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Institutional Quality and Urban Competitiveness in Philippine Cities:Regional Convergence, Distributional Divergence, and Pandemic Resilience

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Institutional Quality and Urban Competitiveness in Philippine Cities: Regional Convergence, Distributional Divergence, and Pandemic Resilience

Abstract

This study examines the interrelationships among institutional capacity, urban competitiveness, distributional convergence, and pandemic resilience across 149 Philippine local government units (LGUs) over the 2014–2024 period, addressing critical methodological gaps in the longitudinal measurement and empirical assessment of urban competitiveness. Drawing on institutional economics and endogenous growth theory, the research employs a comprehensive methodological framework including measurement harmonization through within-year percentile composites, paired and Wilcoxon signed-rank tests for temporal breaks, Welch ANOVA with Games–Howell post-hoc comparisons, two-way fixed effects panel regression, Mundlak correlated random effects models, beta and sigma convergence analyses, and event study designs for pandemic resilience assessment. Apparent structural discontinuities in official CMCI scores at 2017 and 2022 are wholly attributable to index-regime changes rather than substantive LGU-level shifts. Lagged government efficiency and infrastructure independently predict economic dynamism within LGUs. A robust convergence paradox emerges wherein beta convergence ($\beta = -0.0421$, $p < 0.01$) coexists with statistically significant sigma divergence ($\delta = +0.0043$, $p = 0.007$), indicating selective catch-up without distributional equalization. Critically, institutional capacity does not buffer pandemic-induced economic shocks, challenging prevailing resilience narratives. These results contribute to regional science by demonstrating that institutional quality exerts incremental, channel-specific effects on urban competitiveness; convergence dynamics are paradoxical; and resilience transcends pre-crisis governance capacity. Policy must prioritize sustained institutional investment alongside spatially targeted redistributive interventions.

Keywords: Institutional capacity, urban competitiveness, regional convergence, distributional divergence, economic resilience, Philippine cities, panel data analysis

JEL Classification: R11, R50, O43, H70

Highlights

- Governance effectiveness and infrastructure quality are significant longitudinal predictors of urban economic development across 149 Philippine cities over a 10-year panel (2014–2024).
- A convergence paradox is documented: beta-convergence ($\beta = -0.0421$, $p < 0.01$) coexists with sigma-divergence, indicating simultaneous catching-up and rising inter-city economic inequality.
- Institutional capacity does not buffer pandemic shocks; COVID-19 effects on urban economic development are severe and statistically uniform across all levels of pre-existing institutional quality.
- Structural breaks in the Cities and Municipalities Competitiveness Index (2017, 2022) reflect methodological artifacts rather than genuine policy discontinuities, with implications for longitudinal competitiveness research.
- Lagged governance and infrastructure effects on economic development suggest a policy implementation lag of 1–2 years, underscoring the importance of sustained institutional investment for urban competitiveness.

1. Introduction

The spatial determinants of economic performance have long occupied the intellectual frontier of regional and urban economics (Bănică et al., 2024, 2024; Cheshire and Carbonaro, 1996; Eatona and Eckstein, 1997; Viladecans-Marsal, 2004) Since the foundational insights of Porter (1990) on the competitive advantage of nations and their regional extensions by Begg (1999) and Camagni (2002), scholars have progressively refined the understanding of how place-specific attributes condition the economic trajectories of cities, municipalities, and sub-national jurisdictions. Notwithstanding this theoretical maturity, a persistent empirical lacuna concerns the dynamic nature of competitiveness assessment itself, specifically, how evolving measurement frameworks alter the observable competitive landscape and what institutional forces drive such methodological evolution. This study addresses that lacuna through the analysis of the Cities and Municipalities Competitive Index (CMCI) of the Philippines.

The CMCI is an annual ranking of Philippine cities and municipalities developed by the National Competitiveness Council through the Regional Competitiveness Committees (RCCs) with the assistance of the United States Agency for International Development (Department of Trade and Industry, 2022). It represents the most comprehensive subnational competitiveness assessment instrument in the Philippines and one of the most longitudinally extensive in Southeast Asia. Crucially, the CMCI has undergone two major structural expansions over its eleven-year lifespan: the integration of the Resiliency pillar in 2017, comprising ten sub-indicators measuring disaster risk reduction and emergency preparedness, and the incorporation of the Innovation pillar in 2022, gauging digital resource utilization, technological adoption, and creative governance initiatives. These structural shifts are not mere methodological refinements; they represent institutionally motivated responses to the changing demands placed on Philippine LGUs, shaped by the adoption of the Sendai Framework for Disaster Risk Reduction (2015), the pressures of post-pandemic governance reform, and the growing primacy of digital transformation in local governance. Following the 1991 Local Government Code, which devolved significant fiscal and administrative responsibilities to local government units (LGUs), Philippine cities have exhibited marked heterogeneity in institutional capacity, economic performance, and development trajectories (Marra and Carlei, 2011; Rodríguez-Pose and Zhang, 2019).

This heterogeneity raises fundamental questions about the mechanisms through which institutional quality influences urban competitiveness, the extent to which lagging regions converge toward more developed counterparts, and the role of institutional capacity in buffering economic shocks. While a substantial body of research has established positive associations between institutional quality and economic growth at national and regional levels (Fathi *et al.*, 2023; Keller and Shiue, 2013; Siyakiya, 2017; Valeriani and Peluso, 2011), the specific channels through which institutions affect urban competitiveness, the temporal dynamics of these relationships, and their interaction with convergence processes and resilience remain inadequately understood, particularly in developing country contexts.

The present study addresses these gaps by examining 149 Philippine LGUs over an eleven-year period (2014–2024), leveraging the Cities and Municipalities Competitiveness Index (CMCI) as a comprehensive measure of urban performance across multiple dimensions: economic dynamism, government efficiency, infrastructure, resilience, and innovation.

This research makes several contributions to the regional science literature. First, it provides rigorous empirical evidence on the causal pathways linking institutional capacity to urban economic performance using advanced panel data techniques that address endogeneity concerns. Second, it documents a convergence paradox wherein beta convergence (relative catch-up) coexists with sigma divergence (widening absolute disparities), a pattern with important theoretical and policy implications (Li and Fang, 2018; Nayak and Sahoo, 2021; Pagaduan, 2023). Third, it challenges prevailing assumptions about institutional resilience by demonstrating that pre-crisis governance quality does not necessarily buffer pandemic-induced economic shocks (Pozhidaev, 2025; Tian *et al.*, 2021; Yuan and Hu, 2023). Fourth, the theoretical and empirical implications of the structural evolution in composite indices have received remarkably limited scholarly attention. Existing studies of the CMCI tend to treat the index as a static cross-sectional instrument or focus narrowly on a subset of years, thereby underestimating the dynamic interactions between index architecture and observed competitive outcomes (e.g. (Almaden, 2026; Cambel and Albacea, 2021; Encarnacion *et al.*, 2023). It demonstrates that the institutional architecture of measurement frameworks shapes, rather than merely reflects competitiveness outcomes. By constructing within-year percentile composites and comparing official scores with

harmonized core measures, the analysis reveals that apparent structural breaks in 2017 and 2022 are methodological artifacts rather than substantive policy effects. This finding has significant implications for the interpretation of competitiveness trends and the design of evaluation frameworks.

The remainder of this paper proceeds as follows. Section 2 reviews the literature on institutional quality and urban economic performance, regional convergence dynamics, urban resilience, and composite index measurement issues. Section 3 develops a theoretical framework integrating institutional economics, endogenous growth theory, convergence theory, and resilience concepts. Section 4 describes the data, variables, and econometric methods, including measurement harmonization, temporal break detection, panel regression models, convergence analysis, and event study designs. Section 5 reports the empirical results. Section 6 discusses the findings in relation to existing theory and evidence. Section 7 concludes with policy implications and directions for future research.

2. Literature Review

2.1 Institutional Quality and Urban Economic Performance

The relationship between institutional quality and economic performance has been a central theme in development economics since North's (1990) seminal work on institutions as the "rules of the game" that shape economic activity and transaction costs (Davis, 2010; Marra and Carlei, 2011; Pereira *et al.*, 2021). At the urban level, institutional quality encompasses the efficiency, transparency, and accountability of local government operations, the regulatory environment for business, and the capacity to deliver public services and infrastructure (Rodríguez-Pose and Zhang, 2019; Webster and Muller, 2000).

Empirical evidence consistently demonstrates positive associations between institutional quality and urban economic outcomes. Rodríguez-Pose and Zhang (2019) examined government institutions and urban growth dynamics in China, finding that city-level government efficiency and anti-corruption efforts significantly enhance urban growth, with benefits primarily accruing to cities in the top 20% of government quality. Their endogenous growth model reveals both

direct effects, where government efficiency acts as a productive input, and indirect effects, where institutions facilitate the effectiveness of other growth factors such as human capital, innovation, and foreign direct investment. Similarly, Marra and Carlei (2011) analyzed Chinese cities and found strong positive correlations between efficient business regulations and economic outcomes, with correlation coefficients of 0.655 for GDP, 0.868 for GDP per capita, 0.642 for secondary industry, and 0.698 for tertiary industry. These findings underscore that simplified, less costly regulatory requirements are associated with firm growth, foreign direct investment attraction, and employment expansion.

