HOW TO MAKE CITIES MORE LIVABLE? URBAN SUSTAINABILITY, INSTITUTIONAL, AND ENTREPRENEURSHIP APPROACHES

Presented by:
María del Mar Martínez Bravo

Doctoral dissertation

International doctorate mention

Almería, May 2021

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¿Cómo hacer las ciudades más habitables? Enfoques de sostenibilidad urbana, institucional y de emprendimiento

Presented by:
María del Mar Martínez Bravo

Supervised by:
Raquel Antolín López
Javier Martínez del Río

Programa de doctorado en Ciencias Económicas, Empresariales y Jurídicas

"*The primary ingredient for progress is optimism. The unwavering belief that something can be better drives the human race forward*."

(Simon Sinek)

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Abstract

Managing urban sustainability and city livability are currently world crucial issues due to the demographic growth trends and the amalgamation of the population within urban areas. Despite the growing interest of scholars in the topic, research on urban management is still in its infancy and underdeveloped. Research on urban management might need to be developed under a holistic approach that integrates city livability, the three dimensions of urban sustainability, and all the actors concerned by, or involved in, urban dynamics. In that line, this doctoral dissertation aims to shed light on cities management around sustainability and livability through the examination of a myriad of urban factors and their interactions. Specifically, the main goal of this doctoral dissertation is to theoretically and empirically analyze urban dynamics in order to give guidance for researchers and policymakers in the transition towards more sustainable and livable cities. This goal is pursued by the examination of the interconnections among the three dimensions of urban sustainability, urban pollution, institutional factors, sustainable entrepreneurship, and city livability. To attain that goal, this doctoral dissertation is structured in several chapters which are built upon studies with different types of theoretical and empirical approaches.

The first subobjective of this thesis, addressed in chapter 2, is to give an overview of pollution issues in cities and to depict potential solutions. The chapter starts by stating the relevance of current urban pollution issues and by explaining their different possible types and sources. The chapter also shows how the actors involved in pollution emissions could reduce, or even revert, their negative impacts on the urban background. Finally, a plan for action for each of the pollution types is suggested based on a variety of initiatives depending on the most relevant polluting source to be addressed. This chapter is developed based on a literature analysis which groups the extant knowledge on the urban pollution field and extends that literature suggesting as solution the effective management of the activities that take place in urban areas.

The second subobjective of this dissertation, tackled in chapter 3, is to analyze the interconnections among urban sustainability and urban pollution to predict city livability. This chapter aims to identify extant trade-offs and synergies in those interconnections and to explain how the three dimensions of urban sustainability (economic, environmental, and social) and urban pollution interact and simultaneously affect city livability. First, a

theoretical model of the relationships is developed based on existing literature that tackles urban sustainability and city livability. Later, the suggested relationships are tested through structural equation model analysis with a sample of perceptual and objective data from 67 European cities. These first two studies that compose this doctoral dissertation (chapter 2 and chapter 3) have been published.

The third subobjective of the doctoral dissertation, addressed in chapter 4, is to examine the moderating role of institutional factors in the relationship between urban sustainability and city livability over time. Specifically, this chapter investigates if certain institutional factors (regulatory institutions and citizens' pressures) might have a positive or negative effect on the relationship among the three dimensions of urban sustainability and city livability. These relationships are analyzed through a panel data analysis in a sample consisting of 20 European cities in the period 2011-2016.

The fourth subobjective of this thesis, illustrated in chapter 5, is to theoretically identify the mechanisms through which sustainable entrepreneurs can lead the transition of cities towards its sustainable development and then, contribute to enhance urban sustainability and city livability. Hence, chapter 5 includes a systematic literature review on whether and how sustainable entrepreneurship can help cities to become more sustainable and livable. The search for works, after screening and the application of exclusion and inclusion criteria, yields a final sample of 22 articles. Additionally, this chapter includes a research agenda that identifies critical research avenues on the effects of entrepreneurial action on urban sustainability and city livability.

Overall, this doctoral dissertation, which stands on theoretical evidence and empirical support, advances knowledge on the literature on urban sustainability by identifying antecedents of city livability and by shedding light on urban dynamics with the aim of serve as a guide towards more sustainable and livable cities.

Resumen

La gestión de la sostenibilidad y de la habitabilidad a nivel urbano es, hoy día, un problema crucial que afecta a todo el contexto mundial debido a las crecientes tendencias demográficas y a la acumulación de la población en las áreas urbanas. A pesar del creciente interés del ámbito académico en el tema, la investigación en gestión urbana aún se encuentra poco desarrollada. La investigación en torno a la gestión urbana necesita ampliarse bajo la perspectiva de un enfoque holístico que integre la habitabilidad, las tres dimensiones de la sostenibilidad y a todos los actores interesados, o involucrados, en las dinámicas urbanas. Precisamente, esta tesis doctoral pretende analizar teórica y empíricamente las dinámicas urbanas para servir de guía a investigadores y mánager urbanos en la transición hacia ciudades más sostenibles y habitables. Este objetivo se persigue examinando las interconexiones entre las tres dimensiones de la sostenibilidad urbana, la contaminación urbana, factores institucionales, el emprendimiento sostenible y la habitabilidad urbana. Para alcanzar este objetivo, la presente tesis doctoral está organizada en varios capítulos que se sustentan en diferentes tipos de análisis teóricos y empíricos.

El primer objetivo específico de esta tesis, abordado en el capítulo 2, es aportar una visión general de los problemas de contaminación en ciudades y describir posibles soluciones. El capítulo empieza exponiendo la relevancia de los actuales problemas de contaminación en las ciudades y explicando los diferentes posibles tipos y fuentes de contaminación que se producen en su contexto. En este capítulo también se muestra cómo los actores involucrados en las emisiones contaminantes podrían reducir, o incluso revertir, sus efectos negativos en el entorno urbano. Finalmente, se sugiere un plan de acción para cada uno de los tipos de contaminación basado en una variedad de iniciativas dependiendo de la fuente contaminante más relevante que se considere. Este capítulo se desarrolla basándose en el análisis y agrupación de literatura existente en el ámbito de la contaminación urbana y extiende dicha literatura proponiendo como solución a la problemática la adecuada gestión de las actividades que tienen lugar en las áreas urbanas.

El segundo subobjetivo de esta tesis, abordado en el capítulo 3, es explorar y analizar las interconexiones entre la contaminación y la sostenibilidad urbanas para predecir la habitabilidad urbana. Este capítulo pretende identificar las contrapartidas y sinergias en

esas interconexiones y explicar cómo las tres dimensiones de la sostenibilidad urbana (económica, medioambiental y social) y la contaminación urbana interactúan y simultáneamente influyen en los niveles de habitabilidad de la ciudad. Primero, se desarrolla el modelo teórico de relaciones basado en literatura previa que aborda sostenibilidad y habitabilidad en ciudades. Después, se exploran las relaciones que se sugieren mediante análisis de modelos de ecuaciones estructurales con una muestra de datos perceptuales y objetivos que incluye información de 67 ciudades europeas. Estos dos primeros trabajos de la tesis doctoral (capítulo 2 y capítulo 3) han sido publicados.

El tercer objetivo específico de la tesis doctoral, abordado en el capítulo 4, es explorar longitudinalmente el papel moderador de factores institucionales en la relación que se produce entre la sostenibilidad y la habitabilidad. En este capítulo se investiga si factores institucionales (instituciones reguladoras y presiones ciudadanas) tienen un efecto positivo o negativo en la relación entre las tres dimensiones de la sostenibilidad urbana y la habitabilidad de la ciudad. Estas relaciones se analizan mediante un análisis de datos de panel en una muestra de 20 ciudades europeas en el periodo 2011-2016.

El cuarto subobjetivo de esta tesis, abordado en el capítulo 5, es identificar teóricamente los mecanismos a través de los cuales los emprendedores sostenibles pueden liderar la transición de las ciudades hacia su desarrollo sostenible y de esa manera, contribuir a promover la sostenibilidad y habitabilidad urbanas. Así, en el capítulo 5 se incluye una revisión sistemática de la literatura acerca de cómo el emprendimiento sostenible puede ayudar a las ciudades a ser más sostenibles y habitables. La búsqueda de estudios, tras clasificarlos y aplicar criterios de inclusión y exclusión, supone una muestra final de 22 artículos. Además, en este capítulo se incluye una agenda de investigación, que identifica vías críticas de investigación en los efectos de las acciones emprendedoras en la sostenibilidad y habitabilidad urbanas.

En conjunto, esta tesis, que se sustenta en evidencia teórica y soporte empírico, desarrolla el conocimiento en la literatura en sostenibilidad urbana identificando antecedentes de la habitabilidad en las ciudades y aportando luz a las dinámicas urbanas con el objetivo de servir como guía hacia ciudades más sostenibles y habitables.

Chapter 1: Introduction

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1. The relevance of urban sustainability and city livability

Achieving suitable levels of urban sustainability and city livability has gained great traction as a research topic (Bibri and Krogstie, 2017; Geng et al., 2019; Martínez-Bravo et al., 2019; Rousseau et al., 2019; Ruth and Franklin, 2014). Researchers are increasingly considering sustainability and livability issues as they have been signaled as grand challenges in cities (e.g., Vardoulakis and Kinney, 2019). In addition, cities have not only been placed in the spotlight by scientific research (e.g., Alberti, 2017), but also have attracted attention from worldwide programs developed by international organizations such as the United Nations, the European Environment Agency, or the World Health Organization. Overall, researchers and international organizations share one common concern that cities are the scenario where grand challenges might be addressed and where sustainable development might be achieved (Parnell, 2016; Rousseau et al., 2019; Selman, 1998, Vardoulakis and Kinney, 2019).

Research in urban sustainability is relevant because cities present both challenges and opportunities in terms of sustainability and livability. They entail a challenge because of the emergence of place-based tensions (Slawinski et al., 2019) due to, for instance, the unprecedented growth of urban population because of migration movements to urban areas in the search for greater facilities, services, transport possibilities, or employment opportunities. Indeed, the United Nations (UN) estimate the population living in cities to reach 6.5 billion people by 2050 against the 4.3 billion people living in 2019 (World Bank, 2020). In that scenario, the world inhabitants need a large quantity of resources from ecosystems and generate tons of waste and pollution (Martos et al., 2016). Furthermore, cities also suppose a challenge because they are responsible of 80 % of the greenhouse gas emissions, consume 75 % of the world energy (Stocchero et al., 2017), and are significant producers of waste (Bulkeley and Betsill, 2003). Hence, many problems (such as resource depletion and scarcity, ecosystems degradation, urban pollution, or social inequalities) arise and entail great challenges that jeopardize existence as humankind knows it.

However, cities might also suppose an opportunity as they are systems where many interdependencies (including synergies and trade-offs) happen and might be advantageous in the transition towards sustainability (Bai et al., 2016). First, higher densities of population, facilities, and services entail more compact urban forms that might entail, among other, less transport needs and energy savings (Jenks and Jones, 2010). In addition, cities suppose hubs for innovation due to their offer of proximity, density, and variety (Athey et al., 2008). In that line, cities are systems with high capacity of adaptation (Parnell, 2016) which, if well managed, might be translated into efficient changes towards more sustainable forms. Overall, cities suppose a challenging but promising scenario where to achieve the attainment of sustainable development.

The issue of defining sustainable city has got researchers' attention and the majority of studies agree on the lack of a widely accepted definition (e.g., Hassan and Lee, 2015; Rousseau et al., 2019). However, it is well-known that a sustainable city might implement initiatives addressing sustainable development targets over time at the local level (Bibri and Krogstie, 2017; Opschoor, 2011, Yan et al., 2018). Hence, based on the sustainable development definition of the World Commission on Environment and Development (1987) and on the triple-bottom-line and time-lasting nature of sustainability (Bibri and Krogstie, 2017; Newman, 1999; Tanguay et al., 2010; Vardoulakis and Kinney, 2019), the definition I suggest in this doctoral dissertation for sustainable city is *an urban delimited area where the economic, environmental, and social needs of all inhabitants are covered without conditioning future citizens to meet their own needs*.

2. The complex and strong relation between urban sustainability and city livability

Previous research literature argues that sustainability is also based on livability standards (Newman, 1999; Ruth and Franklin, 2014; Tanguay et al., 2010), while others suggest that sustainability is a compulsory requirement for livability (Alberti, 2017; Bulkeley and Betsill, 2003; Marans and Stimson, 2011). Anyhow, urban sustainability and city livability hold strong relationships and interdependencies, and, in turn, urban sustainability issues might likely impact city livability levels (Martínez-Bravo et al., 2019). As city livability refers to the ability of a city to provide adequate conditions for citizens to thrive, have a good quality of living, and perceive their position in life as

satisfactory (Macke et al., 2018; Marans, 2015; Ruth and Franklin, 2014), sustainability aspects might condition city livability perceptions. For instance, economic urban sustainability aspects such as housing affordability or job opportunities might worsen because a higher urban population density might likely make more difficult to find affordable housing or reduce jobs opportunities (Marans and Stimson, 2011). Also, regarding environmental sustainability aspects such as, for example, waste management, a greater population might consume more goods and might, in turn, complicate dealing with greater amounts of wastes (Bulkeley and Betsill, 2003). Social urban sustainability issues such as access to public services might become less available with greater populations as the demand of those services might rise too (Marans and Stimson, 2011). Overall, the current challenges that negatively affect the three dimensions of urban sustainability might, in turn, worsen city livability levels.

In that context, the relationships among the economic, environmental, and social dimensions of urban sustainability and city livability are not only complex but also frequently entail tradeoffs (Martínez-Bravo et al., 2019) as some practices might have unexpected or unforeseen impacts. Specifically, one might think that the high presence of job opportunities, which might be linked with high levels of economic urban sustainability, might suppose greater city livability perceptions. However, great job opportunities might also mean a high presence of companies, industries, or high road traffic rates to reach the workplaces which all might likely suppose higher levels of urban pollution which might, in turn, worsen city livability levels. Similarly, one might think that the abundance of social services might positively impact city livability levels. However, the development of effective social services might entail the need of abundant economic resources which might likely be economically detrimental for other initiatives (e.g., green areas maintenance) which might, in turn, negatively affect city livability levels as well. As illustrated, the potential trade-offs that arise when considering the interconnections among the three dimensions of urban sustainability and city livability might be numerous and, sometimes, unforeseen.

3. Urban actors involved in sustainability and livability challenges

Researchers and practitioners have acknowledged the necessity of the cooperation among the different urban actors when looking for more sustainable cities (e.g., Bai et al., 2016;

Bibri and Krogstie, 2017; Pataki, 2015; Vardoulakis and Kinney, 2019). Urban actors might cause some of the problems but, at the same time, might have the leading role in the achievement of the solution. Hereafter, we expose how urban actors (citizens, governments, and entrepreneurs (Vardoulakis and Kinney, 2019)) might impact sustainability challenges and contribute to solve them.

First, *citizens* are expected to be crucial actors when tackling sustainability challenges (Fritz et al., 2019), as they are the primary elements of the society. Citizens are likely to impact urban sustainability levels through their daily lives' routines because they are the primary consumers of products and the primary users of urban services. Thus, if they overconsume products, especially those which are not environment friendly, or if they make a non-sustainable use of services, they might likely negatively impact the urban environment. In addition, citizens might also have the power to reduce, or even revert, the negative effects of their actions or behaviors. For example, the daily use of non-polluting transport systems (e.g., walking or cycling) might avoid pollution emissions in a city and, hence, might improve urban sustainability levels. Furthermore, citizens with higher sustainability awareness might choose governments with a higher orientation towards sustainability issues (Buijs et al., 2016; Delmas and Toffel, 2004). Thus, those citizens are likely to exert pressure in policymaking or even act as agents of change by, for instance, requiring governments or companies to embrace more sustainable policies or initiatives (e.g., Sine and Lee, 2009; Weber et al., 2008). Hence, dwellers decisions and actions are likely to be a relevant component when facing sustainability challenges (Bujis et al., 2016; Delmas and Toffel, 2004; Fritz et al., 2019; Kraay et al., 2010; Sine and Lee, 2009; Weber et al., 2008).

Local governments are suggested to be key elements in urban sustainability issues as well (Portney, 2003; Vardoulakis and Kinney, 2019; Zeemering, 2009). First, governments initiatives influence the characteristics of the city (Zeemering, 2009) as, for instance, the quality of public spaces and services. Hence, if governments enhance the quality of green spaces or address the environmental impacts of public transport systems, they are likely to improve urban sustainability levels (Portney, 2003). Second, local governments might have the ability to foster community proactive behaviors through public campaigns (Stevens, 2010). For instance, displaying the tangible benefits that reducing or recycling might have on the environment might make citizens more prone to reduce or recycle.

Third, local regulations might condition the actions of companies (Iwanow and Kirkpatrick, 2007; Kraay et al., 2010) and citizens in sustainability issues. Thus, if governments establish strict regulations tackling, for example, companies' emissions or citizens recycling attitudes, the sustainability of a city might more likely improve.

In addition, *entrepreneurs* might also influence urban sustainability for different reasons. First, entrepreneurial activities might have detrimental effects for urban sustainability such as higher economic competitiveness in housing prices, polluting emissions from their activities or social exclusion of specific minorities such as those with limited economic resources (Lee, 2018). However, urban sustainable entrepreneurs might have the capacity to restore the negative effects that the urban actors might exert on urban sustainability (Slawinski et al., 2019). For instance, environmental entrepreneurs have been signaled as key actors for renovating and maintaining both nature and ecosystems (Antolín-López et al., 2019). Hence, in the presence of high rates of sustainable entrepreneurship, the economic opportunities for citizens, their resources, their feelings towards the community and their life, might likely improve too which, in turn, might mean higher sustainability levels. Second, entrepreneurship in specific activities might address sustainability issues as well. For example, they might initiate activities fostering social development (e.g., culture regeneration initiatives) which might, in turn, improve sustainability levels (Zhang and Swanson, 2014). Indeed, sustainable entrepreneurs might address market failures in order to increase sustainability (Dean and McMullen, 2007; York and Venkataraman, 2010). Specifically, sustainable entrepreneurs operating at the city-level have been pointed out as a solution for place-based issues as the new ventures of those entrepreneurs are likely to modify the urban environment where they act (Cohen and Muñoz, 2015; Slawinski et al., 2019).

4. Problems and gaps in urban sustainability research

After a thorough literature analysis, a myriad of relevant research gaps was identified. Even if there might exist other, this doctoral dissertation explicitly tackles some of them. In that line, this dissertation addresses certain urban issues that particularly condition the achievement of urban sustainability and city livability standards. First, pollution is one of the most threatening issues for cities' sustainability and city livability (Goel, 2006; Whiteman et al., 2011). Cities might be places with high presence of companies and

industries and high rates of road traffic which might be translated into pollution emissions (Kolk and Tsang, 2017) that might likely affect human health and well-being (Martínez-Bravo and Martínez-del-Río, 2019; Ruth and Franklin, 2014). Indeed, the World Health Organization (WHO) estimates the air pollution related premature deaths in cities up to seven million per year (Mannucci and Franchini, 2017). However, there are relatively few papers actually including overall cities' pollution. Hence, analyzing the importance and the causes of, as well as solutions for, urban pollution problems becomes critical in cities management.

Second, the lack of holistic approaches when approaching multifaceted problems such as those related to sustainability or city livability (Bibri and Krogstie, 2017; Ruth and Franklin, 2014; Zhang et al., 2018) might entail potential failures. Numerous initiatives which address single-aspect issues frequently also entail negative, and somehow unexpected, consequences. For instance, green building initiatives (e.g., Khoshnava et al., 2018) might likely reduce urban pollution and improve the environmental urban sustainability, and thus, enhance the quality of living of some city dwellers but, at the same time, housing might probably be more difficult to afford or to maintain for citizens with limited economic resources. This example serves to illustrate the necessity of studying the trade-offs and complementarities among the different dimensions of urban sustainability, urban pollution, and city livability in order to coordinate action towards more sustainable and livable cities (Bai et al., 2016; Tomor et al., 2019).

Third, even if institutional theory has been a theoretical pillar in the study of business sustainability (e.g., Hoffman and Jennings, 2015), the role of institutions has not been purposefully analyzed at city-level within the context of urban sustainability and city livability. In addition, the scarce extant research at the intersection of institutions and urban sustainability or city livability is mainly conceptual (Kaal, 2011; Węziak-Białowolska, 2016), based on single-city studies (e.g., Ellis and Roberts, 2015), or do not address these relationships from a longitudinal perspective (Bornemann and Strassheim, 2019). Thus, there is interest in empirically analyzing how livability, sustainability, and institutions interrelate at city-level over time.

Fourth, although companies' cooperation has been pointed out as essential for achieving sustainability goals (Cummings et al., 2020), the literature evaluating how entrepreneurs

might impact, and play a relevant role towards, sustainable development at the city-level remains somehow unexplored (Scheyvens et al., 2016; Stafford-Smith et al., 2017). Previous literature on sustainable entrepreneurship has already highlighted the role of entrepreneurs as key agents for resolving environmental and social problems (Dean and McMullen, 2007; York and Venkataraman, 2010). More recently, a stream of research emphasized the relevance of the place-embeddedness of entrepreneurs who are likely to modify the urban environment where their ventures take place (Cohen and Muñoz, 2015). Indeed, entrepreneurs might have the capacity to address exclusive and intertwined urban challenges which might likely result in the improvement of the quality of living (Cohen and Kietzmann, 2014). However, even if the role of place in entrepreneurship has been signaled as relevant (McKeever et al., 2015), scarce literature takes it into consideration (Cohen and Kietzmann, 2014; Cohen and Muñoz, 2015). Thus, it might be interesting to analyze if sustainable entrepreneurs might have an impact on urban sustainability and city livability in the cities where they operate.

5. Research goals and contribution

Even if management research on urban sustainability has been gaining relevance in the last years, this research topic is still in its infancy and underdeveloped. First, some scholars suggest that most of existing studies analyze single aspects of urban sustainability issues without holding a general perspective (Bibri and Krogstie, 2017; Zhang et al., 2018). For instance, some authors focus on specific city programs or technologies like Fujii et al., (2014) who developed an insightful study but analyzed a very specific issue such as organic solid waste management and how it was addressed through smart recycling practices. However, sustainability has been signaled as a multifaceted problem whose solution might need to hold a holistic approach that considers a diversity of urban factors from an integrated perspective (Elmqvist et al., 2018; Runhaar et al., 2009; Zhang et al., 2018).

Second, the majority of the studies are not supported by empirical quantitative analysis (Węziak-Białowolska, 2016), that is, they adopt a conceptual approach (e.g., Vogel, 2019) or are based on single-city or single-country analysis (e.g., Affolderbach and Schulz, 2017) which analyze places that may hold certain specificities that other might

not (Slawinski et al., 2019; Zeemering, 2009) and challenge the generalization of their results to other contexts.

Third, despite the growing acknowledged importance of time effects on sustainability performance (e.g., Ortiz-de-Mandojana and Bansal, 2016), there is a lack of studies considering time factors in urban dynamics (Bornemann and Strassheim, 2019). Thus, there are very few longitudinal studies that address causal relationships between urban factors to predict urban sustainability and/or city livability.

Finally, there is a lack of studies drawing on institutional or entrepreneurship theories to explain urban dynamics in the pursuit of the transition towards the sustainable development of cities and the enhancement of city livability (George et al., 2016; Nakamura, 2019).

In this context, the main research objective of this dissertation is **to theoretically and empirically analyze urban dynamics in order to give guidance for researchers and policymakers in the transition towards more sustainable and livable cities**. This objective is pursued by examining the interconnections among the three dimensions of urban sustainability, urban pollution, institutional factors, sustainable entrepreneurship, and city livability. This broad research objective is divided into four specific subobjectives that are addressed through a combination of studies that include a diversity of theoretical approaches (urban sustainability trade-offs, institutional, and entrepreneurship theories), different methodological approaches (literature review, cross-sectional, and longitudinal analysis), and rich datasets consisting of multi-city and multi-country data.

Subobjective 1. The first subobjective of this thesis is **to give an overview of pollution issues at the city-level and depict potential solutions**. Urban pollution refers to the presence or introduction of poisonous or harmful substances in cities (Martínez-Bravo and Martínez-del-Río, 2019). Hence, with that purpose, this thesis first states the relevance of current urban pollution problems and explains the different types of urban pollution: air, water, soil, waste, and noise pollution (Cachada et al., 2018; Diamond et al., 2015; European Environmental Agency, 2015; Goel, 2006; Paiva Vianna et al., 2015; Schweitzer and Noblet, 2018; Zannin et al., 2006). Afterwards, it shows how the actors

involved in pollution emission (governments, entrepreneurs, and citizens) could reduce, or even restore, urban pollution negative impacts on the urban background. Finally, the thesis aims to attain its first subobjective by suggesting a plan for action for each of the pollution types mentioned with a variety of initiatives depending on the predominant pollution issue in each situation. The subobjective 1 is addressed in chapter 2.

Subobjective 2. The second subobjective of this dissertation is **to theoretically explain the interconnections among urban pollution, sustainability, and livability** in European cities. Ensuring urban sustainability and city livability is becoming increasingly challenging due to the unprecedented growth of urban population (Bibri and Krogstie, 2017; Gorissen et al., 2018; Marans, 2015). Thus, the second subobjective of this thesis is to develop a theoretical model that explains how the three dimensions of urban sustainability (economic, environmental, and social) and urban pollution interact and simultaneously affect city livability. Those relationships are tested using a structural equation model (SEM) analysis in a 2015 sample of perceptual data of dwellers in 67 European cities and secondary data on urban pollution. Overall, the findings advance the knowledge on the interplay and trade-offs between the pillars of urban sustainability and their impact on city livability. The outcomes of the work pursue not only to find the antecedents of city livability in urban areas in order to develop empirically based knowledge, but also to advice decision and policymakers in urban dynamics issues. This second subobjective is tackled in chapter 3.

Subobjective 3. The third subobjective of this thesis project is **to longitudinally study the effect of two relevant institutional factors on the relationship among sustainability and livability** in European cities. Extant literature argues that city livability might benefit from institutions management fostering urban sustainability (Ruth and Franklin, 2014; Santos and Martins, 2007; Dempsey et al., 2011). In that line, the third subobjective investigates whether institutional factors, specifically regulatory institutions and citizens' pressures, have a moderating effect on the relationship among sustainability and livability in cities. To test those relationships, the study develops a panel data analysis on a sample composed of data from 20 European cities in the period 2011-2016. Thus, with this subobjective, the dissertation extends current knowledge on the interconnections between urban sustainability, city livability and their institutional background. The third subobjective of the doctoral dissertation is addressed in chapter 4.

Subobjective 4. To attain the main goal of the thesis, its fourth subobjective is **to theoretically analyze the existing research addressing the role that entrepreneurs suppose in the transition towards more sustainable and livable cities and to provide a research agenda**. The role of sustainable entrepreneurs has been positioned as crucial for sustainability transitions (Cohen and Muñoz, 2015; Slawinski et al., 2019). However, the literature addressing sustainable entrepreneurs' impact on sustainability and livability at the city-level remains somehow unexplored (Scheyvens et al., 2016; Stafford-Smith et al., 2017) and there is a lack of integrated perspectives considering all the research already published. Thus, the fourth subobjective extends the existing literature on urban sustainability by performing a systematic literature review on whether and how sustainable entrepreneurship might lead cities to become more sustainable and livable. Also, this subobjective develops a research agenda that identifies critical research avenues on the effects of entrepreneurial action on urban sustainability and livability features. The fourth subobjective of the doctoral dissertation is tackled in chapter 5.

Consequently, this doctoral dissertation aims to attain its main objective by tackling the four aforementioned subobjectives based on the development of theoretical knowledge with a holistic perspective and supported by empirical analysis. The attainment of each of the four subobjectives entails theoretical and empirical developments that are explained in detail in each of the following chapters. Specifically, this thesis pursues to contribute to the literature on urban sustainability by a) stating the great relevance, grouping existing literature, and providing guidance in terms of urban pollution issues and their solution, b) exploring the interconnections and trade-offs among economic, environmental, and social urban sustainability and pollution as antecedents of city livability, c) analyzing whether the institutional framework, more specifically regulatory institutions and citizens' pressures, might boost the impact of each of the three dimensions of urban sustainability on city livability, and d) reviewing extant research on the effects of sustainable entrepreneurs' effects on the three dimensions of urban sustainability and on city livability and providing a research agenda in the field.

6. Dissertation structure

To attain the main objective and different subobjectives proposed, the thesis is structured as follows. The document starts with this introduction as a first chapter with the aim of

contextualizing the studies carried out and of justifying their relevance and the importance of attaining the main goal of the thesis.

Later, the second chapter aims to give an overview of urban pollution issues. That chapter firstly englobes a description of pollution issues in cities as well as possible polluting sources. Afterwards, it proposes suggestions in order to address urban pollution and to reduce emissions from the perspectives of the different actors involved. Finally, it offers a specific plan for action to face urban pollution depending on the type of pollution considered – e.g., air, water, noise, etc.

Once the pollution problems are exposed and some potential solutions presented in the second chapter, the third one focuses on analyzing the relationships among urban pollution, the three dimensions of urban sustainability, and city livability in European cities. With that objective, the chapter starts with the elaboration of a theoretical framework based on previous literature to, later, empirically test it with data of different variables with European cities information. The chapter also gives guidance on how urban actors could face cities issues in order to make them more sustainable and livable.

Next, the fourth chapter also presents a theoretical framework that is empirically tested. However, this chapter not only adds the analysis of the effect of institutional framework factors on urban sustainability and city livability, but also analyzes those relationships longitudinally. Specifically, regulatory institutions and citizens' pressures are tested to analyze if their presence might influence over time the effects of the three dimensions of urban sustainability on city livability.

