

Alone in the Multitude? Central Cities and their Role in Public Services Networks

BY

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List of Abbreviations or Nomenclature

CBSA	Core Based Statistical Area
ERGM	Exponential Random Graph Models
IBD	Iowa Alcoholic Beverages Division
ICMA	International City/County Management Association
ILA	Interlocal Agreements
GIS	Geographic Information System
MSA	Metropolitan Statistical Areas
OMB	Office of Management and Budget
P3	Public Private Partnership
SAOM	Stochastic Actor Oriented Models
SIENA	Simulation Investigation for Empirical Network Analysis
SMSA	Standard Metropolitan Statistical Area

Summary

This three-essay dissertation studies the role of central or principal cities in public services networks. The standards that define central cities have evolved at a different pace than that of metropolitan regions. Central cities are not only the largest core jurisdictions in their regions but a larger list of cities that concentrate population and jobs and form polycentric structures of interdependence in their regions. Our knowledge on the cross-boundary dynamics between central and noncentral cities for public service delivery remains incipient. The three essays on this dissertation are intended to address the general question of how central cities interact with their neighboring jurisdictions to provide services. The first essay presents a systematic review aimed to summarize how much have we learned during the last 50 years about central cities and collaboration for service delivery in the United States. Its findings highlight the question of how generalizable are the findings of local governments' collaboration to central cities. The second essay presents a descriptive network analysis focused on analyzing where are central cities located in four service networks- economic development, water systems, street and roads, and public safety. The essay discusses the common partners for central cities in each service domain and how the activities performed collaboratively between central cities and other jurisdictions differ from those not involving central cities. The third essay presents longitudinal network models that analyze how general characteristics of central cities affect their likelihood of collaboration for service delivery. Variables that operationalize fiscal health, demographic diversity, and city's longevity are included in two service models- information services and public safety. While longevity and demographic diversity show no statistically significant results, budget solvency shows a negative relationship with collaboration. Based on these findings, higher levels of fiscal stress as one characteristic of central cities increase the likelihood of collaboration across time.

Introduction

Metropolitan regions are one of the clearest spaces where the collective action dilemmas that *disarticulated states* face when addressing interjurisdictional public issues (Frederickson, 1999). From economic development to public safety, cooperation through interlocal collective action has become the usual prescription to the challenges that urban and suburban communities face (Oakerson, 1999; Ostrom, 1998). Although research on cross-boundary cooperation in urban areas has come a long way, the focus of metropolitan governance and collaboration has shifted in such a way that the study of service delivery and governance networks has dropped or overlooked central cities in the United States.

Central cities can be defined as incorporated places that concentrate the largest population in a metropolitan area, and whose number of workers exceed the number of resident workers (OMB, 2010). These core urban actors are salient within their regions not only in terms of economic flows, jobs, and demographic concentration, but also as social, political, and cultural hubs. Some of these jurisdictions predate the nation-states where they are located. Based on the definition provided before, central cities are not only the quintessential metropolitan spaces that come to mind when thinking of a large metropolis, like New York City, Chicago, Paris, Bogotá, Tokyo, or Mexico City. The core-periphery dynamics that create interdependence between central and noncentral governments are present in all metropolitan regions. One of the most basic purposes of this dissertation is to insist on a broader and more complex concept of central cities capable of capture under its lens central-noncentral dynamics involving less visible but highly central cities, like Indianapolis, Des Moines, Querétaro, Birmingham or Nagoya.

Besides their demographic density and jobs concentration, the urban governance literature has identified certain attributes generally present in central cities, like population decline, crime rates higher than the average in the region, demographic diversity and the departure of private companies'

headquarters and capitals (Kinahan, 2021). Decentralization toward suburban in metropolitan regions of the United States has been documented since 1980 (Dye, 1984; Schlichting, 1981). Federal housing policies and the expansion of infrastructure like the interstate highway system have been identified as factors that accelerated the decline of central cities (Baum-Snow, 2007; Brinkman & Lin, 2020).

While a significant number of central cities regained population in the late 2000s due to a recession that affected more negatively suburban growth, the COVID pandemic of 2020 shifted population in central cities back to decline numbers (Frey, 2022). This recent decentralization process due to the pandemic has put into question the need of private organizations for a fixed physical workplace. Indeed, central cities are, *de facto*, less central than they used to be fifty years ago. From the accelerated decline of cities in the Rust Belt to the relocation of businesses and warehouses to municipalities in the suburbs of Chicago and Los Angeles, the relative centralized dynamics of metropolitan regions have shifted. Nonetheless, the fact that these core jurisdictions follow similar paths of decline with the associated challenges of said evolution frames them as an appealing unit of analysis for metropolitan governance and public services scholars.

Central cities in the United States are the largest incorporated places in every metropolitan region. Although these jurisdictions have been largely studied in the literature of policy networks and metropolitan governance (Acuto et al., 2017; Arnold et al., 2017; Berardo & Scholz, 2010; Portney & Berry, 2016; Vogel & Harrigan, 2007), studies focused on central cities in the United States and service delivery networks are still scarce (Sanchez, Forthcoming). The three essays in this dissertation aim to reduce this gap following different approaches.

Several arguments make the study of central cities in service delivery networks relevant. First, resources disparities keep increasing in the United States' metropolitan regions (Aldag & Warner, 2018; Chernick & Reschovsky, 2017; Frederickson, 1999; Lowery, 2000; Nice & Fredericksen, 1995). Due to

reduced funding from higher levels of government and patterns of mobility within metropolitan areas following Tiebout's (1956) concept of a market of local governments and services/taxes bundles, some municipalities are better equipped to provide public services than others and experience different intensities of citizens' demands in terms of number of services and quality. Central cities generally share a similar path of reinforced patterns of population decline followed by resources decline, unlike some of their neighboring affluent suburban municipalities (Frey, 2022; McDonald, 2022; Schlichting, 1981). In this regard, cross-boundary cooperation for service delivery can be an alternative for central cities to escape these reinforcing cycles and to reduce the resources disparities in their regions.

Second, collaboration has become a pervasive concept and a common prescription to face wicked problems and achieve more efficient arrangements (Aldag & Warner, 2018; Weber & Khademian, 2008). Local governments that experience both fiscal pressures and high service demands could find in cross-boundary cooperation institutional mechanisms to maintain service quality and reduce costs. However, to what extent the same elements that make cities look for collaborative arrangements prevent them to collaborate is a question that can be answered by studying local units in which these elements are highly present.

Third, reduced funding to cities in the United State has driven cities to adopt an entrepreneurial role to attract citizens, businesses, and generate their own revenue (Feiock & Carr, 2001; Gordon, 2007; Hawkins, 2010). Local governments compete with their neighboring jurisdictions performing economic development activities to root citizens and capitals within their boundaries. This competition generates tense relationships in metropolitan regions that hinder regional governance efforts (Foster, 1997; Warren et al., 1992) and can impact as well potential interlocal mechanisms for service delivery. Central cities that have historically concentrated economic activities might be natural rivals of smaller cities that have embraced an entrepreneurial role, reducing their likelihood to collaborate for the provision of services (Y.

Lee, 2016; Minkoff, 2013). By analyzing different service areas, this essay can contribute to identify under which circumstances do central and noncentral cities collaborate despite competitive dynamics.

Lastly, although the Office of Management and Budget (OMB) and the US Census Bureau update their delineations and inventories of Core Based Statistical Areas (CBSA) and central cities, regions in the United States are evolving in such a way that past dichotomies of central city/suburb or central/noncentral city are less clear as they were in the past (Bahl et al., 1992; Gainsborough, 2001; Savitch & Vogel, 2004). Suburban municipalities have started to mirror central cities not only in their entrepreneurial role but also in experiencing higher rates of crime, inequity, and fiscal pressures (Haughwout, 1999; Morris, 2019; Steinacker, 2004). Developing a research strategy that can break the dichotomy central/non-central can capture the complexity of resources and scale differences in metropolitan regions, while contributing to overcome methodological limitations due to the small number of observations if only central cities defined by the OMB are analyzed.

Structure of the three-essay dissertation. This dissertation addresses the aforementioned topic in a three-essays structure. The first essay presents a systematic review focused on United States' central cities in cross-boundary relations for service delivery from 1970 to 2022. This systematic approach addresses the initial question that motivated this research: are central cities missing in the public administration literature of cross-boundary collaboration and metropolitan governance? And what have we learned from the studies that have included central cities in their analysis of collaboration for public service delivery? The review consists of a set of keywords aimed to identify peer-reviewed publications in 41 public administration and public policy journals.

Additionally, the first essay presents a review of the evolution of the term "central city". Urban municipalities have evolved and experienced population growth since the updated definitions were issued by the Census Bureau in 1983 (Ottensmann, 1996). This historical review is highly related to the

main question of the first essay: in which way is the evolution of the term related to the apparent fading of central cities in the literature?

The second essay takes advantage of a unique dataset of interlocal agreements (ILAs) in the state of Iowa to develop an exploratory network analysis during a 15-year period to investigate what is the position that central cities hold in public safety, water system, economic development, and street and roads systems networks. The essay aims to identify whether the collaborative dynamics for service delivery of central cities differ from those of noncentral cities and who are their most common partners. Additionally, the essay takes a closer look at the type of activities conducted by central cities and their partners within each service domain. While central cities are not isolated nodes in any of the networks studied, counties are more central actors in these service networks, except for the one of economic development, in which central cities are considerably more active collaborating with state and county level agencies.

The third essay presents longitudinal network models that range from 2006 to 2016 analyzing whether some of the main attributes that confer the central nature to cities -fiscal stress, demographic diversity, and longevity of the jurisdiction- affect the likelihood of a city to collaborate with other local units to provide services in two distinct domains: police protection and information services. Stochastic actor-oriented models are a suitable approach to study nodal and structural variables longitudinally, overcoming some limitations of previous research on the topic that relies on cross-sectional models. The essay introduces an initial approximation of a broader concept of central cities besides population, opening the path for future research focused on attributes like longevity of a jurisdiction, demographic diversity, and fiscal health. Lastly, a brief conclusion is presented after the third essay, summarizing the most salient findings of the three essays, and discussing avenues for future research related to an agenda focused on central cities.

Home, sweet home: what has been studied and what is missing about central cities and collaboration for public service delivery in the United States? A systematic review

Introduction

Central cities occupy an important symbolic and physical position in metropolitan regions. These local governments are relevant within their regions not only in terms of economic flows, jobs, demographic concentration, but also as social and cultural hubs (Bunce & Neal, 1984; Judd et al., 1999). Some of them predate the nation-states where they are located. Besides their longevity, central cities share critical challenges like population decline, inequity, climate change, and fiscal stress (Dye, 1984; Krause et al., 2021; Warner et al., 2021). Under these concentrations of assets and challenges, central cities in the United States are local governments responsible for the provision of a large array of public services. Contracting out and collaboration have become flexible solutions that cities develop to achieve more efficient outcomes while addressing increased demands for services from residents and nonresidents of their jurisdictions.

In 1961, Ostrom, Tiebout and Warren theoretically explored the possibility of separating the provision of public services from its production, opening what would become in the literature and in practice one of the most prevalent forms of intergovernmental and cross-sector relationships. Within the field of public administration, the transaction costs theory and the institutional collective action framework (Coase, 1937; Kim et al., 2020; Williamson, 1981a), as well as the common pool resources ideas by Ostrom (1992), the contracting out literature (Carr et al., 2009; Hefetz & Warner, 2012), the administrative conjunctions and epistemic communities dynamics (Frederickson, 1999; LeRoux et al., 2010; Leroux & Carr, 2007) have contributed to our general understanding of elements that hinder or foster collaboration at the local level.

While this body of literature studies cross-boundary relations for public service delivery, it has not addressed the question of what the role of central cities in these relations is. Paraphrasing and expanding this general question, a thorough review of empirical research can unveil how much do we know about the way central cities behave in cross-boundary arrangements for service delivery. It is important to note that the term “central city” has been used more predominantly in the United States, although concepts like “principal city”, “megacity” and “global city” have been used as synonyms in literature focused on other countries, even if they hold significant conceptual differences (Castells, 2010; Page & Lebens, 1986; Sassen, 1991). Although all megacities can be considered central cities, not all central cities reach the population threshold to be considered megacities (United Nations, 2018). Similarly, while central cities like New York or Paris are global cities following Sassen’s (1991) concept, other central cities like Omaha, in the United States, or Querétaro in Mexico would not be considered global cities. Regardless of these discrepancies, central cities are the focus of study in the United States and other latitudes (Acuto et al., 2017; Canton, 2011; Koonings & Kruijt, 2009; Page & Lebens, 1986; Sassen, 1991).

This study attempts to condense the state of the art in the literature of central cities in cross-boundary dynamics for service delivery in the United States by presenting a systematic review of the empirical studies on cross-boundary arrangements for service delivery in the last 52 years (1970-2023). The review starts a few years after the publication of Ostrom, Tiebout, and Warren (1961) and was designed to identify empirical work focused on cross-boundary arrangements for public service delivery. By narrowing the scope of the review, service delivery literature stays at the core of this study, leaving aside empirical work related to policy networks, metropolitan, and regional governance involving central cities.

The relevance of this question does not rely only on the fact that central cities still concentrate resources, populations, infrastructure, and problems. A large number of central cities have experienced

population decline, and the departure of private companies' headquarters and capitals (Kinahan, 2021). The pandemic has only accelerated these decentralization processes, questioning, for instance, the need of private organizations for a fixed physical workplace. Indeed, central cities are, *de facto*, less central than they used to be fifty years ago. From the accelerated decline of cities in the Rust Belt to the relocation of businesses and warehouses to municipalities in the suburbs of Chicago and Los Angeles, the relative centralized dynamics of metropolitan regions have shifted. Nonetheless, the fact that these core jurisdictions follow similar paths of decline with the associated challenges of said evolution frames them as an appealing yet overlooked unit of analysis for metropolitan governance scholars.

Two elements are the main characteristics of metropolitan regions in the United States: fragmentation and competition (Carr & Feiock, 1999; Hawkins, 2010; Lowery, 2000; Minkoff, 2013; Oakerson & Parks, 1989). Metropolitan governance occurs within a context of institutional fragmentation, increased pressure for service delivery, and reduced funding from higher levels of government (Frederickson, 1999; Oakerson, 1999). Unlike the idealistic polycentric assumptions on self-regulated markets of taxes-services bundles, resource disparities in metropolitan spaces keep increasing (Aldag & Warner, 2018; Bahl et al., 1992; Chernick & Reschovsky, 2017; Lowery, 2000; Nice & Fredericksen, 1995; Reese & Sands, 2006; Reilly et al., 2007). As a result, some local governments become more or less capable of providing public services while experiencing fiscal stress. Whether it is for cost savings, increased quality or access to services (Murin, 1985), cross-boundary arrangements can be a viable service delivery alternative for central cities- the local units that have been experiencing this decline more generally. In this regard, reviewing how much do we know about how cross-boundary cooperation involving central cities occurs becomes salient.

An additional consequence of increased demands for services and declining external funding is the competitive environment in which cities operate. In order to increase their own revenue, local governments compete to attract citizens and businesses that can increase their taxpayer base. While this

competition could result in a market of competitive public services for citizens, as theorized by Tiebout (1956), but can discourage collaboration across jurisdictions, particularly between suburban municipalities and central cities (Foster, 1997; Warren et al., 1992). A systematic review focused on the latter can contribute to our understanding of when and what elements enable collaboration under competitive interlocal conditions.

Lastly, the evolution and growth of metropolitan spaces has resulted in suburban municipalities becoming increasingly similar to central cities in multiple dimensions. Not only have they attracted capitals and residents that used to be concentrated in central cities, but they are experiencing increased rates of crime, fiscal stress, without having the business districts and cultural attractions that central cities have (Steinacker, 2004). In some cases, suburbs mirror the decline, public problems, and dynamics of central cities that they have become *de facto* central cities to smaller jurisdictions (Haughwout, 1999; Morris, 2019). In this regard, given that these central-noncentral complex interdependence not only has not dissipated but has become more prevalent, a systematic recount of how much we know about these dynamics is relevant.

Given that central cities are not static social and institutional spaces, the first section of this study presents an update of the evolution of the term “central city”, expanding the thorough and comprehensive review by Ottensman in 1996. The criteria to be officially considered central city and even the term itself keep evolving as metropolitan regions develop. The second section covers the methodology of the systematic review, while the third section presents the main findings of the review. The discussion section addresses gaps and avenues for future research based on the findings of this review.

The evolution of central cities as a concept

In 1982, The U.S. Census Bureau defined central cities as the largest incorporated space in each Standard Metropolitan Statistical Area (SMSA), and up to two additional cities if each of their populations were one third or more of the population of the largest city in the region (U.S. Census Bureau, 1982). An updated definition on 1991, integrating employment concentration and dynamics that acknowledged commuting and interdependent dynamics between cities (Ottensmann, 1996). The new definition classified central cities as those with populations of at least 250,000, as well as cities with 25,000 inhabitants or more and employment/resident ratio (U.S. Census Bureau, 1991). This update eliminated the limit imposed by the old definition that allowed up to three central cities in a Metropolitan Statistical Areas (MSA). Under the 1991 update, an MSA could have as many central cities as long as they met the standards established. As a result, an increase from 429 to 509 central cities occurred after the update of 1991 (Ottensmann, 1996).

