Peer-reviewed version available at Sustainability 2018, 10, 4431; doi:10.3390/su10124431

Article

Urban resilience discourse analysis: towards a multi-level approach to cities

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Abstract: This study aims to understand the current state of research in urban resilience and to open a discussion about multi-level perspectives for this concept. Starting with the history of the concept of resilience, we identify three main stages in resilience concept's evolution: conceptualization, contextualization and operationalization. Confusion occurs between sustainability and resilience, therefore we clearly separate these two concepts by creating conceptual maps. Such maps also underline the specificities of urban and regional resilience discourses. We illustrate that urban resilience research, operating within intra-urban processes, is oriented towards natural disasters, while regional resilience research, operating mostly within inter-urban processes, is oriented towards economic shocks. We show that these two approaches to resilience – urban and regional – are complementary, and we propose to integrate them into a multi-level perspective. By combining these two discourses, we propose a multi-level approach to urban resilience that takes into account both top-down and bottom-up resistance processes. In the discussion section, we propose to take the panarchy perspective as a theoretical framework for multi-level urban resilience, that explains the interactions between different levels through adaptive cycles, relationships between which can help to explain urban resilience.

Keywords: urban resilience; regional resilience; sustainability; cities; multi-level approach; complex systems; panarchy; adaptive cycles

1. Introduction

Today the concept of urban resilience has a growing interest among both scholars and practitioners. One of the explanations of this popularity can be the fact that the notion of resilience raised the demand for further clarification, both for theoretical analyses and for implementation in urban policies. Indeed, in the wake of UN Habitat's Urban Agenda 2030, based on the City Resilience Profiling Program (CRPP) (UN Habitat, 2015), non-governmental organizations (such as ICLEI, Cities Alliance, The Ecological Sequestration Trust, 100 Resilient Cities etc.) expressed more concern with this concept [1].

However, the notion appears very polysemic and its measures and operationalization remain unclear, especially when resilience is applied for the analyses of socio-political, or socio-ecological systems, such as cities [2]. Besides this, it is unclear whether "resilience" is an inner property of a system, or it must be understood as an interaction between a system and its context [3]. When Martin [4] considers regional resilience as a process corresponding to certain stages of economic system's reaction to shocks, does he limit the resilience mechanism to the regional system itself, or does he take into account both this system and its national or international environment producing the shock?

Particularly, it remains unclear to which extent resilience processes or/and properties appear either inside cities, or between cities and their environment, or between cities in a system of cities? In other words, we can ask ourselves how the city level behaves regarding individual actors, composing them and their interactions on one hand, and influence from other cities, with which they strongly interact on the other hand? If we deal with economic resilience, can we say that "economic environment" for a city is a system of cities to which a city belongs?

Based on the literature review of urban resilience discourse, we found that scholars mostly consider resilience of cities towards local problems such as natural disasters, domestic consequences of climate change, resilience of communication networks inside a city: in other words, they focus on the case-specific issues considering local consequences and resilience in this case is oriented towards bottom-up shocks. Contrary to this approach, studies in regional resilience concentrate on external shocks to regions such as economic recessions, international trade restrictions, world crises etc. Taking into account macro-shocks, as main stress factors for a region, they consider resilience towards top-down processes that are the same for many regions but affect them differently. Therefore, these two resilience discourses (urban and regional) emphasize two different scales of shock origin: urban resilience research deals with local shocks, while regional resilience studies take national or international shocks as main stress factors. Being urban resilience scholars, we find this view of urban resilience narrow, and therefore, propose to consider cities' resilience in a multi-level perspective that embraces intra-city (micro-level) and inter-city (system of cities that constitutes macro-level) processes, where a city itself constitutes a separate meso-level [5,6]. We argue that cities, being complex adaptive systems that include social, economic and ecological dimensions, experience both types of shocks: bottom-up, coming from inside a city, and top-down, external shocks that come from national or international scales. Because of this, we propose to consider a city as a connector between micro processes that are unfolding at the level of actors inside a city, and macro processes that unfold on the level of system of cities. To illustrate this multi-level perspective, we consider urban resilience in an economic dimension.

The paper builds the multi-level perspective in four steps: in the first section, we revisit the historical perspective of the resilience concept and identify several stages of its evolution in time, namely conceptualization, contextualization and operationalization (1). Having noticed a confusion between the term resilience and sustainability in the literature, we compared these two concepts and highlight the common and different features in order to avoid further confusion (2). Then, regarding urban resilience, as a consequence of the contextualization stage, we conduct a systematic literature review of its discourse by creating conceptual maps: both for urban and regional resilience discourses, in order to illustrate differences between them, but also their complementary character (3). In the last section, we propose a multi-level perspective that integrates both urban and regional resilience perspectives and includes internal and external processes to cities. Furthermore, in this section, we review a possible application of the panarchy theory to explain interactions between different city levels. (4).

2. Evolution of the resilience concept

In 1973, C.S. Holling introduced the notion of resilience into the ecological discourse defining it as "*a measure of the persistence of systems and of their* ***ability to absorb*** *change and disturbance and still* ***maintain*** *the same relationships between populations or state variables*" [[7] p.14]. Until the middle of 1990 the two parameters – ability to absorb and maintaining – remained unchanged [8–11]. In the papers of that time, the authors conceptualized the notion of resilience based on the distinction between stability and resilience. Stability is the ability of a system to return to an equilibrium state after a temporary disturbance: the more rapidly it returns and the less it fluctuates, the more stable it would be [12]. Resilience then qualifies the ability to absorb shocks and maintain the same type of relationships between different entities within the system.

With time, the notion of resilience became more complex: it was spread from ecology to a wider range of fields such as economy, engineering, sociology, complex science and others. According to a large state of the art that we built on the emergence of the concept and its diffusion among fields,

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resilience had gone through three main stages of evolution: conceptualization, contextualization and operationalization. The main criteria for this separation were the focus of papers in certain periods of time and the type of questions they opened for further discussion.

1.1 Conceptualization stage (1973-mid 1990) – new property of ecological system?

Searching for the theoretical foundation of the idea of resilience, it can be stated that the main questions during a first conceptualization stage were about the nature of resilience, its essence and description [7–10,12]. Resilience, along with stability, was considered as a property (or mode of behaviour) of only ecological systems [7], without being applied to other complex systems.

