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Economic resilience of smart cities in 2018–2024: selected cities of the European Union

SUMMARY OF THE DOCTORAL THESIS IN ECONOMICS AND FINANCE

Author: mgr Alicja Kozak

Supervisor: prof. dr hab. Bogusława Drelich-Skulska

Introduction

Contemporary cities operate under the overlapping influence of global megatrends such as urbanisation, digitalisation, the climate and energy transition, and increasing environmental turbulence. These processes simultaneously enhance cities' development potential and increase their systemic vulnerability, revealing tensions between economic efficiency and the maintenance of social cohesion and continuity of core urban functions. As a result, cities combine the role of engines of growth with that of areas particularly exposed to the accumulation of economic, social, and environmental risks.

These dynamics have been brought into sharp relief by recent experience, as urban development has been shaped by a sequence of strong exogenous shocks beyond the direct control of local economic policy. Health, geopolitical, energy, migration, and climate crises, alongside escalating threats in cyberspace, have exposed the high sensitivity of urban economies to external conditions, generating pressure on labour markets, investment, mobility, and the continuity of economic processes.

In response to these processes, increasing attention in the scholarly literature has been devoted to the concept of **urban resilience (UR)**, understood as the capacity of urban systems to function and adapt under changing environmental conditions while maintaining fundamental social, economic, infrastructural, and institutional functions. This concept encompasses the continuity of core socio-economic processes, as well as adaptation and the gradual reconfiguration of resources and functional mechanisms over the longer term. Importantly, resilience is not conceived as an end state or a one-off outcome, but rather as a characteristic of how a city is organised, how available resources are utilised, and how development policies are designed to ensure long-term functional viability.

Within this framework, **economic urban resilience (UER)** is distinguished as a specific dimension of urban resilience, focusing on those aspects of the urban system that determine the capacity of the urban

economy to sustain economic activity, operational capabilities, and development potential over time. Despite growing research interest, the concept remains ambiguous in terms of both its substantive scope and its position within economic theory, making it the subject of ongoing debate and interpretative disagreement.

This ambiguity stems from the relatively recent emergence of economic urban resilience within the social sciences, its interdisciplinary nature, and the diversity of analytical approaches applied to its study. At the same time, there is increasing recognition that without UER, sustained socio-economic development of cities is not feasible under conditions of rising volatility and uncertainty, in which exogenous shocks are no longer incidental. In this sense, UER constitutes the economic dimension of urban resilience, encompassing both the functioning of the local economy and the long-term determinants of residents' welfare.

Against this backdrop, the concept of the **smart city** has gained prominence over the past two decades as an approach to managing urban development based on the use of digital technologies, data, and organisational innovation. In the literature, smart city is primarily treated as a set of operational practices and tools aimed at improving infrastructure, public services, and administration, and far less frequently as an analytical framework explaining the long-term functioning of urban economies.

Research gap

Despite the strong presence of the smart city concept in both academic discourse and urban governance practice, economic urban resilience is rarely examined in depth with reference to smart cities as a distinct category. A clear deficit of empirical studies and coherent diagnostic frameworks means that prevailing approaches to economic urban resilience remain largely static, reducing it to a set of partial indicators and neglecting its processual dimension.

This gap justifies the focus of the present dissertation on the economic resilience of smart cities, shifting the analytical emphasis from assessments of current operational performance to the analysis of long-term processes of economic continuity, adaptation, and structural change as reflected in cities' development trajectories.

Accordingly, **the dissertation concentrates on the analysis of economic urban resilience in smart cities, using the European Union as an empirical context that enables comparison of diverse urban development trajectories within a relatively coherent institutional environment over the period 2018–2024**. The selected time frame was deliberately chosen to encompass both the pre-shock period and the years in which strong exogenous shocks materialised and shaped the functioning of European cities.