In December 2000, the Office of Management and Budget (OMB) issued updated standards for defining metropolitan and micropolitan statistical areas. This update acknowledged the change from MSA to Core Based Statistical Areas and replaced the term “central city” for “principal city”. This new definition replaced the previous standards as well to be considered a principal city. The new definition depicts a principal city as the largest incorporated place with a population of at least 10,000 people, plus any additional incorporated place of at least 25,000 inhabitants in which 100,000 or more persons work, or any incorporated place of at least 50,000 people in which the number of jobs exceeds the number of residents (Office of Management and Budget, 2000). These standards replaced the fixated ratio of employment/residents stated in previous definitions for a more comprehensive understanding of employment and commuting and removed the threshold of 250,000 inhabitants for the largest city in the CBSA. Hence, although the literature still uses the term “central cities”, the current official term and

standards are the ones established by the OMB in 2000, given that the following updates on the standards delineating metropolitan areas and principal cities corresponding to 2010 and 2020 did not change the term nor its standards (Office of Management and Budget, 2020, 2020).

Although there is no explanation for the change from central to principal cities, the changes to the standards delineating principal cities proposed by the Office of Management and Budget in 2000 resulted in a larger list of cities that include medium sized jurisdictions and even local governments that could be classified as suburban municipalities by some researchers and practitioners. Some researchers contend that the change shows that the OMB has shifted from a notion of monocentric metropolitan spaces to one of polycentric regions in which smaller jurisdictions than the traditional core cities have become salient in their region. The new standards that define both Core Based Statistical Areas (CBSA) - term that broadened the previous concept of Metropolitan Statistical Area- replaced “central” for “principal” and modified the standards that define principal cities. Under these new standards, principal cities are the largest incorporated place in the CBSA “[...] each place each place of at least 250,000 population or in which at least 100,000 persons work AND each place with a population of at least 50,000, but less than 250,000 in which employment meets or exceeds the number of employed residents AND each place with a population that is at least 10,000 and 1/3 the size of the largest place, and in which employment meets or exceeds the number of employed residents” (Office of Management and Budget, 2000).

The change in the standards that define principal cities resulted in a larger list of cities, from the 554 included based on the old standards to 1255 principal cities following the new standards. The new list includes medium sized cities that have significantly increased their population and jobs concentrations besides the largest core cities that comprise the list of central cities. This change reflects the evolution of a concept that is less about centrality as a spatial monocentric term and more about the salience of cities in their regions in a polycentric configuration.

Methodology for systematic review

The identification of relevant research works was based on an adaptation of the systematic search conducted by Medina et al. (2022) and Siciliano et al. (2021) on mechanisms for network formation, which in turn is an adaptation of the Prisma protocol proposed by Moher et al. (2009). Considering that the focus of this search was on the role of central cities in public services cross-boundary arrangements, the review was bounded to the 40-core public administration and policy journals identified by Siciliano et al. (2021), plus an additional journal -Economic Development Quarterly, given its relevance in the field of local governments, public administration, and public services. The selection of these journals relies on their mission statements, bibliometrics and perception of relevance by journal editors (Medina et al. 2022; Siciliano et al. 2021). The appendix section of this review offers a list of the 41 journals considered in the search process.

The articles search covers the research production from 1970 to April 2023. This entails a period of over 50 years and starts a few years after the foundational work by Ostrom et al. (1961) related to the separation of production and provision of public services. This date range is robust enough to capture the debate between polycentrism and consolidation that followed Ostrom et al. (1961) and Tiebout's (1956) ideas of local public expenditures, the works related to tension and conflict between central cities and suburbs, and the prolific trend of contracting out both in literature and practice (Andrew, 2009b; Emerson, 2000; Hefetz & Warner, 2012; Murin, 1985). The screening and eligibility Prisma protocol is based on a series of steps that refine the search on each of the 41 journals. The steps narrow the results from the general elements of the systematic review up to the specific focus of analysis. In this study, the first step consists of a search on the websites of each journal for articles including in the title, keywords, or abstract the following terms: "collaboration" OR "governance" OR "intergovernmental" OR "cooperation" OR "cross-boundary" OR "public services" OR "metropolitan" OR "interlocal" OR

“regionalism” AND “central city” OR “central cities” OR “principal city” OR “principal cities” OR “largest cities” OR “megacities” OR “legacy cities”.

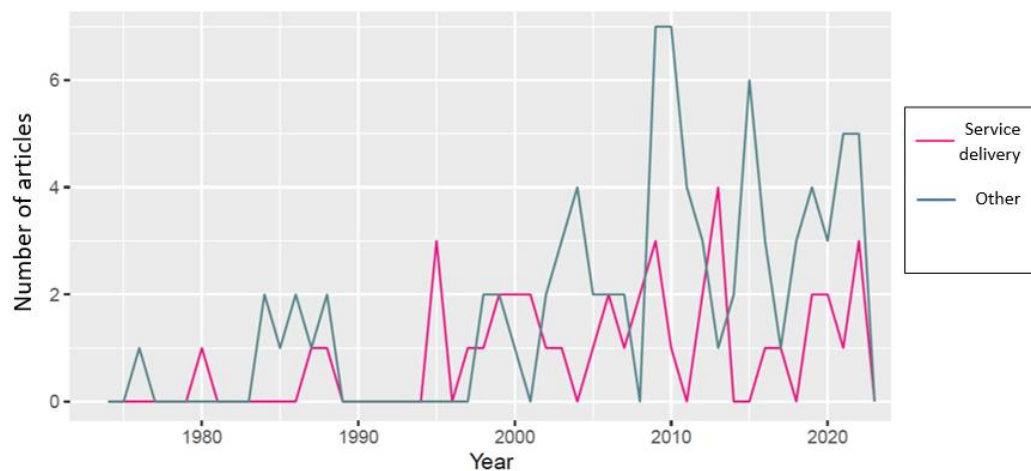
The second step consists of the review of the abstracts of each article that resulted from step 1 to identify whether the analysis includes at least one central city. Step 3 considered the identification of whether the central city is located in the United States. Step 4 identified the articles that met the criteria of steps 1, 2, and 3, and addressed empirically cross-boundary dynamics , intergovernmental relations, or cross sector collaboration. Lastly, step 5 considered a dichotomic selection of whether the article was focused on service delivery (1) or other topics (0) like policy networks, local and regional governance, local politics and elections. Although metropolitan governance and policy networks research involving central cities is highly relevant, this review is focused on cross-boundary dynamics involving central cities.

The application of this adapted protocol removed empirical research on cross-boundary interactions for service delivery outside the United States, conceptual articles, book reviews, commentaries or replies to published articles, and introductions of special issues. 734 articles resulted from applying step 1 throughout all the journals selected, 463 included at least one principal city, and in 384 of them this city is located in the United States. Of these 384 articles, only 126 studied cross-boundary or intergovernmental dynamics. In total, the review identified 42 articles that met the criteria of all the previous steps and were focused on service delivery.

Additionally, the review integrated a coding process applied to the 42 articles that reached the last step of the protocol. Within the full text of the document, this coding extracted the method of analysis conducted in each article (case study, ordinary least squares, exponential random graph models, stochastic actor-oriented models, logistic regression, QCA, and fixed-effects models). Lastly, the coding extracted the articles’ topic, service area or public issue. For this last part of coding, an inductive process

was followed in which a first round of 20 articles were classified by topic based on the keywords on the article for those articles that include keywords, followed by a process that collapsed smaller categories into broader boxes to achieve a more parsimonious classification. For this thematic categorization, two coders reviewed the first 20 articles, achieving an intercoder reliability of approximately 85%, and then achieved general consensus related to which smaller groups could be collapsed into larger categories. All 42 articles were classified into one of 12 thematic categories.

Figure 1. Comparison of “service delivery” and “other” articles including at least one central city



General numbers and trends

This article investigates what have we learned about the intersection of central cities and cross-boundary dynamics for service delivery in the last 50 years and what are some identifiable trends, topics, observations, and potential biases in this particular intersection. **Figure 1** shows the comparison between steps 4 and 5 in the protocol, that is articles that include at least one central city in the United States, focused on cross-boundary dynamics and specifically studying public service delivery (step 5), and those that do not meet the last step due to their interest in local management, policy networks or governance. Although there are not stable trends in either of the two lines, the number of articles focused on service delivery is significantly lower than those related to policy and governance in the last 20 years. In terms of the journal where the articles are published, both the initial results and the final

selection show the niche-oriented nature of these works, as expected. Three journals specialized in urban affairs and local governments concentrate 62% of the total articles in the first step- Urban Affairs Review, Journal of Urban Affairs, and State and Local Government Review. Three journals with a more general focus in public administration and policy (Journal of Public Administration Research and Theory, Public Administration Review, and Policy Studies Journal) concentrate approximately 10% of the initial results. This concentration becomes nuanced when observing the final selection of 42 articles: 7 of them are published in Urban Affairs Review, 4 of them in Urban Affairs Review, and the rest are distributed among other 17 journals, showing a more even distribution of the articles that meet all the criteria for this study.

Data and Methods

The review identified empirical research that includes at least one central city in its analysis. As can be read in **Table 1**, among the 42 selected articles, 7 used samples of cities and other local governments at the national level, including at least one central city. 10 articles were identified whose focus is New York City and/or its Core Based Statistical Area (CBSA), which represents 23.81% of the total. Articles analyzing Los Angeles or its CBSA represent 16.6% of the total with 7 articles. The Indianapolis and Orlando CBSA sum each 3 articles, or 7.14% of the total. The cities and CBSAs of Chicago, Boston, Buffalo, Dallas, Philadelphia, Houston, Milwaukee, and Kansas City are listed with 1 article (2.3%) among the total 42. Three studies use state lines to bound their local governments' analysis, focused on cities in Iowa, Michigan, and Ohio, and 1 article in the final selection compares European cities with United States' cities.

Table 1. Data used in the articles that meet the search criteria

Data	Number	Percentage
New York City	10	23.81%
National sample	7	16.67%
Los Angeles	7	16.67%
Indianapolis	3	7.14%
Orlando	3	7.14%
Chicago	1	2.38%
Boston	1	2.38%
Buffalo	1	2.38%
Dallas	1	2.38%
Philadelphia	1	2.38%
Houston	1	2.38%
Milwaukee	1	2.38%
Kansas City	1	2.38%
Iowa Cities	1	2.38%
Michigan Cities	1	2.38%
Ohio Cities	1	2.38%
European and US cities	1	2.38%
Total	42	100.00

In terms of methods of analysis, as can be read in **Table 2**, almost 50% (n=20) articles use a qualitative approach and present one case study or a set of case studies. Logistic regression and OLS regression come next in frequency (19% and 11.9%, respectively), as well as social network analysis (11.9%). While the analytical method differs, articles in the traditional regression analysis categories and the case studies study transaction costs and determinants of collaboration (Bielefeld et al., 1995; Chambré, 1999; Ferris & Graddy, 1988; Joassart-Marcelli & Musso, 2005; Lamothe & Lamothe, 2012; MacIndoe, 2013; Mandell, 1999; O'Regan & Oster, 2002; Wilson, 2013; Zambrano-Gutiérrez et al., 2017). Generally, researchers on these articles consider logistic and linear models as suitable designs to study probability of contracting out, privatization or other collaborative arrangements for service delivery.

Network analysis articles address questions related to partner selection and determinants of collaboration (Andrew, 2009b; R. Feiock et al., 2010; Lee & Lee, 2020; Olivier & Schlager, 2022; Park et

al., 2019). The articles that used exponential random graph models (ERGM) analyze cross-sectional collaborative networks (Feiock et al., 2010; Olivier & Schlager, 2022), while the articles using Stochastic actor-oriented models study service delivery collaborative networks at different points in time (Andrew, 2009b; Y. Lee & Lee, 2020; Park et al., 2019). Lastly, within the traditional regression models group, the articles that used fixed effects models and hierarchical linear models study cities and school districts nested in networks, and control for type of service and year (Chen, 2008; Hugg, 2019; Zambrano-Gutiérrez et al., 2017).

Table 2. Articles by method of analysis

Method	Number	Percentage
Case study	20	47.62
Logistic Regression	8	19.05
OLS Regression	5	11.90
Network Models	5	11.90
Fixed-effects Modeling	2	4.76
Hierarchical Linear Modeling	1	2.38
QCA	1	2.38

Partner selection and service areas

Besides the identification of the data used in the articles and the method of analysis, the review identified the general topic and service area or public issue on which the articles were focused. Empirical work focused on cross-sector collaboration or coproduction of services accounts for the largest percentage in the final selection with approximately 31% of the total (n=13), as can be read in **Table 3** below. Although these articles addressed different services, its main focus was on the nature and dynamics of the arrangements between city governments and nonprofit organizations in the production of services (Bielefeld et al., 1995; Chambré, 1999; Chen, 2008; Cheng & Li, 2022; Cohen, 2001; English & Dicke, 2020; Gronbjerg, 1987; MacIndoe, 2013; Mandell, 1999; O'Regan & Oster, 2002; Pincetl, 2003; Wilson, 2013). While cross-sector collaboration can entail both city-nongovernmental organizations and

city-for profit organizations' arrangements, all 13 articles in the category "cross-sector collaboration/coproduction" analyze the interaction between city governments and nonprofit organizations, while articles about contracting out arrangements with private organizations (also described as privatization and public-private partnerships (P3)) are included in the Contracting out category (Emerson, 2000; Lamothe & Lamothe, 2012; Rubin & Rubin, 2007; Schlager et al., 2021).

The categories of service delivery and contracting out account for approximately 24% and 14%, respectively (n=10 and n=6). These categories group articles that analyze more than one service area and are interested in identifying in which service areas are contracting out and joint-production more likely to occur. In this regard, findings state that collaborative arrangements in services areas related to system maintenance (*i.e.* street and roads and solid waste management) are more likely than lifestyle services (*i.e.* economic development) (Gainsborough, 2001; Hugg, 2019; Williams, 1971). Similarly, contracting out with private organizations is more likely when competition at the local level and citizen interest on the service are low, and in service areas that imply low asset specificity (Hefetz & Warner, 2012; Hilvert & Swindell, 2013). The economic development category groups articles exploring how collaboration among cities in providing economic development services can occur despite tense dynamics of interlocal competition for business, resources and citizens (English & Dicke, 2020; R. Feiock et al., 2010; Y. Lee & Lee, 2020; Romero de Ávila Serrano, 2019; Schlager et al., 2021). The rest of the total selection of 42 articles are focused on services like parks and recreation, water services, sustainability/energy, public health, emergency management, welfare/social services, education, and public safety. The main topics and service areas in these smaller categories are partner selection and performance of collaborative arrangements for service delivery (Andrew, 2009b; Brecher & Wise, 2008; Ellson, 1980; Kapucu, 2006; Milward & Provan, 1998; Payton & Kennedy, 2013).

Table 3. Articles by service area

Service Area	Number	Percentage
Cross sector collaboration/coproduction	13	30.95%
Service delivery	10	23.81%
Contracting out	6	14.29%
Economic development	4	9.52%
Water Services	2	4.76%
Parks and Recreation	1	2.38%
Sustainability/Energy	1	2.38%
Public Health	1	2.38%
Emergency Management	1	2.38%
Welfare/Social services	1	2.38%
Education	1	2.38%
Public safety	1	2.38%
Total	42	100%

Insights for central cities

The findings of the articles in this review can be summarized in three types of insights in regard to central cities and cross-boundary dynamics for service delivery. First, findings of studies in which central cities are one observation in the sample analyzed and their central nature is not considered as a variable of interest. Second, results in which central cities are the main unit of analysis on a case study but only as the case that reflects specific aspects of cross-boundary dynamics, not focused on their central characteristics. And third, results in which central city as an attribute or characteristic of a local government impacts in a specific way cross-boundary dynamics for service delivery.

One of the most compelling questions that a systematic review like this entails is to what extent findings of empirical research on cross-boundary dynamics for service delivery are applicable to central cities. When central cities are part of a large sample of local governments in analyses, it is implied that the findings apply on average to all the observations in the sample. However, a significant number of articles dropped central cities in their analyses due to scale differences (Arnold et al., 2017; Blair, 2002; Boulton et al., 2022; Hawkins, 2010; Ihrke et al., 2003; Jimenez, 2017; Moore et al., 2005; Nelson &

Nollenberger, 2011). This methodological decision casts doubts on the assumption that findings of studies in which central cities are included apply equally both to central and noncentral cities. If that assumption is valid, then it would be expected that central cities followed collaborative patterns for service delivery similar to noncentral cities. The question regarding this distinction could be addressed if studies focused on central cities produce findings similar to those that do not make a distinction between central and noncentral cities. The following lines show the findings of both studies in which central cities are one observation among other cities or local governments and those that include central cities as well as noncentral units but focus their analysis on the distinction between central and noncentral.

Central cities as one more observation of the sample. The findings from the first group provide insights related to partner selection and determinants of cross-boundary arrangements. Cities in general opt to contract other local governments for services like public safety and fire protection. Some works argue that high citizen interest on the service drives cities to contract out to other local governments due to their reliability (Hefetz & Warner, 2012). Similarly, other works contend that asset specificity and concerns about service disruption make more likely for cities to contract services like police and fire protection to other local governments than to private contractors (Hilvert & Swindell, 2013; Joassart-Marcelli & Musso, 2005). Other insights on partner selection state that proximity and being located in the same county increases the likelihood of collaboration at the local level (Lee & Lee, 2020).

