Collaborative Governance and Public Education:
Interlocal Networks and Student Outcomes

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DISSERTATION

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List of Abbreviations

DMACC	Des Moines Area Community College
DMPS	Des Moines Public Schools
HTML	Hypertext Markup Language
IAC	Iowa Administrative Code
ICA	Institutional Collective Action
IJA	Interjurisdictional Agreement
ILA	Interlocal Agreement
ITBS	Iowa Test of Basic Skills
ITED	Iowa Tests of Educational Development
JCS	Juvenile Court Services
PDF	Portable Document Format
SRO	School Resource Officer

Summary

This dissertation empirically tests the hypothesized relationship between interorganizational collaboration and desired policy outcomes in the domain of public education. These tests are enabled by combining 25 years of archival data derived from interlocal and intergovernmental agreements filed with the Iowa Secretary of State with statistics encompassing 333 public school districts maintained by the Iowa Department of Education. Using methods from network graph theory to operationalize social capital, I examine the consequences of statewide collaborative governance networks oriented around improving student academic performance and decreasing occurrences of undesired behavior (i.e., truancy, suspensions, and expulsions).

To determine whether a district's participation and position in these cross-sector, interlocal governance networks improve student outcomes, both qualitative and quantitative analyses were conducted. Different types of collaborations were distinguished by reading and classifying all interlocal agreements (ILAs) involving at least one public school district into substantive topics. ILAs concerned with improving academic performance or student discipline were then used to calculate district-level network metrics that served as predictors of performance across a series of panel linear models. Empirical support for the hypothesized relationships between these ILA network metrics and district-level student outcomes was generally found to be weak and inconsistent. ILA collaboration networks may affect individual schools or students within districts differently; due to data constraints, only a district-level analysis was viable, preventing examination of possible heterogeneous effects within districts.

Please note that portions of Chapters 1 and 2 include arguments and phrases that first appeared in my *Urban Affairs Review* publication, "Public Service-Function Types and Interlocal Agreement Network Structure: A Longitudinal Study of Iowa" (Hugg, 2019). SAGE's Archiving and Sharing Policy allows authors to use, at any time and in any format, accepted manuscripts (full policy statement can be found in the appendix).

1 Introduction

Research Question

Does a public school district's participation and position in cross-sector, interlocal education governance networks improve student outcomes?

1.1 The Network Governance Era

The use of interorganizational public management networks as a policy tool to address public problems is an increasingly dominant topic in local governance research. These networks are "structures of interdependence involving multiple organizations or parts thereof, where one unit is not merely the formal subordinate of the others in some larger hierarchical arrangement" (O'Toole, 1997, p. 45); "typically intersectoral, intergovernmental, and based functionally in a specific policy or policy area"; and are composed of "agencies involved in a public policy making and administrative structure through which public goods and services are planned, designed, produced, and delivered" (McGuire, 2003, p. 4).

Taking cues from social network theory and methodology, public administration academics have modeled interorganizational governance networks by aggregating individual in-

stances of interlocal collaborations. Decades ago, scholars declared the lack of empirical studies for the hypothesized relationship between interlocal collaboration and desired policy outcomes to be a significant gap in the literature (Provan & Milward, 1995, 2001). These collaborations, which are often formalized via an interlocal agreement (ILA), have consequently become a prominent subject within the broad body of public governance research. For example, a growing literature on institutional collective action (ICA), which conceptualizes collective action problems from the organizational rather than individual perspective, views ILAs as an administrative tool capable of overcoming collective action problems because of its potential to lower transaction costs (Feiock, 2013; Feiock, Steinacker, & Park, 2009; Post, 2004).

The network perspective enables inferences about the formation of social and policy networks, which in turn may improve our understanding of how the policy process works. Although this branch of the public administration literature has principally focused on the antecedents of network formation and the role that certain network characteristics (e.g., centralization, density, and transitivity) can play, the consequences of governance networks (e.g., policy performance) are quickly gaining prominence. O'Toole (1997) argued that the public administration network research agenda should revolve around practical applications, stating that "the most important question regarding networks and public administration is the pragmatic one: So what?" (p. 47).

The scarcity of research that addresses both the problem of limited network data availability and the lack of network performance measures represents a sizable knowledge gap (Hu, Khosa, & Kapucu, 2016; Provan & Milward, 2001). This dissertation aims to fill that gap by empirically testing the connection between ILA network structures and public

education outcomes using a new and robust longitudinal data set capable of addressing both of these limitations concurrently. In addition to being an important analysis for both social network and education scholars, the insights this dissertation offers into how intergovernmental and public–private collaborations are managed, measured, and evaluated is of interest to public administration academics more generally. Its approach to examining ILAs, which are employed as a governance tool across the United States, can be adapted to any policy domain.

1.2 Practical Significance

Furthering the cause of improving society, which should be considered the ultimate goal of science, requires developing sound theoretical and empirical groundworks within each and across all disciplines. For many of the social sciences, this means cultivating better approaches for implementing and measuring the effectiveness of public policy.

Everyone stands to benefit from an educated society, given the well-established relationships between increased levels of formal education and higher income, lower crime, and improved health (Cutler & Lleras-Muney, 2006; Griliches & Mason, 1972; Herd, Goesling, & House, 2007; Lochner & Moretti, 2004; Schnittker, 2004). Constrained by limited budgets, public school administrators and lawmakers alike are starved for cost-effective policy innovations that have the potential to improve student outcomes. Principals, superintendents, and school board members would be interested in knowing if a school district's position within an interlocal education network that is specifically oriented around promoting academic advancement improves that district's overall academic performance (e.g., by collaborating with

local community colleges to allow high school students to enroll in advanced classes and earn college credit). Providing empirical evidence for the claim that school districts who more actively participate in an interlocal collaboration network experience higher standardized test scores and lower student removal rates, for example, could pave the road for the widespread implementation of an important policy innovation (i.e., ILAs).

Further, if found to be significant across different service areas, geographical contexts, and time frames, the hypothesized connection between interlocal network structure and improved performance has the potential to carry important implications for governance norms (Brass, Galaskiewicz, Greve, & Tsai, 2004; Moolenaar, Sleegers, & Daly, 2012; Schalk, Torenvlied, & Allen, 2009; Siciliano, 2017). This line of work has already spurred analyses examining the effect of intergovernmental collaboration in other policy domains, including economic development, health, and environmental protection. If, all else equal, certain network configurations or patterns lead to more optimal public service outcomes, policymakers could design incentives to promote particular patterns of interaction.

1.3 Combatting Limited Data Availability

Though 25 years have elapsed since Provan and Milward's (1995) pioneering study on the perceived effectiveness of an interorganizational mental health service delivery network, the scarcity of serviceable data continues to be the leading obstacle for the vast majority of current network governance research. This unwieldy problem can be clarified by dividing it into four related components: (1) small sample sizes; (2) lack of longitudinal observations; (3) small number of public service areas; and (4) narrow geographical scope. These data

availability constraints emerge from the logistical challenges and cost (both in terms of time and finances) associated with gathering usable network data.

Existing network studies have principally relied on data generated by surveys composed of relatively small sample sizes that ignore non-governmental organizations and isolates, which may fail to capture the complete composition of a network (Lubell, 2013). Though techniques to circumvent this problem exist (Siciliano, Yenigun, & Ertan, 2012), these omissions nonetheless increase the probability of arriving at a flawed conclusion, especially if the missing organizations are influential or well-connected actors.

Further, collaboration networks are, usually, only observed once. When only a single network slice is available, there is no network variation to observe; it is impossible to understand the effect of, for example, organizational and network-wide characteristics or the presence of a given organization in a collaboration network. There are no valid empirical approaches for determining whether any network property or component is an inflection point, indicative of a secular trend, or unique to the observation's time period.

With respect to service areas, public education has been somewhat excluded from the nascent networked governance literature (Kapucu, Hu, & Khosa, 2017). Scholars have examined health and human services (e.g., Provan & Huang, 2012), economic development (e.g., Carr, Hawkins, & Westberg, 2017; Feiock, Lee, & Park, 2012; Hawkins, Hu, & Feiock, 2016; Sangsoo Kim, Song, & Park, 2018), emergency management (e.g., Andrew, Arlikatti, Siebeneck, Pongponrat, & Jaikampan, 2016; Jung & Song, 2015; Jung, Song, & Feiock, 2017), and environmental protection (e.g., Scott, 2015; Yi, 2018).

Interlocal collaboration studies have examined only a single service type within an individual metropolitan region, with few exceptions (Andrew & Carr, 2013; Carr et al., 2017;

Hawkins et al., 2016; Y. Lee, Lee, & Feiock, 2012; LeRoux, Brandenburger, & Pandey, 2010; Thurmaier & Wood, 2002). Selecting a highly-localized unit of analysis renders consideration of comparisons to other geographical areas or other service contexts difficult if not impossible.

This dissertation overcomes three of these four data limitations by using the Iowa 28E ILA database. As per Chapter 28E of the Iowa Code, records formalizing interlocal collaborations must be filed with the state government via the Office of the Secretary of State. At the time of writing, the online repository of these ILAs encompasses metadata on over 20,000 agreements, over 2,000 of which involve at least one public school district. Agreement filing dates range from January 1993 to the present, providing researchers with over 25 years of archival network data to examine across 33 different service categories. Unlike prior research, which is often focused on a single county or metropolitan region, this data contains information on all 99 counties, 947 municipalities, and 333 public school districts in the state of Iowa.

1.4 Measuring Network Performance

Koliba et al. (2010) describe performance management as a "critical function in the effective governance of not only public bureaucracies, but entire governance networks as well" (p. 262). There is a clear need for contributions to this body of work; developing a consensus may persuade policymakers that, within the realm of public education, there are cost-effective benefits to be realized by having school districts collaborate with other school districts, city and county governments, nonprofit organizations, and even private sector firms. However, the few empirical studies that concern the performance of a service network suffer

from narrow generalizability; due to the data limitations discussed in the previous section, much of the prior literature is not generalizable across time or beyond a relatively small geographical area.

Numerous public administration scholars have advanced theory-driven approaches to conceptualizing governance network effectiveness, suggesting difficult-to-operationalize definitions and indicators of performance. Elements that have been theorized to exist in effective collaborative networks include: reaching goal consensus, building trust and social capital, creating a stable interorganizational culture, and remaining consistent with democratic principles (Herranz, 2010; Mandell & Keast, 2007; Skelcher & Sullivan, 2008; Turrini, Cristofoli, Frosini, & Nasi, 2010).

Assessments of both interpersonal social networks and interorganizational public service networks have traditionally been accomplished by collecting either perceptions of network efficacy or externally verifiable quantitative measures. In the case of perceived network effectiveness, researchers often resort to interviewing a network's participants (e.g., representatives of constituent organizations) or its clients (e.g., family members of patients who are clients of a mental health network). Obtaining perceptions of performance in this manner is often necessary for service networks with goals that are difficult to objectively measure.

When Provan and Milward (1995) published their research paper on operationalizing interorganizational service network effectiveness, they proclaimed "comparative research on the effectiveness of organizational networks" to be "virtually nonexistent" (p. 7). In addition to mailing out questionnaires, the authors examined a mental health network spanning four U.S. cities via in-person interviews of health agency clients, their family members, and their case managers. Provan and Milward concluded that "differences in network effective-

ness could be explained by aspects of network structure and context, namely, centralized integration, external control, stability, and resource munificence" (p. 27). A follow-up study that examined three of those four mental health networks found that "differences in client outcomes across systems could be explained reasonably well by focusing on the overlap among cliques of provider agencies through both reciprocated referrals and case coordination" (Provan & Sebastian, 1998, p. 459).

The supposition that network position could affect substantive outcomes is a decades-old hypothesis. Though an abundance of studies has relied on individual or organizational perception of network effectiveness to infer relationships between network attributes and performance (Lubell, Mewhirter, Berardo, & Scholz, 2017; Mewhirter & Berardo, 2018; Peters, Klijn, Stronks, & Harting, 2017; Schalk et al., 2009), perceptions about outcomes cannot serve as a substitute for verifiable outcome measures because the former can be distorted by a variety of cognitive biases or a lack of perfect information (Andersen, Heinesen, & Pedersen, 2014; K. Brown & Coulter, 1983; Kelly & Swindell, 2002; Meier & O'Toole, 2013). Fortunately, there are numerous evaluations of network performance that do not rely on the impressions of those participating in or interacting with a public service network.

Since O'Toole and Meier (2004) remarked that "rigorous demonstration of the link between public management and intergovernmental program performance" was "absent from research" (p. 470), interest in collaborative governance network research that relies on objective quantitative measures of substantive effects has surged, especially within the past few years. Outcome dimensions that the extant literature have leveraged as their dependent variables include: watershed quality data from the U.S. Environmental Protection Agency (Scott, 2015); operating costs of fire protection services, provided by the Norwegian statistics

bureau (Blåka, 2017); municipal-level financial data sourced from comprehensive annual financial reports (Jimenez, 2017); successfully securing funding for water supply projects in Nepal (Shrestha, 2018); regional growth in wages and an increase in the number of business establishments and employees, sourced from the U.S. Census Bureau (S.-H. Chen, Feiock, & Hsieh, 2016; Sangsoo Kim et al., 2018); change in renewable energy capacity and the number of available jobs that benefit the environment or conserve natural resources, obtained via the U.S. Bureau of Labor Statistics and U.S. Energy Information Administration's State Energy Data System respectively (Yi, 2018); and police service operational expenditures sourced from the California State Controller (Zeemering, 2018).

A number of studies have examined how interpersonal social networks in educational settings influence student outcomes. For example, Baldwin, Bedell, and Johnson (1997) found that centrality within friendship and communication networks formed among master of business administration (MBA) students positively affected their attitudes and grades, concluding that "social networks clearly mattered to important educational outcomes" (p. 1390).

Building on their earlier work examining school districts in Texas, O'Toole and Meier (2004) relied on a host of performance indicators to measure education performance, including pass rates and scores from three standardized tests (the Texas Assessment of Academic Skills, ACT, and SAT), attendance rates, and dropout rates. The authors concluded that, overall, educational system performance improved when school district superintendents more frequently engaged in "networking activities," defined as interactions with "school board members, local business leaders, other school superintendents, state legislators, and the Texas Education Agency" (p. 479).

Moolenar, Sleegers, and Daly (2012) evaluated the impact that teacher collaboration network structures had on national standardized test scores across 53 primary schools within a single large school district in the Netherlands. Controlling for socioeconomic status, they concluded that "the density of work related and personal advice networks affected teachers' perceptions of collective efficacy, which in turn was associated with increased student achievement" (p. 258).

Returning to the United States, Siciliano (2017) analyzed the relationship between teacher advice network structures and 4th through 8th grade student test scores in reading and math across 21 schools, concluding that "teachers tied to peers with greater levels of organizational commitment tend to have higher performance" (p. 91).

Two studies that evaluated interorganizational network performance include Powell, Koput, and Smith-Doerr (1996), who found that centrality within an interorganizational knowledge network of biotechnology startups improved rate of company growth, and Uzzi (1996), who reported a positive relationship between network embeddedness and the probability of survival among apparel firms in New York (Uzzi notes, however, that the effect is non-linear, and reverses after reaching a threshold). Outside of Meier and O'Toole (2004) and their related work, as well as Leana and Pil's contributions on the effect of external social capital on organizational performance (Leana & Pil, 2006; Pil & Leana, 2009), there are few studies that examine the consequences of interorganizational education networks.

The existing research has generally endeavored to measure the performance of either interpersonal or interorganizational networks by relying on perceptions of network effectiveness or external quantitative metrics at a single point in time. Further, few studies have examined interorganizational networks oriented around public education, despite being a

critically-important local government service. This dissertation will concurrently address these shortcomings by combining metadata from the Iowa 28E agreement database (briefly described above) with an expansive school district attribute data set (sourced from the Iowa Department of Education and assembled specifically for the forthcoming analyses) that includes multiple performance variables for all 333 of the state's public school districts.

1.5 Overview of Forthcoming Analysis

This dissertation leverages a 25-year archival data set derived from formal intergovernmental and intersector agreements filed with the Iowa Secretary of State along with statistics released by the Iowa Department of Education for 333 public school districts to examine the consequences of statewide collaborative governance networks oriented around public education.