Research Problem, objectives, and hypotheses

In light of the identified research gap, the research problem addressed in this dissertation concerns the empirical analysis of economic urban resilience in smart cities from a temporal perspective. The core of the research problem is expressed in the following question: How did the trajectory and differentiation of economic urban resilience evolve in selected smart cities of the European Union over the period 2018–2024?

Based on the research problem, the main objective of the dissertation (**M_O**) is to diagnose the course and differentiation of economic urban resilience in selected smart cities of the European Union in the years 2018–2024 and to interpret these patterns in the context of the specific characteristics of smart cities.

In order to achieve the main objective, **a set of specific objectives was defined**, as presented below.

- Specific Objective 1 (**SO_1**): To systematise the ways in which the development of contemporary cities is conceptualised in the literature, with particular attention to urbanisation processes, socio-economic transformations, and the evolution of dominant development models.
- Specific Objective 2 (**SO_2**): To define the content, analytical meaning, and conceptual boundaries of urban resilience and economic urban resilience as discussed in the literature.
- Specific Objective 3 (**SO_3**): To conceptualise economic urban resilience in relation to smart cities.
- Specific Objective 4 (**SO_4**): To identify, systematise, and critically assess existing approaches to the measurement of economic urban resilience, including those applied in research on smart cities.
- Specific Objective 5 (**SO_5**): To develop a methodology for the diagnostic assessment of economic urban resilience of smart cities in the European Union.
- Specific Objective 6 (**SO_6**): To analyse the evolution of economic urban resilience in the selected smart cities of the European Union over the period 2018–2024 and to identify characteristic typological models.

The implementation of the empirical objective (SO6) is based on the adoption of a general research assumption that structures the interpretation of the course of economic urban resilience in the analysed cities. This assumption is formulated as the main hypothesis (H), according to which the development of economic resilience in smart cities of the European Union over the period 2018–2024 was not homogeneous; nevertheless, among the analysed urban centres it is possible to identify similar patterns in its evolution, which may be interpreted as typological models.

The main hypothesis (**H**) is further specified through the auxiliary hypotheses outlined below.

- Auxiliary Hypothesis 1 (**H_1**): In the analysed smart cities, the process of economic urban resilience over the period 2018–2024 did not follow a linear trajectory, but consisted of sequences of distinct phases of response and adjustment, the configuration of which differed across the cities studied.
- Auxiliary Hypothesis 2 (**H_2**): The course of economic urban resilience in the analysed smart cities during 2018–2024 was embedded in differentiated configurations of intangible capital and the digital sphere.

Time frame of the study

The study covers the period 2018–2024, which was selected on methodological and empirical grounds relevant to a process-oriented analysis of economic urban resilience. The year 2018 serves as an analytical reference point, allowing the identification of the conditions under which urban economies operated prior to a sequence of strong exogenous shocks, under conditions of relatively greater macroeconomic and institutional stability.

The years 2019–2024 encompass a period of escalating and interacting crises—initiated by the COVID-19 pandemic and subsequently compounded by geopolitical, energy, and climate-related shocks—thereby enabling the observation of responses and adaptive processes within urban economies. The adopted time frame thus allows economic urban resilience to be analysed as a process evolving over time, while relying on relatively coherent and comparable statistical data for cities across the European Union.

Methods, Techniques, and Research Tools

For the purposes of developing the theoretical and conceptual layer of the dissertation (the conceptual framework of UER), the following methods were employed:

- Analysis and critical review of the subject literature (both academic and grey literature);
- Document analysis using a desk research approach, including reports, strategies, and institutional studies;
- Conceptual analysis and systematisation of terms and categories, aimed at defining conceptual boundaries and structuring the analytical framework of the study.

For the development of the analytical framework of UER, the following methods and techniques were applied:

- A systematic literature review in an integrated variant, supplemented by chain-searching;
- Formalised selection and evaluation of sources using an original eligibility assessment framework;
- Comparative analysis of different analytical and diagnostic approaches;
- Indicator mapping;
- Hierarchical (pillar-based) and process-oriented classification of indicators;
- Elements of descriptive statistics used to analyse the structure of indicator sets.