Regarding determinants for collaboration, articles in this first group highlight the relevance of social embeddedness as a potential driver of collaboration. Professional networks of local officials and past collaborative experience can increase trust and reduce transaction costs of potential partners (Carr et al., 2009; Hoornbeek et al., 2016). Lowering transaction costs can be achieved as well through formal institutional mechanisms at the local level, such as contractual clauses on sanctions, shared decision-making, and monitoring (Olivier & Schlager, 2022; Schlager et al., 2021). Similarly, institutional incentives

and rules established at the state level can turn state-level agencies into collaboration facilitators (Foster, 1997; Gainsborough, 2001). Lastly, homophily at the local level -cities that are more similar based on certain characteristics- and preferential attachment -popular actors in a network attracting incoming collaborative ties- are presented by articles in this group as drivers of collaboration (Andrew, 2009b; Lee & Lee, 2020).

Central cities as case of study whose focus is not their central nature. The findings from studies in this group emphasize two elements: (1) the salience of nonprofit organizations as a key collaborator of central cities for service production, and (2) resource dependence as the critical concept that explains why city-nonprofit collaborations can be stable in time and show adequate performance. Seven out of the twenty case studies in the final selection analyze contracting out and other collaborative arrangements between a central city and nonprofit organizations. Due to the close relationship between nonprofit organizations and their community, contracting these organizations nonprofits to deliver services in large jurisdictions can increase service quality and coverage, although an overabundance of nonprofits operating in the same service domain can increase the administrative burden on the citizen side (Chambré, 1999; Cohen, 2001; Hilvert & Swindell, 2013; Mandell, 1999).

Articles in this group using resource dependence as a conceptual lens contend that cities and nonprofit organizations have an interdependent relationship and exchange resources based on their respective strengths. Nonprofit organizations that work closely with their community can easily gather support for certain city programs and deliver services more efficiently than cities on their own (Wilson, 2013). Nonprofit organizations depend on the cities' own or external revenue that allows said organizations to operate and produce services, while cities rely on the attachment of these organizations to their communities and their capacity to distribute benefits and allocate services (Gronbjerg, 1987; Wilson, 2013). Although coordination takes time and implies an investment of human and other resources by cities and nonprofit organizations, effective and less-vertical leadership by a governmental

unit, nonprofit-city government dyads can improve the access to services, quality, time of response, and overall performance (Bielefeld et al., 1995; Mandell, 1999; Wilson, 2013). Some nonprofit organizations understand their strength in their community to a point that they assume their role in an urban regime similar to that of business interests, advocating for their mission and organizational values (Pincetl, 2003).

Central city as an independent variable of interest. Regardless of the method of analysis and service area, only 3 articles in the final selection use the concept of central city as one of the main independent variables. Foster (1997) suggests a regional impulses framework to compare different collaborative cases at the metropolitan level. In the article, the case of Buffalo is used to demonstrate the usefulness of the framework. One of the main findings states that population decline and increased fiscal stress make central cities undesirable partners for collaborative service delivery. Additionally, past decisions of actors in a metropolitan area regarding the development of a shared regional vision create inertial patterns of regionalism and fragmentation (Foster, 1997). Historical and increasing resources disparities between central cities and suburbs result in a low-receptive environment to collaboration.

Longevity of a local government is another attribute of central cities analyzed by Ferris and Graddy (1988). While studying the production choice decision of cities, the authors contend that older jurisdictions -generally central cities- are less likely to engage in contracting out arrangements for most services, like waste management, transportation, and street repair, but more likely to contract out elderly services. The authors' explanation of this finding can be related to the inertial patterns suggested by Foster (1997)- waste management and street repair are "core" services in cities, traditionally produced in house (Ferris & Graddy, 1988). Elderly services, on the contrary, can be considered "acquired" or more recent services, for which central cities have not followed inertial patterns of in-house production.

Lastly, Wood (2006) tested whether central cities and suburbs that mirror central city's negative attributes are more or less likely to enter in intergovernmental service arrangements than wealthy suburbs in the bi-state MSA of Kansas City. His results point toward a negative relationship between being a central city or an at-risk suburb and the likelihood of intergovernmental arrangements for service delivery. His analysis shows mixed findings: on the Missouri side of the MSA, bedroom affluent suburbs are more likely to engage in intergovernmental partnerships for service delivery, compared to central cities and at-risk suburbs (Wood, 2006). This difference is not statistically significant in the Kansas side of the MSA. While acknowledging that a small number of cities in the Kansas region might explain the partial lack of statistically significant results, Wood (2006) argues that communities with higher per capita income are more tolerant to the use of intergovernmental innovative arrangements to achieve more efficient services. Wealthier municipalities might also have higher expectations in terms of quality of services, driving local officials in these communities to find alternative service-delivery solutions to meet their constituencies' demands (Wood).

Limitations and gaps in the literature

As discussed in the previous section, there are some limitations in terms of how valid these insights are to central cities. Quantitative research using traditional regression analysis relies on the assumption of a normal distribution of the observations. In these samples, central cities are natural outliers in different dimensions. Traditional regression models treat these outliers as nuisance to be reduced. Although they can produce statistically significant results and have an adequate explanatory power, given that central cities are scarce in these samples and treated as outliers, the results produced by these analyses might not be fully applicable to central cities. Even more, in some studies central cities are dropped from the analyses arguing scale differences prevent them to be included in quantitative approaches, and that their inherent characteristics make them unfit for comparisons with other local governments in the sample

(Arnold et al., 2017; Blair, 2002; Boulton et al., 2022; Hawkins, 2010; Ihrke et al., 2003; Jimenez, 2017; Moore et al., 2005; Nelson & Nollenberger, 2011).

The fact that the largest percentage (30%) of the articles in the final selection address cross-boundary dynamics between central cities and nonprofit organizations is an interesting finding. It highlights the potential that interdependent relations between city governments in large jurisdictions and nonprofit organizations have in the delivery of public services. Additionally, it might be reflecting competitive dynamics at the local level that prevent city governments from collaborating or engaging in intergovernmental service delivery (Hamilton, 2002; Hawkins, 2010; Swanstrom, 2001). However, the lack of empirical studies focused on collaboration between city governments does not necessarily imply that these dyads are not present in practice. One of the major challenges of studying administrative conjunctions at the local level that are both flexible and contingent is that, given their degree of formality, it can be hard to track and study them (Agranoff & McGuire, 1998; Frederickson, 1999; Kim et al., 2020). By studying collaboration when it becomes noticeable, the research on central cities and cross-boundary dynamics might be biased toward cross-sector collaborative arrangements that have become salient due to their stability or success.

A similar bias might be rooted in the geographical location of the cities studied in the articles identified by this review. Although there are over 400 central or principal cities in the United States (Office of Management and Budget, 2015), only 15 central or principal cities were identified in the final selection of this systematic review. Rigorous research designs result in generalizable findings, but future research can focus on central cities besides the two quintessential central cities most studied in this review- New York City and Los Angeles. Researchers can bound their analyses on the metropolitan area where their university is located for practical purposes, but until more research is conducted focused on other central cities and metropolitan areas, the concentration of research on central cities and

collaboration for service delivery in a small number of cities might have low generalizability and could incur in selection bias.

Overcoming the challenges of researching central cities

Studying central cities following quantitative approaches will necessarily face the challenge imposed by the fact that there might be only one or two central cities among a larger number of local units in a metropolitan area of study. The lack of variation in terms of the attribute central/noncentral can result in not statistically significant findings or in dropping central cities as outliers to improve the results in traditional regression methods. Alternative approaches of social network analysis like stochastic actor-oriented models (SAOM) and exponential random-graph models (ERGM) can contribute to overcome this limitation. These network analysis methods simulate interdependent decisions of actors that create, maintain, and dissolve ties. Central cities can be studied in terms of the role they play in these service delivery networks populated by noncentral municipalities, private and nonprofit organizations.

In terms of data collection, an alternative to correct selection bias could be the identification of archival data that collects collaborative dynamics systematically and in a longitudinal way. Examples of this alternative approaches are Rubado's (2021) analysis of interlocal collaboration in the United States that uses financial data related to transfers from over than 30,000 jurisdictions over 30 years. Other examples include hyperlink networks of clean energy that link agencies through their websites (Yi, 2018) and Hugg's (2019) longitudinal study of interlocal agreements using a statewide dataset of cross-boundary formal agreements.

Lastly, one of the articles in the final selection of this review proposed an argument that has been significantly overlooked. Metropolitan areas and cities are not static units but dynamic social spaces that evolve toward increased urbanization (United Nations, 2018). In this regard, although the Office of Management and Budget has updated several times the criteria to classify central or principal

cities, categorizing cities into a rigid dichotomic variable of central/noncentral might have been adequate in the past but could be obscuring the current complexity of metropolitan areas in the United States. Wood (2006) argues that local governments in the United States are more diverse than just the city-suburb dichotomy. While some central cities might be experiencing decline, others might be bringing back citizens and business to their jurisdiction. Similarly, while some suburbs keep increasing their wealth, attracting high-income residents and businesses within their boundaries, other suburbs could be losing the population and resources that the affluent suburbs acquired. This evolution creates new dynamics of development, decline and resource disparities in which suburban municipalities act as de facto central cities to other surrounding municipalities. Wood (2006) grouped together central cities and at-risk suburban municipalities and included affluent suburbs in a different category. By concentrating jobs, residents and financial resources, these local governments could be creating similar tensions with their neighboring local units to the ones they experienced in the past with the central city (Haughwout, 1999; Steinacker, 2004; Wood, 2010).

In this regard, researchers on this subject can think of the central nature of cities as a continuum rather than a dichotomy. Besides the insights related to partner selection and determinants for collaboration, the articles in this systematic review reach a general consensus on the main features that make a city central, beyond the criteria established by the OMB. The empirical work reviewed describes central cities as are (1) older jurisdictions, (2) more demographically, and (3) operate under higher fiscal stress compared to their surrounding municipalities (Bunce & Neal, 1984; Chernick & Reschovsky, 2017; Congressional Budget Office, 1975; Dye, 1984; Ferris & Graddy, 1988; Foster, 1997; Frisken & Norris, 2001; Hamilton, 2002; Joassart-Marcelli & Musso, 2005; Mactdanus, 1981; Mattiuzzi & Weir, 2020; Simpson & Kelly, 2008; Svara, 1988; Thomson, 2021).

A continuum that considers these three variables -fiscal stress, age, and diversity- could locate cities somewhere between the two sides of the dichotomy: central and noncentral. Thus, a combined

score on these three attributes could capture in a more comprehensive fashion the complexity of metropolitan regions beyond the classifications of the OMB. Scholars could then have more than one or two central cities as observations for large n studies and conduct qualitative studies including cases with different degrees of centrality. This proposition is a first exploration on how to think of a more sophisticated understanding of the resources' allocation and disparities in metropolitan regions. Future research can test this combined score or complement it with other attributes supported by previous work.

Conclusion

The systematic review presents a thorough synthesis of what we have learned and what is missing in terms of United States' central cities and cross-boundary arrangements for public service delivery. Among the insights identified, one of the most salient is related to partner selection: several articles analyzed the interdependent relationship between central cities and nonprofit organizations in service delivery. Resource dependence theory can shed light on the strength of these dyads: city governments provide funds that allow nonprofit organizations to operate (Pfeffer & Salancik, 1978). On their behalf, nonprofit organizations gather community support and adequate mechanisms to deliver services. Future research can explore with adequate depth if intercity rivalry could be another factor that drives central cities to engage more with nonprofit organizations than other public actors in the region.

Additionally, in terms of type of services, central cities engage in more cross-boundary arrangements on services associated with system maintenance functions, with lower asset specificity, and lower interest of citizens. Lastly, the age of central cities is another factor that could reduce the likelihood of cross-boundary collaboration, considering that historical patterns of in-house production or insulation can prevent local governments from exploring alternative mechanisms to lower costs, increase quality and coverage of services.

The purpose of this systematic review, besides summarizing our learning of the subject, is to become a call to collaboration to fill the gaps in the literature and provide useful insights for practitioners working on more or less central local governments. Resource disparities will prevail, and fragmentation might be a fixed attribute of metropolitan governance, but scholars on the subject do not necessarily have to follow the same patterns.

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Appendix. Search Results by Journal

Journal	Step 1. Search word criteria	Step 2. Central City	Step 3. In the US	Step 4. Cross-boundary dynamics	Step 5. Service Delivery
Administration and Society	4	4	4	1	0
The American Review of Public Administration	12	12	12	3	1
Australian Journal of Public Administration	1	0	0	0	0
Canadian Public Administration	1	0	0	0	0
Economic Development Quarterly	27	23	23	4	1
Evaluation Review	6	6	6	0	0
Financial Accountability and Management	0	0	0	0	0
Human Relations	1	0	0	0	0
International Journal of Public Administration	24	22	22	5	0
International Review of Administrative Sciences	1	0	0	0	0
Journal of Accounting and Public Policy (JAPP)	8	5	5	0	0
Journal of Health Politics, Policy, and Law (JHPPL)	1	1	1	0	0
Journal of Management Studies	1	1	1	0	0
Journal of Policy Analysis & Management	6	6	6	2	1
Journal of Public Administration Research and Theory	38	20	19	5	3
Journal of Public Budgeting, Accounting & Financial Management	1	1	1	1	1
Journal of Public Policy (JPP)	5	1	1	0	0
Journal of Urban Affairs (UA)	84	62	51	25	4
Municipal Finance Journal	5	3	3	0	0
National Tax Journal	1	1	1	1	0
Nonprofit and Voluntary Sector Quarterly	11	11	11	3	2
Nonprofit Management and Leadership	3	3	3	2	2
Organization Studies	0	0	0	0	0
Policy Sciences	11	3	3	1	0
Policy Studies Journal	10	7	7	3	3
Political Psychology Journal	0	0	0	0	0
Political Science Quarterly	7	3	3	0	0
Public Administration	7	6	5	4	3
Public Administration & Development	2	1	1	0	0
Public Administration Quarterly	17	4	3	3	1
Public Administration Review	23	17	17	7	3
Public Budgeting and Finance	10	5	4	0	0
Public Finance Review	8	5	5	2	1
Public Management Review	1	1	1	1	0
Public Performance & Management Review	6	6	6	2	1
Publius	7	7	7	3	2
Review of Policy Research	6	5	5	3	2
Review of Public Personnel Administration	3	2	2	0	0
Social Science Quarterly	4	4	4	1	1
State and Local Government Review	140	36	32	14	3
Urban Affairs Review	231	169	109	30	7
Total	734	463	384	126	42

All by myself? Central Cities and their Role in Service Delivery Networks

Introduction

Local governments are known for being the closest governmental actor to citizens, which situates them in the strategic and critical position of knowing their constituencies' demands for services and having to address these increasing demands with reduced external funding and constraints in their own revenue.

Central cities, or principal cities, experience these demands and decline more strongly than affluent neighboring jurisdictions, and are expected to provide public services for both residents and commuters (Chernick & Reschovsky, 2017; Ferris & Graddy, 1988; Foster, 1997; Frisken & Norris, 2001; Hamilton, 2002; Joassart-Marcelli & Musso, 2005). Although these jurisdictions have been thoroughly studied in the literature of policy networks and metropolitan governance, our knowledge of their role in service delivery networks remains incipient. This article presents an exploratory network analysis focused on this gap using a statewide dataset of formal interlocal agreements during a 15-year period.

Central cities can be defined as the largest incorporated places in a Core Based-Statistical Area (CBSA) with a population of at least 10,000 people, plus any additional incorporated place of at least 25,000 inhabitants in which 100,000 or more persons work, or any incorporated place of at least 50,000 people in which the number of jobs exceeds the number of residents (Office of Management and Budget, 2000). Although the public administration and policy literature has devoted great attention to these large jurisdictions regarding specific policy domains and public issues (Acuto et al., 2017; Arnold et al., 2017; Berardo & Scholz, 2010; Portney & Berry, 2016; Vogel & Harrigan, 2007), less is known about their role in interlocal networks of contracting and joint-production of public services (Sanchez, Forthcoming). This article aims to contribute to fill this gap in the literature by investigating in what type of service networks are central cities more active, who are the most common partners of central cities, and how is their position different from noncentral cities across time.

These questions are relevant for several reasons. First, institutional fragmentation in metropolitan regions and reduced funding from higher levels of governments have created considerable resources disparities between jurisdictions (Aldag & Warner, 2018; Chernick & Reschovsky, 2017; Frederickson, 1999; Lowery, 2000; Nice & Fredericksen, 1995). In this fragmented arena, some local governments can face their constituencies' demands for services better than others. If part of the polycentric argument of Tiebout and his colleagues (Ostrom et al., 1961; Tiebout, 1956) regarding a perfect market of service/taxes bundles is correct, cities can enter in negative cycles of population and resources decline leading to decreased revenue and reduced services. Cross-boundary arrangements for service delivery can be an alternative to break these cycles for central cities.

Second, collaboration has been generally understood as a mechanism to achieve economies of scale and lower costs in producing services (Bel & Sebó, 2019; Byrnes & Dollery, 2002; Ostrom et al., 1961). Although local governments can enter into cross-boundary dynamics for other reasons (Aldag & Warner, 2018), cost savings are still one critical concern of local governments. Elements like population and installed capacity enable economies of scale and have an impact on the cost of producing services in cross-boundary arrangements. Hence, given that central cities have at least one of said elements, they could become a preferred partner in service areas where economies of scale are possible.