1.2 Contextualization stage (mid 1995-mid 2000) – property of any complex system?

A next stage began with the collaboration between ecologists and economists [13]. Operating an enormous variation of definitions of resilience mainly depending on the context of application, they tried to keep a kind of universal definition of resilience. Levin et al. [13] expanded the application of resilience and argued that resilience is a "*property of any complex, non-linear systems, whether ecological or socioeconomic, do not lend themselves to management protocols based on assumptions of linear, globally stable, single equilibrium systems*" [citation from [14] p. 259]. At the same time, the problem of conceptualization still exists, for example, Hanley [15] notices that the concept of resilience is highly suggestive and suffers from imprecision of definition and conceptualization, which in turn weakens its value as an analytical or explanatory tool. Another novelty of the contextualization stage of resilience was the introduction of the role of institutions in resilience discourse [16,17]. It was justified as an essential link between social and ecological resilience and defined in a broad sense to include routines, together with rules and norms that govern society, as well as the more usual notion of formal institutions with memberships, constituencies and stakeholders. The question of institutions is essential for urban resilience, first of all, because of non-adaptability of institutions to the whole city system: most cities are spread between numerous municipalities, where institutional power is distributed and rarely coordinated. Another question that was raised at that time, concerned the relationship between resilience and sustainability [18–21], that still remains topical in scientific discourse.

1.3. Operationalization stage (mid 2000 - now) – how to measure this property/processes?

Since scholars agreed that resilience can be applied to any complex systems (physical ones like water supply systems or hypothetical ones such as systems of cities for example), the following question appears: how to measure resilience in such different applications? In fact, in the recent publications on resilience, enormous amounts of diverse questions are discussed in terms of operationalization. In this stage, resilience continued to spread to new areas: an engineering perspective [22], water supply resilience [23], energy supply resilience [24], road-bridge networks [25], urban and regional resilience [26–28]. The main accent, however, was on how to distinguish different phases in resilience mechanisms [4,29] and to understand why some systems are resilient and others not. All these studies indicate the effort of scholars to make the resilience notion more concrete and measurable.

At this stage, the delineation of several resilience notions took place. On the one hand, resilience of water, energy or food supply systems can be aggregated into a layer-oriented resilience discourse, because they all consider a certain layer on a given territory and that's why operationalization can be extended from one layer to another with certain limitations (We consider a layer as a network system on a given territory, e.g. water supply system or metro system). On the other hand, urban (meso level) and community (micro level) resilience can also be combined into one discourse, because they consider similar types of shocks (local bottom-up) and analyze them on the micro to the meso levels [30]. Besides, regional resilience constitutes its own discourse, very different from all the previous ones with a very strong domination of the economic context and with top-down shocks that come from macro level (national and international). Economists and economic geographers decompose

resilience into certain stages, such as vulnerability, resistance, robustness and recoverability [31], or resistance, rebound and recuperation [29]. There is an important distinction between an economic approach to resilience and a complex system perspective: the economists emphasize resilience as a process that can be divided into several stages, while the complex system approach underlines resilience as a property of complex adaptive systems. Is it a strong dichotomy or can these approaches be integrated into one model? If yes, which theoretical framework should be used for this combination?

This periodization of the resilience evolution in the literature is rather suggestive, as the discourse is still developing, embracing new topics and areas and requiring further conceptual explanation. As a consequence of such a wide use of the resilience concept and its multi-disciplinary nature, some other quite similar, have been introduced into the resilience discourse, but still distinct notions such as vulnerability [2,32], adaptability and transformability [33–35]. Partially, this is linked to a disciplinary origin of the researchers who study resilience: for example, in the complex system approach scholars tend to use more sophisticated vocabulary that link, resilience with adaptability and sustainability with transformability [33]. This supplement of other notions adds confusion to the already existing tensions between sustainability and resilience [35,36] that need further comprehension.

3. Systematic mapping of the literature

Today these three stages result in a substantial corpus of literature on resilience, in various contexts and on distinct levels. Considering this huge amount of literature from 1973 to 2018, we constructed several corpuses of literature based on the Scopus database with *four steps*:

I. Search for the papers in Scopus where some focused terms are present in the title of the papers. We made it on several topics:
   a. Resilience and sustainability (242 articles)
   b. Urban resilience (596 articles)
   c. Regional resilience (174 articles)

II. For each topic, considering the entire abstracts of the papers, we built the networks of terms appearing in the same sentences: Nodes are terms, links are co-occurrences between them. We then calculated the conditional distance between terms[1], which is an absolute measure that reflects the interaction between two terms in the corpus – indication of highest co-occurrences. It highlights words centrality among other words, that is a complementary measure to the simple "occurrences" that means how many times each word appear in the texts.

III. Selection of the words occurring more than 5 times;

IV. Application of clustering analysis detecting nodes that are more connected to each other[2].

With this approach we were able to better determine common points and differences between resilience and sustainability (2.1), and to clarify the urban resilience discourse (2.2) and the regional resilience approach (2.3).

3.1. Resilience and sustainability

Particularly, the relationship between resilience and sustainability still remains unclear [35,38,39] and it is important to explain it further. Many scholars noticed that resilience and sustainability concepts have many things in common: first of all, they both concern ecology, economy and society, moreover, resilience seems to be even wider, because it also deals with psychology and engineering [22,40]; secondly, they both can be applied to different levels as firm, city and regional levels [39,41,42]. Nevertheless, quite often one can find a definition of resilience based on the

[1] We used Gargantext that is open access software of the Institute of Complex Systems in Paris (URL: https://gargantext.org/)

[2] We used the Louvain cluster technique [37] with the Gephi open access software (URL: https://gephi.org/)

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opposition to sustainability [35]. The question of the relationship between these two concepts was indicated as one of the main "constructive tensions" in resilience research [43] that encourage us to go deeper into this issue.

With the methodology previously described, the below graph was created and can support reflections on the conceptual building of both concepts (Fig.1). The main purpose of this graph is to visualize the relationship between resilience and sustainability and to select the elements that can be used in the multi-level perspective to urban resilience. The size of the nodes indicates the occurrences of the terms, the thickness of links indicates the number of co-occurrences between terms in the same sentences and the color of terms indicates their belonging to different clusters.