Chapter 2 will begin with a review of the extant collaborative governance and network analysis literatures, including the published research that relies on the above-mentioned ILA data. This work has primarily used the database as a sampling frame, and has examined how citizen perception of overall public service quality in small municipalities was affected by the number of ILAs filed, the motivations behind a local government's decision to enter into an ILA, and the factors that predict ILA network formation (e.g., service-function type and participant characteristics). Next, causal mechanisms that are potentially responsible for linking cooperative activity within interlocal education service networks to improvements in student outcomes are discussed. The chapter concludes with a set of testable hypotheses generated by social capital theory.

Chapter 3 will begin with an overview of the dependent variables created from public school district data acquired from the Iowa Department of Education. Definitions for the independent variables are then provided. The chapter concludes with a comprehensive discussion of the Iowa ILA database, which includes detailed descriptions of the processes that were developed and implemented for acquiring and formatting the raw data prior to transforming the agreement metadata into adjacency matrices suitable for network analysis.

To better understand the substantive topics covered by the 2,042 ILAs involving public school districts, Chapter 4 will include qualitative examinations of the agreements' text and summarize examples of agreements from each of the topics. Chapter 5 then estimates a series of two-way fixed effects panel regressions to determine if a school district's level of engagement within subnetworks aimed at improving student academic performance and decreasing occurrences of undesired behavior (i.e., truancy, suspensions, and expulsions) yields significant results. District-level academic performance will be measured via high school graduate counts, math and reading proficiency rates (i.e., the number of students considered proficient in math and reading divided by the total number of students tested), and average ACT scores. Control variables will include enrollment totals, the percentage of enrolled students that are female and non-white (given the demographics of Iowa, all racial minorities will be collapsed into a single variable), the number of students who are eligible for free or reduced-price lunch, district spending per student, student to full-time teacher ratio, average teacher salary and years of experience, and the number of teachers with advanced degrees.

Finally, Chapter 6 will summarize this dissertation's major findings, deliberate on the generalizability and limitations of those findings, suggest directions for future research

in this area of the public administration scholarship, and speculate on the potential policy implications of this work.

2 Literature Review and Hypotheses

This chapter will review the extant collaborative governance and social network analysis research to situate this dissertation within the broader body of literature, suggest causal mechanisms through which governance networks can impact substantive outcomes (specifically, the development of social capital), and construct a set of falsifiable hypotheses (for a summary, refer to Table 1 at the end of the chapter).

2.1 Extant Collaborative Governance Literature

Seeking to understand the myriad forms of intergovernmental cooperation, scholars have largely approached the study of collaborative governance by analyzing the joint exercise of governmental powers. Archetypical forms of shared service arrangements include: providing grants or other subsidies to support the provision of a service, sharing resources (e.g., personnel, equipment, or knowledge), entering into joint purchasing agreements, jointly producing or operating a service or facility, transferring functions, and creating new joint entities to govern shared assets (Morse & Abernathy, 2015).

Interlocal Collaborations and the Joint Exercise of Governmental Powers

Frederickson (1999) described three key features of contemporary public administration: (1) the rise of the disarticulated state, and the accompanying significant decline in the capacity of the state to deal with complex social and economic issues; (2) that "public" once exclusively referred to government but now encompasses a wide range of organizations,

including nonprofit groups and a host of quasi-governmental organizations that work with governments to provide services to the public; and (3) the reform of public management, including the New Public Management movement and its promotion of entrepreneurial behavior and risk-taking by public employees.

To overcome the problems induced by the disarticulated state, Frederickson introduced the concept of administrative conjunction, which refers to the "array and character of horizontal and informal association between actors representing units in a networked public and the administrative behavior of those actors" (p. 708). Frederickson contends that administrative conjunction is primarily an administrative activity carried out by "like-minded institutional professionals," effectively-permanent public administrators who abide by a set of professional norms and hold long-term perspectives (p. 709). Unlike politicians, who hold short-term election-oriented outlooks, these administrators can achieve governance via interjurisdictional collaborations.

Proponents of new regionalism, a school of thought formed as a response to polycentrism, argue that informal regional collaborative governance structures are more feasible than creating general-purpose regional governments and would improve both service provision and economic competitiveness in the global economy (Carr, 2004; Savitch & Vogel, 2000). Determinants of intergovernmental and cross-sector cooperation include: community demographics and the characteristics of neighboring local governments (LeRoux & Carr, 2007), the existence of trust and low risk levels (Carr et al., 2017; Hatley, Elling, & Carr, 2015), potential improvements in the efficiency or effectiveness of providing a public good or service, the need to address a pending or current policy failure, (Bryson, Crosby, & Stone, 2006; Morgan & Hirlinger, 1991), prior instances of collaboration (Lamothe, Lamothe, &

Feiock, 2008), the presence of fiscal constraints and professional management (Bel & Warner, 2016), and the retention of political autonomy (Visser, 2004).

Scholars have also explored the challenges associated with the formation of inter-jurisdictional cooperative arrangements. A review of the literature on service collaboration risk conducted by Carr and Hawkins (2013) found that scholars have placed a significant emphasis on understanding how the design and use of contracts and institutional arrangements mitigate the risks that accompany the joint provision of a public service, noting that administrator social networks can play an important role in alleviating risk. While local government managers recognize the potential benefits of interlocal collaboration, they often lack the requisite training on how to create and maintain those relationships. Despite incurring some transaction costs and requiring a different skill set to manage, networked governance remains a potential technique for effectively extending jurisdictional boundaries (Dougherty & Miller, 2010).

Interlocal Agreements

Notwithstanding pessimistic claims that "regions will continue as governmentally fragmented entities resistant to nearly all efforts to achieve regional governance" and that even "economic imperatives will not overcome the political impediments to regionalism" (Norris, 2001, p. 569), researchers continue to expand their evaluations of local governments and their use of both intergovernmental and intersector collaboration. These joint ventures are often formalized by an interlocal agreement (ILA), an institutional form of collaboration that does not require boundary changes or other reforms that carry greater political visibility and risk. Complex governance networks emerge from "large numbers of independent governments

(voluntarily) cooperating through multiple, overlapping webs of interlocal agreements," and are discussed later in this chapter (Savitch & Vogel, 2000, p. 164).

As with the extant interlocal collaboration literature, published peer-reviewed studies of ILAs primarily focus on the determinants of creating an agreement. For example, Kwon and Feiock (2010) describe a two-stage process that local governments undergo when deciding to collaborate via an ILA: in the first stage, communities consider "the nature of the immediate problem faced plus specific demands for performance and efficiency gains that can result from service cooperation," and in the second stage, implementation costs (i.e., the costs associated with negotiating and enforcing an agreement) are considered (p. 876).

Qualitative analyses of interviews conducted with city officials found that establishing a culture of reciprocity was critical to forming ILAs (Thurmaier & Wood, 2002) and that city administrators weighed community preferences and anticipated negative reactions from the public heavily when considering participation in an ILA (Zeemering, 2012). Hatley et al. (2015) similarly surveyed officials from five Detroit suburbs that sought to form a single authority tasked with providing both fire and emergency medical services (EMS) to each community. The Five City Fire Authority (FCFA) was never created because of (1) changing political dynamics (supportive mayors were ousted by the electorate); (2) state laws concerned with salary and union collective bargaining agreements, which sowed doubts about short-term savings (a critically important consideration for city council members); and (3) a lack of trust between participants, which was particularly acute between elected officials and the rank-and-file EMS personnel.

A forthcoming chapter section will provide additional examples of ILA usage in the course of reviewing the extant network analysis literature.

Academic Literature on Interlocal Collaboration in Iowa

Chapter 28E of the Iowa Code permits "state and local governments in Iowa to make efficient use of their powers by enabling them to provide joint services and facilities with other agencies and to cooperate in other ways of mutual advantage." In the context of legally-authorized intergovernmental collaborations, an "agency" refers to both private agencies, defined as "an individual and any form of business organization authorized under the laws of this or any other state," and public agencies, defined as "any political subdivision of this state; any agency of the state government or of the United States; and any political subdivision of another state" (Iowa Code, Chapter 28E, Section 2).

The Iowa Code requires that the records which formalize all intersector collaborations be filed with the state government via the Office of the Secretary of State. Section 8 of Chapter 28E requires agreement amendments and termination notices to be filed with the Secretary of State as well. Termination notices are used to end an agreement prior to its initial expiration date, and only requires filing a short form that includes the date and filing number of the agreement being terminated.

Given this dissertation's emphasis on instances of collaboration between public school districts, it should be noted that Section 42 of Chapter 28E states: "Two or more school districts may enter an agreement pursuant to this chapter for the purpose of financing projects for which debt obligations may be or have been incurred pursuant to Chapter 296 ['Indebtedness of School Corporations'] or 298 ['School Taxes and Bonds']."

Despite the strict legal requirements associated with notifying the state government of intergovernmental collaborations and the existence of a public online database of agreements

maintained by the Secretary of State, very few academic studies have made use of or even referenced Iowa's ILAs. Andrew (2009) published a useful overview of the interjurisdictional agreement (IJA) literature in *State and Local Government Review*, stating that "what is known about current patterns of IJA usage mostly comes from comprehensive studies of agreements in just three states: Michigan, Iowa, and Florida" (p. 135). However, the subsequent section concerning Iowa only cited two published peer-reviewed journal articles.

The first article, published in *City & Community* and written by Morton, Chen, and Morse (2008), examined how citizen perception of overall public service quality in small municipalities was affected by (1) civic structure, defined as the extent of public engagement with local problems, and (2) the number of ILAs their town filed between 1993 and 2003. The authors mailed questionnaires to 150 households in each of 99 randomly-selected rural Iowa cities (with 9,962 respondents, the survey enjoyed a 67% response rate). Respondents were asked about service delivery quality in five areas: police protection, jail, streets and roads, fire, and emergency management. In all five service areas, civic structure was positively and significantly associated with service quality ($p < 0.05$). The number of ILAs, in contrast, failed to reach statistical significance in all service areas except police protection, which was negatively associated with perceived service quality ($p < 0.01$). Morton and colleagues noted that the addition of population as a control caused the number of ILAs to become a largely insignificant predictor.

The second article, published in the *American Review of Public Administration* and written by Chen and Thurmaier (2009), used the Iowa 28E agreement database as a sampling frame for a survey-based analysis aimed at gaining a deeper understanding of the motivations behind a local government's decision to enter into an ILA. To determine whether

public officials believed its history of ILA usage could be considered a success for their jurisdiction, the authors mailed surveys to the individual responsible for filing their city or county government's ILAs (usually a city clerk or county auditor, respectively) based on contact information provided on agreements submitted to the Iowa Secretary of State between 1993 and 2004. Chen and Thurmaier concluded that the "most common reasons for the creation of agreements is a belief by public officials that an ILA will increase the effectiveness and efficiency of a public service," noting that these reasons were "much more commonly cited than the fiscal condition of the local government" (p. 13).

Though Morton et al. (2008) and Chen and Thurmaier (2009) represent the only peer-reviewed journal articles that include a meaningful investigation into 28E agreements, scholarly consideration of interlocal collaborations in Iowa is expected to experience an increase due to the growing research agenda at the University of Illinois at Chicago's (UIC) Networks & Governance Lab (NGL). The NGL has assembled a comprehensive data set composed of every Chapter 28E ILA from January 1993 through December 2018 (the data acquisition and cleaning process is described in great detail in the next chapter).

Transaction Costs and Institutional Collective Action

Transaction cost theory, and the related theory of institutional collective action, remain topics of perennial importance in the field of public administration. These theories suggest that certain network characteristics and configurations reduce costs and improve operational efficiency. Volumes of literature have been produced that examine governments and their drive to reduce transaction costs (Bel & Sebő, 2019; T. L. Brown & Potoski, 2003; Coase, 1937; Lowery, 2000; Williamson, 1975). As suggested in the previous chapter, much of

the interlocal governance network literature views ILAs as an administrative tool capable of overcoming collective action problems (Feiock, 2013; Post, 2004); the "transaction costs perspective on intergovernmental agreements maintains that cooperation will occur only when the benefits to an agreement outweigh the costs of achieving it" (Feiock et al., 2009, p. 261).

The institutional collective action (ICA) framework, perhaps most associated with urban governance professor Richard Feiock, conceptualizes the problem of collective action from an organizational, rather than individual, perspective. In short, institutions are concerned with minimizing risk, reducing financial expenditures (to either maximize profit in the case of private sector firms or to improve public service provision efficiency in the case of governments), and ameliorating political concerns. These factors are widely considered to be the antecedents of institutional collective action; solutions to collective action problems involve striking an institutional balance between potential gains, transaction costs, and risks (Feiock, 2009).

Feiock (2013) further developed his ICA framework to incorporate mechanisms that can resolve collective action dilemmas, which include informal networks, constructed networks, contracts, mandated agreements, partnerships, councils of governments, and centralized regional authorities. Feiock explains that collective action dilemmas arise in fragmented systems when the decisions of one government affect the functional operations of another government, a phenomenon he describes as the "externalities of choice." To better sort these mechanisms, Feiock develops a two-dimensional taxonomy: (1) the scope of political authority, divided into the categories of network embeddedness, contracts, delegated authority, and imposed authority, and (2) how encompassing the mechanism is, which is further divided into three categories: narrow or bilateral, intermediate or multilateral, and "encompass-

ing complex" or collective. Informal networks, for example, would be classified as narrow and embedded, while annexation would be classified as encompassing complex and imposed authority.

Prior to Feiock, Post (2004) formulated an ICA theory that applies to local governments in metropolitan areas. She explains that the principles of individual collective action (i.e., the role of common policy objectives; the increased risk of shirking and free riding that exists in large groups, where monitoring costs are higher; and the use of selective incentives as a potential solution) apply to institutional collective action as well. Post theorizes that local government cooperation is more likely when there are more municipalities in a geographic area, suggesting that geographical proximity may help lower the cost of monitoring other cooperating governments. Other predictors of interlocal government cooperation include: the presence of a strong leader or entrepreneur, when federal government grants require or incentivize it, potential cost savings, the potential to maintain service continuity, and when there are capital-intensive goods or services involved. The likelihood of cooperation decreases as: the number of involved governments increases, heterogeneity of the constituencies increases, the number of burdensome state laws that govern ILAs increases, and when goods and services are labor intensive.

In his book on institutional change and economic performance, North wrote that the "costliness of information is the key to the costs of transacting, which consist of the costs of measuring the valuable attributes of what is being exchanged and the costs of protecting rights and policing and enforcing agreements" (North, 1990, p. 27). In social network analysis, the phenomenon where nodes tend to form relationships with well-connected nodes to reduce risk and improve knowledge access is known as "preferential attachment" (Barabási &

Albert, 1999; Berardo & Scholz, 2010; Robins, Lewis, & Wang, 2012). Triadic closure, measured via transitivity, is another well-researched network strategy for reducing uncertainty and lessening the risk of defection when forming new ties that involves creating highly-clustered structures to improve each actor's ability to monitor their collaborators (Park & Rethemeyer, 2012; Shrestha & Feiock, 2016).

From the perspective of transaction cost theory and the institutional collective action framework, organizations decide to engage in an interlocal collaboration when doing so would reduce its costs relative to direct production. The social network analysis literature suggests that establishing strong ties with well-connected nodes and creating clusters of collaborators reduces the costs associated with uncertainty, risk, monitoring, and enforcement, all of which are forms of transaction costs (Feiock et al., 2009). All organizations seek to reduce their production costs (i.e., improve operational efficiency) over time; if engaging in an interlocal collaboration network improves its efficiency, an organization would be inclined to actively participate. Expanding the scope of an organization's engagement in such a network is therefore expected to enhance its efficiency.