Third, as funding from higher levels of government has reduced, cities have adopted an entrepreneurial role and compete with other municipalities to attract citizens and businesses to increase their own revenue. This competitive environment generates a tension that is not only reflected in a fragmented regional governance (Foster, 1997; Warren et al., 1992) but can also hinder the potential for collaboration in service delivery networks. By analyzing services that entail high and low community values and relevance, this study can contribute to our understanding of what are the types of public services that are produced in cross-boundary dynamics given competitive metropolitan environments.

Lastly, the flow of citizens and resources within metropolitan areas has to some extent blurred the distinction between some central cities and their neighboring municipalities. Suburban municipalities that experience growth are mirroring central cities not only by attracting businesses and citizens but also in terms of demands for public services, fiscal stress, crime, and even decline (Haughwout, 1999; Morris, 2019; Steinacker, 2004). In this sense, the findings of an exploratory study like this are not generalizable to other central cities defined by the Office of Management and Budget (OMB), but also for the suburban municipalities that have become central cities for practical purposes to other smaller municipalities.

The following section presents a review of the research and a set of propositions based on previous research. Then, the methodology and data are explained, followed by a section that presents the most relevant findings of the study. Lastly, a discussion section positions these findings in terms of their contribution to the literature on public services and cross-boundary cooperation in metropolitan regions.

Literature review

Central cities are defined by the Office of Management and Budget (OMB) as the largest incorporated places with populations of at least 10,000 people, plus any additional incorporated place of at least 250,000 inhabitants or in which 100,000 or more persons work, or any incorporated place of at least 50,000 people in which the number of jobs exceeds the number of residents (Office of Management and Budget, 2000). This definition has been updated following the growth and evolution of metropolitan areas (currently defined as Core Based-Statistical Areas (CBSA)). The most recent update, in 2000, replaced the label “central city” for “principal city”. Notwithstanding, the new label has not replaced “central city” in the public administration and policy literature (Sánchez, Forthcoming).

Central opposing attributes. Central cities in service networks posit an interesting tension regarding their likelihood of engaging in cross-boundary cooperation. Certain attributes of central cities make them more likely to be found in collaborative arrangements for service delivery while some other attributes make them a less-desirable partner. LeRoux, Brandenburger, and Pandey (2010) explain that densely populated cities tend to be more cooperative in service delivery arrangements due to their “full-service” nature, capable of selling off excess service capacity to neighboring jurisdictions that cannot afford certain equipment or personnel. Similarly, large populations in central cities imply that these jurisdictions are able to achieve economies of scale in certain service areas. Hence, smaller jurisdictions whose populations are not large enough to achieve economies of scale can purchase services from central cities instead of investing in equipment or personnel to produce services in house (Aldag et al., 2020; Bel & Sebó, 2019; Byrnes & Dollery, 2002).

The literature on transaction costs, however, pays attention to other attributes of central cities. Collective action entails a series of costs and risks inherent in switching from an in-house production of services to joint delivery or contracting out arrangements. Actors incur in costs while searching for collaborators, negotiating arrangements, bargaining, and monitoring the actions of their counterparts (Carr et al., 2009; Chen et al., 2019; Foster, 1997; Lubell, 2013). Central cities under high fiscal stress might not be able to afford these transaction costs, or these costs might surpass the expected savings to the point that maintaining the production of services in house might be their best solution (Aldag et al., 2020; Carr & Hawkins, 2013).

Besides central cities’ own perception of their fiscal health, other actors in the region can consider their perception of central cities’ fiscal health when assessing the risks of a potential collaborative arrangement. Collaborators analyze the risks of defection on their counterparts before engaging in cross-boundary dynamics and make decisions trying to avoid failures or service interruptions, particularly on highly asset-specific services (Brown & Potoski, 2003; Carr et al., 2009). This

concern of service compliance makes that negative financial measures -revenue per capita, percentage of federal aid, and median house value- turn central cities into unappealing partners for prospective collaborators (Carr & Feiock, 2004; Foster, 1997).

Differences in services and central cities. It is expected that networks of distinct public services look and evolve differently. The nature of services can increase the transaction costs when produced in a collaborative arrangement, depending on the asset specificity of the service or measure difficulty. Services that are highly asset-specific for which finding other suppliers or buyers is difficult, as well as services which are difficult to measure entail high transaction costs (Brown & Potoski, 2003). Hence, it is expected that the role of central cities will differ depending on the nature of the service produced.

The importance that citizens assign to different services can affect the likelihood of their collaborative production as well. Using Williams (1971) categorization of system maintenance and lifestyle services, empirical research has produced interesting findings. System maintenance are services for which citizens do not have a strong preference in terms of its production and do not involve high identity or community values. On the contrary, lifestyle services are the ones in which citizens are not neutral because the choices of their production reflect the values of the community. These lifestyle services can also reflect the efforts of cities to compete in their regions attracting citizens and residents (Hawkins, 2010; Lee, 2016). In this regard, services that imply less competitive dynamics and low citizens' preferences are more likely to be found in joint-production arrangements, rather than lifestyle services (Gainsborough, 2001; Hugg, 2019; Williams, 1971). Similar studies point to the same direction, classifying services in terms of the citizens' interest on them, and found that contracting out is more likely when citizens' interest on the service is low (Hilvert & Swindell, 2013). In this regard, collaborative arrangements involving central cities are more likely to occur in system maintenance and low citizens' interest services, such as street and roads repair and solid waste management.

In terms of partner selection, increased pressure for service provision and decreased funding from higher levels of government have created competitive dynamics in metropolitan regions. City governments simultaneously collaborate in some activities and compete to attract businesses and citizens to generate revenue (Hawkins, 2010; Lee et al., 2012; Lee, 2016). Some service areas are more likely to be negatively affected in terms of cross-boundary cooperation by these competitive dynamics, especially the ones that are inherent of the entrepreneurial role of cities, like economic development (Lee et al., 2012). In the context of intercity competition, local governments might be more likely to contract out or collaborate with other local units instead of cities, such as private and nonprofit organizations or county level agencies (Hefetz & Warner, 2012; Hilvert & Swindell, 2013).

Social capital theory can provide a different rationale regarding the likelihood of collaborative arrangements between central and noncentral cities. Local governments can reduce the uncertainty that collaboration involves and lower transaction costs by partnering with similar governmental units. This process is known as *homophily* (Andrew, 2009b). Suburban municipalities are more similar to other suburban units than central cities in terms of demographics, population density, and median household income. In consequence, suburban municipalities can choose similar partners in service delivery networks because they share similar resources, values, and service needs, lowering the transaction costs of working together (Carr & Siciliano, 2019).

Data and methodology

Iowa is a state located in the Midwest region of the United States and has 1,954 local governments, of which 947 are cities, 99 are counties, 380 school districts, and 528 special districts (U.S. Census Bureau, 2020). As can be seen on **Table 1**, The state has 9 Metropolitan Statistical Areas (MSA), all of which have one central or principal city except for two, Des Moines-West Des Moines and Waterloo-Cedar Falls, which have two central cities each.

The Interlocal Collaboration Dataset. This study uses a dataset that includes all 947 cities and 99 counties in the state. Additionally, it includes organizations from the private and nonprofit sector, and state-level and federal agencies. The descriptive statistics for cities and counties in the dataset can be read in **Table 2.**

Table 1. Central or Principal Cities and Metropolitan Statistical Areas an in Iowa

City	Metropolitan Statistical Area	County	Population (2020)
Ames	Ames	Story	66,427
Cedar Rapids	Cedar Rapids	Linn	126,326
Davenport	Davenport-Moline-Rock Island	Scott	101,724
Des Moines	Des Moines-West Des Moines	Polk	214,133
West Des Moines	Des Moines-West Des Moines	Polk, Dallas, Madison, and Warren	68,723
Dubuque	Dubuque	Dubuque	59,667
Iowa City	Iowa City	Johnson	74,596
Council Bluffs	Omaha-Council Bluffs	Pottawattamie	62,415
Sioux City	Sioux City	Woodbury	85,617
Waterloo	Waterloo-Cedar Falls	Black Hawk	68,406
Cedar Falls	Waterloo-Cedar Falls	Black Hawk	39,260

U.S. Census Bureau, 2020

Table 2. The Interlocal Collaboration Dataset: Descriptive statistics

	Population	Median Household Income	Operating Expenses	Nonwhite Population	Age 65+
Min.	8	8,247.00	174,384	0	0
Mean	5,023	39,164	7,840,674	381.5	752
Max	474,045	113,393	569,051,690	66,118	46,103

This study conducts a networks exploration based on formal collaborative dynamics registered in the dataset as Interlocal Agreements (ILAs). The State of Iowa requires that all the agreements involving at least one local government must be filed in the repository of the Iowa Secretary of State before entering into force (Iowa Code, 2018). This registry is publicly available through an online repository that stores information regarding the participating partners of an agreement, its purpose, duration, contractual obligations, responsibilities, financial arrangements, and a virtual copy of the actual agreement signed by

Iowa local governments, state and federal-level agencies, public and nonprofit organizations. A custom web-scraping script was developed to download the agreements filed from 1993 to 2016 in all 30 service areas in the online repository.

For the purpose of this study, ILAs service statewide networks were constructed from 2006 to 2018 across 4 service areas: economic development, public safety, street and roads, and water systems. The service areas were selected following two rationales. First, street and roads and water systems are both public services that can be understood as system maintenance functions and relative low citizens' interest -that is, constituents are neutral in terms of the decentralization of the production of said services (Hilvert & Swindell, 2013; Williams, 1971). Public safety and economic development are services that can be considered lifestyle functions and to which citizens generally assign more importance. The 28E online repository classifies separately ILAs related to police protection, criminal investigation, and jail and corrections. This study groups these three categories to build a public safety statewide network.

The second rationale aims for producing findings that are relevant in the practitioner arena and that are generalizable due to the ubiquity of the service areas studied in the United States. All four service areas selected are salient in practice due to the nature of the works and activities that the services involve and the investments that local governments have to make to perform said tasks. Street and roads and public safety entail large investments in equipment and personnel, respectively. These expenditures at the local level are only inferior to welfare and education functions (US Census Bureau, 2018). Additionally, these services can be found in most local governments in the United States, compared to other service domains that can be considered less essential and, therefore, not provided by smaller local units. Given their nature as core or basic services, these areas are relevant for effective collaborative governance, according to the International City/County Management Association (ICMA, 2016).

Networks as a method and a perspective. Collaboration and networks have become ubiquitous concepts in the field of public administration. Both rank as the most frequently used keywords for articles published by the Journal of Public Administration Research and Theory (JPART) in the last years (Journal of Public Administration Research & Theory [@JPART1991], 2019). However, their extensive use makes necessary a distinction between networks as a metaphor, a perspective, and a method of analysis. The first one refers to the studies that analyze organizing processes that are not necessarily based on nodes and ties but aim to encompass interactive dynamics that are more complex than a traditional hierarchy (Isett et al., 2011). The second one is more utilitarian than metaphorical. Networks, in this regard, are used as a conceptual lens to understand collaborative dynamics or other shared governance activities. Under this use of the concept, networks are a structural phenomenon formed by actors and the relations between these actors (Medina et al., 2022; Siciliano et al., 2021). The third one refers to networks as social network analysis- a methodological tool to analyze nodes and the relationship between them based on the exchange of resources or information through ties (Isett et al., 2011; Siciliano et al., 2021). This article will use the second and third understandings of networks, studying collaborative public service dynamics as a structural phenomenon using social network analysis to describe the position of central cities in said networks. Centrality, in this regard, is a nodal attribute that depicts the structural importance of a node in the network. However, the contribution of a node does not rely only on how central the node is in the network, as its brokerage role can make a node's contribution to a network important regardless of its centrality (Borgatti et al., 2018).

Social network analysis allows researchers to identify the position of determined actors in a network, whether said actors are isolated or rather central nodes, and what nodes are the ones with which they form ties more frequently (Borgatti et al., 2018; Luke, 2015). Social network analysis is not only a tool used to identify how central is one type of node in a network, but also to measure structural properties of the network as a whole. This study analyzes two of these structural measures: centrality

and density. Network centralization refers to the degree to which a network is dominated by one node (Borgatti et al., 2018). The common visual example of a centralized network is a star shaped network, in which the node at the center dominates the network. In this sense, networks can have low or high degrees of centralization and visually resemble more or less star shaped or core-periphery structures. Although centralization can be measured in different ways, one of the most common is to sum the difference between each node's centrality and that of the most central node in the network (Borgatti et al., 2018; LeRoux & Carr, 2010). The network centralization degree is expressed in a number between 0 and 1, where 1 is a fully centralized network.

Besides centralization, density is one of the basic network attributes that can be measured. It is a measure of cohesion, the degree to which a network is tangled up (Borgatti et al., 2018). The most common and simplest measure of cohesion is density, which is based on the total number of ties in a network. Density can be compared to the intercept in traditional regression models in the sense that it calculates the probability of a tie between any random pair of nodes. It is expressed as the total number of ties observed as a proportion of the total possible ties in a network (Borgatti et al., 2018; LeRoux & Carr, 2010). Density can take a value between 0 and 1, where 1 represents a fully dense network where all the nodes are connected to each other. Whether the value of density is low or high depends on the context of the network studied. Depending on the size of the network and the type of resources exchanged through the ties, values closer to 0 can be low density networks in some cases but highly dense in some others.

Findings

For this study, eleven yearly waves were created for each of the four service networks, ranging from 2008 to 2018. **Table 3** summarizes the network statistics of the four networks across time. As the table shows, all four networks are considerably stable through time. The public safety and street and road systems networks have a decline in their number of ties from 2008 to 2009, but then show a progressive

increase in the rest of the waves, like the remaining two networks. Although density is one of the most basic network measures, it only shows the ratio of existing ties against the total possible ties. This can be problematic as it does not integrate the size of the network into the ratio. Larger networks are expected to have lower density scores as the likelihood of all nodes to have ties with each other is lower than in smaller networks (Borgatti et al., 2018; Medina et al., 2022). Average degree is generally used as a more comprehensive measure of density that allows comparisons across networks and periods of observation. As can be seen in **Table 3**, all four networks have a stable and increasing score in average degree, showing a slowly increased density through time.

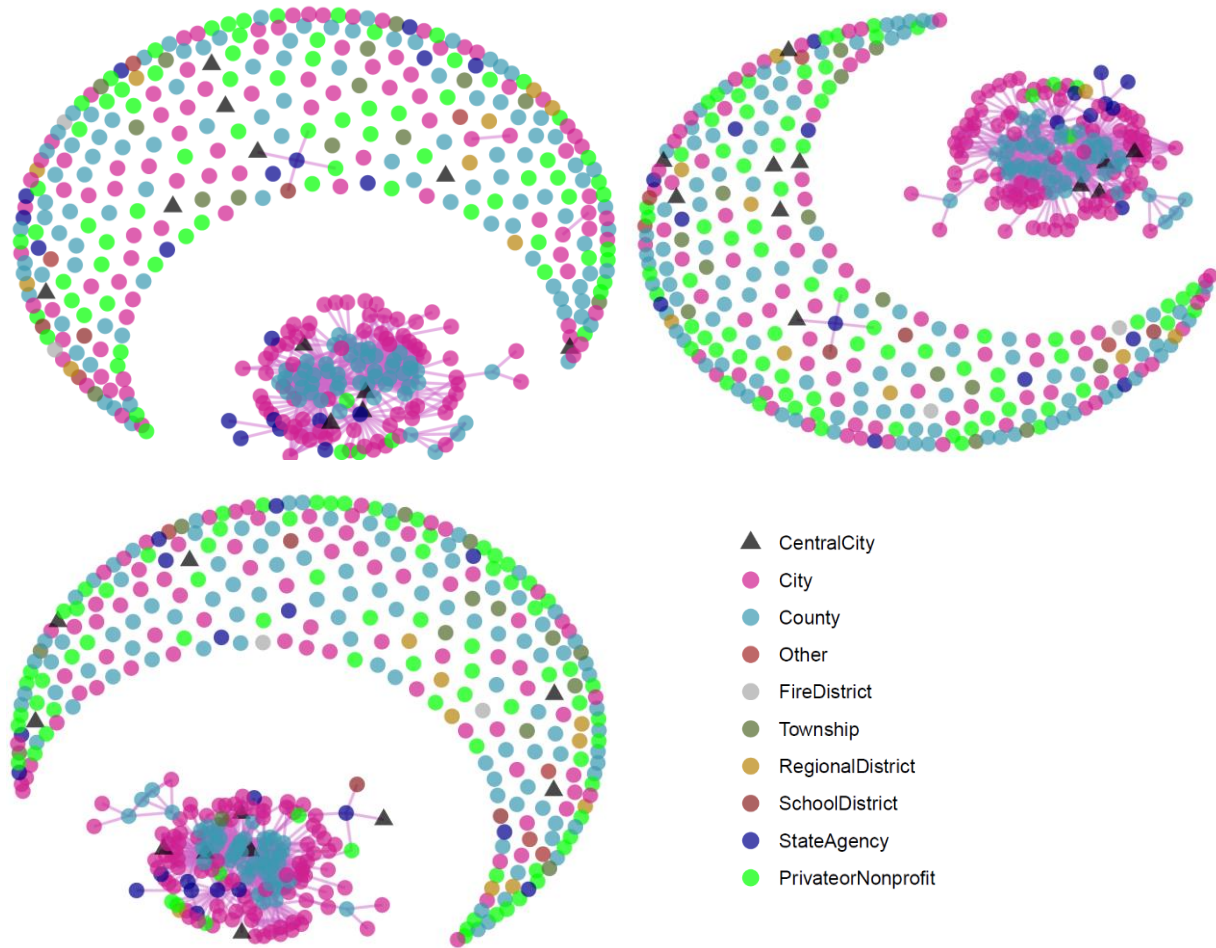
Table 3. Descriptive Network Statistics of Four Service Areas Across Time

Public Safety											
Wave	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Density	0.004	0.004	0.004	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.005
Average degree	4.119	3.803	4.119	4.449	4.675	4.803	4.981	5.048	5.12	5.172	5.205
Number of ties	2154	1989	2154	2327	2445	2512	2605	2640	2678	2705	2722
Street and Road Systems											
Density	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Average degree	0.365	0.35	0.365	0.394	0.426	0.434	0.463	0.488	0.512	0.56	0.598
Number of ties	191	183	191	206	223	227	242	255	268	293	313
Water System											
Density	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Average degree	0.704	0.711	0.711	0.711	0.713	0.713	0.713	0.784	0.828	0.83	1.421
Number of ties	368	372	372	372	373	373	373	410	433	434	743
Economic Development											
Density	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002
Average degree	1.451	1.48	1.497	1.499	1.499	1.535	1.541	1.623	1.623	1.623	1.623
Number of ties	759	774	783	784	784	803	806	849	849	849	849

Social network analysis tools allow researchers to represent the position of nodes in networks visually.