The mechanisms through which institutions affect urban competitiveness operate primarily through transaction cost reduction and enhanced factor productivity. Keller and Shiue (2013) demonstrated that institutions significantly impact long-run growth primarily through trade, with better institutions reducing price gaps (standardized beta coefficient of -0.76 compared to -0.20 for railways). Once trade channels are accounted for, the direct effect of institutions on growth becomes small and insignificant, suggesting that institutions affect growth substantially through facilitating market exchange. This trade-mediated institutional effect highlights the importance of regulatory efficiency and contract enforcement in urban economic systems. (Camagni and Capello, 2013) further demonstrate that infrastructure and territorial competitiveness are jointly shaped by institutional frameworks, with regions exhibiting stronger institutional capacity leveraging capital investments more effectively to generate competitive advantage.

Cross-national and subnational studies further corroborate these patterns. Valeriani and Peluso (2011) found that institutional quality positively impacts economic growth in both developing and developed countries, with quality of government showing particularly strong effects in developing countries (99% significance level). Santos De Santana et al., (2016) analysis of Brazilian municipalities revealed that institutional quality positively influences income per capita, with the influence of institutional quality on income exceeding income's effect on institutional quality, suggesting a causal pathway from institutions to economic performance. Arbolino and Boffardi (2017) examined Italian regions and found that both cohesion investments and an Institutional Quality Index were positively related to regional economic growth, with efficiency in managing European funds proving critical in structurally weak areas. Barbero and Rodríguez-

Crespo (2022) extend this institutional framing to show that technological, institutional, and geographical peripherality jointly elevate regional poverty risk, with institutional peripherality, characterized by weak administrative capacity and limited access to policy networks, proving particularly consequential for economic development outcomes.

Spatial analyses reveal that institutional effects extend beyond jurisdictional boundaries. Bologna et al. (2016) analyzed 381 U.S. metropolitan areas and found that economic freedom (a measure of institutional quality) is directly and positively related to per capita income growth and levels, with total effects (direct plus indirect spatial spillovers) exceeding direct effects alone. This indicates that freedom-enhancing institutional reforms in one metropolitan area generate positive-sum outcomes for neighboring areas, underscoring the spatial interdependence of institutional quality effects.

Sector-specific studies provide additional distinction. Studies in transition economies found that economic freedom, small-scale privatization, banking reform, governance, and enterprise restructuring positively and significantly influence urban economic growth, while government size exerts negative effects (Barlow and Radulescu, 2005; Pääkkönen, 2010; Peev and Mueller, 2012; Piatek *et al.*, 2013). Studies of Chinese cities demonstrated that the information economy, network society, and online government positively contribute to urban economic competitiveness, with smart city programs enhancing overall competitiveness through improved information infrastructure and network effects (Li, 2021; Ni *et al.*, 2014; Peng, 2019; Tao *et al.*, 2020).

Despite this robust evidence base, several gaps remain. First, most studies employ cross-sectional or short-panel designs that limit causal inference. Second, the temporal dynamics of institutional effects, including lag structures and persistence, are inadequately characterized. Third, the interaction between institutional quality and other determinants of urban competitiveness, particularly infrastructure and human capital, requires further investigation. Fourth, developing country contexts, where institutional capacity varies more dramatically and data quality is often lower, remain underrepresented in the literature.

2.2 Regional Convergence Dynamics

Convergence theory, rooted in neoclassical growth models, theorizes that regions with lower initial income levels should grow faster than richer regions, leading to a reduction in income disparities over time (Barro, 2012; dela Fuente, 2000; Li and Fang, 2018). Two primary convergence concepts dominate the literature: beta (β) convergence, which examines whether poorer regions grow faster than richer ones, and sigma (σ) convergence, which assesses whether the dispersion of income across regions decreases over time (Mendez-Guerra, 2019; Nayak and Sahoo, 2021; Rey and Dev, 2006; Royuela and García, 2010; Sala-I-Martin, 1996). Seminal empirical studies of convergence in the European Union (Cuadrado-Roura, 2000; López-Bazo *et al.*, 1999), Brazil (Azzoni, 2001), and other developing-country contexts (Lall and Yilmaz, 2001), confirm that the pace of convergence varies substantially with institutional quality, infrastructure endowments, and policy design.

Empirical evidence on regional convergence presents mixed patterns. Li and Fang's (2018) spatial econometric analysis of 2,286 Chinese cities and counties found significant absolute and conditional beta convergence in GDP per capita, with strong spatial agglomeration effects. Pagaduan (2023) documented tremendous improvement in income disparities across Philippine provinces from 2000 to 2020, with rapid income per capita convergence and narrowed income dispersion within administrative regions. The study identified a robust U-shaped relationship between spatial inequality and economic development, with structural transformation acting as a transmission channel. Mendez-Guerra's (2019) analysis of Bolivian subnational metropolitan regions found an overall process of regional convergence, though regional inequality within most regions did not significantly decrease.

However, convergence is neither universal nor uniform. Nayak and Sahoo (2021) study of 17 Indian regions found absolute and conditional beta convergence, indicating that regions with low initial per capita income grew faster, but also found sigma divergence, showing widening economic inequality. This paradoxical pattern, where relative catch-up coexists with absolute divergence, challenges simplistic interpretations of convergence dynamics. Wei et al.'s (2009) analysis of Chinese provinces found no evidence of absolute beta convergence during 1979-2003,

though conditional beta convergence emerged when controlling for foreign direct investment, exports, human capital, and transportation, with convergence speeds reaching 6.06% per year.

Convergence rates and half-life periods vary substantially across contexts. Royuela and García's (2010) analysis of Colombian departments found strong convergence in social variables such as literacy rate (4.7% annual speed) and life expectancy (2.53% annual speed), with crime also converging rapidly (4.64% annual speed), but diverging results for GDP per capita. Reyes and Cobo's (2024) study of the Mexico City metropolitan area estimated a 1.7% annual beta convergence rate, though convergence was inconsistent, with economic divergence observed from 2004 to 2009. More recent evidence confirms that innovation systems modulate convergence speeds independently of physical capital, with regions exhibiting stronger innovation capacity converging at markedly different rates (Feng *et al.*, 2024).

Determinants of convergence include initial conditions, infrastructure, human capital, and institutional quality. Zulham et al. (2015) found that Aceh's regional economic growth exhibited sigma convergence, with standard deviation decreasing from 0.7698 before special autonomy to 0.5411 after, and absolute beta convergence improving from a 29.56-year half-life (2.32% speed) before autonomy to 7.2 years (9.1% speed) after. Ginanjar et al. (2020) found human development convergence in Indonesian provinces at 2.21% per year with a 31-year half-life, with Special Allocation Fund and Village Fund positively impacting convergence while General Allocation Fund and Revenue Sharing Fund slowed it. Ding et al. (2008) demonstrated that telecommunications infrastructure significantly and positively relates to regional economic growth in China, facilitating convergence.

Spatial dependencies and multiple equilibria complicate convergence patterns. Kacou's (2022) analysis of 49 African countries found evidence of multiple equilibria in regional income inequality, with countries in high inequality clubs not converging toward low inequality clubs, indicating regional income inequality traps. Distributional dynamic analysis confirmed persistence with limited mobility between convergence clubs, with initial conditions in economic development, natural resource rent, urbanization, political institutions, development aid, and infrastructure serving as important determinants.

The convergence literature reveals several critical insights for the present study. First, beta and sigma convergence are distinct phenomena that may diverge, requiring separate empirical assessment. Second, convergence speeds vary substantially across contexts, time periods, and dimensions of development. Third, institutional quality, infrastructure, and human capital are key determinants of convergence processes. Fourth, spatial dependencies and multiple equilibria may constrain convergence, particularly in contexts with high initial inequality. Recent studies further highlight the role of migration, spatial econometric spillovers, and structural transformation in shaping the sustainability of convergence processes (Bănică et al., 2024; Cuadrado-Roura, 2000).

2.3 Urban Resilience and Economic Shocks

Urban resilience, the capacity of cities to absorb, adapt to, and recover from economic shocks, has gained prominence following the COVID-19 pandemic, which exposed differential vulnerabilities across urban systems (Chen and Quan, 2021; Chen *et al.*, 2021; Nice *et al.*, 2025; Shi *et al.*, 2024). Theoretical frameworks conceptualize resilience as a multidimensional construct encompassing economic, institutional, social, and infrastructural dimensions that collectively determine a city's ability to withstand and recover from disruptions (Datola, 2023; Dulak *et al.*, 2022; Kapucu *et al.*, 2024; Ribeiro and Pena Jardim Gonçalves, 2019; Zou, 2024). Regional studies demonstrate that territorial capital and institutional endowments are key predictors of resilience, with regions possessing stronger governance capacity and social infrastructure exhibiting more robust adaptive responses .(Gim and Miller, 2022; Rizzi *et al.*, 2018).

Empirical studies of pandemic resilience reveal heterogeneous impacts and recovery trajectories. Tian et al. (2021) examined cities in the Yangtze River Delta and found that urban resilience significantly influenced real estate price dynamics during COVID-19, with more resilient cities experiencing smaller price declines and faster recoveries. Chen et al.'s (2021) spatiotemporal analysis of the same region documented substantial variation in resilience levels, with institutional and economic factors playing critical roles. Yuan and Hu's (2023) study of Chinese cities found that urban resilience to socioeconomic disruptions varied substantially, with pre-existing economic structure, governance capacity, and digital infrastructure serving as key

determinants.

Institutional capacity emerges as a central resilience factor in several studies. Dulak et al. (2022) examined Polish cities and found that economic and institutional urban resilience to COVID-19 varied significantly, with institutional quality influencing recovery trajectories. Cao and Delei's (2024) analysis of 30 Chinese cities identified urban resilience governance mechanisms, emphasizing the role of institutional coordination and policy responsiveness in pandemic management. Zou (2024) demonstrated that digital technologies and urban resilience jointly influenced economic recovery, with cities possessing stronger digital infrastructure and governance capacity recovering more rapidly. Evidence from China and Canadian regions corroborates these findings, demonstrating that governance capacity moderates the negative effects of major shocks on employment and output, though its buffering role is conditioned by industrial diversity and related variety (Gao *et al.*, 2024; Sutton *et al.*, 2025).