For the purposes of the empirical study, the following methods and tools were employed:

- A process-oriented diagnostic research method;
- Purposive case selection;
- Secondary data analysis;
- Indicator-based analysis;
- Normalisation of diagnostic variables (min–max normalisation);
- Percentile transformation of ranking data;
- Multidimensional comparative analysis;
- Analysis of the dynamics of economic phenomena using time-series data;
- Cross-case analysis;
- Analysis of development trajectories;
- Empirical typology method;
- Triangulation of quantitative and qualitative data;
- Contextual analysis of institutional conditions.

The application of the above methods, techniques, and research tools was aligned with the logic of achieving the specific objectives of the dissertation and is reflected in its structure, in which successive chapters correspond to distinct stages of the research process: from theoretical and conceptual approaches, through the methodological stage, to the empirical diagnosis of the economic resilience of smart cities. The dissertation consists of an introduction, five substantive chapters, a conclusion, and supplementary sections including appendices, lists of tables, figures, charts, equations, and references. The structure of the chapters is presented in Figure 1.

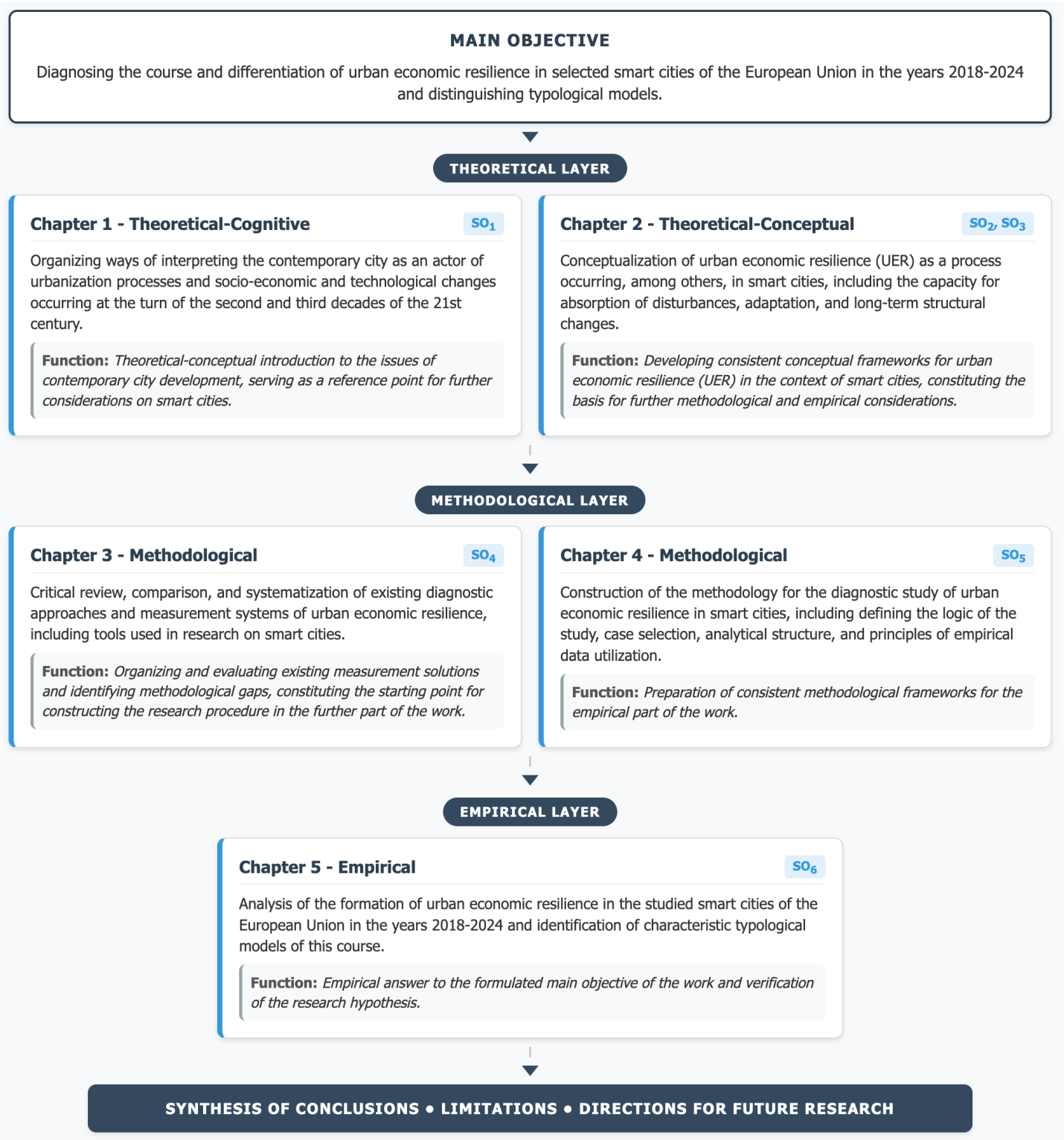

Figure 1. Analytical Model of the Doctoral Dissertation

Source: Author's own elaboration.

Chapter 1, "Contemporary Cities at the Turn of the Second and Third Decades of the 21st Century," has a theoretical and cognitive character and fulfils Specific Objective SO1. The chapter systematises approaches to understanding the contemporary city as a dynamic socio-economic system operating

under conditions of intensified urbanisation, globalisation, and digitalisation. The city is analysed as an active participant in development processes, responding to technological, institutional, and social change. A process-oriented perspective is combined with a structural socio-economic approach, presenting the city as a system undergoing continuous transformation—from industrial and post-industrial models to contemporary concepts based on knowledge, innovation, intangible capital, and digital technologies. An integral part of the chapter is a critical discussion of the smart city concept, treated as a stage in the evolution of thinking about the city rather than as an autonomous development model, which provides a reference point for subsequent analyses of urban resilience.