Although this dissertation initially sought to examine the relationship between efficiency and performance, operationalizing efficiency in the context of Iowa public schools proved to be prohibitively difficult. First, cost savings may not be the primary purpose of many, or even most, of the ILAs that form the basis of a collaboration network. Second, cost savings achieved from participating in an ILA network could potentially be reflected in a school district's budget, but only if those savings were not disbursed elsewhere. Finally, correctly inferring the direction and purpose of financial transfers was particularly challenging due to both the summary nature of the publicly-released budgetary data and the Iowa

School Cash Anticipation Program (ISCAP), which is joined via interlocal agreement and does not appear as a separate line item in school budgets. When active, ISCAP enables schools to "pool their temporary cash flow management needs" via "various cost-effective cash flow borrowing structures," including the ability to "issue warrant certificates to finance cash flow deficits until revenues from property taxes and state foundation aid are received" (Iowa Association of School Boards, 2019b).

2.2 Extant Network Analysis Literature

Public administration network scholars have developed a research agenda oriented around cooperative structures that can be inferred from ILAs and other instances of interlocal cooperation, primarily focusing on the political, legal, and demographic characteristics that affect an organization's inclination to participate in a collaboration. These governance structures are "interorganizational networks comprised of relatively stable patterns of coordinated action and resource exchanges" that have historically been an integral component of intersector arrangements (Koliba et al., 2010, p. 14).

Theoretical arguments advanced by the social network analysis literature suggest that certain network positions, such as having connections to many different actors or operating as a broker between disparate clusters of actors, confer numerous benefits. For example, relying on weak ties that span networks has been found to be helpful in obtaining a new job (Granovetter, 1973) and for spreading new, innovative ideas (Burt, 2004). The collaborative governance network strain of the public administration literature has conducted similar explorations in the context of both informal networks, which form between partici-

pants naturally (often to exchange information or advice), and formal networks, which result from explicitly-created cooperative arrangements and are usually designed to deliver a public service.

It is important to conceptually distinguish informal networks from formal networks because the approaches for studying each can differ. Mapping the structures of informal networks require obtaining data via interviews and surveys of network participants, while the structures of formal networks can be inferred from documents (e.g., interlocal agreements). To situate this dissertation within the broader body of extant network analysis literature, the following subsections will review relevant studies concerning both informal and formal networks.

Informal Networks

Over the past two decades, information and advice networks that exist within both public and private sector organizations have been gaining attention across the social sciences. These informal social networks have been found to affect employees' emotional commitment and knowledge-sharing capabilities (Soonhee Kim & Lee, 2006; J. Lee & Kim, 2011), while advice ties can "influence firms' responses to economic adversity" (McDonald & Westphal, 2003).

Within public administration, researchers have focused on the informal networks that form between public servants, such as local elected officials and school teachers. For example, Feiock and colleagues surveyed 40 city and county governments in the Orlando, Florida metropolitan area to better understand the relationship between a network's structure, an actor's position within that network, and their information seeking behavior. The authors

concluded that "elected officials tend to actively and independently be engaged in network structures that can verify the quality and reliability of information" (Feiock, In Won Lee, Hyung Jun Park, & Lee, 2010, p. 256).

Informal social networks are not exclusively built around seeking and providing information and advice. For example, Romzek et al. (2014) provide insight into the role that interpersonal interactions play in maintaining informal accountability within a cross-sector, county-based service delivery network that offered social services to children in Kansas, Maryland, and Michigan. Interviews conducted by the authors revealed a system of rewards and sanctions, socially-constructed within a complex and dynamic environment of shared norms and behavior.

For scholars that study government organizations, advice network ties that form between public school teachers and principals appear to be of particular interest. Built on the basis of seeking and providing information and skilled guidance, this type of social network has been shown to strengthen professional teaching norms and values, with principals often playing a central role (Gibbons, 2004; Spillane & Kim, 2012).

Prior claims about the important role that intraorganizational social networks play have been largely substantiated by network studies published in the last five years. Though much of this early research relied on familiar econometric approaches (e.g., hierarchical linear models), the most recent work has integrated the use of sophisticated network graph models. For example, Siciliano (2015) conducted a meta-analysis of exponential random graph models (ERGMs) that estimated structural and actor attribute effects on the probability of advice tie formation between two school teachers. His results suggest that "teachers rely on mutual

relations, closure, friendship, and work function similarity in determining advice-seeking behavior more so than peer status" (p. 555).

In a similar study, Siciliano et al. (2017) leveraged longitudinal data gathered from social networks oriented around conferring on the Common Core State Standards Initiative, finding that teachers turned to their friends and to those that taught at the same grade level when seeking advice about implementing the Common Core. Siciliano has also examined the extent to which student performance is affected by school teacher advice networks, in a study discussed in the next chapter section.

Overall, research produced at the intersection of public administration and social network analysis has demonstrated that information and advice networks can have important implications for implementing education policy.

Formal Networks

To further contextualize the network analysis literature, this section will provide several representative examples of prior examinations of formalized governance networks that emerge from explicitly-created organizations or collaborative agreements. Governance networks are interorganizational and "comprised of multiple actors, often spanning sectors and scale, working together to influence the creation, implementation, and monitoring of public policies" (Koliba et al., 2010, p. xxv). Operating under this definition, service delivery networks can be considered a type of governance network, since public services are a result of implementing public policies that call for the provision of that service.

Though qualitative analyses offer an in-depth and nuanced understanding of an inter-local service collaboration network, public administration scholars have generally preferred

the use of quantitative methods for studying governance networks, which range in complexity from simple linear regressions to advanced stochastic actor-oriented models. Drawing from data generated by the National Administrative Studies Project IV (NASP-IV), LeRoux, Brandenburger, and Pandey (2010) estimated a set of negative binomial regressions to argue that "interlocal service cooperation increases when jurisdictional actors network frequently through a regional association or council of government and when they are united by a common set of professional norms and disciplinary values" (p. 268).

Using ILAs among 44 general-purpose governments in Michigan across eight service areas, LeRoux and Carr (2010) tested a theorized relationship between network density, network centralization, and service type. Network density is calculated by dividing the number of ties that exist in a network by the total number of ties possible (i.e., the number of ties that would exist if each node was connected to one another), while network centralization refers to the extent to which a network revolves around a single node. Using Williams' (1971) system maintenance and lifestyle typology to classify public services, LeRoux and Carr found that, though there were mixed results with respect to network density, centralization within system maintenance service networks was significantly higher relative to lifestyle service networks.

LeRoux and Carr (2010) expanded on work published by Wood (2006), who examined the number of system maintenance and lifestyle ILAs in the Kansas City metropolitan area, and arrived at similar conclusions. Nearly 10 years later, a replication and extension study that used a more expansive data set and hierarchical linear models offered validation for the claim that there is a distinction to be made between collaborations aimed at providing system maintenance services and collaborations that provide lifestyle services; over time,

organizations that decided to join an ILA were more inclined to do so for system maintenance services than lifestyle services, and preferred to create ties with well-connected, central participants (Hugg, 2019).

Shrestha and Feiock (2011) estimated the determinants of interlocal cooperative behavior among municipalities in the state of Georgia. They found that services with high levels of asset specificity (i.e., services that require dedicated investments to produce a given service) increased the likelihood of interlocal collaboration, while services with high measurement difficulties (i.e., the challenges associated with operationalizing service performance in both its provision process and outcomes) decreased the likelihood of interlocal collaboration.

To examine pay-for-service agreement networks in Pinellas County, Florida, Shrestha and Feiock (2009) relied on quadratic assignment procedure (QAP), a simulation-based technique for calculating correlations between network graphs and for calculating standard errors when modeling dyadic variables. The authors found that "local jurisdictions develop cross-service reciprocity networks in a multiple services contract environment" in an effort to "resolve credibility of commitment problems they encounter in entering and maintaining interlocal service contracts" (p. 801). QAP has also been used to determine the extent to which perceived levels of cooperation and competition predict tie formation within economic development collaboration networks in the Orlando metropolitan area (I.-W. Lee, Feiock, & Lee, 2012), as well as to determine whether political homophily facilitates interlocal collaborations in South Korea (Song, Park, & Jung, 2018).

2.3 Hypotheses

To determine if ILA network engagement influences student outcomes, a set of hypotheses will be developed and tested. These hypotheses will suggest that the extent to which a school district is engaged in both statewide ILA networks and its own local network directly affects student outcomes via the enhancement of social capital. For a conceptual model of the hypotheses, refer to Figure 1 at the end of the chapter; for a summary of the hypotheses, refer to Table 1, also at the end of the chapter.

Agreement Topic Networks

The performance of interlocal networks should be judged on the basis of the networks' goals; if the agreements that form the basis of a network are aimed at, for example, joining a statewide consortium that operates a drug testing program for school bus drivers, it would hardly be fair to judge its performance on the basis of student outcomes. Determining the impact on academic and discipline outcomes within agreement topic networks primarily oriented around allowing high school students to take community college classes for credit or sourcing school resource officers from local police departments respectively, however, would significantly improve construct validity. The ILA education network will therefore be broken down into subnetworks composed of agreements from each major substantive topic, or "agreement topic networks." These topics will be determined by a qualitative analysis conducted in Chapter 4.

Mechanisms Linking Network Structure to Performance

Social capital, which forms the basis of collaborative networking, has been broadly defined as "the goodwill that is engendered by the fabric of social relations and that can be mobilized to facilitate action" (Adler & Kwon, 2002, p. 17). The social capital literature suggests that enhancing social capital through collaboration "facilitates access to broader sources of information and improves information's quality, relevance, and timeliness" (Adler & Kwon, 2002, p. 29). This expansion in the flow of knowledge can ultimately yield improvements in outcomes, as summarized by Meier, Favero, & Compton (2016):

> The literature investigating the links between social capital and the outcomes of public programs largely began with the work of sociologists Bourdieu (1986) and Coleman (1988), who posit that social capital benefits certain public policy goals including performance in education. [...] Social capital, as a set of social structures, is expected to improve the productive efforts of individuals in society. Social networks enable the transfer of information that can benefit the goals and functioning of (public) organizations. [...] Within the context of schools, social capital can enable teachers, students, and parents to locate and access the cultural, human, and institutional resources necessary to achieve better outcomes (Coleman, 1988; Portes, 1998). (Meier, Favero, & Compton, 2016, p. 240)

In a networking context, social capital can be operationalized in several different ways. For example, building social capital by establishing relationships with many different actors

can be represented by one's changing degree centrality. Augmenting the strength of these relationships is also of importance; having a strong relationship with someone enhances the quality of that tie, which can be measured in terms of its intensity, duration, or both.

A handful of studies have specifically examined the role that internal and external social capital (derived from relationships within and between organizations, respectively) plays in networks that exist within public schools. To test the relationship between social capital and student performance, Leana and Pil (2006) conducted an 18-month examination of a public school district in the northeastern United States. Social capital was assessed via survey instruments, created after conducting semi-structured interviews and engaging in passive observation of day-to-day school activities. The authors suggest that performance is enhanced when teachers "share information, have quality relations, and share the same conception of the school's mission" (p. 335) and that higher levels of external social capital enable the mobilization of external resources, which in turn yield positive effects on student performance. They conclude that both internal and external social capital improve student achievement in mathematics and reading.

A similar study conducted by Pil and Leana (2009) evaluated both horizontal ties (i.e., relationships among teachers) and vertical ties (i.e., relationships between teachers and their supervisors, usually a school principal or assistant principal), measuring social capital via the number and strength of ties. The authors' hierarchical analysis found that social capital had "important individual- and group-level effects on individual performance" (p. 1119).

In an effort to identify the factors that contribute to the development of social capital, Spillane, Kim, and Frank (2012) examined advice and information networks among

elementary school teachers in a mid-sized public school district, arguing that "advice and information are fundamental building blocks for developing knowledge, a critical ingredient for improving instruction in schools" (p. 75). Using data generated by a questionnaire, the authors found that race and gender homophily was a significant predictor of tie formation, as was teaching at the same grade level and having a leadership position within the school.

Siciliano (2016) similarly examined advice and information networks in a mid-sized public school district, though focusing instead on the effect of network ties on teacher self-efficacy, or a teacher's assessment of their effectiveness (i.e., the ability to accomplish educational goals). He found that an alter's willingness to share knowledge and alter self-efficacy had a positive and significant effect on an ego's self-efficacy, concluding that there is "tentative evidence to suggest that both knowledge access and peer influence are positively associated with teacher self-efficacy" (p. 249).

Collectively, the evidence presented in the studies reviewed above suggest that the characteristics associated with the social capital that arises from networks of relationships exhibit certain effects within public schools. By engaging in the ILA education network, students, teachers, and principals form bonds and build social capital with outside organizations. The mobilization of that social capital results in advice and knowledge being exchanged (e.g., sharing best practices, teaching approaches, course plans, syllabi, and ideas on how to present material differently or deal with unruly children); student outcomes are consequently expected to improve as these relationships form and strengthen.

Changes in school district characteristics, the diffusion of knowledge and advice, and district use of ILAs as an administrative innovation all occur over time. Indeed, the adoption of policy innovations is largely driven by changing internal determinants, or "political,

economic, or social characteristics internal to the jurisdiction," and external diffusion, or the notion that governments implement policies to emulate "previous adoptions by other governments" (Berry & Berry, 2017, p. 254). Consequently, the hypotheses outlined below each incorporate a longitudinal component.

Since social capital in the network context can be operationalized in many different ways, this dissertation examines five measures of social capital: (1) active agreement count; (2) degree centrality; (3) tie strength; (4) average duration of active ties; and (5) ego network transitivity. For evaluating network effectiveness, Provan and Milward (2001) described the "strength of ties between network agencies" as a "particularly useful measure" (p. 419).

Creating and maintaining multiple ties with a given set of organizations via different active ILAs reinforces those relationships, opening additional avenues for communication. School districts that form multiple ties with other school districts or external organizations gain exposure to new ideas via diverse channels of communication, and are consequently more exposed to a greater variety of information and expertise. For example, a school district collaborating with both another school district and a local community college to host guest instructors is well-positioned to learn from different backgrounds. This heterogeneity raises the probability of encountering and learning about novel approaches for improving outcomes.

The first three measures therefore concern the qualities of school districts' collaborative relationships, which include the extent to which a school district is involved with an ILA network — measured via (1) the total number of ILAs a school district is actively participating in and (2) the number of organizations a school district is collaborating with — and how intense a district's relationships are, measured via (3) the number of active collaborations a school district is engaged in.

H_1: Increases in the number of agreements a school district is actively participating in will improve student outcomes over time.

H_2: Increases in number of actors a school district is connected to (i.e., degree centrality) will improve student outcomes over time.

H_3: Increases in the number of active relationships a school district is a part of (i.e., tie strength) will improve student outcomes over time.

Long-term relationships foster trust, a sense of goodwill, and interorganizational knowledge that can be applied toward solving problems. Consider a hypothetical ILA between a city police department and a school district to create a new school resource officer program. At first, police and school administrators may not know which strategies are best for reducing suspension and expulsion rates (e.g., the structure and implementation of crime prevention classes or the optimal level of discretion that the in-school officer should be allowed to wield). Over time, however, collaboration participants accumulate experience and learn how to best manage the school resource officer to reduce mistakes and emphasize effective strategies. Relationship length will be measured via the average duration, in years, of a school district's active collaboration ties.

H_4: Increases in the average duration of active agreements will improve student outcomes over time.

Node- and network-level measures can be calculated for overall and ego networks, the latter of which refers to networks that form around a particular actor (Crossley et al., 2015). These network segments are of interest because, "at least in certain contexts, strong, multiplex, reciprocal ties among small network subgroups can be particularly effective" (Provan & Sebastian, 1998, p. 461). Network metrics at the level of the ego network could consequently be of significance.

