Fiscal Decentralisation and Regional Development in Kenya: A Spatiotemporal Econometric Analysis of Poverty, Growth, Health and Economic Spillovers under Devolution

Doctoral Dissertation

MUTHAMA, Wencelaus Musyoka

Supervised by

Professor Dr. Gál Zoltán

University of Pécs

Doctoral School of Regional Policy and Economics

Faculty of Business and Economics

Hungary

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CHAPTER ONE: INTRODUCTION

1.0. Introduction

1.1. Research Background

Inequality, poverty, and regional disparities remain persistent global challenges, with particularly destabilising effects in Sub-Saharan Africa and Kenya (Berg and Ostry 2017; Willis and Gona 2013). These issues have renewed interest in the developmental role of fiscal decentralisation. Classical fiscal federalism suggests that efficiency and accountability improve when services are customised to local preferences (Oates 1999; 2008), while second-generation perspectives highlight institutional quality, bargaining, and incentives (Qian and Weingast 1997; Weingast 2009; Oates 2005). Meanwhile, New Economic Geography demonstrates how agglomeration and factor mobility impact spatial inequality (Krugman 1991; 1998), raising questions about whether decentralisation reduces or worsens divergence. Furthermore, empirical evidence, mainly from advanced economies with strong institutions, remains inconclusive: some studies associate decentralisation with reduced disparities, whereas others indicate it entrenches inequalities. In Sub-Saharan Africa, research is limited, and analyses at the national level often obscure spatial heterogeneity, spillovers, and institutional asymmetries.

Kenya offers a compelling empirical setting. Since the 2010 Constitution introduced one of Africa's most ambitious devolution reforms, decentralisation has aimed to address historical marginalisation and promote equity across 47 counties. However, results remain uneven: inequalities between counties persist, poverty and health disparities show spatial clustering, and fiscal capacities vary significantly. These patterns emphasise the need for spatially grounded analyses of how fiscal and institutional structures interact to affect welfare and convergence.

1.2. Motivation of the study

This study is motivated by theoretical ambiguity, empirical gaps, and methodological limitations. First, despite decades of debate, the role of fiscal decentralisation in reducing poverty, inequality, and regional disparities remains inconclusive, constraining evidence-based policymaking in contexts such as Kenya's ongoing devolution. Second, most empirical work has focused on developed economies, leaving developing countries underexplored despite their distinct political, fiscal, and institutional dynamics. Kenya's recent devolution thus provides a timely and policy-relevant setting to investigate these issues in an African context. Third, regional development outcomes are inherently spatial, shaped by geographic spillovers,

clustering, and fiscal interdependencies, yet conventional econometric approaches often neglect these dimensions, leading to biased or partial conclusions. This study addresses these gaps by employing spatiotemporal econometric techniques, capturing inter-county spillovers, convergence dynamics, and location-specific effects. Table 1.1 outlines the research questions guiding this dissertation.

TABLE 1.1 RESEARCH QUESTIONS AND PLACEMENT IN THE DISSERTATION

Chapter and study type	Research question
Chapter 2: Theoretical and Systematic Literature Review	RQ1: How does fiscal decentralisation influence regional development, and what theoretical and empirical gaps remain post-2010?
Chapter 4: Poverty (Empirical study 1)	RQ2: How do different dimensions of fiscal decentralisation affect poverty reduction across Kenyan counties, including spatial spillovers and age-specific effects
Chapter 5: Economic Growth and Convergence (Empirical Study 2)	RQ3: How does fiscal decentralisation affect county-level economic performance and spatial spillovers?
	RQ4: Does fiscal decentralisation promote absolute or conditional convergence among Kenyan counties?
Chapter 6: Health outcomes (Empirical study 3)	RQ5: How does fiscal decentralisation shape spatial disparities in health outcomes, and which fiscal instruments are most effective in improving key indicators?

1.3 Dissertation Framework

This dissertation comprises a theoretical and systematic literature review along with three empirical studies. The review places fiscal decentralisation within regional development theory and highlights key research gaps. The empirical chapters employ spatial econometric techniques to emphasise the significance of spatial dependence and spillovers in analysing regional public finance. The first study examines the spatiotemporal effects of fiscal decentralisation on poverty reduction; the second explores its role in shaping county-level economic performance and convergence; and the third evaluates how decentralisation and spatial interdependence influence health outcomes. Collectively, they provide insights into how fiscal decentralisation and spatial interdependencies impact regional economic growth and welfare. The dissertation concludes by synthesising the central thesis, policy implications, limitations, and directions for future research. It also emphasises the contextual, thematic, and methodological contributions as a comprehensive advance in the study of fiscal decentralisation and regional development.

1.4. Kenya’s Country Profile in the Context of Devolution

Kenya, the largest economy in East Africa and among the top ten in Africa, accounts for approximately 40% of the region's GDP. Its 2010 Constitution introduced a constitutionally protected two-tier system of governance: the national government and 47 county governments, aimed at addressing historical centralisation, regional inequalities, and uneven service delivery. At the same time, counties are empowered to establish municipalities and urban boards. Counties oversee service provision in key devolved sectors, including health, agriculture, water, local infrastructure, and early childhood education. The devolution framework is founded on subsidiarity, inclusivity, equity, and intergovernmental cooperation, making it one of Africa’s most ambitious experiments in fiscal decentralisation.

However, the transition has encountered persistent challenges: limited mobilisation of own-source revenue (OSR), weak administrative capacity, coordination failures, gaps in fiscal accountability, and risks of elite capture. Despite these issues, devolution remains a key element of Kenya’s governance and development framework, offering the promise of inclusive growth and spatial equity through enhanced local accountability and participatory planning. After a decade, it is still empirically unclear whether regional service delivery outcomes and development disparities are decreasing or increasing. This dissertation directly addresses this gap by analysing Kenya's devolution's spatial and fiscal dynamics.

Figure 1-1 is a choropleth map illustrating the significant disparities in geographical size, population density, and the locations of Kenya’s counties.

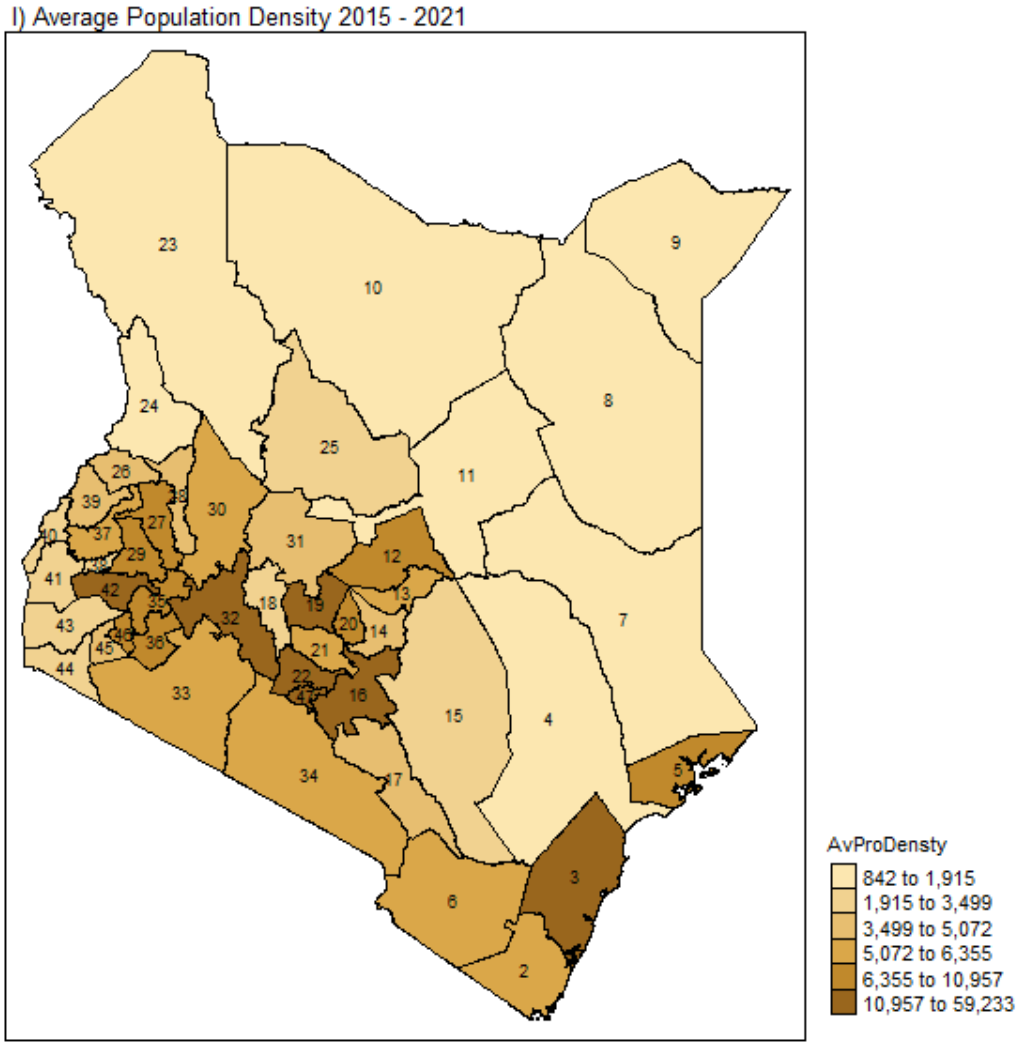


FIGURE 1.1. CHOROPLETH MAP OF THE COUNTIES OF KENYA AND THEIR POPULATION DENSITIES - 2021

Source: Authors' Visualisation

Note: 1=Mombasa, 2=Kwale, 3=Kilifi, 4=Tana River, 5= Lamu, 6=Taita Taveta, 7 = Garissa, 8=Wajir, 9 = Mandera, 10= Marsabit, 11 = Isiolo, 12 = Meru, 13 = Tharaka -Nithi, 14 = Embu, 15 = Kitui, 16 = Machakos, 17 = Makueni, 18 = Nyandarua, 19 = Nyeri, 20 = Kirinyaga, 21 = Murang'a, 22 = Kiambu, 23 = Turkana, 24 = West Pokot, 25 = Samburu, 26 = Trans Nzoia, 27 = Uasin Gishu, 28 = Elgeyo-Marakwet, 29 = Nandi, 30 = Baringo, 31 = Laikipia, 32= Nakuru, 33 = Narok, 34 = Kajiado, 35 = Kericho, 36 = Bomet, 37 = Kakamega, 38 = Vihiga, 39 = Bungoma, 40 = Busia, 41 = Siaya, 42 = Kisumu, 43 = Homa Bay, 44 = Migori, 45 = Kisii, 46 = Nyamira, 47 = Nairobi City

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

This chapter discusses the study's theoretical foundations and synthesises empirical findings from previous research. The empirical section adopts a systematic literature review approach to ensure thorough and transparent coverage of the relevant evidence.

2.2. Theoretical literature

Persistent inequality, poverty, and regional disparities continue to define development challenges, with destabilising effects in Sub-Saharan Africa and Kenya (Berg & Ostry 2017; Willis & Gona 2013). These dynamics have renewed focus on fiscal decentralisation to promote inclusive development. Anchored on regional development theory, this dissertation places fiscal decentralisation within an integrative framework that combines New Economic Geography (NEG), Convergence Theory, and Fiscal Federalism to analyse spatially uneven development.