Chapter 2, "Characteristics of Urban Resilience and Economic Urban Resilience," is theoretical and conceptual in nature and fulfils Specific Objectives SO2 and SO3. It focuses on clarifying the concept of resilience in relation to cities and on distinguishing economic urban resilience as a separate analytical category. The chapter demonstrates that urban resilience is a multidimensional concept, dependent on research perspective and scale of analysis, which justifies its process-oriented interpretation as a sequence of responses, adjustments, and changes unfolding over time. Particular attention is devoted to economic urban resilience (UER), understood as the capacity of a city's economic system to function, adapt, and—under favourable conditions—modify its development pathways. UER is clearly distinguished from stability and short-term robustness, and its application to smart cities highlights the key role of intangible capital and the digital layer, which may enhance adaptability but do not in themselves guarantee economic resilience.

Chapter 3, "Research and Assessment of the Economic Urban Resilience (UER) of Smart Cities (SC)," has a methodological character and fulfils Specific Objective SO4. It concentrates on the systematisation and critical evaluation of existing approaches to measuring economic urban resilience and on establishing a coherent methodological foundation for research on UER in smart cities. The chapter demonstrates that existing measurement frameworks—both academic and institutional—are highly heterogeneous in terms of scope, construction logic, and underlying assumptions, revealing significant limitations of the tools currently in use. A key component of the chapter is an original systematisation of the measurement literature, based on uniform methodological criteria, resulting in the organisation of an extensive set of indicators into a coherent analytical framework. Although the chapter does not yet introduce the actual measurement of UER in smart cities, it provides the direct methodological groundwork for the research procedure developed in the subsequent chapter.

