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CREATIVITY AS A DRIVER TO RESILIENCE IN CITIES.

The more creative the more resilient

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ABSTRACT

The OECD defines urban resilience as a city's ability to prepare for, absorb, and recover from adverse events, which are increasingly frequent due to human activity. We propose a direct relationship between resilience and creativity, where innovation is key to improving preparedness, reducing risks, and accelerating recovery.

Based on the analysis of 175 cities from the Global Observatory of Attractive Cities for Talent and other sources, we developed creativity and resilience indices considering factors such as innovation, technology, culture, and risk preparedness.

The study shows that the most creative cities are also the most resilient, as their innovative capacity enables effective solutions to challenges like natural disasters or economic crises, thereby fostering more adaptable and prepared urban environments.

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1.Why Creativity in Cities

This article addresses the relationship between urban creativity and city resilience, exploring how the capacity for innovation can directly influence a city's ability to confront and recover from adverse events. The research focuses on developing and analyzing two key indices: the Creative Cities Index and the Resilient Cities Index. The former evaluates various aspects of creativity and innovation in an urban environment, including the level of technological innovation, the quality and accessibility of education, the presence of cultural institutions such as museums and theaters, the diversity and richness of the gastronomic scene, and the dynamism in film and music production. The Resilient Cities Index, on the other hand, measures a city's ability to prepare for, absorb, recover from, and adapt to adverse events, whether natural, economic, or social in origin.

The primary objective of this study is to determine whether a significant correlation exists between these two indices, which could indicate that more creative cities also tend to be more resilient. Through both quantitative and qualitative analysis, the study seeks to identify patterns and trends that could inform the development of urban policies that integrate creativity as an essential component of resilience.

1.1 The more Creative, the more Resilient

Una ciudad creativa es más resiliente porque su capacidad para innovar, adaptarse, y colaborar le permite enfrentar desastres naturales de manera más eficaz, reducir su vulnerabilidad, y recuperarse más rápidamente, asegurando un futuro más seguro y sostenible para sus habitantes.

A creative city is more resilient because its ability to innovate, adapt, and collaborate allows it to face natural disasters more effectively, reduce its vulnerability, and recover more quickly, ensuring a safer and more sustainable future for its inhabitants.

2. What will be studied? Hypothesis

Research on urban resilience has gained importance in a world increasingly exposed to global risks such as climate change, accelerated urbanization, and economic crises. However, the connection between creativity and innovation and a city's ability to be resilient has not been sufficiently explored. Understanding this relationship is crucial for the development of policies and strategies that promote cities that are not only more innovative but also safer and better prepared to face future adversities. By proposing different hypotheses, the aim is to demonstrate that more creative cities are also more resilient, this study provides a valuable framework for urban planning and policy formulation that integrates creativity as a key element of resilience.

2.1. Innovation and Preparation

A creative city fosters innovation across urban life, from architecture to resource management and infrastructure design, enhancing its resilience to disasters. By generating novel solutions, such cities can both anticipate and respond more effectively to threats, developing smart, adaptive infrastructure such as early warning systems and earthquake-resistant buildings. For example:

- **Tokyo, Japan**: A global leader in earthquake and tsunami preparedness, Tokyo has advanced early warning systems, anti-seismic buildings, and robust communication networks for emergencies (The World Bank, 2019).

Figure 1: Innovation

Source: PxHerec 2024

- **San Francisco, USA**: In its seismic zone, San Francisco has retrofitted older buildings and developed real-time monitoring for seismic events, enhancing rapid response.
- **Copenhagen, Denmark**: The city manages flooding with innovative systems like "blue streets" and sustainable urban drainage systems (SUDS), combined with real-time rainwater monitoring (Backhaus & Fryd, 2012).
- **Rotterdam, Netherlands**: Below sea level, Rotterdam uses advanced water management infrastructure, including dikes and early flood warning systems, backed by big data.
- **Singapore**: Technologies such as the Marina Barrage, sensors, and climate monitoring systems ensure flood risk management and water security.
- **Santiago de Chile**: Situated in a seismic zone, Santiago has earthquake-resistant infrastructure and an advanced early warning system using real-time seismic data.

2.2. Reducing Exposure and Impact

Creative cities utilize advanced technology, strategic urban planning, and proactive management to reduce exposure to natural disasters. Here are some examples:

- **Los Angeles, USA**: Facing an increase in wildfires due to climate change, the city has implemented advanced fire-monitoring systems that use satellites and drones to detect fire outbreaks in real time. Additionally, artificial intelligence models the spread of fires, optimizing evacuation strategies and response efforts.
- **Venice, Italy**: The MOSE system, a series of mobile barriers, is activated during high tides to protect the city from flooding. This technological solution has been a critical tool for mitigating risks associated with rising sea levels (Irwin, 2020).
- **Miami, USA**: To reduce hurricane and flood risks, Miami has implemented storm protection infrastructures, including advanced levees and water pumps. The city also uses climate modeling technology to guide urban development and ensure construction takes place in less vulnerable areas.
- **Quito, Ecuador**: Quito has mitigated landslide risks by installing sensors that monitor ground movements, while also promoting reforestation and maintaining green areas as natural barriers against landslides. These efforts combine technology with nature-based solutions.
- **Bangkok, Thailand**: Bangkok addresses flood risks through a smart drainage system that incorporates canals, pumping stations, and large underground reservoirs. These elements work together to manage significant volumes of water during monsoon rains. The city also relies on

monitoring technology to predict flooding and direct mitigation efforts where they are most needed.

- **Seoul, South Korea**: Seoul has reduced its flood risk through large underground infrastructure projects, like the Cheonggyecheon River Tunnel, which diverts water and doubles as a public space during dry seasons. Real-time data monitoring ensures water flow is managed efficiently to prevent flooding in vulnerable areas.

These cities illustrate how the combination of innovative technology and careful urban planning can significantly reduce the risks and impacts of natural disasters, protecting both people and infrastructure (The World Bank, 2022).