NEG emphasises agglomeration economies, factor mobility, and spatial spillovers, showing how decentralisation may reinforce core-periphery inequalities if wealthier regions leverage stronger fiscal capacity (Krugman 1991, 1998). Convergence theory interrogates whether poorer regions catch up with wealthier ones under absolute or conditional convergence or remain locked in divergence. First-generation fiscal federalism provides the normative logic for assigning revenue and expenditure responsibilities across government levels, highlighting efficiency, accountability, and equity (Oates 1999, 2008). Second-generation contributions stress institutional quality, bargaining, and incentives as decisive (Qian & Weingast, 1997; Oates, 2005; Weingast, 2009). Synthesised, these perspectives position fiscal decentralisation as a multidimensional process whose outcomes depend on spatial structure, institutional asymmetries and transfer design.

This integrative framework structures three nexuses central to the dissertation. The poverty nexus examines how decentralisation interacts with inequality and fiscal capacity, with outcomes depending on redistribution, efficiency, or concurrency logics (Hernandez-Trillo 2016; Faguet 2014). The economic dynamics nexus evaluates growth and convergence, where fiscal reallocation may improve performance if expenditure shares shift from suboptimal allocations (Davoodi & Zou 1998). However, effects depend on institutional strength and spatial interdependence. The health nexus considers whether decentralisation enhances service delivery, though outcomes are influenced by accountability, local capacity, and spatial dependence (Kyriacou & Roca-Sagalés 2024).

Empirical evidence remains inconclusive: some studies connect decentralisation with reduced disparities, while others underscore increased inequalities. Much of this stems from advanced economies with strong institutions, leaving gaps in developing contexts where institutional asymmetries and spatial spillovers are more pronounced. Kenya offers a crucial test case for its ambitious devolution reforms addressing historical marginalisation across 47 counties since the 2010 Constitution.

2.3. Empirical literature review (Systematic literature review)

As of February 2024, few systematic literature reviews have thoroughly examined the relationship between fiscal decentralisation, economic growth, and convergence, or their implications for development outcomes such as poverty, inequality, health, and citizen well-being. Unlike traditional narrative reviews, systematic reviews improve objectivity, reliability, and reproducibility (Pollock and Berge, 2018; Liberati et al., 2009). This study systematically assesses research on fiscal decentralisation and its developmental impacts since 2010, with four objectives: a) synthesise evidence on how intergovernmental fiscal transfers and revenue autonomy influence regional growth, convergence, and economic development; b) identify gaps regarding how different fiscal instruments shape central-subnational relations and their relative effectiveness in fostering growth and convergence; c) characterise the evolution of research on fiscal decentralisation and its implications for regional convergence or divergence; and d) propose future research agendas to address knowledge gaps regarding the role of fiscal transfers and local revenue in shaping regional development, convergence, and service delivery in developing-country contexts.

2.3.1. Method

The research questions are framed using the Context–Intervention–Mechanism–Outcome (CIMO) logic (Denyer et al., 2008), which structures propositions by linking contexts (C) with interventions (I) that activate mechanisms (M) to generate outcomes (O). In this study, the context (C) is fiscally decentralised developing countries, where institutional asymmetries and capacity constraints distinguish decentralisation dynamics from those in advanced economies. The intervention (I) comprises fiscal instruments, notably intergovernmental transfers (conditional and unconditional grants) and own-source revenue (OSR). The mechanisms (M) capture how these instruments shape subnational governments' fiscal capacity, accountability, and ability to deliver public goods, thereby influencing economic performance and spatial development trajectories. The outcomes (O) concern the distributional and welfare effects of

fiscal decentralisation, specifically its impact on poverty reduction, inequality, and regional economic convergencewell-being.

The Context, Interventions, Mechanisms, and Outcome (CIMO) Logical Framework is presented in Figure 2-1

The Context, Interventions, Mechanisms, and Outcome (CIMO) Logical Framework

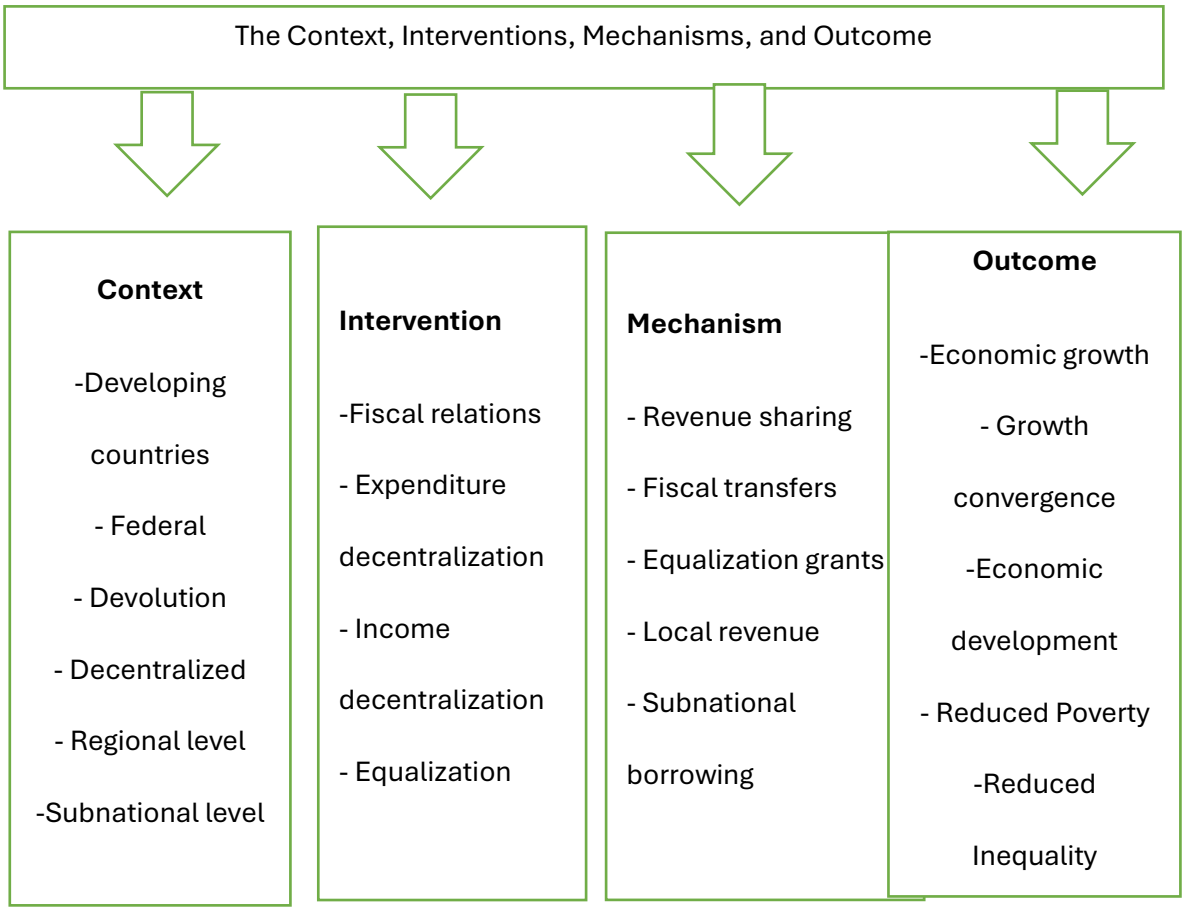


FIGURE 2.1: THE CIMO LOGICAL FRAMEWORK OF KEYWORDS

Source: Authors' elaboration

The systematic search followed the CIMO logic and PRISMA guidelines (Denyer et al., 2008; Waddington et al., 2012). Web of Science, Scopus, and EconLit databases were chosen for their multidisciplinary scope and disciplinary depth in economics. The search combined keywords related to fiscal decentralisation and regional development, limited to peer-reviewed English-language journal articles (2010–February 2024) in business and economics. After removing duplicates, titles and abstracts were screened based on predefined inclusion criteria,

resulting in 72 studies. Only Q1 and Q2 journals were included to ensure quality and comparability, leading to a final sample of 40 articles for detailed content analysis. Keyword co-occurrence network analysis was conducted to identify thematic clusters and emerging research frontiers. The selection process is illustrated in Figure 2-2 (PRISMA flow diagram), outlining the stages of identification, screening, eligibility assessment, and inclusion criteria.

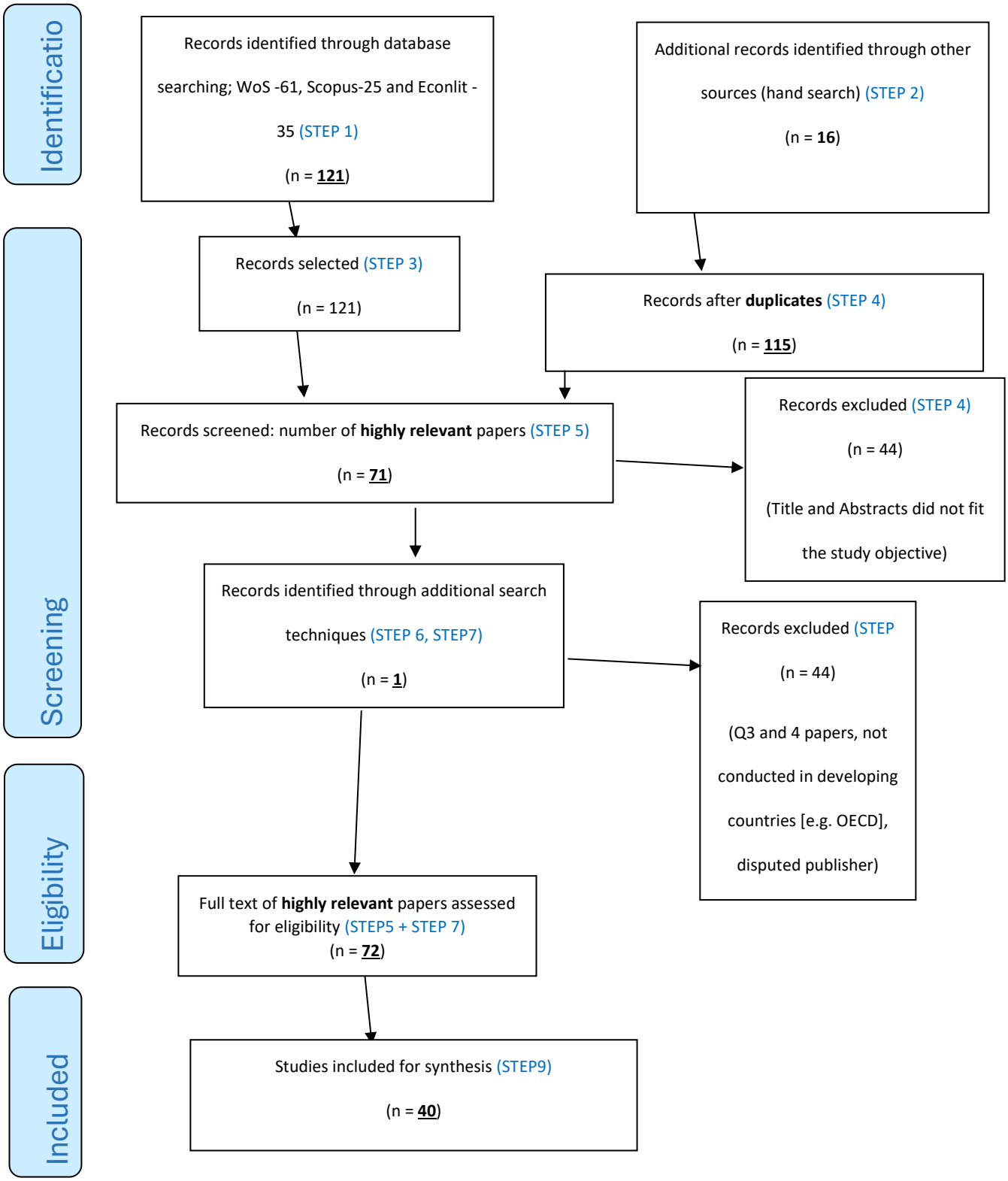


Figure 2-2: PRISMA Flow Chart of document identification, screening for eligibility and inclusion for review