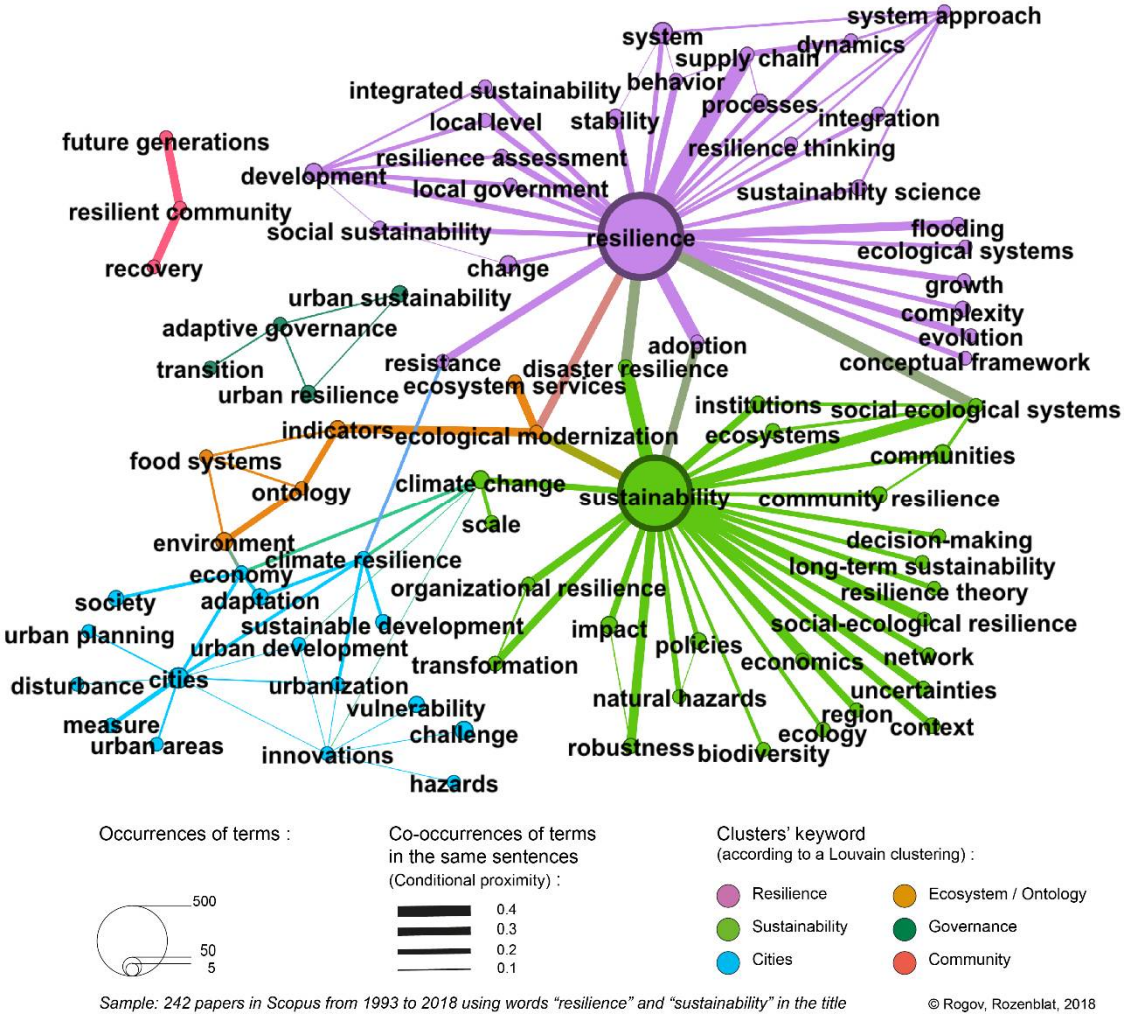

Figure 1. Co-occurrences of terms appearing in the abstracts of papers with "Sustainability & resilience" in their title

The resulting graph underlines that only four terms appear linked to both resilience and sustainability: *ecological modernization*, *disaster resilience*, *adoption* and *social ecological systems* [38,44–46]. The papers that create links between these two terms analyze both sustainability and resilience and their interpretation depends on the focus of studies. For example, papers considering **adoption** are mostly either about adoption of different sustainable practices, policies or systems in agriculture [47–49], or they address questions of implementation of different sustainability and resilience policies and standards [50]. Studies in **disaster resilience** are often concerning community level from different perspectives: in engineering context [51], from tourism development view [52], as a case study [53]. Others argue that disaster resilience and urban sustainability should be connected through a "glocal" approach for cities [54] that stresses the links inside cities (local) and between them (global). Despite certain peculiarities such as units of analyses, most of these studies agree that resilience and sustainability are hierarchical terms, where resilience is a part of sustainability: resilience is a

"foundation" for sustainability [52], resilience is a "requirement" for urban system sustainability [54], resilience is a necessary condition for sustainability [51].

Can we apply the same relationship between these two terms to complex systems such as cities? In the literature about **social-ecological systems (SES)** (city is often considered as such system) most of the studies are conceptual and analyze the differences and similarities between sustainability and resilience as a main objective of their papers [38,44,46,55]. Some of the scholars argue that resilience may be a new way to conceptualize sustainability [2,33,56,57]. Others, insist that in spite of many common features they stay distinct because of their different disciplinary origins and various time cross-scale interactions [35,38,46,58].

In fact, even being very tightly linked, these two concepts have also notable differences: resilience is linked to such terms as "evolution", "complexity", "process" and "change" that imply the process of **adaptation** as a key characteristic of resilience. In contrast, sustainability is linked to terms such as "policies", "decision-making", "institutions" and "climate change" – in other words, it rather illustrates the process of **transformation** as a key characteristic of sustainability. The difference between adaptation and transformation is made based on cross-scale interactions: in any complex adaptive system, adaptation at one scale might require transformations at other scales, and building resilience at a certain scale can reduce resilience at other scales [38]. Adaptation relates to the decision-making processes and actions undertaken to adjust a system to future shocks, stresses, or other changing conditions, in a way that maintains essential system functioning [34]. Moreover, adaptive measures are often specific and local (for example, adaptation is often related to climate resilience). Adaptation addresses a potential threat and associated vulnerability, and adjusts the system as a response to that threat [35]. Transformation, by contrast, implies a more pervasive and radical reorganization of the social-ecological system: it is a fundamental alteration of a system once the current ecological, social, or economic conditions become untenable or are undesirable [33,34,59].