2.3. Acceleration of Recovery

Creative cities are known for their ability to recover quickly from disasters, leveraging innovation in infrastructure, urban planning, and community engagement. Here are some notable examples:

- **Christchurch, New Zealand**: After the devastating earthquakes of 2010 and 2011, Christchurch implemented the "Re" project, a temporary shopping mall made from shipping containers. This innovative solution revitalized the local economy and attracted residents and tourists. The city also involved the community in redesigning the downtown area, resulting in a more inclusive and resilient urban environment (Brand & Nicholson, 2016).
- **Kobe, Japan**: Following the 1995 earthquake, Kobe focused on resilient urban planning by implementing earthquake-resistant building technologies. The city also developed parks that serve as temporary shelters in emergencies and established the Hanshin-Awaji Earthquake Memorial Museum to educate the public on disaster prevention.
- **New Orleans, USA**: After Hurricane Katrina in 2005, New Orleans utilized creative solutions to recover, including the Coastal Ecosystem Protection and Restoration Project, which combined engineering with wetland restoration. The city also promoted resilient housing and supported cultural revitalization to maintain community spirit.
- **Sendai, Japan**: In the aftermath of the 2011 earthquake and tsunami, Sendai stood out for its innovative recovery strategies, such as eco-districts that integrate sustainability with reconstruction. The city also prioritized public disaster education and energy efficiency, creating a more resilient and environmentally sustainable urban area.
- **Greensburg, Kansas, USA**: Following a tornado that nearly destroyed the town in 2007, Greensburg rebuilt itself as a "green city," using sustainable technologies and renewable energy. The new infrastructure emphasized energy efficiency and resilience to future disasters, making the town a model for innovative recovery.
- **Valdivia, Chile**: After the 1960 earthquake, Valdivia took advantage of the altered landscape by turning damaged areas into parks and recreational spaces. The city strengthened its warning and evacuation systems and promoted scientific research to better understand seismic risks, enhancing its long-term resilience.

These examples show how innovation in urban planning, infrastructure, and community engagement can significantly accelerate recovery from natural disasters, while also building a safer, more sustainable future.

2.4. Adaptative Cities

Creativity plays a crucial role in fostering adaptability in urban environments, enabling cities to dynamically adjust to various challenges, such as climate change, natural disasters, and social or

economic shifts. Cities that embrace creative solutions develop flexible infrastructures and systems that can be easily modified to respond to evolving threats or conditions. Below are examples of cities that have successfully applied creative approaches to enhance their adaptability:

- **Rotterdam, Netherlands**: Rotterdam has implemented an adaptive approach to water management. Public plazas can convert into temporary pools during heavy rains, and the city has also developed "water squares" that serve as recreational areas but flood in a controlled manner during storms. Rotterdam's "Climate Proof" program aims to make the city fully climate-resilient by 2025 (Dircke & Molenaar, 2015).
- **Copenhagen, Denmark:** Copenhagen uses a "sponge city" strategy to manage increased rainfall and potential flooding. Parks, plazas, and streets are designed to retain and drain rainwater naturally. The city's water management systems are highly adaptable, with infrastructure that can be modified based on future needs.
- **Singapore:** Singapore has adopted a comprehensive approach to climate challenges through green infrastructures like vertical gardens and green roofs. It uses advanced technology, such as sensors and real-time data analytics, to monitor and adapt its water and energy management systems. The Marina Barrage serves as both a flood control system and a water reservoir.
- **Boston, USA:** Boston's "Climate Ready Boston" initiative integrates adaptive coastal infrastructure, such as parks that double as flood barriers, and modular buildings that can adjust to changing climate conditions or rising sea levels (Boston, 2016).
- **Sydney, Australia:** Sydney employs tactical urbanism, using temporary and adjustable interventions in public spaces. These flexible spaces can be repurposed based on changing needs, whether for disaster preparedness or different weather conditions. The city also adapts infrastructure to withstand extreme events like wildfires and floods.
- **New York, USA:** After Hurricane Sandy in 2012, New York implemented "The Big U," an adaptive flood protection system that surrounds Lower Manhattan. This project combines recreational areas with flood barriers and includes flexible building standards to adjust for rising sea levels (Lewis, 2023).
- **Tokyo, Japan:** Tokyo has invested in earthquake-resistant infrastructure with advanced anti-seismic technology that adapts based on earthquake intensity. Additionally, Tokyo has developed flexible transportation and communication systems that can be rapidly reconfigured in response to disasters like earthquakes and tsunamis.

These cities showcase how creativity and innovation in urban planning and infrastructure design can make cities more adaptable and prepared for future challenges. By integrating flexible systems, they not only withstand disasters but also create more resilient and sustainable communities.

2.5. Community Engagement and Collaboration

Creative cities foster citizen participation and collaboration across various sectors of society. This inclusive approach ensures that communities are actively engaged in risk management, allowing solutions to be tailored to their specific needs. An organized and creative civil society is better equipped to respond collectively to crises, enhancing resilience. Below are examples of cities that have excelled in promoting community involvement, which has strengthened their resilience to natural disasters:

- **Barcelona, Spain:** Barcelona's "Superilles" (Superblocks) program has transformed urban spaces to be more sustainable and livable by actively involving residents in decision-making.

This community-driven approach has fostered social cohesion, which enables a faster, more coordinated response during emergencies.

- **Portland, United States:** Portland's strong sense of community and commitment to sustainability has led to programs where residents collaborate with authorities to create resilient public spaces, such as community gardens that act as natural flood barriers. This consistent collaboration has built a well-prepared population ready to face disasters.
- **Christchurch, New Zealand**: After the earthquakes in 2010 and 2011, Christchurch used public consultations to involve residents in the city's redesign. This collaboration helped accelerate reconstruction and strengthened the social fabric, making the community more resilient to future disasters.
- **Bogotá, Colombia:** Bogotá's tactical urbanism initiatives involve citizens in transforming their neighborhoods, from creating public spaces to road safety programs. These interventions, often temporary but impactful, foster collaboration and strengthen social cohesion, improving the city's ability to face natural disasters.
- **Los Angeles, United States:** The "Ready Your LA Neighborhood" (RYLAN) program promotes community participation in disaster preparedness. It trains residents to organize at the neighborhood level, developing personalized emergency plans, which has resulted in a more prepared and resilient community.
- **Kobe, Japan:** After the 1995 earthquake, Kobe adopted a reconstruction approach that involved citizens in planning new infrastructure. This collaboration between residents, government, and businesses not only rebuilt the city but also created a more cohesive community, better prepared for future crises.
- **Medellín, Colombia:** Medellín's programs such as "Bibliotecas Parques" and the "Metrocable" have improved urban infrastructure while promoting social inclusion. By involving citizens, especially in vulnerable neighborhoods, the city has strengthened social cohesion and reduced vulnerability to both natural and social disasters (Capillé, 2018).

These cities illustrate how community participation and collaboration between citizens and authorities can significantly boost a city's resilience, enhancing its ability to respond and recover from natural disasters and other challenges.

2.6. Economic and Cultural Readiness

Creativity plays a significant role in driving economic and social diversification, which reduces a city's vulnerability to natural disasters. A diverse economy is less likely to collapse in the face of extreme events, and a diverse, creative population offers a broader range of resources and strategies to handle adversity. Cities with robust innovation ecosystems can leverage local technology and collaborative networks to quickly recover after disasters. This diversification enables greater flexibility and resilience, fostering a more dynamic economy that can adapt and rebuild more effectively.

