhoods as a whole, and resident conception of neighbourhood as discussed in section 3.1 of the paper is usually much larger than the 200m by 200m areas plotted to distinguish between rates of building change.

Although Figure 5 suggests more pronounced neighbourhood belonging in Mar Mikhael, the baseline regression presented in Table 2 reveals that location, at least in the case of these two neighbourhoods, becomes insignificant as other relevant confounders are added to the analysis (Wald test = 1.70; $P>.05$). Age is a main determinant of neighbourhood belonging and statistically significant (Wald test = 5.24; $P<.01$), where the older the resident the more likely the feeling of neighbourhood belonging. Nationality can also influence neighbourhood belonging, as shown in the right panel of Figure 5 – Syrian nationals are less likely to form attachments to their neighbourhoods, as they often described holding stronger attachments to their cities of origin (Wald test = 3.01; P>.05). As we can see in Table 2, however, this tendency is actually driven not by nationality but by the number of years lived in a place (Wald test = 33.91; P<.001). Perceived good quality of building conditions also increases likelihood of strong neighbourhood belonging, indicating a key role for the built environment and a city's physical structure (Wald test = 10.82; P<.001) (Balducci & Checchi 2009).

Unlike in other case studies, there is no evidence that neighbourhood-based social relations are influenced by residents' reactions to changing forms of urban governance and policy (Johnstone & Whitehead 2004). The likelihood of having signed a petition either generally or specifically to oppose a major change to the local urban environment does not significantly affect neighbourhood belonging. This might be a result of the small degree of success that sociopolitical activism has had in these contexts, which often leads residents to 'let go'. Although the 'concept of neighbourhood has salience when acted upon … for political or social purposes' (Martin 2003, p.380), this is usually reinforced with obtaining desired outcomes, which has not been the case in our case studies. The change in percentage of non-Lebanese population (2009-2018) mainly as a result of the influx of displaced Syrians, highlighted by many respondents as one of the main sources of change in both neighbourhoods, negatively influences neighbourhood belonging but is not significant. This suggests that despite Lebanese discontent with Syrians living in their neighbourhoods, as noted by 65% of Lebanese respondents, the 'hidden' quality of the Syrian neighbours (Pietrostefani 2019) does not significantly lower the odds of feeling strong neighbourhood belonging. Qualitative commentaries suggested that this lack of significance may be driven by Ras Beirut, whose long-term residents although often wary of newcomers live in a historically demographically mixed area. Indeed an analysis of the Mar Mikhael subset suggests a negative and significant relationship in this neighbourhood, in line with research that finds that the arrival of 'racialised others' can be perceives as a disruption.

It is difficult to assess the 'symbolic' elements influencing neighbourhood belonging in the quantitative analysis, though there were clear references to them in the responses to the open-ended questions and interviews. In most cases, this surfaced when residents mentioned landmarks that no longer existed, but that people still referred to when giving directions or simply when discussing their neighbourhood. Multiple references were made to the old brewery (*Grande Brasserie du Levant*) in Mar Mikhael, and to the old cinema in Hamra Ras Beirut, even though neither location still exists. This presents a distinction between the *lived* and *symbolic* aspects of neighbourhood, highlighting how these two aspects need not necessarily empirically overlap. Could neighbourhood belonging be more closely related to these memories than to the change in population trends? Indeed, neighbourhood belonging studies have underlined the contradictions between residents' appreciation of their ongoing convivial neighbourly relations and their lament over different forms of change (Watt, 2006).

Figure 5 Average Neighbourhood Belonging



Note: Left Panel: Average of all neighbourhood belonging variables. MM: Mar Mikhael. RB: Ras Beirut. Right Panel: y-axis is percentage of residents in top two quintiles of neighbourhood belonging average. 1: Mar Mikhael. 2: Ras Beirut

Table 2 Results of Neighbourhood Belonging logit analysis

	Model I: Ordinal Logistic Regression, OR [a]							Model II: Binary Logistic Regression, OR [b]						
N. Belonging	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
RB [c]	0.670***	0.795*	0.794*	0.893	0.860	0.855	0.866	0.643***	0.774*	0.771*	0.863	0.821	0.802	0.811
	(0.0793)	(0.0968)	(0.0968)	(0.111)	(0.108)	(0.109)	(0.110)	(0.0870)	(0.112)	(0.111)	(0.128)	(0.124)	(0.123)	(0.124)
Age [d]		1.436***	1.433***	1.129**	1.132**	1.133**	1.134**		1.475***	1.479***	1.172**	1.164**	1.167**	1.163**
		(0.0728)	(0.0726)	(0.0683)	(0.0687)	(0.0687)	(0.0689)		(0.0908)	(0.0914)	(0.0863)	(0.0861)	(0.0863)	(0.0860)
2. Syrian [e]		0.849	0.880	1.205	1.134	1.132	1.140		0.927	0.955	1.301	1.227	1.225	1.221
		(0.151)	(0.158)	(0.225)	(0.214)	(0.214)	(0.216)		(0.198)	(0.206)	(0.296)	(0.283)	(0.283)	(0.282)
3. Other		0.416***	0.415***	0.602**	0.571**	0.570**	0.574**		0.472**	0.471**	0.681	0.660	0.655	0.656
		(0.0941)	(0.0944)	(0.141)	(0.135)	(0.134)	(0.135)		(0.148)	(0.148)	(0.222)	(0.216)	(0.214)	(0.215)
2. Female [f]		0.775**	0.784**	0.793**	0.784**	0.784**	0.782**		0.850	0.855	0.895	0.896	0.896	0.897
		(0.0902)	(0.0915)	(0.0933)	(0.0926)	(0.0926)	(0.0925)		(0.119)	(0.119)	(0.128)	(0.129)	(0.130)	(0.130)
Education [g]		0.810***	0.777***	0.802***	0.835**	0.835**	0.833**		0.754***	0.728***	0.735***	0.758***	0.760***	0.761***
		(0.0592)	(0.0598)	(0.0631)	(0.0665)	(0.0665)	(0.0665)		(0.0634)	(0.0647)	(0.0671)	(0.0702)	(0.0704)	(0.0706)
Income [h]			1.056*	1.064**	1.059*	1.060*	1.058*			1.048	1.062	1.060	1.064	1.062
			(0.0325)	(0.0330)	(0.0331)	(0.0333)	(0.0331)			(0.0398)	(0.0415)	(0.0420)	(0.0423)	(0.0422)
N° Years Lived				1.030***	1.029***	1.030***	1.029***				1.027***	1.028***	1.028***	1.028***
				(0.00417)	(0.00418)	(0.00419)	(0.00418)				(0.00477)	(0.00481)	(0.00483)	(0.00482)
Build. Condition [i]					1.259***	1.259***	1.261***					1.313***	1.312***	1.310***
					(0.0855)	(0.0855)	(0.0857)					(0.109)	(0.109)	(0.109)
Petition [j]						0.946							0.806	
						(0.186)							(0.191)	
Δ % non-Leb. [k]							0.618							0.636
							(0.237)							(0.215)
Observations	1,055	1,055	1,055	1,050	1,043	1,043	1,043	1,055	1,055	1,055	1,050	1,043	1,043	
Log likelihood	-1425	-1373	-1372	-1337	-1322	-1322	-1312	-699	-627	-626	-606	-595	-595	-595
LR chi2	11.49	114.74	124.88	161.93	170.50	197.27	234.67	10.56	124.08	124.88	161.93	170.50	197.27	198.43
Pseudo R2	0.07	0.09	0.09	0.12	0.13	0.14	0.20	0.07	0.09	0.09	0.12	0.13	0.15	0.18

Notes: Logistic models fitted and interpreted in terms of their coefficients interpreted as odds ratios. If the OR > 1 then the odds of Y=1 increases and if the OR < 1 then the odds of Y=1 decreases (Stock & Watson 2011) [a] Ordinal Neighbourhood Belonging (NB) : 1 Low average rate of NB to 5 High average rate of NB. [b] Top quintile of NB: 1 = top quintile; 0 = all else. [c] 1. Mar Mikhael. 2. Ras Beirut. [d] Age brackets: 1. <21, 2. 22-34, 3. 35-49, 4. 50-64, 5. >6. [e] Nationalities: 1. Lebanese, 2. Syrian or Palestinian, 3. Other. [f] Gender: 1 Man, 2 Woman. [d] Education brackets: 1 None, 2, Elementary, 3 Secondary, 4 University. [e] Income brackets: 1. $450 (minimum wage), 2. $450 – 1,600, 3. $1,601 – 3,000, 4. $3,001 – 5,000, 5. $5,001 – 8,000, 6. $8,001 – 12,000, 7. $12,001 – 16,000, 8. <$16,001. [I] Building Conditions: 1. Very Poor, 2. Below Average, 3. Above Average, 4.Excellent. [j] Signed a Petition to oppose major change dummy. [k] Δ % non-Lebanese residents per neighbourhood block. *p < 0.05, **p < 0.01, ***p < 0.001

5.6 Who is Willing to Pay more?

The willingness to pay section in the survey was introduced with a hypothetical scenario. Respondents were asked to imagine they could decide whether a building would be demolished, and a new tall building constructed to replace it next to their building. They were then asked if they would be willing to pay the developer to prevent this change and how much they would be willing to pay every month for a year. The specific time frame and monthly instalment scenario were chosen to simplify the conception of the payment method and to give assurance that this payment would not be indefinite. A very similar approach was taken for the sidewalk-open space questions detailed in Table A3 of the appendix.