Therefore, it can be deduced that resilience is focused on the system dynamics and operates within adaptive cycles. Resilience perceives change as a normal, multiple stable state and the result of this change is emergent and open ended. Sustainability, in its turn, seeks to address the major challenges facing society, understanding the biophysical drivers and constraints on a system's future, but focuses on the measurable change in terms of human decisions, institutional dynamics, and shared attitudes [35]. Simply put, we can agree with Redman [35], who argued that sustainability prioritizes outcomes, and resilience prioritizes process (but is not equal to it!). The multi-scale dynamics of these processes and outcomes is a central part of the **panarchy perspective** [60] that we propose to use as a theoretical framework to address urban resilience in a multi-level perspective.

It is noteworthy, that Holling introduced the notion of resilience into ecological discourse, and as a continuum 40 years after, he proposed a panarchy perspective to explain resilience of human and natural systems, where the key element is interactions between different adaptive cycles. According to panarchy [60], an adaptive cycle operates within three dimensions: potential (inherent potential of a system that is available for change), connectedness (measure of flexibility or rigidity) and resilience, where resilience is equal to adaptive capacity and opposite to vulnerability. The resilience of a system varies depending on the stage of their multi-level time and space adaptive cycles (exploitation, conservation, release or reorganization) and the interactions between them.

Before going deeper into the panarchy perspective it is critical to distinguish the time cross-scale interactions considered in the resilience concept and in the sustainability concept. To synthesize the differences between resilience and sustainability, we constructed a schema (Tab.1) that based on the graph interpretation and conducted literature review. From the graph of Figure 1 we selected some terms that appear only in one cluster: sustainability or resilience. They were chosen because they best characterize a distinct character and essence of sustainability and resilience approaches, especially concerning the terms' interpretation, the methodologies and the time processes. Operating in the same domains, these two approaches have different objects of analysis that are linked with each other the same way as sustainability and resilience, namely through time cross-scale interaction.

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Table 1. Differences between the concepts of sustainability and resilience

	RESILIENCE	COMMON FEATURES	SUSTAINABILITY
Graph terms interpretation	change, behavior, complexity evolution , system approach dynamics, system	- adoption → of different practices, policies, standards - disaster resilience - ecological modernization → - Hierarchical relationship between sustainability & resilience; - Mostly community level; - Case studies; - Gocal approach - social ecological systems → Complex System Approach	long-term sustainability, policies decision-making, institutions climate change, transformation
Methodological differences	Resilience Theory Approach	Multi-domain operation: - ecology - economy - society	Sustainability Science Approach
Time processes	**ADAPTATION** - Adaptive cycles and multiple equilibria - Result of change is emergent and open-ended - Emergent properties guide trajectory	Time cross -scale interaction Short term — Complex Adaptive System — Long term	**TRANSFORMATION** - Radical reorganization of the SES - Creation of new order, open ended - Reorder system dynamics - Shift from one trajectory to another

Resilience, having its origins in ecology, operates within adaptive cycles that are initiated by shocks: in other words, it is a short-term characteristic of system behavior before, during and after a change. Sustainability, in contrast, operates within a long-term perspective and, therefore, somehow includes adaptive cycles where resilience acts. Having an origin in social science, the sustainability approach aims at achieving certain goals (for example, Sustainable Development Goals) where desired results are specified in advance and the focus is on certain human interventions that lead to sustainability: in other words, the outcomes are predefined and can be achieved through transformation of a system [33,35,38]. Therefore, it can be said that sustainable development, as a long-term goal, is based on resilience systems that, in a short-term, operate within sudden shocks and negative stress factors. All of this shows a complementary relationship between these two concepts.

In the resilience cluster (in purple in Figure 1) there is a subgraph linked to "system approach". However, "system approach" on that graph is also linked to "sustainability approach" what opens a question about the role of complex systems in sustainability creation. According to Lizarralde *et al.* [61], both paradigms of sustainability and resilience adopt a system approach to understand complexity, highlighting the importance of long-term effects and taking the holistic view of strongly interconnected variables. Particularly, Lizarralde et al. [61] argue, that system resilience consists of:

- multiple levels of analyses and intervention (from individual to the national level);
- multiple time-scales (prevention, emergency, rehabilitation, reconstruction, long-term development);
- multiple sectors of intervention;
- multiple types of intervention and units of analyses.

This systemic perspective on resilience, revealing its complexity and dynamics, brings new questions: what are the relationships between different levels in system resilience creation? Can resilience of a system on one level reduce or increase resilience on other levels? For example, if we take a city, how macro level – system of cities – can influence meso level – a city itself? And how micro level – individuals – can affect the ability of a city to adapt? Can we say that urban resilience is shaped both by the interactions within a city and between cities? To address these questions, we decided to construct and analyze an urban resilience discourse.

3.2. Urban resilience discourse

To construct an urban resilience discourse, we used the same 4 step method as before. We created a new corpus of literature on urban resilience from Scopus that includes 596 papers from 1990 to 2018. Based on the conditional distance, we built networks of term co-occurrences. The constructed graph (Fig.2) illustrates the dominating position of ecological topics in urban resilience: more than 30

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terms out of 125 in total are linked in one way or another to ecology (terms such as "natural disaster", ecosystem services", urban climate resilience" etc.). For comparison, only 9 terms represent the social domain of urban resilience (terms such as "social resilience", "social support", "social vulnerability" etc.) and 3 belong to the economic domain, namely, "economy", "economic recessions" and "economic growth". Why is there such a disbalance in urban resilience research between these three main dimensions of the classical understanding of resilience? Why do scholars often equalize terms "community resilience" and "urban resilience"? Why don't urban resilience scholars ever talk about city's resilience to economic shocks?