Capacity for Learning and Continuous Improvement: Creative cities are characterized by their ability to continuously learn and improve. Creativity fosters a mindset of experimentation and adaptation, where cities are willing to test new ideas, learn from past experiences, and adjust their strategies accordingly. This approach ensures that cities remain flexible and resilient in the face of future challenges. By integrating lessons from previous crises, creative cities continuously refine their preparedness, making them better equipped to face new risks.

Culture of Resilience: A creative city often fosters a culture of resilience, where innovation is seen as a crucial tool for overcoming challenges. This culture promotes critical thinking, mental flexibility, and a proactive attitude toward adversity. Such cities are better equipped to confront and overcome crises constructively, as they prioritize innovation in infrastructure, policy, and

community engagement. A strong culture of resilience ensures that cities can adapt to changing conditions and emerge stronger from disruptions.

Some examples of cities:

- **Tokyo, Japan:** Tokyo's diversified economy, with strong sectors in technology, finance, and advanced manufacturing, makes it highly resilient. The city's social and cultural diversity, supported by inclusive policies, further strengthens its ability to handle crises, such as earthquakes. Tokyo's adaptability demonstrates how a robust economy and inclusive society can foster resilience (Tokyo Metropolitan Government, 2023).
- **Zurich, Switzerland**: Zurich's strength lies in its diversified economy, with key sectors including banking, insurance, and biotechnology. This economic diversity, combined with strong social cohesion fostered by inclusive policies, allows Zurich to remain resilient in the face of both economic and natural crises. The city's high quality of life and sense of community reinforce its preparedness (OECD, 2020).
- **Copenhagen, Denmark:** Known for its ability to learn and continuously improve, Copenhagen is a leader in sustainability and innovative urban solutions. By integrating adaptive infrastructure based on lessons learned from previous floods, the city exemplifies continuous improvement, making it increasingly resilient to environmental challenges (UNESCO, 2021).
- **Reykjavik, Iceland**: Reykjavik's resilience stems from its ability to continuously adapt to its harsh geological environment. The city has developed innovative geothermal energy strategies and climate-resilient infrastructure, demonstrating how cities can thrive by constantly improving and adjusting to new challenges (OECD, 2020).
- **Wellington, New Zealand**: Wellington has cultivated a strong culture of resilience, largely due to its location in a seismically active zone. The city engages its community in disaster preparedness and regularly implements emergency drills, creating a proactive and resilient population ready to respond to crises (New Zealand Government, 2020).
- **San Francisco, United States**: San Francisco's resilience is built around its preparation for earthquakes and other natural disasters. The city has invested in earthquake-proof infrastructure, early warning systems, and community education, fostering a culture of resilience and preparedness (World Bank, 2019).

3. Research & Findings

3.1. Research methodology.

3.1.1 Resilience Research

Urban resilience can be defined as: "The ongoing capacity of cities to absorb, adapt, transform and pre-pare for shocks and stresses along the economic, social, institutional and environmental dimensions, with the aim of maintaining the functions of a city and improving response to future shocks." (OECD, 2018).

The OECD further provides a solid framework, based on city disaster preparedness by defining 4 sectors that drive resilience in cities:

A resilient society is inclusive, cohesive, and able to withstand and recover from adverse events. (OECD, 2018). It is measured through indicators such as demographic diversity, poverty levels, household income, and access to essential services. Strong community networks, security, and citizen well-being are also critical, as a healthy and well-connected population can better respond and adapt to crises. The integration of vulnerable populations into social protection systems and the promotion of social cohesion are also vital elements that strengthen societal resilience (UN-Habitat, 2017).

- **Barcelona, Spain** has demonstrated the value of community engagement through its **Superilles** (Superblocks) initiative, which transforms urban spaces to be more sustainable and livable. This participatory approach strengthens community ties, fostering social cohesion that improves resilience during emergencies (Capillé, 2018).
- **Los Angeles, USA** promotes community preparedness with its **Ready Your LA Neighborhood (RYLAN)** program, which trains residents to develop personalized emergency plans, strengthening their capacity to respond collectively to disasters like earthquakes and wildfires (City of Los Angeles, 2024).

The natural environment of a resilient city must be healthy and robust (OECD, 2018). Factors such as population density, access to green spaces, sustainable land use, and proximity to open areas all contribute to urban quality of life. An infrastructure that meets basic needs and coherent land-use policies are essential for a city to withstand environmental impacts and promote sustainable development. Enhancing ecological resilience also involves addressing climate change adaptation strategies, as outlined in the Paris Agreement and the Sendai Framework for Disaster Risk Reduction (UNISDR, 2015).

- **Copenhagen, Denmark** is renowned for its **sponge city** approach, which uses green infrastructure like parks and plazas to manage rainwater and mitigate flood risks. This innovative strategy allows the city to naturally drain rainwater and reduce the impact of extreme weather events (Backhaus & Fryd, 2012).
- **Rotterdam, Netherlands** employs flexible infrastructures, such as its **water squares**, which function as recreational areas during dry weather but transform into temporary water basins during floods. These adaptive solutions are part of Rotterdam's **Climate Proof** program, designed to make the city climate resilient by 2025 (Dircke & Molenaar, 2015).

In governance, resilience involves clear and effective leadership, strategic and integrated management, and the presence of competent and transparent public institutions (OECD, 2018). Government revenue, community participation, and the decentralization of power to local and regional governments are key indicators. Strong governance is vital for effective crisis response and recovery. The UN's "Making Cities Resilient" campaign emphasizes the role of local governments in developing urban policies that enhance disaster preparedness and improve governance capacity (UNDRR, 2020).

- **Kobe, Japan** demonstrated strong governance after the 1995 earthquake by involving citizens in planning and reconstruction efforts. This collaboration between local government, residents, and businesses not only rebuilt the city's infrastructure but also strengthened its social fabric, enhancing the community's preparedness for future disasters. (World Bank, 2022)
- **Tokyo, Japan**, with its advanced **early warning systems** and earthquake-resistant infrastructure, has shown the importance of proactive governance in minimizing the impacts of natural disasters. Tokyo's government has integrated big data and technology into its emergency planning systems to better predict and manage risks. (The World Bank, 2019)

A resilient economy is diverse and dynamic, capable of generating sustainable growth and providing employment to its citizens (OECD, 2018). Economic indicators proposed by the OECD include GDP growth rate, unemployment, business creation and failure rates, and the demographic composition of the employed population. These factors together provide insight into the economic stability and adaptability of a city, as well as its ability to offer job opportunities and adjust to economic changes. A resilient economy not only responds to crises but also promotes equitable development, as highlighted by the New Urban Agenda (Habitat III, 2016).