I focus on these two simple attributes for the WTP question – new buildings and sidewalks – as the urban reality of Beirut with its multi-faceted changes makes it difficult to present more complex situations.[57] Although contingent valuation and choice experiments have gained increasing acceptance in academic and policy-making circles (Carson et al. 2001), WTP has been shown to be particularly low in less-developed countries both in absolute terms and as a percentage of income (Whittington 2010; Alam 2005). In the case of Beirut, given the very low trust in institutions and third-party non-sectarian ties (Bou Akar 2018), the concept of willingness to pay in a hypothetical scenario was understood with difficulty, and the final version of the survey therefore opted for the simplest set-up. Although the construction of a building close to their residence was a very realistic scenario, with 24% of respondents commenting that this had happened to them at some point in their life, giving residents decision power was almost unheard of to most respondents. I am, however, not overly concerned with hypothetical bias – when people's stated WTP exceeds their true WTP – as the lowering effect of mistrust in governance on WTP outweighs potential effect of hypothetical bias (Murphy et al. 2005).

Prior to being asked the WTP questions, respondents were first asked how much the presented tall building scenario would bother or stress them. A new skyscraper being built bothered and stressed residents considerably less in areas with high BC rates, as illustrated in Figure A15 of section 4.2 of the appendix. Reasons behind this are illustrated in the respondents' comments: 'this has already happened in my area, I have

[57] The scenarios initially combined a set of choices as well as a range in prices (choice experiments) (Strazzera et al. 2012), but the exercise was simplified after the pilot survey because of the difficulties experienced in obtaining reliable responses.

no way of stopping this' and 'there are already tall buildings blocking my views around me'. One respondent even insisted on showing the interviewer how their terrace, which once had a view, is now simply a space between two concrete walls, as the side of a new building had been erected immediately next to the edge of the terrace.

Figure 6 WTP by neighbourhood and BC rate

Note: WTP – What would you be willing to pay in order for change from picture A to picture B not to happen? (every month for a year) *$0 a month for a year, $1-4 a month for a year, $5-10 a month for a year, $11-20 a month for a year, $21-50 a month for a year, If, $51 or more, how much?* MM: Mar Mikhael. RB: Ras Beirut. 1-4 indicate the quartiles of building change, 1 being the least change and 4 being the most change.

Forty-nine percent of residents were willing to pay the developer to prevent a new building from rising next to their current residence when asked without a picture illustrating the change, while fifty-one percent were WTP when asked with a picture. Although these percentages do not substantially differ, the amount residents were willing to pay every month for a year did slightly increase when the before and after pictures were shown, signalling the significance of visual aids when asking questions related to physical changes in the urban environment. Findings suggest a negative relationship between WTP and rate of BC, as illustrated in Figure 6. I observe a higher WTP in Mar Mikhael than in Ras Beirut and generally a higher WTP in areas having undergone less building change. The left-hand side of zero in the graphs shows percentages of residents not WTP, while the right-hand side of zero shows residents WTP. Figure 6 suggests that, despite residents' general satisfaction with heavily transformed urban environments, there is still a desire to stop excessive building practices especially in areas that maintain low rates of building change, implying that the renovation desired by residents in these areas does not involve substantial transformation of building design and heights but, as suggested by residents' comments, is centred around infrastructure renovation and modernization of existing buildings rather than complete substitution. This is supported by greater percentages of residents having petitioned to object to a major change in their urban environments in areas with low rates of BC.

Estimates presented in Table 4 confirm the negative relationship between WTP and BC rates. This is especially pronounced for the last quartile of the BC variable. Residents living in areas with high BC rates have almost 50% lower odds of being WTP to stop new construction near their location of residence. Age is a main determinant and statistically significant, older residents are less willing to pay to stop excessive construction. Non-Lebanese residents are also less WTP to stop new constructions, but this is only weakly significant. Residents with higher education present higher WTP but education becomes insignificant with the inclusion of income, stressing, as noted in the literature (Alberini et al. 2003) the role of resident disposable income in the economic valuation of public goods. While valuing protection of urban heritage and well-designed architecture has strong positive relationship with WTP, having signed a petition has a significantly negative relationship with WTP, possibly marking the 'lost hope' of resident who have been active in safeguarding their urban environments. Residents having strong feelings of neighbourhood belonging have close to 50% higher odd of being WTP to stop new construction and, as predicted, confidence in local government has a negative and significant relationship with WTP, underling resident mistrust of local institutions.

An open-ended question was asked to residents who were not willing to pay to stop a new building from rising next to their current residence to enquire further about the reasons behind their decision. This questions helped respondents avoid being misleading, revealed rates of genuine zero responses and protest beliefs comprehensively (Brander & Koetse 2011; Calia & Strazzera 2000). In line with other literature (Chen & Hua 2015), 32% of respondents said they could not afford to pay due to budget constraints and a notable 38% of respondents said they 'did not trust developers' and that there was 'no point in paying as the building would be built anyway' (Table 3). The respondent distrust with developers and planning agencies responsible for changes in their urban environments is clear, marking the number of responses which rejected the contingent market in light of their lack of trust with the planning system (Oh & Hong 2012). Nineteen percent of respondents remarked that the municipality should be responsible for moderating morphological changes, and the monetary responsibility should not fall with residents. Many of these same respondents also remarked that they did not believe the municipality would actually take action and this is why they *would* pay.

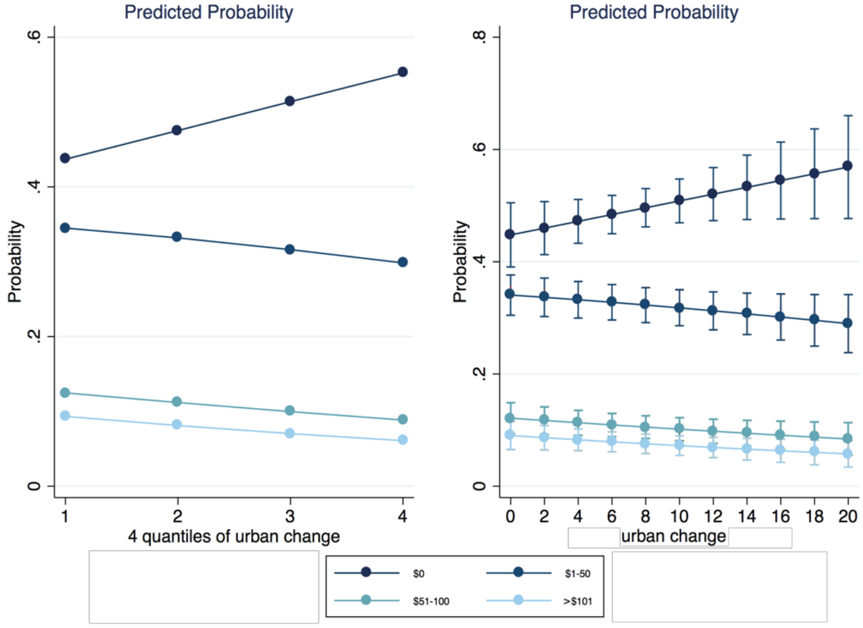
Table 3 Respondent's reasons for not making WTP bids

Reasons why respondents were not WTP	% of respondents
Don't trust Developers/ No point	38%
Cannot afford	32%
Municipality's responsibility/Regulation	19%
Pro development	17%
Short term resident	4%
Don't care	9%

Figure 7 shows the predicted probabilities of model in column 7 of Table 4. It clearly identifies how WTP=0 increases with BC rates, while WTP decreases with BC rates. The estimates also suggest that while small amounts of WTP ($1-50 a month for a year) decrease at a steady rate, larger monetary amounts ($50-100 and over $100 a month for a year) decrease with a flatter curve, suggesting that BC rates do not significantly influence resident WTP at these larger values. This suggests that people able to pay these higher amounts as a percentage of income are present in all areas within the study.

Figure 8 shows us that WTP for sidewalk improvement does not present a clear correlation with BC rates. However, Mar Mikhael residents are generally more WTP, referring back to comments underlining the need for improved local infrastructure. More generally WTP for sidewalk improvement is much higher, seventy-four percent of respondents were WTP to improve local sidewalks remarking that usable, un-obstructed sidewalks were essential to their daily lives, while continual construction was 'something [they] were used to'. This suggests that spaces with both infrastructural and social uses present a higher local value. NGO interviewees in both neighbourhoods commented that people's awareness of a climate of building exceptions in many respects probably made their thinking incredibly practical with respect to the presented scenarios. 'Well-designed architecture and a balanced skyline are unrealistic in Beirut', but 'walkable sidewalks are still something Beirut residents can expect'.