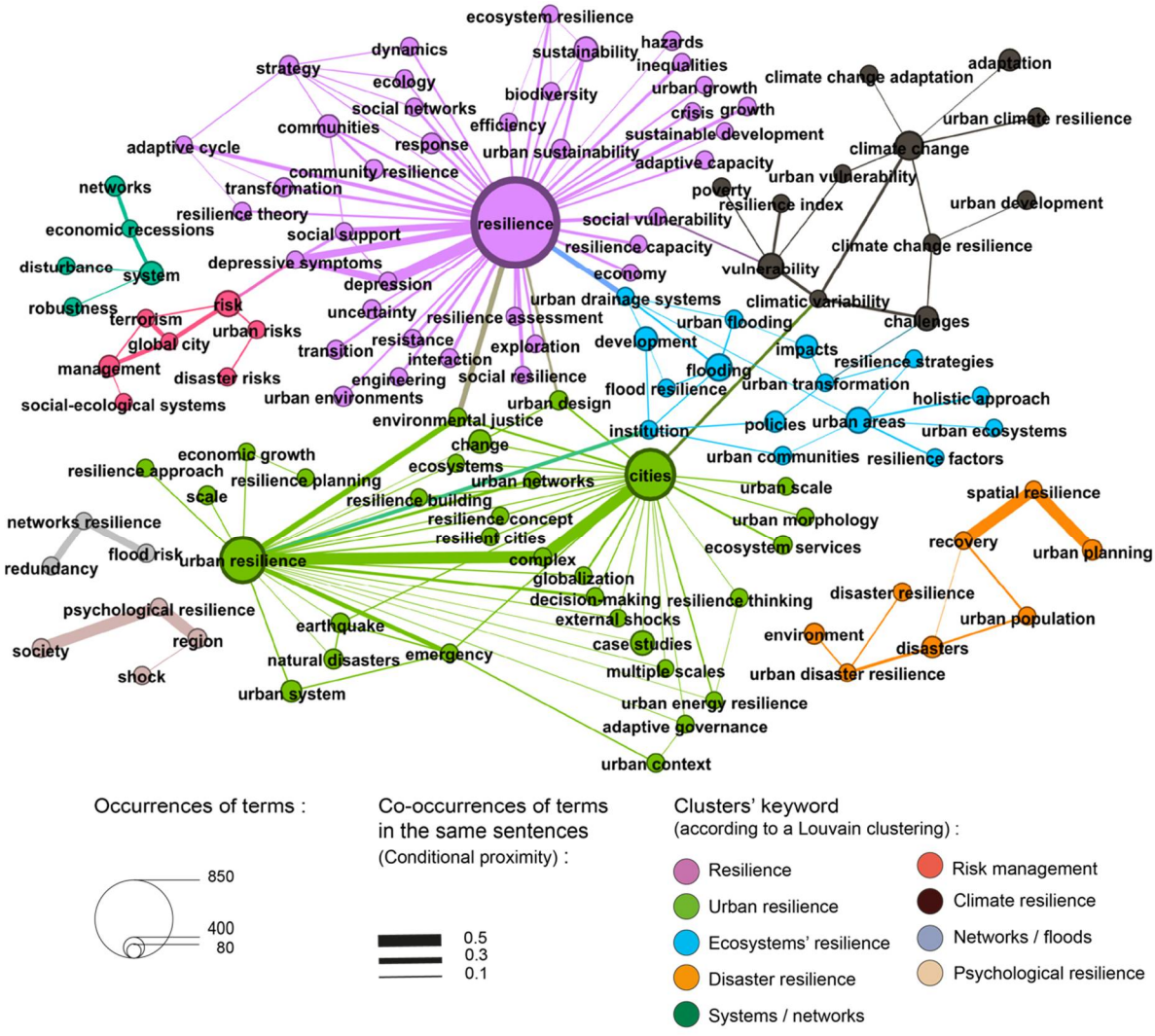

Figure 2. Co-occurrences of terms in the abstracts of papers with "Urban resilience" in their title

The dominating position of ecological topics in urban resilience can be clearly seen on the Figure 2: there are such separate terms as "*urban climate resilience*", "*flood resilience*", "*urban disaster resilience*", "*urban energy resilience*", "*ecosystem resilience*", "*community resilience*". Moreover, terms from ecology appear in most of the clusters. Even though these terms belong to different clusters, due to the specific problems they address, they are always considered in an urban or community context. Social resilience in this graph is also very often linked to ecology, especially when it concerns consequences of natural disasters for cities and communities [62–64].

In the graph there are terms such as "*economic growth*" that are directly linked to urban resilience, or such as "*economic recessions*" that are in separate clusters. According to most of the papers in this sample of literature, economic growth on the one hand, can be a result of disaster risk reduction policies [65], but on the other hand, can be slowed down because of natural disasters such as flooding [66]. Meerow [67], discussing economic consequences of natural disasters, wonders how global

processes interact with contextual factors. More concretely, Lee [68] asks how urban resilience can combine local and extra-local competences in order to develop an inter-city system that is the major strategy for cities to mitigate and adapt to climate change and economic recessions. Economic recessions in urban resilience literature are mainly considered in certain contexts such as effects of economic shocks for communities [69] or for particular markets such as the housing market [70]. We must agree with Peyroux [71], who noticed that there is a substantial gap in understanding the relationships between urban resilience and economic growth.

On the way to construct a multi-level approach to urban resilience, we paid special attention to certain terms linking "*urban resilience*" and "*cities*". Papers concerning the term "*multiple scales*" are either about the influence of natural *hazards* to technical networks on different scales [72] or about the influence of natural hazards to diverse urban morphological entities [73], or about the multi-scale approach in ecosystem management [74,75]. However, some papers apply multi-scale approach directly to a city considering cities as functional nodes in global market networks [76]. Chelleri *et al.* Chelleri [76] argues that addressing multi-scale and temporal aspects of urban resilience will allow greater understanding of global sustainability challenges, though they admit that further research is required to understand urban resilience as a multi-scale process.

Aiming to consider systems of cities (also sometimes called urban systems) as a macro level, we focused on the papers talking about "*urban networks*" and "*urban systems*". However, this approach did not meet our expectations: All articles using one of these terms either deals with different types of technical networks inside cities [77–79], or internal urban systems that consist of such types of networks that include flows of infrastructure, resources, materials, energy and waste [80–82]. In other words, they consider different networks inside cities, but they do not study systems of cities where cities constitute networks and interdependencies between each other. Besides, analyzing the literature about "*external shocks*" inside the urban resilience context, we found that authors considering economic shocks [29,83] analyze the unemployment growth rate in different cities in the time of different phases of economic crises, and justify it as one of the main indicators of urban economic resilience. We must admit that this economic research direction in urban resilience is not mainstream and rather opens a possibility for further research, rather than shows an established field of studies.

Thus, the analyses of "*urban resilience*" discourse revealed that the notion of urban resilience is concentrated around the problems that have local and intra-city characters, such as the consequences of natural disasters mostly. However, not only research communities consider urban resilience in this narrow framework: in an official document ISO 37123 "*Sustainable Development Communities – Indicators for Resilience Cities*" (ISO 37123, 2018) [84] issued by United Nations, *shocks* are defined only as natural or man-made event that causes a disaster, namely, floods, earthquakes, hurricanes, wild-fires, chemical spills, power outages ([84], p. 10) and *resilient economy* is considered in the context of disaster losses as a percentage of city GDP ([84]p.11). Moreover, the biggest international annual event on urban resilience "*Resilient Cities*" [3] that principally gathers policy makers and few researchers, focuses exclusively on natural disasters and discusses different policies and institutional mechanisms to mitigate their consequences for cities.