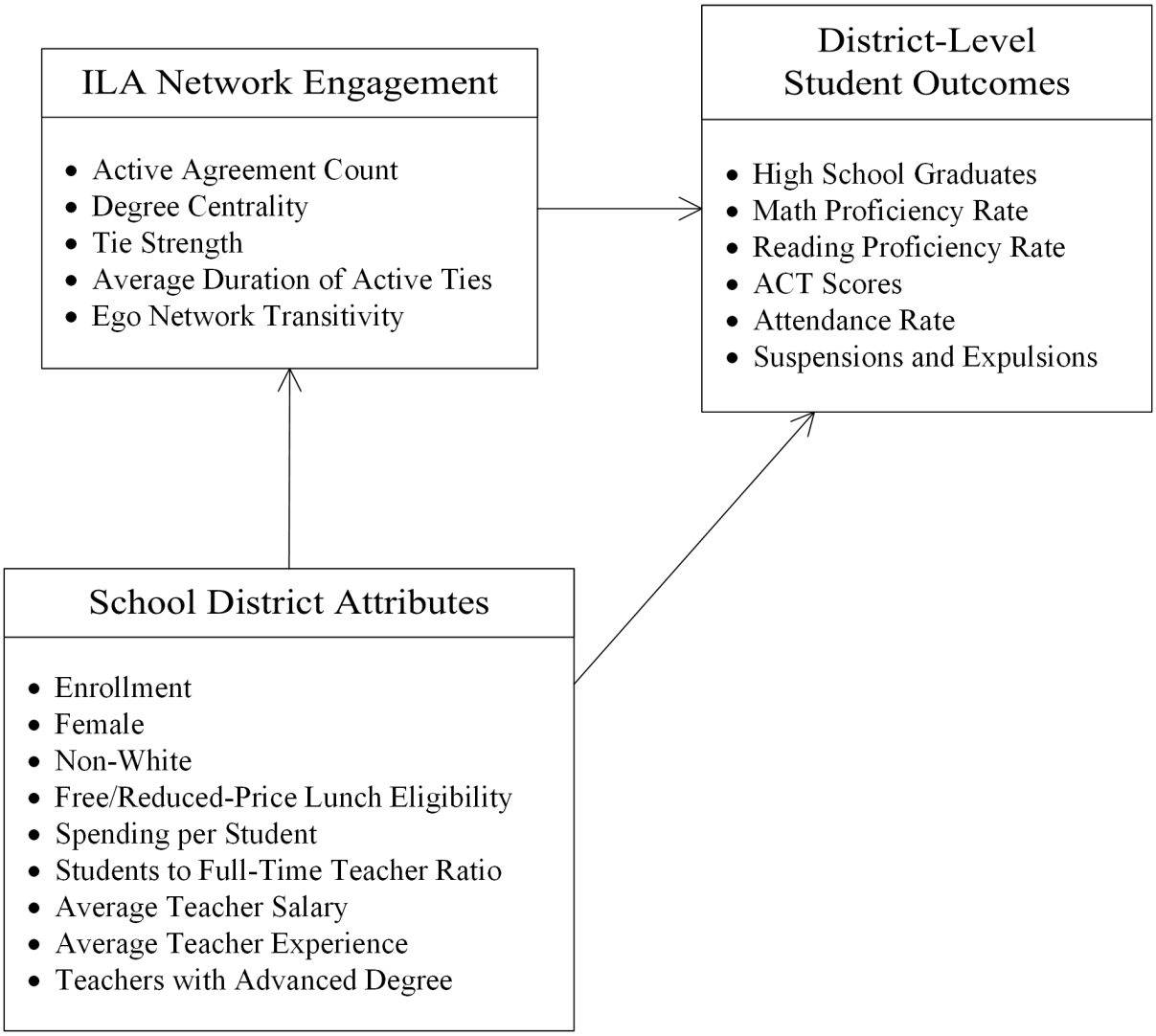
Due to a higher number of communication channels, increased transitivity within a network cluster can expedite the flow of local community knowledge. Consider a school district that is largely or entirely disconnected from the statewide education network but belongs to a highly-interconnected subnetwork (composed only of alters to whom they are tied). The extent of this district's network interconnectedness in the education agreement network at-large may not be of much consequence relative to its ego network position, especially in a rural state where districts could be as far as 400 miles away from one another.

H_5: Increases in the transitivity of a school district's ego network will improve student outcomes over time.

Table 1: Summary of Hypotheses

Hypotheses	
H_1: Active Agreement Count	$\rightarrow$ Improved Student Outcomes
H_2: Degree Centrality	$\rightarrow$ Improved Student Outcomes
H_3: Tie Strength	$\rightarrow$ Improved Student Outcomes
H_4: Average Duration of Active Ties	$\rightarrow$ Improved Student Outcomes
H_5: Ego Network Transitivity	$\rightarrow$ Improved Student Outcomes

Figure 1: Conceptual Model of Hypotheses



3 Data and Measures

This chapter operationalizes the concepts used in the previous chapter's hypotheses by detailing the dependent, independent, and control variables that will be utilized in the next chapter's quantitative analyses. The first half of the chapter briefly discusses approaches for measuring educational performance before providing an overview of the school district data acquired from the Iowa Department of Education. The second half of the chapter formally defines the social network analysis concepts employed by the previous chapter's hypotheses and provides a comprehensive overview of Iowa's 28E interlocal agreement database by summarizing the published research that relies on the database and detailing the data acquisition and formatting process.

3.1 Dependent Variables

Measuring Student Performance

In many domains, measuring policy performance is a relatively straightforward task because the policy objectives are widely agreed-upon. Policies aimed at improving environmental conditions, for example, can be evaluated on the basis of air and water quality measurements derived from scientific tools created specifically to determine air and water quality; emergency medical service and fire departments can look to response times to assess service quality; and policies aimed at economic development can be judged based on whether the target jurisdiction is enjoying lower unemployment rates or higher median household incomes.

The ultimate goal of public education, however, is multifaceted and subsequently less clear. Increasingly, scholars are recognizing that "to successfully participate in an increasingly diverse democracy and engage in the evolving workplace, students need more than content knowledge in specific subject areas" and "need to be able to communicate their ideas through a variety of media and to a variety of audiences, work together with others to solve problems, think creatively, and manage their own learning" (Rickles, Zeiser, Yang, O'Day, & Garet, 2019, p. 214). Yet if the role of public education in our society is to prepare students for dutiful, civic-minded engagement with their government and, more generally, to create introspective thinkers with the capacity to critically evaluate claims, then it is difficult to envision a pragmatic approach for operationalizing performance that would not encounter significant debate.

Consequently, education scholars and policymakers alike have opted to rely on certain quantitative measures (mainly, standardized test scores) to gauge student performance. However, this approach is not without its critics. There are many types of intelligence and talents that are incapable of being adequately captured by any form of standardized examination (e.g., artistically-gifted students or those with superior social skills), and many education researchers argue that the results from standardized tests are biased due to a myriad of factors, including the "teaching to the test" phenomenon, wherein teachers target their instruction toward skills known to be important for a given exam (Dee, Jacob, & Schwartz, 2013; Hamilton et al., 2007; Jennings & Bearak, 2014); student demographics, such as race and socioeconomic status (Gagnon & Schneider, 2019); and a failure to adequately assess the performance of students not well suited to highly-structured tests.

Since inventing a new approach for measuring public education performance falls outside the scope of this dissertation, the forthcoming analyses will necessarily be constrained by the data made available by the Iowa Department of Education. Fortunately, there are several variables that can be used to reflect the common scholarly conceptualization of student performance, including the number of high school graduates, math and reading proficiency rates, and ACT scores. High-performing schools are those that, over time, increase the number of students that graduate (controlling for total enrollment), increase the percentage of students that are considered proficient in math and reading, and increase their average ACT composite scores.

In addition, several variables not strictly related to academics but still within the purview of school district performance are of interest, including truancy rates and the number of suspensions and expulsions. A school district that is improving its performance in the area of student discipline would exhibit decreasing truancy rates and fewer instances of suspensions and expulsions over time.

Public School District Data

The Iowa Department of Education hosts an extensive assortment of public school district administrative data on their website in the form of Microsoft Excel spreadsheets. The data was downloaded and then merged by district code number, a unique identifier used internally by the Iowa Department of Education that persists across time. The 333 public school districts in active operation as of 2017 were treated as the population of districts. Due to dissolutions and mergers, 43 district codes were rendered defunct between 1993 and 2017; these school districts were dropped from the data set.

All school district variables were merged by district code number, with ACT scores being a notable exception. Since the aptly-named ACT, Inc. (the nonprofit organization responsible for administering the standardized exam) uses its own district numbering system, ACT scores were merged by creating a look-up table that matched both Iowa Department of Education district code numbers and ACT district code numbers to school district names.

Although the quantitative analyses in Chapter 5 were restricted to years where data was known to be available, a handful of school districts did not report values for each variable for every year. Consequently, there were still instances of missing data. A multiple imputation R package that employs a bootstrapped expectation-maximization algorithm was used to create an imputed data set (Honaker, King, & Blackwell, 2011).

Student Outcome Measures

The quantitative analysis in Chapter 5 relies on six district-level performance variables: (1) the number of high school graduates; (2) math and (3) reading proficiency rates, or the number of students considered proficient in math and reading divided by the number of students tested; (4) average ACT composite scores; (5) average daily attendance rate; and (6) suspension and expulsion rates. Math and reading proficiency is determined by the Iowa Assessments, a series of annual standardized tests that were previously named (and still colloquially referred to as) the Iowa Test of Basic Skills ("the ITBS"), administered to students in kindergarten through 8th grade, and the Iowa Tests of Educational Development ("the ITEDs"), proctored to high school students.

These six metrics represent the dependent variables for Hypotheses 1 through 5. An overview of the public school district data used in the forthcoming quantitative analysis can

be found in Table 2; descriptive statistics of that same data, for both all districts and for selected districts, can be found in Tables 3, 4, and 5. Visualizations of the across-time and across-state variation that exists for select variables — average ACT scores, suspension and expulsion rates, average daily attendance rates, non-white students to total enrollment, and average teacher salary — can be found in the appendix (see Figures A1 through A10).

Table 2: Overview of Public School District Variables

Variable	*Type*	*Available School Years*	*Missing Data*
Outcome Measures			
High School Graduate Counts	#	1995 – 2017	4.078%
Math Proficiency Rates	%	2006 – 2017	0.024%
Reading Proficiency Rates	%	2006 – 2017	0.025%
Average ACT Scores	#	2012 – 2017	0.045%
Attendance Rate	%	2009 – 2017	0.000%
Suspension and Expulsion Counts	#	2009 – 2017	0.000%
Student Control Variables			
Enrollment Totals	#	1993 – 2017	0.000%
Female	%	1997 – 2017	0.159%
Non-White	%	1997 – 2017	0.159%
Free/Reduced-Price Lunch Eligibility	%	2001 – 2017	0.000%
Spending per Student	$	1995 – 2017	0.000%
Faculty Control Variables			
Students to Full-Time Teacher Ratio	%	2002 – 2017	0.000%
Average Teacher Salary	$	2002 – 2017	0.000%
Average Teacher Experience	# of Years	2002 – 2017	0.000%
Teachers with Advanced Degree	%	2002 – 2017	0.001%

Table 3: Descriptive Statistics for All Public School Districts

Variable	*Mean*	*Std. Dev.*	*Min.*	*Med.*	*Max.*
Outcome Measures					
High School Graduate Counts	99.930	155.834	8.311	56.130	1696.391
Math Proficiency Rates	80.536	5.307	61.709	81.040	93.751
Reading Proficiency Rates	77.015	5.338	57.197	77.159	91.221
Average ACT Scores	21.693	1.069	17.267	21.683	25.450
Attendance Rate	95.504	0.740	93.267	95.556	97.300
Suspension and Expulsion Counts	7.792	6.305	1.130	5.925	45.866
Student Control Variables					
Enrollment Totals	1450.288	2669.885	103.720	719.880	32162.440
Female	48.458	1.310	41.241	48.514	53.240
Non-White	7.283	8.482	0.901	4.539	61.285
Free/Reduced-Price Lunch Eligibility	31.910	10.783	6.566	31.207	63.737
Spending per Student	8.704	1.481	6.719	8.382	17.691
Faculty Control Variables					
Students to Full-Time Teacher Ratio	13.755	1.637	8.330	13.827	19.492
Average Teacher Salary	44.869	4.296	34.711	44.710	56.982
Average Teacher Experience	14.766	1.973	9.181	14.884	19.604
Teachers with Advanced Degree	20.789	10.728	0.000	18.913	56.153

Calculations were performed on school district averages of each variable across all years.
Spending per student and teacher salary expressed in thousands of dollars.

Table 4: Descriptive Statistics for Selected School Districts, 2017 Outcomes

School District	*Diplomas*	*Math*	*Reading*	*ACT Score*	*Removals*
Des Moines	1,891	60.257%	60.681%	17.8	12.652
Cedar Rapids	1,068	69.457%	69.093%	23.7	13.279
Davenport	972	64.075%	62.960%	20.8	26.417
Iowa City	890	75.638%	76.461%	25.0	6.914
Sioux City	832	71.646%	70.474%	20.2	10.408
Dubuque	764	74.869%	70.547%	23.2	11.218
Ankeny	671	92.008%	88.342%	23.5	3.635
Waterloo	653	66.031%	61.526%	20.1	28.062
West Des Moines	650	82.554%	79.547%	24.5	6.046
Council Bluffs	588	66.944%	66.317%	20.5	25.838
Waukee	536	90.530%	86.966%	23.6	2.884
Johnston	490	91.602%	88.776%	24.1	6.500
Southeast Polk	463	84.090%	80.849%	23.0	8.617
Linn-Mar	462	86.926%	83.206%	24.2	5.916
Cedar Falls	371	88.326%	84.679%	23.6	6.526
Bettendorf	369	86.251%	83.454%	23.4	14.669
College	342	77.865%	75.140%	23.1	8.781
Muscatine	328	70.983%	71.651%	19.4	24.703
Urbandale	316	86.507%	83.674%	22.7	5.617
Western Dubuque	312	88.269%	80.596%	22.9	4.505
Marshalltown	311	65.227%	59.637%	21.5	9.571
Pleasant Valley	300	93.264%	89.304%	24.5	3.793
Ames	279	88.421%	86.623%	25.2	5.677
Ottumwa	277	69.643%	63.290%	20.4	19.103
Indianola	264	86.293%	84.855%	22.6	12.222
Clinton	250	78.548%	75.596%	19.8	37.605
Mason City	233	71.104%	69.405%	22.3	24.338
Fort Dodge	224	61.521%	62.427%	23.0	20.697
North Scott	213	87.338%	82.307%	23.0	5.856
Burlington	208	65.307%	67.783%	22.3	21.848
Dallas Center-Grimes	183	91.020%	87.365%	23.4	4.682

Table 5: Descriptive Statistics for Selected School Districts, 2017 Controls

School District	*Enrollment*	*Non-White*	*Teacher Salary*	*Spending per Student*
Des Moines	33,884	59.713%	$58,715	$11,708
Cedar Rapids	16,846	34.109%	$68,807	$19,850
Davenport	15,823	44.309%	$59,128	$16,748
Sioux City	14,893	48.942%	$63,348	$13,931
Iowa City	13,986	41.920%	$70,220	$15,657
Ankeny	11,473	13.562%	$66,566	$11,858
Dubuque	11,214	21.803%	$54,552	$16,291
Waterloo	11,047	50.521%	$54,032	$13,687
Waukee	9,813	20.340%	$62,254	$11,023
West Des Moines	9,230	34.496%	$65,267	$13,276
Council Bluffs	9,188	23.868%	$61,877	$14,607
Linn-Mar	7,624	19.071%	$70,131	$11,013
Johnston	7,185	23.772%	$65,356	$10,085
Southeast Polk	7,091	17.684%	$62,867	$11,676
College	5,694	19.424%	$61,615	$10,104
Cedar Falls	5,516	16.062%	$59,459	$10,593
Muscatine	5,222	35.255%	$54,873	$10,019
Marshalltown	5,099	65.268%	$58,516	$9,624
Bettendorf	4,881	22.987%	$58,431	$10,079
Pleasant Valley	4,851	21.356%	$63,155	$8,954
Ames	4,580	32.511%	$58,081	$9,190
Ottumwa	4,570	35.492%	$57,800	$8,752
Urbandale	4,255	24.653%	$58,001	$9,961
Burlington	3,982	31.592%	$55,985	$8,983
Mason City	3,965	20.202%	$64,106	$9,910
Fort Dodge	3,904	26.537%	$56,863	$9,062
Clinton	3,683	25.903%	$56,993	$9,864
Indianola	3,641	8.569%	$65,630	$10,090
Western Dubuque	3,596	8.398%	$54,048	$9,250
North Scott	3,296	11.044%	$57,557	$8,825
Dallas Center-Grimes	3,140	8.025%	$55,129	$7,604

3.2 Independent Variables

Networks are composed of nodes and ties. Nodes are the entities in a network that form connections with one another; though nodes can be almost anything, they are usually individuals or organizations. The nature of node characteristics, often referred to as "attributes," can be qualitative (e.g., a node's organization type being a city or county) or quantitative (e.g., if nodes represent counties, total population or unemployment rate). Network ties, or the relationships between nodes, can similarly have a variety of attributes, including strength (e.g., how strongly one actor is connected to another), duration, and direction. Network ties are either directional (e.g., a school district seeking advice from a community college but the community college not seeking advice from the school district represents a non-symmetric directional tie) or non-directional.