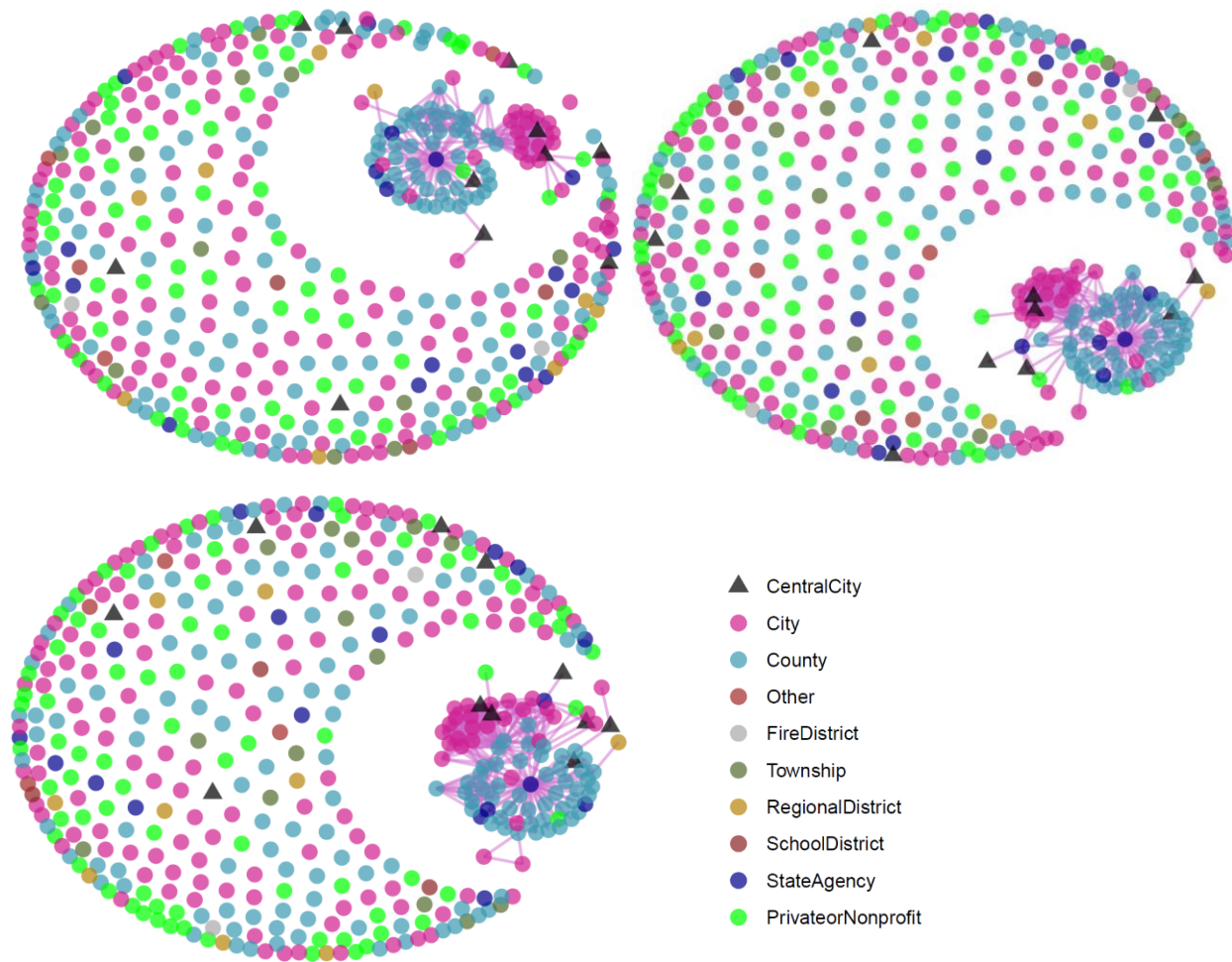
These visualizations help to identify clusters and the evolution of networks across time. Figures **1** to **4** show plots for three points in time -2008, 2014, and 2018- for each of the four service areas.

Figure 1. Network Visualizations of public safety: 2008,2014, and 2018



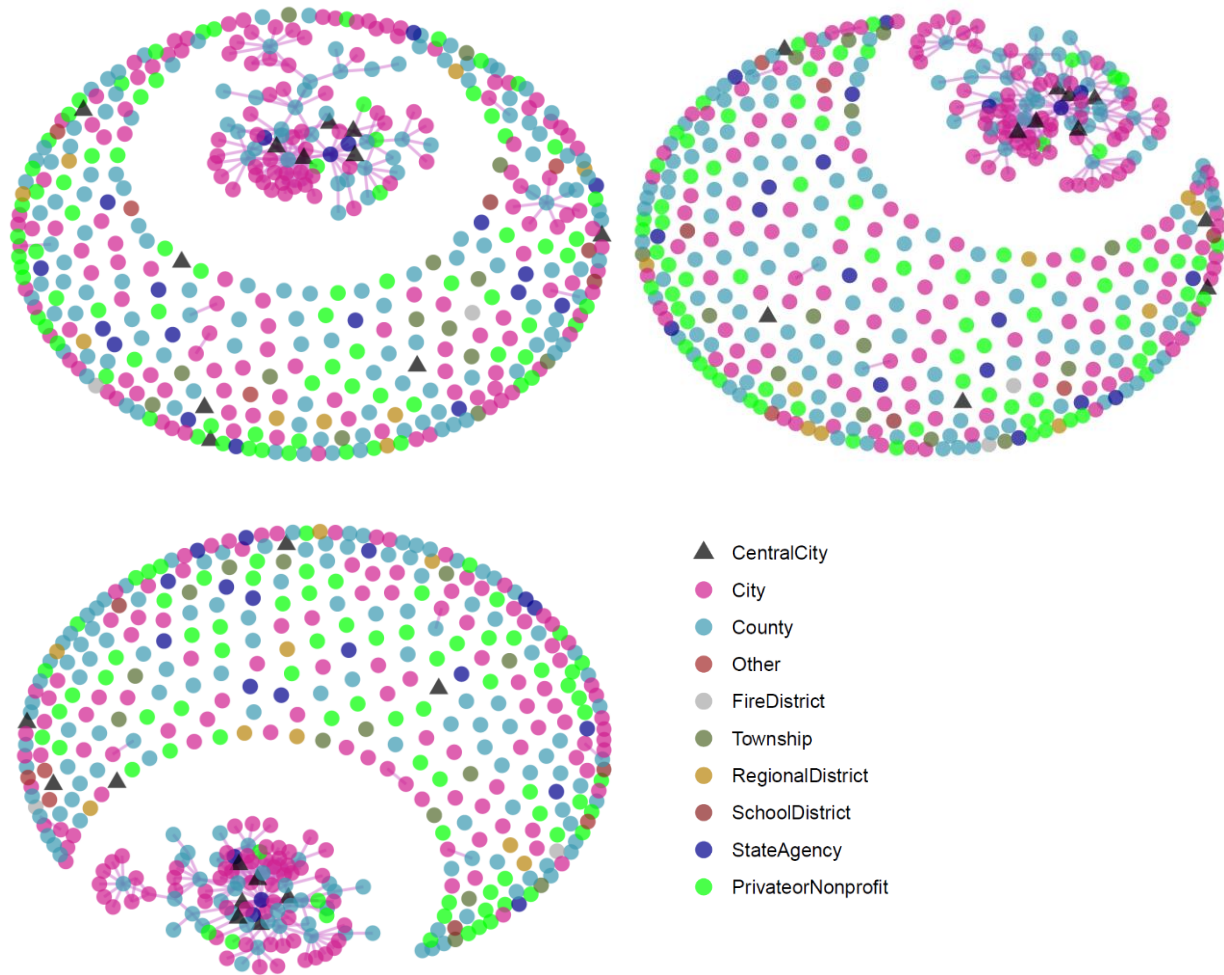
In the public safety network, county level agencies are the most central actors. A brief exploration of the content of the ILAs in this service area shows that counties provide corrections, patrolling and criminal investigation services to small cities. Four cities can be found in the clusters of 2008 and 2014, whereas six central cities can be identified connected to other ties in 2018. The remaining central cities are isolated in the three observed points in time.

Figure 2. Network Visualizations of water system: 2008,2014, and 2018



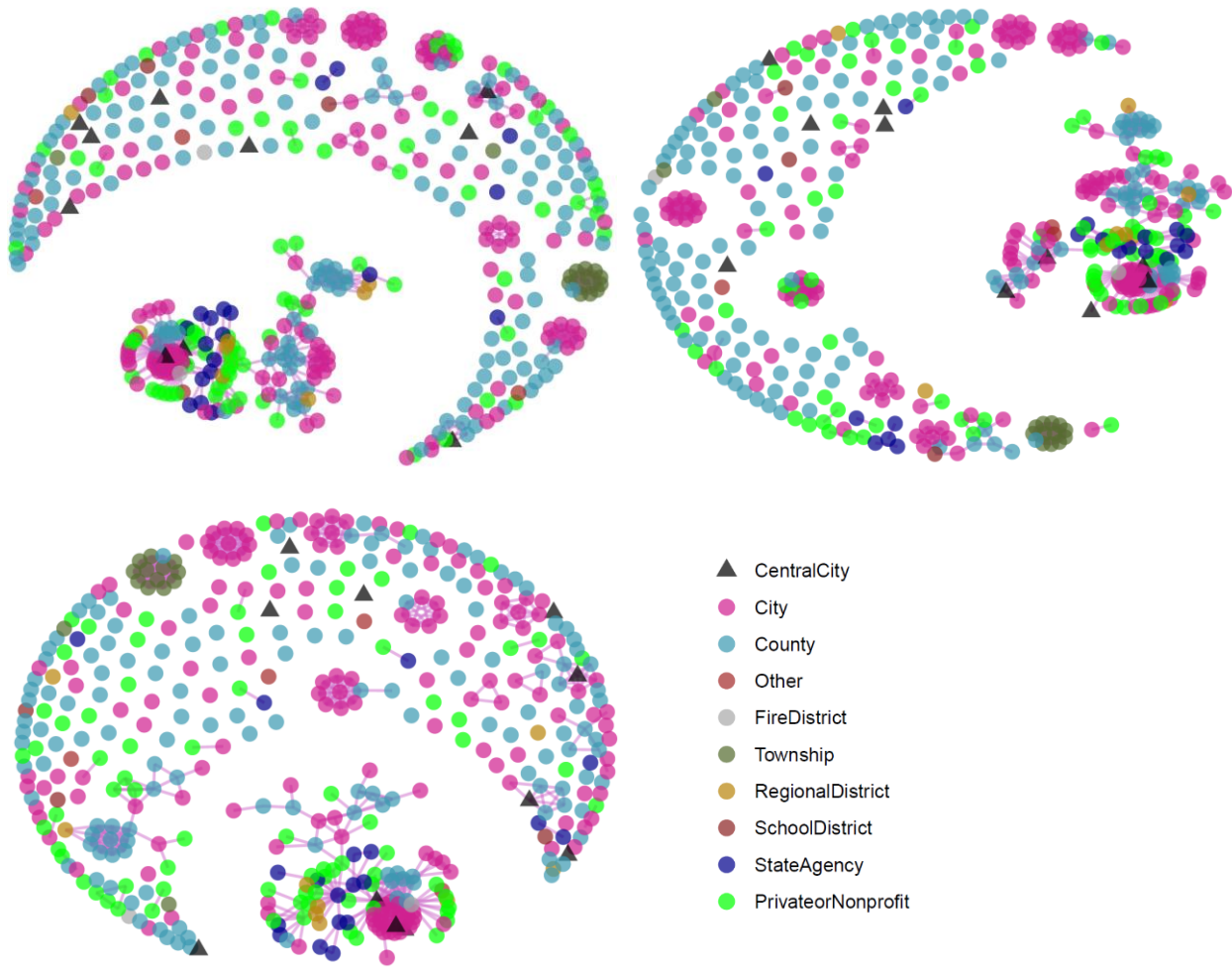
In the water system network, visualized in **Figure 2**, one state-level agency is the most central actor- the Iowa Department of Transportation. The agency formed ties that remained active in the period studied with counties. A basic review of the ILAs that connect the state agency and counties show cooperative activities for the operation and maintenance of flood warning systems. Four central cities can be identified in the 2014 cluster, whereas 6 central cities can be seen connected to other ties in 2008 and 2018.

Figure 3. Network Visualizations of street and roads systems: 2008,2014, and 2018



As discussed before, the street and roads systems network is less dense than the remaining three, as seen on **Figure 3**. The visualization for the three years shows a larger number of isolated nodes and depicts one state-level agency as the most central node- the Iowa Department of Transportation. A brief exploration of the ILAs including the agency show cooperative activities with cities and counties to repair segments of primary roads, construct segments from airports to cities, and share GIS data. Five central cities are part of the cluster of connected nodes in the three years represented.

Figure 4. Network Visualizations of economic development: 2008,2014, and 2018



Unlike the previous networks, economic development shows more than one cluster in the visualizations of **Figure 4**. Besides the large cluster composed of different actors, it is possible to identify smaller clusters of counties, townships, and cities across time. Some of the most central actors in the network are Iowa state level agencies, like the Department of Workforce Development, the Department of Economic Development, and the Public Employment Relations Board. Two central cities can be identified in the larger cluster, and two more are part of smaller cluster in years 2008 and 2018.

Centralization, Transitivity and Partner Selection. Besides the general knowledge about the position of different actors in the networks, it is possible to determine the level of centralization and transitivity in the network, and to explore the most common partners of central cities in each of the service delivery networks. The following lines summarize specific findings in this regard.

Public Safety. This network formed by three service areas -police protection, criminal investigation, and jail and corrections- is one of the most centralized of the four service networks studied, as seen in **Figure 1.**

. Centralization, as discussed before, refers to the degree to which a network is dominated by one particular node (Borgatti et al., 2018). Star-shaped network plots depict highly centralized networks. Degree centrality in a network can take values from 0 to 1, where 1 is a perfectly centralized network. The average centralization of the public safety networks is 0.075 corresponds to a low centralized network, as can be observed in the figure. Transitivity is a measure that refers to the extent to which actors tend to form closed triads (Borgatti et al., 2018; Medina et al., 2022; Siciliano et al., 2021). It is commonly related to the assumption “a friend of a friend becomes a friend” in the sense that two nodes that are connected independently to a third node are more likely to form a tie with each other. The measure captures the tendency for triadic closure and can take values from 0 to 1. In this regard, the public safety network registers 0.61 as the average transitivity across time, which can be interpreted as a slow tendency toward triadic closure.

Degree centrality measures how central is a node in its network based on its number of ties. Directed networks have information of which node is the sender and receiver of a tie (Borgatti et al., 2018). The dataset used in this study corresponds to a non-directed network in which it is not possible to determine tie senders or receivers. Counties are the most central actors in the public safety network and their most frequent partners are cities. A brief exploration of the ILAs between these two local governments shows service contracts related to patrolling services and other law enforcement activities that allow small cities to access public safety services. Wright County is the most central actor in the

network with a degree centrality score of 84, followed by Franklin County (64), Hancock (56), Story (56), and Marshall County (55). The highest position of a city in the degree centrality ranking is Pocahontas City, with a degree centrality of 33. Besides Waterloo City, which registers a degree centrality of 33, the rest of the central cities rank at the lower positions in this measure. Most of the largest central cities in the state, like Ames City and West Des Moines have average degree centrality scores of 12, only above jurisdictions with scores of 1 and 0.