- **Zurich, Switzerland** benefits from its diversified economy, including sectors like banking, insurance, and technology, which help the city maintain stability in the face of economic and

natural crises. Zurich's strong social policies further reinforce its resilience. *(World Bank, 2022)*

- **San Francisco, USA**, located in a highly seismic zone, has invested in earthquake-resistant technologies and resilient infrastructure. The city's diverse economy, driven by technology, finance, and innovation, allows it to recover quickly from disasters. *(World Bank, 2019)*

Figure1: San Francisco skyline at sunset

Source: Goodfon, n.f.

Building on the OECD framework, the World Risk Index (WRI) provides a comprehensive methodology to quantify disaster risk by evaluating both exposure to extreme events and vulnerability. The WRI combines social, economic, and environmental factors with an emphasis on the preparedness and response capacity of cities. Since its development in 2011 by the Alliance for Development Aid (Bündnis Entwicklung Hilft) in collaboration with the Institute for International Law of Peace and Armed Conflict (IFHV) at Ruhr University Bochum, the WRI has been an essential tool for assessing disaster risks on a global scale (Bündnis Entwicklung Hilft, 2019).

The WRI methodology employs a weighted approach to the indicators used in its four main dimensions: exposure, vulnerability, susceptibility, and adaptive capacity. By applying these indicators, the WRI seeks to identify regions where the impact of disasters would be most devastating due to a combination of high exposure and population vulnerability (Bündnis Entwicklung Hilft, 2019). This approach aligns with the Sendai Framework for Disaster Risk Reduction (2015-2030), which advocates for a proactive risk assessment and management strategy across all levels of government.

As cities are increasingly facing diverse adverse events, it is essential to recognize that each city's geographic location, socioeconomic conditions, and unique characteristics influence its level of risk. Hazards, defined by the United Nations Office for Disaster Risk Reduction (UNDRR) as "dangerous phenomena, substances, human activities, or conditions that may cause loss of life, injury, property damage, or environmental harm," can be classified into two main categories: natural hazards and anthropogenic hazards (UNDRR, 2019).

Natural hazards, such as earthquakes, floods, and hurricanes, are driven by environmental processes, while anthropogenic hazards stem from human activities such as industrial accidents, pollution, and social unrest. Both types of hazards significantly impact urban areas and can exacerbate pre-existing vulnerabilities, particularly in densely populated or economically disadvantaged regions (World Bank, 2019). This dual classification is crucial for understanding the multifaceted nature of urban risks, and it underscores the need for cities to integrate both preparedness and risk reduction strategies into their resilience planning.

In assessing urban resilience, it is not enough to solely focus on a city's preparedness for disasters; it is equally important to evaluate the specific risks that a city faces. A city's level of resilience is influenced by both its preparedness measures and its risk exposure. As stated by the United Nations Development Programme (UNDP), reducing disaster risk involves a combination of strengthening preparedness mechanisms and minimizing exposure to hazards (UNDP, 2020). Therefore, cities must prioritize a holistic approach that considers both dimensions—preparedness and risk—to enhance their overall resilience.

3.1.1.1 Resilience Index

After an in-depth contextual analysis, the selection of key dimensions for assessing urban resilience was carried out by comparing multiple theoretical frameworks and evaluating their application in real-world case studies. The OECD dimensions, which encompass economic, social, cultural, infrastructural, and governance aspects, were supplemented with additional dimensions identified during the contextual analysis.

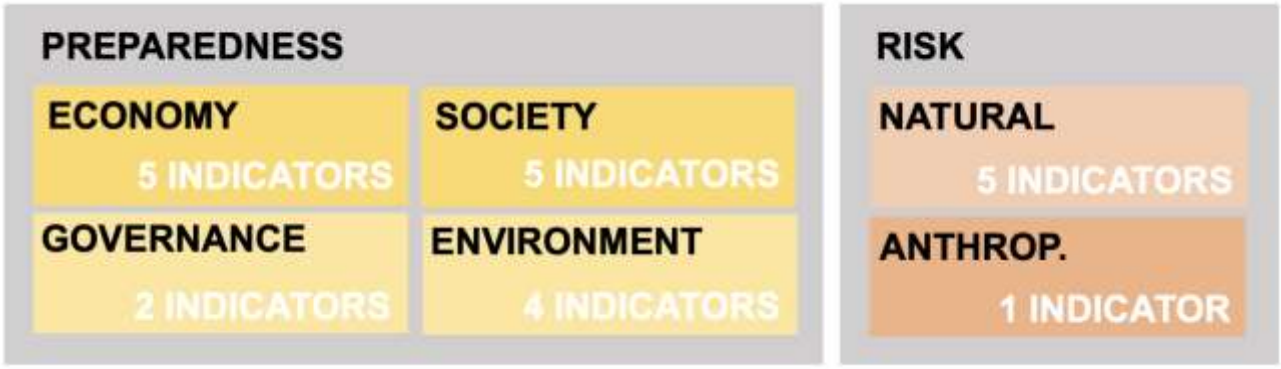
This process led to the identification of key additional dimensions to assess not only the exposure of cities to specific risks, both natural and anthropogenic, but also their preparedness to face them.

As a result, it was established that to calculate a more precise and illustrative resilience index, it is crucial to consider both the cities' preparedness (OECD dimensions) and their level of exposure to risks. This approach offers a more comprehensive view of their vulnerability and response capacity.

After identifying the key dimensions, the next step was to select specific indicators that were both quantifiable and representative of each dimension. This process involved gathering detailed information from a variety of reliable sources, including government databases, international organization reports, and academic studies. The data collected covered the dimensions of resilience, such as economic, environmental, social, cultural, and governance-related indicators, along with indicators reflecting exposure to both natural and anthropogenic risks.

The selection of indicators was guided by the need to ensure they were applicable to all cities included in the study and capable of providing precise and relevant measurements for each dimension. Special attention was given to ensuring that the data were comprehensive, up-to-date, and comparable across the different cities.

Figure 1. Figure showing the dimensions of resilience and the number of indicators used for measuring each sub-dimension.