Figure 7 WTP Predicted Probabilities



Note: Left panel: Uses quartiles of BC index, 1 being the least change and 4 being the most change. Right panel: Continuous values of BC index.

Figure 8 WTP to improve sidewalks

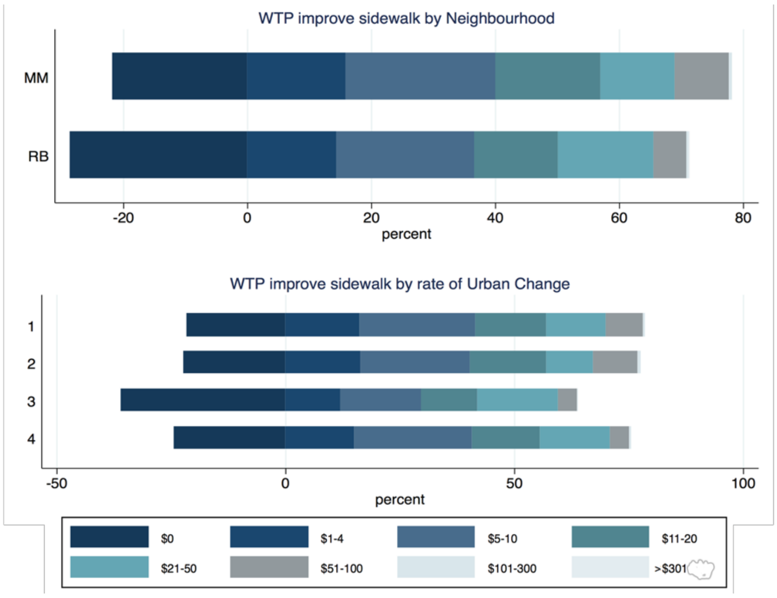


Table 4 Results of WTP logit analysis

	Model I: Ordinal Logistic Regression, OR [a]									Model II: Binary Logistic Regression, OR [b]				
WTP	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
2. BC *light green*	0.746*	0.714**	0.747*	0.754*	0.760	0.806	0.785	0.839	0.795	0.826	0.829	0.833	0.865	0.840
	(0.120)	(0.116)	(0.124)	(0.126)	(0.127)	(0.135)	(0.132)	(0.145)	(0.140)	(0.149)	(0.151)	(0.152)	(0.159)	(0.155)
3. BC *yellow*	0.737**	0.673**	0.688**	0.718**	0.713**	0.750*	0.704**	0.911	0.836	0.873	0.889	0.874	0.924	0.851
	(0.114)	(0.106)	(0.111)	(0.117)	(0.116)	(0.122)	(0.116)	(0.154)	(0.144)	(0.155)	(0.159)	(0.157)	(0.168)	(0.157)
4. BC *red*	0.589***	0.570***	0.575***	0.582***	0.569***	0.530***	0.534***	0.624***	0.590***	0.612**	0.614**	0.593***	0.556***	0.562***
	(0.101)	(0.0991)	(0.105)	(0.107)	(0.105)	(0.0991)	(0.100)	(0.113)	(0.109)	(0.120)	(0.121)	(0.117)	(0.112)	(0.114)
Age [c]		0.888**	0.886**	0.877**	0.873**	0.858**	0.867**		0.820***	0.825***	0.821***	0.817***	0.801***	0.813***
		(0.0430)	(0.0544)	(0.0544)	(0.0543)	(0.0538)	(0.0543)		(0.0442)	(0.0558)	(0.0558)	(0.0556)	(0.0552)	(0.0564)
Nationality [d]		0.818*	0.830	0.842	0.824*	0.830	0.862		0.815*	0.802*	0.809*	0.788*	0.794*	0.832
		(0.0858)	(0.0952)	(0.0969)	(0.0953)	(0.0970)	(0.101)		(0.0908)	(0.0987)	(0.0999)	(0.0983)	(0.100)	(0.106)
2. Female [e]		0.990	0.934	0.921	0.926	0.959	0.949		0.997	0.957	0.949	0.954	0.992	0.975
		(0.116)	(0.113)	(0.112)	(0.113)	(0.118)	(0.116)		(0.127)	(0.126)	(0.125)	(0.126)	(0.133)	(0.131)
Education [f]		1.130*	1.042	1.022	1.039	1.077	1.048		1.124	1.064	1.049	1.074	1.107	1.077
		(0.0801)	(0.0806)	(0.0797)	(0.0816)	(0.0855)	(0.0841)		(0.0841)	(0.0881)	(0.0875)	(0.0904)	(0.0947)	(0.0930)
Income [g]			1.101***	1.097***	1.099***	1.092***	1.086**			1.057	1.056	1.058	1.052	1.043
			(0.0356)	(0.0356)	(0.0358)	(0.0357)	(0.0356)			(0.0377)	(0.0379)	(0.0381)	(0.0381)	(0.0381)
Housing tenure [h]			0.991	1.002	1.004	1.050	1.023			1.071	1.075	1.079	1.127	1.087
			(0.0848)	(0.0862)	(0.0865)	(0.0915)	(0.0896)			(0.0995)	(0.100)	(0.101)	(0.107)	(0.104)
N° Years Lived			0.999	1.000	0.999	0.995	0.994			1.000	1.000	0.999	0.995	0.994
			(0.00437)	(0.00442)	(0.00443)	(0.00453)	(0.00455)			(0.00465)	(0.00468)	(0.00470)	(0.00483)	(0.00487)
Protect UH [i]				1.374***	1.381***	1.353***	1.369***				1.219*	1.232**	1.207*	1.232**
				(0.139)	(0.141)	(0.139)	(0.139)				(0.126)	(0.128)	(0.126)	(0.129)
Petition [j]				0.686*	0.685*	0.675*	0.695*				0.829	0.831	0.831	0.864
				(0.140)	(0.140)	(0.138)	(0.142)				(0.182)	(0.183)	(0.185)	(0.193)
Open space [k]					1.115**	1.118**	1.118**					1.151**	1.150**	1.154**
					(0.0592)	(0.0594)	(0.0594)					(0.0672)	(0.0678)	(0.0685)
NB [l]						1.399***	1.477***						1.377***	1.483***
						(0.103)	(0.114)						(0.111)	(0.125)
Conf. Gov [m]							0.825**							0.768***
							(0.0631)							(0.0644)
Observations	1,055	1,022	1,022	1,022	1,022	1,022	1,022	1,055	1,022	1,022	1,022	1,022	1,022	1,022
Log likelihood	-1734	-1726	-1455	-1448	-1447	-1437	-1371	-727	-716	-597	-595	-593	-585	-553
LR chi2	9.89	25.32	34.20	47.49	50.40	69.12	65.26	7.25	29.51	30.11	34.66	38.36	54.27	54.56
Pseudo R2	0.02	0.07	0.11	0.16	0.17	0.20	0.23	0.05	0.20	0.24	0.28	0.31	0.44	0.46

Note: Logistic models fitted and interpreted in terms of their coefficients interpreted as odds ratios. If the OR > 1 then the odds of Y=1 increases and if the OR < 1 then the odds of Y=1 decreases (Stock & Watson 2011) [a] Ordinal WTP : 1. \$0 2. \$1-50 3. \$51-100 4. >\$101. [b] Binary WTP: 1 = yes; 0 = no. [c] Age brackets: 1. <21, 2. 22-34, 3. 35-49, 4. 50-64, 5. >6. [d] Nationalities: 1. Lebanese, 2. Syrian or Palestinian, 3. Other. [e] Gender: 1 Man, 2 Woman. [f] Education brackets: 1 None, 2, Elementary, 3 Secondary, 4 University. [g] Income brackets: 1. \$450 (minimum wage), 2. \$450 – 1,600, 3. \$1,601 – 3,000, 4. \$3,001 – 5,000, 5. \$5,001 – 8,000, 6. \$8,001 – 12,000, 7. \$12,001 – 16,000, 8. <\$16,001. [h] Housing Tenure: 1. Old ownership 2. Old rent 3. New rent. [i] Believes in importance of Urban Heritage [j] Signed a Petition to oppose major change dummy. [k] Satisfaction with open spaces in local neighbourhood . [l] Overall Neighbourhood Belonging: 1 Low average rate of NB to 5 High average rate of NB. [m] Confidence in Government *p < 0.05, **p < 0.01, ***p < 0.001

5.7 Conclusion

The quality of the urban environment in less-developed countries has been increasingly recognized as a key determinant of quality of life (Whittington 2010). This study sheds light on how morphological densification affects the complex values attached by residents to their urban environments in a quantitively understudied context in the Global South. It also contributes to uncovering some of the darker realities of planning practices (Alexander et al. 2012). The intention of this paper is to extend recent arguments on the effects of actually existing planning practices (Fawaz 2017), in this case by examining how living in continual construction, an everyday reality of many deregulated cities in less-developed countries, affects local resident attitudes and values. Specifically, by exploring how dramatic urban restructuring affects resident values of architectural amenities, open space (sidewalks), and neighbourhood belonging.