Regarding partner selection, central cities can be found in the most common type of dyads in this network: city-county, but its frequency is considerably lower than it is for noncentral cities. Additionally, central cities can be found in configurations city-county, and in multiple-actor arrangements involving only cities. The first one can be exemplified by agreement M036659, involving Des Moines City and Polk County. In this ILA, both local governments work together to train and deploy a tactical special unit that can act as a response team in specific law enforcement issues. The second one can be represented by agreement M500733, formed by West Des Moines, Waukee, Urbandale, Polk City, Pleasant Hill, Johnston, Clive, Ankeny, and Altoona. The ILA refers to the creation and operation of the Central Iowa Traffic Safety Taskforce- a joint arrangement to enforce traffic activities within one another's jurisdiction.

Lastly, five of the total central cities formed dyads with a state level agency- the Iowa Alcoholic Beverages Division (IBD). Agreement M024597 is an example of these partnerships: the police department of West Des Moines and the IBD fund and provide tobacco enforcement activities. None of the noncentral cities have ILAs with the IBD or any other state agency in this network.

Water System. Among the four service areas studied, the water system network is the one that resembles more a star-shaped network, as can be seen in **Figure 2**. Its average centralization score is 0.04. This relatively low score on centralization can be explained by the large number of isolates in the

network. However, the network visualization shows one state-level agency as a central actor in the water system network: the Iowa Department of Transportation. The average transitivity score of the water system network is 0.83, showing a tendency toward triadic closure.

Compared to the public safety network, central cities in the water system network have higher scores on degree centrality. Among the central cities, Ames and Davenport are at the top, with average scores of 85, followed by Council Bluffs, Des Moines, and West Des Moines with average scores of 77. Cedar Falls and Waterloo rank at the bottom with average degree centrality scores of 7. Noncentral cities and some counties in the network have higher degree centrality scores, but the gap between this score in central and non-central cities is not as large as in the economic development network.

In terms of partner selection, central cities can be identified in ILAs involving noncentral cities, counties, and regional districts, as in agreement M504123. These agreements involving multiple actors create and operate regional drinking water commissions. To a lesser extent, central cities can be found in triads involving noncentral cities, like the triad Des Moines-Bondurant-Altoona, all three located in Polk County. Alongside these cities' triads, central cities can be identified in dyads tied to regional water conservation districts across time, the most frequent being Warren Regional district. Lastly, the water system network includes dyads of central cities, like Des Moines-West Des Moines. However, these central cities' dyads are considerably infrequent, given their location. The fact that West Des Moines is a central city that neighbors the largest central city in the region, Des Moines, can explain this central cities' dyad, given the low likelihood of collaboration with nodes that are located at larger distances.

Street and roads systems. Although there is a large cluster in the network visualizations shown in **Figure 3**, there are several star-shaped configurations besides the largest one with a state-level agency at the center. These configurations show one county level unit tied to several cities. The fact that there are other star-shaped configurations explains why the average centralization score of this network is lower

than the previous ones, 0.02. The measure for transitivity is considerably lower than in the previous networks with a score of 0.18. Nodes in this network are less prone to triadic closure than in other service areas.

The most central node in the network, as seen in the plot, is the Iowa Department of Transportation. At the local level, counties are the most central actors in this network, with degree centrality scores ranging between 24 and 18. Among central cities, Des Moines and West Des Moines have the same degree centrality score, 11, whereas Iowa City, Ames, Cedar Falls, Dubuque City, Sioux, and Waterloo have a degree centrality score of 1. Council Bluffs and Davenport rank at the bottom as isolated nodes with 0 degree centrality. The average degree centrality score for noncentral cities is similar to that of Des Moines and West Des Moines, depicting noncentral cities as more central actors in this network than most central cities.

In terms of partner selection, most of the ties of this network are dyadic arrangements rather than multiple-actors ILAs. The most common dyads are state agency-city, as represented by ILAs like M028949 dyads between the Iowa Department of Transportation and Cedar Rapids. These agreements generally assign responsibilities between the two actors in terms of maintenance of primary road extensions. Several dyads involving one central city and one noncentral city can be identified in this network, like the one formed by Cedar Rapids and Marion in agreement M502779, in which the two cities work together to conduct improvements in retaining walls, storm sewer, and other paving activities. However, these city-city dyads with one central city are not frequent. Central cities are more likely to be found in dyadic arrangements with the county they are located in or the state-level transportation agency.

Economic Development. The economic development network has an average centralization score across time of 0.0301, which corresponds to a low centralized network. The average score for transitivity in the

is 0.9, which can be interpreted as a high tendency toward triadic closure. Among the local governments in economic development, three central cities have high scores of degree centrality- Des Moines, West Des Moines, and Ames, only below Polk and Dallas counties as the local governments with the highest degree centrality. The average degree centrality of these cities, which are also three of the largest cities in the state in terms of population, ranges between 30 and 37. Among the 4 service areas in this study, the economic development network is the one where central cities have a higher average degree centrality contrasting with scores of 0 degree centrality of a large number of small cities that are isolated nodes in this network.

As discussed before, state agencies like the Department of Workforce Development are also central actors in this network. On the contrary, the isolated central cities' nodes in the visualizations of **Figure 4** correspond to the cities of Sioux, Dubuque, Davenport, and Cedar Falls.

In terms of partner selection of central cities, the most common dyad involving central cities in economic development is central city-county, as represented by ILAs of Des Moines and the county where the city is located, Polk, as in agreement M005605 in which the two local governments fund a joint neighborhood development corporation. The second most common dyad is central city-state agency, as can be represented by agreement L004803 in which the Iowa Department of Economic Development provides funding so the city Des Moines can establish a city business center. Although certain clusters group central and noncentral cities, these structures are considerably less common than the dyads listed before. Lastly, there is one configuration in this network that ties one central city and several counties. This type of configuration is exclusive to central cities, as there are no ILAs involving noncentral cities and counties. An example of these configurations is agreement L006896, in which the city of Des Moines and the counties of Boone, Dallas, Jasper, Madison, Marion, Polk, Story, and Warren establish the Central Iowa Employment and Training Consortium to develop training programs and become a grant recipient.

Conclusion

This descriptive network study contributes to the general understanding of how service delivery network involving central cities look and evolve across time. A basic and overarching finding across service domains is that some central cities are isolated nodes while others are active units in their networks, not different than what can be observed in noncentral cities. The fact that some central cities remain isolated during the period of study while others create and maintain collaborative ties points toward the idea that among central cities there might be differences in service demands, resources, service and collaborative capacity that affect their position in the network.

Specific findings on each service domain open interesting paths for future research. Within the public safety network, central cities create dyadic relationships with counties in the same way that noncentral cities do. However, a brief exploration of the content of the ILAs central cities form in this network shows that the activities they collaborate on are significantly different. Noncentral city/county dyads involve counties providing law enforcement services to small jurisdictions that probably do not have the population or resources for an in-house police department. Central cities have their own police departments and produce these services by themselves but collaborate with counties in training and deploying special units for specific law enforcement activities that noncentral cities might not need frequently. While the configuration in the network can be the same, that is city/county, the purpose of the collaboration is different when the city is central. Similarly, the fact that the dyad city/state-level agency is exclusive to central cities can be explained as well by the activity performed in the ILA. These collaborative arrangements with the Iowa Alcoholic Beverages Division are focused on tobacco enforcement activities that might require more attention of police departments in denser cities than in smaller jurisdictions.

Regarding economic development, central cities are more active nodes compared to their position in the other networks. While competition might prevent both central and noncentral cities from

collaborating with each other, there might be differences between central and noncentral jurisdictions in terms of capacity and needs. For instance, smaller jurisdictions could lack the capacity to join work development consortia with a series of counties to receive grants, while central cities can be in a better position to become a partner in these consortia and dedicate resources and personnel to these activities. Additionally, a considerable number of small suburban municipalities have higher levels of median household income and local revenue and lower demands for services than central cities (Bahl et al., 1992; Gainsborough, 2001). The fiscal stress that central cities experience might drive them to seek collaborative arrangements in economic development that noncentral cities do not pursue with the same intensity.

Service domains that entail less competition and imply public works result in networks in which actors collaborate with their coterminous jurisdictions. Even if central and noncentral cities compete in other service domains or differ in fiscal or demographic attributes, the fact that they share primary roads drives them to form dyadic relations to maintain and improve road infrastructure. Similarly, the water system network shows collaborative arrangements lead by regional water districts that group central and noncentral cities. These new joint entities, such as the Central Iowa Regional Drinking Water Commission (M502065), allow their members to fund and provide water supply, treatment, and distribution services in a cost-effective manner. The high capital-intensive nature of these services and the essentiality of a public service like water might create collaborative dynamics between central and noncentral cities that are not present in more competitive service domains.

Lastly, future research can contribute to a more complex understanding of the nuances not only between central and noncentral cities but also within central cities. The fact that the smallest central cities in the state are not active nodes in service networks like economic development and that other central cities are isolated nodes in service arenas like public safety shows that the central attribute of these jurisdictions does not make their resources, needs, and position in networks similar. Further

research efforts can break down the dichotomy of central/non-central established by the OMB and better capture the nuances between central cities. A categorization of local governments rooted on the attributes that make a city central that can escape a binary classification and allow researchers to locate cities in a continuum of centrality could contribute to a deeper understanding of the role that central cities play in service delivery networks.

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Tired of being alone? A longitudinal analysis of central cities in service delivery networks

Introduction

Central or principal cities have played a significant and symbolic role in the development of metropolitan regions. These large jurisdictions concentrate capitals, jobs, citizens, recreational and cultural activities (Bunce & Neal, 1984; Judd et al., 1999). At the same time, they face challenges like inequity, population decline, climate change and fiscal stress (Dye, 1984; Krause et al., 2021; Warner et al., 2021). Like any municipal government, central cities are the first contact that citizens have with government and have embraced both an entrepreneurial role generating own revenue and a provider role facing citizens' demands for public services.

Cross-boundary collaboration has been consolidating as one flexible mechanism for local governments to address increased demands for services more efficiently than producing services individually and as a means to create governance venues in fragmented metropolitan regions (Aldag & Warner, 2018; Nelles, 2013; Warner et al., 2021). Central cities in the United States are the largest incorporated places in a Core Based-Statistical Area (CBSA) with a population of at least 10,000 people, plus any additional incorporated place of at least 25,000 inhabitants in which 100,000 or more persons work, or any incorporated place of at least 50,000 people in which the number of jobs exceeds the number of residents (Office of Management and Budget, 2000). Although these jurisdictions have been largely studied in the literature of policy networks and metropolitan governance (Acuto et al., 2017; Arnold et al., 2017; Berardo & Scholz, 2010; Portney & Berry, 2016; Vogel & Harrigan, 2007), studies focused on central cities in the United States and service delivery networks are still scarce (Sanchez, Forthcoming). This essay aims to reduce this gap in the literature by analyzing whether the characteristics of central cities make them more or less likely to collaborate with other local governments to provide public services using a stochastic actor-oriented model on four service domains using a longitudinal dataset of interlocal collaboration.

Shedding light on understanding whether central cities have more or less opportunities to find efficient collaborative arrangements is relevant for several reasons. First, collaboration has become a pervasive concept and a common prescription to face wicked problems and achieve more efficient arrangements (Aldag & Warner, 2018; Weber & Khademian, 2008). Local governments that experience both fiscal pressures and high service demands could find in cross-boundary cooperation institutional mechanisms to maintain service quality and reduce costs. However, to what extent the same elements that make cities look for collaborative arrangements prevent them to collaborate is a question that can be answered by studying local units in which these elements are highly present.

Second, resources disparities keep increasing in the United States' metropolitan regions (Aldag & Warner, 2018; Chernick & Reschovsky, 2017; Frederickson, 1999; Lowery, 2000; Nice & Fredericksen, 1995). Due to reduced funding from higher levels of government and patterns of mobility within metropolitan areas following Tiebout's (1956) concept of a market of local governments and services/taxes bundles, some municipalities are better equipped to provide public services than others and experience different intensities of citizens' demands in terms of number of services and quality. Central cities generally share a similar path of reinforced patterns of population decline followed by resources decline, unlike some of their neighboring affluent suburban municipalities. In this regard, cross-boundary cooperation for service delivery can be an alternative for central cities to escape these reinforcing cycles and to reduce the resources disparities in their regions.

Second, reduced funding to cities in the United State has driven cities to adopt an entrepreneurial role to attract citizens, businesses, and generate their own revenue (Feiock & Carr, 2001; Gordon, 2007; Hawkins, 2010). Local governments compete with their neighboring jurisdictions performing economic development activities to root citizens and capitals within their boundaries. This competition generates tense relationships in metropolitan regions that hinder regional governance efforts (Foster, 1997; Warren et al., 1992) and can impact as well potential interlocal mechanisms for

service delivery. Central cities that have historically concentrated economic activities might be natural rivals of smaller cities that have embraced an entrepreneurial role, reducing their likelihood to collaborate for the provision of services (Lee, 2016; Minkoff, 2013). By analyzing different service areas, this essay can contribute to identify under which circumstances do central and noncentral cities collaborate despite competitive dynamics.

Lastly, although the OMB and the US Census Bureau update their delineations and inventories of CBSAs and central cities, regions in the United States are evolving in such a way that past dichotomies of central city/suburb or central/noncentral city are less clear as they were in the past (Bahl et al., 1992; Gainsborough, 2001; Savitch & Vogel, 2004). Suburban municipalities have started to mirror central cities not only in their entrepreneurial role but also in experiencing higher rates of crime, inequity, and fiscal pressures (Haughwout, 1999; Morris, 2019; Steinacker, 2004). Developing a research strategy that can break the dichotomy central/non-central can capture the complexity of resources and scale differences in metropolitan regions, while contributing to overcome methodological limitations due to the small number of observations if only central cities defined by the OMB are analyzed.

This essay takes advantage of a unique dataset of interlocal agreements (ILAs) in the state of Iowa to develop longitudinal network models that range from 2006 to 2016 analyzing whether some of the main attributes that confer the central nature to cities -fiscal stress, demographic diversity, and longevity of the jurisdiction- affect the likelihood of a city to collaborate with other local units to provide services in two distinct domains: police protection and information services. The following section presents a review of the relevant research related to this topic and presents the hypotheses that will be tested in this study. Then, the data and methodology are described, followed by a section that presents the results of the network models. Lastly, a discussion section contrasts the hypotheses listed in the literature review and highlights the contribution of the findings in this paper, as well as avenues for future research.

Literature review

The literature on cross-boundary cooperation highlights the historical tension between central cities and their surrounding jurisdictions. A considerable number of suburban municipalities were founded by wealthy households who rejected the diversity and issues of the central cities (Dahl, 1989). The apparently opposed interests from central-city and suburban residents resulted in a tension in which any interaction with the central city represented a potential suburban loss of identity, and a threat to the suburban lifestyle (Friskien, 1973). Historical tensions that perdure across time create inertial patterns in which neighboring jurisdictions govern regional issues and provide services independently (Dahl, 1989). In a similar way, officials from suburban municipalities avoided dependent relations with the central cities for considering them a potential backdoor for consolidation or coercion (Norris, 2001; Savitch & Vogel, 2004).

The differences in lifestyles between central cities and suburban municipalities is reflected in the public services provided by their local governments. Williams (1971) proposed a conceptual framework to classify public services based on their social access control. This framework classifies services in two groups: system maintenance and lifestyle services. System maintenance services are those for which citizens express a neutral preference in regard to controlling their social access. Services for which citizens could have a greater concern about controlling social access are considered part of the city's identity and classified as lifestyle services. Similarly, Hilvert & Swindell (2013) classify services in terms of the interest that citizens raise on them. According to their categorization, when citizens' interest is low the probability of contracting out services will be higher.

Based on these classifications, cross-boundary arrangements involving central cities are more likely to exist in system maintenance or low citizens' interest service domains, such as information services or street and roads systems. On the contrary, services identified as part of a communities'

lifestyle and where citizens' interest is higher reduce the likelihood of collaborative arrangements involving central cities.

Research on cross-boundary cooperation has also studied the topic using the transaction costs conceptual lens, which can understand the attributes of central cities and their impact in collaborative dynamics differently . Given that collective action implies costs and risks, actors weigh the benefits of collaboration against the costs that bargaining, negotiating, and monitoring entail (Carr et al., 2009; Chen et al., 2019; Foster, 1997; Lubell, 2013). When the costs of collective action are considered higher than its benefits, actors choose to keep producing public goods in-house (Coase, 1937; Williamson, 1981b). In environments of large resources disparities, some actors might be better equipped to afford the costs of seeking and maintaining collaboration while others have to keep producing services independently, even if collaboration would result in cost savings. In this sense, as central cities generally experience higher fiscal stress than their neighboring jurisdictions, they might be less capable of absorbing the costs of collective action and, therefore, maintain an internal production of services (Aldag et al., 2020; Carr & Hawkins, 2013).