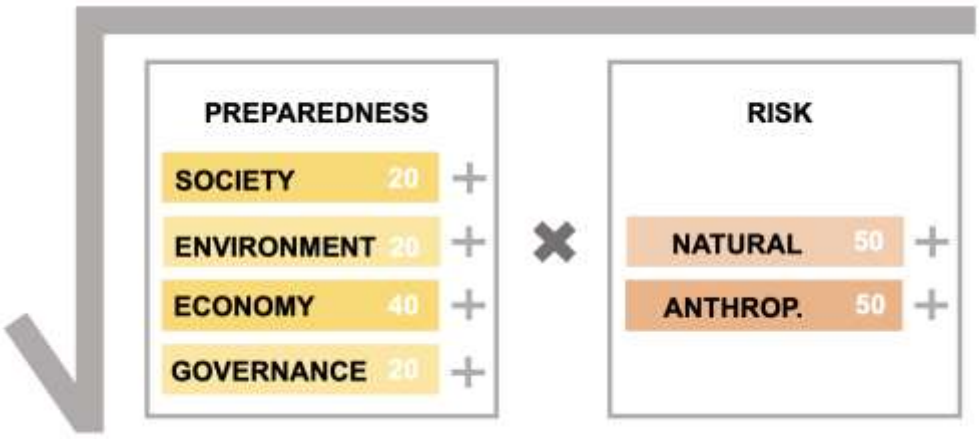
Source: Own elaboration, 2025.

A finalized list of quantifiable and relevant indicators was established, categorized into two main groups: preparedness and exposure. Additionally, a complete dataset was compiled for all indicators across the 175 cities from the Global Observatory of Attractive Cities for Talent (Ondiviela, 2021).

After gathering the data for each city, the next step was to assign weights to the indicators, giving each one a relative importance based on its relevance in evaluating urban resilience. To ensure the accuracy of this weighting process, meetings were held with Professor José Antonio Ondiviela, a Smart Cities expert, who contributed his expertise in identifying the most critical indicators.

With the data collected and the indicators weighted, the next step was to implement the aggregation method for each of the 175 cities. This process involved normalizing the data to ensure comparability across cities. Techniques such as the min-max scaling were applied, and additional calculations were made to reverse the effect of variables that negatively impacted the resilience index. This adjustment ensured that variables with adverse effects were appropriately reflected in the final score. Following the WRI methodology, the geometric average was used to calculate the resilience results.

Figure 2. The formula used to calculate the weighted resilience index is shown. The weights assigned to each sub-dimension are also displayed.



Source: Own elaboration, 2025.

As a result, a resilience index was calculated for each of the 175 cities, providing a comparative measure of their ability to withstand and adapt to various risks.

3.1.2 Creativity Research

Urban creativity can be defined as:
"the capacity to generate ideas, products, or services that transform the urban environment and improve quality of life through the use of cultural, technological, economic, and social resources" (Florida, 2002, pp. 21-22). The term popularized by Richard Florida in his book *The Rise of the Creative Class* (2002), refers to a segment of the workforce whose economic function is to create new ideas, products, and services. This class includes professionals in fields like science, technology, design, art, and media. Florida argues that cities that can attract this creative class experience greater economic success due to their ability to innovate.

In addition to cultural and artistic contributions, creative cities are linked to technological innovation. Creative clusters, startup hubs, and innovation districts often emerge in cities that support entrepreneurship and technological advances. The Global Innovation Index (GII), for instance, examines how cities and nations foster innovation through education, research, and industry partnerships.

In this context, the development of a creative city index requires identifying several key dimensions that address the most relevant aspects of creativity in urban settings. Based on previous

studies and recent analyses, these dimensions include the creative economy, culture and diversity, talent and education, innovation and intellectual property, government support, and public perception and reputation.

- **Creative Economy**: Creative industries such as design, fashion, film, music, and advertising play a crucial role in the economic growth of cities. According to UNCTAD (2010), these industries are a key source of employment and value generation in urban environments, where their impact can be measured through their contribution to local GDP and the number of jobs in creative sectors.
- **Culture and Diversity**: Creative cities promote cultural diversity as a driver for innovation. The presence of a robust cultural offering, such as international events and festivals, and the inclusion of different demographic groups foster a collaborative environment that stimulates creativity (Landry, 2008). Cities with high levels of cultural diversity are more likely to generate disruptive ideas and encourage cultural exchange.
- **Talent and Education**: The ability to attract, retain, and develop talent is essential for urban creativity. High-level educational institutions, as well as a skilled workforce, are fundamental to the growth of creative sectors. UNESCO's Global Report on Education and Culture (2013) emphasizes that access to higher education and training in creative disciplines are essential for continuous innovation in cities.
- **Innovation and Intellectual Property**: Technological innovation and the protection of intellectual property are key pillars of creative cities. According to the Global Innovation Index (WIPO, 2023), cities that invest in research and development (R&D) and foster innovative startups are those that lead in technological advancements and applied creativity. Moreover, the number of patent and trademark applications is a clear indicator of urban creative dynamism.
- **Government Support:** Government support in the form of funding and cultural policies plays a crucial role in sustaining urban creativity. According to UNESCO (2024), cities that allocate greater financial resources and facilitate policies to support culture and innovation tend to have more robust creative ecosystems.
- **Public Perception and Reputation**: Finally, a city's reputation as a global creative hub influence both its ability to attract talent and its economic competitiveness. Indicators such as world's best city rankings (World's Best Cities, 2023) reflect how cities are perceived in terms of creativity, innovation, and quality of life.

3.1.2.1 Creativity Index

Following the identification of the key dimensions, specific indicators were selected to provide measurable and reliable data for each dimension. Each dimension was broken down into subdimensions, ensuring that all critical aspects of urban creativity were captured. To ensure the accuracy and relevance of the Creative City Index, these indicators were weighted based on their relative importance in fostering urban creativity.

Figure 3. Displays the dimensions used to measure a city's creativity and the number of indicators per dimension

Source: Own elaboration, 2025.

The weighting process was informed by meetings with experts in urban development and innovation, like the consultations with Smart Cities expert José Antonio Ondiviela for the Resilience Index. Weights assigned are available in the appendix 2.

Once the indicators were selected and weighted, the next step was to normalize the data to ensure comparability across the 175 cities in the study. Techniques like the min-max scaling were applied, which adjusted the values of the indicators to a uniform scale, allowing for a fair comparison between cities. Additionally, certain variables that negatively impacted the Creative City Index were adjusted to reflect their proper influence, ensuring that negative impacts were correctly represented in the final score.

After normalization, an aggregation method was applied to calculate the Creative City Index for each city. This involved computing a weighted average of the key dimensions to provide a balanced assessment of each city's creative strengths and weaknesses. The weights that were assigned to each dimension where the following:

This approach provided a comprehensive view of each city's creative capacity, incorporating economic, cultural, social, and policy-driven factors. As a result, the Creative City Index was calculated for all 175 cities, offering a comparative measure of their potential to foster creativity, innovation, and cultural vibrancy.