Social network data is usually formatted as either an adjacency matrix, a square matrix in which "rows and columns represent nodes and an entry in row i and column j represents a tie from i to j," or as an edgelist, where rows represent a tie in the network and two columns indicate a pair of nodes that share a tie. Adjacency matrices can indicate tie strength in each (i, j) cell; edgelists include a third column to indicate tie strength (Borgatti, Everett, & Johnson, 2013, pp. 18, 67).

The five independent variables used in Hypotheses 1 through 5 (degree centrality; tie strength; average tie duration; active agreement count; and ego network transitivity) are defined below.

Degree Centrality

There are numerous approaches to understanding a node's position and its relationships with other nodes within a network, foremost among which is centrality (Wasserman & Faust, 1994). The most straightforward conceptualization of centrality stems from the supposition that central network actors are the most active in that they have more ties with other actors. This simple measure of degree centrality is calculated by summing the number of ties each node has,

$$Node\ Degree\ Centrality = \sum_{j} x_{ij}$$

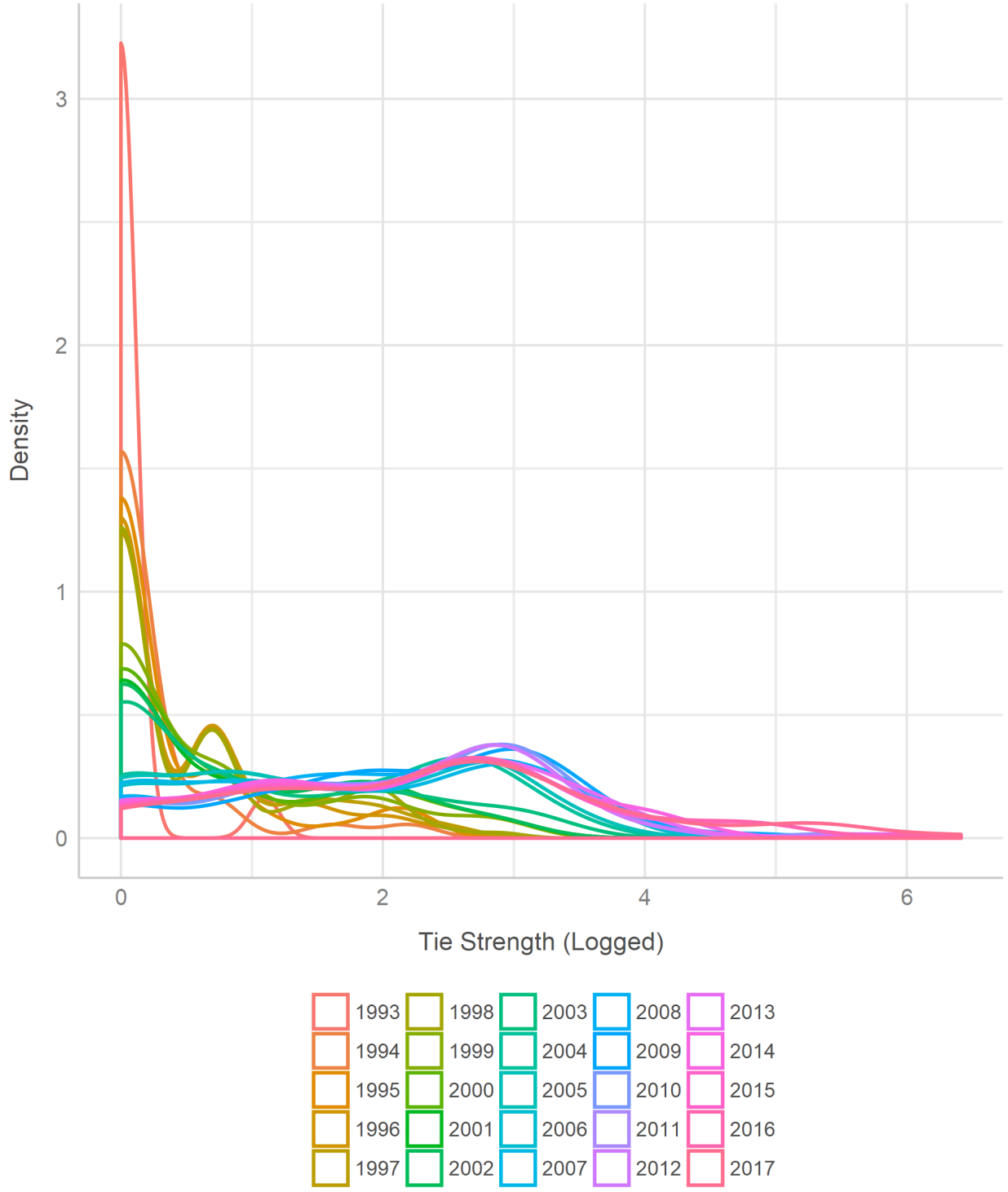
where x_{ij} is the (i, j) entry of x undirected adjacency matrix for each ith node.

Active Agreement Count, Tie Strength, and Average Duration of Active Ties

Active agreement count simply refers to, for each year, the number of in-force (i.e., active) agreements each school district was party to. Tie strength and average duration were calculated for each pair of nodes for each year. Tie strength was determined by counting the number of ILA agreements that were in force between two given nodes. For example, two school districts that were only signatories to three active agreements would each be assigned a tie strength of three.

A density plot of tie strength over time is shown in Figure 2. The data was log-transformed only to avoid presenting a skewed and visually-unappealing graph. Of note is the relatively low tie strength that persisted throughout the 1990s and the rapid shift toward relatively high tie strength beginning in the early- to mid-2000s.

Figure 2: Tie Strength (Logged), 1993 – 2017



The average duration of active ties was calculated by summing the duration of each active agreement (i.e., the number of years an agreement has been in force) each school district was party to and dividing the result by the total number of active agreements. A school district that is collaborating with three other school districts through three separate agreements that have been active for one, three, and four years respectively, for example, would have an average tie duration of 2.667 years.

For a density plot of average active tie duration over time, see Figure 3. Note the conspicuous increasing trend, implying that school districts tend to maintain an ILA tie once it is formed.

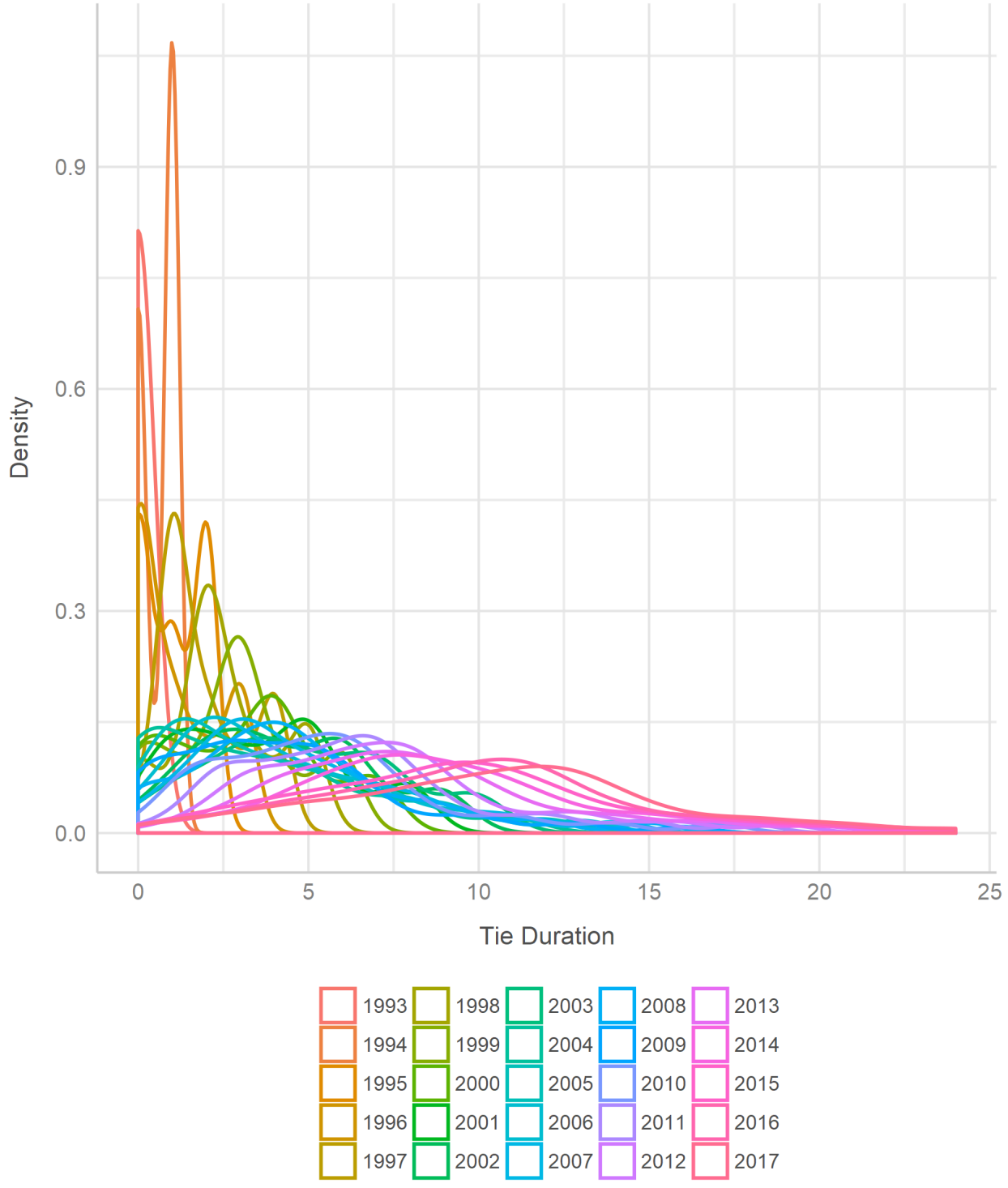
Network Transitivity

Network transitivity refers to the social tendency of forming closed clusters ("a friend of a friend is a friend"). If node i is connected to node j, and node j is connected to node k, node i is inclined to form a relationship with node k. Expressed in matrix notation, network transitivity refers to, across all possible triads, the proportion of triads where (i, j), (j, k), and (i, k) have ties,

$$Network\ Transitivity = \frac{\sum_{i,j,k} x_{ij}x_{jk}x_{ik}}{\sum_{i,j,k} x_{ij}x_{jk}}$$

for each (i, j, k) triad in an x undirected adjacency matrix. As per the hypotheses detailed in the previous chapter, this metric will be calculated for each node with respect to its ego network, not with respect to the entire network.

Figure 3: Average Duration of Active Ties, 1993 – 2017



Network Data Acquisition Process

Recall that Chapter 28E of the Iowa Code requires records formalizing all intersector collaborations to be filed with the state government. The Iowa Secretary of State maintains an online repository of all 28E agreements, which includes a photocopy or electronic version of the agreement along with textual metadata provided by the filer for almost every agreement filed on or after January 1, 1993. Each agreement's page lists its internal filing number, filing date, expiration date, service type, a short (i.e., one sentence or phrase) summary of its purpose, and each participant's name, organization type, home county, and state region. A "related agreements" section also exists on each page but has proven to be unreliable; it was subsequently excluded from the metadata acquisition process. The aforementioned termination notices simply include the filing number of the agreement being terminated and the filing date of the notice itself.

To construct the interlocal education network data, every agreement involving at least one public school district, and its accompanying metadata, had to be extracted from its filing page on the Secretary of State's website. To do so, a series of web scraping and data wrangling scripts were developed using the R statistical programming language and the *rvest* package.

Downloading 28E agreements *en masse* required assembling a list of desired agreement filing numbers, unique identifiers used internally by the Secretary of State database. Filing numbers are composed of one letter (either an "L" or "M") followed by a six-digit number. Given that these filing numbers are listed on each agreement's web page along with an

assortment of other useful metadata, all of the metadata was acquired prior to downloading the agreements themselves.

Determining how the web server front end constructed URLs was the first step to obtaining all of the agreement metadata hosted by the 28E repository (a URL, or uniform resource locator, is colloquially known as a web address). In addition to having a unique filing number, each agreement has a unique five-digit URL identification number that is only used in the context of displaying agreement information on the Secretary of State website. For example, the agreement between the City of Cedar Rapids and the Iowa Department of Transportation filed on February 3, 2017 lists "M509735" as its filing number but has "31337" as its URL identification number. To access this agreement's web page, a user could navigate to the 28E agreement search page (`https://sos.iowa.gov/28E/Controller.aspx?cmd=SOSSearch`) and input "M509735" in the "search by number" field, or manually navigate to a URL containing the correct identification number (i.e., `https://sos.iowa.gov/28E/Controller.aspx?cmd=SOSDetail&id=31337`). From a programming perspective, automating data extraction from web pages returned via URL is much simpler than doing so by manipulating submission forms.

After discovering the range of URL identification numbers through trial and error, the structure of the agreement pages needed to be deciphered. Fortunately, the HTML (Hypertext Markup Language, the building blocks of web pages) of each agreement page was standardized, rendering the task of writing an R script that saved each desired web page and extracted the necessary tables relatively straightforward.

To review, the process my set of metadata web scraping scripts iterates through is as follows: (1) build a URL that contains the desired agreement's unique identifier; (2)

temporarily save the HTML returned from the constructed URL; (3) convert the desired HTML tables into R data frames; and (4) bind the R data frames to a single master data table that persists across loop iterations. After each desired agreement's metadata has been extracted, the master data object is written out as a comma-separated value (CSV) file.

A nearly-identical process was undertaken to obtain termination notice metadata, with the only notable differences being that termination notices (1) are hosted by a separate database, which required deciphering a different URL scheme, and (2) have their own unique URL identification numbers that are completely unrelated to the agreement they are terminating (the filing number of the agreement being terminated is, of course, listed on the web page of each termination notice).

The raw data then needed to undergo an extensive transformation process to enable analysis. Agreements that listed fewer than two participants were dropped since any valid agreement requires at least two participants. Agreements filed prior to 1993 were also dropped since, before that point, the vast majority of agreements only list the filing number, filing date, and the service type. The Secretary of State website even displays a disclaimer, warning users that "the 28E database contains only limited detail regarding agreements filed prior to 1993." Since participant information is not recorded at all for these agreements, they have been omitted.

Though not used in this dissertation's analyses, the complete augmented 28E agreement database flags agreements that do not renew or extend an existing agreement (i.e., an "original" agreement). Since scrutinizing the text of each agreement is not feasible, this was accomplished by flagging every agreement as an original, setting that flag to zero if an agreement's one-sentence summary included the words "amend," "renew," "extend," or "ex-

tension," and manually correcting the false positives. Corrections "by hand" were necessary because the summaries for original agreements could include parts or all of those words (e.g., "Iowa Code as amended," "Clean Air Act Amendments of 1990," "road extensions," "county extension office," and "urban renewal project").