Once that all those relationships are theoretically elaborated and empirically tested in chapter 3 and 4, chapter 5 aims to link entrepreneurial impacts with urban sustainability and city livability. Thus, chapter 5 integrates a systematic literature review of extant research on the effects of sustainable entrepreneurs' initiatives on the three dimensions of urban sustainability and city livability. Also, the chapter provides a research agenda specifying the topics that have not been addressed by research yet. Finally, the last section of the current doctoral dissertation exposes the research and practical contributions and implications of the studies that compose this thesis as well as the limitations and further research horizons that arise.

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Chapter 2: Urban pollution and emission reduction

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Chapter 2: Urban pollution and emission reduction

Abstract

Although there is not a universally accepted definition, the concept of urban pollution refers to the presence or introduction in cities and urban areas of poisonous or harmful substances. Urban pollution may come from natural sources, but the most detrimental are those emissions related to human activities. The anthropogenic sources of pollution, such as factories, industries, transportation, and so on, are typically exacerbated in cities due to the local concentration of humans and human activities. For instance, pollution in cities is affected by global environmental threads, such as global warming, and by locally originated environmental challenges, such as waste management, recycling, and light and noise generation.

Keywords: urban pollution, pollution solutions, pollution remediation, initiatives against urban pollution.

1. Introduction

The latest assessments carried out by the United Nations Environment Programme (UNEP) in 2016 revealed the extent of environmental problems. Pollution affects air, water, land, oceans and even climate (Diamond et al., 2015), influencing their quality and disturbing humans and environmental conditions (UNEP, 2017). Cities are major contributors to pollution problems (Whiteman et al., 2011) because there is a direct relationship between population densities and levels of pollution (Goel, 2006). The United Nations (UN) estimates that by 2050, more than two-thirds of the world's population will be living in cities (Muñoz and Cohen, 2016). The consequences of this increase include a dramatic transformation of the physical urban space and its adjacent areas.

Interestingly, cities pose both a challenge and an opportunity for environmental problems: a challenge because cities are a major focus of pollution. For instance, cities consume 75 % of the world's energy (Whiteman et al., 2011) and are responsible of more than 80 % of the worldwide greenhouse gas emissions (Martos et al., 2016). However, the increasing concentration of the world's population in cities also constitutes an opportunity because they can offer a sustainable lifestyle and because their density enables efficiency due to economies of scale (Muñoz and Cohen, 2016).

The aim of this chapter is to explain what urban pollution is as well as to define the different sources and types of urban pollution and to expose a collection of potential measures that could be carried out to reduce emissions in cities.

This chapter starts with an analysis of the concept of urban pollution, its types and sources (such as air, land, water, waste and noise) and the polluting elements they involve, the health and environmental issues they imply and the established guidelines. Later, the different actors involved in avoiding or slowing urban pollution down. Specifically, we analyse the role of governments, companies and citizens. Finally, some specific measures to solve ever increasing urban pollution will be suggested, including initiatives to address air, water, noise, waste and general pollution.

2. Definition and types of urban pollution

There is not a universally accepted definition of "urban pollution." The Oxford English Dictionary defines the term *pollution* as “the presence in or introduction into the environment of a substance which has harmful or poisonous effects.” The concept of urban pollution includes all forms of pollution that occur in cities. This chapter refers to pollution in urban areas.

The 2017 UNEP report defined the most important pollution issues across regions as air pollution, water pollution, chemicals and waste. These forms of pollution are present and exacerbated in cities. In addition, as stated by the World Health Organization, urban noise pollution is the third most hazardous type of environmental pollution in cities (Zannin et al., 2006).

2.1. Air pollution

The urban air is constantly being polluted by natural sources such as volcanoes, wildfires, dust storms, and sea salt spray, or from sources related to human activities such as power plants, industry, households, transport, agriculture, and waste treatment (UNEP, 2017). Air pollution is intensified in cities because of housing, population density, industry accumulation and traffic.

Regarding the air pollutants, there are two large groups depending on their provenance. Primary pollutants are those that are directly emitted into the atmosphere (carbon monoxide or sulfur dioxide), and secondary pollutants, such as ozone, are formed because of chemical reactions between other pollutants and atmospheric gases (Holman, 1999).

It is important to distinguish the types of pollutants when addressing air pollution problems in order to choose the correct measure to implement, because a reduction in some of the responsible emissions could imply an increase in its concentrations (e.g., the reduction in nitrogen oxide emissions can lead to an increase in local ozone concentrations) (Holman, 1999).

According to the World Health Organization (WHO, 2017a), the air pollutants that mainly affect human health are particulate matter (PM), ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and carbon monoxide (CO).

Particulate matter is the most important, as it affects more people than any other air pollutant (UNEP, 2017). PM refers to harmful particles of different elements that can be inhaled. These particles include those whose diameter is smaller than 10 microns (PM_{10}), and there are fine particles with a diameter of less than 2.5 microns ($PM_{2.5}$), which present the biggest risk to health because of their capacity of entering peoples' lungs and bloodstream (WHO, 2017a). The WHO established PM guidelines to be met by cities with regards to air quality (WHO, 2016), which are specified below in Table 1. In 2016, these guidelines were not fulfilled by 98 % of cities in low- and middle-income countries and 56 % of cities in high-income countries with more than 100 000 inhabitants (WHO, 2017b). Black carbon is the main component of $PM_{2.5}$ and is also known as a "short-lived climate pollutant" because it settles in the atmosphere in a shorter time than carbon dioxide (CO_2) does. Black carbon is the second highest contributor to climate change (after CO_2), even with its short lifetime (WHO, 2017a).

Ground-level ozone is a secondary pollutant because it is not emitted directly into the air but formed because of chemical reactions in the presence of sunlight. Therefore, depending of the region, ozone formation mechanisms may be different according to the existent substances and the sunlight intensity (Liu et al., 2018). This pollutant is responsible of a variety of breathing problems and respiratory diseases such as asthma (United States Environmental Protection Agency (USEPA), 2017a). Ozone damages plants and materials and acts as a 'greenhouse gas' contributing to the greenhouse effect. Its high levels are often related to visibility problems as well (Pleijel, 2000).

An important component of ozone and particulate matter is nitrogen dioxide. This gas is mainly created by industrial and traffic sources (WHO, 2017a) since it is emitted into the air as a result of fuel combustion (USEPA, 2017a). When NO_2 interacts with water, oxygen and other chemicals, it causes acid rain and hazy air, which can harm lakes, forests, natural parks, and coastal waters (USEPA, 2017b). Some studies suggest that this pollutant is associated with asthma and wheezing issues (e.g., Gauderman et al., 2005).

Sulfur dioxide is created by the combustion of fuels containing sulfur (European Environment Agency, 2010). This compound can harm the human respiratory system (USEPA, 2017c). In addition, the generation of SO_2 results in acid deposition, which can affect soil and water quality, damaging lakes, forests and vegetation. Sulfur dioxide is also a PM precursor (European Environment Agency, 2010).

Carbon monoxide is a colorless, odorless, tasteless, non-corrosive, and highly poisonous gas that has a similar density as that of air (European Environment Agency, 2017). CO is very flammable, and it is released during combustion (USEPA, 2017d). It is not common to find very high levels of CO outdoors, but when it is present, it is particularly dangerous for people with heart diseases because of the limited amount of oxygen traveling to the heart (USEPA, 2017d).

In 2005, the World Health Organisation established the "WHO Air Quality Guidelines" in order to fix the limits for key air pollutants that pose health risks. These limits have been evolving to be more restrictive. The guidelines are established by experts based on evidence derived from current scientific evaluations for particulate matter, ozone, nitrogen dioxide and sulfur dioxide in all WHO regions:

Table 1. WHO annual means guidelines by air pollutant

Pollutant	WHO annual means guidelines ($\mu g/m^3$)
Particulate Matter PM_{10}	20
Particulate Matter $PM_{2.5}$	10
Ozone O_3	100 (8-hour mean)
Nitrogen dioxide NO_2	40
Sulfur dioxide SO_2	20 (24-hour mean)

Source: self-elaboration with data gathered from WHO (2016)

According to the WHO (2016), with a reduction in particulate matter (PM_{10}) emissions from 70 to 20 μg/m, the air pollution-related deaths would fall by approximately 15 %.

2.2. Water/freshwater, marine and coastal pollution

Most of the water in Earth is contained in oceans and ice caps. This fact hinders the possibility of their exploitation. For this reason, most of the human demand for water is

satisfied by rainwater and groundwater resources, even though this quantity is very limited (Goel, 2006). Additionally, in cities, industrialization and population growth are increasing water consumption and deteriorating water quality.

In urban areas, water can be present both as surface water and as groundwater depending on where it is located. The first is located in lakes, reservoirs, ponds, rivers, and streams, while groundwater is present in porous rock units. Water pollution depends on the type of water affected, as the different types of exposure to contaminants will define the pollution engendered (Schweitzer and Noblet, 2018).

Physical factors, such as heat or radiation, can promote the creation of biopollutants in the water. However, the main sources of water pollution are chemicals that remain dissolved or suspended in water and cause environmental reactions that can result in the formation of water contamination (Goel, 2006). Some examples of the possible impacts on human health caused by chemicals are cell mutagenesis or the emergence of antibiotic-resistant bacteria (UNEP, 2017). Humans and the environment are exposed to chemical contamination not only through water but also through polluted food, polluted workplace environments, sprays, detergents, textiles, cosmetics, construction materials and furniture (UNEP, 2016; Ke et al., 2015).

Schweitzer and Noblet (2018) divided the sources of water pollution into two large groups: point and nonpoint sources. Point sources imply localized identifiable sources of contaminants (mines, power plants, factories, etc.). Nonpoint sources are those extended over a large geographic area (urban runoff, vehicles, etc.). The point sources include the following: wastewater effluent (municipal and industrial), runoff and leachate from waste disposal sites, runoff and infiltration from animal feedlots, runoff from mines, oil fields, unsewered industrial sites, storm sewer outfalls from cities with a population over 100 000 inhabitants, overflows of combined storm and sanitary sewers, and runoff from construction sites over 2 hectares.

The nonpoint sources include the following: runoff from agriculture (including return flow from irrigated agriculture), runoff from pastures and ranges, urban runoff from unsewered areas and sewered areas with a population over 100 000 inhabitants, septic tank leachate and runoff from failed septic systems, runoff from construction sites over 2

hectares, runoff from abandoned mines, atmospheric deposition over a water surface, and activities on land that generate contaminants, such has logging, wetland conversion, construction, and development of land or waterways (Carpenter, 1998).

Water contaminants come from anthropogenic sources of organic chemicals, marine debris and plastic in the environment, metals and metalloids, nutrients, radionuclides, bacterial contamination and other water pathogens, and algal toxins (Schweitzer and Noblet, 2018).

The World Health Organization established guidelines regarding water types because water quality necessities vary depending on the water type: drinking water, wastewater reuse, and recreational water (WHO, 2001). The guidelines for drinking water are stricter than those of wastewater reuse or recreational water.

2.3. Soil and land pollution

Soil and land urban pollution can be caused by natural sources (soil geochemistry, geology, salt, landslides) or by anthropogenic sources (land-based farming, industry, extractives, waste, wastewater, transport, energy production) (UNEP, 2017). Soil and land are the basis for every system of either a natural or human origin. In cities, soil has two main roles: supporting urban development and embracing parks and gardens, which play an important environmental role in urban communities (Cachada, et al., 2018).

Disrupted water, nutrient, and biological cycles are the main reasons why soils employed for urban development or transport infrastructures are losing most of their functions (EC, 2012). The assessment of soil quality depends on what it is used for. This assessment is performed through chemical, physical and biological indicators (Cachada et al., 2018). According to the 2010 Environment Report of the European Environment Agency (EEA), urban soil degradation is being increased because of the following causes:

- soil sealing (the permanent covering of soil with an impermeable material),
- soil erosion (which has an effect on water bodies such as freshwater),
- desertification,
- soil acidification (caused by the deposition of acidifying air pollutants),
- threats to soil biodiversity, and
- soil contamination.

Soil features have a direct effect on water and atmosphere quality, as they represent the interface between the biosphere, the atmosphere and the hydrosphere. Soil features consequently influence human health (Cachada et al., 2018).

2.4. Waste pollution

The generation of waste doubled between 1970 and 2000 (United Nations Environment Programme and International Solid Waste Association, 2015) and is continuously growing (UNEP, 2017). In addition, the UNEP (United Nations Environmental Programme) (2017) shows a clear and direct relationship between the quantity of individuals' solid waste and the income level of their respective countries.

In some countries (mostly those with developing or underdeveloped economies), the equipment and skills to handle the management of different types of waste are scarce. Consequently, environmental impacts and health risks are greater than those in developed countries. Additionally, such a situation implies the loss of value of many recycled materials (EEA, 2015a), as their subsequent reuse cannot be optimized.

There are different types of wastes: food waste, commercial and industrial waste, construction and demolition waste, agricultural waste, forestry waste, mining waste and quarrying waste. Disasters contribute to the generation of waste as well (UNEP, 2017).

Waste derived from chemicals is a cross-cutting pollutant (UNEP, 2017) because the effect covers different forms of pollution (e.g., chemicals can contribute to air pollution as well as to water pollution, and waste can contribute to soil and to water pollution). Therefore, waste implications for the environment and health are multi-faceted and intertwined with several other sources of pollution.

In Europe, waste generated from production and consumption is decreasing even as the economic outputs are increasing. For example, waste generation from manufacturing between 2004 and 2012 in the EU-28 and Norway fell by 25 %, even though there was an increase of 7 % in sectorial economic output (EEA, 2015a).

2.5. Noise pollution

According to the World Health Organization, noise pollution is one of the three most harmful types of environmental pollution in cities (Khilman, 2004). As the population of a city grows, the city becomes noisier, implying a larger problem (Zannin et al., 2006).

Noise pollution sources are mainly transportation and industrial activity. Noise pollution increases because of society's growing demand for greater mobility and productivity (EEA, 2015b). However, noise from road traffic is the most important threat for citizens because it covers a large area and it affects many people (EEA, 2014). Fisher et al. (2017) classified the most disturbing environmental noises as noise from road traffic, railways and airports, which result in diverse health problems in people living in those environments.

Noise is a very invasive pollutant that affects the health and well-being of exposed humans (EEA, 2015b). According to Maschke (1999), noise pollution and its consequences are stress-inducing and have a psychosocial impact on people's condition. The primary specific health issues related to noise pollution are hearing problems, cardiovascular disease, cognitive impairment, sleep disorders, tinnitus and annoyance (Paiva Vianna et al., 2015).

The European Union instrument that controls noise pollution is the Environmental Noise Directive (END). The END measures and monitors the actions developed to address land-based noise emissions (EEA, 2015b).

3. Addressing urban pollution and reducing emissions

Cities are constantly evolving, and the knowledge underlying their design and planning is perennially expanding (Bribi and Krogstie, 2017). This ability creates a resiliency in cities, which can be used to address pollution problems. The term resilience, in reference to cities, was first applied by Holling (1973, p.17) from an ecological perspective referring to the ability of a system to absorb disturbances and still persist (Jong et al., 2015). Cities have the potential to create evolve and adapt to address emergent pollution issues. In this sense, addressing urban pollution has already shown important achievements in different fields (health, well-being, and economy, in addition to the

natural environment environment) such as, for example, the healing of the ozone layer. Further actions could foster even more this kind of progress (UNEP, 2017).

The framework proposed by the UNEP (2017) is based on a plan that prioritizes targeted interventions catalogued from risk assessment and scientific evidence of impacts. These interventions address "hard-hitting" pollutants and key pollution areas. There are an important number of 'hard-hitting' pollutants and others that have exceeded exposure thresholds, and they must be addressed first. In addition to focusing on those kind of pollutants, it is important to identify and face the key pollution areas in cities, which contribute the most to health and environmental problems.

The environmental sustainability of a city embraces different aspects aiming to attain its sustainable development (Brundtland, 1987) including environmental measures that aim to reintegrate natural processes within the city (Newman, 1999). Ecosystems are a favorable performer in the battle against pollution. Ecosystems surround cities or are present in the majority of them (naturally or artificially). Moreover, ecosystems have the capacity to reduce pollutants in the air, water and soil. Caring for ecosystems (creating or restoring them) can thus help regulate some contaminants. Some examples of possible environmental measures to apply in cities and in their surroundings are vegetative barriers, green walls and roofs or organic farming.

Furthermore, achieving a pleasing sustainable economic development of a region entails distancing the production of wealth from harming the environment (Anderberg and Clark, 2013) and natural resource consumption (International Resource Panel, 2015).

However, a study showed that there is a difference in the timeline regarding the discovery of one pollution problem and the moment when it is addressed (UN, 2015) because of economic, social and legal factors. It is important to address a problem as soon as possible after discovering it in order to minimize its effects on human health and the state of the environment.

To face urban pollution, there is a necessity of implementing measures promoting urban sustainability and reducing impacts on the city environment. In the coming sections, this

chapter analyses how governments, companies and citizens (actors) may address urban pollution.

3.1. The role of governments in urban pollution

Environmental governance in cities plays a vital role in the battle against pollution and the objective of reducing emissions. As the UN (1992, p.258) at the Earth Summit in Rio de Janeiro stated about governance and sustainable goals:

> "[...]so many of the problems and solutions being addressed by Agenda 21 have their roots in local activities, the participation and cooperation of local authorities will be a determining factor in fulfilling its objectives. Local authorities construct, operate and maintain economic, social and environmental infrastructure, oversee planning processes, establish local environmental policies and regulations, and assist in implementing national and subnational environmental policies. As the level of governance closest to the people, they play a vital role in educating, mobilizing and responding to the public to promote sustainable development."

The role of governments and local authorities in urban pollution is multifaceted. First, local authorities regulate pollution caps, building standards and companies' basic requirements for the best corporate governance practices (Fox et al., 2002). The positive consequences of local regulations are as follows: regulation of some air, water and soil pollutants, air quality improvement, reduction in pollution flow from streets to properties, pollutant filtration, pollutant removal, etc. However, the strength of the local regulative institutions is also a relevant factor. Policies encouraging more sustainable practices or discouraging highly pollutant ones are more efficient in countries where they have been consistent and persistently promoted (Querol and Amato, 2017).

Second, local governments are key actors in fostering community involvement through policy programs (Bulkeley and Betsill, 2005). If governments focus on sustainable issues, companies and citizens are likely to embrace sustainable management styles and

lifestyles. Hence, local governments are crucial when national governments attempt to reach internationally agreed-upon targets (Bulkeley and Betsill, 2005).

Third, local authorities are significant polluting agents by themselves, as they are responsible for the pollution generated by the building of local infrastructure, public transportation or energy consumption in public facilities (e.g., city halls, sport facilities and others).

Fourth, local authorities also manage “green” services such as green areas, local waste management systems or freshwater. For instance, green and natural spaces yield environmental benefits including the improvement of temperature (Vu et al., 1998), providing citizens shelter from pollution (Tyrväinen, 1997), and wind palliation (Lacy, 1977). These areas are beneficial not only for the space where they are placed but also for their surroundings because they entail an increase in property values, they ameliorate the access to natural light, they provide passive solar heat to the buildings (Yannis, 1994), and they favor natural ventilation, thereby providing 'free' cooling to buildings (Watkins et al., 2002). These effects result in a reduction in the necessity of air conditioning systems and therefore a decrease in energy consumption and pollutant emission (Jenks and Jones, 2010).

3.2. The role of entrepreneurs and large companies in urban pollution

The role of companies in urban pollution is also a double-edged sword. On the one hand, the triple bottom line of sustainability in a region –i.e. economic, social and environmental— is strongly dependent on its companies and industrial activities, which are mostly located in cities. On the other hand, economic activities also create pollution in the cities. Actually, as the economy improves in a country or region, pollution levels increase—instead of decrease—accordingly (Prell, 2015).

Pollution issues, together with searching for sustainable development alternatives for a region, can be the basis for developing companies’ policies and practices. Changes in economic activities in companies looking for a more sustainable status have the potential to increase efficiency and ameliorate the consumption of raw materials (Cohen and Muñoz 2016). In addition, emerging initiatives to develop practical applications of

circularity to the production and supply chain systems are starting to show evidence of a significant potential to increase efficiency and reduce pollution and waste (UNEP, 2017).

Indeed, urban pollution might be considered a “window of opportunity” for social or environmental entrepreneurs to make a profit while providing solutions for environmental problems. Urban pollution issues can be seen as opportunities to be solved with innovations and new business models (Hoffman and Woody, 2008). Developing new ventures striving for urban sustainability can be a powerful tool to increase urban well-being and economic development and simultaneously reduce pollution (Cohen and Muñoz, 2016).

3.3. The role of citizens in urban pollution

The UN estimates that by 2050, more than two-thirds of the world's population will be living in cities (Muñoz and Cohen, 2016). Because of the population in cities, there exists a direct relationship between population densities and pollution levels (Goel, 2006). Cities can offer a more sustainable lifestyle because of their density (Muñoz and Cohen, 2016), and they can take advantage of economies of scale related to environmental services (UNEP, 2017).

The best way to ensure that every single part of the society confronts urban pollution is starting with its primary elements: citizens. Reducing waste impact, for example, is more effective if it involves minimizing resource inputs (Newman, 1999) in every action of every integrant of a city's population. This approach includes how people act in their personal and professional lives.

> "It is not in the technologies that the answer lies but in the ways humans make choices, their willingness to seek out new connections, to invent new combinations, to explore the possibilities of the world around us" (Cohen-Rosenthal, 2000, p.250).

Public policies designed by local authorities to reduce/prevent waste, increase green businesses or reduce automobile use can only be successful when citizens are aware of the importance of such programs and engage actively. Citizens must recognize the value

of such programs and be willing to participate in them. In other words, the extent to which local institutions support a culture of sustainability within the community is a critical factor to reduce urban pollution. Such a culture of sustainability encompasses the normative institutions composed of shared values, behaviors (actions), social norms, and attitudes of community residents, as long as there are cognitive institutions or levels of understanding (knowledge) supportive of sustainability (DiMaggio and Powell, 1983; Marans 2015).

4. Potential solutions for urban pollution

Addressing urban pollution problems is a complex issue (UNEP, 2017; EEA, 2015; EEA, 2014) for several reasons:

- It frequently implies a multiplicity of sources, actors and consequences.
- There is a lack of solid and reliable data in many fields related to urban pollution, what diminishes legitimacy of regulatory caps and limits.
- The frequently large time lag between decision-making and implementation may render an action inconsequential (EEA 2014) or insufficient and may make short-term decision biases play a role in the intentions of stakeholders (authorities, citizens and business) to engage in initiatives favourable to urban sustainability.

However, this section provides a compilation of typical solutions for the most threatening and frequent urban pollution problems, allowing for the possibility that some initiatives may favor pollution problems of a different nature and origin. We highlight collaborative public management that promotes multi-organizational arrangements, which tends to be more powerful than single organizations when facing problems (Muñoz and Cohen, 2016).

In Figure 1, a number of actions are suggested. These actions are classified according to the city pollution issue each of them addresses. If the action proposed tackles two or more types of urban pollution, it is classified as a general pollution issue at the end of the figure (e.g., measures concerning renewable energy can help to reduce the pollution related to air, water, and soil).

Figure 1. Specific actions to face urban pollution

AIR. Implement and improve air quality legal frameworks to respect air quality WHO guidelines.
Promote electric, hybrid, and natural gas vehicles, create low-emission zones (LEZ) in city centers, and discourage diesel car use.
Provide good-quality access to public transport and non-motorized transportation infrastructure in cities.
Impose mandatory requirements for domestic biomass combustion sources and promote fiscal incentives for alternative ones.
Ban the uncontrolled combustion of agricultural residues.
Regulate and reduce air emissions from commercial transport tackling fuel quality improvements, alternative fuels, engine improvements, after-treatment, operational changes and market incentives.

WATER. Provide safe drinking water and access to sanitation for all by 2030.
Increase wastewater treatment, recycling and reuse in order to reduce its discharge into freshwater and marine water bodies.
Implement and improve guidelines to manage and protect systems that contribute to water purification.
Improve monitoring systems in surface water and groundwater.

NOISE. Reinforce traffic policies and restrictions as well as improve public transport networks and promote less noisy transport means.
Promote or improve acoustical planning to better apply sound insulation measures and noise control of sources.
Identify the areas of highest decibel levels (hotspots) and prioritize addressing them.
Pay attention to maintaining silence in those areas where the acoustic environment is good.

FACING URBAN POLLUTION

SOIL. Appropriate land management in order to protect, maintain and improve the delivery of soil-based ecosystem services.
Minimize point-source pollutants (e.g. heavy metals from industries).
Rethinking the use of tailings and dams in the functioning and remediation of contaminated sites.

WASTE. Promote the prevention of waste production.
Assist governments in addressing open waste burning and dumping.
Food waste prevention and reduction.
Introduce producer responsibility schemes to collect, treat and safely recycle waste from production and consumption.
Reduce/eliminate the leaking of radioactive waste.
Establish waste regulation and collection in the marine environment of coastal cities.
Reduce and phase out the use of certain types of plastic (e.g. microbeads, packaging, single-use, plastics) and promote their recovery.
Extend product life.
Minimize the generation of waste, and improve its collection, separation, reuse, recycling, recovery and final disposal through policy frameworks and regulations at the national and subnational levels.
Eliminate uncontrolled dumping and open waste burning.
Increase public awareness and international collaboration on research and product development.
Increase material and energy recovery waste, including throughout recycling.
Reduce food waste throughout value chains, including at the consumer level.

GENERAL. Put in place a system to track pollution levels and assess the efficiency of the measures being carried out (e.g. a list of sustainability indicators that includes technically sound studies and public opinion).
Increase personal and public investment in renewable energy and energy efficiency.
Enhance climate change activities in governments and businesses to better tackle local and regional pollution.
Include local stakeholders in decision-making regarding cities future pollution planning.
Designate and expand green spaces in urban areas.
Create data collection systems and national and international organizations to share, control and identify opportunities and risks, and to make information available to the public.
Invest in long-term environmental monitoring following industrial closures.
Develop and strengthen multi-stakeholder partnerships.
Undertake community sensitization and education activities.
Assess the linkages between chemicals, waste and air quality and their combined impacts on the environment and health.
Promote life-cycle management.
Raise awareness on sustainable lifestyle changes.
Make thematic assessments on emerging environment-health related issues and further develop capacity and monitoring tools.
Provide reliable and effective consumer information on the impacts of consumer products throughout their life cycles.

Source: self-elaboration with information gathered from UNEP (2017), Querol and Amato (2017), EEA (2015a), UNEP (2016), Ramaswami et al., (2016), EEA (2014), Martos et al., (2016)

5. Final Remarks

Urban pollution is one of the greatest challenges the human species is facing nowadays. Pollution directly influences humans' health and well-being. In addition, pollution generation and its consequences are usually exacerbated in cities due to population and economic activity density. However, cities also pose a solution. Geographical concentration also allows a more efficient allocation of resources and initiatives to fase urban pollution problems. For better or worse, relatively small improvements in urban pollution management may imply huge impacts on the environment. To introduce such improvements, we all should unite because fighting against urban pollution is more effective when every institution and actor of the society (e.g., citizens, companies, and local governments) is aware and involved in the problem.

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Chapter 3: Trade-offs among urban sustainability, pollution and livability in European cities

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Chapter 3: Trade-offs among urban sustainability, pollution and livability in European cities

Abstract

This paper aims to explore the interactions between urban sustainability, urban pollution and city livability. Specifically, we propose a theoretical model that explains how the three pillars of urban sustainability (economic, environmental, and social) and urban pollution interact and simultaneously affect city livability. These relationships are tested using a structural equation model (SEM) in a sample of responses from 40,798 citizens in 79 European cities and secondary data on urban pollution. Overall, our findings show that although urban economic sustainability is positively associated with urban pollution, it is indirectly negatively associated with urban pollution via urban environmental sustainability and positively associated with city livability via urban social sustainability. In addition, we found that urban social sustainability is positively associated with city livability, while urban pollution is negatively related to city livability. Therefore, our results advance the knowledge on the interplay and trade-offs between the pillars of urban sustainability and their impact on city livability.

Keywords: city livability, urban sustainability, urban pollution, sustainable city.

1. Introduction

City livability can be conceptualized as a city's ability to provide adequate conditions for citizens to thrive and have a good quality of life (Marans, 2015; Ruth and Franklin, 2014). Although city livability is shaped by objective conditions (e.g., employment levels, quantity of green spaces and squares, public services, leisure offerings), it consists of individuals' perceptions of their well-being and ability to progress both socially and economically (e.g., Koramaz and Türkoğlu, 2018; Macke et al., 2018; Marans, 2015; Mouratidis, 2017; Ruth and Franklin, 2014). Cities show greater levels of livability when they are regarded as hubs for culture, education, leisure, commerce, and social and economic development (c.f. Marans and Stimson, 2011).

However, ensuring city livability is becoming increasingly challenging due to the unprecedented growth in the number of people living in cities (Marans, 2015). According to the United Nations (UN), in 2017, 4 billion people—half of humanity—lived in cities, and this figure is expected to reach 6.5 billion by 2050. If current demographic trends continue, cities will face serious tensions among a plethora of economic, environmental, and social forces that will significantly affect the well-being and quality of life of their dwellers. For example, offering housing for city dwellers without straining land and natural resources will be challenging. Likewise, offering basic services for a growing urban population, such as waste removal and health care, frequently poses a challenge for limited public economic resources. The complexity and relevance of the issue has led to the consideration of sustainability and livability in cities as one of the global grand challenges of the XXI century. Indeed, it is one of the UN's sustainable development goals. Therefore, understanding how the synergies and trade-offs between urban economic, environmental and social aspects—the three interconnected pillars of urban sustainability (Jenks and Jones, 2010; Tanguay et al., 2010)—affect city livability is critical for implementing efficient and effective urban action.

In response to these issues, city governments worldwide have initiated a variety of programs to ensure quality of life. Previous research has explored some of these governmental initiatives, such as land management (Lu et al., 2016), smart recycling systems (Fujii et al., 2014), sustainable consumption and production (Vergragt et al., 2016), green building (Khoshnava et al., 2018), circular economy policies (e.g., Bayulken

and Huisingh, 2015) and industrial symbiosis actions (e.g., Dong et al., 2013). Considerable attention has been paid to ways these initiatives directly improve urban quality of life.