Chapter 4, "Methodology of the Diagnostic Study of the Economic Resilience of Smart Cities in the European Union," fulfils Specific Objective SO5 and is methodological in nature. The chapter presents the author's approach to translating earlier theoretical findings into a coherent research procedure, grounded in a process-oriented understanding of economic urban resilience and the multi-layered

structure of the urban system. It discusses the analytical logic applied to the economic core, intangible capital, and the digital component, as well as the stages of the research procedure, including city selection, the use of secondary data, and the preparation of empirical material. The chapter addresses methodological gaps identified earlier by integrating existing approaches into a unified framework tailored to the specific characteristics of smart cities, thereby providing a direct analytical foundation for the empirical part of the dissertation.

Chapter 5, "Results and Conclusions from the Study of the Economic Urban Resilience of Selected Smart Cities in the European Union," fulfils Specific Objective SO6 and constitutes the direct implementation of the main objective of the dissertation. It presents the results of a diagnostic study of five smart cities in the European Union over the period 2018–2024, focusing on the dynamic reconstruction and assessment of the course of economic urban resilience. The analysis covers cities' responses to exogenous shocks and the mechanisms of absorption, adaptation, and—where applicable—signals of transformation, which made it possible to identify distinct trajectories and recurring configurations of resilience interpreted as typological models. The chapter thus provides an empirical verification of the adopted assumptions and a direct response to the research problem, forming the basis for the formulation of the final conclusions.

Summary of Research Findings

The achievement of the main objective resulted from a sequence of theoretical, methodological, and empirical analyses grounded in a process-oriented approach to the economic resilience of smart cities. Conceptualising economic urban resilience (UER) as a dynamic phenomenon made it possible to structure the conceptual framework, develop a diagnostic research procedure, and identify differentiated trajectories and typological models of economic resilience.

The adopted structure of the dissertation enabled the consistent implementation of all specific objectives (**SO_1–SO_6**), progressing from the systematisation of theoretical foundations, through the construction of a methodological framework, to the empirical diagnosis of the economic resilience of smart cities.

The implementation of Specific Objective **SO_1** involved systematising approaches to the development of contemporary cities in the literature and embedding subsequent analyses within a broad context of urban transformation, which allowed the city to be treated as a dynamic socio-economic system.

Specific Objective **SO_2** enabled the precise delineation of the conceptual boundaries of urban resilience and economic urban resilience. As a result of a critical review of the literature, this category was conceptualised as a process unfolding over time, encompassing both the maintenance of functioning

under conditions of disturbance and the capacity for adaptation and structural change within urban economies.

The implementation of Specific Objective **SO_3** consisted in linking the concept of economic urban resilience to the smart city framework. Smart cities were thus conceptualised not as a set of technological solutions, but as a specific institutional and organisational context in which the digital layer may enhance the resilience of the urban economy, without automatically determining it.

Specific Objective **SO_4** was achieved through an original systematisation of approaches to measuring urban resilience, based on a review of 3,871 studies and their selection according to uniform methodological criteria. This resulted in the identification of 719 indicators, consolidated into a coherent analytical database comprising six pillars, twenty-seven thematic groups, and the phases of the resilience process. The analysis revealed significant asymmetries in existing measurement systems, particularly the insufficient consideration of the digital component and transformational phases.

Specific Objective **SO_5** was fulfilled through the design of a coherent and replicable methodology for the diagnostic assessment of the economic resilience of smart cities, enabling an empirical, process-oriented analysis of UER in the smart city context. The developed procedure integrates theoretical insights with the requirements of comparative temporal analysis, serving as a link between the systematisation of measurement approaches and the empirical analysis of resilience trajectories.

The empirical analyses confirmed the main research hypothesis (**H**), indicating that the evolution of economic resilience in smart cities of the European Union over the period 2018–2024 was heterogeneous. At the same time, the results demonstrated the possibility of identifying recurrent and comparable patterns in this process, which can be interpreted as typological models of economic resilience, despite differing local conditions.

Building on the above findings, the empirical analysis identified **three typological models of the economic resilience of smart cities (UER SC)**, understood as qualitatively distinct outcomes of the economic resilience process.