3.2 Findings

The initial hypothesis proposed that creativity and innovation are key drivers in enhancing urban resilience across multiple dimensions. Creative cities are expected to leverage innovation in urban planning, infrastructure design, and resource management to improve their preparedness for potential threats. Moreover, creativity is believed to reduce exposure to risks, accelerate recovery, and foster adaptability and community engagement. Cities such as Tokyo, San Francisco, Copenhagen, Rotterdam, and Singapore exemplify how innovation strengthens resilience, while Los Angeles, Venice, Quito, and Seoul illustrate how creative solutions can mitigate risks. Cities like Christchurch, Kobe, and New Orleans showcase the role of innovation in speeding up recovery efforts. Additionally, Barcelona, Portland, and Bogotá demonstrate how creativity fosters civic engagement and collaboration, further strengthening resilience.

The analysis confirms a strong link between creativity, preparedness, and resilience. A very strong correlation (0.95) between the Resilience Index and Preparedness indicates that cities with higher preparedness levels are generally more resilient. This finding underscores the importance of well-prepared cities, characterized by robust infrastructure, effective governance, and strategic urban planning, in managing both short-term shocks and long-term stresses. Preparedness thus becomes a cornerstone of resilience, with proactive governance, disaster readiness, and strategic

planning playing crucial roles in ensuring that cities can absorb, adapt to, and recover from crises. Cities that invest in preparedness consistently show higher resilience levels.

Additionally, the correlation between the Creative Index and Preparedness (0.71) suggests that cities with thriving creative sectors are often better equipped to face challenges. Creativity fosters innovation, technological advancements, and adaptive solutions, enhancing a city's capacity to plan for and mitigate risks. A strong creative economy also supports the development of effective policies, infrastructure, and preparedness strategies. Consequently, creativity not only drives innovation but also strengthens a city's readiness to handle crises, further contributing to its overall resilience.

Furthermore, a moderate positive correlation (0.61) between the Resilience Index and the Creative Index indicates that cities with greater creative potential tend to be more resilient. Although this relationship is not as strong as the one between resilience and preparedness, it suggests that creativity plays a complementary role in enhancing resilience. However, other factors, such as governance, infrastructure, and public services, are more critical in determining a city's ability to withstand and recover from adverse events. Nevertheless, creativity serves as an important complementary factor, fostering problem-solving abilities and innovation, which can further bolster resilience.

In conclusion, the analysis emphasizes the critical role of preparedness in achieving resilience while highlighting creativity's significant contribution to enhancing preparedness. Cities that prioritize creativity, innovation, and strong governance—such as those highlighted in the hypothesis—tend to perform better in both resilience and preparedness, validating the importance of creativity as a strategic asset for urban development.

3.2.1 Innovation & Preparation

The analysis reveals key insights into how creativity, innovation, and intellectual property protection influence a city's capacity to be prepared for challenges and crises. Below are the main findings:

Creative Economy & Preparedness have a moderate positive correlation 0.54 was found between the creative economy and preparedness. This suggests that cities with stronger creative economies tend to be better prepared for challenges, although the relationship is not exceptionally strong. Creative industries likely contribute by fostering innovation and adaptive solutions that enhance a city's ability to respond to crises.

Intellectual Property & Innovation & Preparedness hold strong positive correlation 0.76, indicating that cities that invest in intellectual property protection and innovation systems are significantly better prepared to handle crises and adapt to changing circumstances. This relationship underscores the importance of technological advancement and creativity in developing adaptive infrastructure and effective crisis management strategies.

A comparison between the most prepared cities (top 25%) and the least prepared cities (bottom 25%) revealed substantial differences in their levels of creativity and innovation:

Table 1. Displays the ratings received by the dimensions specified in the columns for the group of cities specified in the rows.

	Creative Economy	Intellectual Property & Innovation	Preparedness
Top Prepared Cities	2.12	5.42	8.35
Bottom Prepared Cities	1.29	2.34	3.10

Source: Own elaboration, 2025.

Cities with higher levels of preparedness have significantly stronger intellectual property and innovation systems 5.42 vs. 2.34 and more developed creative economies 2.12 vs. 1.29. This supports the hypothesis that innovation in urban life and resource management is crucial for improving preparedness, as it enables cities to implement novel solutions that enhance their resilience.

The strong correlation 0.76 between innovation and preparedness indicates that cities with the capacity to innovate are better equipped to develop adaptive infrastructure, which helps them respond to and anticipate crises more effectively.

This analysis validates the hypothesis that creativity and innovation lead to better preparedness, allowing cities to implement solutions that strengthen their resilience in the face of global challenges.

3.2.2 Reducing Exposure impact.

In creative cities, innovation plays a crucial role in reducing both exposure to and the impact of natural disasters and other threats. Through the development and implementation of advanced technologies, strategic urban planning, and proactive environmental management, these cities are able to devise effective strategies that mitigate risks, decrease vulnerability, and limit the damage caused by inevitable crises. The ability to foresee, adapt, and respond to potential hazards allows these cities to protect their populations, infrastructures, and economies more efficiently than their less innovative counterparts.

Innovative solutions often involve integrating real-time data, predictive technologies, and nature-based systems into urban planning frameworks. This multifaceted approach enables creative cities not only to react to disasters but to anticipate them, preventing more severe consequences. These cities focus on proactive risk management, ensuring that adaptive infrastructures and early warning systems are in place to minimize both immediate impacts and long-term vulnerabilities.

Several cities have demonstrated remarkable progress in reducing their exposure and risk to natural disasters through the following methods:

- **Advanced Technologies:** Many cities leverage cutting-edge technologies such as satellite monitoring, artificial intelligence, and drones to predict and track potential threats like fires, floods, and earthquakes. By integrating these technologies with real-time data, cities can respond faster and more precisely to emerging crises, reducing the likelihood of catastrophic damage.
- **Urban Planning Strategies:** Creative cities employ smart planning techniques that prioritize risk reduction. These include zoning policies that restrict development in high-risk areas, retrofitting vulnerable infrastructure, and designing multi-functional spaces that can serve as flood zones or evacuation points during emergencies. Urban design in these cities not only addresses aesthetic and functional needs but also incorporates resilience into its core.
- **Environmental Management:** By focusing on sustainable environmental practices, such as reforestation, wetland restoration, and the creation of green urban spaces, cities reduce their exposure to environmental risks. These natural barriers help mitigate the effects of climate-related threats like floods and landslides, while also promoting biodiversity and enhancing the overall resilience of the city.
- **Early Warning Systems:** Cities with strong innovation capacities often implement sophisticated early warning systems that provide timely alerts about impending disasters. These systems give residents and authorities crucial time to prepare and respond, significantly reducing casualties and damage.