Next, to match ILA participants across agreements, typographical and organization classification errors had to be corrected. Unfortunately, agreement filers do not use a consistent name for their jurisdiction (e.g., the capital of Iowa is referred to as both "City of Des Moines" and "Des Moines"). Creating a uniform naming convention for participants of all organizational types is critical for enabling the analyses in Chapters 4 and 5 for two reasons: (1) a standardized list of school district names allows for matching participant names from the agreement network data to school district attribute data provided by the Iowa Department of Education, and (2) it ensures that only agreements involving public school districts are included. For example, Des Moines Area Community College (DMACC) campuses were occasionally classified as a K–12 school district despite being a two-year community college system. Further, ILA participants would often fail to list the name of the government being represented and instead list either the name of a senior public official in their jurisdiction (e.g., "Steve Siegel" instead of "Wapello County") or the name of their department ("Polk County Department of the Auditor" instead of "Polk County"). This necessitated the creation of a new variable that mapped ILA participants to a canonical (or "official") name.

Adjacency matrices representing the state of the interlocal education network were then created for each year. Recall from Chapter 2 that an adjacency matrix is a square matrix in which "the rows and columns represent nodes and an entry in row i and column j

represents a tie from i to j" (Borgatti et al., 2013, p. 18). To align with the data provided by the Iowa Department of Education, which is based on the academic school year, network years were adjusted to begin in August and end in July the following calendar year. In any given year, a tie was considered to exist if two participants were both signatories to the same in-force agreement (i.e., an agreement that has been filed but has yet to expire or be terminated). Each adjacency matrix cell contains a value representing the number of ties each education network participant has with every other education network participant. The universe of potential participants is composed of every public school district and any organization that has been party to at least one ILA involving a public school district at any time between 1993 and 2017. A network isolate in this context refers to a participant that is involved in zero active agreements in a given year. Both network-level and node-level metrics can be calculated from adjacency matrices.

The final step of the data acquisition process was to download every education agreement that involved at least one public school district. With the filing numbers and cleaned participant metadata ready for analysis, compiling a list of desired education agreements was straightforward; unlike the metadata scraping process, which required a separate URL identification number, downloading a PDF of an agreement only required its filing number. After writing an R script that downloaded every ILA where at least one public school district was a participant, non-PDF documents were manually converted to the PDF format (older agreements were occasionally uploaded in a tagged image file format, or TIFF). Finally, all PDF files were individually verified to ensure that none were corrupted and that each agreement page was rotated correctly.

3.3 Control Variables

Since student performance has been widely shown to be dependent on racial and socioeconomic factors (Berkowitz, Moore, Astor, & Benbenishty, 2017; Roscigno & Ainsworth-Darnell, 1999), several controls are necessary. There are five district-level control variables: (1) enrollment totals; (2) the percentage of enrolled students that are female; (3) the percentage of enrolled students that are non-white; (4) the percentage of students that are eligible for free or reduced-price lunch; and (5) spending per student, calculated by dividing total district expenditures by enrollment.

The four faculty control variables include: (1) students to full-time teacher ratio; (2) average teacher salary; (3) average teacher experience in number of years; and (4) the percentage of teachers with an advanced degree (i.e., a master's or PhD).

4 Qualitative Analysis

To enable a nuanced examination of the potential relationships between interlocal education networks involving public school districts and student outcomes, this chapter will conduct a qualitative analysis that classifies each ILA into substantive topics. ILAs designed to improve academic outcomes or maintain student discipline will then be subject to a series of quantitative analyses in Chapter 5.

4.1 Understanding School District Agreements

Though basic conclusions about the structure of Iowa's interlocal education network can be inferred from the metadata alone, gaining a substantive understanding of the topics covered by interlocal education agreements requires reading the agreements themselves. As discussed in Chapter 3, an R script designed to download all 2,042 agreements where at least one participant is a public school district was used to acquire the raw documents. However, the online database returned a message stating "This agreement has no uploaded scanned agreement on file" for 21 agreements. The forthcoming analysis therefore only uses 2,021 agreements.

Topic classification was initially attempted by leveraging automated natural language processing techniques. The potential of using this type of machine learning in the social sciences was succinctly summarized by a recent article in the *Journal of Public Administration Research and Theory*:

> Hollibaugh (2018) uses topic models to measure changes in the priorities of federal agencies using documents generated by these agencies. Similarly, Anastasopoulos, Moldogaziev, and Scott (2017) use county budget statements from California to measure and test Schick's (1966) theory of budgeting functions and priorities. In political science research Roberts et al. (2014) use topic models to extract politically relevant information from open-ended survey responses. (Anastasopoulos & Whitford, 2018)

Since structural topic models rely on word usage, a corpus of plain text is required. However, 28E agreements obtained from the Secretary of State's website only exist in PDF form, and had to be converted into text. Despite using modern open-source optical character recognition engines to complete this task, a significant amount of the output included garbled text. This was likely due to a combination of factors, including: the deteriorated quality of older documents that were scanned from an original hard copy; inconsistently-formatted appendix tables; and difficulty in handling ink stamps, government logos, and signatures that appeared on the agreements.

In addition, preliminary structural topic models struggled to correctly identify more than a handful of substantive topics because of how 28E agreements are often worded. Most of an agreement's text is devoted to defining the participants, providing clear definitions of the governance structure, delineating financial responsibilities, establishing conditions for termination of the agreement, and other legalese; relatively few words are devoted to the agreement's purpose, and those words are often nebulous. For example, a five-page 2017 agreement between the City of Bloomfield and the Davis County Community School District (M510627) devoted a single sentence to describing its purpose: "The purpose of

this Agreement is to provide a benefit to the School and to provide a benefit to the City all authorized by Chapter 28E Code of Iowa." Inferring the substantive topic of this particular ILA, which amended an existing ILA, required reading other agreements involving the same two participants.

For these reasons, each of the 2,021 agreements were read twice; once to establish the universe of potential agreement categories and a second time to classify agreements into said categories (summarized in Table 6). During the first pass, a phrase describing the purpose of an ILA was recorded when new topics were encountered. This list of phrases was then reduced by combining topics that were similar or frequently overlapped. For example, agreements created to coordinate the use of grounds, facilities, or equipment were collapsed into a single topic because details about all three would often be provided in the same ILA (e.g., a school district and a city sharing the use of a baseball field, gymnasium, and the equipment used to maintain both). A second classification pass of the ILAs using the reduced topic list was then conducted to ensure consistency.

Finally, to strengthen the connection between substantive topic and student performance outcome, a third pass of the "improve academic outcomes" ILAs was conducted to classify agreements on the basis of whether they primarily applied to or were intended for high school students. District diploma counts and ACT scores are both clearly associated with high school students, and standardized tests scores are available for 10th and 11th graders (depending on the year). Of the 584 ILAs that aimed to improve academic outcomes, 519 principally affected high school students (88.870%); the remaining 65 were excluded from the next chapter's quantitative analyses. Quantitative models that use all 584 ILAs to predict standardized tests scores across all grade levels can be found in the appendix.

Table 6: Summary of Agreement Topics

Topic	*Count*
Improving Academic Outcomes	**584**
Academic Advancement and Student Needs Programs	508
Admitting Students from Different Districts	58
Sharing Teachers	18
Student Discipline	**541**
Juvenile Court Services and School-Based Supervision Programs	459
Providing School Resource Officers	82
Other Interlocal Coordination	**884**
Pre-School and Child Care Programs	211
Coordinating Use of Grounds, Facilities, or Equipment	204
Coordinating Purchase or Construction of Grounds, Facilities, or Equipment	83
Employee Benefits Associations/Pooling Administrative Responsibilities	64
Iowa School Cash Anticipation Program	55
Coordinating Minor Civil Engineering Projects	52
Iowa Drug and Alcohol Testing Program	42
Sharing Staff	39
General Interlocal Coordination	36
Providing Crossing Guards	28
Coordinating Intergovernmental Transfers	25
Joint Purchasing of Petroleum and Other Goods	13
Providing School Nurses	11
Sharing Superintendents	9
Inmate Public Service Work Program	5
Coordinating Student Transportation	4
Driver Education Programs	3
Filing Errors	**12**
Incorrect Participant Metadata or Incomplete Document	10
Termination Notice	2
Grand Total	**2,021**

Intercoder Reliability

As with any research that involves coding, intercoder reliability is an important consideration. In the current analysis, I classified ILAs into topic categories using the procedure described above. To present a measure of intercoder reliability, an academic colleague was provided 100 randomly-selected ILAs (approximately 5% of the total sample) and a list of the 24 substantive topics displayed in Table 6. The external coder, an Iowa native who holds a PhD in political science from Duke University, was asked to read and classify each agreement based on the topic that was predominantly discussed in the text. In addition, he was asked to determine whether the "improving academic outcome" ILAs principally affected high school students.

Of the 100 randomly-selected ILAs, the external coder and I classified 97 into the same category; of the 38 "improving academic outcome" ILAs contained in the 5% sample, the third-party coder and I both flagged the same 36 as being primarily oriented toward benefiting high school students. Disagreement over three of the sampled ILAs stemmed from subjective interpretations of whether an agreement "predominantly" concerned the coordination of either (1) the *purchase or construction* of grounds, facilities, or equipment; or (2) the *use* of grounds, facilities, or equipment. In these cases, both topics were covered in the same ILA (i.e., the purchase, construction, and use of grounds and facilities were included in the text). These discrepancies were resolved via a joint review and discussion of the ILAs in question.

Very high intercoder reliability was anticipated due to the presence of template ILAs, which refer to groups of agreements that use identical text and include blanks to allow for

variation in participant names and filing dates. A significant proportion of the subtopics that compose the "improving academic outcomes" and "student discipline" topics — the subjects this dissertation is principally concerned with — consist of templates. Details concerning the classification process for the remaining non-template cases are provided in the forthcoming sections.

To reiterate, the external coder and I classified 97 of 100 randomly-selected ILAs into the same category and made identical determinations with respect to whether the 38 "improving academic outcome" ILAs in the sample principally affected high school students.

4.2 Improving Academic Outcomes

The broad "improving academic outcomes" topic is composed of three ILA subtopics: (1) "academic advancement and student needs programs," which aim to bolster academic advancement, and establish and operate programs that assist students with special needs; (2) "admitting students from different districts," which facilitate the admittance of students from external school districts; and (3) "sharing teachers," which straightforwardly involve the sharing of K–12 school teachers.

Academic Advancement and Student Needs Programs

The most common academic advancement programs involved school districts collaborating with local community colleges to allow high school students to enroll in introductory college courses for dual credit (i.e., high school credit to satisfy graduation requirements and college credit that could later be transferred to a community college or undergraduate degree

program). Community college systems that appeared frequently were based in areas with higher population, including: Des Moines Area Community College (DMACC) in central Iowa; Kirkwood in Cedar Rapids; Iowa Western in Council Bluffs; Hawkeye Community College in Waterloo; Indian Hills in Ottumwa; and Iowa Central in Fort Dodge. High school students were either able to enroll in classes on the community college's campus, or instructors from a community college would travel to local high schools in the school district to offer a small selection of classes (the course offerings were often listed in the agreements; introductory nursing and automotive mechanics, for example, were very common).

An agreement between Kirkwood Community College and four local public school districts (M500819) provides a representative example. The agreement's mission is to "create a dynamic learning environment for students to master skills essential to a cluster of careers within a career pathway and provide a seamless transition to postsecondary education or work." As is the case for many of the agreements in this category, providing students with "the opportunity for dual credit (high school and college)" is listed among its goals.

Examples of other ILAs that were considered to be encouraging academic advancement include school districts collaborating with one another to operate academic decathlons (M507857); establishing a jointly-operated local academy to "provide an appropriate educational experience for talented and gifted students" (L005815); and granting a school district permission to construct a house on municipality-owned land for an industrial technology class (M000433), providing a real-world model for enrolled students to learn the basics of home repair and manual craftsmanship.

Agreements that created programs to address student needs, whether they have a learning disability, are considered at risk of dropping out of school, or seek to return after

dropping out, were considered to be part of the broad improving academic outcomes category because the text of the agreements frequently cited the provision of instruction as the collaboration's ultimate purpose. For example, an agreement between the Urbandale Community School District and five other public school districts (M509788) established a jointly-administered program to serve "students in grades 9–12 who are identified as at-risk of dropping out of school." The program, governed by the superintendents of each participating school district, provides students identified as "at-risk or as potential or returning dropouts" with a "quality education" via "appropriate alternative instructional programming beyond the costs of providing instruction for students in a regular curriculum."

Admitting Students from Different Districts

Agreements concerned with admitting students from different school districts also intend to improve academic performance, with one district often acknowledging that they lack the sufficient resources to provide a sufficient challenge for their "talented and gifted" students. This class of agreements predominantly involves the Des Moines Independent Community School District (usually shortened to "Des Moines Public Schools" or "DMPS") and another school district located in central Iowa. DMPS operates both Central Campus, a generically-named regional academy that offers vocational courses (and hosts Scavo Campus, an alternative high school), and Central Academy, a highly-selective academic program for students in grades 8 through 12 that is typically excluded from analyses and rankings due to being a magnet school.

Given the demand for enrollment in Central Campus and Central Academy, the number of school districts located in central Iowa, and the need to file agreement renewal docu-

ments, DMPS lawyers drafted a template agreement containing only a handful of blanks to be filled in with the name of the external school district's name, the agreement's effective date, and signatures from the president of each district's board of directors (often referred to as the "chair of the school board"). An agreement between DMPS and the Saydel Community School District (M507703) provides an example of the template, which states that DMPS "has available the personnel, classrooms, laboratories, equipment, and facilities necessary to provide specialized programs for students residing in and attending the Des Moines Independent Community School District and the [external school district] to jointly utilize school personnel, classrooms, laboratories, equipment, and facilities for providing vocational and other specialized programs." The template further states that the agreement "will be administered day-to-day by the Director of Central Campus."

Sharing Teachers

Jointly sharing the services of a teacher is the final type of agreement oriented around improving academic outcomes. These ILAs typically share the services of one or two teachers for specific classes. For example, an agreement between the Westwood and Monona Community School Districts (M030142) was created to share the services of one science teacher. All of the expenses incurred in the employment of said science teacher, including "salary, fringe benefits, IPERS [Iowa Public Employees' Retirement System], FICA, and travel," were to be evenly split between the two districts. Other subjects taught by teachers shared via agreements in this category include physics and Spanish (M506336), family and consumer science (e.g., M500985), and industrial technology (e.g., M500943 and M500985).

Improving academic outcomes is the ultimate goal of ILAs that establish academic advancement programs, allow students to enroll in external school districts, and share K–12 teachers. By engaging with Kirkwood, students, teachers, and principals from four school districts in the Cedar Rapids metropolitan area were afforded an opportunity to forge new bonds (i.e., build social capital), which potentially facilitated knowledge and advice being exchanged. These ILAs provide favorable circumstances for public school faculty and community college instructors to share best practices, course plans, and syllabi, while high school students are exposed to more challenging courses and topics they might not otherwise have been exposed to. ILAs that allow students the chance to enroll in a different school district or that share the services of a teacher grant access to more rigorous classes and a set of course offerings that may have otherwise been unavailable to them. Magnet schools enabled by these ILAs encourage diverse, academically-oriented students to learn in the same classrooms and forge new social ties that enable a free flow of knowledge and advice.

4.3 Student Discipline

The broad "student discipline" topic involves ILAs from two subtopics: (1) "Juvenile Court Services and school-based supervision programs," which consist of school-based supervision programs overseen by the state's juvenile court system (and partially funded by the Iowa Department of Human Services), and (2) "providing school resource officers," which facilitate the placement of local police officers in schools.

Juvenile Court Services and School-Based Supervision Programs

Chapter 15 of the 441 Iowa Administrative Code (IAC) defines "school-based supervision" as "a program that provides for salaried staff, known as juvenile court school liaisons, to be hired by providers." These liaisons "provide on-site services at middle and high schools to children experiencing truancy or other behavior problems at school and at home or in the community" and "assist with behavior and classroom management, conflict resolution, school attendance, and violence prevention" (IAC 441-151.31.232). Each state judicial district's chief juvenile court officer is "responsible for selecting school-based programs for funding and for managing the judicial district's school-based supervision allocation to ensure that resources are targeted effectively among schools within the district." The chief juvenile court officer may also "elect to develop an intergovernmental 28E agreement with the school district," though the school district may instead request that a contract "be developed with an independent provider pursuant to a competitive bid" (IAC 441-151.31.6).