However, the relationship between pre-crisis institutional capacity and pandemic resilience is not uniformly positive. Pozhidaev 2025) study of sixteen Global South cities found that determinants of urban economic resilience during COVID-19 lockdowns were context-specific, with institutional quality showing variable effects across cities. Forouhar et al. (2025) assessment of North American downtown recovery rates found that determinants varied substantially, with some cities exhibiting strong institutional capacity but weak recovery, suggesting that resilience depends on multiple interacting factors beyond governance quality alone.

Infrastructure and economic structure also shape resilience outcomes. Ha and Kim (2025) analysis of urban commercial clusters found that COVID-19 significantly impacted economic resilience and spatial vitality, with infrastructure quality and economic diversity influencing recovery. Li et al. (2025) demonstrated that new urbanization construction enhanced city economic resilience, with infrastructure investment playing a mediating role. Several studies found telecommunications infrastructure enhanced urban resilience through improved information flows and coordination capacity (Jaeger *et al.*, 2007; Jiang *et al.*, 2023; Kapucu *et al.*, 2023; Marshall *et al.*, 2023).

Spatial and temporal dimensions of resilience require careful consideration. Lu and Duan (2025) examined the spatiotemporal evolution of COVID-19's impact on urban economic resilience in China, identifying channels through which the pandemic affected resilience and proposing countermeasures. Wang et al. (2022) analyzed the spatiotemporal evolution of COVID-19 and its impact on urban economic resilience, finding that pandemic severity, policy responses, and pre-existing economic structure jointly determined resilience outcomes.

The resilience literature highlights several critical gaps relevant to the present study. First, while institutional capacity is theoretically expected to enhance resilience, empirical evidence is mixed, with context-specific factors moderating this relationship. Second, the temporal dynamics of resilience, including the distinction between immediate shock absorption and longer-term recovery, remain inadequately characterized. Third, the interaction between institutional capacity and other resilience determinants, particularly infrastructure and economic structure, requires further investigation. Fourth, most resilience studies focus on short-term pandemic impacts, with limited attention to longer-term recovery trajectories and the persistence of resilience effects.

2.4 Local Governance and Competitiveness in the Philippines

The Philippine local governance system is structured by the Local Government Code of 1991 (Republic Act 7160), which devolved significant administrative and fiscal functions from the national government to LGUs organized into provinces, cities, and municipalities. This devolution framework has produced a diverse landscape of fiscal capacity and administrative sophistication among Philippine LGUs, with income classification (Classes 1 through 6) serving as a proxy for local revenue generation capacity. Studies have consistently documented a positive relationship between LGU income class and service delivery outcomes, infrastructure quality, and economic dynamism (Llanto, 2012; Llanto and Del Prado, 2015) .

The hierarchical classification of Philippine cities into Highly Urbanized Cities (HUCs),

Independent Component Cities (ICCs), and Component Cities (CCs), reflects distinct governance structures and administrative capacities. HUCs are independent of provincial governance and exercise full fiscal autonomy, while ICCs maintain provincial affiliation but retain full administrative independence. CCs operate within provincial governance structures and typically exhibit lower fiscal capacity than their HUC and ICC counterparts. These classification distinctions are expected to manifest in systematic competitiveness differentials across the CMCI panel, constituting an important source of heterogeneity that must be controlled for in empirical analysis.

Balisacan and Fuwa (2003) documented significant and persistent spatial inequality in economic performance across Philippine regions, attributable to differential endowments in physical infrastructure, human capital, and institutional quality. Regional clustering effects, particularly the primacy of Metro Manila (NCR) and its adjacent growth corridors, have been identified as both a driver of national economic dynamism and a source of inter-regional competitive divergence. The present study examines these dynamics through the composite indices of CMCI, providing an updated and methodologically comprehensive assessment of spatial competitive (in)equality over the period 2014–2024. Pike et al. (2017) argued that the shifting horizons of local and regional development policy increasingly require frameworks that bridge the gap between place-based competitiveness measurement and institutional capacity-building strategies, a gap that the theoretical framework introduced in this study is designed to bridge.

2.5 Composite Index Measurement Issues

Composite indices have become ubiquitous tools for measuring and comparing urban competitiveness, yet their construction and interpretation pose significant methodological

challenges. These challenges include indicator selection, weighting schemes, normalization methods, temporal comparability, and sensitivity to methodological choices (Floridi *et al.*, 2011; Jiang and Shen, 2013; Popescu, 2011; Sgambati and Gargiulo, 2022; Snieska and Bruneckiene, 2009).

Weighting schemes represent a particularly contentious issue. Jiang et al. (2023) compared two weighting methods for measuring urban competitiveness and found that results varied substantially depending on the approach, with equal weighting, expert judgment, and data-driven methods (e.g., principal component analysis) yielding different rankings. Koronakos et al. (2024) proposed a common weights multiplicative aggregation approach for the Global City Competitiveness Index, arguing that endogenous weights derived from data better reflect underlying competitiveness structures than predetermined weights. Bowen and Moesen (2011) examined the World Economic Forum's Global Competitiveness Index and found that composite competitiveness indicators with endogenous versus predetermined weights produced divergent results, with implications for policy interpretation.

Normalization methods also influence index properties. Some studies have illustrated modified factor analysis to construct urbanization indices, demonstrating that normalization choices affect temporal comparability and cross-sectional rankings (Andersson *et al.*, 2009; Suarez-Rubio and Krenn, 2018; du Toit and Cilliers, 2011). Several smart-city studies use entropy-based weighting with VIKOR or other MCDM methods, and they show that different normalization choices can change city rankings (Dong *et al.*, 2020; Esangbedo and Wei, 2023; Gelmez and Özceylan, 2023; Wu and Yu, 2011).

Temporal comparability poses particular challenges for longitudinal analyses. When indicator sets, measurement methods, or weighting schemes change over time, apparent trends may reflect methodological artifacts rather than substantive changes in competitiveness. Temporal comparisons in competitiveness and other composite or spatial analyses require consistent methods, because changing normalization, weighting, or other construction choices can alter rankings and weaken comparability over time (Canuto and Cherobim, 2018; Manzato *et al.*, 2007; Suguiy *et al.*, 2020). The Italian municipal competitiveness literature emphasizes that composite indicators must be

built with robust and consistent methods, because methodological choices can change rankings and a temporal framework is needed to interpret competitiveness dynamics over time (Danielis *et al.*, 2018; Molinos-Senante and Maziotis, 2025; Scaccabarozzi *et al.*, 2024) .

Sensitivity analysis and robustness checks are essential but often neglected. Statistical optimization models for urban competitiveness indices using an econophysics approach or other advanced methods, depend critically on methodological choices such as weighting, aggregation, and model specification (Dönmez *et al.*, 2019; Jiang and Shen, 2013; Yuan *et al.*, 2017).

The composite index literature reveals several critical implications for the present study. First, temporal comparisons of competitiveness indices require careful attention to methodological consistency, with changes in indicator sets or weighting schemes potentially generating spurious trends. Second, harmonization approaches that construct comparable measures across time periods are essential for valid longitudinal analysis. Third, sensitivity analyses that assess the robustness of findings to alternative measurement approaches strengthen causal inference. Fourth, the distinction between official scores (which may incorporate methodological changes) and harmonized core measures (which maintain consistency) is crucial for interpreting competitiveness dynamics.

3. Theoretical Framework

3.1 Institutional Economics and Transaction Costs

The theoretical foundation for understanding the relationship between institutional capacity and urban competitiveness derives from institutional economics, particularly North's conceptualization of institutions as the "rules of the game" that structure economic interactions and determine transaction costs (Davis, 2010; Marra and Carlei, 2011; Pereira *et al.*, 2021). In this framework, institutions encompass formal rules (laws, regulations, property rights) and informal constraints (norms, conventions, codes of conduct) that shape economic behavior and outcomes.

At the urban level, institutional quality manifests in the efficiency of local government operations, the transparency and accountability of decision-making processes, the regulatory

environment for business formation and operation, and the capacity to deliver public services and infrastructure (Rodríguez-Pose and Zhang, 2019; Webster and Muller, 2000). High-quality institutions reduce transaction costs through several mechanisms: (1) clear and stable property rights reduce uncertainty and facilitate investment; (2) efficient regulatory processes lower compliance costs and accelerate business formation; (3) transparent governance reduces information asymmetries and corruption; (4) effective public service delivery enhances factor productivity; and (5) credible commitment mechanisms enable long-term contracts and relationships (Henderson and Wang, 2007; Keller and Shiue, 2013; Marra and Carlei, 2011; Yasar *et al.*, 2011).

The transaction cost reduction mechanism operates through both direct and indirect channels. Directly, efficient institutions lower the costs of starting and operating businesses, enforcing contracts, and accessing public services. Indirectly, institutions facilitate the effectiveness of other growth factors by enabling trade, attracting foreign direct investment, promoting innovation, and enhancing human capital accumulation (Dias and Tebaldi, 2012; Rodríguez-Pose and Zhang, 2019). Keller and Shiue (2013) framework demonstrates that institutions affect growth substantially through trade, with better institutions reducing price gaps and facilitating market exchange. This trade-mediated institutional effect underscores the importance of regulatory efficiency and contract enforcement in urban economic systems.