However, recent studies have pointed that initiatives examined in previous research frequently aim to address a single aspect of a multifaceted problem (Bibri and Krogstie, 2017; Elmqvist et al., 2018), and most of the extant literature lacks a holistic perspective (Zhang et al., 2018). Moreover, the initiatives studied frequently have positive and negative aspects—e.g., recycling facilities reduce pollution but entail significant investments—and scholars and policymakers face difficulty in deciding which initiatives should be implemented and which should be ignored in a given urban context. In addition, most of the existing literature is not supported by empirical analysis (Węziak-Białowolska, 2016), or it relies on single-city research designs, which limits generalization to other cities. Thus, there is a need for research addressing how multiple factors and initiatives interact as cities transition toward sustainability and enhanced city livability (Gorissen et al., 2018; Jenk and Jones, 2010; Valcárcel-Aguiar and Murias, 2018).

As one way to address these issues, we offer a theoretical model that explains how the economic, environmental and social dimensions[1] of urban sustainability are interconnected and simultaneously affect urban pollution and city livability. We advocate that cities are complex systems where "any effort to promote livability must be based on an understanding of underlying geographic and dynamic behaviors of society and its biophysical environment, as well as their interactions" (Ruth and Franklin, 2014:19). In other words, studying city livability requires a holistic perspective that simultaneously addresses widely diverging but interconnected factors related to economic prosperity, the natural environment, and social cohesion (Godschalk, 2004; Jenks and Jones, 2010; Williams et al., 2017).

[1] In this article, we differentiate urban *environmental sustainability*, which relates to the natural environment in an urban area, such as the availability of green areas, air quality, or noise levels (Türksever and Atalik, 2001; Krekel et al., 2016; Węziak-Białowolska, 2016; Zenker et al., 2013), from *social sustainability*, which relates to human interaction and well-being in an urban areas, such as social equity, integration of minorities, and low levels of criminality (e.g., Burton, 2000; Dempsey et al., 2011; Jenks and Jones, 2010).

More specifically, the goal of this work is to study the interactions between the three pillars of urban sustainability and pollution as antecedents of city livability. We empirically analyze these relationships using a sample that includes the responses of 40,798 citizens from 79 different European cities extracted from the Eurobarometer 419 and secondary data on urban pollution gathered from the World Health Organization (WHO) in 2015. Taken together, our findings confirm the critical role of urban sustainability in predicting city livability. Our results reveal specific synergies and trade-offs between urban sustainability dimensions and suggest that negative outcomes can be mitigated by adequate urban strategies. Our results also provide practical insight into how local municipalities may generate solutions to better govern trade-offs and interconnections among economic development and environmental and social progress.

The paper proceeds as follows. The first section presents the theoretical background and the hypotheses on how urban economic, environmental and social sustainability interact to predict urban pollution and, in more recent years, city livability. Then, our sample and variables are explained. We then present and discuss the results derived from the empirical analysis and explain their contributions and implications for policy. After presenting the limitations and future lines of research, we conclude with final remarks regarding our study on city livability.

2. Theoretical background and hypotheses

2.1.The complex relationship between sustainability and city livability

The literature on the antecedents of city livability has identified a great number of place-based factors affecting city livability (see Węziak-Białowolska, 2016 for a review). This body of literature emphasizes that city livability is the result of complex processes composed of multiple antecedents and their interactions (e.g., Koramaz and Türkoğlu, 2018; Marans, 2015; Runhaar et al., 2009; Shafer et al., 2000; Valcárcel-Aguiar and Murias, 2018).

These interactions or trade-offs have been studied in the context of urban sustainability, and research has addressed them from urban economic, environmental and social perspectives (Dempsey et al., 2011; Jenks and Jones, 2010; Shafer et al., 2000; Tanguay et al., 2010; Valcárcel-Aguiar and Murias, 2018). The lack of previous studies on how urban economic, environmental and social sustainability are related to city livability may

be partly due to the complex and interconnected nature of these relations. For instance, one might expect that greater levels of economic sustainability (e.g., abundance of jobs, companies and business opportunities) foster better perceptions of city livability. However, greater levels of economic activity might also increase urban pollution and overcrowding, which in turn might lower city livability.

Similarly, common sense suggests that a perception of high urban environmental sustainability (e.g., abundance of parks, green areas, public transport services, waste treatment facilities) will be associated with lower levels of urban pollution. However, environmental sustainability might be costly, and cities' economic resources are scarce. A vibrant economy—which is frequently associated with higher pollution—may be necessary to afford environmental expenditures.

Therefore, achieving a high level of city livability requires finding a complex balance among various dimensions that are often paradoxical and entail contradictions and trade-offs (Ruth and Franklin, 2014; Santos and Martins, 2007; Shafer et al., 2000). However, little is still known about how multiple initiatives together help cities transition towards sustainability and improve city livability (Bibri and Krogstie, 2017; Gorissen et al., 2018; Valcárcel-Aguiar and Murias, 2018). In the following sections, we aim to address and explain those complex interconnections to develop a theoretical model on the trade-offs and interplays among urban sustainability, urban pollution and city livability.

2.2. Interconnections among economic sustainability, urban pollution, and city livability

Urban economic sustainability can be conceptualized as the ability of cities to allow city dwellers to thrive and progress economically (Santos and Martins, 2007). Economically sustainable cities are characterized by abundant employment opportunities, housing that is affordable for median- and low-income residents, a reasonable cost of living, and economic equality, which involves the efficient and fair allocation of economic resources (Glaeser and Mare, 2001; Türksever and Atalik, 2001; Zenker et al., 2013).

Most economic activities entail the generation of some waste or emission as inputs or "raw materials" are transformed into products and services. Therefore, the proliferation of businesses and industries in a city will likely increase the amount of waste and pollution

generated. First, the polluting effect of industries and business may be aggravated by enhanced pollution from wealthier households (e.g., Yang et al., 2017), as the total emissions of a household tend to increase when domestic income grows (Brännlund and Ghalwash, 2008). Wealthier households typically consume more food, energy and superfluous products and services, thus generating additional waste (Newman, 1999).

Second, economic progress frequently coincides with the proliferation of larger houses in suburbs and an overall population increase. These phenomena typically entail larger emissions associated with transport and distribution because transport means are important contributors to cities' air (WHO, 2017) and noise pollution (Fisher et al., 2017). The physical expansion of cities also has implications for land use. For instance, Lu et al., (2016) found that one result of the development of Shanghai has been the exhaustion of land use, leading to steady land reclamation from river sediment. Reclaiming land may cause coastal degradation and the loss of biodiversity.

Increased pollution in turn affects city livability. One of the fundamental factors of city livability is health (Hankins and Powers, 2009). Health in cities is highly deteriorated because of pollution issues related to unsustainable urban development and associated factors (Fisher et al., 2017; Krefis et al., 2018). Urban pollution creates many health problems, from asthma derived from air pollution (United States Environmental Protection Agency, 2017) to sleep disorders associated with noise pollution (Paiva Vianna et al., 2015).

Another detrimental effect of pollution concerns leisure activities. People tend to be less willing to engage in leisure activities in open spaces if pollution problems may affect their health. In densely populated cities, green areas are less enjoyable due to saturation and insufficient green space provision. Therefore, citizens' perceptions of their quality of life will be lower (Haaland and van den Bosch, 2015).

Thus, we pose the following hypotheses:

H1: Urban economic sustainability is positively associated with urban pollution.

H2: Urban pollution is negatively associated with city livability.

Based on these two hypotheses, we might conclude that economic sustainability is negatively associated with city livability (mediated by urban pollution). However, in the next sections, we contend that—paradoxically—the relationship is not so simple, as urban social and environmental sustainability are positively associated with both urban economic sustainability and city livability.

2.3. Interconnections among environmental sustainability, economic sustainability, and urban pollution

Environmental sustainability can be defined as the "maintenance of natural capital" (Goodland, 1995, p.10). Applied to the context of cities, a city is environmentally sustainable when its natural capital is maintained and integrated into the city's daily life (Tanguay et al., 2010). The natural capital of a city includes the availability of green areas, air quality, noise levels, the degree of cleanliness (Türksever and Atalik, 2001; Krekel et al., 2016; Węziak-Białowolska, 2016; Zenker et al., 2013) and initiatives favoring energy efficiency and climate change mitigation, e.g., traffic and transport policies (Jenks and Jones, 2010).

Municipalities' efforts to create green areas may diminish pollution levels. Green areas not only create a shelter from pollution (Tyrväinen, 1997) but also directly improve air quality and temperature (Vu et al., 1998) and reduce noise pollution (Bolund and Hunhammar, 1999). In addition, green spaces ameliorate the access to natural light of buildings and streets, and they may act as passive solar heat in winter (Yannis, 1994) and free cooling for buildings during the summer (Watkins et al., 2002), thus diminishing energy consumption and emissions (Jenks and Jones, 2010).

Urban measures to ensure public transport efficiency and availability can also contribute to reducing pollution levels (Türksever and Atalik, 2001). Citizens' perceptions of public transport efficiency and quality may positively affect the extent to which they use it instead of less efficient private transport means (e.g., cars). The substitution of private car use with public transport use can potentially diminish CO_2 and other pollutant emissions in a city.

Similarly, community initiatives that discourage the use of nonrenewable resources and promote the use of renewable resources and waste recycling/reuse may decrease urban

pollution emissions. For instance, Fujii et al., (2014) and Ohnishi et al., (2018) illustrated how the promotion of urban symbiosis in Korea, Japan and China generated significant environmental benefits for cities, including decreases in the emissions of several pollutants, and Chen et al., (2018) found that the use of renewables in urban systems significantly lessened air pollutant emissions.

Therefore, we suggest the following:

H3: Urban environmental sustainability is negatively associated with urban pollution.

Urban environmental initiatives reduce pollution at a relevant economic cost (Newman, 1999). For instance, sustainable public transport systems impose high economic costs on municipalities, such as costs related to vehicle ownership and maintenance, specific infrastructure investments (such as underground stations), operations (such as oil and salaries), parking, insurance, accidents, and vandalism. Due to the positive externalities of public transport (Zegras, 1998), municipalities typically subsidize public long-term transport investments and operational costs.

Other urban environmental sustainability initiatives require significant economic expenditures. Such initiatives include smart recycling systems (Fujii et al., 2014), sustainable urban electric power systems (Chen et al., 2018), pollution monitoring systems (Kularatna and Sudantha, 2008), and the maintenance of green areas. Therefore, cities need economic resources to address and maintain environmental sustainability initiatives and infrastructures. The fewer economic resources that are available, the less likely a city government is to devote its limited resources to costly environmental initiatives.

Therefore, we suggest the following:

H4: Urban economic sustainability has a negative indirect association with urban pollution mediated by urban environmental sustainability.

2.4. Interconnections among social sustainability, economic sustainability, and city livability

Urban social sustainability can be defined as a city's ability to function as a long-term, viable setting for human interaction, participation, communication, and cultural and social development (Shafer et al., 2000). Socially sustainable cities display high levels of social equity (equal access to key services such as health care and education), integration of minorities, and low levels of criminality (e.g., Burton, 2000; Dempsey et al., 2011; Jenks and Jones, 2010).

A socially sustainable city is one that is not racially or socially exclusive (e.g., Dempsey et al., 2011). Social exclusion may take the form of culturally and economically isolated neighborhoods with poorer living environments where very few enjoy living. In contrast, cities with high social diversity and integration are characterized by diverse and strongly interrelated economies, populations and responses to social challenges. Integration facilitates varied social interactions, community spirit and cultural vitality (Rudlin and Falk, 1999; Shafer et al., 2000), which may result in better quality of life (Jenks and Jones, 2010) and make cities more resilient and livable (Ruth and Franklin, 2014).

Safety—i.e., low criminality—is also a key element of urban social sustainability (e.g., Burton, 2000; Dempsey et al., 2011). Crime obstructs positive social interactions in a city (Martos et al., 2016), while a sense of safety enhances trust and reciprocity in neighborhoods; it enables residents to enjoy walks, cultural and community activities and time outdoors, thus making cities more livable and enjoyable.

Finally, another essential component of urban social sustainability is equitable access to key services such as education and training, hospitals and health care, and cultural and neighborhood facilities (Bramley and Power, 2009; Dempsey et al., 2011). Citizens who lack access to these services may have to commute frequently to access them in other urban areas and may ultimately consider moving closer to such services. For example, a family with a chronically ill child may frequently have to drive to the hospital, which makes life harder. Similarly, the absence of high-quality schools may diminish the perceived livability of a neighborhood.

Thus, we suggest the following:

H5: Urban social sustainability is positively associated with city livability.

The social and cultural context of a city does not develop in a vacuum. Although urban social sustainability depends on the geographic and dynamic behaviors of a society (Ruth and Franklin, 2014), economic resources are necessary for these behaviors to take place (Marans, 2015).

Urban social sustainability—and its effect on city livability—partly relies on the tangible resources of a society (Marans, 2015; Valcárcel-Aguiar and Murias, 2018). For instance, equitable access to facilities and services such as hospitals, schools and sports facilities depends on their proximity to the neighborhood, their physical availability, and their quality. Similarly, although multiple factors may influence perceptions of safety and crime, one of those factors is the resources devoted by the community to security—i.e., the number of police officers—and the restoration of abandoned areas.

Social cohesion and cultural diversity may also be facilitated by the availability of economic resources and a good urban design. For instance, the literature on urban sociology suggests that social inclusion is strongly dependent on social relationships among dwellers (e.g., Dempsey et al., 2011). High-density, mixed-use streets with apartment residences facilitate more social interaction than residential suburbs (Bramley and Power, 2009). Participation in civics (e.g., political participation), sports teams, or neighborhood festivities enhances the sense of social inclusion (Dempsey, 2006; Dempsey et al., 2011). Although these activities may also occur spontaneously in a neighborhood, they benefit from city support for sports clubs and competitions, neighborhood facilities and civil groups.

Therefore, compared with other cities, a city enjoying a vigorous economy is more likely to receive the funds (via taxes) needed to invest in and maintain the social infrastructures and services that support social sustainability. Consequently, economic sustainability may exert an indirect positive effect on livability through the mediation of social sustainability.

Thus, we suggest the following:

H6: Urban economic sustainability has a positive indirect association with city livability mediated by social sustainability.

3. Methodology

3.1. Data collection

This study addresses the proposed relationships merging data from a Eurobarometer survey called "Flash Eurobarometer 419: Quality of Life in European Cities" [2] and objective data on urban pollution gathered from the WHO repository. The Eurobarometer survey, which collected data from 40,798 citizens from 79 different European cities, was conducted at the request of the Directorate-General for Regional and Urban Policy of the European Commission to assess citizens' satisfaction with various aspects of urban life. The survey covered one to six cities per country, depending on each country's size and population. Approximately 500 citizens were interviewed during 2015 by phone in each city in the respondent's mother tongue.

Objective pollution data were obtained from the Global Health Observatory data repository of the WHO[3]. The retrieved data included particulate matter (PM), which refers to harmful particles of different elements that can be inhaled and breathed. We chose this type of pollutant for our study because of data availability and because it presents one of the most dangerous risks to human health (WHO, 2017).

We added pollution data to the Eurobarometer survey data when available. There were no pollution data for 12 of the 79 cities included in the Eurobarometer survey. Thus, the number of cities included in the study was 67[4], and the final sample consisted of 33,579 cases.

3.2. Measures

We used perceptual data because city livability inherently relies on citizens' perceptions, and it is almost impossible to measure under objective measures. Similarly, "sustainability is not an end state that can be achieved, but a moving target that is

[2] More info: http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/urban/survey2015_en.pdf
[3] http://apps.who.int/gho/data/view.main.AMBIENTCITY2016?lang=en
[4] Graz, Wien, Antwerp, Brussels, Liege, Bruges, Sofia, Zagreb, Ostrava, Praha, Berlin, Dortmund, Essen, Rostock, Hamburg, Leipzig, Munich, Copenhagen, Tallinn, Barcelona, Madrid, Oviedo, Helsinki, Oulu, Bordeaux, Lille, Marseille, Paris, Rennes, Strasbourg, Athens, Budapest, Miskolc, Dublin, Bologna, Napoli, Palermo, Roma, Torino, Verona, Vilnius, Luxembourg, Riga, Amsterdam, Groningen, Rotterdam, Oslo, Bialystok, Gdansk, Warszawa, Braga, Lisbon, Bucharest, Cluj-Napoc, Malmo, Stockholm, Ljubljana, Bratislava, Kosice, Belfast, Cardiff, Glasgow, London, Manchester, Newcastle, Geneva, Zurich.

continuously changing and improving" (Williams et al., 2017, p.871). Therefore, perceptual data allow comparisons across a wide number of cities. Table 2 provides more information about the exact wording of the variables and the validity of the survey instruments.

Table 2. Variables and their operationalization

Construct	No. of items	Cronbach's alpha	*t*-value	Std. estimate	Description
City livability	2	n.a.			I am satisfied to live in my city
					On the whole, I agree that my city is a good place to live
Economic sustainability	2	n.a.			It is easy to find a job
					It is easy to find good housing at a reasonable price
Social sustainability	4	.599	n.a.	n.a.	I am satisfied with the schools
			33.03	.08	The presence of foreigners is good for the city
			32.84	.07	Foreigners that live in my city are well integrated
			32.79	.07	I feel safe in my city
Environmental sustainability	5	.697	49.46	.03	I am satisfied with the green spaces such as parks and gardens
			52.36	.03	I am satisfied with the quality of the air
			50.93	.03	I am satisfied with the noise level
			50.47	.03	I am satisfied with the cleanliness
			n.a.	n.a.	My city is committed to fight against climate change
Urban pollution	2	n.a.			PM 2.5
					PM 10

Dependent variable: City livability

The dependent variable (DV) of this study was operationalized through opinions regarding two aspects of the Eurobarometer survey: satisfaction with living in the city and agreement on whether the city is a good place to live. The answers to both questions were classified using a 5-point Likert scale.

Independent variables

Economic sustainability

To measure the economic sustainability of a city, we used two items extracted from the Eurobarometer survey: the ease of finding a job and the ease of finding good housing at a reasonable price. Both questions were measured on a 5-point Likert scale.

Social sustainability

To measure the extent to which a city is socially sustainable, we used a scale including five items: a) satisfaction with health care services, doctors and hospitals, b) satisfaction with schools, c) agreement on whether the presence of foreigners is good for the city, d) agreement on whether foreigners who live in the city are well integrated, and e) the feeling of safety in the city. The responses to these questions were also classified on a 5-point Likert scale. An exploratory factor analysis (EFA) revealed one factor that had an eigenvalue higher than 1.0 and explained 39.68 % of the variance. However, after we conducted confirmatory factor analysis (CFA) to assess convergent validity, the first item was found not to have a significant factor loading, and it was removed from the scale as recommended for formative scales (Hair et al., 1999). The purified four-item scale now explained 45.75 % of the variance and yielded a Cronbach's alpha coefficient of 0.60, which is an acceptable reliability value in social sciences (Hair et al., 1999). The CFA showed construct independence, a good fit to the data and convergent validity (comparative fix index [CFI] = .95; root mean square error of approximation [RMSEA] = .089; all factor loadings were significant at $p < .05$). A composite reliability (CR) test was conducted to further assess convergent validity, which obtained a CR value of .68. This value is slightly below the established cut-off point of .70 (Hair et al., 1999).

Environmental sustainability

To operationalize the concept of environmental sustainability, we used a scale with the following five items: a) satisfaction with green spaces such as parks and gardens, b) satisfaction with air quality, c) satisfaction with the noise level, d) satisfaction with cleanliness and e) agreement on whether the city is committed to fighting climate change (e.g., energy efficiency, green transport). The answers to the five statements were classified on a 5-point Likert scale. The EFA identified one factor that had an eigenvalue larger than 1.0 and explained 45.55 % of the variance. The CFA revealed good internal consistency reliability (Cronbach's alpha of .69) and a reasonable fit to the data (CFI = .97; RMSEA = .06; all factor loadings were significant at $p < .05$). CR measured .73, indicating convergent validity (Hair et al., 1999).

Urban pollution

This dimension was operationalized through the PM measured in each city. This pollutant includes particles with a diameter smaller than 10 microns (PM_{10}) and fine particles with a diameter of less than 2.5 microns ($PM_{2.5}$), which present the greatest risk to health because of their capacity to enter people's lungs and bloodstream (WHO, 2017). The data gathered included the annual means of $PM_{2.5}$ and PM_{10} in $\mu g/m^3$ in the cities in 2015.

Control variables

To rule out possible alternative explanations to the results obtained, we introduced the following control variables: age, gender, years living in the city, marital status, last year of studies and occupation. Some of these variables were classified as numerical (age, years living in the city and last year of studies), and others were classified as dichotomic (gender) or categorical (marital status and occupation). Respondents' marital status, age, and knowledge of the city may influence their perceptions of city livability.

Divergent validity

We used the Fornell and Larcker (1981) criterion to assess divergent validity. This criterion proposes comparing each construct's average variance extracted (AVE) with its squared correlations with other constructs (Henseler et al., 2015). For the two self-developed scales, we found that the correlations among the constructs were smaller than the AVE, which provides support for the assumption of divergent validity in our model (Fornell and Larcker, 1981).

Common method bias

To test the relationships proposed in H1 to H4, we used secondary objective data for urban pollution. Therefore, common method bias should not be a problem. For the hypotheses that do not involve urban pollution (H5 and H6), actions were carried out to minimize the potential for common method variance during the elaboration of the survey. First, this paper's goal greatly differed from the objectives of the Eurobarometer survey, which made it extremely difficult for the interviewees to guess the purpose of the relationships that we aimed to address and modify their answers accordingly. Second, the Eurobarometer design team followed the guidelines proposed by Podsakoff et al., (2003)

during the questionnaire elaboration and response collection. Overall, we feel confident that common method variance is not a significant problem in this study.

3.3. Structural equation model analysis

A structural equation model (SEM) was specified using the maximum likelihood estimation procedure in EQS 6.3 to test the hypotheses. The equations of the proposed model were as follows:

(1) $Soc = b_1 * Eco + \varepsilon_1$

(2) $Liv = b_2 * Soc - b_3 * Pol \pm Control\ variables\ effects + \varepsilon_2$

(3) $Pol = b_4 * Eco - b_5 * Env + \varepsilon_3$

(4) $Env = b_6 * Eco + \varepsilon_4$

We believe that SEM was the appropriate analytical technique for three reasons. First, we used SEM because of its ability to assess the simultaneous fit of a complete model in which dependent latent variables—here, urban pollution—become independent variables in a subsequent regression equation. Second, SEM allows for the measurement of unobserved latent variables based on multiple indicators and for testing the relationships among them; all relevant paths are directly tested and none are omitted, as in ANOVA (Baron and Kenny, 1986). This feature enables the use of multi-item measures of the five constructs referred to in the hypotheses and the testing of the relationships among them, resulting in enhanced theory development potential. Third, SEM incorporates explicit estimations of measurement errors and correlated measurement errors instead of assuming that constructs are measured without error.

4. Results

To develop the model, we tested the paths from age, gender, years living in the city, marital status, last year of studies and occupation to city livability. The model fit the data relatively well. However, some of the paths from the control variables to city livability were found to be nonsignificant (age, marital status, last year of studies and occupation). As recommended (e.g., Hair et al., 1999), to obtain a more parsimonious model that fit the data well, we sequentially erased the least significant relationship among the

nonsignificant paths to ensure that we did not erase any nonsignificant paths that became significant in a subsequent model. After trying 4 models, our final model included only the two paths found to be significant: gender and years living in the city. Our model of the antecedents of city livability, derived from the current literature and the preliminary analysis described below, is illustrated in Figure 2.

Figure 2. Theoretical framework proposed

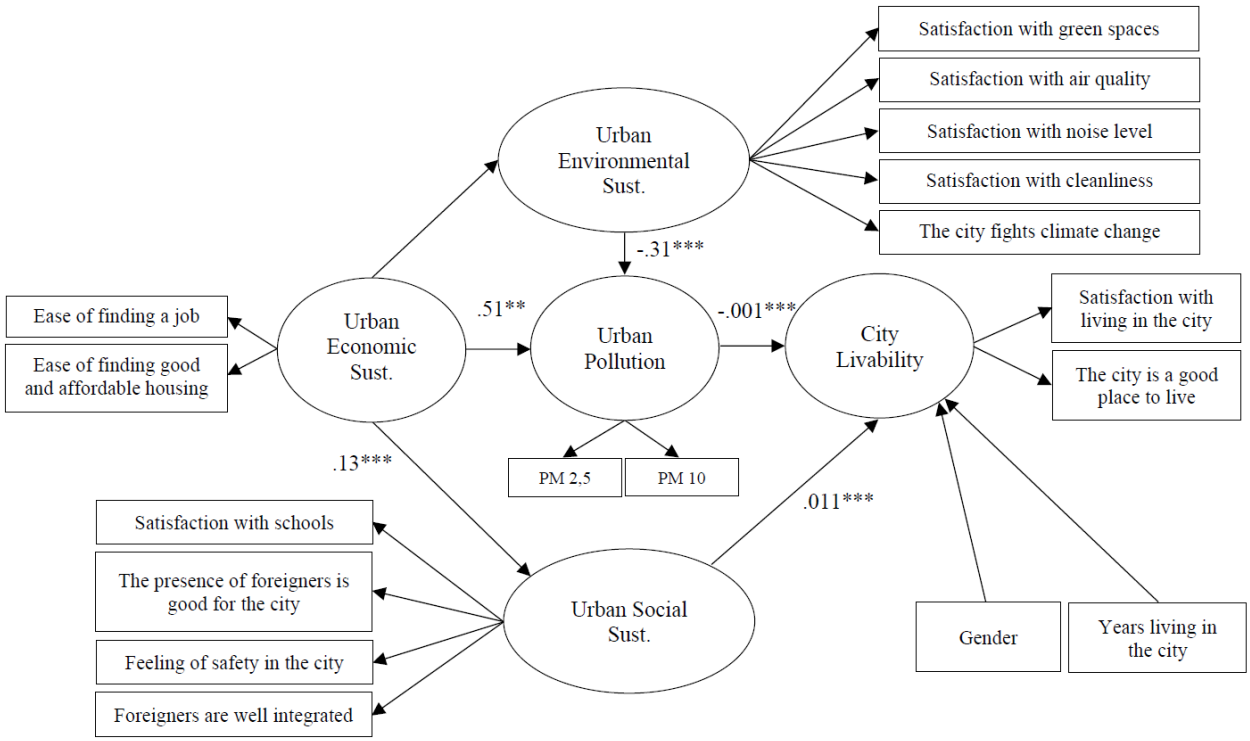

Table 3 shows the descriptive statistics and correlations among the aggregated constructs and control variables.

Table 3. Correlations among latent constructs and control variables

	Construct	1	2	3	4	5	6	7	8	9	10	11
	Latent constructs											
1	Urban economic sust.	1										
2	Urban social sust.	.98**	1									
3	Urban environmental sust.	.68**	.79**	1								
4	Urban pollution	.31**	.30**	.41**	1							
5	City livability	.84**	.85**	.68**	.29*	1						
	Control variables											
6	Age	.00	.00	.00	.00	.00	1					
7	Gender	.00	.00	.00	.00	.00	.00	1				
8	Years living in the city	.00	.00	-.42**	.00	.00	.00	.00	1			
9	Marital status	.00	.00	.00	.00	.00	.00	.00	.00	1		

10	Last year of studies	.00	.00	-.003	.00	.00	.00	.00	.00	.00	1	
11	Occupation	.00	.00	-.19*	.00	.00	.00	.00	.00	.00	.00	1

* p< 05; ** p < 01

Table 4 describes the final simplified model, including only the significant relationships. The overall goodness of fit (GFI) is adequate (i.e., CFI = .99; RMSEA = .058). The chi-square statistic examines the fit of the proposed model to the underlying data. A nonsignificant chi-square demonstrates that the model is not significantly different from the underlying data. However, the chi-square test is biased when the sample size is greater than 200 (Hair et al., 1999). Other indices used in this study were the non-normed fit index (NNFI), the GFI and the incremental fit index (IFI). The results show that the proposed model is acceptable.

Table 4. Final model description

Parameter			**Std. Estimate (*t*)**	**Conclusion**
Structural coefficients				
H1: Urban economic sust.	→	Urban pollution	.51 (3.29)***	*H1: Supported*
H2: Urban pollution	→	City livability	-.001 (-3.915)***	*H2: Supported*
H3: Urban environmental sust.	→	Urban pollution	-.29 (-19.79)***	*H3: Supported*
Urban economic sust.	→	Urban env. sust.	.07 (22.75)***	*Significant*
H4: Urban economic sust.	→(ind)	Urban pollution	-.55 (-15.82) ***	*H4: Supported*
H5: Urban social sust.	→	City livability	.01 (55.88)***	*H5: Supported*
Urban economic sust.	→	Urban social sust.	.13 (23.67)***	*Significant*
H6: Urban economic sust.	→(ind)	City livability	.08 (23.06) ***	*H6: Supported*
Controls				
Years living in the city	→	City livability	-.128 (-4.28)***	*Significant*
Gender	→	City livability	-.046 (-4.11)***	*Significant*
Goodness-of-fit statistics				
Chi-square			7437	
d.f.			111	
p			.00000	
NNFI			.989	
CFI			.991	
IFI			.991	
RMSEA			.058	

†< .1; * p< 05; ** p < 01; *** p <.001

H1 suggests that the higher the economic sustainability of a city is, the higher the pollution in that city. The standardized coefficient of this path in our model is .507, and the t-value (3.29) is significant. Consequently, our results support H1. H2 suggests that urban pollution is negatively associated with city livability. The standardized coefficient

of this path is -.001, and the t-value (-3.92) is significant. Therefore, H2 is supported by our data.