FIGURE 2.2: PRISMA FLOW CHART

Source: Author elaboration

2.3.2 Results and Discussions

Document exploratory analysis (Keywords co-occurrence network analysis)

Keyword co-occurrence analysis shows that research on fiscal decentralisation since 2010 has mainly focused on intergovernmental relations, fiscal policy, and economic development. Meanwhile, less common but highly connected terms (such as foreign aid, governance, inequality, and natural resources) indicate emerging yet underexplored links to international finance, redistributive outcomes, and resource-based revenues (Kiani Mavi et al., 2020; Suthar et al., 2021; Tamala et al., 2022). Thematic shifts demonstrate a move from a narrow focus on multi-level governance to broader development issues, including poverty, inequality, the flypaper effect, and sustainable resource use.

Figure 2-3: Overlay Network Visualisation of Keywords of the 72 eligible articles

The Keywords Network Analysis

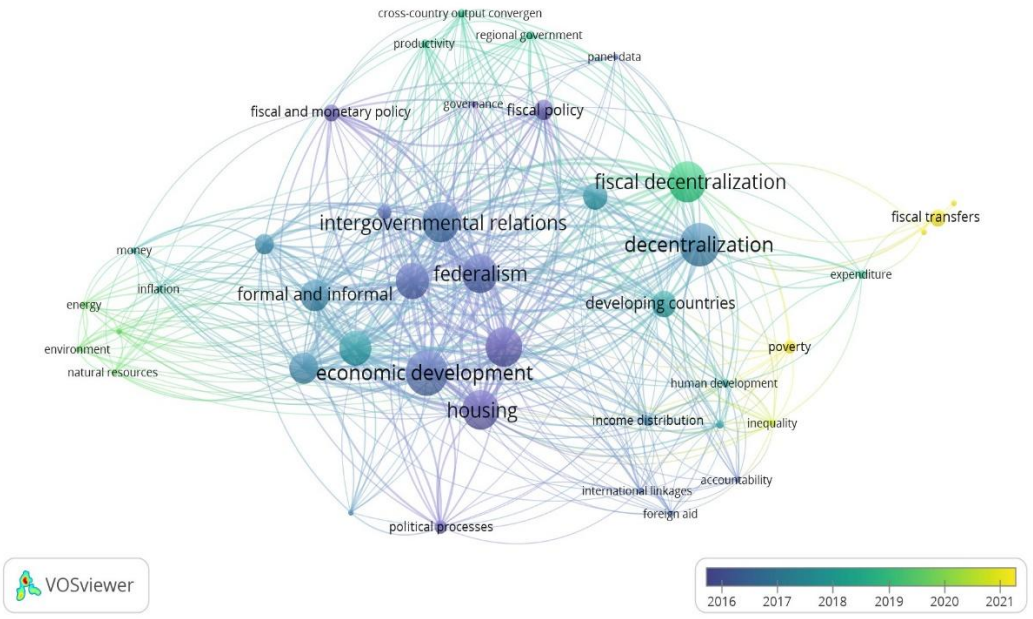


FIGURE 2.3: OVERLAY NETWORK VISUALISATIONS OF KEYWORDS

Source: Authors' elaboration

2.3.3 Results of individual studies and discussions

The fiscal decentralisation literature clusters six themes, yet findings remain fragmented and nuanced.

2.3.3.1 Economic growth, regional disparities, and convergence.

Growth, disparities, and convergence. Evidence on FD's impact is mixed: positive, negative, or insignificant, depending on instruments (transfers versus own-source revenue), institutional capacity, and geography (Jalil et al. 2014; Hanif & Gago-de Santos 2017; Im 2010; Shanmugam & Rangasamy 2024). Research mainly focuses on Asia, with Africa, Latin America, and Eastern Europe being underexplored. Gaps include the relative effectiveness of transfers versus autonomy, spatial spillovers, and governance effects.

2.3.3.2. Intergovernmental fiscal relations (IGFR) and local governance

Revenue and expenditure allocations remain weakly linked to development outcomes. Vertical imbalances encourage dependence, while borrowing, equalisation, and resource taxation are not fully examined despite their importance for fairness and capacity. Analyses seldom incorporate autonomy, borrowing regulations, and redistribution.

2.3.3.3 Environment and natural resources

FD may improve accountability and efficiency (Akita et al. 2021; Wang et al. 2022) but can worsen outcomes in contexts of weak governance (Perez-Sebastian & Raveh 2016; Li et al. 2022). Little research investigates growth-environment trade-offs, resource dependence, or common-pool management in developing economies.

2.3.3.4 Spatial dependence

Few studies incorporate spatial dynamics, despite evidence that spillovers transmit fiscal and economic shocks across jurisdictions (Fossen et al. 2017; Chen 2021). This gap is particularly evident in developing contexts with shared resources and high mobility.

2.3.3.5 Poverty, inequalities and welfare.

Findings remain inconclusive: FD can help reduce poverty and inequality, but it often worsens disparities when capacity is limited, or transfers are distorted (Hernandez-Trillo 2016; Sanogo 2019; Rogers 2014). Governance quality serves as an important mediator.

2.3.3.6 Aid effectiveness

The role of FD in shaping aid outcomes remains uncertain (Lessmann 2012; Khan & Mohomed 2017; Kaye-Essien 2021), and limited comparative research has been conducted on mechanisms.

FD research is theoretically fragmented and regionally uneven. Progress requires integrative frameworks connecting fiscal architecture, spatial interdependence, and development outcomes.

CHAPTER THREE: METHODOLOGY

3.1. Introduction

Spatial econometric analysis involves a two-stage process: the first stage, Exploratory Spatial Data Analysis (ESDA), detects and visualises patterns of spatial autocorrelation, while the second stage, Confirmatory Spatial Data Analysis (CSDA), formally tests and estimates spatial spillovers within econometric models.

3.2. Exploratory Spatial Data Analysis (ESDA)

ESDA extends traditional exploratory data analysis into the spatial domain, detecting dependence, heterogeneity, clustering, and outliers (Anselin 1996; Unwin 1996). As the first stage of spatial econometric investigation, ESDA provides empirical justification for formal modelling by revealing patterns hidden to non-spatial methods. In this study, ESDA was used to (a) characterise spatial distributions, (b) test global and local spatial autocorrelation, and (c) identify clusters, regimes, and outliers. We employed global measures, local measures, and visual tools.

Global measures summarise spatial association across the study area. Moran's I evaluates correlations between observations and spatially weighted neighbours, indicating clustering or dispersion (Moran 1950). Geary's C complements this by emphasising local differences (Geary 1954), while the Getis–Ord Gi* statistic highlights hotspots and coldspots (Getis & Ord 1992). These indices jointly test for spatial randomness.

Local measures, or Local Indicators of Spatial Association (LISA), identify unit-level clustering and outliers (Anselin 1995). Local Moran's I breaks down the global statistic into high-high, low-low, and outlier categories, while Local Getis-Ord Gi* detects spatial concentrations of extreme values. These diagnostics assist in recognising spatial heterogeneity and potential regimes.

Visual tools complement these statistical tests. Choropleth maps depict distributions but can be affected by classification schemes (Griffin n.d.). Moran scatterplots connect standardised values to their spatial lags, directly relating to global Moran's I (Anselin 1996). LISA cluster maps build on this by displaying significant clusters and outliers, confirmed through permutation tests (Anselin 1995; Anselin et al. 2006).

This study's choropleth maps visualised disparities, Moran's I tested for global autocorrelation, and LISA maps identified local clusters and outliers. These tools combined

visual intuition with statistical rigour, providing the empirical foundation for confirmatory spatial panel models.

3.3. Confirmatory Spatial Data Analysis (CSDA)

We initially estimated non-spatial panel models, pooled OLS, fixed effects, and random effects, as baseline analyses for fiscal decentralisation and development outcomes. Model selection was guided by the Hausman test, with fixed effects preferred when unobserved heterogeneity correlates with covariates (Baltagi & Liu, 2016). However, these estimators assume cross-sectional independence and are vulnerable to bias if spatial spillovers exist.

To evaluate this, we employed Lagrange Multiplier (LM) diagnostics (Anselin, 1996). The LM-Lag identifies endogenous dependence through a spatially lagged dependent variable, while the LM-Error detects residual autocorrelation; robust versions distinguish between the two. Significant results provided the basis for progressing to spatial econometric models.

Spatial modelling followed a systematic approach. The Spatial Lag of X (SLX) incorporated spatial lags of covariates, capturing local spillovers but excluding endogenous feedback (Halleck Vega & Elhorst, 2015). The Spatial Autoregressive (SAR) and Spatial Error (SEM) models separately addressed endogenous interactions and correlated shocks across space (Anselin, 1988; Elhorst, 2003). The Spatial Durbin Model (SDM) expanded on these by including lags of both dependent and independent variables, enabling the estimation of direct, indirect, and feedback effects (LeSage & Pace, 2009). Lastly, the SARAR and SARAR-SDM specifications combined spatial lags in both the dependent variable and the error process, providing the most comprehensive representation of spatial dependence, with dynamic extensions capturing persistence over time (Elhorst, 2014).

3.4. Convergence Tests

We examined both absolute and conditional convergence in regional growth. Absolute convergence assumes poorer regions will catch up to richer ones, while conditional convergence allows regions to converge towards different steady states determined by structural and policy factors. Spatial spillovers further lead to “spatial club convergence,” where regions with similar conditions tend to converge (Chenglin et al., 2013; Ahmad & Hall, 2017). Spatial econometric models capture these dynamics: the Spatial Durbin Model (SDM) and SARAR identify global spillovers, while the SDEM captures local ones (Furková, 2019; LeSage & Pace, 2009, 2014; Halleck Vega & Elhorst, 2015). We introduced temporal lags for path dependence and spatial lags for contemporaneous spillovers to account for persistence. Concerns about

simultaneity were addressed via spatiotemporal lags and by decomposing direct, indirect, and total effects (Kopczewska et al., 2017; Elhorst, 2010, 2014).