By embracing innovation, creative cities are better positioned to reduce the risks and impacts associated with natural disasters. This proactive approach not only enhances their resilience but also creates a safer and more sustainable urban environment.

3.2.3 Acceleration of Recovery

This hypothesis posits that cities with stronger creative economies and innovation capabilities can recover more quickly from crises.

Coming back to the correlation mentioned between preparedness and Intellectual Property & Innovation suggests that cities investing in innovation are better prepared, which likely leads to faster recovery. Both San Francisco and Berlin have demonstrated exceptional resilience through innovation, responding rapidly to economic and environmental shocks. San Francisco's ability to recover quickly from the COVID-19 pandemic, driven by its strong technology and creative sectors, positioned the city as a model of rapid economic rebound, with high vaccination rates and a coordinated public health response (Lockhart, 2021, June 15). Meanwhile, Berlin's focus on innovation and technology, alongside its sustainable urban development initiatives, has solidified its role as a resilient economic hub, capable of adapting to global challenges (IP Global, 2024, February 1)

The correlation -0.84 between Non-Natural Risk and Preparedness shows that cities facing lower risks (economic crises, social disruptions) are also the ones investing more in preparedness. Even though it is true the geolocalization and other variables impact heavily in the risk that city faces Cities like Amsterdam and Stockholm, which score high in both Preparedness and Intellectual Property & Innovation, are well-equipped to accelerate recovery through innovative recovery plans and crisis management strategies.

3.2.4 Adaptive Cities

Creative cities can adapt to changing environments and challenges more effectively, especially through innovation in urban planning and governance.

Governance Efficiency & Preparedness are closely linked, with a correlation of 0.77, indicating that cities with higher governance efficiency are better prepared for various challenges. This preparation, in turn, helps cities adapt more easily to new and evolving circumstances. Cities like Zurich and Oslo exemplify this relationship, showcasing how strong governance fosters adaptability and resilience, especially through the integration of creativity and innovation into urban infrastructure.

Zurich stands out in flood management and resilience efforts. The Zurich Flood Resilience Program, a collaboration between Zurich Insurance Group and international organizations, has played a pivotal role in developing strategies that mitigate flood risks while improving the adaptive capacity of communities. By combining interdisciplinary approaches with long-term adaptive planning, Zurich has become a global leader in flood resilience (Zurich Insurance Group, 2014). Additionally, Zurich regularly ranks high in smart city indices, reflecting its forward-thinking urban policies and strategic use of technology to enhance the quality of life for its residents (Smart Cities World, 2023).

Oslo is also recognized for its sustainable and innovative governance. The city has implemented various technological advancements, including environmental sustainability initiatives, which helped it win the title of European Green Capital in 2019. Oslo's smart city strategies have made it one of the most resilient urban centers, combining governance and technology to tackle climate challenges and foster urban adaptation. Its inclusive approach to governance further reinforces the city's capacity to address environmental and economic shocks effectively (World Technology Leader, 2023).

Both Zurich and Oslo illustrate how efficient governance, when coupled with innovative solutions, enables cities to become more adaptable and resilient to crises.

3.2.5 Community Engagement and Collaboration

To validate the role of community engagement as a key factor in both resilience and how creative culture can contribute to resilience, there are several key variables in the dataset that capture aspects of social participation, governance, and cultural engagement. Here are some relevant variables from your dataset:

The analysis of creativity and its relationship with other civic and social variables reveals several important insights. A moderately strong correlation 0.59 between tolerance to immigrants and creativity suggests that creative cities tend to demonstrate higher inclusivity toward immigrant communities. Immigrants often bring diverse perspectives, innovative ideas, and entrepreneurial spirit, contributing to the city's creative output. Similarly, cities with a higher level of civic engagement 0.50 tend to foster a more dynamic creative sector. Public participation in governance and local initiatives promotes innovation, as engaged citizens actively contribute to cultural projects and creative industries. In contrast, weaker correlations with social capital 0.26 and tolerance to minorities 0.25 suggest that while inclusivity and strong social networks are important, other factors—such as education, infrastructure, and supportive cultural policies—play a more direct role in driving creativity.

This revised focus suggests that creative cities are characterized by high tolerance toward immigrants and a strong sense of public engagement, rather than the reverse relationship where civic participation necessarily leads to creativity. Cities like New York and London, known for their vibrant creative sectors, exemplify this trend, benefiting from diverse immigrant populations and active civic participation.

In New York, the city's participatory budgeting initiatives, such as "The People's Money" program, have actively engaged residents, including immigrant communities, to vote on local budgeting decisions regardless of their citizenship status. This civic engagement has helped foster a more inclusive and creative environment, where diverse immigrant populations contribute to cultural initiatives, such as public arts and community-driven projects. New York's immigrant artists have also played a significant role in sustaining its arts ecosystem, with immigrants making up nearly 29% of the city's artist population, underscoring their role in driving creative and cultural innovation (NYC.gov, 2024; Center for an Urban Future, 2024).

Similarly, London has consistently been recognized for its immigrant-friendly policies and active civic participation, which contribute to its thriving creative industries. The city's diverse cultural fabric, supported by robust public engagement, has been vital in making London one of the world's leading creative capitals. London's reputation as a creative hub is reinforced by the significant role of immigrants in driving the city's innovation and cultural output, as seen in sectors such as design, technology, and the arts.

Together, these cities exemplify how strong civic engagement and tolerance toward immigrants contribute to a city's creative potential and vibrancy, validating the hypothesis that inclusivity and active public participation are critical drivers of urban creativity (Center for an Urban Future, 2024; NYC.gov, 2024).

In terms of resilience, the correlations suggest a strong relationship between civic engagement 0.66, social capital 0.62, and resilience, confirming that well-connected communities are better equipped to withstand and recover from crises. Cities with engaged citizens and robust social networks can collectively respond to challenges, fostering quicker recovery and adaptability. Additionally, cities with higher tolerance to minorities 0.62 and immigrants 0.58 also demonstrate higher resilience, as inclusivity contributes to social cohesion and adaptability. This highlights the importance of embracing diversity and community participation in building resilient urban environments.

In conclusion, while creativity is moderately supported by civic engagement and tolerance, it is more directly influenced by other factors such as infrastructure and policy. On the other hand, resilience strongly benefits from community participation, social cohesion, and inclusivity. These findings suggest that cities aiming to be both creative and resilient must foster civic engagement

and inclusivity while also investing in policies and infrastructure that directly support innovation and adaptability.