The vast majority of the juvenile court services (JCS) and school-based supervision program ILAs are templates with blanks that allow for variation in the participating school and state judicial districts. The Iowa Department of Human Services, which usually reimburses school districts half of the costs associated with JCS liaisons, is almost always a signatory as well.

Providing School Resource Officers

In some cases, school districts opt to collaborate with their local police department to obtain the services of a school resource officer (SRO). Districts usually agree to reimburse

a portion of or the full cost associated with having a full-time SRO on school grounds. An agreement filed in 1994 between the Newton Community School District and the Newton Police Department provides an early definition of an SRO's purpose:

> The SRO will work with school staff to identify students who are at risk for gang-related involvement and/or abuse. The SRO will work with community committees to develop strategy related to juvenile substance abuse prevention, juvenile crime, and truancy. The SRO will coordinate and provide educational training to students and staff regarding health and safety issues. (L005528)

Further, numerous SRO agreements state that the SRO will both provide "guidance and support" to school staff and students, and serve as a liaison between the school district and the police department "in order to resolve matters of mutual concern" (M510057).

Both JCS school-based supervision and SRO agreements explicitly state the reduction of truancy and disruptive behavior, which often results in suspensions and expulsions, as a goal. It is clear that these types of agreements are meant to instill student discipline by allowing students to directly interact with JCS liaisons and SROs.

4.4 Other Interlocal Coordination

There were 17 categories that did not directly relate to improving academic outcomes or student discipline. Though not strictly relevant for the forthcoming quantitative analysis,

a brief summary of representative agreements concerning each of these topics provides context to the broader interlocal education network.

Pre-School and Child Care Programs

Chapter 256C of the Iowa Code establishes a statewide pre-school program "to provide an opportunity for all young children in the state to enter school ready to learn by expanding voluntary access to quality preschool curricula for all children who are four years old" (Iowa Code, Chapter 256C, Section 2). Organizations that wish to join the program must meet certain requirements established by the Iowa Board of Education, including class sizes, teacher-to-child ratios, and student learning standards. Section 3 of Chapter 256C references Chapter 28's interlocal agreements, requiring public school districts that participate in the program to "submit a collaborative program proposal that demonstrates the involvement of multiple community stakeholders." School districts that are signatories to agreements in this category are almost always collaborating with privately-operated child care facilities (both nonprofit and for-profit), rather than another school district or governmental entity.

Coordinating Use of Grounds, Facilities, or Equipment

Over 200 ILAs serve as a mechanism, usually between a school district and a local municipality, to coordinate the use of grounds, facilities, and equipment. The type of grounds being shared were almost always related to sports; baseball diamonds, football fields, soccer fields, and tennis courts were frequently mentioned. Examples of shared facility use ranged from basketball courts in a school gymnasium to allowing local theater troupes to perform in a school auditorium. Shared equipment usually pertained to the upkeep or use of related

grounds and facilities (e.g., lawnmowers to maintain grass fields or a city providing tower space to a school district for radio communications equipment).

Coordinating Purchase or Construction of Grounds, Facilities, or Equipment

School districts and city governments will often jointly purchase real estate (e.g., land for a public park) or other major assets (e.g., a digital community sign) and share building construction (e.g., developing a community center) or other land development costs (again, often related to recreational sports). Relative to coordinating the shared use of grounds or facilities, the shared purchase of capital assets or construction of new buildings requires a higher level of financial investment and commitment. These ILAs were consequently placed in separate categories.

Employee Benefits Associations/Pooling Administrative Responsibilities

Virtually all school districts belong to a statewide benefits organization that provides medical, dental, vision, life, and disability insurance. The current iteration of this program is known as the Iowa Schools Employee Benefits Association (ISEBA). School districts may elect to join other risk-pooling benefit trusts, such as the Iowa Governmental Health Care Plan (IGHCP).

To similarly benefit from economies of scale, smaller school districts may pool administrative responsibilities commonly tasked to human resource departments, such as "conducting research and surveys of wages, salaries, and employee benefits for comparable positions in school districts and businesses, both within and outside the state of Iowa" and "handling personnel grievances upon request" (L005739).

Iowa School Cash Anticipation Program

Though inactive at the time of writing, ISCAP formerly enabled schools to "pool their temporary cash flow management needs" via "various cost-effective cash flow borrowing structures," including the ability to "issue warrant certificates to finance cash flow deficits until revenues from property taxes and state foundation aid are received" (Iowa Association of School Boards, 2019b).

Coordinating Minor Civil Engineering Projects

A surprising number of the ILAs involved school districts working with a local city or county government to work on minor civil engineering projects. Examples included widening turning lanes on roads that connected to a school (e.g., M013280), building sidewalks and crosswalks for student use (e.g., M510294), and replacing water mains and sewer lines in school buildings (e.g., M510397).

Iowa Drug and Alcohol Testing Program

IDATP assists school districts to "economically and efficiently comply with state and federal drug and alcohol testing requirements" and "provides updates on the regulations, sample policies, and sample forms for ease in meeting the employer's responsibilities to their drivers" (Iowa Association of School Boards, 2019a). For member school districts, IDATP will conduct random drug screenings of drivers on a monthly basis, in addition to pre-employment and post-accident screenings.

Sharing Staff

School districts with low enrollment totals often opt to share the services of a single staff member. Examples of shared staff members include a maintenance director responsible for training and supervising custodial staff (e.g., M510321), an information technology operations manager (e.g., M508971), and a school counselor (e.g., M509985).

Providing Crossing Guards

Usually involving one school district and one municipal government, agreements in this category establish and operate adult crossing guard programs (e.g., M510363). Generally, school districts are responsible for hiring and paying the crossing guards' wages, while the city provides employee training and reimburses the school district for a portion of the crossing guard's hourly wage.

Coordinating Intergovernmental Transfers

To generate revenue for local or regional projects, municipal governments have the option of imposing a local option sales tax, subject to approval by the voters via referendum. To coordinate intergovernmental transfers of funds generated by the tax, cities will occasionally enter into an interlocal agreement with a school district that specifies which projects the funds should be used for and the proportion of revenue districts can expect. For example, a 1997 agreement between the City of Des Moines and DMPS allocates 16.5% of the revenue generated by a newly-imposed 1% city-wide sales tax toward the school district's plan to "finance the construction, improvement, and equipping of schools" (L006414).

Joint Purchasing of Petroleum and Other Goods

To obtain a feasible price, school districts, municipal governments, and county governments that operate in areas with particularly low populations must jointly purchase petroleum to fuel school buses and government vehicles (e.g., L005386 and M000407). Occasionally, school districts and local governments will jointly purchase other goods, such as computer hardware (e.g., M000582).

Providing School Nurses

To ensure that a qualified, licensed nurse is available on school grounds, local hospitals may cooperate with districts to offer medical personnel (e.g., L005854, M015084, and M506365). School districts typically provide office space, the necessary medical supplies, and a portion of the nurse's salary.

Sharing Superintendents

Given that over half of Iowa school districts enroll less than 1,000 students, several school boards have opted to hire one person to serve as superintendent for two districts (e.g., M032479, M502969, and M508554). These agreements are typically short, usually stating the proportions each school district will pay toward the superintendent's salary and benefit package, their term of employment, and formal duties.

Inmate Public Service Work Program

Five agreements involved the Iowa Department of Corrections collaborating with public school districts as part of a broader work program in which "inmates of state correctional institutions provide products or services to other departments or agencies of the state or to political subdivisions of the state" (M027277). These template agreements provide inmate services for the "construction or maintenance" of "public or charitable facilities," environmental maintenance (such as brush and weed cutting, tree planting, and erosion control), or educational or vocational training outside of the state correctional institutions (M027894).

Coordinating Student Transportation

Four agreements involved transporting students on buses; participants ranged from two adjacent school districts, one public and one private school with overlapping service areas, and a public school district paying its local municipality a fee to allow students to ride on city bus routes (L006076, M028961, M500518, and M503635).

Driver Education Programs

In three agreements, local community colleges provided on-site classroom services and behind-the-wheel driver training for high school students. School districts provided the instructional materials and classroom space, while community colleges provided the instructor and cars (L005811, M500782, and M502371).

General Interlocal Coordination

Finally, agreements that did not clearly fit into any other category were classified as "general interlocal coordination." Examples of these agreements include: creating regional recreation boards with a vaguely-defined mission of providing a "recreational activities program" (e.g., M024929), DMPS teachers participating in AmeriCorps collaborating with the City of Des Moines' Department of Parks and Recreation to coordinate volunteer efforts (M005902); a municipal utility offering electricity to a single school district at a discounted price (M022583); and providing general legal services to school districts in the Quad Cities metropolitan area (L005662 and L005665).

4.5 Filing Errors

There were 12 agreements that contained incorrect participant metadata (e.g., M032235 classified the City of West Des Moines as a school district and inexplicably used "West Des Moines Community School District" as the participant name), uploaded an incomplete document (e.g., L006064), or was actually a termination notice mistakenly filed as a new agreement (M000020 and M502216). These ILAs have been excluded from all forthcoming analyses.

4.6 Analysis

Though there is a conspicuous upward trend in the number of ILAs that school districts participate in over time, the fluctuation in active agreements concerned with improving academic outcomes and student discipline is considerably less tumultuous, with totals re-

maining relatively constant since 2015 (see Figure 4). At the same time, tie strength and average duration of active ties steadily increased over time, with both stabilizing in recent years (as visualized in Chapter 3). These relationships may be due to an ILA network "lock in" effect, where school districts gradually establish ILAs with a stable set of external actors and only file new agreements when old ones expire.

Figure 4 further conveys that the academic outcomes subnetwork experienced a drastic increase in ILA filings during 2008 and 2009. The bulk of these agreements were between school districts and the Des Moines Area Community College (DMACC) system, which operates six academic campuses located in Ankeny, Des Moines, West Des Moines, Newton, Boone, and Carroll. Given the breadth of its geographical presence, DMACC is well-positioned to collaborate with dozens of public school districts across the state. The influx of agreements could be due to a large financial donation that bolstered DMACC's collaborative capacity or a simple batch filing of older or previously-unfiled agreements (a review of DMACC's summary of its history did not provide an explanation).

To enable initial broad-based inferences, school districts were placed into four tiers based on quantiles of enrollment, ITED math proficiency rates (i.e., the number of high school students considered proficient in math divided by the number of students tested), and the number of reported suspensions and expulsions divided by total enrollment (see Tables 7 and 8). Note that each metric operates separately; for example, a school district can be classified as Tier 4 for enrollment, Tier 1 for math proficiency rates, and Tier 2 for removal rates. The average number of active agreements was then calculated for each school district tier type, for each of the broad topic subnetworks, for each year.

Figure 4: Active Agreements by Topic, 1993 – 2017

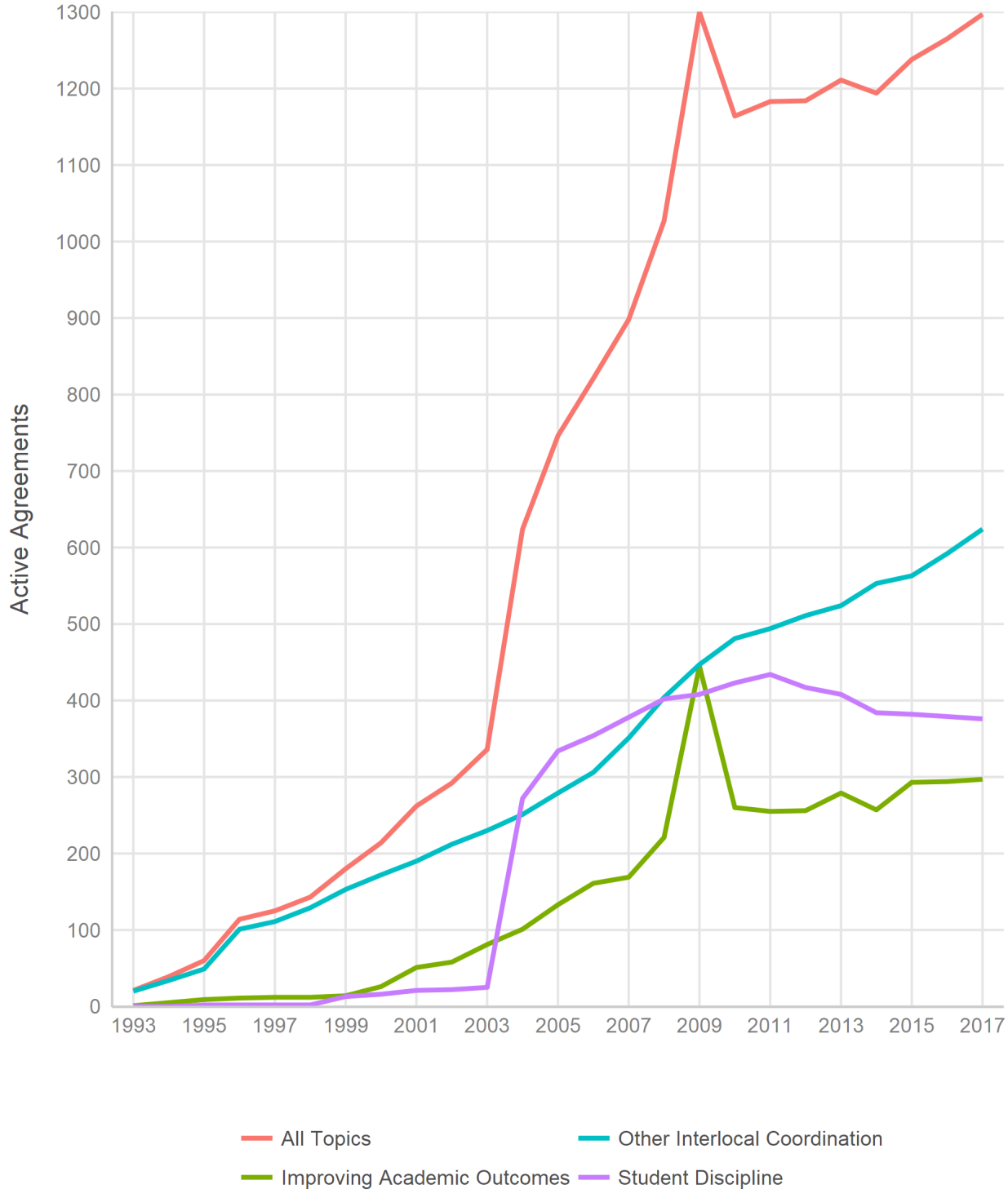


Table 7: District Quantile Binning Boundaries

Classification	*Enrollment*	*Math Proficiency Rates*	*Removal Rates*
Tier 1	[0, 518)	[0%, 81%)	[0%, 0.20%)
Tier 2	[518, 867)	[81%, 87%)	[0.20%, 0.47%)
Tier 3	[867, 1,694)	[87%, 91%)	[0.47%, 1%)
Tier 4	1,694+	91%+	1%+

Table 8: District Count by Tier, 2017

Classification	*Enrollment*	*Math Proficiency Rates*	*Removal Rates*
Tier 1	98	82	75
Tier 2	94	90	79
Tier 3	79	62	88
Tier 4	62	75	91

School district enrollment tier and the average number of active agreements were positively associated across all subnetworks, with larger districts being party to more active agreements than smaller districts (see Figure 5). This may be due to a relationship between district size and ILA subtopic preferences. Generally, ILAs that enabled the admission of students from an external school districts involved DMPS (a Tier 4 enrollment district) and another district in in the Des Moines metropolitan area (usually a Tier 3 or another Tier 4 enrollment district). Programs that allowed high school students to enroll in community colleges for dual credit similarly involved larger districts, as community college campuses are primarily concentrated in urban areas.

In contrast, smaller districts were more likely to collaborate with similarly small districts to share the services of one or two teachers for specific classes. Since small districts operate in sparsely-populated, rural areas of the state, there are fewer potential collaborators available; the average small district would expectedly be involved in fewer active agreements.

The student discipline subnetwork experienced a noteworthy increase in ILA filings involving the Iowa Department of Human Services and one of eight state judicial districts during the 2004 school year. However, this escalation of ILA filings will not directly impact regression models in the next chapter because attendance, suspension, and expulsion data are only publicly available from 2009 onward. As with the improving academic outcomes subnetwork, districts in higher enrollment tiers are, on average, active in more student discipline ILAs.