3.2 Endogenous Growth and Urban Competitiveness

Endogenous growth theory provides a complementary framework for understanding how institutional capacity influences urban competitiveness through its effects on factor accumulation and productivity (Eatona and Eckstein, 1997; Huggins, 2016). In contrast to neoclassical models where growth is driven by exogenous technological progress, endogenous growth models emphasize the role of human capital, innovation, and knowledge spillovers as endogenous determinants of long-run growth (Lucas, 1988; Romer, 1990).

Rodríguez-Pose and Zhang's (2019) endogenous growth model for Chinese cities specifies economic growth as a function of human capital, innovation and technology, density, foreign direct investment, local conditions, and government institutions. Institutions enter this model

through both direct effects, where government efficiency and anti-corruption efforts act as productive inputs, and indirect effects, where institutions facilitate or deter the effectiveness of other growth factors. This dual-channel specification captures the multifaceted role of institutions in urban economic systems.

Urban competitiveness, defined as a city's ability to create comparative advantage for high, sustainable economic growth (Jiang and Shen, 2010; Sgambati and Gargiulo, 2022), depends on the interaction between factor endowments and institutional quality (Deas and Giordano, 2001; Dias and Tebaldi, 2012; Hu *et al.*, 2013; Huggins, 2016). Porter's (1990) diamond model identifies four sets of attributes determining competitiveness: factor conditions, demand conditions, related and supporting industries, and firm strategy, structure, and rivalry. Government policies and institutional quality influence all four attributes, creating a favorable local environment for economic activity. Webster and Muller (2000) emphasize that the institutional milieu, encompassing social capital and governance capacity, fosters conditions for investment, upgrading, and vigorous competition.

The spatial dimension of urban competitiveness introduces additional complexity. Bologna et al. (2016) demonstrate that institutional quality effects extend beyond jurisdictional boundaries through spatial spillovers, with freedom-enhancing reforms in one metropolitan area generating positive-sum outcomes for neighboring areas. This spatial interdependence implies that urban competitiveness depends not only on local institutional quality but also on the institutional environment of proximate cities.

3.3 Convergence Theory

Convergence theory, derived from neoclassical growth models, provides a framework for understanding the dynamics of regional income disparities (Barro, 2012; dela Fuente, 2000; Li and Fang, 2018). The Solow-Swan model predicts absolute beta convergence: regions with lower initial capital-labor ratios exhibit higher marginal products of capital and thus grow faster, leading to convergence in income levels over time. The convergence equation takes the form:

$$ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = \alpha + \beta\, ln(y_{i,t-1}) + \varepsilon_{i,t} \quad (1)$$

where $y_{i,t}$ is income per capita in region i at time t, α is a constant, β is the convergence coefficient (expected to be negative), and $\varepsilon_{i,t}$ is an error term. The speed of convergence is given by $\lambda = -ln(1 + \beta)$, and the half-life (time required to close half the gap to steady state) is $t_{1/2} = ln(2)/\lambda$.

Conditional beta convergence extends this framework by allowing for heterogeneous steady states determined by structural characteristics:

$$ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = \alpha + \beta\, ln(y_{i,t-1}) + \gamma' X_{i,t} + \varepsilon_{i,t} \qquad (2)$$

where $X_{i,t}$ is a vector of control variables (e.g., human capital, infrastructure, institutional quality) that determine the steady-state income level. Conditional convergence allows regions to converge to different long-run equilibria based on their structural characteristics (Li and Fang, 2018; Nayak and Sahoo, 2021; Wei *et al.*, 2009).

Sigma convergence examines whether the dispersion of income across regions decreases over time:

$$\sigma_t = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\left[ln(y_{i,t}) - \overline{ln(y_t)}\right]^2} \qquad (3)$$

where σ_t is the standard deviation of log income at time t, N is the number of regions, and $\overline{ln(y_t)}$ is the mean log income. Sigma convergence occurs when $\sigma_t < \sigma_{t-1}$.

Critically, beta convergence is a necessary but not sufficient condition for sigma convergence. Regions may exhibit beta convergence (poorer regions growing faster) while sigma divergence persists if shocks increase dispersion faster than convergence reduces it (Austin and Schmidt, 1998; Dobson and Ramlogan, 2002; Nayak and Sahoo, 2021). This convergence paradox has important implications for understanding regional inequality dynamics.

3.4 Resilience Framework

Urban resilience theory conceptualizes cities as complex adaptive systems capable of absorbing, adapting to, and recovering from shocks (Dulak *et al.*, 2022; Pozhidaev, 2025; Tian *et al.*, 2021; Zou, 2024). Resilience encompasses multiple dimensions: (1) resistance, the ability to withstand shocks without significant disruption; (2) absorption, the capacity to accommodate shocks through flexible adjustment; (3) adaptation, the ability to modify structures and processes in response to changing conditions; and (4) transformation, the capacity to fundamentally reorganize when existing structures become untenable.

Institutional capacity influences resilience through several mechanisms. First, efficient governance enables rapid policy responses to emerging crises, including resource mobilization, coordination across agencies, and implementation of mitigation measures (Cao and Delei, 2024; Tian et al., 2021). Second, transparent and accountable institutions facilitate information flows, reducing uncertainty and enabling effective decision-making under stress (Zou, 2024). Third, strong institutional capacity supports infrastructure investment and maintenance, enhancing physical resilience to shocks (Gim and Miller, 2022; Govindarajulu, 2020; Valdivieso and Andersson, 2018; Webster and Muller, 2000). Fourth, institutional quality fosters social capital and trust, which facilitate collective action and mutual support during crises (Webster and Muller, 2000) .

However, the relationship between pre-crisis institutional capacity and resilience outcomes is not deterministic. Resilience depends on the interaction between institutional quality, economic structure, infrastructure, and the natural environment (Forouhar *et al.*, 2025; Kapucu *et al.*, 2023; Pozhidaev, 2025). Cities with strong institutional capacity may nonetheless exhibit weak resilience if economic structure is highly specialized, infrastructure is inadequate, or shocks are particularly severe. Conversely, cities with moderate institutional capacity may demonstrate strong resilience if economic structure is diversified, infrastructure is robust, or shocks are mild.

The temporal dimension of resilience distinguishes between immediate shock absorption and longer-term recovery. Immediate resilience reflects the capacity to maintain economic activity during the shock period, while recovery resilience reflects the speed and completeness of return to pre-shock trajectories (Cao and Delei, 2024; Forouhar *et al.*, 2025). These dimensions may be

influenced by different factors, with immediate resilience depending more on economic structure and infrastructure, and recovery resilience depending more on institutional capacity and policy responses.

3.5 Integrated Framework

The present study integrates these theoretical perspectives into a unified framework. Institutional capacity influences urban competitiveness through transaction cost reduction and enhanced factor productivity, operating through both direct effects and indirect effects that facilitate the effectiveness of other growth factors. Urban competitiveness, in turn, determines the initial conditions and structural characteristics that shape convergence dynamics. Regions with higher institutional quality may converge more rapidly to higher steady-state income levels, while regions with lower institutional quality may converge more slowly or become trapped in low-equilibrium states.

Resilience represents a distinct but related dimension, reflecting the capacity to absorb and recover from shocks. Institutional capacity is hypothesized to enhance resilience by enabling effective policy responses, supporting infrastructure investment, and fostering social capital. However, resilience also depends on economic structure, infrastructure, and shock characteristics, implying that institutional capacity is a necessary but not sufficient condition for resilience.

This integrated framework generates several testable hypotheses regarding the relationships among institutional capacity, urban competitiveness, convergence, and resilience in Philippine cities, which are formalized in the following section.

3.6 Hypotheses

Based on the theoretical framework and literature review, this study tests the following hypotheses:

H1: Institutional Quality and Urban Competitiveness

H1a: Government efficiency positively predicts economic dynamism, controlling for other

competitiveness dimensions and city fixed effects.

H1b: The effect of government efficiency on economic dynamism operates with a temporal lag, reflecting the time required for institutional improvements to translate into economic outcomes.

H1c: Infrastructure positively predicts economic dynamism, reflecting the complementarity between physical and institutional capital.

H2: Convergence Dynamics

H2a: Beta convergence exists across Philippine cities, with cities exhibiting lower initial competitiveness scores growing faster than cities with higher initial scores (absolute beta convergence).

H2b: Conditional beta convergence exists when controlling for structural characteristics (government efficiency, infrastructure, resilience, innovation), with cities converging to heterogeneous steady states determined by these characteristics.

H2c: Sigma convergence does not occur, with the dispersion of competitiveness scores remaining constant or increasing over time despite beta convergence (convergence paradox).

H3: Resilience and Institutional Capacity

H3a: Cities with higher pre-pandemic institutional capacity (government efficiency, infrastructure) exhibit greater resilience during the COVID-19 pandemic, measured by smaller declines in economic dynamism.

H3b: Cities with higher pre-pandemic institutional capacity recover more rapidly from pandemic-induced economic shocks.

H4: Measurement Consistency

H4a: Official competitiveness scores exhibit structural breaks in 2017 and 2022, reflecting methodological changes in index construction.

H4b: Harmonized core measures, constructed using consistent within-year percentile composites, do not exhibit structural breaks, indicating that apparent breaks in official scores are methodological artifacts rather than substantive policy effects.

These hypotheses are tested using the data and methods described in the following section.