Regarding environmental sustainability, H3 suggests that the higher the environmental sustainability of a city is, the lower the pollution in that city. The standardized coefficient of this path is -.296, and the t-value (-19.79) is significant. Therefore, H3 is supported. H4 suggests an indirect effect of urban economic sustainability on pollution mediated by environmental sustainability. The standardized coefficient of this path is -.545, and the t-value (-15.82) is significant. Therefore, H4 is supported in our sample.

Regarding social sustainability, on the one hand, H5 suggests that the higher the social sustainability of a city is, the higher the livability in that city. The standardized coefficient of this path is .011, and the t-value (55.88) is significant. Consequently, we find support for H5 in our sample. On the other hand, H6 suggests an indirect effect of urban economic sustainability on city livability mediated by social sustainability. The standardized coefficient of this indirect path is .080, and the t-value (23.06) is significant. Consequently, our results support H6.

In addition to the hypotheses suggested, we also include paths from the control variables to city livability in our model. Our results broadly confirm the significance of two of the six paths tested. The effect of gender (stdr. coeff. = -.046; t = -4.11) and years living in the city (stdr. coeff. = -.128; t = -4.28) are found to be significant.

Robustness tests

We performed a number of additional analyses to assess the robustness of our estimates. First, as it could be argued that the results might depend on the way the DV was measured, we substituted our measure of city livability for the two items (one item in each model) that compose it ("satisfaction with living in the city" and "the city is a good place to live") in two alternative SEM models (Model 9 and Model 10, respectively). In both alternative models, the results remained qualitatively unchanged, and none of the significant relationships found in our final model was nonsignificant in the alternative SEM models.

Second, we tested the SEM model erasing the control variables that had significant relationships with our DV. We found that (a) the significance of the hypotheses remained qualitatively unchanged, and (b) although the GFI indicators were below the indicators of our final model, the data also fit this model acceptably well. We believe that this outcome provides further evidence that there are significant underlying relationships among the concepts included in the model and that there are no spurious relationships resulting from an arbitrary inclusion of controls.

Third, to ensure that the results found could not be attributed to particular specifications of the statistical method followed (SEM), we tested the relationships suggested in the hypotheses using OLS regressions. To do so, we had to test 2 models, one with city livability as the DV (Model 11) and another with urban pollution as the DV (Model 12). We included gender and years in the city as controls. Again, the significance of the hypotheses remained unchanged. This outcome indicates that the results obtained were not a result of the specifications of the SEM methods.

Finally, we experimented with the controls and measures of our DV using OLS regressions. We tested the models described above (Models 9, 10, 11 and 12) but did not include any controls. The significance of the relationships found in all these models remained unchanged. The results reported above are available upon request and were robust to each of these alternative specifications.

5. Discussion

To test our hypotheses, we merged a large sample of responses from citizens in different European cities with secondary objective data on air pollution in those cities. We found a significant relationship between economic sustainability and pollution (H1) and a negative association between pollution and city livability (H2). Considering only these two results, one might expect a negative effect of economic sustainability on city livability. Interestingly, we found support for a positive indirect effect of economic sustainability on city livability that is explained by two other effects in the model. First, there is a positive indirect effect of economic sustainability on urban pollution via environmental sustainability (H3 and H4). Second, we found support for a positive

indirect effect of economic sustainability on city livability via social sustainability (H5 and H6).

Therefore, we obtained interesting and somewhat counterintuitive results. Although we found that economic sustainability has a negative impact on pollution and that pollution has a negative effect on livability, we also found an overall indirect positive association between economic sustainability and city livability due to the mediation effect of social sustainability, which reverts the effect of pollution.

In addition, although we found support for a direct positive association between economic sustainability and urban pollution, we found that this effect is indeed mitigated by the mediating role of environmental sustainability. Environmental sustainability is supported by economic sustainability and diminishes urban pollution. Overall, this finding suggests that the relationship between economic sustainability, environmental sustainability and pollution is complex. Cities are not necessarily condemned to choosing between staggering pollution and economic progress. Local authorities may and should address regulations and economic resources to effectively revert and prevent the negative pollution impacts of a growing local economy.

Taken together, these two findings suggest that the relationships between the three pillars of urban sustainability, pollution and livability at a city-level include trade-offs and mediating effects. This finding is in line with previous studies that highlight the importance of adopting a multi-dimensional approach (Koramaz and Türkoğlu, 2018; Marans, 2015; Valcárcel-Aguiar and Murias, 2018) and exploring the synergies and trade-offs between the three pillars of urban sustainability (Jenks and Jones, 2010; Tanguay et al., 2010) for effective urban action that ensures the well-being of dwellers.

This paper contributes to the literature on urban sustainability (e.g., Bayulken and Huisingh, 2015, Bibri and Krogstie, 2017, Elmqvist et al., 2018, Martos et al., 2016, McCormick et al., 2013, Petit-Boix et al., 2017, Vergragt et al., 2016) in a number of ways. First, our paper conceptually develops and empirically tests a theoretical model of the antecedents of city livability that reflects how the complex interplay between the three pillars of a sustainable city with urban pollution determine city livability. We do not regard economic, environmental and social sustainability as isolated goals to achieve

(DV). We relate them with pollution and city livability in an interconnected model and explain the trade-offs and mediating effects. By developing this model, we emphasize that cities are dynamic and complex systems that require holistic perspectives to be understood and managed (e.g., Bibri and Krogstie, 2017; Elmqvist et al., 2018; Runhaar et al., 2009). This perspective has significant potential to augment the scholarly understanding of cities' sustainability.

Second, although this concept had received little attention to date, we set city livability in the spotlight and theorize about its antecedents. We contend that enhanced city livability should be a relevant goal (DV) of the urban sustainability literature. Improvements in the economic, environmental and social sustainability of cities are goals that not only stand *per se* but also are important because they affect city livability. One of the benefits of developing research on the antecedents of city livability is its appeal for local policymakers. Given that city livability perceptions hold the potential to alter voting patterns, research on the antecedents of city livability may spark discussions that municipalities might want to engage in and take real action.

Third, to our knowledge, our study is one of the first to provide empirical support for the antecedents of city livability. Although the literature on this topic is emerging, most of the extant research is theoretical (e.g., Bayulken and Huisingh, 2015, Bribi and Krogstie, 2017, Martos et al., 2016, McDermott et al., 2017, Petit-Boix et al., 2017, Vergragt et al., 2016), and empirical studies are lacking (Węziak-Białowolska, 2016). We found empirical support for our hypotheses, the proposed model fit the data well, and the results remained unchanged after several robustness checks, resulting in high potential for theory development.

Context must be considered when interpreting our results. Our paper provides support for the theory developed using a dataset representing 79 European cities. While we believe there is a reasonable basis for generalization, cultural, social and economic forces may alter the interpretation of our results. In developing countries, large cities are frequently over-crowded, and livability levels are sometimes low. One might think that economic sustainability is of paramount importance to improve dwellers' life conditions. However, our results emphasize that translating economic progress into environmental (e.g., green areas, recycling, waste management) and social (e.g., social equity, access to basic

services) sustainability might be even more critical in these contexts. For economic development that effectively improves daily life, cities must invest their resources to increase environmental and social services and facilities.

5.1. Implications for policymakers

Our study provides practical advice to municipalities and local policymakers to improve their extant understanding of the dynamics of city livability. Our findings suggest that policymakers should not approach economic, environmental and sustainability goals as conflicting. Although some specific trade-offs may arise, city government should ensure that economic progress is translated into more resources for environmental and social programs in order to improve livability perceptions. In doing so, policymakers should adopt a holistic perspective when designing their urban policies (Bibri and Krogstie, 2017; Elmqvist et al., 2018; Runhaar et al., 2009) and exploit the potential for establishing "virtuous circles" between the three dimensions of sustainability and city livability.

Moreover, our results show that urban pollution levels significantly affect city livability. Given the potentially relevant role of citizens' livability perceptions in their voting intentions, local authorities should be aware that pollution is not only an issue for ecosystems, public health, and future generations but also may affect their chances to be re-elected in future elections.

The findings of the study have general implications for city management in different ways. On the one hand, for policymakers in smaller communities, the results serve as an example and confirmation of the benefits of applying sustainable practices from a holistic point of view. On the other hand, municipalities may focus on how cities' images improve when they are known as sustainable practitioners due to the consequent higher city livability perceptions, for instance.

5.2. Limitations and further research

The results of this research should be interpreted through the lens of its limitations. First, our database has several advantages, such as its sample size, its multi-country nature, its combination of perceptions with objective measures, and its representativeness of a large number of cities. These features provide some basis for generalization. However, the data did not allow us to develop a longitudinal design that would have enabled us to establish

causality in the tested hypotheses. Second, although we included secondary data for one of the variables present in most of our hypotheses, in the case of H5 and H6, the data for the implied variables came from the same source, and the presence of common method variance cannot be ruled out.

Several future research directions appear to be promising. First, the study of the evolution of this theoretical framework over time with data from future Eurobarometer surveys and WHO measurements would confirm the causality of the relationships tested. Second, the analysis of specific cities that are already (or soon will be) applying environmental—and smart—practices and policies may provide insights into the different advancements depending on regions or cultures.

Finally, the interpretation of the relationships of this study may vary depending on the development levels on continents other than Europe. The process of the delocalization of industries from Western to Eastern countries may have produced a "pollution outsourcing" effect for Western cities. In developing countries, economic activity might be based to a greater extent on industrial activity, resulting in a stronger association between economic sustainability and urban pollution than in Europe. It would be interesting to explore whether this effect impacts the relationships tested in other geographical areas.

6. Conclusion

This paper explores how the interplay between pollution and the three pillars of urban sustainability (economic, social and environmental) determines city livability. The results from a sample that merges the responses of 33,579 citizens from 67 European cities and objective urban pollution data show that pollution is negatively associated with city livability. We also found that economic sustainability is negatively associated with pollution (via environmental sustainability) and positively associated with city livability (via social sustainability).

Our paper contributes to the literature on urban sustainability by placing city livability in the spotlight and investigating the notion that sustainability and pollution are antecedents of citizens' satisfaction with their cities. We hope that our paper helps spark research on

how to increase city livability because given current societal trends, improving city livability means impacting the quality of life of a large proportion of humanity.

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Chapter 4: The role of institutional factors in the transition towards more sustainable and livable cities

Chapter 4: The role of institutional factors in the transition towards more sustainable and livable cities

Abstract

This study analyzes the longitudinal relationships between the three dimensions of urban sustainability and city livability, while exploring the moderating effect of relevant institutional factors on those relationships. Specifically, we propose that regulatory institutions and citizens' pressures moderate the relationships between economic, environmental, and social urban sustainability and city livability in the long term. We test those relationships in a sample composed of data from 20 European cities from 2011 to 2016. Overall, our findings validate the causal positive effect of the three urban sustainability dimensions on city livability. In addition, our results confirm the moderating effect of regulatory institutions on the relationship between social urban sustainability and city livability, and the moderating effects of citizens' pressures on the relationships between environmental and social urban sustainability and city livability. Therefore, these results help to extend current knowledge on the interconnections between urban sustainability, city livability and their institutional background.

Keywords**:** city livability, urban sustainability, institutional framework, regulatory institutions, citizens' pressures.

1. Introduction

City livability has lately been threatened due to population growth and great urban development (Marans, 2015; Martínez-Bravo et al., 2019). Indeed, the United Nations (UN) estimate the population living in cities to reach 6.5 billion people by 2050 against the 4.3 billion people living in 2019 (World Bank, 2020). Due to this demographic growth, cities are experimenting tensions related to economic, environmental, and social sustainability issues, that may significantly affect the quality of life and well-being of their dwellers (Baker, 2007; Burger and Christen 2011). Hence, ensuring city livability and sustainability are regarded as two of the grand societal challenges of the twenty first century (Ruth and Franklin, 2014; Gorissen et al., 2018) as grand societal challenges have been defined as large-scale problems that transcend national borders (Ferraro et al., 2015, George et al., 2016). Grand challenges are "highly significant yet potentially solvable problems" (Eisenhardt et al., 2016, p.113) that require urgent action (George et al., 2016). To stimulate action against the world's most pressing grand societal challenges, in September 2015 the UN developed a list of 17 sustainable development goals (SDGs) at an historic summit supported by 193 member states in order to ensure a better and more sustainable future for all. In its SDG 11 "Sustainable Cities and Communities", the UN acknowledge that there needs to be a future in which cities support positive economic, environmental, and social links as a means to ensure adequate living conditions and equal opportunities for all.

In this context, knowledge on the potential influences of institutional factors on urban dynamics might potentially help cities in the path towards sustainability for two main reasons. First, institutional theory specifies that the nature of sustainability problems is not economic or technological, but it relies on behavioral and cultural aspects of the society (Hoffman and Jennings, 2015). Thus, institutional theory highlights human performance as the origin of, and the solution for, sustainability issues as "it is our individuals beliefs, cultural norms, and societal institutions that guide the development of that activity" (Bazerman and Hoffman, 1999, p.40). Second, institutionalists consider that the derived knowledge, the information used to create practical solutions (Schultz and Hatch, 2005), is a "socially constructed" fact (Hoffman and Jennings, 2015, p.16) which is transmitted through institutional mechanisms. Thus, the information gathered in

sustainability issues for generating solutions might be efficiently accepted, treated, analyzed, and diffused within the institutional framework (Hoffman and Jennings, 2015).

However, even if institutional factors have been considered antecedents of urban sustainability (Hoffman and Jennings, 2015; Bazermann and Hoffman, 1999) and urban sustainability antecedent of city livability (Martínez-Bravo et al., 2019), the role of institutions has not been analyzed, to the best of our knowledge, at urban level within the context of urban sustainability and city livability. Indeed, research on how to govern cities for a sustainable transition is still very scant (George et al., 2016). For example, there are not empirical studies addressing the role of the institutional background on the relationship among urban sustainability and city livability. Furthermore, the studies that address the influences of urban sustainability or institutional factors on city livability are mainly theoretical (Węziak-Białowolska, 2016; e.g., Kaal, 2011), address cases of a specific city or region (e.g., Ellis and Roberts, 2015), or do not consider time factors (Bornemann and Strassheim, 2019). In consequence, there is a need of empirically analyzing how livability, sustainability, and institutional factors interrelate at city-level over time. Thus, with this work we aim to address this gap in the literature by building up a theoretical model, based on empirical evidence, on how those variables are interconnected considering the component of causality. The specific research question that this paper addresses is: *which is the role of institutional factors in the relationship among urban sustainability and city livability?* To address this research question, we have dived into institutions and urban sustainability literatures and we have gathered perceptual and objective data to develop a database with urban and inhabitants' information from 20 European cities in the period from 2011 to 2016. We have developed a theoretical framework including relationships among the variables examined (urban sustainability dimensions, institutional factors, and city livability). In addition, we have empirically analyzed those relationships using random effects regressions for panel data.

This paper contributes to the institutional and urban sustainability literatures applying institutional theory to cities and by showing that certain institutional factors, specifically regulatory institutions and citizens' pressures, might promote the positive relationship among urban sustainability and city livability. Overall, we suggest that in the presence of a sound institutional background, urban sustainability translates into greater city livability. In other words, our approach nurtures the literature on urban sustainability by

signaling that regulatory institutions and citizens' pressures might foster the impact of urban sustainability on city livability.

In the next section we expose the theoretical background of the research and the hypotheses that we elaborated based on precedent literature. Later, we explain the methodology that we followed as well as the results obtained. Afterwards, we develop the contributions and implications that this work might have to, later, expose the limitations and the further research lines linked to the study. To finish, we conclude the paper stating the main conclusions for our main concern: city livability.

2. Theoretical framework and hypotheses

The concept of city livability refers to the capacity of a city to offer their citizens a suitable context to progress, have a good quality of living, and perceive their position in life as satisfactory (Macke et al., 2018; Marans, 2015; Martínez-Bravo et al., 2019; Ruth and Franklin, 2014). Improving the quality of life in cities is one of the most relevant purposes of public policies and institutions (Santos and Martins, 2007). Indeed, low attention to livability issues might be due to, among others, low responsibility from institutions (Ruth and Franklin, 2014). Building upon the institutional framework that suggests that individual and organizational behaviors are influenced by institutional mechanisms (DiMaggio and Powell, 1983), we argue that city management behaviors and decisions might be also influenced by institutional pressures. Thus, through this paper we aim to illustrate that institutional pressures and city behaviors (hence, urban sustainability and city livability decisions) are closely related too.

Hodgson (2006, p.18) defined institutions as "systems of established and embedded social rules that structure social interactions". In this line, institutional pressures might be seen as social exchanges that are expected to happen in a specific way (Ouchi, 1980) due to the relevant presence of tradition and routinization philosophies in the social background of every society (Giddens, 1979). Social rules emerge due to normative pressures coming from the struggle of facing ambiguous situations (DiMaggio and Powell, 1983) and they are not only shaped by society, but also by what government might penalize (Arora and De, 2020) or reward (Berrone et al., 2016). As a result, high levels of certain institutional variables might suppose that all the actors of a city (city decision-makers, companies'

managers, and city dwellers) are strongly influenced, or even limited, by institutional pressures.

First, institutional pressures might shape and condition the decisions related to the management of cities. In other words, the managers of a specific city, might hold common values and non-written norms that might always influence their decisions in a certain way. Second, as the institutional framework might define what behaviors are appropriate and meaningful (Zucker, 1977), institutional factors might influence individuals' behaviors in terms of sustainability and livability decisions. For instance, if most of the citizens in a certain city usually recycle, it will be taken-for-granted that recycling is an appropriate and meaningful behavior in that city. On the contrary, if recycling is not seen as a legitimated practice, citizens will be less expected to recycle. Established social norms might influence urban sustainability this way. In consequence, because city management decisions and dwellers behaviors might be conditioned by social norms, institutionalization and institutional factors might relevantly influence the transition towards urban sustainability and city livability.

Third, certain institutional factors might contribute to the transition towards urban sustainability and livability because to institutionalize is to "infuse with value beyond the technical requirements of the task at hand" (Selznick, 1957, p.17). Thus, institutional factors might not only guide decision-makers and citizens in sustainability and livability choices because of their taken-for-granted nature (Scott, 1987) but also might instill increased value to the search of more sustainable and livable cities. Indeed, as institutions are "products of interaction and adaptation" (Scott, 1987, p.494), institutional factors are likely to be successful in cities where interaction and adaptation opportunities are higher because of greater population densities and higher challenges presence (Jenks and Jones, 2010).

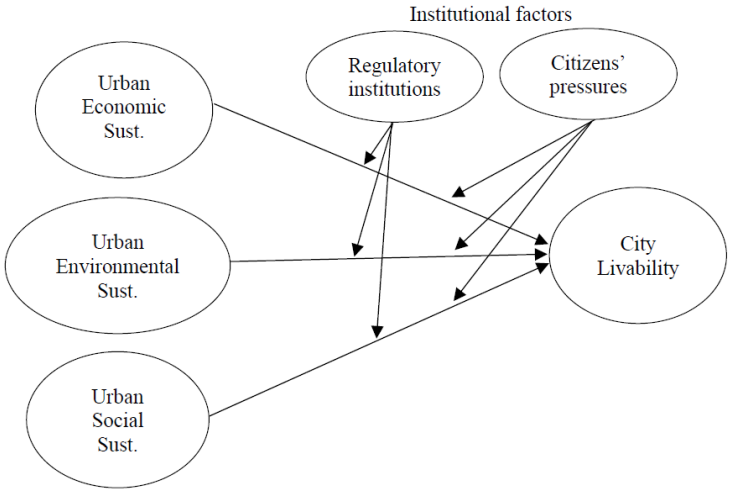
In this paper, we focus on two institutional factors: regulatory institutions and citizens' pressures. These are two relevant institutions in cities because cities might need both to be supported by coherent regulations (Camagni et al., 1998) and embraced by citizens actions (Fritz et al., 2019) to attain the needed urban sustainable development degree.

First, the concept of *regulatory institutions* refers to the extent to which governments are competent to promote sound policies and regulations related to businesses development (Iwanow and Kirkpatrick, 2007; Kraay et al., 2010). Some of the factors that regulatory institutions include are prices control, banks supervision, excessive regulations management, quality-improving initiatives, or exports performance (De Mesquita and Stephenson, 2007; Iwanow and Kirkpatrick, 2007; Kaufmann et al., 2005). In that line, regulations weight and rigidity might give an idea of the importance given by governments to limiting and mitigating the negative effects of businesses on the urban background and to achieve good urban sustainability and city livability levels (Ruth and Franklin, 2014).

Second, the idea of *citizens' pressures* refers to citizens' possibilities of participating in governance issues (Kaufmann et al., 2005) or influencing governments decisions (Kraay et al., 2010). Citizens' pressures might be translated into quantifiable information through their votes and through the data that they generate. First, citizens' wishes are to a certain extent considered because of their votes in elections; second, they might express their opinion thanks to freedom of expression, freedom of association and free media channels through which decision-makers might collect information at the citizen-level. In that line, citizens' pressures may play a relevant role in urban sustainability because they might transmit their interests to politicians through their votes (Delmas and Toffel, 2004) or their opinions and because they hold local genuine information and knowledge (Leuenberger and Wakin, 2007).

Thus, both institutional factors (regulatory institutions and citizens' pressures) might guide the path towards the achievement of the sustainable development goals and towards urban sustainability which, in turn, might improve city livability (Martínez-Bravo et al., 2019). In the following paragraphs, we theoretically illustrate the relationships shown in Figure 3 among the three dimensions (economic, environmental, and social) of urban sustainability and city livability as well as the moderation that the institutional factors may exert on those relationships.

Figure 3. Theoretical model proposed



2.1.Economic urban sustainability, city livability, and the influence of institutional factors

First, economic urban sustainability advocates for an effective and innovative management of the extant urban economic resources (Wu and Zhi, 2016) which also means the fair allocation of those resources (Glaeser and Mare, 2001). In a city economically sustainable dwellers might more likely be able to cover their basic needs, as well as to thrive and prosper economically (Santos and Martins, 2007). For instance, cities with suitable levels of economic sustainability might offer decent and sufficient job opportunities (S. González-García et al., 2018) or might not hinder citizens' necessities or initiatives with difficult administrative processes (Jiang et al., 2020). An economically sustainable city might not only hold healthy economic resources (Jenks and Jones, 2010) but also benefit from scale and network economies.

Economic urban sustainability characteristics are likely to affect city livability in different manners. For instance, within an economically sustainable city, infrastructure costs might decrease because of the capacity of sheltering more inhabitants in smaller spaces (Jenks and Jones, 2010). Thus, decision-makers might have the possibility of allocating more economic resources for carefully designing and maintaining infrastructures (e.g., beautiful and façades and streets). Consequently, if decision-makers consider a city's physical appearance and if they design the urban background in consequence, citizens might feel greater city livability (Kashef, 2016).

Furthermore, economic urban sustainability might involve not only a city with a healthy and robust economy but also a prosper job market. In that context, an economically sustainable city might attract workers and important companies looking for better conditions or for greater opportunities (Glaeser and Mare, 2001) such as improved networking or highly qualified work environments. Thus, the city might achieve higher competitiveness which is proven to result in migration movements of people in the search for improved quality of life (Marans and Stimson, 2011).

Therefore, we suggest:

H1a: Economic urban sustainability positively affects city livability

In terms of how regulatory pressures might influence this relationship, we argue that, as regulatory institutions entail the sound promotion of businesses development (Kraay et al., 2010), a city where the businesses are well-settled might foster a robust urban economy because the city might shelter dynamic and strong companies and industries. In that background, the city might more likely present labor opportunities due to networking (Jenks and Jones, 2010) or to the strength of specific local resources, activities, or services (Omholt, 2015). Hence, it might be more likely to find greater and better job opportunities that are associated with high economic urban sustainability levels which, in turn, might foster the quality of life in the city (Türksever and Atalik, 2001). Thus, the presence of regulatory pressures might reinforce the relationship between economic urban sustainability and city livability.

In addition, regulatory institutions action involves prices control of products and services in most industries (Kaufmann et al., 2005). Thus, regulatory pressures might likely influence market stability (Mizuta et al., 2003) because sellers might be obliged to limit prices fluctuations. In that line, prices might be reasonable related to the cost of living and citizens might find their wages appropriate to live with quality. Hence, in the presence of efficient regulatory institutions, individuals might find affordable to live in the city, which is a characteristic related to high economic urban sustainability levels (Glaeser and Mare, 2001). In consequence, regulatory pressures might again reinforce the relationship among economic urban sustainability and city livability.

Thus, we suggest:

H1b: Economic urban sustainability has a greater positive impact on city livability in the presence of regulatory institutions

Furthermore, with respects to the impact that citizens' pressures might have on the relationship among economic urban sustainability and city livability, in a context where the levels of citizens' pressures are low, minorities and immigrants might struggle with the administrative processes or with the local language and might have problems to access and follow quality education (Ross and Willigen, 1997). In that case, it might result in future workers less qualified who might limitedly contribute to the city's economic sustainability compared to high-qualified workers (Genaidy et al., 2010). Thus, in the presence of citizens' pressures, citizens might have access to better education opportunities and a better educational background. Those specificities might likely result in better qualified future workers who might suppose that economic urban sustainability fosters city livability in a greater manner.

In addition, with limited levels of citizens' pressures, the population segments less likely to develop the freedom of expression, of association or the free media might be those with limited economic resources (Kraay et al., 2010). Indeed, those communities with limited economic resources are usually perceived as less powerful within the institutional context (Delmas and Toffel, 2004). They might have, for example, more difficulties to acquire electronic devices and, in consequence, it will be more difficult for them to keep informed or to express their needs and governments would less likely know how those segments of the population could thrive and progress economically. Thus, it would be difficult to improve economic urban sustainability (Santos and Martins, 2007) while covering all the population needs which might impact general city livability levels (Macke et al., 2018). Accordingly, with higher levels of citizens' pressures and, hence, with all the population segments effectively communicating their needs, economic urban sustainability might have a greater effect on city livability.

Thus, we suggest:

H1c: Economic urban sustainability has a greater positive impact on city livability in the presence of citizens' pressures

2.2. Environmental urban sustainability, city livability and the influence of the institutional framework

Environmental sustainability aims to support the system where human life happens (Goodland, 1995). In the framework of urban areas, environmental urban sustainability refers to the natural and physical features of the city such as "air, water, green spaces, waste…" (Santos and Martins, 2007, p.414). Thus, it is also related to energy generation resources and transport networks (Tanguay et al., 2010) which both might influence the natural and physical features of a city. In consequence, a city environmentally sustainable might involve air and water quality, good and sufficient green spaces, efficient waste management systems, efficient and non-pollutant transport systems, and eco-friendly energy plans (Fujii et al., 2014; Jenks and Jones, 2010; Martos et al., 2016). Environmental urban sustainability aspects might impact city livability levels for different reasons.

First, in terms of pollution impacts, a city with a high presence of activities that entail pollution emissions might entail an unhealthy urban background (Martínez-Bravo and Martínez-del-Río, 2019) in which the population might likely experiment greater health issues (Paiva Vianna et al., 2015). For instance, the World Health Organization (WHO) claims that air pollution causes approximately seven million deaths per year and is responsible of one third of stroke, lung cancer and heart disease related deaths (World Health Organization, 2020). However, a city with high levels of environmental sustainability is likely to confront pollution issues and, in turn, address health problems' origin. In consequence, as health is a fundamental factor of city livability (Macke et al., 2018; Ruth and Franklin, 2014), increasing environmental sustainability might entail the improvement of health standards and city livability levels.

Moreover, regarding the natural features of the city, the presence of vegetation involves phycological benefits for the population in different ways (Tyrväinen, 1997, Martos et al., 2016). First, vegetation absorbs noise pollution (Bolund and Hunhammar; 1999, Martos et al., 2016) which is related with psychological disorders such as sleep difficulties (Paiva Vianna et al., 2015). Second, green zones might suppose pleasant landscapes for

citizens which provide them with harmony and calmness (Tyrväien, 1997). Third, improving citizens' urban background and urban green spaces might increase their wellbeing as a result of their connection with nature (Rioux and Werner, 2011).

In consequence, we pose the following hypothesis:

H2a: Environmental urban sustainability positively affects city livability

As mentioned before, regulatory institutions also suppose the sound promotion of businesses (Kraay et al., 2010). Besides, companies' activities usually imply the generation of great quantities of wastes and pollution in addition to those from households. However, in the presence of strong regulatory institutions, governments might more likely control the economic activities outcomes that entail environment degradation (Aragón-Correa et al., 2020). In that line, if environment degradation is limited or punished by governments, the perceptions of city livability might likely improve (Rioux and Werner, 2011). In consequence, if regulatory institutions levels are high, the relationship among environmental urban sustainability and city livability might be stronger.

The sound promotion of the companies' activities resulting from regulatory institutions initiatives (Kraay et al., 2010) might smooth entrepreneurial activities (Pacheco et al., 2010). Thus, big companies might not suppose a barrier for new sustainable entrepreneurs and their initiatives might help to shape the solutions for sustainability problems (Dean and McMullen, 2007; York and Venkataraman, 2010) in environmental contexts (Cohen and Winn, 2007; Short et al., 2009). In consequence, within situations in which there exists a high presence of regulatory institutions, environmental entrepreneurs might be more encouraged to suggest solutions to environmental sustainability cities issues and might, in turn, improve city livability levels more pronouncedly.

H2b: Environmental urban sustainability has a greater positive impact on city livability in the presence of regulatory institutions

In addition, environmental sustainability might improve city livability by offering citizens where to spend leisure time or where to meet (Goodland, 1995). In that framework, in the

presence of citizens' pressures (hence citizens' freedom of association), environmentalists and groups of ecologists might be more likely to meet (Sine et al., 2005), to discuss and to state the relevance of climate change and environment degradation issues. In that line, activists' groups or NGOs integrated by citizens might arise and become institutional disruptors who might likely favor changes (Sine and Lee, 2009) towards sustainable systems. Hence, environmental issues would be more likely addressed by governments and social norms might more likely be reflected on local policies promoting environmental sustainability. Indeed, there are diverse examples where organizations have lessened their environmental impact due to ecologists' groups pressures (Baron, 2003; Delmas and Toffel, 2004). Thus, high levels of citizens' pressures may foster environmentalists, ecologists, and environmental entrepreneurs' meetings under certain social norms (Meek et al., 2010) and environmental urban sustainability might, in turn, greatly positively impact city livability.