Although living in areas with different rates of building change does not affect preferences for architectural amenities, it affects resident socio-political activism towards the preservation of their built environment, and it affects their use of ad-hoc open spaces such as sidewalks. The data further validates the use of sidewalks as an alternative form of open space, although it is not as widespread as initially hypothesized. Neighbourhood belonging is not significantly affected by construction rates, but significantly increases both with the number of years lived in a given neighbourhood and in locations boasting better building conditions, confirming a role for the built environment with regards to intangible urban amenities. Moreover, despite Lebanese discontent with the Syrian influx in urban areas, higher numbers of Syrian neighbours do not significantly lower the odds of feeling strong neighbourhood belonging mostly likely linked to the 'hidden' realities of many Syrian residents in the two neighbourhoods considered.

In assessing indicative monetary values, this paper also finds that while approximately fifty percent of respondents were WTP to stop disruptive building near their location of residence, seventy-four percent were willing to pay to improve local sidewalks. Many remarked that it was a matter of prioritising, un-obstructed sidewalks were essential to their daily lives, while continual construction although bothersome was hard to change given the well-known influence of politicians on developers. Indeed, residents living in areas with high BC rates had almost 50% lower odds of being WTP to stop new construction near their location of residence both because of their 'lost hope' and their lack of confidence that paying would stop developers from building.

This paper hopes to incite researchers to collect quantitative data in Global South cities despite the difficulties involved. Collecting such data not only allows for the better understanding of local residents' reactions to urban development processes but can also facilitate adapted localised urban interventions by exploiting the geolocalized nature of such data. Moreover, although it is certainly challenging to overcome forms of illegality in a context where the market has largely taken over public roles, by performing a type of public consultation, such data should also motivate a critical analysis of legal texts and a review of the processes through which they are operationalized, aiming to make these processes more responsive and democratic (Friedmann 1992; Albrechts & Balducci 2017).

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5.9 Appendix : A permanent (re)construction site?

5.9.1 Introduction

This appendix complements the main paper by providing additional detail not included in the main paper for brevity. To facilitate comprehension, it partially duplicates parts of the prose in the main text. Section 2 includes some additional material on the data used and presents further insights on what the data tells us about the institutional setting. Section 3 presents further detail on the survey data collection, including the sampling strategy, survey implementation and design. Section 4 presents complementary results that are not essential for the message of the main paper but may be of interest to some readers. The appendix is designed to complement arguments and specification in the main paper, it is not designed to stand alone or replace the reading of the main paper.

5.10 Urban Data

5.10.1 Open Spaces

Figure A1 illustrates the nature of public spaces in Beirut but taking the area of Hamra, part of Ras Beirut, as an example. The data illustrated in this map was collected by the author during complementary fieldwork in Beirut. The map clearly shows that most open space in the area are actually private, and therefore not necessarily accessible to local residents, but only to individuals having access to the relevant private institutions. Figure A1 illustrates that numerous gatherings happening in public spaces are on sidewalks or edges of buildings, supporting the claim that sidewalks are often appropriated as public open spaces given the scarcity of formalised public spaces such as public garden or plazas.

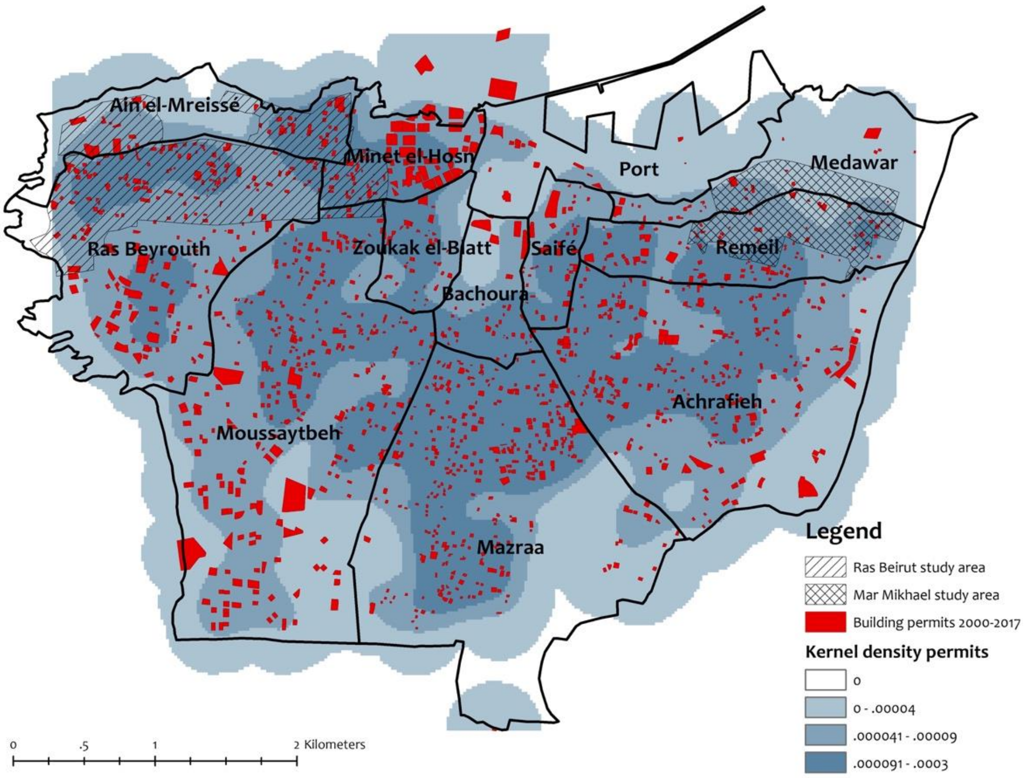
Figure A1 Open Spaces in Hamra (Ras Beirut)

5.10.2 Construction Data

Until recently, only a limited number of visual and quantitative records were available documenting the conspicuous construction activities that have taken place in Beirut in the last 20 years. To investigate the relationship between changing urban form and the value residents attach to their urban environments I exploit a recently assembled data set on construction permits (Gebara, Khechen, & Marot, 2016). This data set was collected through a collaboration between AUB Neighbourhood Initiative and the Cities Programme at the London School of Economics and Political Science (LSE) and was made available by the Neighbourhood Initiative. The data was obtained from photocopies of the permit records issued for all plots that received a building permit in municipal Beirut between 2000 and 2013. This included information on the permit itself (registration number, issuance date and status), the proposed new project (building use, construction quality, total built-up area, responsible architect and land owner) and the geographic location of the permitted structure (cadastral zone and lot number) (Gebara et al., 2016).

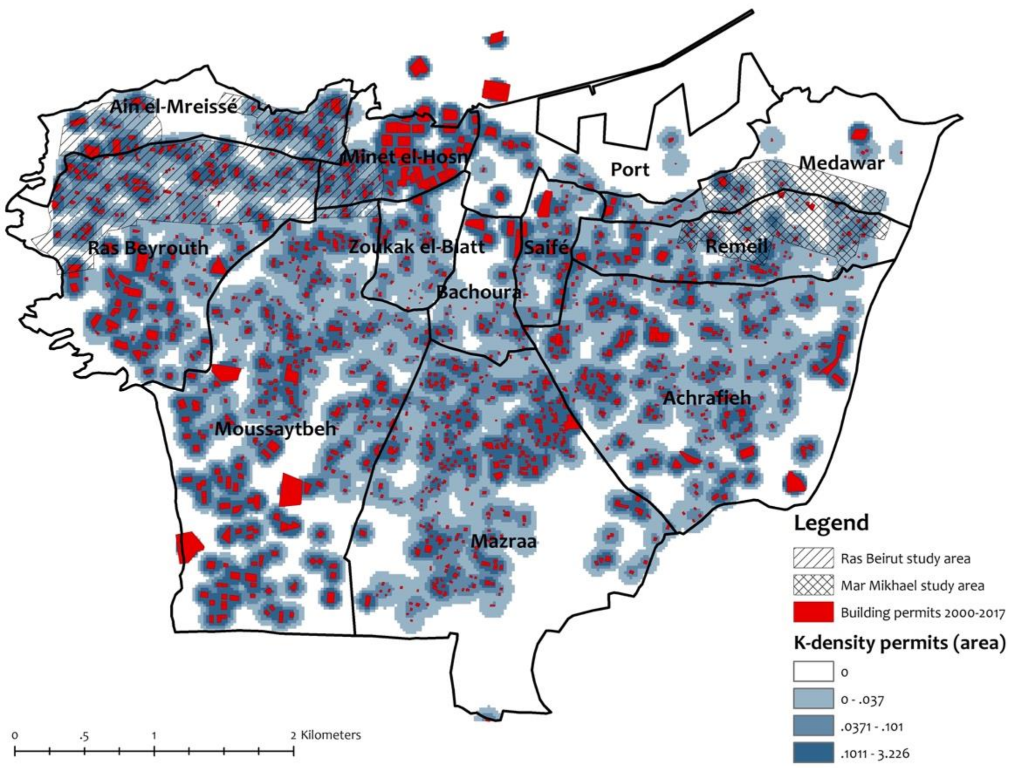
The data was instrumental in the site-selection of this study as it allowed the identification of areas which have experienced different rates of construction. Figures Figure A2 and Figure A3 present k-densities of constructions according to the number or total surface of new constructions, allowing me to identify patterns in changes of urban form according to area Figures Figure A2 and Figure A3 illustrate how Mar Mikhael has less concentration of new constructions both in terms of number and area built.