3.5. Data

This study employs spatiotemporal analysis on balanced fiscal and demographic panel data from Kenya, complemented by health indicators from the WHO Global Burden of Disease database. Fiscal data were sourced from the Office of the Controller of Budget, while economic indicators (Gross Value Added) were obtained from the Kenya National Bureau of Statistics. Data management and econometric analysis were conducted in R (RStudio) using packages including plm, splm, spdep, sp, tidyverse, ggplot2, and tmap.

CHAPTER FOUR: EMPIRICAL RESULTS (STUDY 1)

Role of Fiscal Decentralisation in Poverty Reduction: Spatiotemporal Evidence from Kenya's Devolution Framework

4.1. Introduction

This research examined the impacts of fiscal decentralisation on poverty reduction, particularly in the context of Kenya's recent experience with devolution. The hypotheses of the study included.

a) H4a: Own-source revenue (OSR), equitable share, and conditional grants have heterogeneous effects on poverty reduction across counties
b) H4b: These effects exhibit spatial spillovers and inter-county feedback mechanisms

4.2. ESDA

4.2.1 Fiscal and Demographic distribution of poverty in Kenya

We considered demographic differences in poverty by disaggregating the population into five age groups: children (0–17), youth (18–35), adults (36–59), retirees (60–69), and senior citizens (70+). These groups experience fiscal policies, especially decentralisation, in different ways, with poverty levels varying across regions and in severity between counties. Figure 4-1 illustrates Kenya's age-specific poverty distribution, which reflects overall poverty trends and reveals significant disparities. For example, poverty among retirees ranges from 10.9% to 76.6%, while among the elderly it varies from 11.1% to 93.7%, emphasising their extreme vulnerability. Additionally, poverty intensity within the county differs by age: in Mandera (County 9), old-age poverty is comparatively lower than in other groups. These results highlight the importance of age-sensitive fiscal policies to tackle diverse vulnerabilities.

The Moran's I results (Table 4-1) show significant positive spatial autocorrelation for total, child, youth, adult, retiree, and senior citizen poverty, indicating geographic clustering. The intensity varies: total, child, youth, and adult poverty exhibit strong clustering, while retiree and senior citizen poverty display moderate clustering.

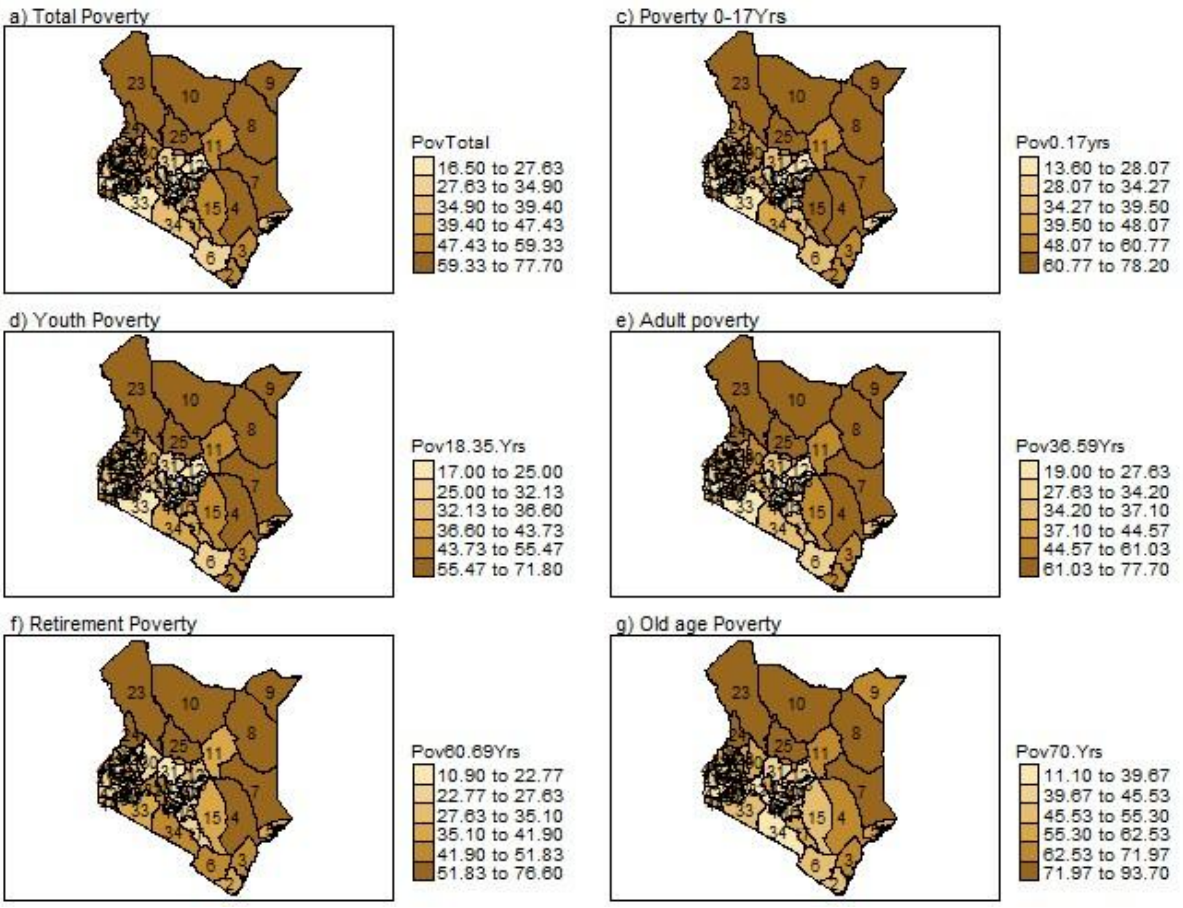


TABLE 4-2: MORAN I TEST RESULTS

Type of poverty	Moran I statistic	Standard deviation	*P*-value	Interpretation
Total Poverty	0.2956	5.5895	2.2E – 08	Strong positive spatial autocorrelation; high/low poverty clusters together
Child Poverty	0.2307	4.3944	4.467E – 13	Significant positive spatial autocorrelation; spatial clustering of child poverty
Youth Poverty	0.3588	6.7566	2.2E – 16	Strong positive spatial autocorrelation; high clustering of youth poverty
Adult Poverty	0.2503	4.7553	9.91E – 07	Significant positive spatial autocorrelation; spatial clustering of adult poverty
Retiree Poverty	0.1392	2.7006	0.009965	Moderate positive spatial autocorrelation; some spatial clustering of retiree poverty
Senior Citizen Poverty	0.3708	6.9672	1.616E – 12	Significant positive spatial autocorrelation; spatial clustering of adult poverty

4.3 CSDA

4.3.1. Non-Spatial Models

Fixed and random-effects models yielded contrasting results regarding how fiscal decentralisation affects poverty. The Hausman test ($p < 0.001$) confirmed fixed effects as the suitable choice. The results demonstrated that transfer-based revenues (equitable share, grants) significantly reduce poverty, although the effects differ across cohorts. However, the non-spatial models exclude spatial dependence and are therefore biased.

4.32. Spatial panel econometric specification, choice and modelling

This sub-section will discuss the results of two spatial panel models: the SLX and SPEM-FE.

4.3.2.1 The Spatial Lag of X (SLX)

The SLX estimates (Table 4-2) reveal heterogeneous spatial effects of fiscal decentralisation on poverty in Kenya. Own-source revenue significantly reduces poverty across all groups, with strong local and spatial lag effects. Conditional grants lower poverty locally, but their spatial lags often increase poverty, indicating spillover inefficiencies. The equitable share is mainly insignificant, except for a strong positive effect on senior poverty, suggesting inequitable targeting. Capital expenditure shows weak or inconsistent local effects but significant negative spatial spillovers, while recurrent expenditure is mostly insignificant. Control variables behave as expected: higher GCP per capita and transition rates reduce poverty, whereas their spatial lags increase poverty, reflecting cross-county diffusion. Overall, decentralisation channels exhibit uneven impacts and spatial externalities.

TABLE 4-2: REGRESSION OUTPUT RESULTS OF THE EFFECTS OF FISCAL DECENTRALISATION ON POVERTY IN KENYA BY AGE

SLX final output: fiscal decentralisation and poverty in Kenya

	Dependent variable:					
	Total	Children	Youth	Adult	Retiree	Senior
	slx1	slx2	slx3	slx4	slx5	slx6
	(1)	(2)	(3)	(4)	(5)	(6)
log(OSR_pc)	−5.541***	−5.226***	−5.937***	−5.199***	−6.172***	−4.549**
	(1.544)	(1.594)	(1.578)	(1.578)	(1.873)	(2.291)

log(equit_pc)	9.914	4.940	7.893	10.551	−1.253	44.101***
	(7.460)	(7.711)	(7.604)	(7.625)	(9.066)	(11.100)
log(grants_pc)	−4.718**	−3.308	−4.968**	−6.416***	−4.541*	−7.062**
	(2.044)	(2.114)	(2.079)	(2.088)	(2.480)	(3.044)
log(Capex_pc)	3.182	4.828*	3.676	2.603	6.363*	−5.706
	(2.705)	(2.799)	(2.743)	(2.755)	(3.261)	(4.004)
log(Opex_pc)	0.732	1.188	1.829	2.033	3.148	−12.020
	(6.197)	(6.400)	(6.312)	(6.341)	(7.564)	(9.222)
log(GCPpc)	−11.496***	−12.414***	−10.647***	−12.331***	−13.119***	−4.006
	(3.125)	(3.223)	(3.196)	(3.194)	(3.779)	(4.630)
log(transrate)	−2.812***	−3.142***	−2.524**	−3.081***	−5.063***	−0.711
	(0.997)	(1.028)	(1.017)	(1.019)	(1.212)	(1.480)
lag.log(OSR_pc)	−8.434**	−7.023*	−10.374***	−7.881**	−6.284	−6.622
	(3.732)	(3.845)	(3.812)	(3.805)	(4.535)	(5.487)
lag.log(equit_pc)	12.524	12.803	15.062	10.927	−2.602	12.972
	(15.862)	(16.385)	(16.157)	(16.220)	(19.292)	(24.115)
lag.log(grants_pc)	8.234*	9.589**	6.391	7.580*	6.485	12.651*
	(4.453)	(4.601)	(4.539)	(4.561)	(5.413)	(6.633)
lag.log(Capex_pc)	−15.242**	−16.642***	−11.680*	−13.417**	−11.473	−20.382**
	(6.043)	(6.255)	(6.165)	(6.175)	(7.358)	(9.042)
lag.log(Opex_pc)	13.235	9.509	11.273	16.014	29.046*	13.844
	(13.075)	(13.510)	(13.331)	(13.383)	(15.951)	(19.456)
lag.log(GCPpc)	14.265*	11.634	20.778***	15.663*	10.343	13.584
	(7.926)	(8.201)	(8.038)	(8.092)	(9.550)	(11.503)
lag.log(transrate)	4.481*	3.411	5.832**	4.749*	5.361*	4.421
	(2.385)	(2.471)	(2.423)	(2.440)	(2.922)	(3.524)

Constant	−135.897	−73.471	−181.194*	−168.493	−93.816	−299.003*
	(104.114)	(107.791)	(106.082)	(106.370)	(126.630)	(155.910)
Observations	141	141	141	141	141	141
Log likelihood	−507.891	−512.432	−510.288	−510.608	−534.542	−563.736
Sigma^2	77.684	82.978	80.670	81.187	114.849	172.160
Akaike Inf. Crit.	1,049.782	1,058.864	1,054.577	1,055.217	1,103.084	1,161.472
Wald test (df = 1)	4.154**	3.666*	3.037*	2.454	0.203	2.960*
LR test (df = 1)	3.592*	3.122*	2.768*	2.222	0.187	2.628
Note:						*P**P***P < 0.01

4.3.2.2 Spatial panel fixed–effects error model (SPEM-FE)–individual effects

Tables 3-5 present six fixed-effects Spatial Error Panel Models (SPEM-FE) analysing poverty across different demographic groups. Spatial dependence is significant in models, emphasising the importance of spillovers per Tobler's First Law. The equitable share consistently decreases poverty among children (−25.7**), adults (−16.9*), and retirees (−41.8***), while grants reduce total (−2.31*), youth (−2.94*), and adult poverty (−2.44*). Own-source revenue, capital, and recurrent expenditure remain insignificant, reflecting counties' limited revenue capacity and overlapping national development spending. Regional controls show limited impact: per capita GCP is significant only for seniors (66.6*), and transition rates are largely insignificant. These findings align with ESDA results, indicating an inverse spatial correlation between poverty and revenue autonomy, demonstrating that transfer-based instruments, especially the equitable share, are the most effective fiscal tools for reducing poverty. Impacts vary across demographic groups. The equitable share notably benefits vulnerable populations.