Furthermore, other environmental urban sustainability aspects such as urban green spaces might be used differently by each citizen depending on their needs and interests. For instance, in parks one might find citizens who go there to play with their children, and citizens who go there to walk their pets. In that sense, green spaces "serve as spaces to diversify 'ecological experience'" rather than to express citizens differences (Buchel and Frantzeskaki, 2015, p.176). Thus, green spaces might serve for leisure areas for citizens who, even with different profiles, might have the possibility to meet diverse people and feel a greater satisfaction within the life they lead. As a result, in the presence of citizen' pressures, environmental urban sustainability might foster city livability more pronouncedly.

In consequence, we suggest the following:

H2c: Environmental urban sustainability will have a greater positive impact on city livability in the presence of citizens' pressures

2.3. Social urban sustainability, city livability and the influence of the institutional framework

Social urban sustainability might suppose for city's inhabitants the possibility of holding a specific social status (Bramley et al., 2009) and maintaining it in the long-term. In that

line, a socially sustainable city might offer all their citizens equal opportunities to reach certain social standards (Marcotullio, 2001) such as integration or social development (Martos et al., 2016). Specifically, urban social sustainability is associated with feelings of safety and the integration of minorities (Dempsey et al., 2011; Jenks and Jones, 2010). The urban features related to social sustainability might influence city livability levels for several reasons.

First, a socially sustainable city might allow their citizens to feel safe in their cities and neighborhoods (Dempsey et al., 2011). In that sense, citizens with a deep feeling of safety might be willing to spend time outdoors enjoying recreational activities and leisure options (Jenks and Jones, 2010). Spending time outdoors and getting involved in leisure activities might also foster interaction among citizens (e.g., walks, leisure matches, meeting in parks). In consequence, these experiences of safety, recreation, participation, and interaction might foster city livability levels.

Second, education is also considered a fundamental factor of social urban sustainability (Martos et al., 2016). A city with an efficient education system and good educational facilities might foster academic, labor, and personal development for those who study there. In that line, citizens would have access to better and greater job opportunities, and healthier personal situations which, in turn, might make them feel more satisfied and perceive their city as more livable (Santos and Martins, 2007).

Thus, we suggest the following:

H3a: Social urban sustainability positively affects city livability

In the presence of regulatory institutions, the job market might be controlled by sound policies (Kraay et al., 2010). Thus, governments might likely ask for companies to integrate minorities within their personnel and, in turn, it might be easier for citizens to have a greater sense of community and fulfillment which might suppose higher levels of social urban sustainability (Dempsey et al., 2011; Shafer et al., 2000) and, in turn, better perceived city livability. Furthermore, in the presence of that sense of community and other social urban sustainability features, such as participation or inclusion (Dempsey et al., 2011), the membership levels of specific interests groups might be higher which

might, in turn, suppose a higher propensity for more stringent regulations (Delmas and Toffel, 2004). Hence, in the presence of sound regulatory institutions, social urban sustainability might have a greater impact on city livability.

Furthermore, entrepreneurs might not only initiate activities addressing environmental sustainability failures but also social sustainability failures (Cohen and Winn, 2007; Short et al., 2009). Hence, social sustainable entrepreneurs might contribute to social sustainability failures by addressing opportunities within social systems (Dean and McMullen, 2007). In that line, social sustainable entrepreneurs might give answer to social issues as well as create social value which, in turn, might be reflected in higher city livability perceptions. In consequence, in the presence of high levels of regulatory institutions and, hence, if governments smooth social entrepreneurial activities, the relationship among social urban sustainability and city livability might be stronger.

H3b: Social urban sustainability will have a greater impact on city livability in the presence of regulatory institutions

On the one hand, citizens' pressures features such as freedom of expression, freedom of association or free media might make citizens interact and feel atmospheres of participation and involvement. In that contexts, inhabitants are likely to feel a great sense of community and integration that might foster social urban sustainability (Jenks and Jones, 2010). As a result, citizens' pressures might reassure the relationship among social urban sustainability and city livability. On the other hand, social sustainable cities might aim to be inclusive fighting against citizens' exclusion (Dempsey et al., 2011). Thus, inclusive cities which hold good levels of citizens' pressures might reinforce the positive effects of social urban sustainability on city livability.

Moreover, citizens are a key part of the exploiters of the systems and initiatives that governments put in place. Indeed, citizen-generated data is considered strongly useful for reporting sustainability progresses (Fritz et al., 2019). In that line, in cities with high levels of citizens' pressures, the residents might give their opinion about their knowledge on usability, usefulness, and maintenance of the facilities and services that the governments launch (Leuenberger and Wakin, 2007). Gathering that information through media (e.g., specific apps for using and/or evaluating services or facilities) might result

in a great amount of citizens' concerns knowledge regarding what they need or what they find useful. For instance, they might give their opinion whether the initiatives implemented in the city foster inclusion, participation, or interaction. For instance, the Singaporean government found out that citizens were (and are) key elements when addressing cities challenges after implementing innovative communication and collaboration initiatives among citizens and decision-makers (Barrionuevo et al., 2012). Thus, social urban sustainability might have a greater impact on city livability thanks to citizens' pressures.

We suggest the following:

H3c: Social urban sustainability will have a greater impact on city livability in the presence of citizens' pressures

3. Methods

3.1. Sample and data collection

In order to test the effects of urban sustainability dimensions and the moderating role of the two institutions dimensions on city livability, we built a unique longitudinal dataset consisting of twenty European cities[5] for the period 2011 and 2016. Therefore, our final sample consists of 120 city-year observations across twenty cities in six years.

This research design ensures variability in the key variables of the study because, in general, the resource allocation in European cities present differences when addressing economic, environmental, and social issues. Each city might have different institutional backgrounds and citizens might perceive differently urban sustainability and city livability (Ruth and Franklin, 2014; Voss and Bornemann, 2011). Therefore, although the cities included in our analysis belong to the same region – the European continent –, they present high levels of heterogeneity that make them a relevant context where to study urban sustainability, institutions, and city livability dynamics. In addition, the

[5] Antwerp, Brussel, Liege, Berlin, Rostock, Hamburg, Leipzig, München, Tallinn, Barcelona, Napoli, Roma, Torino, Verona, Vilnius, Riga, Ljubljana, London, Manchester, Newcastle.

longitudinal nature of our study allows us to establish causality relationships among the studied variables and city livability.

Our sample resulted from the combination of a variety of international and well-reputed databases. First, we collected data on urban sustainability and city livability from the Eurobarometer (EB) surveys which gather information in the most important cities of each European country. We used the "Quality of Life in European Cities" survey which is developed each two or three years and for which there is available information for 2007, 2009, 2012, and 2015. The surveys consist of five hundred interviews per city in main cities and includes questions about citizens' perceptions about urban life and issues related to city livability and the three pillars of urban sustainability, among others. Since 2007, the surveys have evolved. The latest surveys (2012 and 2015) include more cities and more questions than the previous ones (2007 and 2009). In this study, we have only considered questions that were common to all the surveys.

Second, we collected the two institutional variables at country-level from the Worldwide Governance Indicators (WGI) project. The World Bank Group launched the WGI project to collect data on governance and institutional factors and created indicators from 1996 to 2018 for over 200 countries all over the world. The dataset that includes the indicators is based upon perceptual information gathered from enterprises, citizens and experts in each country and considers information from over thirty different databases.

Finally, we also gathered information from other databases to add control variables to our research. We collected variables including urban population, Gross Domestic Product (GDP), urban employment rate, urban age dependency ratio, number of cars in the city, environmental taxes, entrepreneurship rate, and innovation rate. Then, we put together all the data and built up the final dataset depending on the availability of data over time. Control variables data availability obliged us to elaborate the dataset from 2011 onwards. Furthermore, we used the 2007 and 2009 Eurobarometer surveys data to interpolate and extrapolate the lacking data in the years that the survey did not take place (2011, 2013, 2014 and 2016). As a result, the dataset holds information for a sample of twenty European cities from 2011 to 2016.

3.2. Variables

The main objective of this study is to analyze institutions and sustainability as city livability determinants. The dependent and independent variables of the research were gathered from the Eurobarometer surveys. For each city and year available, there were about five-hundred respondents stating their satisfaction towards various aspects. Thus, in order to have a representative value for each aspect, we calculated the average of the five-hundred answers and set a unique value for each aspect in each city and year. As mentioned before, there were no data for all the years that our period of study covered, so we linearly interpolated and extrapolated the available information with the aim of obtaining the lacking data in the surveys, which is appropriate based on our dataset nature (Cui et al., 2015; El Ghoul et al., 2012; Hilary and Hui, 2009). All the answers of the Eurobarometer surveys were classified using a 5-point Likert scale.

Dependent variable

City livability is the dependent variable (DV) of this study. We measured city livability through the Eurobarometer survey question which asks citizens about their satisfaction with living in their city. We consider that this statement might correctly measure the livability degree of a city because precedent research describes it as the satisfaction of the citizens living there (Marans and Stimson, 2011; Santos and Martins, 2007).

Independent variables

Prior to empirically analyze the relationships, we carried out several tests for assuring that the data for the independent variables were appropriate for the analysis. First, taking into account all the of the Eurobarometer surveys that made reference to sustainability dimensions, we explored the sampling adequacy with the Kaiser-Meyer-Olkin (KMO) test for each item. We removed one of the items for not achieving the threshold for KMO values of 0.50 (Kaiser, 1970). We also assessed the factorability of the data with the KMO test for the totality of the items which yielded a value of 0.798 (also exceeding the cut-off point) and with the Bartlett's sphericity test which was significant (chi-square=3196, d.f.=136, $p < .001$). Thus, we concluded that our scales involved strong factorability. Afterwards, a principal component analysis (PCA) revealed three components with eigenvalues exceeding the cut-off value for the extraction suggested by Kaiser-Guttman (eigenvalue>1). Based on a theoretical review of extant literature and on the results of the

PCA, we constructed the three factors for the study: economic, environmental, and social urban sustainability.

Economic urban sustainability. To measure economic urban sustainability, we used a construct built upon two items of the Eurobarometer survey based on the PCA results and on previous literature: the ease of finding a job and agreement on whether administrative services help citizens efficiently. Those statements might give an idea whether citizens are able to thrive economically and, hence, whether there are good levels or economic sustainability in the city (Santos and Martins, 2007).

Environmental urban sustainability. Looking into the definition of environmental urban sustainability and guided by the PCA results, the operationalization of this variable was based on the combination of seven items from the Eurobarometer surveys: (1) satisfaction with public transport, (2) satisfaction with public spaces, (3) satisfaction with green spaces, (4) satisfaction with the quality of the air, (5) satisfaction with the noise level, (6) satisfaction with cleanliness, and (7) agreement on whether the city is committed to fight against climate change. Those items are appropriate for measuring environmental urban sustainability because they include the natural and physical features of the city (Santos and Martins, 2007), and energy and transport issues (Tanguay et al., 2010). A principal component analysis revealed only one factor with an eigenvalue larger than 1.0 which explained 75.16 % of the variance. We found a value for the Cronbach alpha of .92, which indicates good internal reliability (Hair et al., 1999) and all the factor loadings were significant. We also conducted a composite reliability (CR) test which yielded a value of .95 fairly above the cut-off point of .70 (Hair et al., 1999).

Social urban sustainability. We operationalized the concept of social sustainability of a city through four items of the Eurobarometer surveys: (1) agreement on whether the presence of foreigners is good for the city, (2) agreement on whether the foreigners who live in the city are well integrated, (3) the feeling of safety in the city, and (4) the feeling of safety in the neighborhood. We consider that those items fit well with the social urban sustainability notion as they include inclusion and safety (Dempsey et al., 2011; Martos et al., 2016; Shafer et al., 2000). The principal components analysis yielded one factor with an eigenvalue larger than 1.0 which accounted for 78.1 % of the variance explained. The Cronbach alpha scale reliability coefficient was found to be .90 showing good

reliability (Hair et al., 1999) and all factor loadings were significant. The CR test yielding a value of .95 indicated convergent validity (Hair et al., 1999).

Moderating variables

The moderating variables of this study were collected from the World Governance Indicators (WGI) project developed by the World Bank Group. Through this project, the World Bank compiled data from over 30 sources with information from citizens, entrepreneurs, experts in the public, private and NGO sectors worldwide (Arora and De, 2020). While the Eurobarometer items have all positive values because they were classified using a 5-point Likert scale, the governance indicators from the WGI ranged approximately from -2,5 to 2,5. First, we accounted for *regulatory institutions* which includes perceptions about the government competence to permit and promote the development of the businesses in terms of elaborating and implementing sound policies and regulations. With that aim, we gathered the regulatory quality indicator from the World Governance Indicators database. Second, we operationalized *citizens' pressures* through the use of the voice and accountability indicator – also from the World Governance Indicators database – that captures, on the one hand, to what extent interviewees perceive that they have the possibility of participating in selecting the government and, on the other hand, freedom of expression, association and media.

Control variables. The control variables of this research include data from different sources at different levels (city- and country-level). *Urban population* information was gathered from the Eurostat database and was measured in thousand inhabitants. The population of a city might be relevant due to greater or less important needs and to economies of scale (Sun et al., 2017). Also, we collected information on *cities GDP* – from the same data source – which was measured in million euros. Cities GDP might be important in this study because economic resources are closely linked to sustainability (C. González-García et al., 2018) and livability (Marans and Stimson, 2011). *Employment rate* and *age dependency* data were gathered from the European Commission Urban and Territorial Database and was measured in percentage. We considered that these data might be important as control variables because they suppose objective information that might influence how citizens perceive the conditions of living in a city (Glaeser and Mare, 2001; Shafer et al., 2000). We added data about the *number of cars per city* from the same

database because cars are important features when taking into account diverse features of sustainability and livability such as quality of living, economic personal situation, environment degradation or accessibility (Fenger, 1999; Jenks and Jones, 2010). We also collected control variables for the study at national level. First, *environmental taxes rates* were collected from the Eurostat database and they were measured in million euro. Second, we added *entrepreneurship data* from the Global Entrepreneurship Monitor where we chose the nascent entrepreneurship rate. Last, we gathered information about the *innovation level* of a country from the World Intellectual Property Organization database where we accounted for the Global Innovation Index ranking. Finally, we included yearly dummy variables in the analysis to control for the possible year effects that could exist in our sample due to specific punctual or unusual situations.

Divergent validity. To analyze divergent validity in our research, we tested Fornell and Larcker (1981) criteria. We compared the average variance extracted (AVE) with the correlation among constructs (Henseler et al., 2015). Thus, we found an AVE value of .74 for the environmental urban sustainability construct and .78 for the social urban sustainability construct and we calculated the correlation among them which resulted to be .63. First, we realized that the AVE was higher than the cut-off point of .50 (Hair et al., 1999) and second, we proved divergent validity also because both of the AVEs values were higher than the correlation among the constructs (Fornell and Larcker, 1981).

Common Method Bias

To test the hypotheses H1a, H2a, and H3a, we used data from the same data source: the Eurobarometer surveys. However, we have strong reasons to confirm that the potential common method variance was low. First, we ran the Harman's single-factor test method (Podsakoff et al., 2003). Specifically, we carried out a principal component analysis with unrotated factors including all the variables used in the hypotheses H1a, H2a, and H3a. The outcomes of the analysis give support for the absence of common method bias problems as we found two factors with eigenvalues over 1. Furthermore, interviewees could not structure their responses according to this paper goal because the surveys were carried out several years before. Second, the survey design was carried out following Podsakoff et al., (2003) guidelines to minimize common method variance. Also, control variables were extracted from different sources.

To test the hypotheses H1b, H1c, H2b, H2c, H3b, and H3c, we used data from two different databases: the Eurobarometer surveys and the World Governance Indicators project. In general, we feel confident that common method bias is not a major issue in this research.

3.3. Statistical Specification

We used random effects (RE) regression for panel data to estimate statistical models of city livability in each city-year study for several reasons. First, there is an emerging stream of literature challenging fixed effects because they fall short when controlling out context and reduce generalizability (Bell and Jones, 2015). Authors favor RE modeling because it considers the clustering of observations (York and Lenox, 2014) as RE model adds an additional assumption of independence to the individual-effects (Cameron and Trivedi, 2009). Then, RE specification models context and heterogeneity avoiding misleading interpretations (Bell and Jones, 2015) that, in our study, would be related to the specificities of each city. Second, we empirically explored what regression model was more appropriate for our research. On the one hand, we run the Breusch-Pagan test comparing OLS regression and RE regression which resulted significant ($p < .001$) indicating the use of a RE model. On the other hand, we run a Hausman test (Greene, 2002) comparing fixed and random effects which resulted not significant ($p = .20$) indicating the use of the RE model as well. In addition, we found support in our data for the assumption made by RE models (Bell and Jones, 2015) related to the normality of residuals. Thus, we found both theoretical and empirical support for the use of the RE regression for our case.

Furthermore, we used one-year lag between the dependent variable (measured at time t) and the independent, moderating and control variables (measured at time t-1) in order to account for casualty relationships.

4. Results

We included in Table 5 the descriptive statistics, standard deviations, and correlations of all the variables. We found some values of correlation among variables slightly high. In the case of economic, environmental, and social urban sustainability, it seems coherent as they are theoretically related because of being part of the same feature: urban

sustainability. In addition, when we run the PCA for defining the items of each of the dimensions, we found three specific factors with the items loading higher in each of the correspondent – economic, environmental, and social – factor. Besides, the divergent validity test confirmed that the constructs were different. For the institutions variables, it seems also rational that the two of them are importantly correlated as they are part of one bigger concept that englobes both of them.

Table 5. Descriptive statistics, standards deviations, and correlations

Variables	M	SD	1	2	3	4	5	6
1. City livability	3.43	.23						
2. Economic urban sust.	2.33	.29	.65**					
3. Urban environm. sust.	2.82	.27	.83**	.78**				
4. Social urban sust.	2.87	.26	.85**	.54**	.81**			
5. Regulatory institutions	3.75	.43	.61**	.52**	.71**	.68**		
6. Citizens' pressures	3.70	.22	.47**	.43**	.56**	.47**	.82**	
7. Ln urban population	13.22	1.22	-.12	-.23*	-.31**	-.21*	.15	.09
8. Ln city GDP	10.84	1.10	-.09	.01	.16	.14	-.27*	-.07
9. Ln city Employment	13.05	.99	-.01	.03	.06	.09	-.06*	-.07
10. Age dependency ratio	61.87	5.76	-.39**	-.23*	-.38**	-.63**	-.40**	-.26**
11. Ln cars	5.97	.29	-.40**	-.57**	-.57**	-.53**	-.50**	-.21*
12. Ln environmental taxes	9.82	1.67	.00	-.07	.03	-.19*	-.12	.04
13. Entrepreneurship rate	3.68	1.71	.00	.26**	.26**	-.14	.13	-.20*
14. Innovation rate	20.29	10.8	.43**	.53**	.59**	.42**	.55**	.29**

Variables	7	8	9	10	11	12	13
8. Ln city GDP	.08						
9. Ln city Employment	.16	.70**					
10. Age dependency ratio	-.19*	-.25**	-.37**	1			
11. Ln cars	.11	-.17*	-.28**	.62**			
12. Ln environmental taxes	.24	.28**	.25**	.34**	.38**		
13. Entrepreneurship rate	-.22*	.06	.13	-.19*	-.62**	-.48**	
14. Innovation rate	-.03	.42**	.41**	-.20*	-.49**	.45**	.09

Note: * p < .05; ** p < .01

Table 6 displays the results of the regression analysis on city livability. As baseline test, model 1 included control variables effects on the dependent variable city livability. Models 2, 3 and 4 included main effects for economic urban, environmental, and social sustainability, respectively. From model 5 to model 10, we included one by one all the individual interactions among each one of the three dimensions of urban sustainability and the two institutions variables. Finally, model 11 included the main effects and all the interaction terms.

Table 6. Regression results on city livability

Variables/model	1	2	3	4	5	6
Ln urban population	-.033 (.040)	-.016 (.033)	.011 (.024)	-.001 (.022)	.015 (.019)	.018 (.021)
Ln city GDP	-.015 (.016)	-.002 (.015)	.010 (.014)	.019 (.014)	.010 (.014)	.009 (.014)
Ln city employment	-.019 (.050)	-.021 (.044)	-.023 (.033)	-.068* (.032)	-.042 (.029)	-.043 (.029)
Age dependency ratio	-.003 (.006)	-.008 (.005)	-.012* (.005)	-.003 (.004)	-.004 (.005)	-.003 (.005)
Ln cars	-.118 (.112)	-.022 (.106)	.020 (.097)	-.191* (.088)	-.057 (.094)	-.000 (.000)
Ln environmental taxes	-.000 (.000)	-.008 (.029)	.014 (.022)	.016 (.020)	.009 (.018)	.000 (.000)
Entrepreneurship rate	.004 (.005)	.007 (.005)	-.000 (.004)	.003 (.004)	.000 (.004)	.000 (.004)
Innovation rate	-.001 (.002)	.000 (.002)	-.001 (.002)	.001 (.001)	.000 (.001)	-.000 (.002)
Economic urban sust.		.281*** (.064)			.315 (.404)	.051 (.063)
Environmental urban sust.			.612*** (.087)		.266** (.103)	.826† (.467)
Social urban sustainability				.425*** (.053)	.332*** (.079)	.344*** (.075)
Regulatory institutions					.105 (.277)	.394 (.355)
Citizens' pressures					.186* (.089)	.366* (.348)
Urban eco. sust. x reg. inst.					-.069 (.111)	
Urban env. sust. x reg. inst.						-.149 (.120)
Urban soc. sust. x reg. inst.						
Urban eco. sust. x cit. press.						
Urban env. sust. x cit. press.						
Urban soc. sust. x cit. press.						
Constant	4.22*** (1.12)	3.75*** (.98)	2.24* (.88)	3.97*** (.74)	1.27 (1.23)	-.18 (1.58)
Observations	100	100	100	100	100	100
R^2	.29	.49	.71	.75	.77	.77

Variables/model	7	8	9	10	11
Ln urban population	-.013 (.020)	.015 (.021)	.018 (.019)	.007 (.021)	.035** (.014)
Ln city GDP	-.007 (.013)	.013 (.014)	.011 (.013)	.009 (.012)	-.000 (.036)
Ln city employment	-.048† (.028)	-.046 (.029)	-.039 (.029)	-.048† (.028)	.011 (.041)
Age dependency ratio	-.006 (005)	-.004 (.005)	-.004 (.005)	-.005 (.004)	.007** (.003)
Ln cars	-.055 (.091)	-.075 (.093)	-.002 (.093)	-.001 (.087)	-.087 (.105)
Ln environmental taxes	.011 (.018)	.011 (.019)	.008 (.018)	.007 (.018)	.029† (.016)
Entrepreneurship rate	.003 (.004)	-.001 (.004)	-.002 (.004)	-.001 (.004)	-.009 (.009)
Innovation rate	-.001 (.001)	-.000 (.002)	-.001 (.001)	-.000 (.004)	-.004 (.004)
Economic urban sust.	.041 (.016)	.908 (.569)	-.009 (.065)	-.007 (.057)	3.574** (1.298)
Environmental urban sust.	.243** (.099)	.275** (.102)	2.585*** (.793)	.234** (.094)	-6.691** (2.378)
Social urban sustainability	1.282*** (.399)	.321*** (.076)	.335*** (.072)	3.580*** (.753)	8.138*** (1.204)
Regulatory institutions	.720** (.329)	-.038 (.047)	-.034 (.043)	-.014 (.040)	-.656 (.999)
Citizens' pressures	.246** (.086)	.703* (.347)	1.827** (.554)	2.805*** (.605)	3.193* (1.579)
Urban eco. sust. x reg. inst.					-.131 (.359)
Urban env. sust. x reg. inst.					-.976† (.572)
Urban soc. sust. x reg. inst.	-.265* (.110)				1.277** (.408)
Urban eco. sust. x cit. press.		-.237 (.159)			-.824 (.626)
Urban env. sust. x cit. press.			-.599** (.202)		2.868** (1.113)
Urban soc. sust. x cit. press.				-.880*** (.204)	-3.276*** (.652)
Constant	-.86 (1.39)	-.07 (1.47)	-4.81* (2.40)	-7.81*** (2.39)	-9.73** (3.61)
Observations	100	100	100	100	100
R^2	.74	.77	.78	.74	.93

Note. Non-standardized regression coefficients and standard errors in parentheses; † < .1; * p < .05; ** p < .01; *** p < .001

We tested our hypotheses through a moderated hierarchical regression analysis (Cohen and Cohen, 1983). First, we analyzed the direct effects of the main variables and, afterwards, we tested the moderating effects. For model 1, only urban population was found to be – marginally – significant ($p < .10$). The findings in model 2, 3 and 4 showed that city livability and economic, environmental, and social urban sustainability are directly and positively related ($p < .000$ in the three cases) and, thus, supported H1a, H2a, and H3a. The outcomes for model 5 and 6 do not support H1b and H2b. However, model 7 showed evidence that H3b is supported and, thus, social urban sustainability will have a greater impact on city livability in the presence of regulatory institutions. In addition, model 8 revealed that H1c was not supported but the outcomes of model 9 and 10 showed that H2c and H3c respectively were supported. Then, environmental urban and social sustainability will have a greater impact on city livability in the presence of citizens' pressures. We also noted that, if removing economic urban sustainability from the models (as it is not significant in any interaction), the hypotheses were not supported. Then, economic urban sustainability also plays its role in determining city livability.

Following Cohen and Cohen (1983) methodology, we illustrated the significant relationships of the supported hypotheses which included moderating effects (H2c, H3b and H3c) in Figures 4, 5 and 6. On the x-axis we included the correspondent urban sustainability dimension and on the y-axis city livability. The two lines in each graphics represent different levels of institutional indicators values: one standard deviation below the mean (low institutional indicator value) and one standard deviation above the mean (high institutional indicator value). In the three cases, the moderating effect of the institutional indicators increases as the moderating variable raises.

Figure 4. The moderating effect of regulatory institutions on the relationships between social urban sustainability and city livability

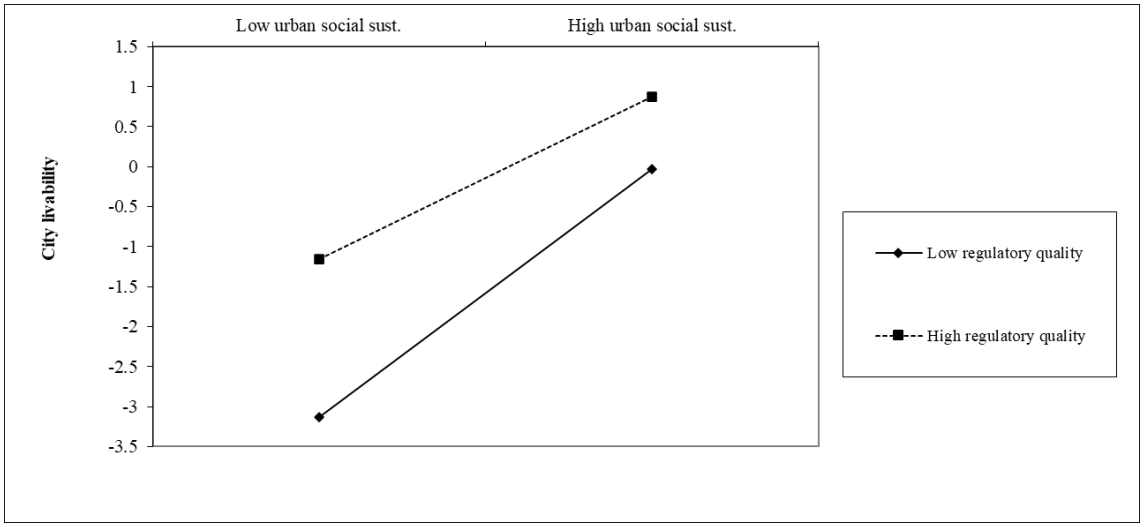


Figure 5. The moderating effect of citizens' pressures on the relationships between environmental urban sustainability and city livability

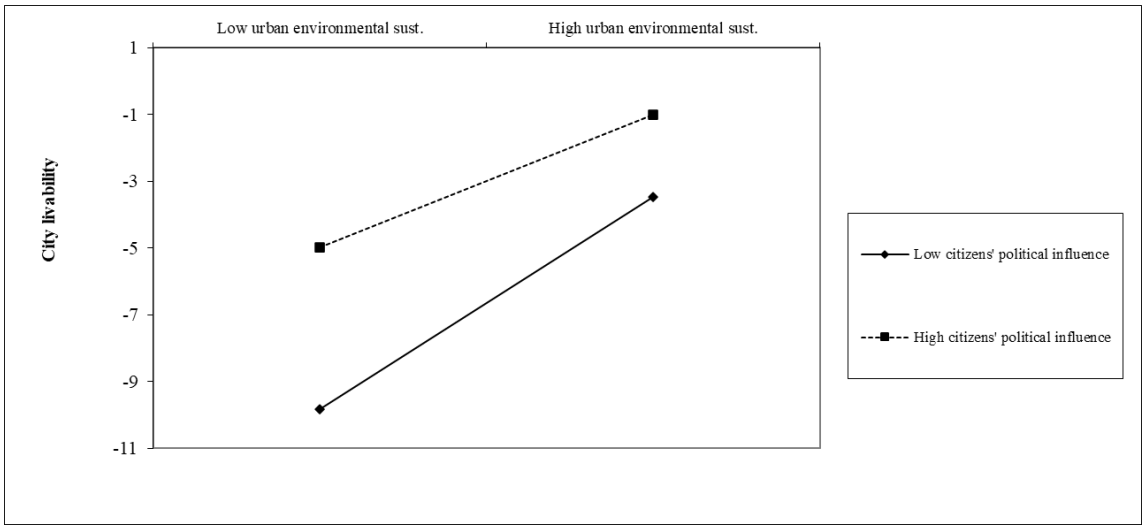
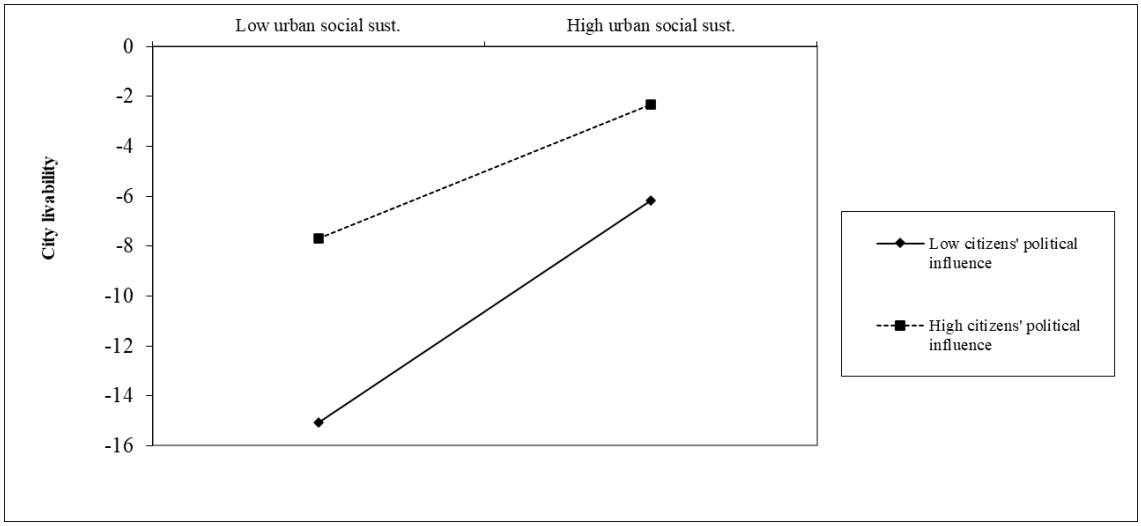


Figure 6. The moderating effect of citizens' pressures on the relationship between social urban sustainability and city livability



Robustness tests

With the aim of further assessing the robustness of the research outcomes, we performed several additional tests. First, instead of only considering city effects, we carried out the analysis controlling also by country by adding country-level effects and, even if the relationships were slightly weaker, we found support for the same hypotheses. Second, we also run the analysis with different combinations of control variables, which lead to similar results and the confirmation of the same hypotheses. Finally, we run the regressions with the specification of fixed effects instead of random effects and the hypotheses previously supported were supported as well. The results of these robustness tests are shown in Table 9 included in Annex 1.