The transaction costs approach provides an additional argument related to central cities. When actors calculate the costs of collaboration, they ponder the risks as well of switching from individual to collective action (Kim et al., 2020). Although services can be jointly produced or contracted out, local governments are still responsible for its provision and can be held accountable in that regard. In consequence, public officials make decisions that mitigate risks of service interruptions or failures. Collaborative arrangements can produce externalities like difficulty to coordinate activities among actors from different jurisdictions (Brown & Potoski, 2003; Carr et al., 2009). Given their public nature, services can have high levels of specificity, and potential collaborators might want to avoid risks of service interruptions if one of the partners defects from an arrangement. In this regard, actors make collaborative decisions based on trust, repeated interaction, and the available information of their

counterparts (Ostrom, 1998). In this regard, attributes like fiscal stress, median household income or revenue per capita can depict central cities as unappealing collaborators and drive more affluent jurisdictions to partner with units that resemble their characteristics (Carr & Feiock, 2004; Foster, 1997).

Other attributes traditionally associated with central cities can affect collaborative dynamics as well. Empirical research show that the age of a jurisdiction is relevant in the sense that diseconomies of scale occur in older, declining jurisdictions (Dye, 1984). Older cities experience population decline and the diseconomies of fixed capital and labor costs. Additionally, older jurisdictions generally have more pressures for service demand due to their aging population and concentration of low-income households (Ferris & Graddy, 1988). Similarly, demographic diversity differentiates central cities from noncentral jurisdictions. The tense historical relationship between cities and suburbs has created an antagonistic perspective in which suburbs perceive themselves as superior, less political, and better managed, and perceive central cities as spaces of increased diversity, decay, and deterioration (Hamilton, 2002). Within this tension, noncentral cities reject interactions with central cities under the argument that collaboration would entail subsidizing services that central cities provide to vulnerable populations due to their demographic diversity (Fleischmann, 1986).

Lastly, globalization processes and reduced external funding for cities have shifted their role into an entrepreneurial local government competing with other local units for capitals and jobs. Cities both compete in the economic development arena but collaborate in other service domains (Hawkins, 2010; Lee et al., 2012; Lee, 2016). These competitive dynamics might affect more some service areas than others, particularly the ones that reflect more the identity and profile of the community. As economic development has become an increasingly salient activity for cities (ICMA, 2016), collaborative dynamics occur in a context of intercity rivalry (Roy & Ong, 2011). This tension might drive cities to collaborate more with local governments of distinct nature, like counties, or with nonprofit or private organizations instead of cities (Hefetz & Warner, 2012; Hilvert & Swindell, 2013).

Derived from this literature review, the hypotheses to be tested in this essay are all related to the attributes of central cities and how these features affect the likelihood of collaboration in different service domains. The hypotheses can be read as follows:

H1. The status and characteristics of central cities reduce their probability to collaborate with other local governments.

H1.1 The number of years that have elapsed since a city's incorporation negatively affects its likelihood of collaboration in service delivery agreements.

H1.2 Higher levels of a city's budget solvency (lower fiscal stress) will positively affect the likelihood of collaborating in service delivery agreements.

H1.3 Higher levels of demographic diversity in a city will negatively affect its likelihood to collaborate in service delivery arrangements .

H2. Central cities are more likely to collaborate with other local government system maintenance and low citizens' interest service areas than in lifestyle service domains.

H3. Due to intercity rivalry, central cities are more likely to collaborate with counties than with other cities.

Data and methodology

The interlocal collaboration dataset. This study takes advantage of a unique dataset of formal interlocal collaboration that registers interlocal agreements (ILAs) in the state of Iowa. Chapter 28E of the State of Iowa's Code requires that every agreement made by public agencies to jointly exercise governmental power must be filed in the repository of the Iowa Office of the Secretary of State (SOS) before entering into force (Chapter 28E of the Iowa Code 2018). The information related to each interlocal agreement filed in one of over 30 service areas is publicly available through an online repository

(<https://sos.iowa.gov/>), including the participating partners, purpose of agreement, duration, contractual obligations, financial arrangements, administrative responsibilities, and the image of the actual agreement signed by the collaborators. A custom web-scraping script was developed to download the publicly available agreements filed from 1993 to 2016 with a total of 18,528 agreements. Public officers register the metadata of the agreements in over 30 service areas, as well as the image of the actual agreements signed by the collaborators.

The state of Iowa has 1,954 local governments, of which 947 are cities, 99 are counties, 380 school districts, and 528 special districts (U.S. Census Bureau, 2020). According to the delineation of Metropolitan Statistical Areas (MSA) by the Office of Management and Budget in 2015, the state has 9 (Office of Management and Budget, 2015), The state has 9 MSAs and eleven central or principal cities, as can be seen in **Table 1**. The dataset in this study consists of ILAs signed by all 947 cities, 99 counties, as well as state and federal-level agencies, special districts, nonprofit and private organizations. Descriptive statistics for the local governments in the dataset across time can be read in **Table 2**.

Table 1. Principal Cities and Metropolitan Statistical Areas an in Iowa

City	Metropolitan Statistical Area	County	Population (2020)
Ames	Ames	Story	66,427
Cedar Rapids	Cedar Rapids	Linn	126,326
Davenport	Davenport-Moline-Rock Island	Scott	101,724
Des Moines	Des Moines-West Des Moines	Polk	214,133
West Des Moines	Des Moines-West Des Moines	Polk, Dallas, Madison, and Warren	68,723
Dubuque	Dubuque	Dubuque	59,667
Iowa City	Iowa City	Johnson	74,596
Council Bluffs	Omaha-Council Bluffs	Pottawattamie	62,415
Sioux City	Sioux City	Woodbury	85,617
Waterloo	Waterloo-Cedar Falls	Black Hawk	68,406
Cedar Falls	Waterloo-Cedar Falls	Black Hawk	39,260

U.S. Census Bureau, 2020

Table 2. The Interlocal Collaboration Dataset: Descriptive statistics

	Population	Median Household Income	Operating Expenses	Nonwhite Population	Age 65+
Min.	8	8,247.00	174,384	0	0
Median	575	39,167	797,748	9	95
Mean	5,023	39,164	7,840,674	381.5	752
Max	474,045	113,393	569,051,690	66,118	46,103

For the purpose of this research, statewide ILAs networks were constructed covering an 11 years period from 2006 to 2016 within the service categories of public safety and information services. The selection of service categories was based on the following criteria: (1) the high frequency in which cities appear as collaborators compared to other service areas in the dataset; (2) following Williams' (1971) and Hilvert & Swindell's (2013) classifications, police protection was selected as a lifestyle/high citizens' interest domain, whereas information services was selected as a system maintenance/low citizens' interest service area; (3) The relative ubiquity of these service categories in most local governments in the United States, compared to other service domains that smaller jurisdictions lack; and (4) the relevance of the policy domains in which these services are located for effective collaborative governance, according to the International City/County Management Association (ICMA 2016).

The service networks consider eleven yearly waves from 2006 to 2016. Ties within the network were based on whether the two local governments (i.e., cities and counties) were active participants in a service agreement during that year. As explained before, the Iowa 28E dataset registers active interlocal agreements signed by local governments across time. The dependent variable is the existence of an active agreement between two cities or counties. The active agreements formed each year in our dataset constitute the ties in the network. For instance, agreement M508903 refers to a shared Geographic Information System (GIS) and a GIS analyst that provides information services to the city of Sioux and Woodbury County. This agreement forms a tie between the two jurisdictions that is dissolved on the termination date specified in the agreement or when the local partners submit a termination notice. In this sense, our networks are established agreement by agreement based on these dyads. Given that the two jurisdictions sign and file the agreement jointly, the ties in the interlocal agreement network are treated as non-directed. The initial year data, 2006, considers not only the agreements that were signed from January to December 2006, but also all agreements that were signed in previous years and remained active in 2006. Thus, the initial wave of data in 2006 represents both pre-existing and newly formed ties. Finally, official sources were used to collect demographic attributes, such as population, nonwhite population, year of incorporation, and budget solvency. Descriptive network statistics for both service networks can be read in **Table 3**.

Table 3. Descriptive network indicators

Observation time	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Information services											
density	0.03	0.031	0.0301	0.03	0.033	0.0335	0.0335	0.037	0.037	0.039	0.0394
average degree	0.031	0.031	0.033	0.038	0.052	0.054	0.054	0.071	0.071	0.075	0.076
number of ties	16	16	17	20	27	28	28	37	37	39	40
Public Safety											
density	0.003	0.004	0.004	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.005
average degree	3.193	3.803	4.119	4.449	4.675	4.803	4.981	5.048	5.12	5.172	5.205
number of ties	1670	1989	2154	2327	2445	2512	2605	2640	2678	2705	2722

The networks perspective and Stochastic Actor-Oriented Models. Networks as a methodological approach allows researchers to identify whether specific dyads are more or less likely to be found in service delivery networks. In general terms, the main research question of this essay can be read as follows: how do the characteristics of central cities affect their likelihood to collaborate in service delivery networks? More specific questions address whether collaboration in central cities is more likely to occur in certain service areas, and whether central cities are more likely to collaborate with counties rather than other cities.

The dyadic relations established through the formation of ILAs are not independent of one another and thus violate assumptions of independence on which traditional statistical methods are based. This study uses Stochastic Actor-Oriented Models (SAOM) as implemented in the RSiena (Simulation Investigation for Empirical Network Analysis) package in R (R Core Team 2016). SAOMs focus on the factors influencing the tie formation, maintenance, and dissolution decisions taken by actors in a network. These decisions are made interdependently by individual actors and such individual decisions scale up to configure the structure of the entire network. SIENA models are an appropriate analytic tool for a panel of network observations (Snijders et al., 2010). The models employ continuous Markov chains to model the evolution of networks in which the structure and attributes of the current state of the network predict the tie changes of the following state. Parameters are estimated through a series of simulations that analyze the decision of a node to create, maintain or dissolve a tie (Ripley et al., 2020; Snijders & Pickup, 2017).

SIENA models are structured by micro-steps taken by each actor in the network (Snijders et al., 2010): on each micro-step, an individual actor can create, maintain, or dissolve a tie. This decision is defined by an objective function that determines the probability of an actor making a particular choice. Tie formation and dissolution in SAOMs can be understood as the dependent variable. In this study, the enactment or maintenance of an active agreement is our dependent variable. The formula for this time-

series picture of network evolution in which the network objective function for actor i is defined by Ripley et al. (2020) as follows:

$$f_{inet}(x) = \sum \beta_{knet} s_{iknet}(x)$$

where β_{knet} are the parameters and s_{iknet} are the effects. The objective function should be understood as the set of rules that determine the behavior of the nodes in the network. This function is defined on the sets of potential states of the network as it is perceived by the focal actor (Snijders et al., 2010). If actors have the possibility of moving to one particular network state, the probability of that movement is higher given that the objective function for that network state is higher.

Independent Variable. The attributes of Central Cities constitute the main independent variables in these service network models. With the intention of capturing a more robust effect of what this central status entails, three main independent variables are included in the models: (1) a continuous variable of the year in which the city was incorporated. Central cities tend to be older jurisdictions. In this regard, the perceived differences between central cities and suburban municipalities, and the tension produced by said perceptions can be captured with this chronological variable. (2) The budget solvency of a city is included as well, considering that central cities generally tend to be more fiscally stressed than suburbs. This measure was constructed by dividing total expenditures by total revenues, following Hendrick (2011) and Wang et al. (2007) approach to fiscal stress measures. (3) The percentage of nonwhite population in the jurisdiction, as a proxy of demographic diversity. Although diversity indices might work better as a measure of diversity, these indices are not available at the city level in the state of Iowa.

Due to their continuous evolution, suburban municipalities are progressively experiencing challenges and issues that were thought to be exclusive of central cities (Morris, 2019). In this sense, the “central” nature of a jurisdiction can be better analyzed in statistical models using more than a dummy variable that states if a jurisdiction is categorized as a central city by the Census Bureau. Continuous

variables like the year of incorporation, budget solvency, and percentage of nonwhite population can capture the degree to which any city has central-city characteristics, and how these attributes affect their likelihood of collaboration.

Control Variables. Several control variables that are common in the literature on interlocal collaboration for services provision are considered (Carr, 2004; Chen et al., 2019; LeRoux et al., 2010). Logged values for population were included both as main effects. The population size is assumed to affect the service needs and the capacity to deliver or pay for the services. Population of 65 years and older was included as well. Additionally, the models include a network effect that calculates the logarithm of the Haversine geographical distance in miles between two nodes, that is, the segment between two points calculated based on their coordinates. It is expected that the likelihood of collaboration is higher between communities which are geographically closer to one another (Minkoff, 2013).

Type of government is included both as a main effect as well. The dataset consists of different kinds of local actors: cities, counties, special districts, nonprofit organizations, private organizations, state-level and federal-level agencies. Including type of government aims to control for different overall tendencies to collaborate between the types of local governments. Although other financial measures are traditionally included in related studies, variables like expenditures and revenue per capital are highly correlated with other variables already included in the model, such as population and budget solvency and, therefore, are not included in the models.

Structural Effects. By default, SIENA models include basic network structural effects: density and degree activity. Density works as an intercept in these models in the sense that, in the absence of other covariates, the value of density corresponds to the overall likelihood of tie formation (Ripley et al. 2019). Even if network density is not related to the hypotheses in this study, it helps researchers understand how connected the actors of the network are connected to each other.

Degree activity effects were originally designed for directed networks in which the sender and receiver are clearly identified. In this study of non-directed networks, an effect that works for this purpose and was designed for non-directed networks is used -degree activity plus popularity (degPlus), as suggested by Ripley et al. (2019). It can be described as the sum of in and out popularity and the in and out-degree activity effects, based on the assumption that, for this type of networks, the parameters for in and out are the same.

Lastly, transitive triads is the third basic structural measure commonly included in Siena models and has been used in public services networks studies previously (Andrew, 2009a). This effect captures the tendency of closing triads when a dyad is present. That is, the tendency of node A to form a tie with node B given that node B has a tie with node C, with which A already has a tie. A positive coefficient of transitive triads suggests a tendency toward triadic closure -or clustering- in the network. A list of the independent and control variables can be read in **Table 4** below.

Table 4. Variables and description

Variables	Definition	SIENA Term
Year of Incorporation	Numeric variable of year in which jurisdiction was incorporated	egoPlusAltX
Percentage of nonwhite population	Number of nonwhite citizens in a jurisdiction as a proportion of the total population	egoPlusAltX
Budget Solvency	Total Revenue/Total Expenses (Operating Expenses + Capital Outlays)	egoPlusAltX
Distance between nodes	Haversine distance between two nodes based on their latitude and longitude	X
Type of government	Dummy if type of local government is a city	egoPlusAltX
Population	Total number of inhabitants in a jurisdiction	egoPlusAltX
Percentage of population 65	Percentage of population of 65 years and more	egoPlusAltX
Density	The overall density of the network	degree (density)
Transitivity	Tendency of network to form triads	GWESP
Degree Activity plus Popularity Effect	Sum of degree popularity and degree activity effects	degPlus

Findings

The results of the two Siena models are summarized in **Table 5**. Both models present good convergence rates (below 0.25) and performed favorably in goodness-of-fit diagnostics. Convergence ratios are measured by comparing how much the simulated values deviate from the observed ones. Ideally, these deviations should be as close as possible to zero. In empirical published work, ratios lower than 0.25 are considered satisfactory (Snijders et al., 2010).

Table 5. Service delivery network models

	Information Services	Public Safety
Independent Variables		
Longevity of Local Government	0.005 (0.009)	-0.008 (0.008)
Budget Solvency	-2.427 (1.228)*	-0.012 (0.335)
Percentage of Non-white Population	-0.004 (0.018)	0.001 (0.001)
Type of Government (City)	0.239 (0.359)	-1.472 (0.446)***
Control Variables		
Distance	-0.045 (0.014)**	-0.031 (0.006)***
Population	0.745 (0.178)***	0.518 (0.107)***
Percentage of Population 65+	0.009 (0.036)	0.039 (0.013)**
Structural Variables		
Density	-10.820 (1.686)***	-6.269 (0.993)***
Popularity	-0.237 (0.286)	-0.200 (0.182)
Transitivity	28.349 (15.866)	15.537 (33.801)
Iterations	5753	4267
***p < 0.001; **p < 0.01; *p < 0.05		

Longevity of a local government points to the hypothesized direction in the information services network but is not statistically significant in any of the two models. Budget solvency is negative and statistically significant in the information services network. This result points in the opposite direction as anticipated in hypothesis H1.2. The more solvent a city is, the less likely it will be to create and maintain a tie. Inversely, the less solvent and more fiscally stressed a city is, the more likely it will be to have an active tie. The percentage of nonwhite population is not statistically significant in any of the models. The dummy variable of type of government is statistically significant in the public safety model. The result can be interpreted as follows: being a city (type of org=1) reduces the likelihood of collaboration.

Inversely, county level nodes are more likely to have active ties in this network. This finding offers support to Hypothesis 3, related to intercity tensions. Given that only one of the central attributes is statistically significant in one of the models, it cannot offer support to hypothesis 2 related to central cities more likely to collaborate in low citizens' interest and system maintenance functions. The negative and significant result of budget solvency in information services but not in public safety point to the opposite direction, showing central cities less likely to collaborate in system maintenance functions. The negative coefficient in the type of government dummy offers support to the idea that intercity rivalry can negatively affect the likelihood of collaboration in service areas in which citizens have more interest. However, given the lack of significance in the rest of the variables, there are no clear distinctions across service domains of the effect of central actors in the likelihood of collaboration.