TABLE 4-3: SPATIAL PANEL FIXED–EFFECTS ERROR MODEL (SPEM-FE) OUTPUTS

Coefficients	Total	Child	Youth	Adult	Retiree	Senior citizen
Lambda	0.7231*** (0.0636)	0.5296*** (0.0890)	0.7002*** (0.0671)	0.7094*** (0.0657)	0.2248 (0.1163)	0.5487*** (0.0868)

Coefficients	Total	Child	Youth	Adult	Retiree	Senior citizen
log(OSR_pc)	0.0034 (1.2470)	−0.3766 (1.5513)	−0.7752 (1.4874)	0.3629 (1.3003)	−0.5429 (2.6290)	0.2662 (3.1253)
log(equit_pc)	−12.5034 (8.3645)	−25.7005** (8.4002)	−18.0798 (9.7330)	−16.9722* (8.5944)	−41.7530*** (10.6781)	−20.2541 (0.2411)
log(grants_pc)	−2.3115* (1.1305)	−2.3187 (1.3575)	−2.9424* (1.3442)	−2.4380* (1.1766)	−3.7051 (2.1185)	−1.7735 (2.7461)
log(Capex_pc)	−0.4192 (1.2308)	1.8763 (1.5265)	−1.1365 (1.4686)	0.4702 (1.2837)	2.6144 (2.5228)	−4.44206 (3.0771)
log(Opex_pc)	4.9346 (3.7219)	6.1622 (4.5342)	5.3870 (4.4299)	5.8964 (3.8760)	−9.1999 (7.3862)	13.4462 (9.1557)
log(GCPpc)	12.9013 (11.7989)	14.4966 (13.9638)	9.2420 (13.9864)	8.6126 (12.2574)	20.8434 (22.4002)	66.6033* (28.258)
log(transrate)	−4.1846 (3.2849)	−5.6832 (3.9740)	1.6058 (3.9089)	−0.3269 (3.4205)	7.4175 (6.2826)	13.3771 (8.0339)

4.5. Conclusion and Hypothesis Outcome

This study examined Kenya's fiscal decentralisation and poverty alleviation (2019–2021), highlighting spatial interdependence in poverty outcomes. Results confirm strong spatial clustering, with significant spillovers across counties. Revenue-based instruments (own-source revenue (OSR), equitable share, and grants) emerge as the most effective tools, while expenditure indicators remain inconclusive. The SLX model shows that OSR significantly reduces poverty locally (−5.54%) and in neighbouring counties (−8.43%). The SPEM-FE underscores transfer-based impacts: equitable share strongly lowers adult (−16.9%) and retiree (−41.8%) poverty, while grants modestly reduce poverty among adults (−2.4%) and retirees (−3.7%).

H4a is partially supported: Equitable share and grants have varied effects across groups, but OSR shows limited within-county significance.

H4b is supported: Strong spatial dependence confirms spillovers in poverty dynamics.

Fiscal decentralisation, especially transfer-based mechanisms, provides an essential pathway for inclusive and regionally responsive poverty reduction in developing economies.

CHAPTER FIVE: EMPIRICAL RESULTS (STUDY 2)

The Nexus Between Fiscal Decentralisation and Regional Economic Dynamics: A Spatio-Temporal Econometric Analysis within Kenya's Devolution Framework

5.1. Introduction

This study examined the long-term impacts of fiscal decentralisation on economic growth and identified the endogenous fiscal factors that drive regional economic performance. Additionally, it tests whether county-level economic growth in Kenya exhibits convergence, suggesting that poorer counties are catching up with richer ones since the advent of devolution in 2013.

The **hypotheses** of the study are

H5a: Fiscal decentralisation positively influences county-level economic performance, with significant spatial spillover impacting neighbouring counties.

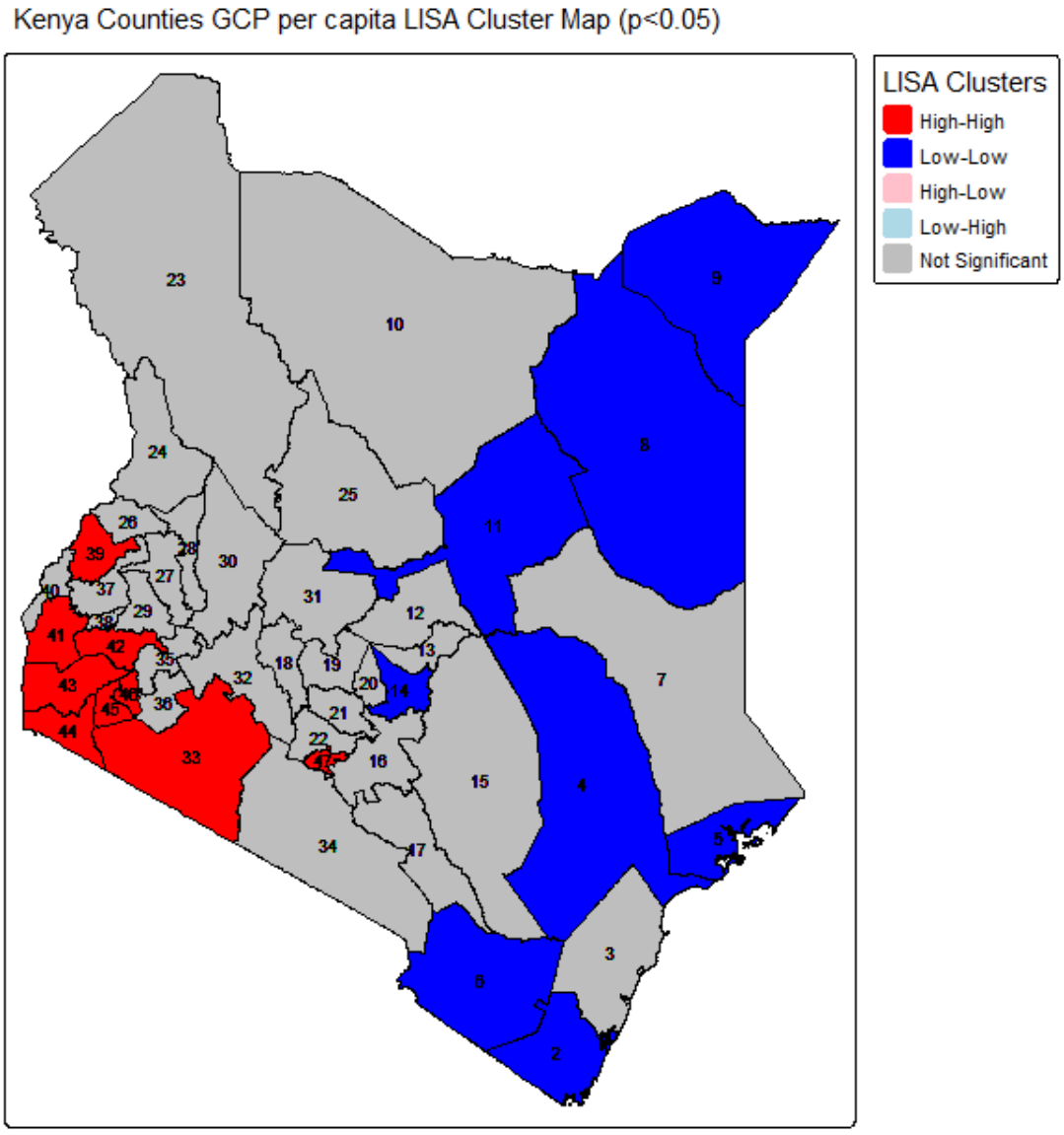
H5b: Kenyan counties exhibit absolute β-convergence under devolution.

H5c: Conditional convergence provides a better fit than absolute convergence when controlling for structural and fiscal heterogeneity.

This study leverages a balanced spatial panel dataset of Kenya's 47 counties from 2013 to 2023. The methodology proceeds as follows: First, we present the description of variables and data sources, the descriptive statistics, a test for spatial dependence and an Exploratory Spatial Data Analysis (ESDA) using choropleth maps. Second, a Confirmatory Spatial Data Analysis (CSDA). Third, testing the convergence hypothesis. The dependent variable is the Gross County Product (GCP) per capita.

5.2. Spatial Dependence and Exploratory Spatial Data Analysis

Global Moran's I (0.186, $p<0.001$) reveals significant positive spatial autocorrelation. Local spatial clustering was further examined using LISA, with results visualised in the choropleth map in Figure 5-1.



Source: Authors' Visualisation

Figure 5-1: LISA Map Cluster Map on GCP per Capita FY 2013/14 – 2022/23

Using the Lagrange Multiplier (LM) test for spatial dependence (Anselin, 1996), results (Table 5-1) reveal significant spatial lag (LM = 70.124) and error (LM = 22.129) dependence, with lag being more dominant.

Table 5-1: Lagrange Multiplier Test for Spatial Dependence (FY 2013/14 – 2022/23)

Test	LM Statistic	p-value	Interpretation

LM Test for Spatial Error Dependence (LM error)	20.047	7.56E-06	Significant spatial error dependence
LM Test for Spatial Lag Dependence (LM lag)	68.042	2.20E-16	Significant spatial lag dependence
Robust LM Test for Spatial Error Dependence (Robust LM error)	22.129	2.55E-06	Spatial error dependence persists after accounting for lag dependence.
Robust LM Test for Spatial Lag Dependence (Robust LM lag)	70.124	2.20E-16	Spatial lag dependence persistence after accounting for error dependence

5.3. Confirmatory Spatial Data Analysis and Econometric Models

This sub-section begins by discussing the baseline non-spatial models. Next, it covers spatiotemporal modelling, including model specifications.