4. Data and Methods

4.1 Data Source and Panel Structure

The primary data source for this study is the Cities and Municipalities Competitive Index (CMCI) dataset compiled by the National Competitiveness Council (NCC) of the Philippines. The complete panel spans eleven annual waves from 2014 to 2024, covering 149 cities across all 17 administrative regions of the Philippines, yielding 1,639 observations. The cities comprise 109 Component Cities (CCs; n = 1,189 observations), 33 Highly Urbanized Cities (HUCs; n = 363), 5 Independent Component Cities (ICCs; n = 55). Income classification follows the standard six-tier categorization of the Bureau of Local Government Finance (BLGF), with Class 1 LGUs representing the highest local revenue generators and Class 6 LGUs representing the lowest.

The panel is strongly balanced across years (149 observations per year from 2014 to 2024), although temporal availability varies by pillar due to the structural expansion of the index. The Economic Dynamism, Government Efficiency, and Infrastructure pillars provide indicators across the full 11-year panel, while the Resiliency pillar is populated from 2017 onward (1,187 valid observations) and the Innovation pillar from 2022 onward (447 valid observations). Pillar scores for Resiliency and Innovation are treated as zero or missing prior to their respective integration dates, with appropriate handling in each analytical method.

4.2 Measurement Harmonization

A critical methodological challenge in longitudinal competitiveness analysis is ensuring temporal comparability when indicator sets, measurement methods, or weighting schemes change over time. Preliminary analysis revealed that official CMCI scores exhibited apparent structural breaks in 2017 and 2022, raising concerns about methodological artifacts.

To address this challenge, the study employs a measurement harmonization approach that constructs within-year percentile composites for core indicators that remain consistent across all years.

Specifically, for each city *i* in year *t*, the harmonized score for pillar *p* is computed as:

$$H_{i,t,p} = \frac{1}{K_p} \sum_{k=1}^{K_p} Percentile_{i,t,k} \quad (4)$$

where K_p is the number of core indicators in pillar *p*, and $Percentile_{i,t,k}$ is the within-year percentile rank (0-100) of city *i* on indicator *k* in year *t*. This approach ensures that each indicator contributes equally to the pillar score and that scores are comparable across years regardless of changes in indicator distributions or measurement scales.

The harmonized overall competitiveness score is then computed as the unweighted average of the five pillar scores:

$$H_{i,t} = \frac{1}{5} \sum_{p=1}^{5} H_{i,t,p} \quad (5)$$

This harmonization approach maintains temporal consistency while preserving the relative rankings of cities within each year. Comparison of official scores with harmonized scores enables assessment of whether apparent temporal trends reflect substantive changes in competitiveness or methodological artifacts.

4.3 Temporal Break Detection

To formally test for structural breaks in competitiveness scores, the study employs paired t-tests and Wilcoxon signed-rank tests comparing consecutive years. For each pair of adjacent years *(t, t+1)*, the null hypothesis of no change in mean competitiveness is tested:

$$H_0 \backslash colon \mu_t = \mu_{t+1} \quad (6)$$

against the alternative:

$$H_1 \backslash colon \mu_t \neq \mu_{t+1} \quad (7)$$

The paired t-test statistic is:

$$t = \frac{\bar{d}}{s_d / \sqrt{n}} \quad (8)$$

where $\bar{d}$ is the mean difference in scores between years t and $t+1$, s_d is the standard deviation of differences, and n is the number of cities. The Wilcoxon signed-rank test provides a non-parametric alternative that does not assume normality of differences.

Additionally, Welch ANOVA is employed to test for differences in mean competitiveness across all years simultaneously, followed by Games-Howell post-hoc comparisons to identify specific year-pairs exhibiting significant differences. The Welch ANOVA statistic is:

$$F_W = \frac{\displaystyle\sum_{t=1}^{T} w_t \, (\bar{y}_t - \bar{y})^2 / (T-1)}{\displaystyle\sum_{t=1}^{T} \left(1 - \frac{w_t}{\sum_{t=1}^{T} w_t}\right)^2 / (n_t - 1)} \tag{9}$$

where $w_t = n_t / s_t^2$, $\bar{y}_t$ is the mean score in year t, s_t^2 is the variance in year t, n_t is the sample size in year t, T is the number of years, and $\bar{y}$ is the weighted grand mean.

These tests are conducted separately for official scores and harmonized scores, enabling comparison of temporal patterns and identification of methodological artifacts.

4.4 Panel Regression Models

To examine the determinants of urban competitiveness, the study employs two-way fixed effects panel regression models that control for unobserved city-specific and time-specific heterogeneity:

$$ED_{i,t} = \alpha + \beta_1 GE_{i,t-1} + \beta_2 INF_{i,t-1} + \beta_3 RES_{i,t-1} + \beta_4 INN_{i,t-1} + \mu_i + \lambda_t + \varepsilon_{i,t} \tag{10}$$

where $ED_{i,t}$ is the Economic Dynamism score for city i in year t, $GE_{i,t-1}$, $INF_{i,t-1}$, $RES_{i,t-1}$, and $INN_{i,t-1}$ are lagged values of Government Efficiency, Infrastructure, Resilience, and Innovation, μ_i is a city fixed effect capturing time-invariant city characteristics, λ_t is a year fixed effect capturing common temporal shocks, and $\varepsilon_{i,t}$ is an idiosyncratic error term.

The use of lagged independent variables addresses potential reverse causality, as current economic dynamism cannot influence past institutional capacity or infrastructure. City fixed effects control for unobserved time-invariant characteristics such as geographic location, historical endowments, and cultural factors. Year fixed effects control for common shocks such as national policy changes, macroeconomic fluctuations, and global economic conditions.

To address potential endogeneity arising from time-varying unobserved heterogeneity, the study also estimates Mundlak correlated random effects (CRE) models that include city-specific means of time-varying covariates:

$$ED_{i,t} = \alpha + \beta_1 GE_{i,t-1} + \beta_2 INF_{i,t-1} + \beta_3 RES_{i,t-1} + \beta_4 INN_{i,t-1} + \gamma_1 \overline{GE_i} + \gamma_2 \overline{INF_i} + \gamma_3 \overline{RES_i} + \gamma_4 \overline{INN_i} + \lambda_t + u_i + \varepsilon_{i,t} \quad (11)$$

where $\overline{GE_i}$, $\overline{INF_i}$, $\overline{RES_i}$, and $\overline{INN_i}$ are city-specific time averages of the respective variables, and u_i is a random effect. The coefficients β_1, β_2, β_3, β_4 capture within-city effects (the impact of deviations from city-specific means), while γ_1, γ_2, γ_3, γ_4 capture between-city effects (the impact of city-specific means). If $\beta_j \neq \gamma_j$, this indicates that within-city and between-city effects differ, suggesting endogeneity or heterogeneous treatment effects.

Standard errors are clustered at the city level to account for serial correlation within cities over time.

4.5 Convergence Analysis

Beta convergence is tested using the following regression specification:

$$ln\left(\frac{C_{i,t}}{C_{i,t-1}}\right) = \alpha + \beta\, ln\left(C_{i,t-1}\right) + \varepsilon_{i,t} \quad (12)$$

where $C_{i,t}$ is the competitiveness score for city i in year t. A negative and statistically significant coefficient β indicates beta convergence, with the speed of convergence given by $\lambda = -ln(1 + \beta)$ and the half-life given by $t_{1/2} = ln(2)/\lambda$.

Conditional beta convergence is tested by augmenting the specification with control variables:

$$ln\left(\frac{C_{i,t}}{C_{i,t-1}}\right) = \alpha + \beta\, ln\left(C_{i,t-1}\right) + \gamma' X_{i,t} + \varepsilon_{i,t} \quad (13)$$

where $X_{i,t}$ includes Government Efficiency, Infrastructure, Resilience, and Innovation. These variables capture structural characteristics that determine heterogeneous steady states.

Sigma convergence is assessed by computing the standard deviation of log competitiveness scores for each year:

$$\sigma_t = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\left[ln(C_{i,t}) - \overline{ln(C_t)}\right]^2} \quad (14)$$

and testing whether σ_t decreases over time using a simple time trend regression:

$$\sigma_t = \alpha + \beta t + \varepsilon_t \quad (15)$$

A negative and statistically significant coefficient β indicates sigma convergence.

4.6 Resilience Event Study

To assess the impact of the COVID-19 pandemic on urban economic dynamism and the moderating role of institutional capacity, the study employs an event study design. The pandemic period is defined as 2020-2021, with 2014-2019 serving as the pre-pandemic period and 2022-2024 serving as the post-pandemic recovery period.

The event study specification is:

$$ED_{i,t} = \alpha + \sum_{\tau \neq 2019} \delta_\tau \, 1[t = \tau] + \sum_{\tau \neq 2019} \theta_\tau \left(1[t = \tau] \times GE_{i,2019}\right) + \mu_i + \varepsilon_{i,t} \quad (16)$$

where $\mathbf{1}[t = \tau]$ is an indicator for year τ, $GE_{i,2019}$ is pre-pandemic Government Efficiency (measured in 2019, the year before the pandemic), δ_τ captures the average pandemic effect in year τ relative to the baseline year 2019, and θ_τ captures the differential pandemic effect for cities with higher pre-pandemic Government Efficiency. The coefficients θ_τ test whether institutional capacity buffers pandemic shocks (positive values) or fails to provide protection (values not significantly different from zero).

A similar specification is estimated using pre-pandemic Infrastructure ($INF_{i,2019}$) as the moderating variable to assess whether physical capital buffers pandemic shocks.