Figure A2 K-densities of constructions according to number of new constructions



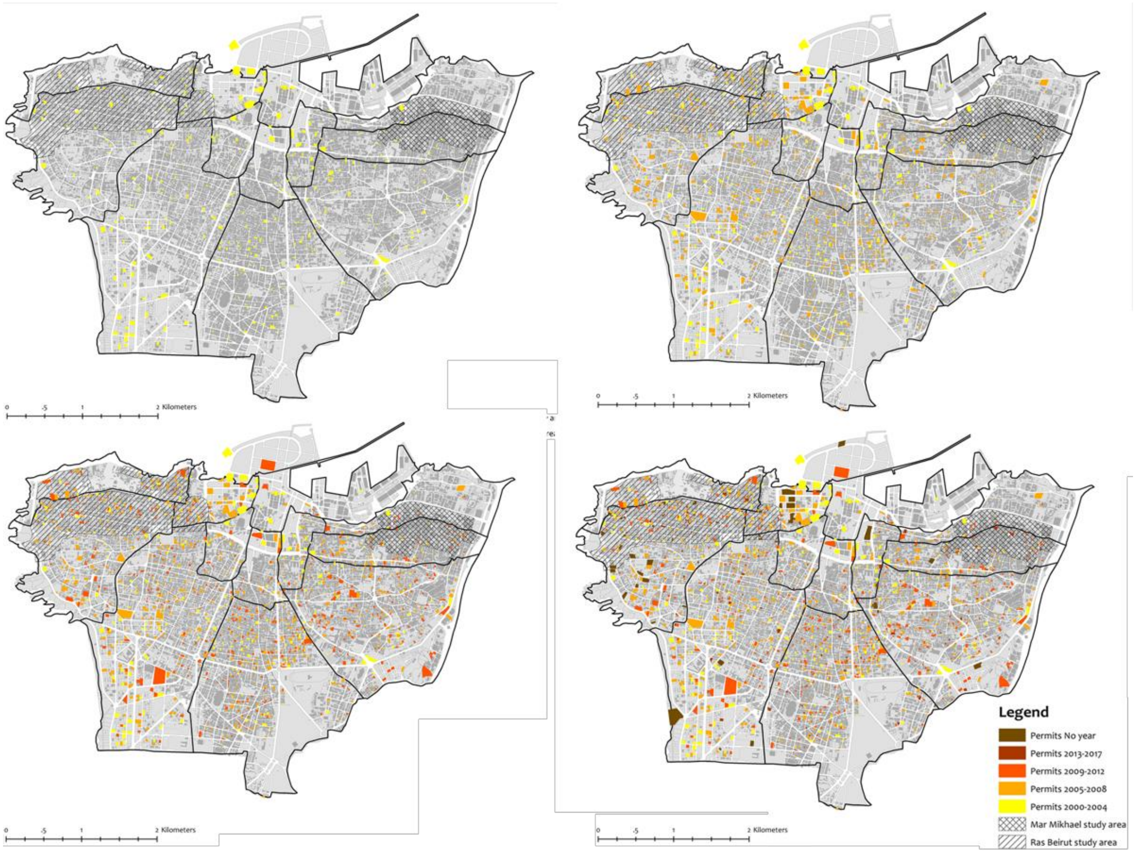
Source: Author's elaboration of Neighbourhood Initiative data (Gebara et al., 2016).

Figure A3 K-densities of constructions according to area of new constructions



Source: Author's elaboration of Neighbourhood Initiative data (Gebara et al., 2016).

Figure A4 Number of new constructions by year brackets



Source: Author's elaboration of Neighbourhood Initiative data (Gebara et al., 2016).

5.11 Survey Data Collection

5.11.1 Neighbourhood Definitions

There is considerable debate about what size constitutes a neighbourhood and, indeed, how this varies for different research questions and affects the results of analyses (see, for example, Galster, 2001). Consequently, we hereby present geographical definitions of both Ras Beirut and Mar Mikhael to better understand how and to what extent each constitutes a 'neighbourhood', despite their different sizes.

Ras Beirut is one of Beirut's 'neighbourhoods,' but it is also one of 12 administrative districts in Municipal Beirut (the others being Achrafieh, Ain Mreisseh, Bachoura, Marfa', Mazraa, Medawar, Minet el Hosn, Moussaitbeh, Remeil, Saifi, and Zoukak al Blat). The municipal district of Ras Beirut is further divided into eight sectors: Jounblat, Hamra, Snoubra, Qoreitem, Ain el-Tineh, Raouche, Manara and, confusingly, Ras Beirut. The sector of Ras Beirut fronts the sea from the Military Beach to the borders of AUB. For the purposes of this paper, I define Ras Beirut through seven sectors of Ras Beirut, all except Jamia, which delimits the American University of Beirut and therefore has few on campus residents as illustrated in Figure A5. These sub-neighbourhood areas were confirmed by recent qualitative research (Kaddour et al., 2014).

Mar Mikhael is also a Beiruti neighbourhood, but it is not one of the city's 12 administrative districts. The administrative districts of Medawar and Marfaa, however are overlapped by a sector which is confusingly called Mar Mikhael. For the purpose of this paper, the Neighbourhood of Mar Mikhael is defined by qualitative finds of what Beirut residents as Mar Mikhael and includes parts of sectors: Jisr, Khodr, Qobayat, Jeitaoui, Mustafa el Roum, Hikmeh and Mar Mikhael as illustrated in Figure A6.

Figure A5 Defining Ras Beirut

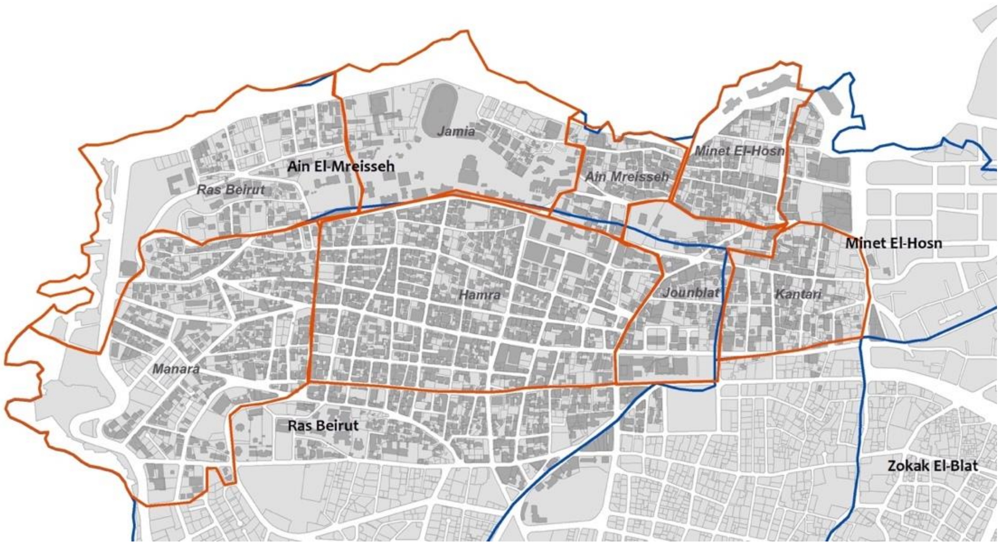
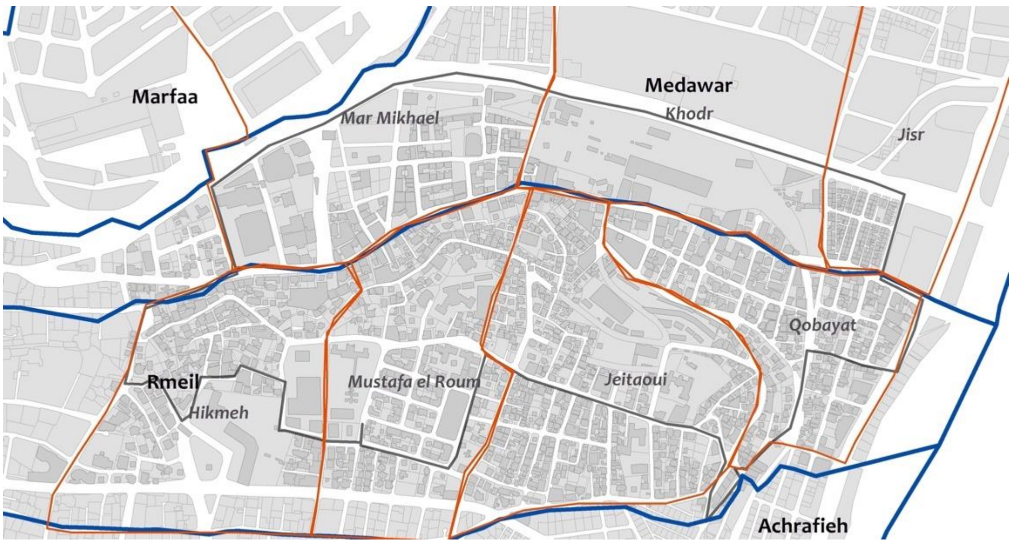


Figure A6 Defining Mar Mikhael



5.11.2 Building Change and Sampling

In order to identify whether and how changing urban form affects the value residents attach to urban amenities, areas that had undergone different rates of construction were identified. The selection process was carried out as follows. The city of Beirut was divided in a fishnet grid of 200 metre by 200 metre square cells, as illustrated in Figure 1. The cells were then limited to the squares overlapping the areas of Ras Beirut and Mar Mikhael.