5.3.1. Non-spatial Econometric Models

The non-spatial estimates (Pooled OLS, FE, RE). Hausman and F-tests reject RE and OLS, confirming FE as the most robust ($R^2 = 0.60$). Nonetheless, the Pesaran CD test ($z = 16.161$, $p < 0.001$) indicates strong cross-sectional dependence, reflecting interconnected county performance through national policies, geography, or spillovers (Pesaran, 2015; Chudik et al., 2011).

5.3.2 Spatiotemporal Econometric Models (Spatial Lag of X [SLX], SDM and SARAR-SDM)

Table 5-3 compares SLX, SDM, and SARAR-SDM estimates, demonstrating that county economic performance in Kenya is influenced by fiscal–demographic fundamentals and spatial interdependencies. In the SLX model, own-source revenue and operational expenditure have strong local impacts, while capital expenditure shows short-term crowding-out effects and weak neighbour influences. Incorporating endogenous feedback in the SDM ($\lambda = 0.51$) changes coefficient signs, such as for population density. Meanwhile, the SARAR-SDM exhibits the strongest feedback ($\lambda \approx 0.73$) and a negative spatial error ($\rho < 0$), indicating spatially correlated shocks from policy competition or structural inequalities. The SARAR–SDM therefore provides the most accurate representation of Kenya's spatial economy, emphasising both positive spillovers from fiscal capacity and negative diffusion of inefficiencies. Policy formulation should focus on coordinating investments in growth hubs and corridors, while reducing disparities in border and lagging counties through harmonised fiscal strategies, transfer redesign, and capacity equalisation to address adverse spatial externalities.

Table 5-3: Results for SLX, SDM, and SARAR-SDM Models, FY 2013/14–2022/23

Variable / Parameter	GMM - SLX (Panel FE)	ML SDM (Panel FE)	ML SARAR-SDM (Panel FE)
log(Equitable share per capita)	–0.0073 (0.0234)	-0.0036 (0.0041)	-0.0037 (0.0036)
log(Total conditional grants per capita)	0.0287 (0.0173)•	0.0035 (0.0031)	0.0012 (0.0023)
log(Own Source Revenue Per capita)	0.3364*** (0.0178)	0.0174* (0.0074)	0.0140* (0.0064)
log(Capital expenditure per capita)	–0.0729** (0.0223)	-0.0079• (0.0043)	-0.0108*** (0.0031)
log(Operations expenditure per capita)	0.1894*** (0.0488)	0.1253*** (0.0131)	0.0919*** (0.0123)
log(Population density)	0.0879*** (0.0180)	-0.0886* (0.0406)	-0.0896** (0.0307)
log(Transition to sec. school rate)	–0.0518*** (0.0154)	0.0083* (0.0038)	0.0034 (0.0031)
lag.log(Equitable share per capita)	–0.1065* (0.0527)	-0.00345 (0.00431)	-0.00951 (0.01052)
lag.log(Total conditional grants per capita)	–0.0426 (0.0405)	0.00342 (0.00321)	0.00302 (0.00640)
lag.log(Own Source Revenue Per capita)	–0.0591• (0.0334)	0.01684** (0.00792)	0.03555* (0.01990)
lag.log(Capital expenditure per capita)	–0.0214 (0.0413)	-0.00770* (0.00449)	-0.02748** (0.01130)
lag.log(Operations expenditure per capita)	0.1935· (0.1002)	0.12147*** (0.02578)	0.23320*** (0.06898)
lag.log(Population density)	0.0533* (0.0212)	-0.08587** (0.04142)	-0.22727** (0.10140)
lag.log(Transition to sec. school rate)	–0.0178 (0.0284)	0.00806** (0.00422)	0.00863 (0.00928)
λ (lambda)	–	0.5099*** (0.0448)	0.7326*** (0.0444)
ρ (rho)	–	–	-0.5839*** (0.1051)
T	10	10	10
N	47	47	47
N	470	470	470

Notes: Standard errors are shown in parentheses. Significance: *** p < 0.001, ** p < 0.01, * p < 0.05, • p < 0.1,

5.3.2.1 Impacts: Direct, Indirect, and Total Effects SARAR–SDM (FE) Model (R = 1000)

Table 5-4 presents SARAR–SDM (FE) impact decompositions. Own-source revenue (OSR) demonstrates positive and significant direct (0.0168) and indirect (0.0356) effects, resulting in a multiplier of 0.0524, aligning with fiscal spillovers through tax mimicking and

yardstick competition. Equitable share and conditional grants remain insignificant, reflecting political allocation and weak targeting. Operational expenditure shows the strongest positive multipliers, indicating service delivery linkages and complementarities, although negative spillovers suggest resource competition. Capital expenditure triggers significant negative short-term effects, in line with gestation lags and inefficiencies. Overall, the findings confirm that fiscal capacity and spatial interdependence are key drivers of county growth.

Table 5-4: Direct, Indirect, and Total Effects (R=1000)

Variable	Direct	Indirect	Total
log(Equitable share pc)	–0.0045 (0.0042)	–0.0095 (0.0100)	–0.0140 (0.0141)
log(Total conditional grants pc)	0.0014 (0.0028)	0.0030 (0.0064)	0.0045 (0.0091)
log(Own Source Revenue pc)	0.0168** (0.0075)	0.0356** (0.0186)	0.0524** (0.0255)
log(Capital expenditure pc)	–0.0130*** (0.0037)	–0.0275** (0.0112)	–0.0405** (0.0145)
log(Operations expenditure pc)	0.1105*** (0.0154)	0.2332*** (0.0692)	0.3437*** (0.0808)
log(Population density)	–0.1076*** (0.0365)	–0.2273** (0.1026)	–0.3349** (0.1353)
log(Transition to sec. school rate)	0.0041 (0.0038)	0.0086 (0.0088)	0.0127 (0.0125)

5.5. Economic performance convergence test results

The results show significant improvements from absolute to conditional and spatial specifications. In the non-spatial absolute model, convergence is modest (–0.203, $R^2 = 0.104$) but becomes much stronger with the addition of time effects (–0.502, $R^2 = 0.258$). Conditional specifications further enhance the fit ($R^2 = 0.335$) while maintaining strong convergence (–0.496), highlighting the importance of fiscal and demographic covariates in explaining disparities. Spatial refinements clarify this picture: the SDM–FE confirms ongoing convergence (–0.485) with diffusion effects ($\rho = 0.152$), whereas the SARAR–SDM indicates displacement ($\rho = –0.704$, $p < 0.001$) and synchronising shocks ($\lambda = 0.755$). Across all models, operational expenditure consistently promotes growth, while equitable share and grants remain neutral, emphasising spatial spillovers as central to Kenya's county convergence dynamics.

Table 5-5: Non-Spatial and Spatial Convergence Hypothesis Test Results (FY 2013/14-2022/23)

Variable	Non-Spatial Absolute (plm, 1-way) (1)	Non-Spatial Absolute (plm, 2-way) (2)	Non-Spatial Conditional (plm,) (3)	Spatial SDM -FE (SPLM) (4)	Spatial SARAR-SDM – FE(SPLM) (5)
Spatial lag (ρ)				0.1520* (0.0606)	-0.7035*** (0.0977)
Spatial error (λ)					0.7553*** (0.0479)
Initial gross county product	-0.203*** (0.031)	-0.502*** (0.044)	-0.496*** (0.038)	-0.4845*** (0.0359)	-0.4775*** (0.0378)
log(Equitable share per capita)			-0.002 (0.004)	-0.0018 (0.0039)	-0.0031 (0.0032)
log(Total grants per capita)			-0.0004 (0.003)	-0.0008 (0.0028)	0.0011 (0.0029)
log(OSR per capita)			0.0062 (0.0075)	0.0051 (0.0069)	-0.0009 (0.0059)
log(Capital expenditure per capita)			0.0075 (0.0061)	0.0072 (0.0057)	0.0018 (0.0052)
log(Operational expenditure per capita)			0.137*** (0.0158)	0.1348*** (0.0146)	0.0873*** (0.0143)
log(Population density)			0.027 (0.042)	0.0264 (0.0389)	-0.1234** (0.0475)
log(transition to secondary rate)			0.0063 (0.0039)	0.0061. (0.0036)	0.0044 (0.0032)
n	47	47	47	47	47
N	423	423	423	423	423
T	9	9	9	9	9
R-squared	0.104	0.258	0.335		

Note: Significance levels: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

5.6 Conclusion and Hypothesis Outcomes

H5a: Partially supported: OSR and operational expenditure improve performance with significant spillovers; transfers are weak; capital spending is negative

H5b: Supported: Kenyan counties display absolute and conditional β-convergence under devolution, with poorer counties catching up.

H5c: Supported: Conditional convergence better explains disparities shaped by fiscal and demographic heterogeneity.

CHAPTER SIX: EMPIRICAL RESULTS (STUDY 3)

Spatial Interdependence and Fiscal-Economic Dynamics in Regional Health: A Spatiotemporal Analysis of Kenya's Devolution

6.1. Introduction

This study established the nexus between fiscal decentralisation and the spatial dependence of health outcomes and other socioeconomic dynamics. It documents the spatial effects of fiscal decentralisation on health outcomes and accounts for the impacts of decentralisation policies and other regional characteristics on achieving and tracking health outcomes.

The study **hypothesis** includes:

H6a: Fiscal decentralisation reduces disparities in health outcomes (mortality, morbidity, composite health), conditional on county capacity and sectoral structure.

H6b: Equitable share and conditional grants are more effective than OSR in improving population-level health indicators.

H6c: Health outcomes are subject to spatial externalities, mediated by population density and sectoral composition.

6.2 Data

Data includes health indicators from the World Health Organisation's Global Burden of Disease database.[1] Fiscal data was compiled from reports from the Office of the Controller of Budget.[2] Economic indicators (Gross Value Added) were sourced from the Kenya National Bureau of Statistics. The descriptive statistics are shown in Table 6-1. The table displays the four Health Outcome Indices on a bounded scale (0–100), suitable for comparing across counties and over time.