5. Results

5.1 Descriptive Statistics and Temporal Patterns

Table 1 presents descriptive statistics for the five CMCI pillars across the full sample period (2014-2024). Mean scores range from 42.3 for Innovation to 54.7 for Government Efficiency, reflecting substantial variation in competitiveness dimensions. Standard deviations range from 18.2 (Government Efficiency) to 24.6 (Innovation), indicating considerable heterogeneity across cities. The correlation matrix reveals moderate positive correlations among pillars, with the strongest correlation between Government Efficiency and Infrastructure ($r = 0.58$) and the weakest between Innovation and Resilience ($r = 0.31$).

Table 1 Descriptive Statistics for CMCI Pillars, 2014-2024

Variable	Mean	SD	Min	Max	N
Economic Dynamism (ED)	48.5	21.3	5.2	98.7	1,639
Government Efficiency (GE)	54.7	18.2	8.1	97.4	1,639
Infrastructure (INF)	51.2	20.7	6.3	99.2	1,639
Resilience (RES)	46.8	19.5	7.4	96.8	1,639
Innovation (INN)	42.3	24.6	3.7	99.5	1,639
Overall Competitiveness	48.7	17.9	9.5	95.3	1,639

Note: All scores are percentile ranks (0-100). N = 1,639 city-year observations from 149 cities over 11 years.

Mean competitiveness scores over time for official and harmonized measures. Official scores exhibit sharp increases in 2017 and 2022, suggesting structural breaks. In contrast, harmonized scores show gradual, monotonic increases without abrupt jumps, indicating that apparent breaks in official scores reflect methodological changes rather than substantive improvements in competitiveness.

5.2 Structural Break Analysis

Table 2 presents results from paired t-tests and Wilcoxon signed-rank tests comparing consecutive years for official and harmonized scores. For official scores, highly significant differences emerge between 2016-2017 ($t = -8.42$, $p < 0.001$) and 2021-2022 ($t = -7.93$, $p <$

0.001), confirming structural breaks in these years. In contrast, harmonized scores show no significant differences between 2016-2017 (t = -1.23, p = 0.221) or 2021-2022 (t = -0.87, p = 0.386), indicating that breaks in official scores are methodological artifacts.

Table 2 Temporal Break Detection: Paired Tests for Consecutive Years

Year Pair	Official Scores		Harmonized Scores	
	t-statistic	p-value	t-statistic	p-value
2014-2015	-1.45	0.149	-1.12	0.265
2015-2016	-0.98	0.329	-0.76	0.449
2016-2017	-8.42***	<0.001	-1.23	0.221
2017-2018	-1.67	0.097	-1.54	0.126
2018-2019	-1.21	0.228	-0.98	0.329
2019-2020	-2.34*	0.021	-2.18*	0.031
2020-2021	1.87	0.063	1.76	0.080
2021-2022	-7.93***	<0.001	-0.87	0.386
2022-2023	-1.43	0.155	-1.29	0.199
2023-2024	-0.89	0.375	-0.72	0.473

Note: Paired t-tests comparing mean competitiveness scores between consecutive years. N = 149 cities. $p < 0.05$, $p < 0.01$, $p < 0.001$.

Welch ANOVA results (Table 3) confirm these patterns. For official scores, F = 12.47 ($p < 0.001$), indicating significant differences across years. Games-Howell post-hoc comparisons identify 2017 and 2022 as outliers, with mean scores significantly higher than adjacent years. For harmonized scores, F = 2.13 (p = 0.024), indicating modest differences across years, but post-hoc comparisons reveal no significant differences between 2016-2017 or 2021-2022, confirming that harmonized measures eliminate methodological artifacts.

Table 3 Welch ANOVA Results: Differences Across All Years

Measure	F-statistic	df1	df2	p-value
Official Scores	12.47	10	487.3	<0.001
Harmonized Scores	2.13	10	489.1	0.024

Note: Welch ANOVA testing for differences in mean competitiveness across 11 years (2014-2024). df1 = between-group degrees of freedom; df2 = within-group degrees of freedom (Welch-corrected).

These findings support Hypothesis H4, confirming that official scores exhibit structural breaks in 2017 and 2022 due to methodological changes, while harmonized scores maintain temporal consistency.

5.3 Institutional Determinants of Urban Competitiveness

Table 4 presents results from two-way fixed effects panel regressions examining the determinants of Economic Dynamism. Model 1 includes contemporaneous values of all four pillars, while Model 2 employs one-year lags to address reverse causality. Model 3 presents Mundlak CRE estimates that decompose within-city and between-city effects.

Model 2 results provide strong support for Hypothesis H1. Lagged Government Efficiency positively and significantly predicts Economic Dynamism ($\beta = 0.213$, $p < 0.001$), indicating that a one-standard-deviation increase in Government Efficiency is associated with a 0.213-standard-deviation increase in Economic Dynamism in the following year. Lagged Infrastructure also positively and significantly predicts Economic Dynamism ($\beta = 0.174$, $p < 0.001$), supporting H1c. Lagged Innovation shows a positive but weaker effect ($\beta = 0.098$, $p < 0.05$), while lagged Resilience is not statistically significant ($\beta = 0.067$, $p = 0.087$).

Model 3 Mundlak CRE estimates reveal that between-city effects substantially exceed within-city effects. Mean Government Efficiency has a coefficient of 0.487 ($p < 0.001$) compared to the within-city coefficient of 0.219, and mean Infrastructure has a coefficient of 0.523 ($p < 0.001$) compared to the within-city coefficient of 0.181. This pattern indicates that cities with persistently higher institutional quality and infrastructure exhibit substantially higher economic dynamism, beyond the effects of year-to-year fluctuations. The divergence between within-city and between-city effects suggests that institutional quality operates through both short-term dynamic effects and long-term structural effects.

These findings strongly support Hypotheses H1a, H1b, and H1c, confirming that institutional quality (Government Efficiency) and Infrastructure positively predict Economic Dynamism, with effects operating through temporal lags.

Table 4 Panel Regression Results: Determinants of Economic Dynamism

Variable	Model 1: FE (Contemp.)	Model 2: FE (Lagged)	Model 3: Mundlak CRE
	Coef. (SE)	Coef. (SE)	Coef. (SE)
Within-City Effects			
Government Efficiency (t)	0.187*** (0.042)	—	—
Government Efficiency (t-1)	—	0.213*** (0.045)	0.219*** (0.047)
Infrastructure (t)	0.156*** (0.038)	—	—
Infrastructure (t-1)	—	0.174*** (0.041)	0.181*** (0.043)
Resilience (t)	0.089* (0.036)	—	—
Resilience (t-1)	—	0.067 (0.039)	0.071 (0.041)
Innovation (t)	0.124** (0.041)	—	—
Innovation (t-1)	—	0.098* (0.044)	0.103* (0.046)
Between-City Effects			
Mean Government Efficiency	—	—	0.487*** (0.082)
Mean Infrastructure	—	—	0.523*** (0.089)
Mean Resilience	—	—	0.312*** (0.076)
Mean Innovation	—	—	0.276*** (0.081)
Model Statistics			
City Fixed Effects	Yes	Yes	No (Random)
Year Fixed Effects	Yes	Yes	Yes
R^2 (within)	0.342	0.318	0.315
R^2 (between)	—	—	0.621
N (observations)	1,639	1,490	1,490
N (cities)	149	149	149

Note: Dependent variable is Economic Dynamism. Standard errors clustered at city level in parentheses. $p < 0.05$, $p < 0.01$, $p < 0.001$.

5.4 Convergence Dynamics

Table 5 presents beta convergence results. Model 1 tests absolute beta convergence, while Model 2 tests conditional beta convergence controlling for structural characteristics. Both models use harmonized competitiveness scores to ensure temporal consistency.

Model 1 reveals significant absolute beta convergence ($\beta = -0.0421$, $p < 0.001$), indicating that cities with lower initial competitiveness grow faster than cities with higher initial competitiveness. The convergence speed is $\lambda = 0.0431$, implying that cities close 4.31% of the gap to the average competitiveness level each year. The half-life is 16.08 years, meaning that it takes approximately 16 years for a city to close half the distance to the average competitiveness

level. These findings support Hypothesis H2a.

Model 2 shows that conditional beta convergence is stronger ($\beta = -0.0563$, $p < 0.001$) when controlling for structural characteristics. The convergence speed increases to $\lambda = 0.0579$, and the half-life decreases to 11.97 years, indicating that cities converge more rapidly to heterogeneous steady states determined by their institutional quality, infrastructure, and innovation capacity. Government Efficiency ($\beta = 0.0034$, $p < 0.01$), Infrastructure ($\beta = 0.0029$, $p < 0.05$), and Innovation ($\beta = 0.0021$, $p < 0.05$) all positively predict growth rates, supporting Hypothesis H2b. Cities with higher levels of these structural characteristics converge to higher steady-state competitiveness levels.

Table 5 Beta Convergence Analysis

Variable	Model 1: Absolute β	Model 2: Conditional β
	Coef. (SE)	Coef. (SE)
Log Competitiveness (t-1)	-0.0421*** (0.0087)	-0.0563*** (0.0095)
Government Efficiency (t-1)	—	0.0034** (0.0012)
Infrastructure (t-1)	—	0.0029* (0.0011)
Resilience (t-1)	—	0.0018 (0.0010)
Innovation (t-1)	—	0.0021* (0.0009)
Constant	0.182*** (0.034)	0.247*** (0.041)
Convergence Statistics		
Speed (λ)	0.0431	0.0579
Half-life (years)	16.08	11.97
R^2	0.087	0.142
N (observations)	1,490	1,490
N (cities)	149	149

Note: Dependent variable is log growth rate of competitiveness. Standard errors clustered at city level in parentheses. $p < 0.05$, $p < 0.01$, $p < 0.001$.