All of this illustrates the main assumption of the urban resilience discourse: most scholars and practitioners consider a city as an isolated entity that create resilience based on the inner processes in cities, neglecting the top down processes that shape urban resilience from outside of a city, namely from the level of systems of cities. We can call it a "lock-in" in research: when the concept is used only partially and in one direction. If we consider the embeddedness of a city into another system, not necessarily into systems of cities, but into regional systems, for example, the dominating approach in resilience discourse will probably change?

3.3. Regional resilience discourse

[3] Global Forum on Urban Resilience and Adaptation "Resilient Cities", URL: https://resilientcities2018.iclei.org/

In doing so, we conducted a third literature review on "regional resilience" in the title and constructed a corpus of literature that includes 174 papers from 1986 to 2018. Using a similar methodology, we created a graph that visualizes terms appearing in these papers (Fig.3).

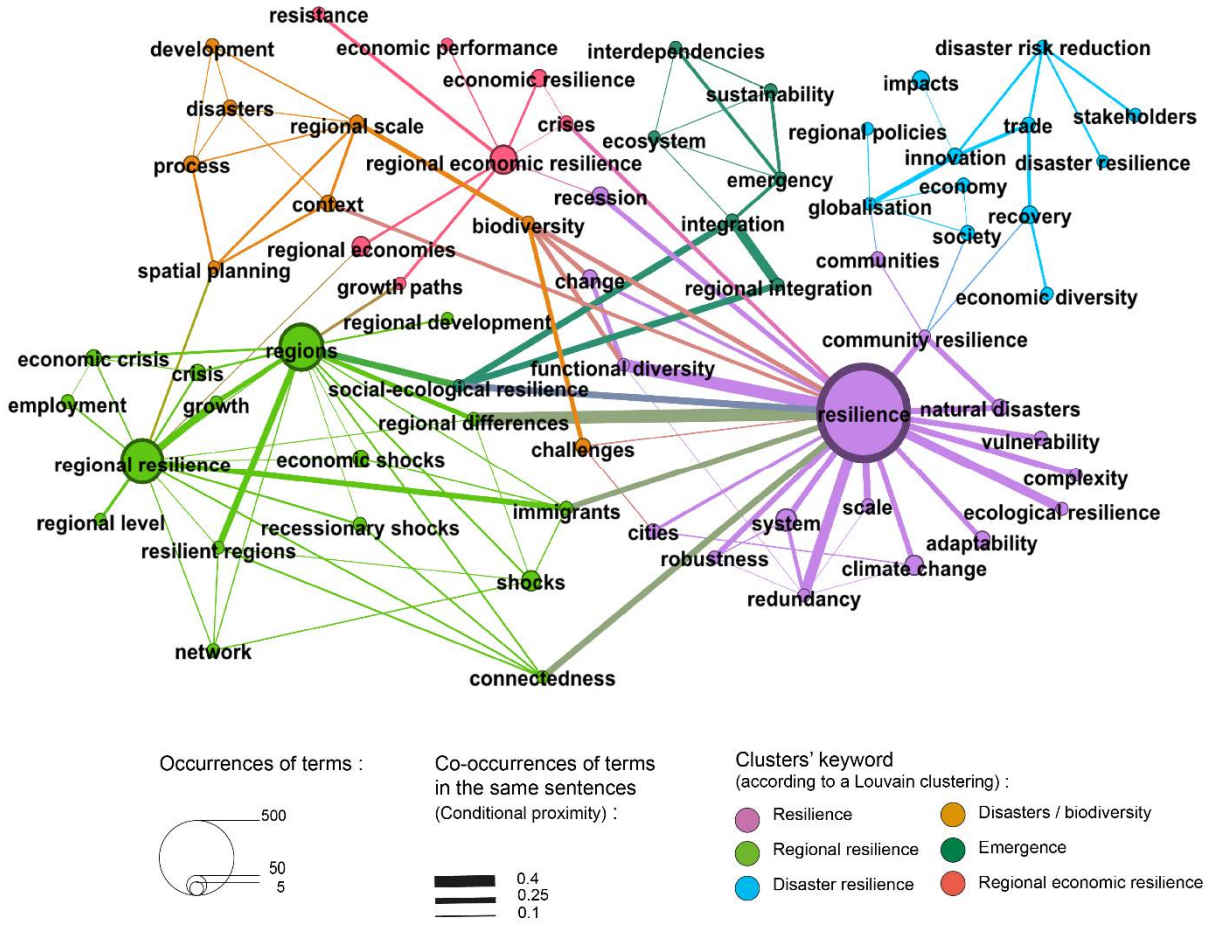

Figure 3. Co-occurrences of terms in the abstracts of papers with "Regional resilience" in the title

According to figure 3, the dominating topic in the regional resilience discourse is economy: in every cluster, there are words linked to an economic context. As shocks on a regional scale, scholars mostly perceive economic crises and recession. At the same time, we can find terms such as "*disaster resilience*", "*climate change*" or "*ecological resilience*" which, nevertheless, don't create their own clusters (for example, unlike "*regional resilience*" and "*regional economic resilience*") and are linked to terms such as "*cities*" and "*community resilience*". And again, we do not exclude that regional resilience does not concern natural disasters at all [85], but we highlight that it is not a dominant topic in this discourse contrary to urban resilience research.

As a measure of regional economic resilience most of the authors use indicators such as employment [86–88], employment growth rate [87,89] or per capita GDP [90]. However, the most common indicator in regional economic resilience analyses is regional employment, because the behavior of the labor market is considered to be one of the main sources of economic resilience on the regional level [86,87]. But one may wonder what is the meaning of a regional level? Explaining why resilience analyses should be concentrated on a regional level, Christopherson argues that regions are manifestations of human actions and social relations being in the constant process of transition ([28] p. 4). But can't we say the same about a city?

In order to understand this separation of topics between urban and regional resilience we need to understand the meaning of "regional" and how scholars distinguish one region from another. The most widespread point of view is to consider regions within administrative boundaries [86,87]: in terms of empirical analyses it is convenient for longitudinal data acquisition. Others argue, that

functional criterion is much more important when distinguishing regions, particularly considering employment rate, even if the data acquisition is more complicated [91]. In doing so, Faggian proposed the so called "local labor systems" that are based on the proximity between houses and workplaces and often cross administrative boundaries. The same issue arises when one talks about cities: how to define their boundaries, administratively or morphologically [92].