The building permit data was used to construct a simple index of building change BC_c as follows:

$$BC_c = \frac{\sum_{b=1}^{n} BUP_{cb}}{area_c}$$

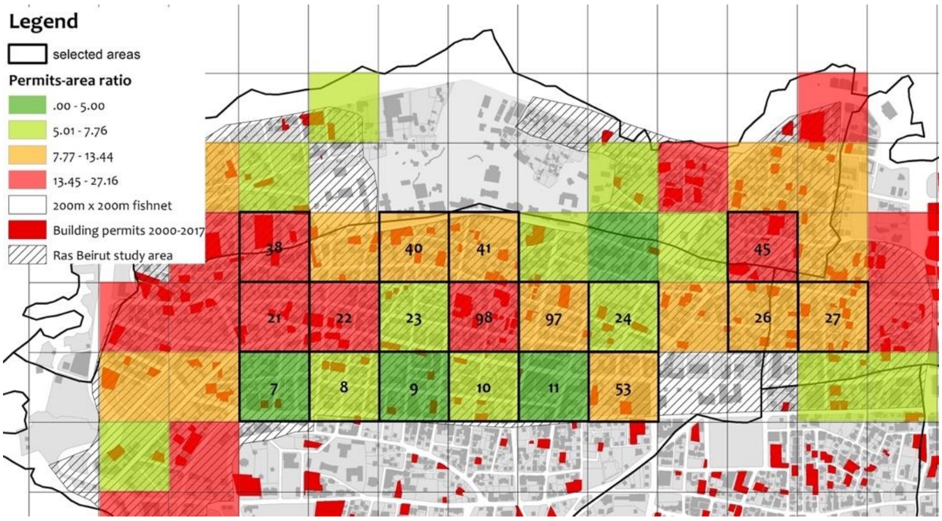
where BUP_b is the sum of the *super built-up areas*[58] b of all new developments within each square *c* and $area_c$ is simply the area of each square *c*, in this case 0.04 square kilometres. The building change index was calculated for the retained squares covering the two neighbourhoods of interest. Twenty-seven squares were then randomly selected over the two neighbourhoods, weighted by the number of observations available in the previous surveys. Squares with a low number of observations were therefore much less likely to be selected, which is why there is continuous selection of squares in the central part of Ras Beirut. This selection was made because of budgetary constraints which allowed for the collection of a maximum 1350 observations. The selection thus allowed for the collection of 50 observations per square which would later allow for the creation of an average per square.

Once the building change ratio had been calculated, the squares were divided into quartiles, from areas of high BC to areas of low BC, as distinct treatment and control areas would have been contextually inappropriate. Quartile classification slightly varies according to whether it is calculated over the whole sampling area or only considering sampled squares. This paper uses the classification as calculated over the whole sampling area; however, the analysis was also run with the alternative and results did not significantly differ. Areas display high rates of BC (more than 13% of the area of a given square), yellow areas display medium rates of BC (7-13%), light green areas display low rates (5-7%) while dark green areas display almost no change to the urban fabric (<5%). Figure 1 in the main paper presents the sampling and data collection strategy.

[58] In urban planning, 'super built-up area' refers to the carpet area + wall area + common area.

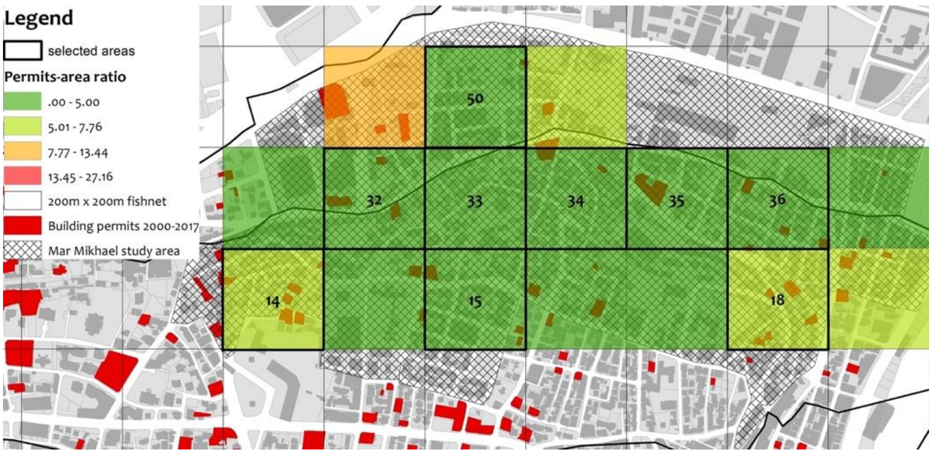
Figures Figure A7Figure A8 show the sampling more precisely for Ras Beirut and Mar Mikhael respectively.

Figure A7 Sampling Ras Beirut



Note: Squares 27 and 9 can have different quartile classifications.

Figure A8 Sampling Mar Mikhael



Note: Square 50 and 18 can have different quartile classifications

5.11.3 Survey design and final sample

Primary data collection was the only possible means of obtaining quantitative data on values residents attach to their urban environments at a detailed level. A household survey was first designed and then drafted, undergoing a long revision process. It was first drafted in English, subsequently translated in Lebanese Arabic and revised by 5 different native Lebanese speakers in order to ensure correct comprehension of words and use of dialect. A pilot survey was first then administered in March 2018. Once the process was tested and reviewed, eight research assistants (RAs) and I collected over

1080 geo-localized observation which were then mapped on GIS. The RAs received both survey methodology and interview training including ethical guidance. I supervised them throughout the process and attended approximately 10% of all interviews I did not carry out myself. It must be noted that the data collection, especially in Ras Beirut, was a very difficult process because residents are often wary of statistical studies as no census has been carried out in Lebanon since 1932.

The geo-localized survey observations were then mapped through Geographical Information Systems (GIS), and matched to the new constructions data. The final sample covers 7.7% of the estimated population and 21.5% of total households in the randomly selected 27 squares. Surveys were conducted face-to-face and the sample was drawn so as to cover the principal nationalities resident in these neighbourhoods, with a 95% confidence level and 5% margin of error. The squares selected also ensured that the sample geographically overlapped by 70% with data previously collected in these neighbourhoods so as to be able to control for population change. Figures A9 and A10 present the mapped data.

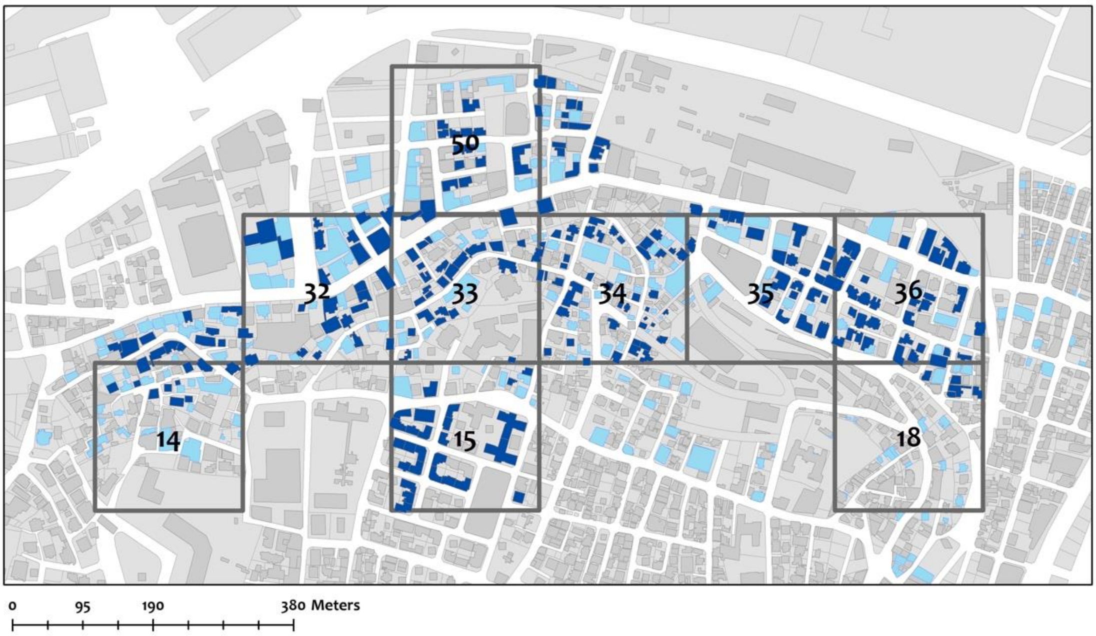
Table A1 Final Sample

Final Sample	Total pop.[a]	Total HH[b]
1,055	13,700	4,900
	7.69%	21.53%

Note: [a] The Total estimated number of residents in the 27 squares under consideration was 13,700. B The total estimated number of households in the 27 squares under consideration was 4,900. The targets originally stipulated were to survey 27.5% households and 10% of the population.