The first model identified is the resource-based resilience model, represented by Amsterdam and Hamburg, in which strong fundamentals of the economic core—high economic mass, productivity, and institutional stability—facilitate effective shock absorption. Within this typological model, a transformational variant (Amsterdam) was distinguished, in which structural resources are more frequently converted into qualitative reconfiguration and elements of bounce forward (a durable shift towards a more advanced development path following a disturbance), as well as a stabilisation-oriented

variant (Hamburg), based primarily on bounce back mechanisms, that is, the maintenance of the existing economic structure with a limited capacity to alter the development trajectory.

The second identified type is the adaptive resilience model based on intangible capital, represented by Vilnius and Ljubljana. In this case, human and social capital, together with digital competences, play a crucial role. These resources enable relatively dynamic adjustments during the response and adaptation phases following a disturbance. Within this model, a cohesive and dynamic variant (Vilnius) was identified, characterised by rapid recovery and relatively durable adaptive effects, as well as an incoherent and asymmetrical variant (Ljubljana), constrained by implementation gaps (discrepancies between declared strategies and their actual implementation) and the absence of a transition to the transformational phase, with responses limited to recovery and adaptation without lasting changes in economic structure or development trajectory.

The third model is survival-oriented resilience, represented by Sofia, in which resilience mechanisms are dominated by quantitative stabilisation aimed at maintaining the functioning of the urban economy without significant structural modernisation. In this case, digitalisation plays a selective role and remains weakly coupled with the economic core, resulting in a limited capacity for a sustained transition to the transformational phase.

The identified models do not constitute a merely descriptive classification, but rather reflect distinct mechanisms shaping the economic resilience of smart cities.

The empirical material collected in the course of the research made it possible to assess the auxiliary hypotheses formulated in the study.

Auxiliary Hypothesis $\mathbf{H_1}$, which assumed that the process of economic resilience in the analysed smart cities over the period 2018–2024 was not linear but unfolded through a sequence of distinct phases of response and adjustment, was confirmed. This non-linearity manifested itself not only in the trajectories of indicators related to the economic core, but above all in the fact that progression through successive phases of the resilience process depended on the degree of coherence and interaction among the three analytical layers distinguished by the author: the economic core, intangible capital, and the digital layer.

Within the UER SC framework, phase-based dynamics denote a processual configuration of resilience rather than a uniform mechanism of response to disturbance. Stable economic fundamentals (phase I) constitute a necessary condition for shock absorption; however, they do not in themselves determine the subsequent course of resilience. Only their reinforcement through knowledge resources and human and social capital enables effective adaptation in phases II–III, and—under favourable configurations—the use of digital tools as a mechanism of durable reconfiguration of economic structures corresponding to

phase IV. Differences between cities therefore concerned not so much the pace of recovery as the logic of phase transitions: in some cases, a return to equilibrium and stabilisation predominated; in others, adaptation based on intangible capital; and in the most favourable configurations, indications of a transition from adaptation towards structural change emerged. The findings thus confirm that the economic resilience of smart cities evolves as a sequence of phases activated and sustained by mutual couplings among the three layers of the urban system, rather than as a uniform, linear process of returning to the pre-shock state.

Auxiliary Hypothesis **H_2**, which assumed that the course of economic resilience in the analysed smart cities during the period 2018–2024 was embedded in differentiated contexts of intangible capital and the digital sphere, was confirmed. The analysis demonstrated that differences between cities were not reducible to variations in the level of resources, but were primarily related to the profile and functional role of intangible capital and the digital layer in relation to the economic core. In other words, human and social capital, as well as digital maturity, did not operate as universal accelerators of resilience; rather, they exhibited differentiated capacities to activate learning processes, adaptation, and—conditionally—reconfiguration of economic structures.