5. Discussion

The main objective of this paper was to analyze the role of institutions, specifically regulatory institutions and citizens' pressures, on the relationship among urban sustainability and city livability. Thus, to answer the research question that we suggested, we combine the literature on urban sustainability and the institutional theory literature to develop a theoretical framework addressing the direct relationships among the three dimensions of urban sustainability and city livability as well as the moderating role of institutional factors in those relationships. To test the suggested relationships and perform the analysis for this paper, we used data on citizens' perceptions from the Eurobarometer

surveys and data on institutional perceptions from the World Governance Indicators project as well as control variables information from a variety of databases.

We found support for the three relationships including the direct effects of economic (H1a), environmental (H2a), and social (H3a) urban sustainability on city livability. Our findings confirm that institutional variables positively moderate those relationships. In addition, we found that regulatory institutions positively moderate the relationship among social urban sustainability and city livability (H3b) and that citizens' pressures positively moderate the relationships among environmental and social urban sustainability, and city livability (H2c and H3c respectively).

Concerning the moderation of the institutions variables in the relationship among environmental urban sustainability and city livability (H2b and H2c), we found distinct results. First, we did not find that the moderation of regulatory institutions within the mentioned relationship was significant. Thus, we might confirm that citizens perceive that governments are not sufficiently implementing sound policies for businesses development in order to improve the link between environmental urban sustainability and city livability. This could be, for instance, due to low efficiency of environment protection initiatives from governments. However, we found support for the moderation of citizens' pressures in the relationship among environmental urban sustainability and city livability. In consequence, citizens perceive that being included in the government issues (through their votes, expression, and media) might improve the relationship among environmental urban sustainability and city livability. These two findings taken together might evoke that citizens' pressures is more effective than regulatory institutions when searching for fostering the relationship among environmental urban sustainability and city livability. Thus, it might guide decision-makers to rethink their actions towards a more environmental protection perspective.

The support of the two relationships of moderation of the institutions variables on the link among social urban sustainability and city livability (H3b and H3c) entails insightful theoretical and practical implications. Most importantly, the fact that institutions variables have the power to exacerbate the relationship between social urban sustainability and city livability. As a result, those findings suggest that it is coherent to highlight the relevance of the institutions variables within the social context of cities. This might be possible

because both institutions variables directly consider social urban sustainability issues such as participation or involvement (Kraay et al., 2010; Jenks and Jones, 2010; Dempsey et al., 2011). Overall, we argue that institutional pressures might contribute to the relationship among environmental and, even more importantly, social urban sustainability and city livability as the quality of living might be tighter linked with environmental and social concerns than with economic concerns once other more basic needs are covered (Zeemering, 2009).

One might think that the absence of support for any of the moderation roles of institutions variables among the relationships between economic urban sustainability and city livability (H1b and H1c respectively) is not coherent because institutional initiatives should promote the fair allocation of economic features with the aim of improving city livability. However, institutional factors in the European context might need to consider other levels of analysis as previous research argues that, in order to attain economic urban sustainability standards, consensus at supranational levels is needed (Erne, 2015; Pitelis, 2013).

This paper contributes to the literature on urban sustainability in a myriad of ways. First, the support of the hypotheses suggesting the positive effect of the three dimensions of urban sustainability on city livability over time (H1a, H2a, H3a) extends precedent research on the connection among urban sustainability and city livability (Macke et al., 2018; Marans, 2015; Martínez-Bravo et al., 2019; Ruth and Franklin, 2014) by empirically confirming the causality of the positive impact of economic, environmental, and social urban sustainability on city livability.

In addition, the support of several of the moderating relationships (H2c, H3b, H3c) reveals the relevance that institutional influences suppose on the link among sustainability and livability in cities. In that line, in terms of the contributions that focus on institutional insights, we found that management decisions in cities might also be shaped by institutional factors. Also, as institutional factors might define what behaviors are appropriate and meaningful (Zucker, 1977), we suggest that they also might define behaviors in terms of sustainability or livability decisions and choices in cities. In this line, we argue that institutional factors, such as regulatory institutions and citizens' pressures, might importantly influence interaction and adaptation opportunities (Scott,

1987) in urban areas which might result in an easier transition towards sustainable and livable cities. In that line, the institutional factors might be relevant not only because their taken-for-granted nature (Scott, 1987), but also because they might "infuse with value beyond technical requirements" (Selznick, 1957, p.17) in the search of more sustainable and livable cities. Thus, institutional factors might not only shape social rules when facing ambiguous situations within the organizational background (Delmas and Toffel, 2004; DiMaggio and Powell, 1983), but also within the urban sustainability management background.

5.1.Practical implications

The findings of our study might provide guidance for decision makers in cities in a number of ways. First, we confirmed that the better the perceptions of economic, environmental, and social urban sustainability, the better the perceptions of city livability (Martínez-Bravo et al., 2019) over time. Thus, if municipalities are looking for improving city livability, it might be interesting for them to first consider urban sustainability causality. Second, institutional initiatives were not found to contribute significantly to foster the link among economic urban sustainability and city livability. As a result, if governments aim to foster the relationship among economic urban sustainability and city livability, they might need to consider other factors or other levels of analysis. For instance, previous research suggests that economic urban sustainability aspects might need to be addressed from more global perspectives such as the supranational one (Pitelis, 2013). Indeed, as "organizations are more likely to mimic the behavior of other organizations that are tied to them through networks" (Delmas and Toffel, 2004, p.214), we argue that, regarding economic urban sustainability initiatives, cities in the network of the European continent might need to observe and mimic other cities of the continent as well. Third, in the presence of sounds institutions, specifically regulatory institutions and citizens' pressures, initiatives aiming to improve environmental and social urban sustainability dimensions might impact city livability in a greater manner.

Moreover, the findings of the study might be useful for other communities in other geographical contexts. Even if we analyzed important cities in each country, smaller cities could follow their big siblings' steps and take them as reference. But not only with the aim of improving the quality of life of their citizens, but also because sustainable and

livable cities attract population (Ruth and Franklin, 2014), companies, development, and even foreign investments (Pisani et al., 2019).

5.2. Limitations and further research

As mentioned before, the data that we used present several strengths as the dataset that we elaborated includes variables from multiple sources with a multi-country, multi-city and longitudinal research design. However, the outcomes of the research might need to be prudently observed because the analysis entail a number of limitations as well. First, we only analyzed relatively large cities. Thus, researchers, policymakers, and other stakeholders might need to be careful when applying our outcomes to smaller communities or cities. Second, we observed the relationships in European cities. Hence, generalizing our outcomes to other regions in other continents might need to be done from a thoughtful perspective. Third, we used linear interpolation in order to obtain the missing data for a part of our sample. Even if it is a usual technique for obtaining missing data in panel data analysis for obtaining the final sample, some variations might not be covered. Finally, the study includes only two aspects of the institutional framework nature for each region. Even if we argue and theoretically explain that regulatory institutions and citizens' pressures are two of the most important institutional factors, other factors might also influence the relationships proposed.

We consider that this research offers different future research lines. First, we encourage future research to examine the interconnections and conclusions of this study in smaller cities instead of observing main cities in order to examine if the relationships suggested also take place within smaller urban areas. Second, scholars could compare if the urban dynamics in other regions or continents present the same behaviors than in our study to observe if there might be differences in the relationships depending on the level of development of the urban area analyzed. Indeed, the economic activity in developing countries might be less focused on environmental or social issues and, in turn, governments might be less prone to advocate for suitable levels of environmental and social urban sustainability. Thus, the interconnections suggested in this study might likely vary. Third, it could be interesting to analyze other institutional factors different than regulatory institutions or citizens' pressures and observe how the relationships behave.

Finally, this study might also be continued with the analysis of institutional factors at other levels, different than the country-level, such as the supranational one.

6. Conclusion

This research analyzes the interactions over time among the three dimensions – economic, environmental, and social – of urban sustainability, and city livability; as well as the moderating effect of institutional factors on those relationships. The research aims to assess the extent to which the institutional environment influences the effect of city sustainability on its livability. Overall, our findings show a significant impact of urban sustainability on city livability. In addition, we found that the effect of environmental and, more importantly, social sustainability on city livability is stronger when regulatory institutions and citizens' pressures levels are high. We suggest that, in the presence of sound institutions (regulations and citizens' ability to influence policy), urban sustainability translates into greater city livability. Our focus is not on the extent to which the institutions are favorable (or not) to sustainability, but on their quality and appropriateness. Moreover, we argue that institutional issues might more likely affect the connection among economic urban sustainability and city livability if they are considered at supranational level which may have an influence due to the specificities of our sample which includes only European data that might have an explicit behavior because of being part of the European continent. Furthermore, thanks to the longitudinal nature of our data, we were able to consider the relevance of the causality component in the relationships. As a result, our study contributes to the literature by stating the importance of institutional factors on the relationship among cities' sustainability and city livability over time.

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Chapter 5: How can entrepreneurs make cities more sustainable and livable? A review and further research agenda

Chapter 5: How can entrepreneurs make cities more sustainable? A review and further research agenda

Abstract

Cities have been revealed as the critical level where the struggle for global sustainability will be won or lost. In fact, the UN Sustainable Development Goals (SDGs) call for immediate action in their SDG 11 "Sustainable Cities and Communities". Even though scholars suggest that entrepreneurs have the potential to address sustainability challenges, the literature analyzing the link among sustainable entrepreneurship and urban sustainability is inconsistent. This article aims to take stock of extant research to advance knowledge on whether and how sustainable entrepreneurship can help cities to become more sustainable, that is, its sustainability impact at city-level. We take an interdisciplinary approach and review the management, entrepreneurship, sustainability, and urban sustainability literature on the topic. Thus, we plan to provide a complete picture of the role of entrepreneurs to promote sustainable cities, identify research gaps, and outline a future research agenda for scholars, policymakers, and entrepreneurs interested in both sustainable entrepreneurship and urban sustainability.

Keywords: sustainable entrepreneurship, urban sustainability, sustainable cities, literature review, research agenda.

1. Introduction

Cities are currently in the spotlight due to the unprecedented population growth which has created urban tensions related to the extenuation of economic, natural, and social resources. Indeed, cities shelter more than half of the world population (World Bank, 2020), consume 75 % of the world's energy, and produce 80 % of the total greenhouse gas emissions (Satterthwaite, 2008). Against this backdrop, the 2030 United Nations (UN) agenda for sustainable development devoted one of the Sustainable Development Goals (SDGs) to "Sustainable Cities and Communities" (UN, 2015). According to the UN, cities are essential for ensuring a sustainable future for all since they represent the scenario where the struggle for global sustainability will be won or lost.

The interest in urban sustainability is gaining traction in management research (e.g., Rousseau et al., 2019) and in urban sustainability research (e.g., Woolthuis et al., 2013) due to the complex relationships that condition urban dynamics (Martínez-Bravo et al., 2019) that pose both challenges and opportunities in the context of cities. A challenge because of the presence of place-based tensions (Slawinski et al., 2019) related to issues such as resources depletion, energy consumption, pollution, or waste production, among other (Bulkeley and Betsill, 2003; Martos et al., 2016; Stocchero et al., 2017). An opportunity because the urban context might entail synergies and trade-offs (Martínez-Bravo et al., 2019) that could be advantageous in the transition towards urban sustainability (Bai et al., 2016). In that context, sustainable entrepreneurs are likely to face those challenges and take advantages of those opportunities through sustainable initiatives (Dean and McMullen, 2007) addressing urban problems contributing to make cities more sustainable.

In this challenging context, some streams of research have signaled that urban sustainability is also based on city livability standards (Newman, 1999; Ruth and Franklin, 2014; Tanguay et al., 2010) and other have pointed out that sustainability is an obliged previous step for achieving city livability (Alberti, 2017; Bulkeley and Betsill, 2003; Marans and Stimson, 2011). City livability refers to what extent a specific urban background might provide adequate conditions for the citizens who dwell it to thrive, have a good quality of living, and perceive their position in life as satisfactory. In consequence, urban sustainability aspects might likely condition city livability

perceptions (Martínez-Bravo et al., 2019). Even if through this study we analyze the effects that sustainable entrepreneurship might suppose on urban sustainability, we also consider the impacts that scholars have signaled on city livability because their great interrelation and because an important number of works mention them.

Sustainable entrepreneurship literature has already signaled entrepreneurs as agents of change towards sustainable development (Pacheco et al., 2010; Johnson and Schaltegger, 2020; Schaltegger and Wagner, 2011) because entrepreneurs' initiatives are likely to address opportunities related to sustainability issues (Dean and McMullen, 2007; Sarracino and Fumarco, 2020; York and Venkataraman, 2010). Sustainable entrepreneurs are likely not only to lead to the sustainable development of ventures (Schaltegger and Wagner, 2011) but also to reduce the degradation of the natural environment (Kuckertz and Wagner, 2010; York et al., 2016) and implement social improvements (Dees, 1998) while considering economic wealth (Cohen and Winn, 2007; Johnson and Schaltegger, 2020). Indeed, research suggests that sustainable entrepreneurs might be able to develop the innovations needed to address sustainability failures (Dean and McMullen, 2007; Cohen and Winn, 2007; Johnson and Schaltegger, 2020; Schaltegger and Wagner, 2011) as their ventures might impact urban sustainability features by, for instance, increasing companies' creation rates, developing economic prosperity, raising employment opportunities, creating new products and services for businesses and the society, or improving the well-being of the population (Audretsch et al., 2015; Campin et al., 2013; Crath, 2017; Huang et al., 2018).

However, the relevance of place has usually been overlooked in the research field of sustainable entrepreneurship (Cohen and Muñoz, 2015; Muñoz and Cohen, 2016; Shrivastava and Kennelly, 2013). Recent literature highlights the emergence of entrepreneurs acting at the urban level (Muñoz and Cohen, 2016) focusing on developing value not only for the local economy, but also for the environment and the society (Cohen and Muñoz, 2015; Shepherd and Patzelt, 2011). Specifically, enterprises with a local focus have been signaled as potential mechanisms to promote sustainability at the city-level (Shrivastava and Kennelly, 2013) because entrepreneurs might address issues related to place specificities (Cohen and Muñoz, 2015).

Even if research on sustainable entrepreneurship has exponentially grown in the last decades (e.g., Lumpkin et al., 2018), the literature analyzing how entrepreneurs might influence and play a role towards sustainable development at the city-level remains somehow unstructured (Cummings et al., 2020; Scheyvens et al., 2016; Stafford-Smith et al., 2017). Sustainable entrepreneurship and urban sustainability literatures are still disconnected and there are still few works focusing on the consequences that entrepreneurs' actions might have on sustainable development (Cummings et al., 2020; Johnson and Schaltegger, 2020; Lumpkin et al., 2018). Thus, we aim to address that research gap by exploring the extant research work that analyzes entrepreneurs' impact on urban sustainability.

In this context, the goal of this study is to take stock of extant research to advance knowledge on whether and how entrepreneurship can help cities to become more sustainable. We aim to connect existing literature on the intersection of entrepreneurship and urban sustainability to develop an integrative framework of the sustainable impacts of entrepreneurs at city-level. More specifically, we want to identify research including sustainable entrepreneurship effects on economic, environmental, and social urban sustainability, the mechanisms through which they operate and the trade-offs and synergies that their actions suppose on each of the dimensions of urban sustainability and their interrelations to, overall, determine urban sustainability. With that objective, we first carry out a systematic literature review of management, entrepreneurship, sustainability, and urban sustainability literature on the topic. Later, we examine and classify all the articles to retain those useful for our research objective and, afterwards, we analyze and explain the retained ones in detail. In addition, we perform a critical assessment of the existing research and we suggest a future research agenda.

2. Methodology

2.1. Sample

This study aims to take stock of extant research in order to advance knowledge on whether and how entrepreneurship can help cities to become more sustainable. With that purpose, we developed a literature research protocol following the recommended stages for a systematic review proposed by Tranfield et al., (2003). Thus, we first defined the research

objective and the scope, which led us to the need of identifying articles theorizing and examining the impacts of entrepreneurship actions on urban sustainability.

Second, we proceeded to search published works on leading journals on the topic. To start, we searched in relevant general management journals (c.f. Cohen, 2006; Podsakoff et al., 2008): *Academy of Management J.*, *Academy of Management Review*, *Administrative Science Quarterly*, *Organization Science*, *J. of Management*, *Management Science*, *J. of Management Studies*, *Organization Studies*, *British J. of Management*, *Strategic Management J.*, and *J. of International Business Studies*. We also searched in top-ranked entrepreneurship journals (*J. of Business Venturing*, *Entrepreneurship Theory and Practice*, *Strategic Entrepreneurship J.*, *J. of Small Business Management*, *International Small Business J.* and *Small Business Economics J.*), top-ranked environmental/sustainability journals (*Business Strategy and the Environment*, *Business & Society*, *Corporate Social Responsibility and Environmental Management*, *J. of Cleaner Production*, and *Organization & Environment*) and top-ranked ethics management journals (*Business Ethics: A European Review*, *J. of Business Ethics*, *Business Ethics Quarterly* and *Business and Society Review*) according to the Social Science Citation Index and following previous literature review on sustainable entrepreneurship and corporate sustainability (e.g., Antolín-López et al., 2019; Montiel et al., 2020).

Finally, as our research aims to identify works at city-level, we searched in regional studies journals categorized under Regional Studies, Planning and the Environment of the ABS journals classification (*Environment and Planning A*, *Environment and Planning D: Society and Space*, *European Urban and Regional Studies*, *J. of Regional Science*, *J. of Rural Studies*, *Regional Science and Urban Economics*, *Regional Studies*, *Urban Studies*, *Town Planning Review*, *Annals of Regional Science*, *Construction Management and Economics*, *European Planning Studies*, *International J. of Urban and Regional Research*, *J. of Industrial Ecology*, *Local Economy*, *Cambridge J. of Regions, Economy and Society*, *Environmental Science and Policy*, *Environmental Science and Technology*, *Global Environmental Change*, *J. of Environmental Management*, *Cities*, *International J. of Green Energy*, *J. of Place Management and Development*, *J. of European Real Estate Research*, *Management of Environmental Quality*, *Regional and Federal Studies*, and *Urban Island Studies*). Furthermore, we searched in other relevant journals that were

frequently cited (*J. of Urban Technology*, *Landscape and Urban Planning*, *Planning Theory & Practice*, *Sustainable Cities and Society*, and *Sustainable Development*).

Third, we defined the keywords to be searched in titles, abstracts, and/or keywords as to identify relevant studies from the list of journals described. For the general management journals, we looked for the terms: city, cities, or urban, and sustainab*, environment*, green, ecological, or social, and entrepren*, venture, venturing, enviropren* or ecopren*. For the entrepreneurship journals, we used the same terms described for cities and sustainability. With regards to the environmental/sustainability and ethics management journals, we used the terms referring to cities and to entrepreneurship. Finally, for the regional studies journals, we looked for the same terms and the combinations used for the general management journals. We did not introduce time restrictions in order to find all existing relevant articles linking entrepreneurship, sustainability and cities. Using the electronic database Web of Science, this process yielded total of 326 articles which shows substantial relevance of the topic and supports the need for the review.

2.2.Data analysis

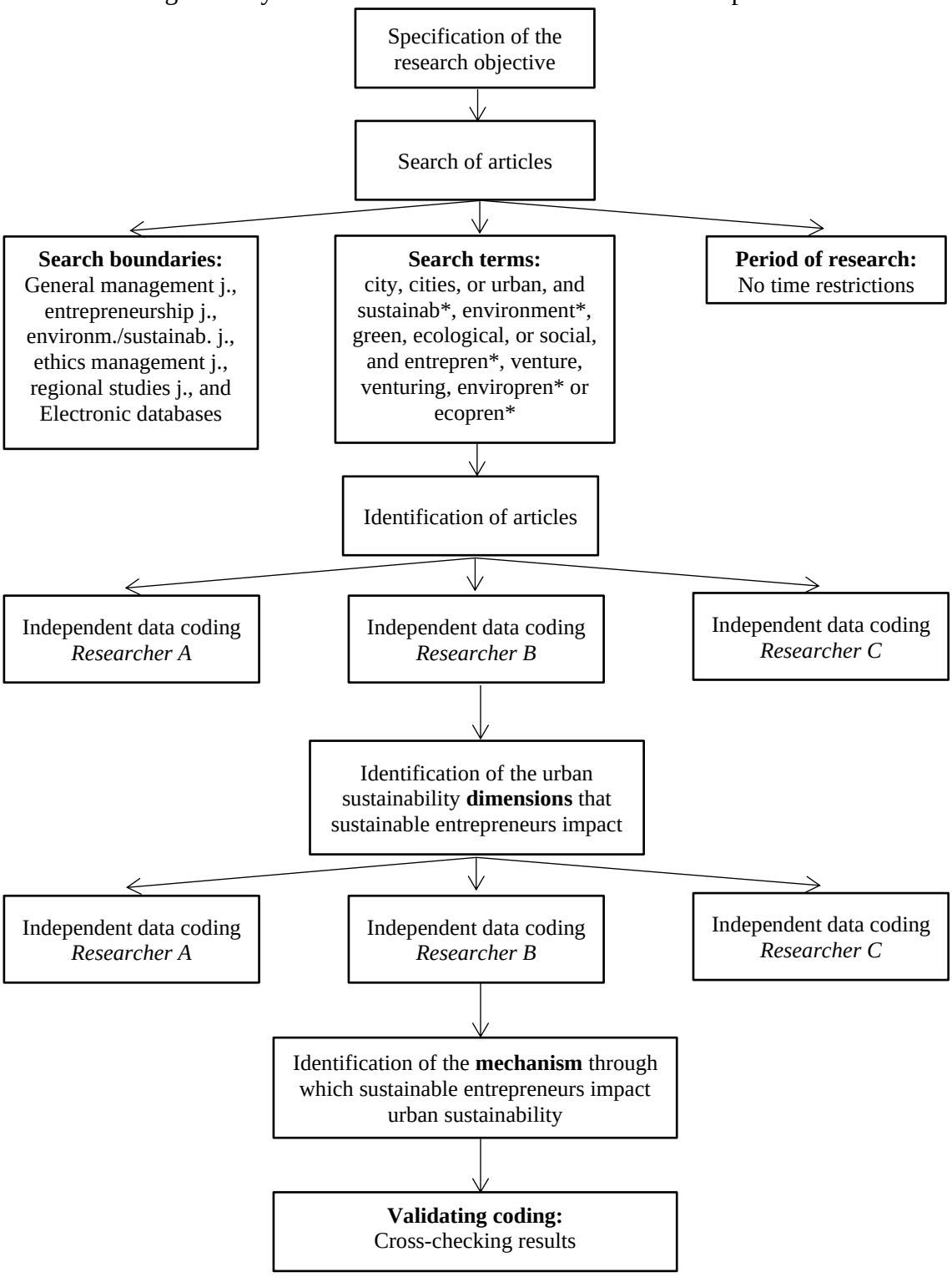
The authors independently screened all the articles to retain the specific ones that focus on the impact of entrepreneurs on urban sustainability dimensions: economic, environmental, and social urban sustainability (Jenks and Jones, 2010; Tanguay et al., 2010). Economic urban sustainability is defined as the extent to which the inhabitants of a specific urban region are able to thrive and progress economically (Martínez-Bravo et al., 2019; Santos and Martins, 2007). Environmental urban sustainability entails how much a city preserves and incorporates its natural capital into the routine life of the area (Tanguay et al., 2010). Social urban sustainability is a city's ability to provide its citizens specific long-term options for covering their social goals of sustainable development (Dempsey et al., 2011) such as inclusion or sense of community (Dempsey et al., 2011; Martos et al., 2016; Shafer et al., 2000).

The authors independently and manually coded each article based on: (1) journal title, (2) type of journal, (3) year of publication, (4) type of article, (5) type of entrepreneur, and (6) whether the article focuses on entrepreneurial impact on urban sustainability, and (7) the type of urban sustainability dimensions addressed. When codifying the articles, we

excluded those unrelated to our research objective. First, we discarded articles that focus on the entrepreneurial role of universities or governments (48 articles have been discarded) instead of focusing on private entrepreneurs. Second, we removed several works that examined entrepreneurship in rural areas (40 articles) rather than in urban areas. Finally, we also discarded articles focusing on how the city characteristics affect the emergence of sustainable entrepreneurs, namely, on the antecedents of sustainable entrepreneurship (213 articles) as with this work we aim to analyze research on how entrepreneurs impact urban sustainability. Besides, we reviewed the references sections of the articles retained to identify additional works. The application of these inclusion and exclusion criteria have led us to a final sample of 22 articles.

For the retained articles, two of the authors performed different rounds of articles reading to further examine the mechanisms through which entrepreneurs have a positive or negative effect on different urban sustainability dimensions, trade-offs, synergies, and potential barriers to their impact. The first two rounds were of 3 papers each, each followed by discussion among the three authors with the aim to make it sure the authors were in the same page when codifying them. Next rounds were of 6 papers each. In total, we conducted 5 rounds of articles analysis and discussion. Figure 7 summarizes the steps that we followed for the literature review and the codification process.

Figure 7. Systematic literature review and codification process



2.3. Final sample description

Below, we present some details of the retained articles. First, Table 7 describes the final articles retained so far based on the type of journal and year of publication. Table 8 illustrates which aspect of urban sustainability is impacted by the entrepreneurs in each of the papers. The tables will be extended and re-worked after completing the analysis of the remaining articles.

Table 7. Number of articles by type of journal and year of publication

Type of outlet	Journal name	2001-2005	2006-2010	2011-2015	2016-2020	Total
General management J.						
	California Management Review					1
Entrepreneurship J.						
	Entrepreneurship Theory and Practice		1			1
	J. of Business Venturing		1			1
	J. of Small Business Management				1	1
Environmental/sustainability J.						
	J. of Cleaner Production			1	2	3
	Organization & Environment			2		2
Ethics management J.						
	J. of Business Ethics			1	1	2
Regional studies J.						
	Cities				1	1
	European Planning Studies		1		2	3
	International J. of Urban and Regional Research	1				1
	J. of Place Management and Development			1		1
	Local Economy				1	1
	Urban Studies			1	3	4
Total		1	2	4	10	22

Table 8. Dimensions that entrepreneurs' actions impact by article

Authors and year of publication	Aspect impacted		
	Economic urban sust.	Environmental urban sust.	Social urban sust.
Campin et al., 2013			X
Cohen and Muñoz, 2015	X	X	X
Cohen and Winn, 2007	X	X	X
Crath, 2017	X		X
Di Marino et al., 2018	X	X	X
Eraydin et al., 2010	X		X
Fairbanks, 2011			X
Huang et al., 2018			X
Hudnut and Detienne, 2010		X	
Kim, 2016			X
Lee, 2018	X		X
Light, 2002	X		X
Lumpkin et al., 2018			X
Muñoz and Cohen, 2016	X	X	X
Nakamura, 2019	X		
Omholt, 2015	X		X
Salone et al., 2017			X
Sarracino and Fumarco, 2020			X
Shrivastava and Kennelly, 2013	X	X	X
Scaffidi, 2019	X		X
Woolthuis et al., 2013	X	X	X
Yu and Gibbs, 2019		X	

We can observe that research at the intersection of sustainable entrepreneurship and urban sustainability has received more interest in regional studies journals. Specifically, 50 % of the articles have been published in regional studies journals, 22.73 % in environmental/sustainability journals, 9.09 % in ethics management journals, 13.64 % in entrepreneurship journals, and only 4.55 % in general management journals. With respect to the year of publication, we have found only 2 papers (9.09 %) published before 2010. These figures signal that the sustainability impact of entrepreneurs at city-level is a recently emerging research line.