3.2.6 Economic and Cultural Readiness

To further validate the hypothesis that states that cities with diversified economies and rich cultural environments are more economically and culturally ready to handle and recover from crises and extend the analysis, it is important to consider the relationship between creative economies and economic diversification. According to UNESCO, cities that foster creative industries tend to have more diversified economies. This diversification is driven by the creative sector's ability to stimulate innovation, attract talent, and foster entrepreneurship across multiple industries, such as technology, media, and the arts. Creative cities often develop robust ecosystems where traditional industries overlap with creative sectors, enhancing economic resilience and flexibility. This diversification allows cities to better absorb and recover from economic shocks, as the creative industries contribute to the overall dynamism and adaptability of the economy. (UNESCO, 2023).

In cities like Zurich and Singapore, creative industries are integrated with robust financial and technological sectors, which allows for greater adaptability and resilience in times of crisis. UNESCO emphasizes that creative economies tend to thrive in cities that prioritize inclusivity and innovation, supporting both cultural development and economic diversification. This dynamic helps cities better absorb economic shocks and maintain long-term sustainability.

Therefore, cities with vibrant creative economies, such as Zurich and **Singapore, benefit from having a more diversified economy. This not only enhances their ability to withstand economic challenges but also strengthens their resilience by fostering innovation and creating more job opportunities across sectors (UNESCO, 2023).

The correlation between Cultural Factors and Preparedness 0.83 also ties into this. Cities with a strong cultural and creative presence, like Vienna and Amsterdam, benefit from having a rich cultural infrastructure that supports diverse industries. In these cities, creative sectors like the arts, design, and architecture interact with technology and business, creating a multifaceted economy. This mix not only enhances economic readiness but also fosters social cohesion, allowing for greater flexibility in crisis management. By promoting cultural diversity and creative industries, cities enhance both their economic and social resilience, making them more adaptable in the face of crises.

In conclusion, creative economies are integral to economic diversification, which is a key factor in crisis preparedness and recovery. Cities that invest in both financial and creative sectors benefit from increased innovation, adaptability, and resilience. The UNESCO's findings support this, showing that cities with thriving creative industries are better positioned to recover from disruptions, further validating the hypothesis that diversified economies and cultural vibrancy contribute significantly to a city's overall readiness and resilience.

4. Conclusions

This study explored the hypothesis that creativity and innovation are key drivers of urban resilience, confirming that cities with a strong creative capacity are better prepared to handle challenges, recover from crises, and adapt to changing environments. The research found a clear correlation between creativity and resilience, highlighting several key points:

- **Preparedness and Innovation**: Cities that prioritize innovation in their planning, infrastructure, and resource management are generally more prepared for adverse events. The correlation between the Creative Index and Preparedness (0.71) illustrates how creativity fosters adaptive solutions, technological advancements, and effective policies, which enhance a city's ability to mitigate risks and improve resilience. Cities like Tokyo, San Francisco, and Copenhagen exemplify how creative solutions contribute to disaster preparedness.

- **Reducing Exposure and Impact**: Innovation plays a crucial role in reducing the exposure and impact of natural disasters and other crises. Creative cities, such as **Los Angeles** and **Venice**, have implemented advanced technological and urban planning solutions that effectively minimize vulnerabilities, demonstrating how innovation can mitigate the risks posed by environmental and social challenges.
- **Acceleration of Recovery**: Creative cities tend to recover more quickly from crises due to their innovation-driven strategies. The study found that cities with strong creative sectors and a focus on technological advancement, like **San Francisco** and **Berlin**, demonstrate resilience through rapid recovery from economic and environmental shocks, confirming the correlation between creativity and recovery capacity.
- **Adaptability and Governance**: The correlation between **Governance Efficiency** and **Preparedness** (0.77) shows that cities with strong governance systems are better able to adapt to evolving circumstances. Cities like **Zurich** and **Oslo** demonstrate how effective governance, when coupled with innovation, fosters urban adaptability, further validating the hypothesis that creative cities are more flexible and better prepared to handle unforeseen challenges.
- **Community Engagement and Collaboration**: Civic participation and collaboration are vital to both creativity and resilience. The correlation between **Civic Engagement** (0.66) and resilience indicates that cities with engaged and connected communities can better withstand and recover from crises. Additionally, creative cities with higher tolerance toward immigrants and minorities, such as **New York** and **London**, benefit from diverse perspectives and social cohesion, which contribute to both creativity and resilience.
- **Economic and Cultural Diversification**: The relationship between creative economies and diversified economies, as highlighted by UNESCO, underscores the importance of cultural and economic vibrancy in enhancing urban resilience. Cities with robust creative sectors, such as **Zurich** and **Singapore**, benefit from diversified economies that make them more adaptable and resilient in times of crisis.

This study supports the hypothesis that creativity and resilience are interconnected. Cities that invest in creativity, innovation, and strong governance not only enhance their ability to respond to crises but also build a more sustainable and adaptable future for their residents.

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6. Appendix

Appendix I. Resilience Index

Table 2. Weights and variables used to measure the resilience of cities.

Natural Risk	50%	Geographical Risk
		SunShine
		Temperature
		Precipitation
		Natural Shocks
Anthropogenic Risks	50%	Non-Natural Shocks
Environment	20%	Sustainable Development Index
		Pollution index
		Green Future index
		Environmental Performance Index
Economy	40%	Gross Domestic Product per capita
		Employability
		Wealth Distribution (GINI)
		Economic Losses from Weather-Related Disasters
		Net Purchasing Power
Society	20%	Poverty Index
		Civil Engagement
		Minority Tolerance
		Immigrant Tolerance
		Social Capital
Governance	20%	Democracy Index
		Government Efficiency

Source: Own elaboration, 2025.

Appendix 2. Creativity Index

Table 3. Weights and variables used to measure the creativity of cities.

Creative Economy	20%	25%	Startups Ecosystem (/Population)	
		25%	Creative Jobs	
		25%	Presence of Forbes Global 2000 Companies	
		25%	Creative GDP	
Culture	15%	50%	Cultural Events & Festivals	Olympics
				Universal Expo
				Cultural Events
		50%	Diversity & Inclusion	Tolerance to Minorities
				Tolerance to Immigrants
Talent & Education	20%	33%	Best Universities Ranking	
		33%	Ease of finding skilled employees	
		33%	Net Purchasing Power	

Intellectual Property & Innovation	20%	50%	Innovation	Global Innovation Index
				Research & Development
				Researchers
		50%	Patent Application	
Goverment	15%	100%	Goverment Expenditure in creativity	
Public Perception & Branding	10%	50%	Creative Cities Index	
		50%	Branding	

Source: Own elaboration, 2025.