Figure A9 Buildings Surveyed Ra Beirut 2009 & 2019

Figure A10 Buildings Surveyed Mar Mikhael 2013-2013



5.11.4 Survey Elements

Table A2 present the opening statement of the survey.

Table A2 Statement

Preamble/scenario description
Hello, How are you today? *The American University of Beirut and the London School of Economics are conducting a research on how people feel (how people value their) about their neighbourhood in two areas of Beirut. We would like to ask you your kind cooperation in answering a few questions, and to express your opinions about your neighbourhood. This will help us gather information about what people value in their urban environments.* *First we/I are/am going to ask you a few general questions about your neighbourhood, then we are going to show you pictures for you to express your opinion on. Afterwards, we will ask you to fill in a questionnaire. We would like to assure you that the whole process is fully anonymous.* *Are you willing to participate?* *We thank you so much for your valuable collaboration.* *Let's get started.* مرحبا، كيفك اليوم؟ الجامعة الأمريكية في بيروت وكليّة لندن للعلوم الاقتصادية عم يعملوا بحث عن شعور العالم تجاه (كيف العالم بقيّموا) حيّون/حارتون بمنطقتين ببيروت. بدنا نطلب منك إذا بتريد تعاونك بالإجابة على بعض الأسئلة، وتعبّر عن رأيك بخصوص حيّك/ حارتك. هالشي رح يساعدنا نجمع معلومات شو العالم بيقدّروا ببيئاتون الحضريّة. بالأول رح إسالك/نسألك بعض الأسئلة العامة عن حيّك/حارتك، بعدين رح فرجيك/نفرجيك صور لتعبّرفيون عن رأيك. من بعدا، رح اطلب/نطلب منك تعبّي استبيان/ استمارة. منحبّ نأكدلك إنو كل العملية رح تكون مجهولة / بلا أسماء. مستعدّ تشارك؟ نحن منتشكرك كتير على تعاونك القيّم. خلينا نبلش.

Questions in the survey covered topics ranging from perceptions and satisfaction with local neighbourhoods, through satisfaction with building conditions and open spaces, perceptions of neighbourhood belonging, experiences with power to influence neighbourhood change, to confidence in local government. Table A3 itemises all principle questions related to this paper.

Table A3 Survey questions

Willingness to Pay
Imagine you could decide whether an old building will be demolished, and a new tall building *Options: $0 a month for a year, $1-4 a month for a year, $5-10 a month for a year, $11-20 a month for a year, $21-50 a month for a year, If, $51 or more, how much?*
Building Change
WTP – Would you be willing to pay the developer in order for a tall building not to be built next to your house and/or blocking your view from your house? If yes, how much (every month for a year)? If not, why? WTP – (with picture) – What would you be willing to pay in order for the change from picture A to picture B not to happen? (every month for a year)
WTA – How much would a developer need to pay you for you to accept the change from picture A to picture B? (every month for a year)
Sidewalks
WTP – How much cost via local tax would you be willing to pay for the realization of the change from picture A to picture B? (every month for a year)
Neighbourhood Belonging
Strongly Disagree, Disagree, Neither, Agree, Strongly Agree
I feel like I belong to this neighbourhood
The friendships and associations I have with other people in my neighbourhood mean a lot to
If I needed advice about something I could go to someone in my neighbourhood
I borrow things and exchange favours with my neighbours
I plan to remain a resident of this neighbourhood for a number of years
I regularly stop and talk with people in my neighbourhood
People around here are willing to help their neighbours
People in this neighbourhood can be trusted
How many of your neighbours do you know by name ?
Architectural Amenities
Strongly Disagree, Disagree, Neither, Agree, Strongly Agree
It is important to protect urban heritage areas
It is important to protect areas with well-designed modern buildings
Legislation/policy is the best mechanism with which to protect the integrity the urban
Philanthropic urban interventions are the best mechanism with which to protect the integrity
At your current residence, have you ever signed a petition objecting a major change in your
Open Space - sidewalks
Very dissatisfied, dissatisfied, Neither, Satisfied, Very Satisfied
With the public open space in your local neighbourhood?
With preserved small green space in your local neighbourhood?
With large undeveloped land in your local neighbourhood?
Yes, No
Does your child/do your children have an outdoor space or facilities where they can play safely?
Do you sit on your local sidewalk for leisure (read a book, smoke argyle etc.)? How often?

Two main sets of CV questions were also presented to respondents throughout the survey. Early in the survey, respondents were asked: 'Would you be willing to pay the developer in order for a tall building not to be built next to your house and/or blocking your view from your house?' If a respondent answered 'Yes', she would then be presented with a payment card with five different offers on the basis of the pre-test. If a respondent answered 'No', she would be asked to explain why. Later in the survey, the respondent would be asked a very similar question but this time with an image

(Figure A11): ‘Would you be willing to pay in order for the change from picture A to picture B not to happen?’ If the respondent answered ‘Yes’, the same payment cards would be presented, and the respondent asked to choose the maximum amount that her household would like to pay. A very similar approach was taken for the sidewalk-open space questions (Figure A12).

Figure A11 Images building change

Before **After**

Note: This change took place in 2014.

Figure A12 Images Sidewalk change

Before **After**

Note: This change took place in 2017

The willingness to pay section in the survey was introduced with a hypothetical scenario. Respondents were asked to imagine they could decide whether a building would be demolished and a new tall building constructed to replace it, next to their building. They were then asked if they would be willing to pay the developer to prevent this change and how much they would be willing to pay every month for a year. The specific time frame and monthly instalment scenario were chosen to simplify the conception of the payment method and to give assurance that this payment would not be indefinite. This is an extremely common scenario in the Beiruti context, 24% of respondents commenting that this had happened to them at some point in their life. A very similar approach was taken for the sidewalk-open space questions.

We focus on these two simple attributes for the WTP question – new buildings and sidewalks – as the urban reality of Beirut with its multi-faceted changes makes it difficult to present more complex situations. The scenarios initially combined a set of choices as well as a range in prices (choice experiments) (Strazzera et al. 2012), but the exercise was simplified after the pilot survey because of the difficulties experienced in obtaining reliable responses. Although contingent valuation and choice experiments have gained increasing acceptance in academic and policy-making circles (Carson et al. 2001), WTP has been shown to be particularly low in less-developed countries both in absolute terms and as a percentage of income (Whittington 2010; Alam 2005). In the case of Beirut, given the very low trust in institutions or third-party non-sectarian ties (Bou Akar 2018), the concept of willingness to pay in a hypothetical scenario was understood with difficulty, and the final version of the survey therefore opted for the simplest scenario.

For this study, I am not overly concerned with hypothetical bias – when people's stated WTP exceeds their true WTP – as the lowering effect of mistrust in governance on WTP outweighs potential effect of hypothetical bias (Murphy et al. 2005). However, there may be bias, given the questions refer to public goods. This study attempted to minimize the problem of hypothetical bias in a number of ways. A small script was added to the valuation scenario, drawing respondents' attention to the problem of mis-stating true values as a result of the hypothetical setting, asking them instead to focus on their responses as if they were in a real-life setting. The WTP format used also presented some very small monetary options to begin with – \$1-4 a month for a year or \$5-10 a month for a year – to encourage realistic responses. Piloting indicated that respondents found this simple formatting of the questions easiest to judge, and therefore the best observational gap between the ideal measurement and the response obtained (Groves 2009, p.52). Piloting also suggested that respondents responded more accurately when presented with pictures.

5.12 Results

5.12.1 Summary Statistics

Table A4 presents some supplementary summary statistics.