3. State of the art: entrepreneurship and sustainability in cities

Our analysis of the literature reveals that entrepreneurial initiatives might influence urban sustainability in a myriad of ways. Hereafter, we group existing works around the three dimensions of urban sustainability: economic, environmental, and social sustainability

(Jenks and Jones, 2010; Tanguay et al., 2010) and we explain the mechanisms through which entrepreneurs impact each of the dimensions and subdimensions presented.

3.1. Entrepreneurs' impact on economic urban sustainability

Economic urban sustainability is defined as the extent to which the inhabitants of a specific urban region are able to thrive and progress economically (Martínez-Bravo et al., 2019; Santos and Martins, 2007). High levels of economic urban sustainability are associated with urban characteristics such as job accessibility, affordable housing, land management, a realistic cost of living, and economic equality (Glaeser and Mare, 2001; Jenks and Jones, 2010; Lange et al., 2015; Türksever and Atalik, 2001; Zenker et al., 2013). Entrepreneurs undoubtedly are part of the economic systems of urban areas. However, economic urban sustainability is more specifically about the ability of citizens to fit in and be in balanced with the economic systems of cities. In that line, entrepreneurial activities might have a strong impact on citizens' options to thrive because entrepreneurs might engender new ideas which, in turn, might positively impact the city economic life. For instance, new ventures might trigger new economic activities (Decker et al., 2014) which, hence, might enhance citizens' accessibility to job opportunities and, in turn, help citizens to progress economically. Our literature review revealed that authors have addressed the effects of entrepreneurs on three specific dimensions of economic urban sustainability: infrastructure, land management and job market.

First, one important feature of economic urban sustainability is the urban infrastructure (Jenks and Jones, 2010). In that line, entrepreneurs' activities might contribute to develop new **infrastructures** for new living and workplaces (Woolthuis et al., 2013) or to create a better physical urban background through improving the built environment (Lee, 2018). On the one hand, Woolthuis et al. (2013) analyze three initiatives related to building, neighborhoods and business park initiatives applying innovative ideas related to compactness or circularity. On the other hand, Lee (2018) explores the process of gentrification from the different actors' perspectives highlighting the outcomes related to the improvements of buildings and housing conditions. In that context, citizens daily lives activities might be hold by higher-quality infrastructures. Thus, entrepreneurs might help citizens to have greater levels of economic urban sustainability.

Second, considering that economic urban sustainability is associated with the specific uses of the land (Lange et al., 2015), entrepreneurial initiatives might influence **land management** because of strengthening local estate prices or reactivating local resources or places (Di Marino et al., 2018; Light, 2002; Nakamura, 2019; Scaffidi, 2019) that might, in turn, provide citizens places where to thrive and progress or even where to upgrade in status or society. Di Marino et al., (2018) analyze how entrepreneurial initiatives related to multi-locality initiatives might create new flexible and attractive sites that might attract mobile workers. Furthermore, Light (2002) addressed the immigration phenomena to Los Angeles where already based Asiatic immigrants promoted neighborhoods for upscale ethnic minorities and marketed them in China and Korea to attract new higher-status immigrants. In addition, Nakamura (2019) examines how entrepreneurial activities might influence the variations in land prices depending on regional activities which might foster the creation of new companies. Also, Scaffidi (2019) analyzes how specific initiatives address weakened areas looking for reactivation of disused sites and local development.

Furthermore, entrepreneurial activities not only entail the creation of general **job opportunities** (Crath, 2017; Eraydin et al., 2010; Light, 2002; Nakamura, 2019; Omholt, 2015) but also englobe initiatives for developing job options for minorities such as workers of very specific sectors (Omholt, 2015), unemployed young and marginalised populations (Crath, 2017), or immigrants (Eraydin et al., 2010; Light, 2002). Thus, entrepreneurship plays a critical role in the offer of job opportunities for as many types of urban inhabitants as possible which, in turn, might lead to higher levels of economic urban sustainability as they might be able to thrive and progress economically.

These entrepreneurial activities based on developing urban infrastructures, optimizing land management, or increasing job opportunities might contribute to enhance the possibilities of economic progress and economic equalities among city dwellers, and then, have a positive impact on city livability. Hence, those citizens might have the opportunity to live and work in cities with better infrastructures, with beneficial land management systems, and with suitable job opportunities which might lead them to experiment higher economic urban sustainability.

However, scholars have also found a controversial outcome from entrepreneurial activities that might have some negative impacts on the land management aspect of economic urban sustainability. Allocation of new businesses on a neighborhood, the consequently gentrification and its subsequent economic boost are likely to limit people with less resources who might have to move away from those improved areas to places where the land or rental is more economical (Lee, 2018; Nakamura, 2019). Therefore, land management might also contribute to increase the economic inequality gap among citizens, which threatens city livability. In the same line, the improvement of the physical background and the optimization of land management might entail the creation of jobs for which a higher education is required and people with less resources might find more difficult to opt for them. Thus, economic urban sustainability and city livability might be threatened as well.

3.2. Entrepreneurs' impact on environmental urban sustainability

Applying Goodland's (1995) definition of environmental sustainability to urban areas, a city might be environmentally sustainable when its natural capital is well preserved and incorporated into the routine life of the area (Tanguay et al., 2010). In that line, well-maintained natural resources might imply valuable green areas (e.g, parks), good air quality, acceptable noise levels, acceptable standards of cleanliness, non-pollutant transport and energy systems, and effective waste management systems (Jenks and Jones, 2010; Krekel et al., 2016; Maller et al., 2012; Türksever and Atalik, 2001; Węziak-Białowolska, 2016; Zenker et al., 2013). Entrepreneurs are likely to contribute to the environmental urban sustainability through new technologies, innovations, solutions for current problems, or new business models fostering the preservation and creation of new urban natural ecosystems (Dean and McMullen, 2007). For instance, the implementation of green roofs in buildings might entail the maintenance of the natural urban ecosystem (Kim et al., 2018) because they might involve better runoff water and air quality, cleanliness, and lower levels of pollution. In this context, we found that scholars have studied the influence of entrepreneurs' initiatives on environmental urban sustainability focusing on two issues/facets of environmental urban sustainability: air pollution reduction and solar energy systems.

First, we found studies including initiatives aiming to tackle **air pollution** issues through technology innovation within extant transport means by designing less polluting devices (Hudnut and DeTienne, 2010) or through teleworking alternatives (Di Marino et al., 2018). Specifically, Hudnut and DeTienne (2010) examine an initiative of the design of a kit for motorcycles with the aim of reducing their emissions and Di Marino et al., (2018) analyze urban teleworking programs – such as working from home, cafeterias and coworking spaces – which might also favor the reduction of air polluting emissions.

Second, we found an article analyzing **green entrepreneurs' activities** related to technology development implementing renewable energy resources such as solar water heater systems (Yu and Gibbs, 2019). They argue that these innovations might lead not only to increased competitiveness but also to empower the city appeal by showing a green image and attracting green investment. In addition, those systems might reduce the need of consuming energy from non-renewable resources and, thus, enhance environmental urban sustainability. Thus, the reduction of the air pollution (Martínez-Bravo and Martínez-del-Río, 2019) and the implementation of systems fed by renewable resources (Tanguay et al., 2010) might contribute to environmental urban sustainability (Martínez-Bravo et al., 2019).

Third, we observed that one article included the **nature integration** within neighborhoods (Woolthius et al., 2013). They analyze three distinct scenarios where urban initiatives were implemented among which they examine a case of smart development with nature. The initiative, started and managed by a citizen, involved urban development around permaculture gardens, ecological buildings for workplaces, a biological farm, and a center where to learn, get information and advice related to the projects. In that context, entrepreneurs' initiatives might promote the integration of the natural capital within the citizens' daily lives and, hence, might enhance environmental urban sustainability (Tanguay et al., 2010).

3.3. Entrepreneurs' impact on social urban sustainability

Social urban sustainability stands as a city's ability to provide its citizens specific long-term options of education, participation, culture, safety, inclusion, sense of community, social cohesion, equitable walkability, equitable accessibility to buildings and services,

interaction and social development (Dempsey et al., 2011; Martos et al., 2016; Martínez-Bravo et al., 2019; Shafer et al., 2000). Thus, a socially sustainable city might allow the whole group of its citizens to feel well-educated, integrated, part of the community, safe and that they have unbiased access to products or services to cover their needs. Entrepreneurs are embedded within the society and, accordingly, their actions might have an impact on the society (Lubberink et al., 2018). Also, entrepreneurial initiatives are more likely to involve social change at community-level instead than at organizational-level as social impact might be extended beyond organizations (Lumpkin et al., 2018). Thus, entrepreneurship is highly likely to impact social urban sustainability features (Slawinski et al., 2019). Our literature review revealed the existence of research addressing the impact of entrepreneurs on several aspects of social urban sustainability: social inclusion, culture, and social development.

First, one of the main aims of social urban sustainability is to be socially and racially inclusive (e.g., Dempsey et al., 2011). We found several works that addressed how entrepreneurs can positively foster social and racial **inclusion**. For instance, some entrepreneurs' initiatives include the promotion of specific age-group inclusion initiatives – such as opportunities for the youth – linked to the reactivation of the local background (Crath, 2017; Scaffidi, 2019). In addition, entrepreneurs' activities might boost the integration or inclusion of minorities because of the creation of employment for immigrants or for workers in very specific sectors (Eraydin et al., 2010; Light, 2002; Omholt, 2015). Also, entrepreneurs might contribute to make a city more inclusive when they promote the accessibility for all to innovative systems (Huang et al., 2018) which may make life easier for all – especially for those with less resources.

Second, social entrepreneurs are likely to favor social urban sustainability through initiatives related to **culture** development or creation such as the reactivation of abandoned places through cultural activities implementation (Kim, 2016; Salone et al., 2017) or the promotion of less popular practices or activities (Omholt, 2015). In that line, social urban sustainability might be influenced by entrepreneurs through general cultural activities (Kim, 2016; Salone et al., 2017) or through cultural initiatives in specific fields (Omholt, 2015).

Third, scholars have also gathered how entrepreneurs might enhance the **social development** of communities. The physical improvement that some entrepreneurs' initiatives involve (Fairbanks, 2011) might also lead citizens to hold better perceptions of the place where they live and might allow them to, for example, feel higher status (e.g., Lee, 2018). Furthermore, the improvement of employment conditions (Di Marino et al., 2018) might make dwellers consider that they are better-recognized workers and that they are able to have a better work-life balance. Thus, entrepreneurs are likely to positively impact social urban sustainability through inclusion, culture or social development initiatives which might lead, in turn, to higher city livability.

4. Critical assessment of existing research

Even if we observed that scholars have begun to explore how entrepreneurs purposefully and positively impact urban sustainability features, we observed that the existing research is still unstructured and there is still potential to be developed. Overall, we found that a) works analyzing entrepreneurs' impact on urban sustainability are scarce and considerably recent, b) researchers have been more likely to address how entrepreneurs impact the social dimension of urban sustainability, and c) the topic has been barely studied within the general management, entrepreneurship, environmental/sustainability, and ethics management journals, being most of the articles published in regional studies journals.

The main particular aspects that have already been addressed are land management, employment accessibility in terms of economic urban sustainability; air pollution reduction, solar energy systems, nature integration in relation with environmental urban sustainability; and social inclusion or integration, culture and social development concerning social urban sustainability. Specifically, we observed a lack of works addressing some specific features of each urban sustainability dimension. For instance, no works addressed key economic urban sustainability aspects such as the dwelling affordability, the cost of living or economic equality. Concerning environmental urban sustainability, the articles only addressed air pollution and specific solar energy systems but did not include the rest of pollution sources, other renewable energy sources initiatives, the natural capital, the cleanliness of the city or environment-friendly transport systems. Works including entrepreneurs' effects on social urban sustainability are more

diverse but still do not address some essential social sustainability issues such as education, safety, equitable walkability, equitable accessibility to buildings or interaction.

Observing the consequences of sustainable entrepreneurial actions that each article analyzes we concluded several main points. First, city livability is confirmed to be an obvious outcome of initiatives promoting sustainability, more specifically of sustainable entrepreneurship initiatives, in several works that we found (Campin et al., 2013; Cohen and Muñoz, 2015; Di Marino et al., 2018; Eraydin et al., 2010; Huang et al., 2018; Lee, 2018; Lumpkin et al., 2018; Muñoz and Cohen, 2015; Sarracino and Fumarco, 2020; Scaffidi, 2019; Shrivastava and Kennelly, 2013). In other words, it seems a good dependent variable for future studies in the field. On the one hand, there are works which mainly focus on the effects that entrepreneurship has on the wellbeing or livability of the communities through micro-businesses responsible behavior (Campin et al., 2013) or through social enterprises (Sarracino and Fumarco, 2020). On the other hand, we found articles that address not only the effects of entrepreneurs on the wellbeing or livability levels, but also on one or several dimensions of urban sustainability (Di Marino et al., 2018; Eraydin et al., 2010; Huang et al., 2018; Lee, 2018; Scaffidi, 2019). For illustration, Di Marino et al. (2018) studied the effect of entrepreneurial actions, such as teleworking initiatives, which might lessen air pollution emissions and, thus enhance environmental urban sustainability while making easier for workers to have a greater work-life balance and, thus, greater city livability perceptions.

Second, measuring overall sustainability improvement based on the effect of just one factor is very challenging. For instance, one might expect that cultural initiatives in certain neighborhoods foster the integration of citizens (Salone et al., 2017) with specific cultural tastes. However, citizens who have no cultural background or interests might not feel a stronger sense of community if cultural initiatives are implemented. Thus, entrepreneurs' cultural initiatives aiming at increasing the integration of citizens might have other negative effects on the sense of community of other citizens. In this case, the consequences of entrepreneurial action on social urban sustainability features might be conflicting. Previous research on urban sustainability states that improving certain aspects of a dimension of the city's sustainability is highly likely to affect as well other aspects or even city livability levels (Martínez-Bravo et al., 2019).

Furthermore, there are very few studies (but see Lee, 2018; Nakamura, 2019) explicitly addressing the negative consequences or trade-offs that urban entrepreneurship might suppose for urban sustainability. For instance, entrepreneurial initiatives might favor gentrification (Nakamura, 2019) which might be detrimental for already established citizens due to a possible increase in prices that might difficult them to follow their standards of life and they could see themselves obliged to move from their neighborhoods. However, some scholars state that citizens might not have any inconvenient to move (Lee, 2018) if they get an economic compensation that might allow them to thrive and live better elsewhere. Thus, there exists, again, a variety of trade-offs behind the implementation of entrepreneurs' initiatives.

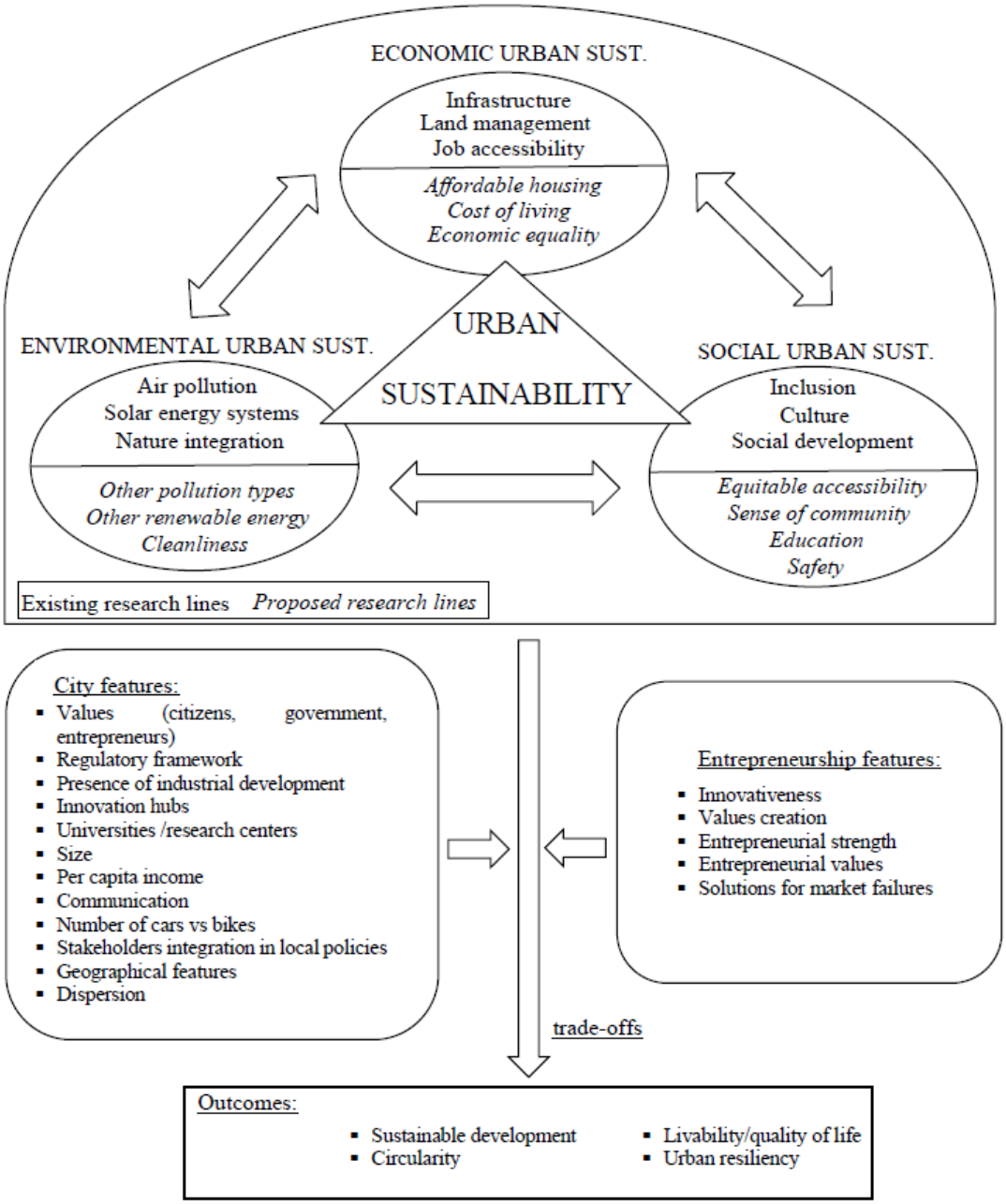
Third, even if there is a growing tendency of publication in the topic and a diversity of articles analyze the influences of the local background or urban factors on entrepreneurial behaviors (213 of our initial sample of 326 articles), the number of published works that analyze sustainable entrepreneurs' effects on urban sustainability remains still low. In addition, regarding the regional scope of the works, most of them carry out single-city or single-country analysis (e.g., Salone et al., 2017). Thus, even if the works might be based on recent literature or empirical evidence, their contributions might be conditioned by specificities of place (Slawinski et al., 2019; Zeemering, 2009). Also, focusing on the specific innovation that entrepreneurs deploy within their activities, we have observed that the works mainly include technology or product innovations. Hence, they scarcely include innovative initiatives to explicitly address harmful behaviors from governments, citizens or companies that might be imperative to tackle.

5. Future research agenda

In Figure 8, we depict the urban sustainability dimensions that have been influenced by sustainable entrepreneurs and researchers have already addressed and some examples of those that have not been analyzed by scholars yet. As shown in the figure, entrepreneurship literature still has enormous potential to develop for capturing the transition towards urban sustainability. In the figure, we illustrate the relevant relationships among the three urban sustainability dimensions as well as the influences and trade-offs that city and entrepreneurship features may exert in the outcomes of entrepreneurial initiatives tackling urban sustainability. Also, we depict the influence that

cities' features and entrepreneurship features might have on the outcomes of entrepreneurs' effects on urban sustainability dimensions. In other words, the consequences of the initiatives that sustainable entrepreneurs carry out might be shaped by the specificities of the context where they operate.

Figure 8. Extant and proposed research lines on sustainable entrepreneurship effects on urban sustainability



Hereafter, we suggest and discuss several further research horizons. First, future research might need to be comprehensive in order to analyze entrepreneurs' effects on the aspects

that have not been studied by scholars yet. Second, we suggest that the fact of analyzing at a time entrepreneurs' effect on several aspects of the same dimension or even on several dimension might be even more enriching and insightful than studying a single one. Indeed, we found some works that explicitly explained entrepreneurs' actions effect on one dimension whereas the actions might impact several dimensions (e.g., Salone et al., 2017). For instance, Kim (2016) analyzed entrepreneurs' cultural regeneration initiatives in old neighborhoods and their effect on social urban sustainability aspects. However, those initiatives might likely also entail greater employment opportunities or even increased economic equality which might mean higher economic urban sustainability levels too. Thus, the outcomes of the works which include sustainable entrepreneurs' impact on a single urban sustainability dimension might have further potential contributions which might, in turn, develop more profoundly the literature on the field. In the same line, we argue that scholars might further contribute to the literature by analyzing potential larger and negative consequences of the initiatives that they are studying and that the improvement of a specific dimension and its consequences might need to be carefully studied because it might also have unforeseen impacts. In addition, it might be beneficial for research if scholars studying sustainable entrepreneurs' initiatives at city-level additionally analyze potential consequences on city livability as it has been signaled as an obvious outcome of urban sustainability (Martínez-Bravo et al., 2019).

Furthermore, and linked with the previous point, scholars could hold a more general approach in order to consider the multi-dimensional nature of sustainability (Valcárcel-Aguiar and Murias, 2019) which might further contribute to urban action. Thus, instead of only addressing entrepreneurs' actions effects from specific viewpoints, a general management perspective could give stronger insights for decision and policy makers. In addition, a more general approach might favor the publications in more general journals such as general entrepreneurship and general management journals. Last, we have observed that some authors confirm the relevance of being a sustainable and a livable city in order to attract people and prosperity (Eraydin et al., 2010; Light, 2002). We suggest that scholars might specifically highlight and give relevance to the consequences that entrepreneurial actions exert on city competitiveness as it might be a great way of attracting people and investment and, in addition, it might be useful for decision and policymaking too.

6. Contributions

Research on the link among sustainable entrepreneurship and urban sustainability, especially on entrepreneurs' impact on sustainability, is still in its infancy and it is our hope that this literature review provides guidance for scholars, policymakers, and entrepreneurs in the transition towards more sustainable cities. Through this paper, we link the literature on sustainable entrepreneurship and the literature on urban sustainability because both literatures might have had occasionally approached the topic of entrepreneurs' impact on urban sustainability, but they do not talk to each other. Doing so, we aim to provide with a better understanding on how entrepreneurs can contribute to a sustainable development at the city-level. We aim to stimulate scholarly thought while providing useful knowledge for policymakers and entrepreneurs on the consequences of entrepreneurial initiatives on urban sustainability.

Specifically, the research contribution of our work is threefold. First, the study contributes not only to the literature on urban sustainability but also to the literature on sustainable entrepreneurship because it provides an integrative and comprehensive overview of the extant knowledge on whether and how entrepreneurs might influence urban sustainability and points out entrepreneurs as key elements in the transition towards more sustainable and livable cities. Indeed, this study reveals the disconnection of existing studies on the effects of entrepreneurs on urban sustainability because we detected that the works published were dispersed in journals of multiple fields and because we observed terminology inconsistency (e.g., purpose-driven urban entrepreneurship, urban-focused entrepreneurial action, or urban entrepreneurship). Thus, extant research falls short to integrate and combine existing knowledge on the connection among sustainable entrepreneurship and urban sustainability as previous works do not build upon conversations among them which, in turn, hinders the advancement of the current state of the art. In consequence, this literature review supposes a very important step for establishing conversations among sustainable entrepreneurship and urban sustainability literatures and for advancing the knowledge in both fields.

Second, this work might be one of the firsts integrating the existing research on sustainable entrepreneurs' effects on sustainability at the city-level and focusing on the overall explicit consequences that entrepreneurs might suppose on urban sustainability.

Even if the collective action of new ventures has been suggested to affect cities (Berrone et al., 2016), the literature on sustainable entrepreneurship has mainly focused on how local backgrounds and urban factors affect the emergence of entrepreneurs and new ventures (e.g., Amezcua et al., 2020; Vedula and Kim, 2018). Previous literature has identified sustainable entrepreneurs as the solution for environmental and social sustainability issues and, indeed, scholars point entrepreneurs as one of the strongest forces that can address sustainability grand challenges. Given that cities are recognized as the level where sustainability goals might be achieved, it seems logical and necessary to know how sustainable entrepreneurs interact with urban factors and how they impact urban sustainability dimensions.

Third, the majority of the works focus on sustainable entrepreneurs' implementation of single practices or technologies addressing just one of the urban sustainability dimensions (e.g., Huang et al., 2018). Previous research states that improving a specific dimension of urban sustainability is highly likely to influence other urban sustainability dimensions (e.g., Martínez-Bravo et al., 2019). Thus, this literature review confirms that a holistic perspective might be needed when examining the complex contexts of cities in order to identify larger consequences of the implemented initiatives. Overall, this literature review contributes to address the three aforementioned research gaps.

Fourth, and concerning the contributions of this work for policymaking, the outcomes of the literature review point out that entrepreneurs could complement the efforts from policymakers for achieving more sustainable and livable cities. Thus, the literature review confirms that it might be relevant for decisionmakers to hold a comprehensive overview of sustainable entrepreneurs' effects when planning urban strategies.

7. Final remarks

Our work is, to the best of our knowledge, one of the firsts that explores the extent to which scholars have, until the date, analyzed the way sustainable entrepreneurs influence urban sustainability. Specifically, we develop an integrative framework that connects existing articles at the intersection of entrepreneurship and urban sustainability. After a literature analysis of existing articles on the topic in general management, entrepreneurship, environmental/sustainability, ethics management, and regional studies

leading journals, we examined 326 articles and retained 22 that specifically focus on the impact of sustainable entrepreneurs on urban sustainability. We suggest that there are still many opportunities for research on how sustainable entrepreneurship impacts urban sustainability levels. Specifically, we expose certain aspects of the three urban sustainability dimensions that have not been addressed yet and the lack of studies on the interconnections between different but related urban factors.

This article highlights the importance of establishing conversations between sustainable entrepreneurship and urban sustainability literatures as a way to increase our knowledge on how sustainability challenges can be overcome. Overall, we consider that this article contributes to the sustainable entrepreneurship and urban sustainability literatures by providing with a theoretical framework that integrates knowledge from both literatures and by helping to discover how sustainable entrepreneurs can help in the transition of our cities towards urban sustainability, how they can navigate through urban dynamics, which kind of positive or negative impacts they might cause, and through which mechanisms or potential trade-offs and synergies.

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Chapter 6: Conclusions

Chapter 6: Conclusions

Urban sustainability is facing great challenges due to the unprecedent population growth that humanity is staring in. In that scenario, researchers started to explore the causes and solutions for sustainability and livability issues in the 1990s and the 1980s respectively (Bibri and Krogstie, 2017; Parker and Simpson, 2018). However, the literature addressing cities as cause of or solution for sustainability issues emerged later and the studies presented some limitations such as single-city analysis or theoretical developments with no empirical support and more grained in a descriptive nature (Ellis and Roberts, 2015; Gorissen et al., 2018; Jenks and Jones, 2010; Valcárcel-Aguiar and Murias, 2019; Węziak-Białowolska, 2016). Indeed, it has been problematic even to provide concise, formal, and worldwide accepted definitions for urban sustainability (Tanguay et al., 2010) and for city livability (Ruth and Franklin, 2014).

In that context, this dissertation aims to theoretically and empirically analyze urban dynamics in order to give guidance for researchers and policymakers in the transition towards more sustainable and livable cities. More specifically, this doctoral dissertation examines the interrelations among the three dimensions of urban sustainability, urban pollution, institutional factors, sustainable entrepreneurship, and city livability. With that objective, this doctoral dissertation is built upon the development of theoretical and empirical research. The main goal of this thesis project was expected to be achieved by developing the literature on urban sustainability to better understand the antecedents and roots of urban sustainability and city livability. In that line, the first work of the thesis aimed to state the relevance and give an overview of pollution issues as well as an agenda for action to face them. The second work pursued to explore and analyze the interconnections among urban pollution, the three dimensions of urban sustainability, and city livability in European cities. The third subobjective was to theoretically and longitudinally explore the role of the institutional environment on the relationship among urban sustainability and city livability also in European cities and adopting a long-term perspective. Finally, the fourth work aimed to theoretically examine the mechanisms through which sustainable entrepreneurship can enhance urban sustainability and city livability by conducting a systematic literature review on the topic.

Hereafter, this chapter presents the findings, conclusions, and contributions attained throughout the thesis dissertation development with respects to the mentioned main objective and several subobjectives. With that aim, the next section presents the research implications of each chapter as well as an overview of the general research implications. Second, the practical implications for policymakers and entrepreneurs are exposed. Afterwards, the chapter presents the limitations of the dissertation as well as further research avenues to, finally, end with some final remarks.

1. Research implications

1.1. Research implications of the second chapter

Chapter 2 contributes to develop the literature on urban sustainability by putting together the most relevant information on urban pollution that was, until the date, somehow disconnected. The chapter first groups the most harmful types of pollution in cities, their main sources and the reasons why each of them might entail detrimental effects within urban areas. Afterwards, it lists the already established limits for each of the pollution types and the negative consequences that surpassing those limits might entail. In addition, the chapter put together not only how different key actors in society (governments, entrepreneurs, large companies, and citizens) might have the opportunity to make a difference in those urban challenging contexts, but also a plan for action combining a variety of initiatives that could be implemented in order to achieve that goal. Thus, chapter 2 extends existing literature on urban sustainability.