Table 6-1. Summary Statistics for Health, Fiscal, and Socioeconomic Variables (2015–2021)

Variable	Mean	SD	Min	25th Pctl	Median	75th Pctl	Max
Composite Health Outcome Index	69.0	19.8	0.0	58.0	72.2	84.7	100.0
Mortality Index	29.9	25.2	0.0	11.7	28.3	40.1	100.0
Morbidity Index	28.9	22.5	0.0	15.0	24.0	40.1	100.0
Health Development Index	64.8	23.9	0.0	55.0	68.2	79.8	100.0

[1] Global Burden of Disease Collaborative Network, Global Burden of Disease Study 2019 (GBD 2019) Results (2020, Institute for Health Metrics and Evaluation – IHME) https://vizhub.healthdata.org/gbd-results/

[2] See reports at https://cob.go.ke/reports/consolidated-county-budget-implementation-review-reports/

Variable	Mean	SD	Min	25th Pctl	Median	75th Pctl	Max
Conditional Grants per capita	954.5	769.3	1.35	496.67	781.54	1173.27	4770.70
Equitable Share per capita	7202.25	2694.56	5.17	5212.27	6246.53	7700.74	22869.33
Own Source Revenue per capita	522.85	421.89	58.11	218.15	362.72	627.73	2826.89
GVA – Agriculture	34233.1	18864.0	615.3	20561.2	28265.7	43475.4	104316.0
GVA – Manufacturing	9010.6	8612.6	782.4	2591.1	5017.0	7953.5	60415.5
GVA – Education	7350.0	3725.2	1935	5403	7157	8489	39095
Population Density (per km²)	553.25	952.71	6.05	56.11	242.56	456.08	7431.88
Crime Index	158.97	65.83	28.02	115.82	154.57	202.28	359.62

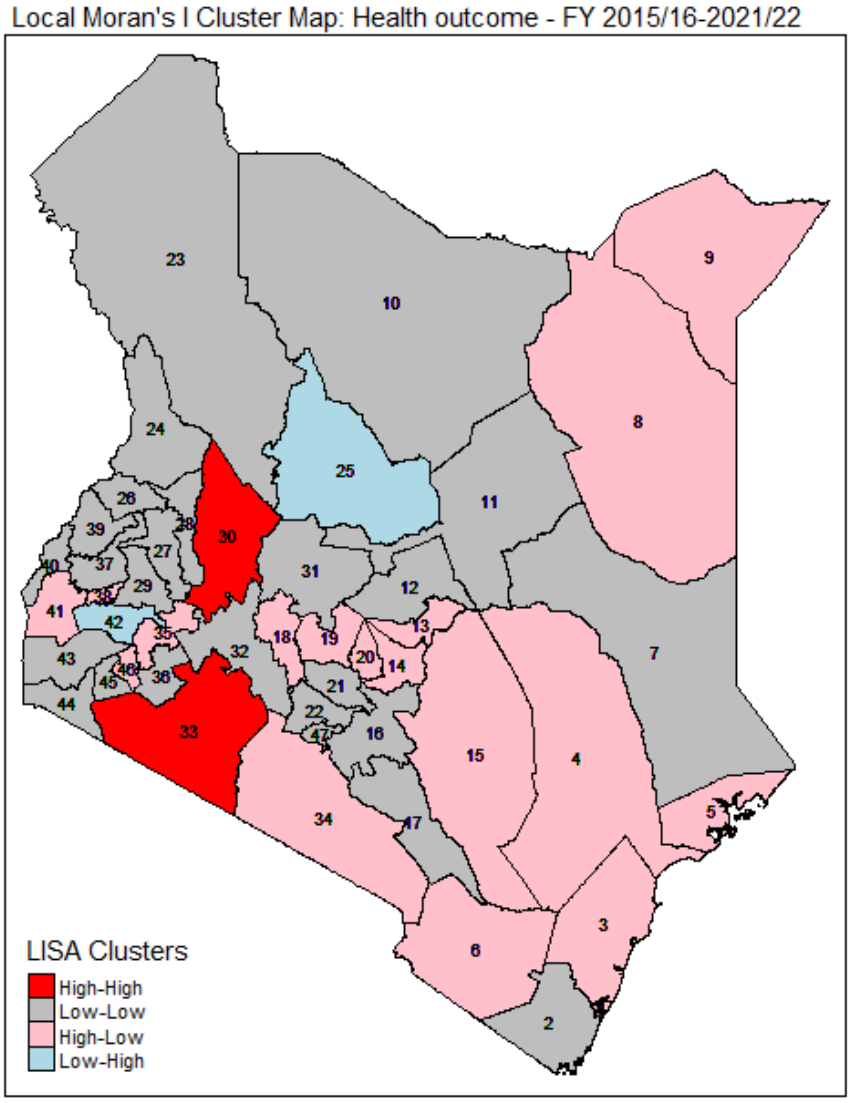
Notes: All currency figures are in Kenyan Shillings (Kshs); Health indices are normalised to a 0–100 scale. SD = Standard Deviation

6.3. ESDA

6.3.1. Test for Spatial Dependence

Using a row-standardised first-order Queens contiguity matrix, we applied Global Moran's I to the baseline composite health outcome residuals. The statistics confirm significant positive spatial autocorrelation. Local indicators of spatial association (LISA) were then mapped (Figure 5-1).

Fig. 5-1 Local Moran's I Cluster Choropleth



Source: Authors' Visualisation

6.4. Confirmatory Spatial Data Analysis (CSDA)

6.4.1. Non-Spatial Fixed Effects Models

Fixed and random effects models were estimated, with Hausman tests favouring fixed effects. Results (Table 6-4) show that conditional grants are the most influential fiscal driver, improving the composite index, lowering mortality and morbidity, and promoting health development. This highlights the superior impact of targeted transfers compared to rule-based allocations. Own-source revenue reduces mortality, indicating that local fiscal autonomy supports life-saving interventions, though limited effects elsewhere reflect spending constraints. The equitable share remains insignificant, underscoring the limited role of untargeted transfers.

The economic structure influences health outcomes: financial and insurance GVA enhances health through credit, risk pooling, and infrastructure; manufacturing GVA worsens morbidity due to externalities; and agriculture GVA increases morbidity through occupational risks and shortages in rural services. Population density worsens mortality and overall health but also raises morbidity, highlighting agglomeration diseconomies and the necessity for spatially targeted health policies. However, non-spatial models tend to be biased in contexts with significant spatial dependence.

Table 6-4. Fixed Effects Health Outcome Models

Variable	FE – Composite Health Index	FE – Mortality Index	FE – Morbidity Index	FE – Health Dev. Index
log(OSR per capita)	1.020	−2.874 ***	2.520	1.791
	(1.204)	(0.863)	(1.694)	(1.189)
log(Equitable share per capita)	0.896	−0.618	−0.951	0.803
	(0.829)	(0.594)	(1.167)	(0.819)
log(Conditional Grants per capita)	2.793 ***	−1.501 ***	−3.526 ***	2.451 ***
	(0.558)	(0.400)	(0.785)	(0.551)
log(GVA- Agriculture per capita)	−3.248	−5.099•	12.514 *	−2.424
	(4.132)	(2.962)	(5.815)	(4.080)
log(GVA- Finance and Insurance per capita)	6.404 ***	−1.218	−11.798 ***	4.706 ***
	(1.341)	(0.961)	(1.887)	(1.324)
log(GVA – Education per capita)	−1.853	−0.166	3.842•	−1.494
	(1.517)	(1.087)	(2.134)	(1.497)
log(GVA Manufacturing per capita)	−19.510 ***	−2.461	39.051 ***	−17.494 ***
	(5.239)	(3.755)	(7.372)	(5.172)
log(Population density)	−61.343 ***	−36.969 ***	160.826 ***	−51.517 ***
	(7.028)	(5.037)	(9.890)	(6.938)
Crime Index	0.023	−0.019•	−0.026	0.017
	(0.015)	(0.011)	(0.021)	(0.015)
R-Squared	0.344	0.352	0.592	0.278
Adj. R-Squared	0.212	0.222	0.509	0.133
F-statistic (9,273)	15.922 *** (p < 2.2e-16)	16.501 *** (p < 2.2e-16)	43.953 *** (p < 2.2e-16)	11.694 *** (p= 1.54e-15)
N	47	47	47	47
N×T	329	329	329	329

Significance codes: *p < 0.001, p < 0.01,* p < 0.05**, •p < 0.1

6.4.2. Confirmatory Spatial Data Analysis

6.4.2.1. Spatial Lag Models for Regional Health Outcomes

The LM tests (Table 6-3) strongly support spatial lag dependence (LM-lag = 423.68, p < 0.001; Robust LM-lag = 103.53, p < 0.001), while the robust LM-error is insignificant (0.018,

p = 0.893), confirming that spatial autocorrelation arises primarily through endogenous lag effects rather than residual error dependence.

Table 6-3: Lagrange Multiplier (LM) and Robust LM Test for Spatial Dependence (FY 2015/16 – 2021/22)

Test	LM Statistic	p-value	Interpretation
LM Test for Spatial Error Dependence (LM error)	320.165	1.3334e-71	Strong evidence of spatial autocorrelation in the error terms under the null hypothesis of spatial independence.
LM Test for Spatial Lag Dependence (LM lag)	423.68	3.8589e-94	Strong spatial dependence in the dependent variable itself, consistent with endogenous spatial interaction effects
Robust LM Test for Spatial Error Dependence (Robust LM error)	0.0182	0.8928	Once spatial lag dependence is controlled for, there is no remaining significant spatial error autocorrelation.
Robust LM Test for Spatial Lag Dependence (Robust LM lag)	103.5332	2.5607e-24	Spatial lag dependence remained strongly significant, even after accounting for possible spatial error dependence.

The Moran's I, LISA, and LM diagnostics confirm strong spatial dependence, supporting the use of Maximum Likelihood SAR panel models for composite, mortality, morbidity, and health development outcomes. Spatial lag coefficients are consistently large and highly significant (λ = 0.73–0.92), indicating robust endogenous spillovers driven by policy diffusion, shared infrastructure, and interconnected service delivery. Composite outcomes (λ = 0.886) show limited OSR gains but significant congestion diseconomies caused by local and neighbouring population density. Mortality (λ = 0.731) highlights OSR's effectiveness in reducing deaths both locally and regionally, while density increases risks along spatial corridors. Morbidity exhibits the strongest spatial dependence (λ = 0.919), with equitable share transfers directly and indirectly alleviating disease burdens, although density promotes transmission across boundaries. Health development (λ = 0.864) benefits most from OSR through both direct and spillover effects, emphasising fiscal decentralisation's importance in building regional health capacity, yet constrained by externalities related to density. Overall, results highlight the dual role of spatial dependence: fiscal capacity and redistributive transfers generate positive spillovers, whereas unmanaged urban concentration incurs cross-county health costs.