Consequently, it was confirmed that the trajectory of UER SC is not determined by the mere presence of high values in the intangible and digital layers. Decisive importance is attached to the degree of their coupling with the economic core and the directional alignment of all three layers within the phase-based framework. In cohesive configurations, intangible capital strengthened adaptive capacities in Phases II–III, while the digital component functioned as an accelerator of adjustment and a potential transition towards elements of Phase IV. In incoherent configurations, by contrast, a mismatch was observed between relatively strong positions in the intangible or digital layers and the limited capacity of the economic core to achieve qualitative improvement, resulting in the stalling of the process at mechanisms of survival or adaptation without durable transformation. Thus, H2 is confirmed insofar as intangible capital and the digital sphere differentiated not only the context of resilience trajectories, but also the range of available mechanisms and the boundaries of possible phase transitions within UER SC.

Contribution to the advancement of knowledge

In theoretical terms, the dissertation systematises dispersed approaches to urban resilience by proposing a process-oriented interpretation of economic urban resilience in smart cities (UER SC), grounded in the interaction between the economic core, intangible capital, and the digital layer. In doing so, it shifts the focus of smart city research away from declarative technological maturity towards the actual mechanisms through which digitalisation is coupled with economic processes. From a methodological

perspective, a key contribution is the development of a replicable diagnostic research procedure that enables a process-based analysis of economic resilience trajectories without reducing them to static and one-dimensional measures.

The analysis demonstrates that economic resilience in smart cities has not yet been established as a distinct and empirically grounded object of operationalisation, measurement, or comparative assessment. A review of the literature, institutional solutions, and benchmarking tools revealed the absence of coherent frameworks for the process-oriented study of UER SC; existing approaches are fragmentary, adaptive in nature, or reduce resilience to simplified indicator-based assessments. Consequently, the dissertation fills an identified research gap by constituting UER SC as an autonomous domain of empirical diagnosis and by structuring its conceptual scope, analytical logic, and methodological foundations for further research.

At the empirical level, the dissertation contributes new knowledge through the reconstruction of economic resilience in selected smart cities of the European Union over the period 2018–2024, conceptualised as a dynamic and phase-based process. The analysis focused on identifying sequences of responses, adaptations, and transformational constraints, as well as the mechanisms underlying them, rather than on comparing levels of resilience. It demonstrates that similar external shocks may lead to qualitatively different resilience trajectories, depending on the configuration of the economic core, intangible capital, and the digital layer, which made it possible to distinguish three typological models of resilience: resource-based, adaptive, and survival-oriented.

This perspective yields important cognitive implications, challenging simplified interpretations of resilience as a universal capacity to return to equilibrium or as a function of technological advancement. The findings indicate that the economic resilience of smart cities is relational and configurational in nature, dependent on the quality of interaction among key layers of the urban system, which justifies moving beyond linear approaches towards the analysis of differentiated development trajectories.

Practical contribution

The cognitive and empirical findings presented above provide a basis for formulating practical implications concerning the design and evaluation of urban policies aimed at strengthening the economic resilience of smart cities. In particular, they point to the need to move away from universal and standardised solutions towards approaches that account for differentiated resilience trajectories, local configurations of the economic core, intangible capital and the digital layer, as well as the specific local context.

In cities representing the resource-based model of economic urban resilience, the most salient feature was the capacity to absorb shocks and rapidly restore the continuity of core economic processes, supported by a strong economic core. At the same time, this very characteristic may contribute to the persistence of dominant patterns of urban economic functioning, thereby limiting the system's propensity for deeper structural change. In such cases, resilience takes the form of maintaining and reproducing the existing configuration rather than its substantive transformation. From a practical perspective, this implies the need for urban policies that ensure strong economic foundations do not merely reproduce established development paths, but instead generate impulses conducive to modifying the structure of the urban economy, particularly in areas where a gradual transition from stabilisation to qualitative change is feasible. Digital solutions, in turn, should not be confined to improving current processes, but should support new forms of economic and institutional organisation, thereby creating space for a shift from restorative responses towards development-oriented actions.