1.2. Research implication of the third chapter

The findings that arise from chapter 3 contribute to existing research in several ways. First, in terms of the complex interconnections among the three dimensions of urban sustainability, urban pollution, and city livability, the outcomes of the chapter confirm the relevance of holding a multi-dimensional perspective and a holistic approach for effective urban action looking for the improvement of city livability (Bibri and Krogstie, 2017; Elmqvist et al., 2018; Jenks and Jones, 2010; Koramaz and Türkoğlu, 2018; Marans, 2015; Runhaar et al., 2009; Tanguay et al., 2010; Valcárcel-Aguiar and Murias, 2019). Second, even if the concept has received limited attention to date (Ruth and Franklin, 2014), the third chapters places city livability in the spotlight and explore its

antecedents. The study suggests that city livability should be a main objective for researchers who aim to nurture the literature on urban sustainability. Extending research on city livability dynamics might be appealing for decision and policymakers as the perceptions of the urban background and the quality of living might influence vote patterns, migration movements, or even investments decisions (Delmas and Toffel, 2014; Ruth and Franklin, 2014; Pisani et al., 2019). Third, the article supposes one of the first works giving empirical support for theory development on the antecedents of city livability. Even if there exist already published works addressing the topic of city livability, the majority of them are theoretical (e.g., Marans, 2015) or address single-country or single-city studies (e.g., Macke et al., 2018) and, thus, there is a lack of theoretical developments with empirical support (Węziak-Białowolska, 2016) including diverse information that might allow certain degree of generalization.

1.3.Research implications of the fourth chapter

First, the study included in the fourth chapter of this doctoral dissertation contributes to the literature on urban sustainability in several manners because it combines the literature on urban sustainability with institutional literature insights and, thus, it develops the extant knowledge on the link among urban sustainability and city livability (Macke et al., 2018; Marans, 2015; Martínez-Bravo et al., 2019; Ruth and Franklin, 2014) with an empirical confirmation of the positive impact of the three dimensions of urban sustainability on city livability and the confirmation of the causality in those relationships. Second, the work reveals the importance that institutional factors might entail in those relationships. An outcome particularly outstanding is the argument that high presence of certain institutional pressures might foster the relationship among environmental and, even more pronouncedly, social urban sustainability and city livability. This might be likely due to the stronger link of the idea of quality of living with environmental and social concerns once the basic needs, and economic necessities, are covered (Zeemering, 2009).

Moreover, in relation with the contributions on institutional research insights, the study argues that management decisions in cities might be shaped by institutional factors as scholars suggest for organizations that managerial decisions are strongly influenced by institutional pressures (Delmas and Toffel, 2004; DiMaggio and Powell, 1983). In line

with previous research which states that institutional factors might condition what behaviors are appropriate and meaningful (Zucker, 1977), the chapter suggests that institutional factors might also define what behaviors are appropriate and meaningful in terms of sustainability and livability in cities. Thus, building upon the role of institutional factors shaping interaction and adaptation opportunities in organizational environments (Scott, 1987), the fourth chapter of the dissertation argues that specific defined behaviors in cities might impact opportunities in terms of interaction and adaptation in the transition towards more sustainable and livable cities. Consequently, building upon extant research on organizational environments highlighting that institutional factors might shape social rules in ambiguous contexts (Delmas and Toffel, 2004; DiMaggio and Powell, 1983), the outcomes of the work suggest that institutional factors might shape social behaviors in ambiguous urban contexts too.

1.4. Research implications of the fifth chapter

The study included in the fifth chapter of this doctoral dissertation is a systematic literature review that contributes to the literature on urban sustainability mainly because it supposes an analysis of extant published research on the impact of sustainable entrepreneurship on urban sustainability that might serve as a guide for scholars to advance the knowledge on the topic. The work identifies the outcomes of sustainable entrepreneurship that research has already observed (e.g., land management or social inclusion) and those aspects that have not been analyzed by scholars yet (e.g., dwelling affordability or the cleanliness of the city). In addition, the work identifies not only the challenge of measuring a general improvement based on an analysis of entrepreneurs' influence on a single dimension, but also remarks the high interrelatedness among dimensions.

Moreover, the systematic literature review's findings show that there are few studies addressing the negative, and frequently unforeseen, consequences that sustainable entrepreneurship might suppose for the urban environment. Besides, the study reveals several works pointing out city livability as an obvious consequence of sustainability. In other words, the study signals city livability as a good dependent variable for future studies in the field. Also, the systematic literature review exposes that, despite the growing recent tendency of publication in the topic, the number of published works and

the aspects and regional scope of the studies remain still limited. Thus, existing works allow limited generalization due to the number of outcomes and the specificities that the single countries or cities analyzed might hold (Slawinski et al., 2019; Zeemering, 2009).

Furthermore, the literature review reveals the disconnection of existing studies on the effects of entrepreneurs on urban sustainability and that extant research falls short in the integration of knowledge from both fields which might, in turn, difficult the advancement of the state of the art due to a lack of conversations among previous works. Finally, the chapter might be useful for the literature on urban sustainability because it offers a research agenda for scholars that might aim to capture entrepreneurs' efforts in the transition towards more sustainable and livable cities.

1.5. Overall research implications

In general terms, this doctoral dissertation extends the literature on urban sustainability by theoretically and empirically examining relevant urban factors such as urban pollution, urban sustainability dimensions, institutional factors, and sustainable entrepreneurship. These factors have been suggested by previous research as important elements to predict city livability, but they have not been observed together until the date. A common research implication that the dissertation supposes for academics is the finding of the scarcity of published research addressing interconnections, synergies, or trade-offs in the urban fields that were analyzed. In this context, this doctoral dissertation places sustainability issues as multifaceted problems and offers holistic approaches to solve those problems for an integrated perspective (Elmqvist et al., 2018; Runhaar et al., 2009; Zhang et al., 2018). In addition, as most of the previous works in the field are not empirically supported (Węziak-Białowolska, 2016), or rely on single-city or single-country analysis (e.g., Affolderbach and Schulz, 2017), this doctoral dissertation advances the literature on urban sustainability by providing theoretical developments with empirical support including information for a variety of cities which, in turn, might allow certain degree of generalization of the outcomes. Furthermore, this doctoral dissertation includes longitudinal explorations of the urban dynamics which supposes the consideration of time factors which are rarely included in urban studies (Bornemann and Strassheim, 2019) even if it has been highlighted the relevance of time effects on sustainability performance (e.g., Ortiz-de-Mandojana and Bansal, 2016). Finally, this

doctoral dissertation extends the literature on urban sustainability because it draws on institutional and entrepreneurship literatures insights to enlighten urban dynamics and to show a feasible path in the transition towards more sustainable and livable cities.

2. Practical implications

The outcomes of the studies that constitute this doctoral dissertation might be useful for a diversity of practitioners as the findings might give guidance for a) tackling urban pollution issues, b) addressing urban pollution and urban sustainability when looking for the improvement of city livability, c) addressing institutional factors that might influence urban sustainability to improve city livability, and d) considering sustainable entrepreneurship to reach urban sustainability and city livability. Below, the thesis practical implications are exposed differentiating their usefulness for policymakers and entrepreneurs.

2.1. Practical implications for decision and policymakers

The outcomes of each of the chapters of this dissertation have different practical implications for urban decision and policymakers. Specifically, chapter 2 provides first information about the most harmful pollution issues for people and the environment, stating why each of them are relevant and explaining the already established limits for human health and wellbeing. Second, the chapter sheds light on how governments and decisionmakers might face those pollution issues by highlighting the potential of collaborative public management. Finally, the chapter offers a plan for action depending on the pollution source to be addressed.

Chapter 3 offers theoretical and practical knowledge for decision and policymakers in a matter of city livability dynamics and antecedents. As it involves the confirmation of trade-offs among the three dimensions of urban sustainability, pollution, and livability, decision and policymakers should ensure that the available economic resources are efficiently translated into environmental and social initiatives in order to influence city livability levels in a greater way compensating the negative effects that might arise from the economic activities. In addition, it might be relevant to evaluate the potential unexpected consequences that some initiatives might suppose as they might impact city livability but could indeed suppose an unexpected effect through other dimensions. For

instance, urban pollution was proven to have a negative effect on city livability but, at the same time, high levels of environmental and social urban sustainability levels could indeed mitigate that negative effect. Thus, the chapter highlights again the relevance of holding a holistic approach when addressing urban dynamics in terms of sustainability and livability issues.

The findings of chapter 4 also provide relevant information for policy and decision-making. First, the outcomes empirically confirm the causality of the positive effect of the three dimensions of urban sustainability on city livability. Second, chapter 4 suggests that environmental urban sustainability is somewhat moderated by the analyzed institutional factors and social urban sustainability fully moderated by them. Thus, it concludes that institutional factors (more specifically regulatory institutions and citizens' pressures) might be able to foster the impact of the three dimensions of urban sustainability on city livability and, especially, of environmental and social urban sustainability on city livability. Hence, decision and policymakers aiming to provoke a stronger impact of environmental and social urban sustainability on city livability might benefit from addressing the soundness of the institutional environment.

In terms of chapter 5 conclusions, it might be relevant for decision and policymakers to retain that the effect that sustainable entrepreneurs might cause on urban sustainability and city livability is generally positive. Thus, chapter 5 might be useful for them because it states the relevance of holding a comprehensive perspective when developing urban strategies. Policymakers might develop their programs and make decisions with the idea of facilitating urban entrepreneurial activities that include potential solutions for urban sustainability and city livability issues while not forgetting that some negative, and usually unforeseen, outcomes may arise and impact other dimensions that the dimensions expected to be addressed. In that line, sustainable entrepreneurs could complement policymakers' efforts for achieving more sustainable and livable cities.

Overall, the outcomes of each of the chapters that form this dissertation might suppose some general insights useful for decision and policymakers. First, the majority of the findings reveals the great relevance for city livability of the interconnections among the three dimensions of urban sustainability, institutional factors, and sustainable entrepreneurship. Second, the institutional framework and the entrepreneurial activity in

cities might be useful to observe and address when looking for improving urban sustainability and city livability levels. Last, improvements in some of the domains that were studied in this doctoral dissertation might be beneficial for cities as it might generate a better perception of them and might attract citizens, workers, companies, or even foreign investments (Ruth and Franklin, 2014; Pisani et al., 2019). Consequently, decision and policymakers might need to hold holistic approaches when addressing urban dynamics in terms of urban sustainability and city livability issues and to consider a variety of urban factors such as urban pollution, institutional factors, or entrepreneurship impacts.

2.2. Practical implications for entrepreneurs

Some relevant implications for entrepreneurs are also derived from this dissertation. In terms of chapter 2 outcomes, environmental and social problems represent nowadays a window of opportunity for entrepreneurs. It might be relevant not only for improving the background where their activities take place but also as the identification of market failures that entrepreneurs could address and take advantage of. In that line, entrepreneurs might have the opportunity to be agents of change in the reduction of urban pollution levels and, thus, in the transition towards sustainability of the urban areas where they operate.

Second, entrepreneurs looking for suitable cities where to locate their businesses might benefit from the outcomes of chapter 3 and 4. For instance, if they seek for backgrounds where their employees might be able to thrive and to have a good quality of living or if they search for healthy places with robust economies, it might be useful for them to observe urban sustainability programs, pollution levels, or the soundness of the institutional framework within the city. Furthermore, and in line with the implications of chapter 2, entrepreneurs might have the capacity to revert the negative consequences of urban behaviors and dynamics on city livability by focusing on practices aimed at improving environmental and social urban sustainability.

Third, related to the outcomes of chapter 5 and probably the most relevant point for entrepreneurs, if they seek to make cities more sustainable and livable, they should not underestimate the unintended consequences of their actions. For instance, social sustainable entrepreneurship might improve city's inclusion or social development but,

in turn, it might be needed to analyze if social developments might make the housing less affordable because of place revaluation and the consequent price increases (Kim, 2016). Thus, entrepreneurs might need to hold a comprehensive approach when looking for positive outcomes in the sustainability and livability levels of communities. Overall, the practical implications that the outcomes of the doctoral dissertation might suppose for entrepreneurs are especially related to the great opportunity that they have in terms of improving cities. Indeed, the findings of all the chapters of the dissertation state that, in one way or another, entrepreneurs might be key in the transition towards sustainable and livable cities.

3. Limitations and future research horizons

3.1. Limitations

Even if this dissertation advances the knowledge on the fields and literatures previously mentioned, it might need to be interpreted through the lenses of several limitations. The outcomes of chapter 2 might advance the knowledge on the management of current urban issues and might be useful for the different actors aiming to fight against urban pollution. However, the findings also entail some shortcomings and, probably, the biggest one is related to specificities of place that might difficult the management of place-based tensions (Slawinski et al., 2019; Zeemering, 2009). For instance, a city implementing greater public transport offer might be successful if citizens are aware of pollution consequences and if the designers of the transport systems manage them appropriately. Thus, the success of the initiatives addressing air pollution reduction might rely on place factors such as citizens awareness or the efficiency of public transport systems. Indeed, urban pollution issues are mainly address from general perspectives that impede the consideration of place-based specificities that might condition the success of urban pollution management initiatives. However, it would be not possible to tackle every single aspect of each specific urban area in a doctoral dissertation.

The findings that arise from chapter 3 might be useful for identifying the antecedents of livability in European cities as well as the current trade-offs that among the three dimensions of urban sustainability and urban pollution. However, this chapter involves limitations mainly related to the nature of the data. Even if the data features provide some basis for generalization due to the sample size, its multi-country and multi-city nature and

the combination of perceptual data and objective measures, the study has not a longitudinal design and, hence, it does not allow to obtain conclusions related to causality. In addition, the cities that were studied belong to the same continent and the relationships on other continents may vary depending on their degree of development.

The outcomes of chapter 4 might be interesting to analyze the influence of the institutional environment on the relationships among the three dimensions of urban sustainability and city livability. In this chapter, which is developed based on empirical evidence as well, the limitations are similar to those of chapter 3. However, chapter 4 does include a longitudinal dataset that allows to make conclusions related to the causality of the relationships. Nevertheless, there is an additional limitation related to the linear interpolation methods carried out for the obtention of missing data which, even if it is a usual technique, some variations might not be covered. Furthermore, even if the study considers two of the most important institutional variables, other institutional factors might also influence the relationships proposed.

The conclusion extracted from chapter 5 might be insightful as the chapter gives an overview of the extant research on the impact of entrepreneurial action on urban sustainability and proposes a research agenda on topics that have not been addressed by scholars for the moment. However, it also entails some limitations that might be mainly related to the research methods such as, for instance, the search of articles in a single database and journals from specific lists. Hence, even if the research method developed is robust and follows other articles guidelines in terms of systematic reviews, some journals or articles could have been not considered.

Overall, the general limitations of the present doctoral dissertation might be summed up as the somewhat limited generalization of the conclusions due to specificities of place (e.g., Slawinski et al., 2019; Zeemering, 2009), such as cities, countries, or continents, and the limited causality of the outcomes as well as some minor limitations related to specificities of some of the methods that were carried out.

3.2. Future research avenues

The outcomes of this doctoral dissertation open up some potential research lines that are presented hereafter. Chapter 2 outcomes and limitations suggest that the topic of urban pollution and emission reduction might still have potential to be developed. For instance, it might be interesting to dive into the specificities of places. Indeed, there might be higher pollution levels in cities with specific industries or factories. For instance, the water in cities with a high presence of textile industries might be associated with too high levels of the recommended parameters for domestic, agricultural, and industrial purposes water (Awomeso et al., 2010) due to the textile industries influence. In those specific cities, governments might need to innovate to reduce or avoid specific types of pollution. Thus, the main potential research line that arises from chapter 2 is studying pollution reduction in cities where specific industries prevail over others.

The outcomes of chapter 3 suggest that the interconnections among the three dimensions of urban sustainability, pollution and city livability are complex and include mediating effects. It confirms the relevance of adopting a multi-dimensional approach (Koramaz and Türkoğlu, 2018) while considering the potential trade-offs among the three dimensions of urban sustainability for effective action plans towards the improvement of citizens' well-being (Jenks and Jones, 2010; Tanguay et al., 2010). In that line, the potential research lines that chapter 3 suggests are more related to the consequences of applying sustainable initiatives. First, it might be interesting to analyze the evolution of the relationships over time to consider the component of causality what, somehow, the following chapter addresses. Second, it might be useful to observe if cities that are already taking into account the conclusions of the study are enhancing the positive variations in their sustainability, pollution, and city livability levels.

Chapter 4 contributes to develop extant research because it has not only a theoretical foundation but also an empirical basis (Kaal, 2011; Węziak-Białowolska, 2016), it addresses a literature gap through a multi-city and multi-country analysis (and not through a single-city or single-country study (e.g., Ellis and Roberts, 2015)), and it gives longitudinal support for precedent single-year research (Martínez-Bravo et al., 2019) while also considering institutional factors. However, it still lets place for other research avenues such as, for instance, analyzing the interactions in smaller cities instead of main cities or to observe the relationships in other regions or continents with other levels of development. Another possibility might be to observe institutional influences at other

levels such as the supranational one (which, in the case of Europe, might be related to the European continent). Also, future research could extent the model proposed in this chapter in order to consider other institutional factors that literature has developed.

Chapter 5 supposes different future research possibilities as well. First, the literature review reveals several aspects that scholars have not addressed yet regarding sustainable entrepreneurs' effects on certain urban sustainability issues. Specifically, the chapter indicates that the aspect that scholars have less frequently analyzed is environmental urban sustainability variations because of entrepreneurial activities. Also, the chapter suggests studying the consequences of entrepreneurs in the dimensions or aspects other than the initially analyzed due to the multi-dimensional nature of sustainability (Valcárcel-Aguiar and Murias, 2019). For instance, entrepreneurs' impact on the culture background (which is defined as a feature of social urban sustainability) might also generate employment opportunities or the revaluation of place (Kim, 2016) which respectively means positive and negative impacts on economic urban sustainability features. Hence, the chapter reveals the importance of holding a general approach when looking for the development of deep contributions.

Overall, this thesis dissertation states that more action towards urban sustainable development is needed in the transition towards more livable cities. Consequently, a potential future research line might be analyzing the motivators and barriers that cities, decision and policymakers face when considering the possibility of including sustainability measures in urban programs. Also, it might be interesting to study behaviors at the individual level (citizen-level) to explore how and to what extent citizens are aware and contribute towards sustainable and livable cities and, thus, it could be useful to create more specific programs for a) sustainability "experts" citizens who aim to further contribute to sustainable development or b) attract citizens who are less involved.

4. Final remarks

The motivation behind this doctoral dissertation is a concern for sustainable development in a situation in which natural resources are increasingly challenged and social value creation is limited. This research which dives into urban sustainability, urban pollution, institutional factors, sustainable entrepreneurship, and city livability is driven by a desire of addressing pressing current challenges in order to create a promising future. Specifically, this dissertation aims to contribute to the literature on urban sustainability due to the current relevance of urban sustainability and city livability issues. Overall, the outcomes derived from the studies presented in this dissertation show that cities present great potential and opportunities to advance towards sustainable development and demonstrate that, in order to allow "future generations to meet their own needs" (World Commission on Environment and Development, 1987), urban sustainability and city livability need to be in the spotlight today.

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Annexes

Annex 1. Robustness tests for the results of chapter 4

Table 9. Table with robustness tests details of chapter 4 results (Annex 1)

Variables/model	1			2		
	A	B	C	A	B	C
Ln urban population	-.28 (.29)	-.05 (.08)	-.02 (.03)	-.21 (.29)	-.06 (.09)	.01 (.03)
Ln city GDP	.01 (.02)	.01 (.02)	.00 (.02)	.01 (.02)	.02 (.02)	.01 (.01)
Ln city employment	.07 (.11)	-.02 (.07)	-.02 (.04)	.06 (.11)	.01 (.07)	-.02 (.03)
Age dependency ratio	-.01 (.01)	.00 (.01)	-.01 (.01)	-.01 (.01)	-.01 (.01)	-.01 (.00)
Ln cars	-.01 (.13)	-.05 (.10)	-.06 (.08)	.03 (.12)	-.03 (.10)	.00 (.07)
Ln environmental taxes	-.07 (.08)	-.11 (.08)		-.03 (.08)	-.05 (.07)	
Entrepreneurship rate	.01 (.01)	.01 (.01)		.00 (.01)	.00 (.01)	
Innovation rate	.00 (.00)	.00 (.00)		-.00 (.00)	-.00 (.00)	
Economic urban sust.	.21* (.08)	.32*** (.07)	.28*** (.06)			
Environmental urban sust.				.49** (.16)	.55*** (.12)	.55*** (.07)
Social urban sustainability						
Regulatory institutions						
Citizens' pressures						
Urban eco. sust. x reg. qual.						
Urban env. sust. x reg. qual.						
Urban soc. sust. x reg. qual.						
Urban eco. sust. x cit. pol. inf.						
Urban env. sust. x cit. pol. inf..						
Urban soc. sust. x cit. pol. inf.						
Constant	6.56 (4.95)	4.27*** (.97)	3.88 (.79)	4.89 (4.76)	3.35*** (1.05)	2.58*** (.69)
Observations	100	100	105	100	100	105
R^2	.06	.92	.49	.24	.89	.68
Variables/model		3			4	
	A	B	C	A	B	C
Ln urban population	.14 (.26)	.04 (.07)	.00 (02)	-.15 (.26)	.14 † (.08)	.02 (.02)
Ln city GDP	.02 (.01)	.03* (.02)	.02 (.01)	.01 (.01)	.01 (.01)	.01 (.01)
Ln city employment	-.02 (.09)	-.10 † (.06)	-.05 (.03)	-.22 † (11)	-.15* (.07)	-.04 (.03)
Age dependency ratio	.00 (.01)	.02** (.01)	-.00 (.00)	-.00 (.01)	.01 (.01)	-.00 (.00)
Ln cars	-.17 (.12)	-.24 (.09)	-.14* (.07)	-.21 † (.12)	-.17† (.09)	-.06 (.07)
Ln environmental taxes	-.09 (.07)	-.15* (.07)		-.06 (.07)	-.11 (.07)	
Entrepreneurship rate	.01 (.00)	.01 † (.00)		.00 (.00)	.00 (.00)	
Innovation rate	.00 (.00)	.00 (.00)		.00 (.00)	.00 (.00)	
Economic urban sust.				.52 (.43)	.38 (.38)	.32 (.36)
Environmental urban sust.				.30* (.15)	.23* (.11)	.28*** (.09)
Social urban sustainability	.34*** (.06)	.46*** (.06)	.44*** (.05)	.34*** (.09)	.37*** (.08)	.31*** (.07)
Regulatory institutions				.21 (.29)	.09 (.25)	.11 (.24)
Citizens' pressures				.26* (.12)	.29** (.11)	.19** (.08)
Urban eco. sust. x reg. qual.				-.11 (.12)	-.07 (.10)	-.07 (.09)
Urban env. sust. x reg. qual.						
Urban soc. sust. x reg. qual.						
Urban eco. sust. x cit. pol. inf.						
Urban env. sust. x cit. pol. inf..						

Urban soc. sust. x cit. pol. inf.						
Constant	6.05 (4.28)	4.21*** (.88)	3.40*** (.59)	6.26 (4.21)	1.21 (1.25)	1.19 (1.13)
Observations	100	100	105	100	100	105
R^2	.17	.93	.73	.34	.96	.75
Variables/model		5			6	
	A	B	C	A	B	C
Ln urban population	.03 (.26)	.14* (.06)	.02 (.02)	.10 (.24)	.15* (.07)	.01 (.02)
Ln city GDP	.01 (.01)	.01 (.01)	.01 (.01)	.00 (.01)	.01 (.01)	.01 (.01)
Ln city employment	-.21† (.11)	-.15** (.06)	-.04 (.03)	-.19† (.10)	-.17** (.06)	-.04 (.03)
Age dependency ratio	.00 (01)	.01* (.01)	-.00 (.00)	-.00 (.01)	.00 (.01)	-.01 (.00)
Ln cars	-.18 (.12)	-.14 (.09)	-.05 (.07)	-.20† (.11)	-.17† (.09)	-.04 (.06)
Ln environmental taxes	-.08 (.08)	-.13† (.07)		-.01 (.07)	-.06 (.06)	
Entrepreneurship rate	.00 (.00)	.01 (.00)		.00 (.00)	.00 (.00)	
Innovation rate	.00 (.00)	.00 (.00)		.00 (.00)	.00 (.00)	
Economic urban sust.	.13† (.07)	.16** (.06)	.06 (.05)	.09 (.07)	.13* (.06)	.04 (.05)
Environmental urban sust.	1.03* (.51)	.64 (.41)	.87* (.42)	.25† (.14)	.26* (.11)	.29*** (.08)
Social urban sustainability	.36*** (.08)	.41*** (.08)	.32*** (.07)	1.58*** (.42)	1.38*** (.39)	1.12** (.37)
Regulatory institutions	.49 (.37)	.28 (.31)	.39 (.31)	.99** (.35)	.78** (.32)	.60† (.31)
Citizens' pressures	.28* (.12)	.31** (.11)	.19* (.08)	.38*** (.11)	.39*** (.11)	.23** (.08)
Urban eco. sust. x reg. qual.						
Urban env. sust. x reg. qual.	-.19 (.13)	-.12 (.11)	-.16 (.11)			
Urban soc. sust. x reg. qual.				-.35** (.11)	-.28** (.11)	-.23* (.11)
Urban eco. sust. x cit. pol. inf.						
Urban env. sust. x cit. pol. inf..						
Urban soc. sust. x cit. pol. inf.						
Constant	2.43 (4.74)	.28 (1.48)	.01 (1.44)	1.94 (4.16)	-1.72 (1.66)	-.72 (1.29)
Observations	100	100	105	100	100	105
R^2	.38	.96	.76	.44	.95	.75
Variables/model		7			8	
	A	B	C	A	B	C
Ln urban population	-.09 (.25)	.13* (.07)	.02 (.02)	.33 (.25)	.13* (.06)	.02 (.02)
Ln city GDP	.01 (.01)	.02 (.01)	.01 (.01)	.01 (.01)	.01 (.01)	.02 (.01)
Ln city employment	-.18† (.11)	-.15* (.06)	-.04 (.03)	-.16 (.10)	-.14 (.01)	-.04 (.03)
Age dependency ratio	-.00 (.00)	.01† (.01)	-.00 (.00)	.01 (01)	.01 (.00)	-.00 (.00)
Ln cars	-.18 (.11)	-.15† (.09)	-.06 (.06)	-.05 (.11)	-.08 (.09)	-.01 (.06)
Ln environmental taxes	-.11 (.08)	-.15* (.07)		-.18* (.07)	-.17** (.07)	
Entrepreneurship rate	.00 (.00)	.01 (.00)		-.00 (.00)	.00 (.00)	
Innovation rate	-.00 (.00)	.00 (.00)		-.00 (.00)	-.00 (.00)	
Economic urban sust.	1.42* (.67)	.97† (.59)	.93† (.49)	.03 (.07)	.09† (.06)	.00 (.06)
Environmental urban sust.	.26† (.15)	.21* (.10)	.28*** (.08)	3.86*** (.89)	2.41*** (.75)	2.28*** (.63)
Social urban sustainability	.33*** (.08)	.38*** (.08)	.31*** (.06)	.37*** (.07)	.41*** (.07)	.34*** (.06)
Regulatory institutions	-.02 (.05)	-.05 (.04)	-.04 (.04)	-.02 (.04)	-.05 (.04)	-.04 (.04)
Citizens' pressures	.98** (.38)	.75* (.33)	.72* (.20)	2.75*** (.62)	1.85*** (.52)	1.67*** (.46)
Urban eco. sust. x reg. qual.						
Urban env. sust. x reg. qual.						
Urban soc. sust. x reg. qual.						
Urban eco. sust. x cit. pol. inf.	-.37† (.19)	-.22 (.17)	-.24† (.14)			
Urban env. sust. x cit. pol. inf..				-.93*** (.23)	-.59** (.19)	-.53*** (.17)
Urban soc. sust. x cit. pol. inf.						
Constant	3.67 (4.26)	.31	-.06 (1.30)	-9.78† (5.39)	-4.16† (2.15)	-3.95* (1.94)

Observations	100	100	105	100	100	105
R^2	.28	.96	.75	.05	.95	.76

Variables/model	9		
	A	B	C
Ln urban population	-.03 (.22)	.17* (.07)	.01 (.02)
Ln city GDP	.01 (.01)	.01 (.01)	.01 (.01)
Ln city employment	-.22* (.09)	-.18** (.06)	-.04 (.03)
Age dependency ratio	.00 (.01)	.01 (.01)	-.01 (.00)
Ln cars	-.14 (.10)	-.09 (.08)	.02 (.06)
Ln environmental taxes	.00 (.06)	-.05 (.06)	
Entrepreneurship rate	.00 (.00)	.00 (.00)	
Innovation rate	.00 (.00)	.00 (.00)	
Economic urban sust.	.05 (.07)	.09† (.05)	.01 (.05)
Environmental urban sust.	.19 (.13)	.24* (.10)	.26*** (.08)
Social urban sustainability	4.22** (.78)	3.72*** (.74)	3.54*** (.72)
Regulatory institutions	.01 (.04)	-.01 (.04)	-.02 (.04)
Citizens' pressures	3.43*** (.64)	3.04*** (.61)	2.77*** (.58)
Urban eco. sust. x reg. qual.			
Urban env. sust. x reg. qual.			
Urban soc. sust. x reg. qual.			
Urban eco. sust. x cit. pol. inf.			
Urban env. sust. x cit. pol. inf..			
Urban soc. sust. x cit. pol. inf.	-1.04*** (.21)	-.91*** (.20)	-.87*** (.19)
Constant	-7.12 (4.43)	-9.20 (2.59)	-7.89*** (2.26)
Observations	100	100	105
R^2	.43	.95	.74

Note. Non-standardized regression coefficients and standard errors in parentheses; † < .1; * p < .05; ** p < .01; *** p < .001

A)fixed effects regression, B)controlling also by country, and C)with control variables only at city-level