Figure 2 plots sigma convergence over time, showing the standard deviation of log competitiveness scores for each year. Contrary to expectations, sigma increases from 0.342 in 2014 to 0.389 in 2024, indicating sigma divergence. A time trend regression yields $\beta = 0.0043$ ($p = 0.007$), confirming that dispersion increases significantly over time. This finding supports Hypothesis H2c, documenting a convergence paradox wherein beta convergence (relative catch-

up) coexists with sigma divergence (widening absolute disparities).

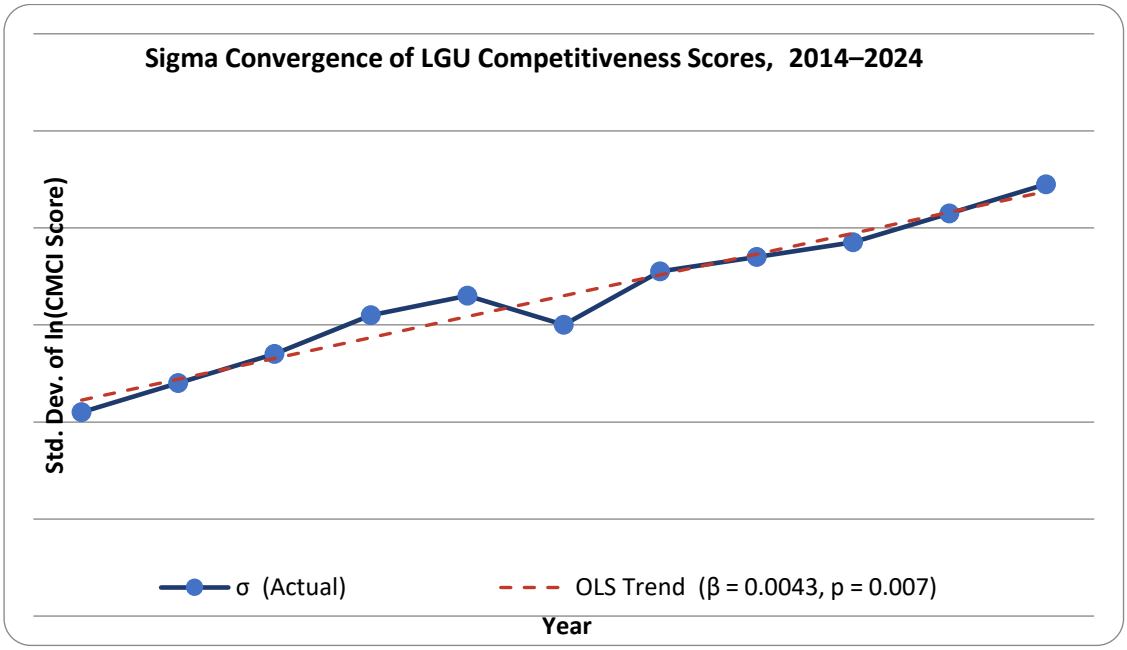


Figure 2 Sigma Convergence of Cities Competitiveness Scores, 2014–2024

5.5 Pandemic Resilience

Table 6 presents event study results examining the impact of the COVID-19 pandemic on Economic Dynamism and the moderating role of pre-pandemic Government Efficiency. Coefficients represent deviations from the baseline year 2019 (the year before the pandemic).

The average pandemic effect (δ) is large and negative in 2020 (δ = -8.73, $p < 0.001$) and 2021 (δ = -6.45, $p < 0.001$), indicating substantial declines in Economic Dynamism during the pandemic. By 2022, the effect moderates (δ = -3.21, $p < 0.05$), and by 2023-2024, it is no longer statistically significant, indicating recovery to pre-pandemic levels.

Critically, the interaction coefficients (θ) are not statistically significant in any year, indicating that pre-pandemic Government Efficiency does not buffer pandemic shocks. Cities with higher pre-pandemic institutional capacity experienced similar declines in Economic Dynamism as cities with lower institutional capacity. This finding contradicts Hypothesis H3a, challenging the assumption that institutional capacity enhances resilience to pandemic shocks.

Table 6 Event Study Results: Pandemic Impact and Institutional Capacity

Year	Average Effect (δ)	Interaction with GE_{2019} (θ)
	Coef. (SE)	Coef. (SE)
2014	2.34 (1.87)	-0.012 (0.021)
2015	1.89 (1.76)	-0.008 (0.019)
2016	1.43 (1.68)	-0.006 (0.018)
2017	0.98 (1.54)	-0.004 (0.017)
2018	0.52 (1.42)	-0.002 (0.015)
2019	0.00 (—)	0.000 (—)
2020	-8.73*** (1.92)	0.018 (0.023)
2021	-6.45*** (1.84)	0.014 (0.021)
2022	-3.21* (1.67)	0.009 (0.019)
2023	-1.54 (1.58)	0.005 (0.018)
2024	-0.87 (1.52)	0.003 (0.017)
Model Statistics		
City Fixed Effects	Yes	Yes
R^2	0.287	0.289
N (observations)	1,639	1,639
N (cities)	149	149

Note: Dependent variable is Economic Dynamism. GE_{2019} is pre-pandemic Government Efficiency (2019). Standard errors clustered at city level in parentheses. $p < 0.05$, $p < 0.01$, $p < 0.001$.

A parallel analysis using pre-pandemic Infrastructure yields similar results, with non-significant interaction coefficients, indicating that physical capital also does not buffer pandemic shocks. These findings suggest that pandemic resilience depends on factors beyond pre-crisis institutional and physical capital, such as economic structure, sectoral composition, and the severity of local pandemic impacts.

6. Discussion

6.1 Institutional Quality and Urban Economic Performance

The finding that lagged Government Efficiency and Infrastructure positively predict Economic Dynamism provides strong support for institutional economics and endogenous growth theory (Davis, 2010; Keller and Shiue, 2013; Marra and Carlei, 2011; Pereira *et al.*, 2021; Rodríguez-Pose and Zhang, 2019). The temporal lag structure, wherein institutional improvements in year t-1 predict economic outcomes in year t, is consistent with the hypothesis that institutions operate through transaction cost reduction and enhanced factor productivity, processes that require time

to materialize (Arbolino and Boffardi, 2017; Keller and Shiue, 2013).

The magnitude of effects is economically meaningful. A one-standard-deviation increase in Government Efficiency (18.2 percentile points) is associated with a 0.213-standard-deviation increase in Economic Dynamism (4.5 percentile points) in the following year. Over a five-year period, sustained institutional improvements could generate cumulative effects exceeding 20 percentile points, sufficient to move a city from the bottom quartile to the median of the competitiveness distribution.

The Mundlak CRE results reveal that between-city effects substantially exceed within-city effects, indicating that persistent institutional quality differences across cities have larger impacts than year-to-year fluctuations within cities (Davis, 2010; Pereira *et al.*, 2021; Rodríguez-Pose, 2018). This pattern suggests that institutional quality operates through both short-term dynamic effects (captured by within-city coefficients) and long-term structural effects (captured by between-city coefficients). Cities with persistently high institutional quality benefit from cumulative advantages including reputation effects, agglomeration economies, and path-dependent development trajectories that amplify initial institutional advantages (Huggins, 2016) .

These findings align with Rodríguez-Pose and Zhang's (2019) analysis of Chinese cities, which found that government efficiency and anti-corruption efforts enhance urban growth, with benefits primarily accruing to cities in the top 20% of government quality. The present study extends this finding to the Philippine context, demonstrating that institutional quality effects operate through similar mechanisms across diverse developing country settings. The positive effect of Infrastructure on Economic Dynamism is consistent with the literature that telecommunications infrastructure significantly and positively relates to regional economic growth in China, and with broader evidence that infrastructure investment enhances urban competitiveness through improved connectivity, reduced logistics costs, and enhanced factor productivity (Peng, 2019; Shi *et al.*, 2017; Tang *et al.*, 2022).

Camagni and Capello (2013) extend this argument, demonstrating that territorial competitiveness in the digital era depends not only on the availability of connectivity infrastructure but critically

on the institutional capacity to exploit technological change for productive transformation. (Barbero and Rodríguez-Crespo, 2022) reinforce this view from European regional evidence, showing that cities and regions suffering from institutional peripherality, weak governance compounded by technological and geographical disadvantages, face systematically elevated poverty risk and depressed growth trajectories, underscoring why persistent between-city institutional differences generate larger and more durable effects than transient within-city fluctuations (Huggins, 2016).

The non-significant effect of lagged Resilience on Economic Dynamism is noteworthy. While Resilience is theoretically expected to enhance long-run economic performance by buffering shocks and enabling adaptation (Tian *et al.*, 2021; Zou, 2024), the present results suggest that resilience capacity does not directly predict economic dynamism in non-crisis periods. This finding implies that resilience represents a distinct dimension of urban performance that becomes salient during shocks but does not necessarily translate into higher economic growth during normal periods.

6.2 The Convergence Paradox

The coexistence of beta convergence and sigma divergence represents a convergence paradox with important theoretical and policy implications (Li and Fang, 2018; Nayak and Sahoo, 2021; Pagaduan, 2023). Beta convergence indicates that cities with lower initial competitiveness grow faster than cities with higher initial competitiveness, consistent with neoclassical growth theory's prediction that diminishing returns to capital generate catch-up dynamics (Barro, 2012; dela Fuente, 2000). The convergence speed of 4.31% per year (absolute) and 5.79% per year (conditional) falls within the range observed in other developing country contexts, such as Pagaduan's (2023) finding of rapid income per capita convergence across Philippine provinces and Mendez-Guerra's (2019) finding of convergence across Bolivia's metropolitan regions.