Table A4 Other Summary Statistics

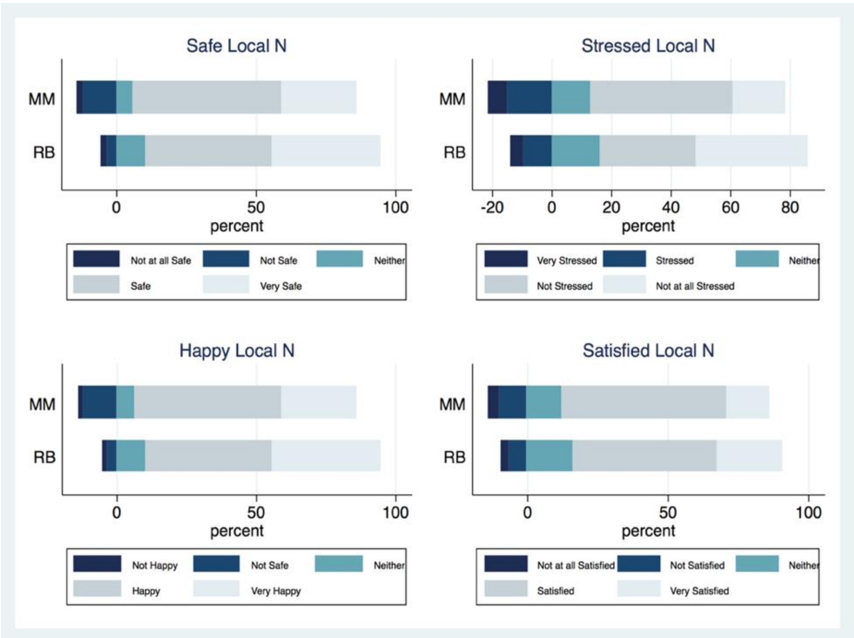
	mean	sd	min	max
Neighbourhood Perception / Building Condition				
Overall perception of N*	3.507978	.4920122	1	5
Not at all changed, Not Changed, Neither, Changed Very Changed				
Perception of change	2.859733	1.414342	1	5
Satisfied Physical Transformation of N*	2.776333	1.116594	1	5
Very Poor, Below Average, Average, Above Average, Excellent				
Overall Building condition	3.121183	.8750002	1	5
Old Building condition	2.405561	1.050294	1	5
Not at all attractive, Not attractive, Neither, Attractive, Very Attractive				
Attractiveness of Local N*	3.755725	1.09939	1	5
Attractiveness of New Constructions	3.446785	1.189552	1	5
Willingness to Pay				
Bothered by Tall Building	8.380362	2.647056	1	10
Stressed by Tall Building	7.908571	2.95231	1	10
Sample Size N = 1055				

Note: * N for Neighbourhood

5.12.2 Descriptive Analysis

Figure A13 presents some complementary descriptive statistics, which illustrate how residents rated how safe, stressed, happy and satisfied they felt with their neighbourhoods to evaluate residents' overall neighbourhood perception. The average of these four variables, by BC rate, results in the lower-right panel of Figure 2 in the main paper.

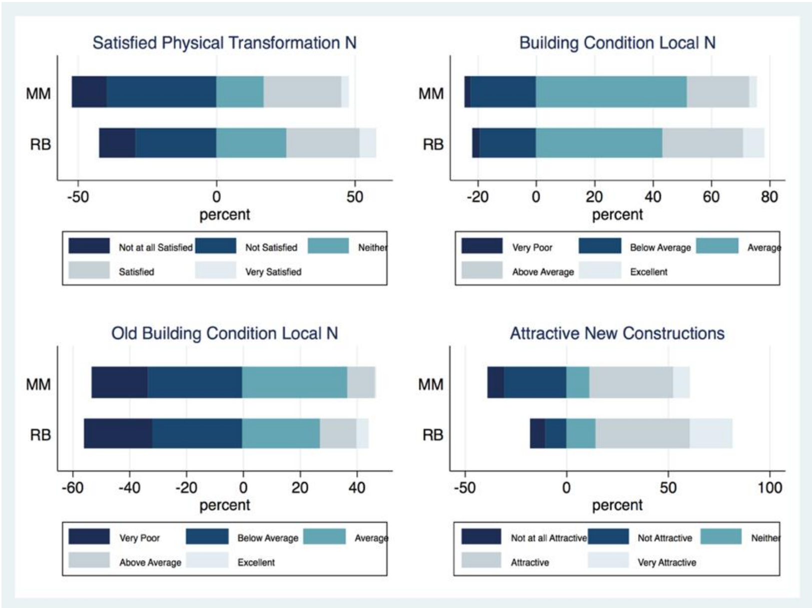
Figure A13 Safety, Stress, Happy, Satisfied



Note: MM – Mar Mikhael; RB – Ras Beirut

Figure A14 replicates Figure 3 in the main paper but plots the relationship by neighbourhood instead of by BC rate.

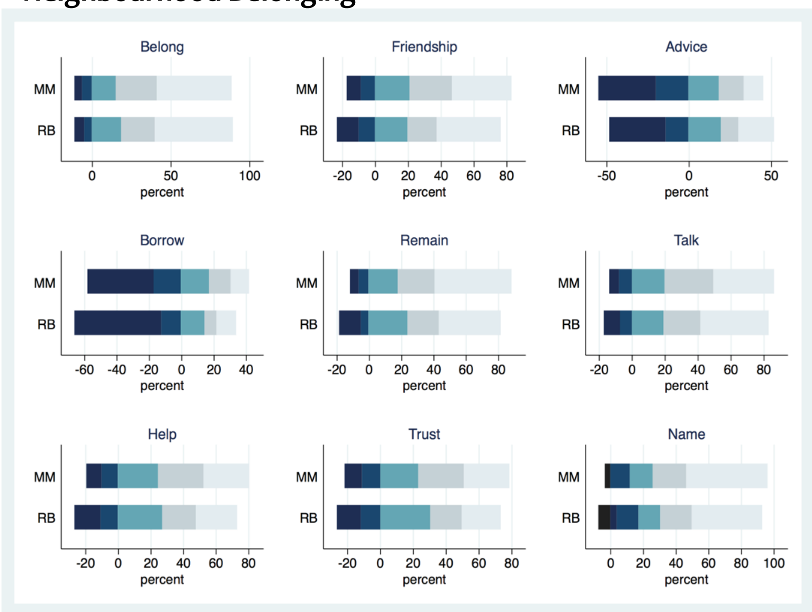
Figure A14 Building Condition



Note: MM – Mar Mikhael; RB – Ras Beirut

Figure A15 presents the relationships between each Neighbourhood Belonging variable and the two case-study neighbourhoods. The average of all these variables is presented in the left panel of Figure 5 in the main paper.

Figure A1. Neighbourhood Belonging



Note: MM – Mar Mikhael; RB – Ras Beirut

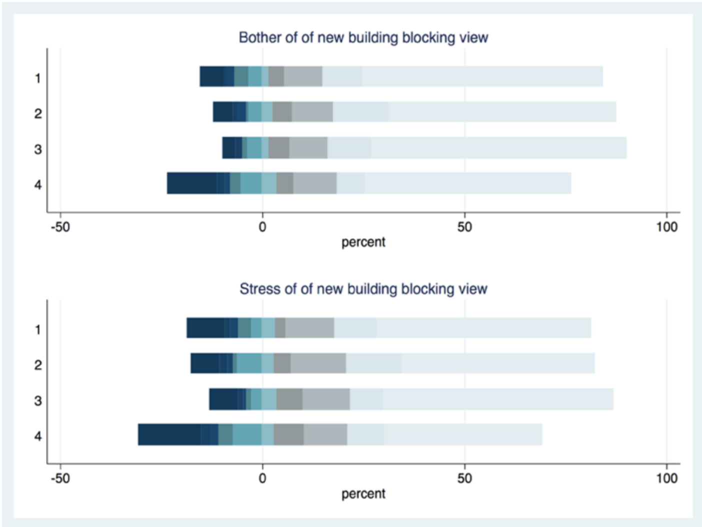
Table A5 Value of Architectural Amenities and Socio-political activism

	Value of urban heritage and well-designed buildings, OR					Signing petition to avoid major change, OR				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Building Change [a]	1.183**	1.210**	1.212**	1.216**	1.180*	0.670***	0.698***	0.661***	0.667***	0.662***
	(0.0966)	(0.0995)	(0.0998)	(0.101)	(0.101)	(0.0673)	(0.0714)	(0.0694)	(0.0705)	(0.0703)
Age		1.098	1.100	1.108	1.103		1.313***	1.320***	1.328***	1.335***
		(0.0847)	(0.0851)	(0.0858)	(0.0859)		(0.123)	(0.127)	(0.129)	(0.130)
Nationality		0.850	0.846	0.855	0.753*		0.496**	0.506**	0.518**	0.506**
		(0.126)	(0.125)	(0.127)	(0.115)		(0.141)	(0.142)	(0.145)	(0.143)
Sex		1.081	1.077	1.066	1.122		1.031	1.079	1.071	1.071
		(0.195)	(0.194)	(0.193)	(0.207)		(0.220)	(0.232)	(0.231)	(0.231)
Education		1.355***	1.396***	1.389***	1.387***		1.221	1.024	1.012	1.012
		(0.137)	(0.152)	(0.153)	(0.154)		(0.167)	(0.149)	(0.148)	(0.148)
Income			0.963	0.965	0.954			1.222***	1.222***	1.223***
			(0.0485)	(0.0488)	(0.0491)			(0.0663)	(0.0664)	(0.0667)
Building Condition				0.908	0.819*				0.895	0.879
				(0.0952)	(0.0908)				(0.113)	(0.112)
Legislation					1.304***					1.032
					(0.0863)					(0.0830)
Philanthropy					1.159**					1.048
					(0.0775)					(0.0835)
Observations	1,055	1,055	1,055	1,048	1,048	1,055	1,055	1,055	1,048	1,048

5.12.3 Results WTP

Prior to being asked the WTP questions, respondents were first asked how much this scenario would bother or stress them. A new skyscraper being built bothered and stressed residents considerably less in areas with high BC rates, as illustrated in Figure A16. The relationship between stress or bother of a new construction in the vicinity of resident living place and rate of BC remains negative and significant

Figure A15 Stress and Bother



5.13 References

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