In centres representing the adaptive model of economic urban resilience, intangible capital plays a decisive role by enabling genuine economic adjustments under conditions of disturbance. The analysis demonstrates that the mere presence of digital solutions does not determine resilience outcomes; what is decisive is their linkage with residents' competences and institutional capacity for cooperation. In practical terms, this means that adaptation may proceed efficiently, yet without adequate embedding in the economic structure it remains temporally limited and does not translate into a lasting change in development direction.

The survival-oriented model of economic urban resilience is characterised by the maintenance of functional continuity without a corresponding qualitative improvement of the economic core. Stability of indicators is achieved primarily through quantitative adjustments rather than through changes in the organisation of economic activity or increases in productivity. In this configuration, the urban economy remains operationally functional but exhibits limited capacity to move beyond its existing development framework. Digital solutions present in this model do not act as a factor altering the logic of the urban system; although visible in selected domains, they fail to establish durable linkages with labour markets or value-creation processes. As a result, digitalisation coexists with low productivity and does not lead to a reconfiguration of economic relations, remaining an adjunct to entrenched modes of operation. This suggests that policies focused solely on sustaining economic activity tend to reinforce the status quo rather than create space for change. For cities operating within this model, a gradual increase in resilience to future shocks requires breaking the isolation between the digital sphere and the urban economy; without such integration, adaptation remains short-lived and the potential for a sustained transition towards more advanced forms of development remains severely constrained.

Limitations of the study

Despite its multidimensional approach to the economic resilience of smart cities, the study is subject to several limitations. The analysis is based on a small, purposively selected sample of cities, which allows for in-depth interpretation of processes but limits the possibility of direct generalisation of the findings. In addition, the use of secondary data means that certain adaptive aspects—particularly those of a qualitative and institutional nature—could only be captured indirectly.

A further, systemic limitation concerns the restricted availability of comparable city-level data. The juxtaposition of the extensive set of indicators identified at the conceptual stage with the actual scope of available empirical data revealed a clear gap between theoretical possibilities and the practical conditions of comparative research, thereby narrowing the analytical field. Moreover, the adopted time horizon (2018–2024) enables the assessment of responses and adaptation but does not allow for an unambiguous evaluation of the durability of structural changes, which should therefore be interpreted as indications of transformation rather than its full completion.

Directions for Future Research

The findings and limitations of the dissertation delineate several directions for future research on the economic resilience of smart cities. First, it appears advisable to extend empirical analyses to a larger and more diverse sample of cities, encompassing different institutional and economic contexts. Such an approach would enable a more in-depth verification of the proposed typology of UER SC, potentially allowing for its further refinement and an assessment of its stability under conditions of greater heterogeneity among urban systems.

A second important direction for future research involves extending the temporal horizon of analysis in order to assess whether the identified adaptive elements lead to durable structural changes or are instead transitional in nature. Long-term studies would allow for a clearer distinction between adaptation and transformation in the development trajectories of smart cities.

Another area requiring further investigation concerns the institutional and decision-making mechanisms that condition the effective coupling of the digital layer with the economic core. Complementing quantitative analyses with qualitative research—such as studies of urban policies and digital strategies—would make it possible to better explain the differentiated roles that digitalisation plays in urban adaptive processes.

A further key direction for future research is the development of urban data infrastructures and methods for collecting city-level data that are comparable across space and over time. The findings of the dissertation indicate that the limited availability of coherent and long-term data constitutes one of the main empirical barriers to research on UER SC, particularly in process-oriented and comparative analyses.

Additionally, future studies may focus on the relationship between the economic resilience of smart cities and public policies implemented at national and supranational levels—especially in the context of the European Union—in order to assess the extent to which policy instruments and regulatory frameworks facilitate the transition of cities from stabilisation mechanisms towards more advanced forms of economic structural reconfiguration.