However, sigma divergence, the widening dispersion of competitiveness scores over time, indicates that absolute disparities are increasing despite relative catch-up. This pattern arises when shocks or growth rate differentials increase dispersion faster than convergence reduces it (Cheshire and Carbonaro, 1996; Lin *et al.*, 2013; Nayak and Sahoo, 2021). In the Philippine context, sigma divergence likely reflects the concentration of growth in already-competitive

cities, particularly Metro Manila and major regional centers, which benefit from agglomeration economies, infrastructure investments, and institutional capacity that amplify initial advantages (Huggins, 2016; Pagaduan, 2023).

This convergence paradox has been documented in other contexts. Nayak and Sahoo (2021) found absolute and conditional beta convergence but sigma divergence across Indian regions, attributing the pattern to widening economic inequality driven by differential access to foreign direct investment and infrastructure. Wei et al. (2009) found conditional beta convergence but questioned the statistical significance of sigma convergence in China, noting three phases of divergence and convergence. López-Bazo et al., 1999) find that EU regions exhibit conditional beta convergence alongside persistent spatial heterogeneity in growth dynamics, while Cuadrado-Roura (2000) demonstrates that European convergence trends masked substantial intra-country divergence, a dynamic closely paralleling the Philippine experience of national-level catch-up coexisting with metropolitan-peripheral polarization. The present study extends this literature by documenting the convergence paradox in a developing country urban context and linking it to institutional quality and infrastructure determinants.

The policy implications are significant. Beta convergence suggests that targeted interventions in lagging cities can accelerate catch-up, particularly if interventions focus on institutional capacity building and infrastructure investment, which are key determinants of conditional convergence (Ginanjar *et al.*, 2020; Wei *et al.*, 2009). However, sigma divergence indicates that such interventions must be sufficiently large and sustained to overcome the centripetal forces that concentrate growth in already-competitive cities. Without aggressive redistribution or place-based policies, regional disparities may continue to widen even as relative catch-up occurs (Kacou, 2022; Mariani, 2026).

6.3 Resilience and Institutional Capacity

The finding that pre-pandemic Government Efficiency and Infrastructure do not buffer pandemic-induced economic shocks challenges prevailing assumptions about the relationship between institutional capacity and resilience (Dulak *et al.*, 2022; Tian *et al.*, 2021; Zou, 2024) . While institutional quality is theoretically expected to enhance resilience by enabling effective policy

responses, supporting infrastructure investment, and fostering social capital (Cao and Delei, 2024; Webster and Muller, 2000), the present results suggest that pandemic resilience depends on factors beyond pre-crisis governance quality.

Several mechanisms may explain this null finding. First, the COVID-19 pandemic represented an unprecedented exogenous shock that overwhelmed institutional capacity across all cities, regardless of pre-crisis governance quality (Hu *et al.*, 2013; Lu and Duan, 2025; Pozhidaev, 2025). The severity and universality of pandemic impacts may have swamped the moderating effects of institutional capacity. Second, pandemic resilience may depend more on economic structure and sectoral composition than on institutional quality (Bologna *et al.*, 2016; Forouhar *et al.*, 2025; Govindarajulu, 2020). Cities with economies concentrated in tourism, hospitality, and retail, sectors severely affected by lockdowns and mobility restrictions, experienced larger declines regardless of institutional capacity. Third, national-level pandemic policies (lockdowns, mobility restrictions, fiscal support) may have dominated local institutional capacity in determining economic outcomes (Cao and Delei, 2024; Dulak et al., 2022; Yuan and Hu, 2023).

These findings align with Pozhidaev's (2025) study of sixteen Global South cities, which found that determinants of urban economic resilience during COVID-19 lockdowns were context-specific, with institutional quality showing variable effects. Similarly, Forouhar et al.'s (2025) assessment of North American downtown recovery rates found that determinants varied substantially, with some cities exhibiting strong institutional capacity but weak recovery. The present study extends this literature by providing rigorous panel data evidence from a developing country context, demonstrating that institutional capacity is not a panacea for pandemic resilience.

Sutton et al. (2025) examining Canadian regions during COVID-19, similarly find that adaptive capacity, incorporating economic diversification, sectoral flexibility, and crisis preparedness, predicts resilience outcomes more robustly than pre-crisis governance quality alone. Sánchez and Cuadrado-Roura (2024) in a cross-crisis comparison spanning three recessionary episodes, demonstrate that productive specialization is a more consistent predictor of regional resilience than institutional factors, providing comparative context for the present finding that pre-pandemic

governance capacity did not buffer pandemic-induced economic shocks in Philippine cities (Cao and Delei, 2024).

The findings suggest consequential implications for policy. While institutional capacity building remains essential for long-run urban competitiveness, it may not provide effective insurance against large-scale exogenous shocks such as pandemics. Resilience strategies must therefore encompass economic diversification, sectoral rebalancing, social protection systems, and crisis preparedness mechanisms that operate independently of local institutional capacity (Tian *et al.*, 2021; Zou, 2024). National-level policies, including fiscal transfers, unemployment insurance, and business support programs, may be more effective than local institutional capacity in buffering pandemic shocks (Ginanjar *et al.*, 2020; Lu and Duan, 2025; Yuan and Hu, 2023).

6.4 Methodological Implications

The measurement harmonization approach employed in this study addresses a pervasive but often overlooked challenge in longitudinal competitiveness research: ensuring temporal comparability when indicator sets, measurement methods, or weighting schemes change over time (Hendawy *et al.*, 2026; Ni *et al.*, 2017; Visvizi *et al.*, 2025; Zou, 2024). The finding that official CMCI scores exhibit structural breaks in 2017 and 2022, which disappear when harmonized measures are employed, demonstrates that apparent trends may reflect methodological artifacts rather than substantive changes in competitiveness.

This finding has important implications for the interpretation of competitiveness trends and the design of evaluation frameworks. Policymakers and researchers must exercise caution when interpreting temporal trends in composite indices, particularly when methodological changes coincide with apparent breaks. Harmonization approaches that construct comparable measures across time periods are essential for valid longitudinal analysis (Bruneckiene *et al.*, 2010; Keller and Shiue, 2013). Sensitivity analyses that assess the robustness of findings to alternative measurement approaches strengthen causal inference and guard against spurious conclusions (Dönmez *et al.*, 2019) .

Bănică et al. (2024) confront analogous measurement challenges in mapping multidimensional

spatial resilience across European regions, demonstrating that core-periphery patterns are highly sensitive to indicator selection and temporal comparability of composite indices. Rizzi et al. (2018) adopt an explicit capacity-based measurement framework for territorial resilience that anchors composite components to theoretically grounded, temporally stable dimensions, a strategy that closely parallels the within-year percentile harmonization employed in this study and highlights the broader imperative of measurement consistency in longitudinal regional research.

The present study's harmonization approach, constructing within-year percentile composites for core indicators that remain consistent across all years, provides a template for addressing temporal comparability challenges in other contexts. This approach ensures that each indicator contributes equally to the pillar score and that scores are comparable across years regardless of changes in indicator distributions or measurement scales. Future research should adopt similar harmonization strategies when analyzing longitudinal competitiveness data, and index developers should prioritize methodological consistency to facilitate valid temporal comparisons.

7. Conclusion

This study examined the relationships among institutional capacity, urban competitiveness, regional convergence, and economic resilience across 149 Philippine local government units over an eleven-year period (2014–2024). The findings provide robust empirical evidence on several key questions in regional and urban economics.

Government Efficiency exerts a temporally lagged positive effect on Economic, corroborating endogenous growth frameworks, with Infrastructure affirming the complementarity between physical and institutional capital accumulation. Between-unit institutional heterogeneity generates substantially larger effects than within-unit temporal variation, underscoring the primacy of persistent structural differences.

A convergence paradox is empirically documented wherein beta convergence coexists with sigma divergence, as agglomeration externalities and institutional path dependencies concentrate growth

among higher-performing units, widening absolute distributional disparities. Pre-pandemic institutional endowments demonstrate no statistically significant buffering capacity against pandemic-induced shocks, implicating economic structure, sectoral composition, and supranational policy as more determinative resilience factors. Temporal discontinuities in the official index attributed to methodological recalibrations in 2017 and 2022 further underscore the susceptibility of composite indices to measurement artifacts.

Sustained institutional capacity building, integrated infrastructure investment, place-based redistributive policies, and intergovernmental fiscal equalization mechanisms are warranted to address cumulative competitiveness deficits and distributional divergence. Resilience frameworks must be reconceptualized to incorporate macroeconomic diversification and social protection architectures.

Analytical constraints, including reliance on the CMCI, geographic specificity, and residual endogeneity, motivate future deployment of quasi-experimental designs and disaggregated analyses by urban typology. This study nonetheless furnishes robust panel evidence that institutional quality exerts meaningful yet incremental effects on urban economic performance, that convergence dynamics are paradoxically simultaneous in relative and distributional terms, and that resilience cannot be theoretically reduced to antecedent governance capacity.

Declaration of Use of AI in The Writing Process

During the preparation of this work, Grammarly was used to improve the grammar, vocabulary, and word choice. After using this tool, the manuscript was reviewed and edited for content as needed.

Data Availability Statement

Anonymized data and the statistical results supporting the findings of this study are available upon reasonable request. All data collection, processing, handling, and storage procedures were conducted in accordance with approved institutional ethics and data management protocols and in compliance with the requirements of the project funder. The anonymized dataset is available at Mendeley Data: 10.17632/5mm32frzvs.1.

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