In general, in regional resilience research, a city is considered to be embedded into another system (region), even though the effects of this system on city resilience are not investigated. Moreover, some scholars note that a region itself, as an economic system, is connected to economic changes at global and national levels [93,94] and each region has its own relative position in national and global markets [95], which means its embeddedness into the processes on a macro level. Here is the fundamental difference between urban and regional resilience research: regional resilience scholars consider a region as an open system, interacting with other systems within national or global scales, and therefore, they take into consideration top down processes that are crucial for economic analyses, which became the main instrument for regional resilience research. Contrary to it, most urban resilience scholars consider a city as an isolated entity and, therefore, analyze only internal shocks that have an origin inside a city and unfold there. Some of them apply a system approach to a city, but they perceive a city only as a system itself, but not as an embedded system into another system – system of cities that constitute a macro level of city's dynamics based on its interactions with other cities [5,96]. We believe, that considering a city as a complex adaptive entity implies the integration of inner processes as embedded into macro processes on the level of systems of cities.

4. Discussion and further research directions

We have seen that resilience, during its conceptual formation, has already been applied to a very wide range of contexts. Due to its multidisciplinary nature, it does not constitute one discourse, rather, depending on the object and level of analyses, we observe a decomposition of the resilience concept into many quite different, but still linked discourses with their own dominating paradigms. It has been shown that depending on the approach, resilience can be understood either as a process or as a system's property. However, we wonder if we take a multi-level perspective, would it be possible to consider resilience as a process on one level and as a system property on another? Analyzing the urban resilience discourse, we have shown that some authors raise the question of a multi-level perspective to cities. For example, Chirisa & Banbauko [97] and Asprone & Manfredi [54] apply a systems approach to cities and argue that contemporary cities are complex systems with networks of composite relationships among their internal components and inter-laced networks that cities have with one another ([54] p. S108). Nonetheless, they don't go further to link a multi-level approach to cities and urban resilience and they do not seem very interested in the relationships between these different urban levels and resilience processes.

The relationships between these different urban levels and resilience processes implicitly exist in the urban resilience discourse, although, because of the focus of this discourse only on one level, it is not yet conceptualized in a cities' context. Having shown the differences in approaches of urban and regional resilience, we propose to consider them as complementary, for the creation of multi-level perspective to a city's resilience (Fig.4).

Peer-reviewed version available at Sustainability 2018, 10, 4431; doi:10.3390/su10124431