Table 6: Spatial Lag Panel Model Estimates

Variable	ML Composite Health Index	ML Mortality Index	ML Morbidity Index	ML Health Dev. Index
Spatial Lag **(λ)**	0.886 ***	0.731 ***	0.919 ***	0.864 ***
	(0.021)	(0.039)	(0.015)	(0.024)
log(OSR per capita)	0.784 .	-1.187 *	0.245	1.369 **
	(0.444)	(0.543)	(0.470)	(0.484)
log(Equitable Share per capita)	0.101	0.161	-0.910 **	-0.161
	(0.306)	(0.372)	(0.321)	(0.333)
log(Conditional Grants per capita)	0.300	-0.353	-0.324	0.315
	(0.207)	(0.251)	(0.217)	(0.225)
log(GVA – Agriculture per capita)	0.886	-2.270	-0.518	0.465
	(1.524)	(1.856)	(1.604)	(1.662)
log(GVA – Financial and Insurance per capita)	0.665	-0.496	-0.509	0.636
	(0.494)	(0.601)	(0.519)	(0.539)
log(GVA- Education per capita)	0.488	-0.664	0.411	0.820
	(0.559)	(0.679)	(0.589)	(0.610)
log(GVA – Manufacturing per capita)	1.879	-3.795	-1.246	0.454
	(1.941)	(2.355)	(2.059)	(2.123)
log(Population Density)	-12.418 ***	-8.076 *	17.086 ***	-14.442 ***
	(2.840)	(3.440)	(3.399)	(3.123)
Crime index	0.0089 (0.006)	-0.0127 .	-0.0049 (0.006)	0.0064
		(0.007)		(0.006)
lag. log(OSR per capita)	5.956	-3.015*	2.861	8.445**
	(3.692).	(1.572)	(5.447)	(3.522)
lag. log(Equitable share per capita)	0.807	0.441	-10.045*	-0.932
	(2.325)	(0.964)	(4.357)	(2.063)
lag. log(Grants per capita)	2.243	-0.913	-3.675	1.906
	(1.719)	(0.705)	(2.662)	(1.498)
lag. log(GVA Agriculture per capita)	6.406	-5.800	-5.603	2.927
	(11.595)	(4.871)	(17.917)	(10.248)
lag. log(GVA Finance & Insuance per capita)	5.168	-1.218	-5.441	4.010
	(4.100)	(1.620)	(6.133)	(3.619)
lag. log(GVA Education per capita)	3.576	-1.727	4.558	4.978
	(4.476)	(1.805)	(6.967)	(4.061)
lag. log(GVA Manufacturing per capita)	14.784	-10.013	-14.764	2.253
	(15.737)	(6.501)	(23.677)	(13.287)
lag. log(Population density)	-92.996***	-20.555*	191.188***	-87.778***
	(30.310)	(9.892)	(59.756)	(27.361)
lag. Crime index	0.068	-0.032	-0.052	0.040
	(0.045).	(0.019).	(0.067)	(0.039)
N	47	47	47	47
N × T	329	329	329	329

Significance codes: *p < 0.001, p < 0.01,* p < 0.05**, .p < 0.1
ML = Maximum Likelihood using `spml`; All models use within estimator and include spatial lag (λ), no spatial error.

6.5. Conclusion and hypothesis outcomes

Spatiotemporal econometric analysis of composite health, mortality, morbidity, and health development outcomes revealed strong spatial dependence, confirming that neighbouring conditions influence county health. Fiscal capacity is crucial: Own-Source Revenue (OSR) directly enhances health development and lowers mortality, with positive spillovers across counties, while equitable share transfers primarily reduce morbidity, supporting their redistributive function. Conversely, population density consistently worsens outcomes by increasing morbidity through transmission and overload effects and hindering broader health development, highlighting the necessity for urban decongestion and decentralised services.

The results demonstrate outcome-specific dynamics: OSR drives mortality and development gains, transfers reduce morbidity, and density generates adverse externalities. These findings align with New Economic Geography and Fiscal Federalism, emphasising that fiscal autonomy, intergovernmental transfers, and spatial coordination are essential for equitable health delivery and progress toward the Sustainable Development Goals.

Hypothesis outcomes

H6a: Supported: Fiscal decentralisation improves health outcomes, conditional on county capacity and structure.

H6b: Rejected: OSR is more effective than transfers in improving population-level health.

H6c: Supported: Spatial externalities, especially from population density, significantly shape health outcomes.

CHAPTER SEVEN: DISSERTATION CONCLUSION

7.1. Introduction

The findings have theoretical and practical implications for New Economic Geography and Fiscal Federalism. We empirically examined how fiscal decentralisation interacts with space and time to impact multidimensional development outcomes within Kenya's devolved context. The dissertation offers actionable recommendations for policymakers aiming to optimise the effectiveness of governance structures devolved in developing countries. The outcomes of the hypotheses are summarised in Table 7-1.

TABLE 7-1: DISSERTATION HYPOTHESIS SUMMARY

Hypothesis	Outcome	Evidence / Rationale
H4a: Own-source revenue (OSR), equitable share, and conditional grants have heterogeneous effects on poverty reduction across counties.	Partially Supported	Equitable share shows strong heterogeneous effects, conditional grants moderate and selective, while OSR is insignificant.
H4b: These effects exhibit spatial spillovers and inter-county feedback mechanisms.	Supported	Significant λ across most groups confirms inter-county spillovers and spatial feedback, except for retirees.
H5a: Fiscal decentralisation positively influences county-level economic performance, with significant spatial spillover impacting neighbouring counties.	Partially Supported	OSR and Operational expenditure are positive with spatial spillovers; grants are weak, the equitable share is insignificant, and capex is negative; λ and ρ confirm inter-county dependence.
H5b: Kenyan counties exhibit absolute β-convergence under devolution.	Supported	Consistently negative and significant β-coefficients for initial GCP confirm absolute convergence.
H5c: Conditional convergence provides a better fit than absolute convergence when controlling for structural and fiscal heterogeneity.	Supported	Conditional models fit better ($R^2 = 0.335$ vs. 0.104–0.258) and capture heterogeneity via operational expenditure and population density.
H6a: Fiscal decentralisation reduces disparities in health outcomes (mortality, morbidity, composite health), conditional on county capacity and sectoral structure.	Supported	OSR and operational expenditure improve health outcomes, especially mortality and health development, conditional on capacity/structure.
H6b: Equitable share and conditional grants are more effective than OSR in improving population-level health indicators.	Rejected	OSR is more consistently effective than equitable share or grants.
H6c: Health outcomes are subject to spatial externalities, mediated by population density and sectoral composition.	Supported	Strong λ and lagged population density effects confirm spatial externalities in health outcomes.

7.2. Outcomes and Theses

This dissertation addresses key gaps in the literature on fiscal decentralisation, which has largely neglected subnational spatial dynamics in the Global South. Using Kenya's constitutionally enshrined devolution since 2013 as a case study, it combines fiscal federalism and New Economic

Geography to explore how fiscal decentralisation interacts with spatial interdependence to influence poverty, economic convergence, and health outcomes.

THESIS 1: *Spatial interdependence mediates the outcomes of fiscal decentralisation policies in Kenya's devolution framework, raising both opportunities and risks*.

All the empirical studies confirm this.

Role of Fiscal Decentralisation and Spatial Effects on Poverty Reduction

THESIS 2: *While all fiscal decentralisation instruments (own-source revenue, intergovernmental transfers, and grants) contribute to poverty reduction in Kenya, their impacts are uneven.*

Own-source revenue and equitable transfers exert strong, consistent pro-poor effects, highlighting the importance of local fiscal autonomy and equity-based transfers in promoting inclusive development under devolution.

THESIS 3: *Fiscal decentralisation unevenly influences poverty outcomes in Kenya, varying by fiscal instrument and county demographic structure*.

Spatial panel analysis of age-disaggregated poverty reveals varied fiscal effects: Equitable shares benefit working-age and retiree groups, while OSR produces widespread, spatially dispersed poverty reduction across all cohorts. This highlights the importance of spatially coordinated and demographically targeted fiscal policies to ensure equitable outcomes under devolution.

Regional Economic Performance and Convergence

THESIS 4: *Fiscal decentralisation drives balanced regional growth in Kenya when Own-Source Revenue is strengthened, spending is efficient, and policies harness inter-county spillovers beyond general transfers.*

Equitable and conditional transfers have limited growth impact due to inefficiencies. Simultaneously, spatial spillovers highlight the necessity for robust local revenue autonomy, coordinated spending, and inter-county fiscal strategies to promote balanced regional growth.

THESIS 5: *Compelling empirical evidence indicates absolute and β-convergence among Kenyan counties under devolution*.

Poorer counties grow faster than wealthier ones, supporting neoclassical convergence, but its pace depends on effective OSR mobilisation and operational spending; inefficiencies in capital expenditure and misaligned transfers hinder convergence, emphasising the need for fiscal capacity reforms and coherent, locally tailored policies.

Regional Health Outcomes

THESIS 6: *Health outcome efficiency under decentralisation depends on fiscal instruments' design and spatial deployment.*

Own-Source Revenue (OSR) most effectively improves mortality and composite health via direct and spillover effects, while equitable share transfers reduce morbidity by targeting underserved areas, highlighting the efficiency gains of spatially and demographically tailored fiscal strategies for inclusive health development.

THESIS 7: *Health outcomes in Kenya are embedded within a spatial system of inter-county dependencies, where spatial externalities amplify or attenuate local gains.*

High population density increases morbidity and hampers health development through notable spatial multiplier effects. This emphasises the need for regional coordination, targeted decongestion, and spatially tailored public health interventions based on principles from new economic geography, spatial epidemiology, urban planning, and fiscal federalism.

7.4. Limitations and suggested future research.

This study clarifies fiscal decentralisation's role in Kenya's development but is limited by county-level data, which may mask intra-county, urban-rural, and sectoral disparities, as well as insufficient focus on governance and political factors. Cross-sectional and aggregate data hinder causal inference. Key gaps include fiscal autonomy in environmental sustainability and aid effectiveness. Future research should utilise finer spatial units, panel data, Bayesian methods, and advanced spatial econometrics to capture spillovers, institutional quality, and sectoral variation, thereby improving the understanding of decentralisation's multidimensional development impacts.

7.5. Funding

The Stipendium Hungaricum Scholarship facilitated this research.

CHAPTER EIGHT: DISSERTATION NOVELTY

8.1. Introduction

This dissertation contributes four key novelties: theoretical, contextual, thematic, and methodological.

8.2. Novelties

8.2.1 Theoretical:

It reconceptualises fiscal decentralisation within regional development theory, integrating classical growth pole, cumulative causation, and core–periphery models with new economic geography, convergence theory, and spatial econometrics. This framework emphasises decentralisation's dual role: direct effects through resource allocation and local accountability and indirect effects via spatial spillovers and intergovernmental feedback.

8.2.2. Contextual:

The study examines Kenya's post-2010 devolution, a highly autonomous and formally institutionalised framework in Sub-Saharan Africa, offering insights into fiscal decentralisation under structural inequality, spatial heterogeneity, and institutional fragility.

8.2.3. Thematic:

The dissertation links decentralisation to poverty, inequality, economic performance, convergence, and regional health outcomes by disaggregating fiscal instruments, own-source revenue, equitable share, and conditional grants. It differentiates absolute and conditional convergence, identifies heterogeneous demographic effects, and demonstrates how spatially embedded fiscal capacity shapes economic and health outcomes.

8.2.4. Methodological:

The research applies exploratory spatial data analysis (ESDA) and spatiotemporal econometric models (SAR, SEM, SDM, SARAR-Durbin) to capture spatial dependence, spillovers, and feedback. Integrating disaggregated fiscal instruments into spatial panels produces precise, outcome-specific estimates, bridging fiscal policy analysis with advanced spatial econometrics.

The dissertation demonstrates that spatial interdependence is key to the success of fiscal decentralisation, providing solid, policy-relevant insights for fostering fair and sustainable regional development.

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List of Publications

1) Apostol, Stefan and Muthama, Wencelaus Musyoka (2024). *Complexity and FDI in market-dependent economies: The hidden effect of industrial offshoring*. ACTA OECONOMICA, 74 (2). pp. 187-212. ISSN 0001-6373
2) Muthama, Wencelaus Musyoka and Gál, Zoltán. (2025). *Role of fiscal decentralisation in poverty reduction: spatio-temporal evidence from Kenya's devolution framework*. Regional Statistics 15(2):292-320 DOI: 10.15196/RS150205