Regarding the control variables, as expected based on previous research, population is positive and statistically significant: larger jurisdictions in terms of population are more likely to form and maintain ties. Distance, as expected, is statistically significant and negative. An increase in the number of miles between two jurisdictions will negatively affect the likelihood of collaboration. In terms of the structural variables, neither popularity nor transitivity are statistically significant. These findings correspond to networks that have low values of centralization and that do not have a tendency to form closed triads.

Discussion

The results of these models offer partial support to the hypothesis focused on central attributes of cities. One of the most common assumptions about central cities is that they permanently experience high levels of fiscal stress. The negative coefficient on budget solvency in the information services model supports the idea that central cities are more likely to engage in cross-boundary relationships. Fiscal stress can drive central cities to seek more efficient arrangements and cost saving schemes by collaborating with other local governments. A different explanation could contend that affluent

jurisdictions have less incentives to collaborate given that in house production of services allows them to maintain the desired level of costs and quality.

Regarding intercity rivalry due to competitive dynamics, the models in this study offer partial support to the idea that both central and noncentral cities are less likely to collaborate in lifestyle and high citizens' interest services. Future research can build on this study and explore dyadic effects to determine if city-county dyads are more likely to occur, and test as well whether the differences in the central attributes of cities increase or decrease their probability to create a tie as a dyadic effect beyond the main effect analysis presented in this study.

As an initial attempt to break down the dichotomy central/non-central and propose the analysis of central attributes that can locate cities in a continuum of centrality, this study contributes to a more complex understanding of the cross-boundary dynamics in metropolitan spaces, and how do resources disparities are reinforced by hindering the creation of collaborative ties that could result in more efficient arrangements for a larger number of local units. Due to its use of a longitudinal and archival dataset that registers all the ILAs signed in a state, the study overcomes limitations of previous research that are based on cross-sectional studies and that collected data through surveys in which the boundaries of networks are set by the decision of researchers of recruiting public officials to survey.

Some limitations can be acknowledged and motivate future research on the topic. First, although datasets of archival data overcome some methodological restrictions, the fact that the dataset used in this study relies on formal collaborative agreements leaves out a potentially large number of cross-boundary dynamics that are more contingent and informal. Second, the lack of significance on two of the central attributes analyzed as independent variables might imply that more sophisticated indicators for demographic diversity and potential historical tensions are needed. Subsequent studies can analyze other states and include diversity indices that capture the demographic diversity of a jurisdiction better

than the percentage of nonwhite population. Similarly, qualitative approaches can better address the question related to the effect of historical tensions on cross-boundary dynamics for service provision. Analyses based on stories and narratives can be highly compelling and effective in capturing how central cities are perceived by public officials of neighboring jurisdictions (Feldman et al., 2004).

Lastly, service domains entail different use of resources, varied levels of asset specificity, and gather more or less interest of citizens. Services that could have been considered highly relevant in the past might receive less attention by the citizens and be considered less as lifestyle activities due to the changing demands of the consumers of said services. Future research can analyze how central cities behave in other service domains, and perhaps introduce a new classification of types of services that allows generalizations. Moreover, other studies can focus their attention on more urbanized states in which the quintessential central cities are located and analyze if there are differences within the group of central cities that require a deeper understanding of the degree in which a city is more or less central, and more or less different to its neighbors.

Despite the limitations discussed, this study can be regarded as a call to action so researchers in local governments can include the concept of central cities in their public services research. The relevance of studying central cities relies on the idea that urbanization is blurring the differences between central and noncentral cities. Suburban municipalities are experiencing population decline and fiscal stress that are generally associated with central cities. Suburbs are not anymore immune to financial difficulties, and can suffer the effects of decline more intensely than central cities given that they do not have unique cultural attractions and business districts that older cities have (Haughwout, 1999; Morris, 2019; Steinacker, 2004). In this sense, studying central cities offers a glance to the future of a large number of cities that were not considered central in the past but will follow the path of their large neighboring municipalities in the coming years.

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Conclusion

The three essays in this dissertation were designed to reduce the literature gap regarding central cities and collaboration for public service delivery in distinct ways. The first essay presents both a systematic review and an update of the evolution of the term central or principal city. Its purpose is to contribute to the field by asking what we have learned about central cities and their role in cross-boundary dynamics for service delivery, and to what remains to be analyzed to achieve a better understanding of joint service delivery involving local governments of different characteristics.

The findings of the systematic review show that only a highly limited number of central cities have been studied in the collaborative service delivery literature, and a significant number of empirical works have dropped central cities from their analyses due to scale differences. Regarding the lessons from summarizing the articles that have included central cities in their analyses, one of the main findings in the systematic review is related to partner selection: several articles analyzed the interdependent relationship between central cities and nonprofit organizations in service delivery. Resource dependence theory can shed light on the strength of these dyads: city governments provide funds that allow nonprofit organizations to operate (Pfeffer & Salancik, 1978). On their behalf, nonprofit organizations gather community support and adequate mechanisms to deliver services. Future research can explore with adequate depth if intercity rivalry could be another factor that drives central cities to engage more with nonprofit organizations than other public actors in the region.

Additionally, in terms of type of services, central cities engage in more cross-boundary arrangements on services associated with system maintenance functions, with lower asset specificity, and lower interest of citizens. Lastly, the age of central cities is another factor that could reduce the likelihood of cross-boundary collaboration, considering that historical patterns of in-house production or insulation can prevent local governments from exploring alternative mechanisms to lower costs, increase quality and coverage of services.

The second essay is intended to investigate what is the position of central cities in service delivery networks. It presents a descriptive network analysis of statewide networks on four service domains: economic development, water system, public safety, and street and roads systems. The findings of this essay support the idea that central cities play a different role in service delivery networks, and that this role is distinct depending on the nature of the service. In public safety activities, for instance, central cities might experience issues and demands for services that noncentral cities do not.

Central cities, for instance, have their own police departments and produce these services by themselves but collaborate with counties in training and deploying special units for specific law enforcement activities that noncentral cities might not need frequently. In economic development, smaller jurisdictions could lack the capacity to join work development consortia with a series of counties to receive grants, while central cities can be in a better position to become a partner in these consortia and dedicate resources and personnel to these activities.

Service domains that entail less competition and imply public works result in networks in which actors collaborate with their coterminous jurisdictions. Even if central and noncentral cities compete in other service domains or differ in fiscal or demographic attributes, the fact that they share primary roads drives them to form dyadic relations to maintain and improve road infrastructure. Similarly, the water system network shows collaborative arrangements lead by regional water districts that group central and noncentral cities. The high capital-intensive nature of these services and the essentiality of a public service like water might create collaborative dynamics between central and noncentral cities that are not present in more competitive service domains.

The third essay presented stochastic actor-oriented models that analyzed whether the attributes of central cities affect their likelihood of collaboration in service networks. Its main contribution is the initial approximation to breaking down the dichotomy central/non-central and introducing a more

complex panorama in which cities can be more or less central in a continuum based on their budget solvency, jurisdiction's age, and demographic diversity. The results of these models offer partial support to the hypothesis focused on central attributes of cities. One of the most common assumptions about central cities is that they permanently experience high levels of fiscal stress. The negative coefficient on budget solvency in the information services model supports the idea that central cities are less likely to engage in cross-boundary relationships.

Following a transaction costs approach, fiscally stressed cities can be seen by other local governments as risky collaborators or partners that could potentially jeopardize the coverage or continuity of services. A different explanation within the transaction costs conceptual framework is that, given that this study is based on formal collaborative agreements submitted in a state-level repository, some cities are less capable of affording the cost of seeking for collaborators, negotiating, and working on highly formalized arrangements that allow them to work together.

Lastly, this dissertation contributes to the field by making a call to research to fill the gaps of what we still need to learn about central cities. Resources disparities persist and urbanization trends follow a steady increase in all countries. The relevance of studying central cities relies on the idea that urbanization is blurring the differences between central and noncentral cities. Suburban municipalities are experiencing population decline and fiscal stress that are generally associated with central cities.

Suburbs are not anymore immune to financial difficulties, and can suffer the effects of decline more intensely than central cities given that they do not have unique cultural attractions and business districts that older cities have (Haughwout, 1999; Morris, 2019; Steinacker, 2004). In this sense, studying central cities offers a glance to the future of a large number of cities that were not considered central in the past but will follow the path of their large neighboring municipalities in the coming years.

Vita

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Sánchez, J., Aguirre, N., & Casas, A. (2020). La corrupción como construcción socio-organizacional: entre el doblamiento de la regla y su rompimiento. *Corruption as a socio-organizational construct: between rule-bending and rule-breaking*. Book chapter in Arellano and Castillo La resbaladilla de la corrupción: estudios sobre los procesos sociales y organizacionales de la corrupción. *The slide of corruption: studies of the social and organizational processes of corruption*. CIDE, Mexico

Sánchez, J. (2018). Línea Doce: un juego clásico de acusaciones. Line 12, a Classic Blame Game. *Gestión y Política Pública*, Vol. 27, Issue 3, pp. 253-280. CIDE, Mexico.

Arellano, D., Sánchez, J. & Flores, U., (2019). Análisis comparativo de metodologías utilizadas para la medición de la corrupción. Comparative Analysis of Methodologies Used for Measuring Corruption. *Reality, Data and Space International Journal of Statistics and Geography*, Volume 10, Number 1. Mexico

Arellano, D., & Sánchez, J. (2014). ¿Uno o varios tipos de gobernanza? Más allá de la gobernanza como moda: la prueba del tránsito organizacional, ("Governance: one size fits all? Beyond the fashion of governance, the test of 'organizational transit'". *Cuadernos de Gobierno y Administración Pública*, Vol. 1, number 2, Universidad Complutense de Madrid. Spain

Sánchez, J. (2018). Reduciendo la brecha de acceso a los servicios jurídicos en la Ciudad de México. Reducing the Gap in the Access to Legal Services in Mexico City. Discussion Report, Inter-American Development Bank (IADB).

BOOK REVIEWS

Book Review: The Quest for Good Governance: How Societies Develop Control of Corruption, by Alina Mungiu-Pippidi, at *Gestión y Política Pública*, 26, Issue 2. Mexico

Book Review: The Blame Game: Spin, Bureaucracy, and Self-Preservation in Government, by Christopher Hood, at *Gestión y Política Pública*, Volume 23, Issue 1. Mexico

WORKS UNDER REVIEW

Sánchez, J., Li, J., Ranjha, A., & Siciliano, M. (Revise and Resubmit) With a little help from my friends? Fiscal stress and collaboration for services delivery: a longitudinal network analysis.

Sánchez, J., Come together, but how? Zooming into economic development collaboration between state and local governments, and nongovernmental organizations

WORKS IN PROGRESS

Sánchez, J. Home Sweet Home: Taking Central Cities Back to Collaboration and Public Administration Literature

McInerney, P.B., Medina, A., & Sánchez, J. Cultures and Networks of Collaboration in Artisanal Industries.

Sánchez, J., Siciliano, M., LeRoux, K. Democratic anchorage and collaboration for public services delivery: a survey experiment approach.

Sánchez, J., & Johnson, B. Local Public Economies: A complex urban governance framework to unify them all?

CONFERENCE PRESENTATIONS

Sánchez, J. (2022). A tale of two cities: collaboration for public service delivery involving central cities. Paper presented at the Public Management Research Conference (PMRC 2022). Phoenix, AZ.

Sánchez, J. (2022). A networks approach to central cities and collaborative arrangements for public services. Paper presented at the Urban Affairs Association Conference (UAA 2022). Washington, DC.

Sánchez, J. (2022). The Lost Role of Central Cities in Cross-Boundary Cooperation. Paper presented at the Midwest Political Science Association Conference (MPSA 2022). Chicago, IL.

Sanchez, J. (2022) Home Sweet Home: Taking Cities Back to Public Administration. A Networks Approach to Central Cities and Collaborative Arrangements for Public Services Delivery. Paper presented at the American Society for Public Administration (ASPA 2022). Jacksonville, FL.

Sánchez, J., Li, J., Rhanja, A., & Siciliano, M. (2021). A Longitudinal Analysis of Fiscal Stress and Local Government Collaboration. PMRC, 2021. Virtual Conference hosted in Honolulu, Hawaii

Sánchez, J., & Johnson, B. (2021). Local Public Economies: A complex urban governance framework to unify them all? IRSPM, 2021. Virtual Conference

Sánchez, J., Li, J., Rhanja, A., & Siciliano, M. (2021). Service-Level Solvency and Local Government Collaboration. ASPA, 2021. Virtual Conference

Sánchez, J. (2020). The paradox of postmodern public administration. Founders Fellows Panel. ASPA, 2020. Anaheim, CA. (Canceled due to COVID-19)

Sánchez, J., & Li, J. (2020). A Longitudinal Analysis of Fiscal Stress and Local Government Collaboration. ASPA, 2020. Anaheim, CA. (Canceled due to COVID-19)

Sánchez, J. (2020). Alone in the multitude: are central cities not collaborating? MPSA 2020. (Canceled due to COVID-19)

Li, J., Siciliano, M., Carr, J., & Sánchez, J. (2020). What does interlocal collaboration look like? A qualitative exploration of institutional forms, participants and rationales in public service delivery. PMRC 2020. Honolulu, Hawaii. (Postponed due to COVID-19)

Sánchez, J. & Li, J. (2020). A Longitudinal Analysis of Fiscal Stress and Local Government Collaboration. MPSA 2020. (Canceled due to COVID-19)

ADDITIONAL TRAINING AND RESEARCH SKILLS

Multilevel Models. Inter-university Consortium for Political and Social Research – Summer Program. University of Michigan, Ann Arbor, July-August 2021

Network Analysis: Advanced Topics. Inter-university Consortium for Political and Social Research – Summer Program. University of Michigan, Ann Arbor, July-August 2021

Meta-analysis online course. Designed and taught by Dr. David DuBois, associate dean for research at UIC's School of Public Health

Field research with Mexican mayors and local public officers (identifying, evaluating and disseminating best practices for public services delivery and anti-poverty strategies). Mexico, 2011-2016

ACADEMIC RESEARCH APPOINTMENTS

University of Illinois at Chicago

2018-2023

Research assistant at the Networks and Governance Lab (NGL), directed by Dr. Jered Carr and Dr. Michael Siciliano.

TEACHING EXPERIENCE

University of Illinois at Chicago

2020-2023

Instructor for undergraduate courses, Public Policy Major

- PPOL-300. Urban Policy and Metropolitan Governance (in person)
- PPOL-210. Introduction to the Policy Process (online section)

Teaching Assistant

- PPOL-210. Introduction to the Policy Process

2019-2020

HONORS AND AWARDS

- ASPA's Founders' Fellowship award, 2020 cohort.
- Fulbright-Garcia Robles Scholarship for pursuing a PhD program, (2017)
- Chicago Consular Corps Scholarship for Graduate Students (2022)
- Laspau-administered scholarship to pursue a degree in the U.S., (2017)
- Student Delegate representing the University of Illinois System at the 2019 Pritzker Forum on Global Cities
- Gran Angular Latin American Novel for Young Readers Award, SM Publisher with the Novel "La primavera del Mars" (2014)
- FeNaI National Novel for Young Readers Award, Norma Publisher with the novel Creepyweb (2016)
- National José Ceballos Maldonado's Dark Humor Short Story Award, Minister of Culture, Michoacán, with the short story "Mausoleo" (2013)
- First place at "La ciudad imaginada" (The imagined city), short story award organized by Mexico City's Ministry of Culture (2011)
- Third Place, National Youth Essay Contest, Proceso Magazine with the essay "De la política envolvente" ("The surrounding politics") (2006)

OTHER PROFESSIONAL EXPERIENCE

El Universal, Newspaper, Mexico

2017-Present

Biweekly editorialist. Metropolis and opinion sections

<https://www.eluniversal.com.mx/jose-antonio-sanchez-cetina>

Centro de Investigación y Docencia Económicas (CIDE)

2011-2018

Adjunct Professor in Public Administration Department

Mexico City

- Conducted field research on urban local governments agenda, metropolitan coordination and blame avoidance practices in Mexico City
- Coordinated research National Technology Innovation award for the social inclusion.

Executive Coordinator and Evaluation Director, Local Management and Government Best Practices Awards. Mexico

2011-2015

Fondo de Cultura Económica

2016-2018

Assistant Editor, Reformas y Políticas Educativas (Educational Reforms and Policies journal)

PROFESSIONAL SERVICE

Urban Affairs Review

2019-Present

Reviewer

ASPA Section of Complexity and Network Studies

2021-Present

Communication Committee Member

University of Illinois at Chicago

2019-2020

Graduate Student Council's Representative of the Department of Public Administration

Programa Adopta Un Talento (PAUTA, UNAM) (*Adopt a Talent Program, nested in the Mexican National Autonomous University*)

2020-Present

Judge of research projects presented by children 8-14 at the national finals.

Chicago Symphony Orchestra (CSO)

2022-Present

CSO Student Ambassador

PROFESSIONAL MEMBERSHIP

Public Management Research Association (PMRA)

American Society for Public Administration (ASPA)

Midwest Political Science Association (MPSA)

Urban Affairs Association (UAA)

LANGUAGES

English | 95% Written and spoken. TOEFL IBT 116 points.

French | 90% Written and spoken, Diplômé de l'Institut Français de l'Amérique Latine (IFAL).

Spanish | Native speaker

OTHER INTERESTS

Music | Alto and Tenor Saxophone player, songwriter