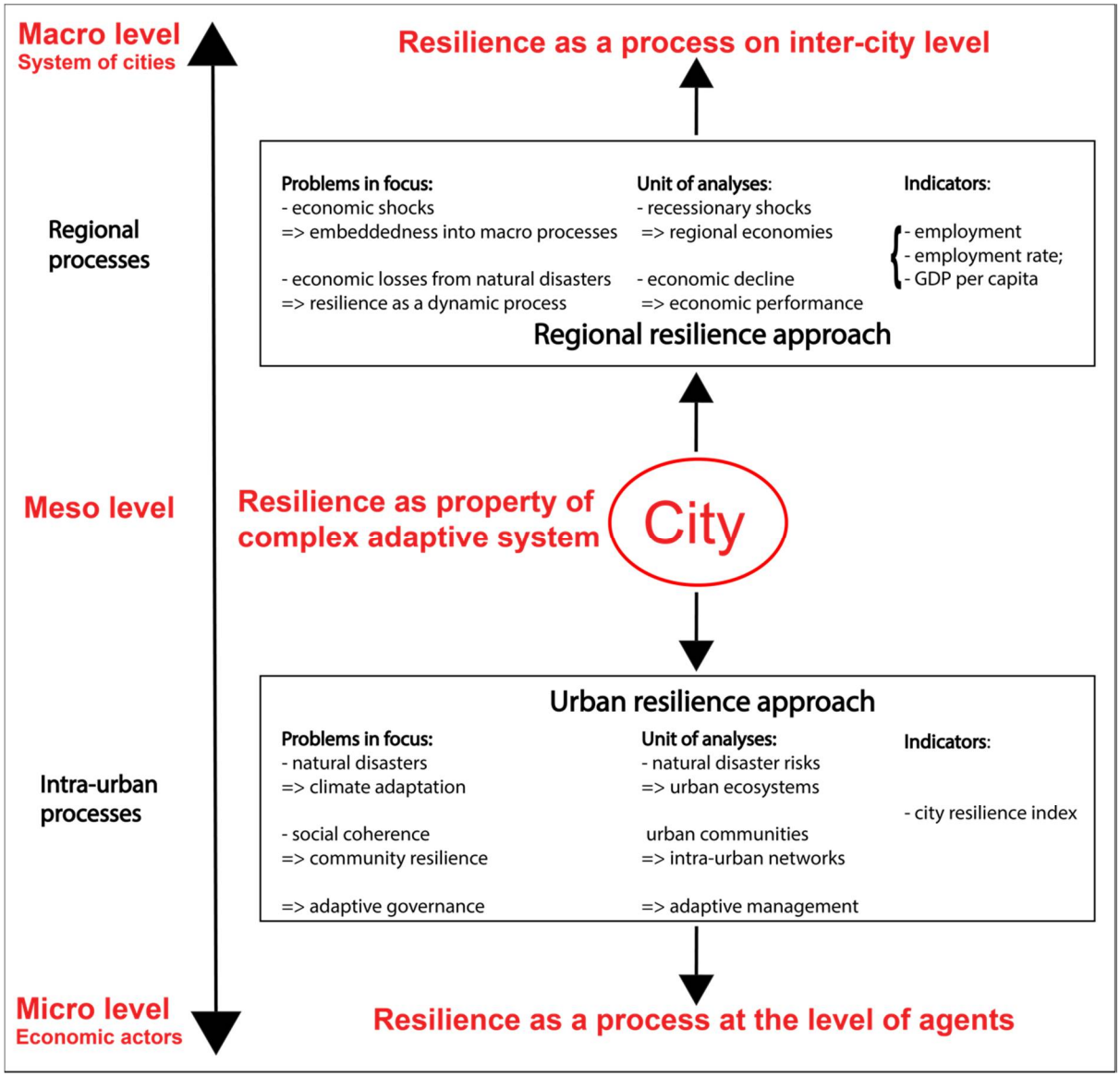

Figure 4. Urban and regional resilience research in a multi-level perspective

As it was shown in the previous sections, urban resilience research concerns intra-urban processes that are mostly linked with cities' resilience to natural disasters on the city or community scales. By contrast, the regional resilience approach highlights an embeddedness of regional processes into macro levels, such as national or global. Taking a city as a unit of analysis, we propose to consider urban resilience as being shaped both by the processes inside and between cities: this way, a city is viewed as a meso-level connector between micro and macro processes. Using a concept of urban hierarchy, Pumain [5] distinguished different city levels: micro, meso and macro. She argues that multiple interactions between individuals, firms and institutions inside a city constitute a special level: **meso level**. She empathizes that "at this level, new properties emerge and characterize the city as a collective entity" ([5] p. 172) and these new properties are the result of both collective interaction and intention of some institutions. Considering a city as a complex adaptive system, we assume that one of these emerging urban properties on the meso level can be resilience. Rozenblat [6] develops a further multi-level approach and associates a meso level of a city with agglomeration economies. Analyzing networks of multinational firms, she considers cities as "connectors of multinational firms networks benefiting from several cluster properties and agglomeration economies rather than simple co-locations in numerous places" ([6] p. 2846). Taking a network approach, Rozenblat argues that "the micro, meso and macro levels describe the same networks, yet different processes occur at each level" ([6] p. 2846). The question for resilience is how processes on different levels can shape urban

resilience, or more precisely, how urban resilience becomes a process on different levels when the system is affected by shock? And how these multi-level processes are interconnected and synchronized?

The relationships between these three levels can be explained within a panarchy theory [60], describing the interactions of adaptive cycles on each level. In cities, similarly to other complex adaptive systems, "*adaptation at one scale might require transformations at other scales, and building resilience at a certain scale can reduce resilience at other scales*" [38]. Therefore, in any multi-level approach it is crucial to define clearly each level in both conceptual and empirical terms and their stage of "adaptive cycles". Only having known how each level can be measured, can one understand the interactions between different levels. In case of an economic shock, urban resilience will depend both on the behavior of individual economic agents inside a city (micro level), and on the different types of flows between cities (such as configuration of economic and trade networks, human migration, government financial support etc.) on the macro level. In turn, a city itself, being a complex adaptive system, constitutes its own meso level [5], where resilience can be interpreted as a property of this adaptive system that have influences from micro and macro levels.

There have been some attempts to apply the panarchy theory to urban resilience [98], but they limit their research only to analyses of adaptive cycles on meso-level, without studying the links between different levels. Therefore, the relationships between different adaptive cycles on the distinct levels remain a black box that opens an opportunity for further research. For instance, if we take the context of economic crises (causes of which are often on the international scale), what would be the relationships between adaptive cycles of national economy, urban economies and the people's behavior in each city? As a macro level, we propose to take a system of cities [5,6], because it can be national, international and transnational, and therefore, we do not limit extremal city's connections within one country but in a global perspective.

We argue that only understanding the relationships and mutual influence of adaptive cycles on different levels can explain a city's resilience to diverse shocks. Multi-scale resilience is fundamental for understanding the interplay between persistence and change [58] and only implementation of cross-scale dynamics in a city as a complex adaptive system can shed light on the diverse urban resilience processes in future research.

5. Conclusion

The notion of resilience has become an important research direction in many areas such as ecology, urban and regional studies, complex systems and, therefore, evolved into a truly multidisciplinary concept. In the beginning of this article, we explored resilience in a historical perspective, identifying its evolution through three stages of development, namely conceptualization, contextualization and operationalization. It has been shown that currently the main question in resilience research is the empirical evaluation of resilience and its decomposition into measurable parts.

We have illustrated that due to the multi-disciplinary nature of the resilience notion, there is often a confusion between quite similar, but still distinct terms such as vulnerability, adaptability, transformability and sustainability. By conducting a literature review, we explored the differences between resilience and sustainability as the terms that generate the biggest confusion. Taking a perspective of complex systems approach, we explained the relationships between these terms through the time-scale dynamics. We argued that resilience operates within adaptive cycles in short-term perspectives as a reaction to shocks, and sustainability is based on the predefined outcomes that imply transformative change of a system in a long-term.

By means of conceptual maps (graphs), we have analyzed the discourses of urban and regional resilience based on a large sample of literature. It has been shown that in a large part of the literature on urban resilience, the main topic is resilience to natural disasters and their consequences on city and community levels. Our analysis has also underlined that concepts of urban resilience and community resilience can be considered as synonyms, which adds to the general confusion around the urban resilience approach. We have shown that urban resilience operates on the intra-urban level

and does not concern the influence of national and global levels on the city's persistence to shocks. Analyzing the regional resilience discourses, we have illustrated that as main shocks, scholars take economic recessions and crises that come top-down from a macro level.

We have proposed a multi-level perspective to urban resilience by introducing a micro level of economic agents, for which the behavior can influence urban resilience during economic crises from bottom-up, and macro level that highlights the embeddedness of cities into national and international processes through a system of cities. In a perspective of the panarchy approach to urban resilience, we think that it is necessary to consider every level of a city – micro, meso and macro – as operating within their own adaptive cycles, and urban resilience as a result of the interactions of these multi-level cycles dynamics. We are convinced that these cross-level interactions are crucial to a higher comprehensive understanding of urban resilience that emphasize a nature of "*a city as a system within system of cities*" [96]. By opening a discussion about the applications of the panarchy theory to urban resilience, we aim to overcome the respective existing "lock in" in urban and regional resilience research. We encourage scholars for more complex research in these areas that would go beyond the current limitations, on the one hand, of one prevailing domain in each discourse (such as ecology in urban resilience and economy in regional resilience), and on the other hand, limitations to one level in order to emphasize the relations between different organizational levels.

Author Contributions: Mikhail Rogov made the original draft preparation of this paper. Celine Rozenblat supervised conceptualization, review, methodology, interpretation and editing processes.

Funding: This research received no external funding.

Acknowledgments: The authors are very grateful to the valuable remarks of Larry Bourne. Also, the authors would like to thank Andrea Ferloni and Mehdi Bida for the numerous discussions and their constructive advice. Finally, the authors express their deep appreciation to Helen Schwager for her help with language editing and proofreading.

Conflicts of Interest: The authors declare no conflict of interest.

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