Relationships between school district math proficiency, removals, and mean active agreements were more difficult to discern (see Figures 6 and 7). Over the past decade, a district's math proficiency tier has been inversely related to student discipline ILAs usage (see

Figure 6, Pane 2); an expected conclusion given that math proficiency rates are negatively correlated with suspension and expulsion rates: $r(4826) = -0.146, p < 0.001$.

By 2017, lower-tier math proficiency school districts were party to a higher number of active agreements. However, this association may be driven by high enrollment school districts participating in a greater number of agreements overall; across all years, high school math proficiency and district enrollment were negatively correlated: $r(4826) = -0.142, p < 0.001$. When examining schools by removals tier, DMPS (which is a Tier 1 removals district due to its outsized enrollment count) similarly exerts a great deal of influence on the mean number of active agreements (see Figure 7).

Figure 5: Mean Active Agreement Count by Size Tier, 1994 – 2017

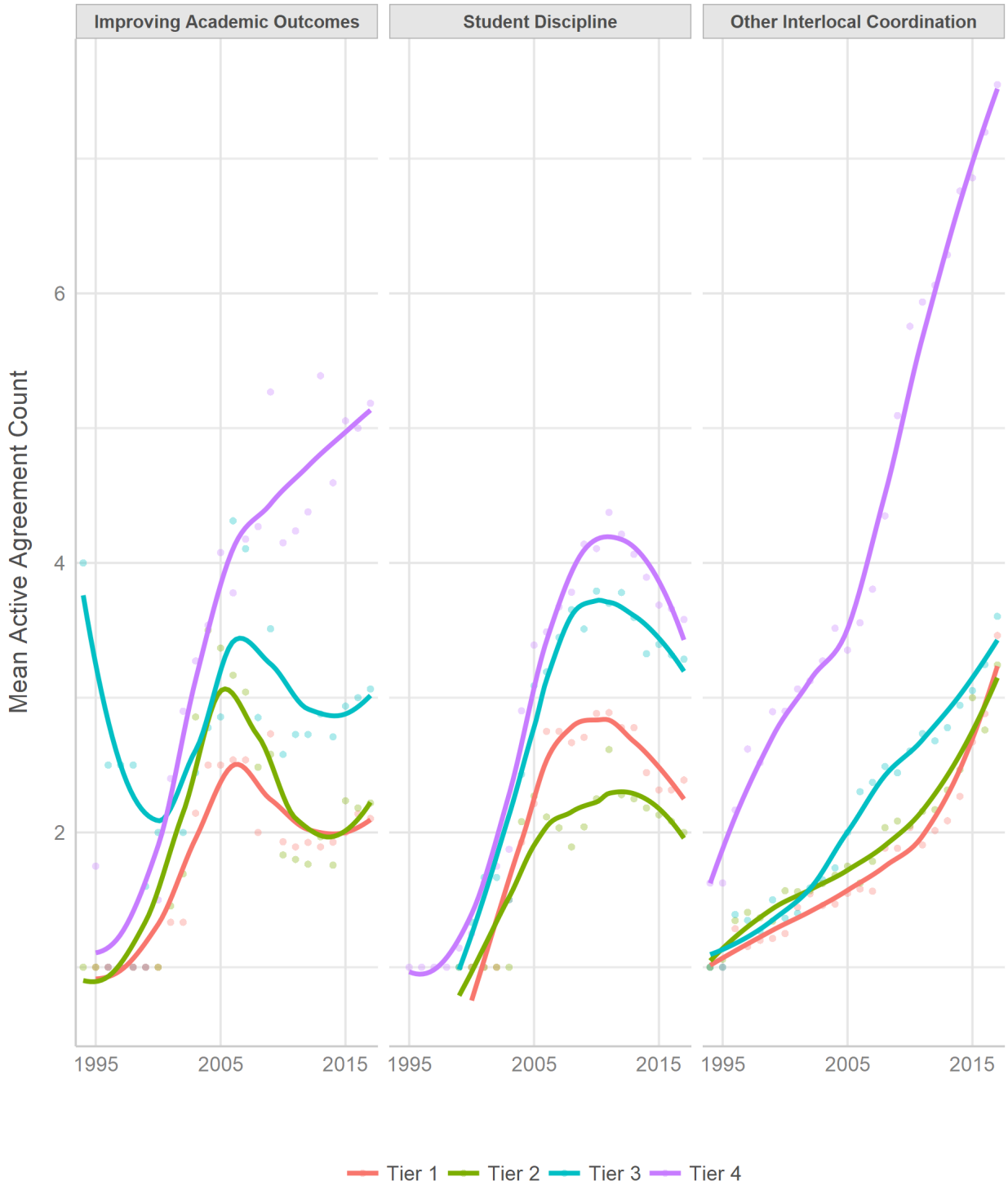


Figure 6: Mean Active Agreement Count by Math Proficiency Tier, 2006 – 2017

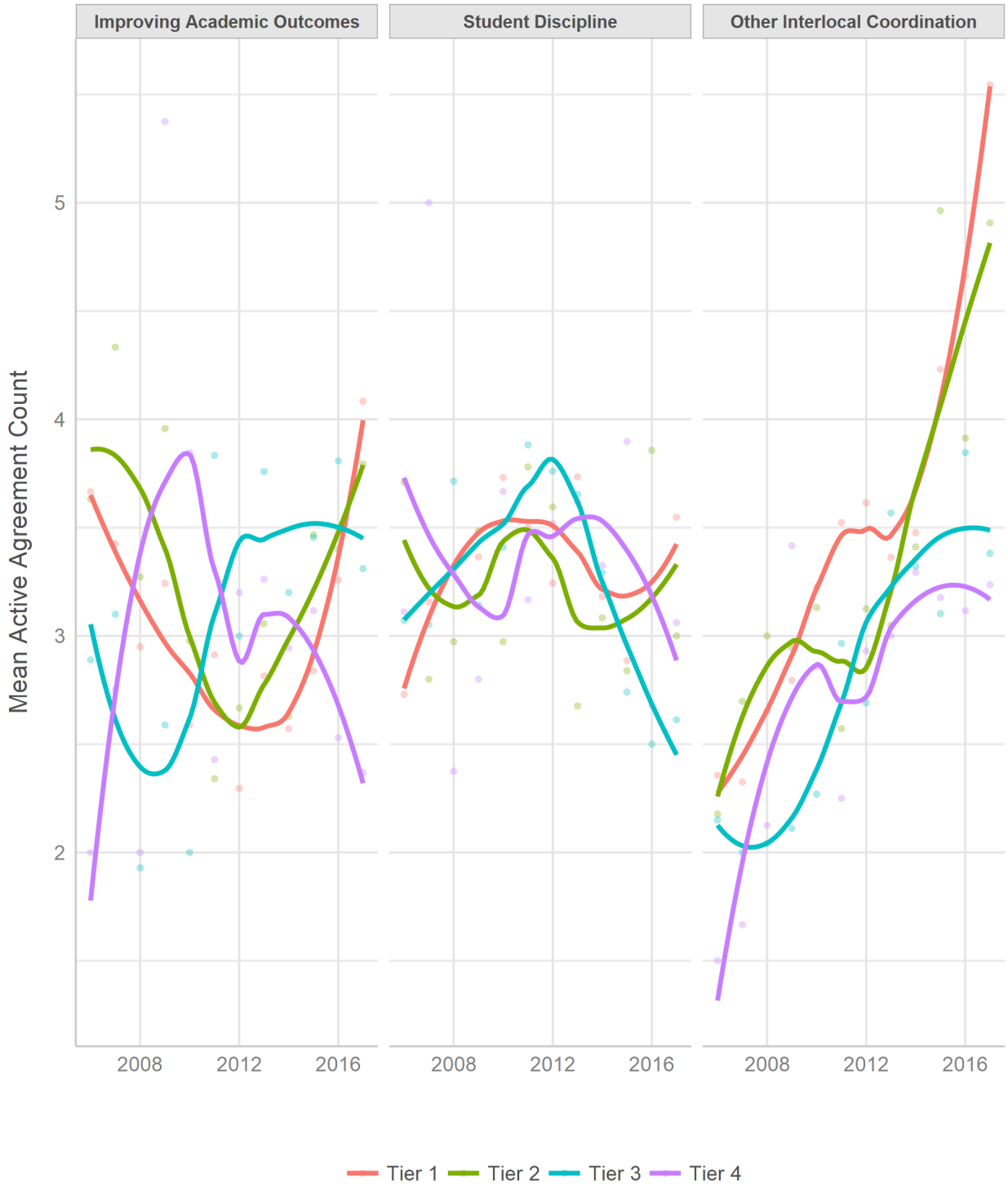
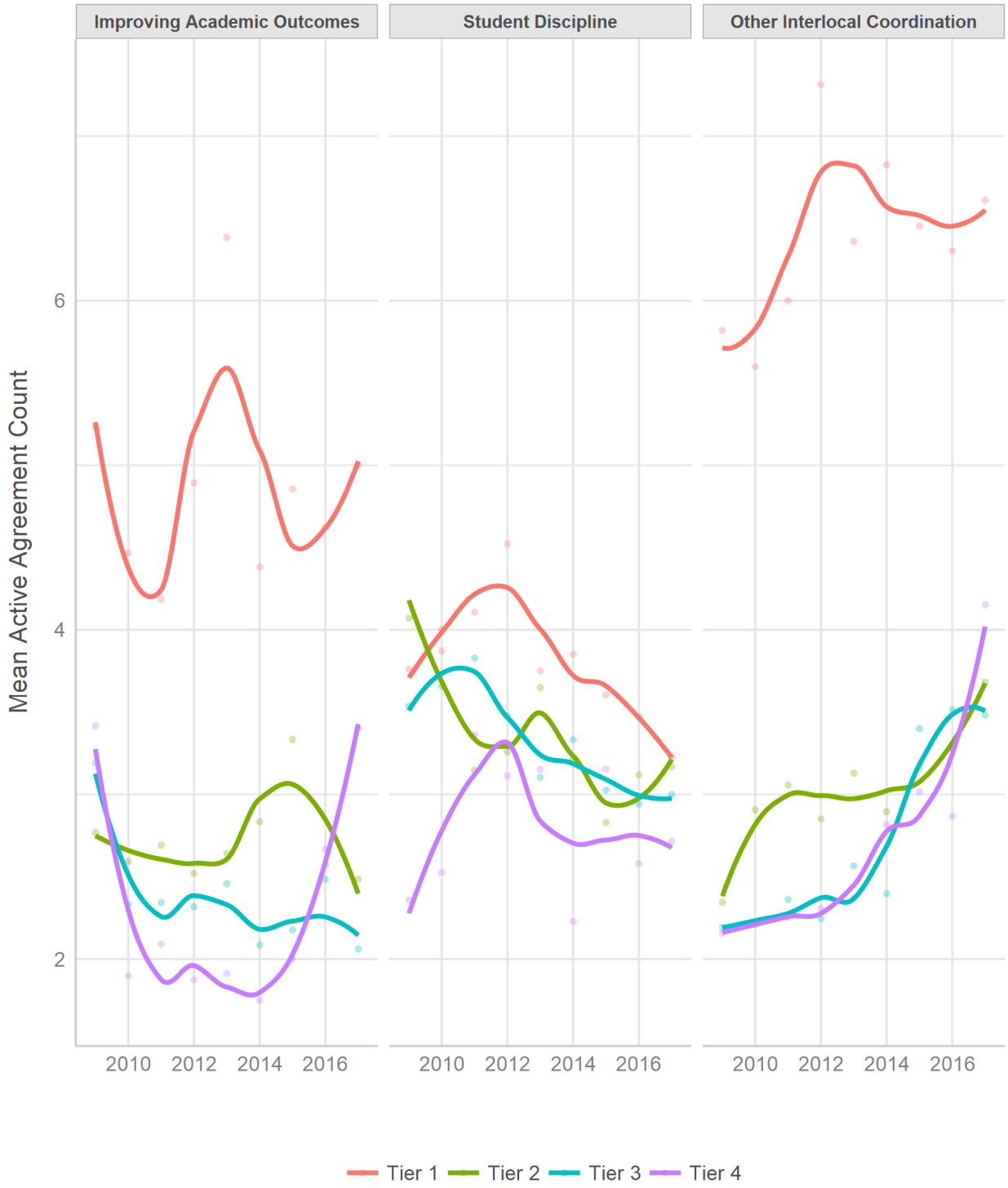


Figure 7: Mean Active Agreement Count by Removals Tier, 2009 – 2017



5 Quantitative Analysis

In the previous chapter, a substantive understanding of ILAs involving Iowa public school districts and what they were aiming to accomplish was gained by parsing the differences between ILAs that compose networks concerned with improving student academic outcomes, upholding student discipline, and facilitating other forms of interlocal coordination. The results of this agreement topic classification process enable empirical evaluations of the link between networks related to the outcomes they are designed to produce and quantitative measures of those outcomes. To examine the relationship between interlocal collaboration networks involving Iowa's public school districts and student outcomes, this chapter estimates a series of panel regressions that include year and district fixed effects.

5.1 Subnetworks and Student Performance Measures

As discussed in Chapter 2, student outcomes should not be used as a basis for judging the performance of an ILA network aimed at, for example, forming a statewide consortium that operates a drug testing program for school bus drivers. The performance of ILA networks should instead be judged on the basis of the networks' goals. Determining the impact on academic and discipline outcomes within agreement topic networks primarily oriented toward allowing high school students to take community college classes for credit or sourcing school resource officers from local police departments respectively, however, would significantly improve construct validity.

The ILA education network was therefore broken down into subnetworks composed of agreements from each major substantive topic, or "agreement topic networks." Subnetworks were constructed using ILAs that were classified as being related to academic outcomes and student discipline. For descriptive statistics and visualizations of these subnetworks, see Tables 9 and 10, and Figures 8 and 9, respectively. Descriptive statistics of the complete network (i.e., all substantive topics), along with a visualization of that network, can be found in the appendix; see Table A1 and Figure A11, respectively.

The differences in overall-network centralization and transitivity are noteworthy. Since 1993, the improving academic outcomes subnetwork has generally been less centralized and but more interconnected (i.e., higher level of transitivity), relative to the student discipline subnetwork (see Table 9). The variance in centralization is attributable to how agreement topics are structured. The improving academic outcomes subnetwork is principally composed of agreements that either (1) enable coordination between a public school district and a community college system (e.g., academic advancement programs), or (2) enable coordination between two or more school districts (e.g., admitting students from external districts). In contrast, the student discipline subnetwork is dominated by school liaison officer agreements that involve collaborating with the same state agency, the Iowa Department of Human Services (see Table 10).

The forthcoming analysis is based on ILA networks composed of actors that include all public school districts and any participant that signed an agreement involving at least one school district, which include non-district entities. Theoretically, these "complete" networks may differ from ILA networks that are only composed of school district nodes (i.e., an "interdistrict" network); collaborations that involve partners from the state government

Table 9: Improving Academic Outcomes Subnetwork Descriptive Statistics

Year	*Node Count*	*Isolate Count*	*Edge Count*	*Centralization*	*Transitivity*	*Newly-Filed ILAs*
1993	385	383	1	0.260%	0.000%	1
1994	385	380	3	0.519%	0.000%	4
1995	385	376	6	0.777%	0.000%	4
1996	385	373	9	0.773%	42.857%	2
1997	385	373	9	0.773%	42.857%	1
1998	385	373	9	0.773%	42.857%	0
1999	385	365	25	1.275%	94.030%	2
2000	385	351	48	2.029%	74.545%	12
2001	385	345	55	3.590%	54.783%	25
2002	385	342	58	3.848%	52.227%	7
2003	385	339	97	4.580%	77.990%	23
2004	385	336	111	4.823%	77.872%	20
2005	385	328	115	4.817%	77.872%	32
2006	385	310	222	4.672%	92.241%	28
2007	385	309	223	4.671%	92.197%	8
2008	385	254	319	5.064%	86.495%	68
2009	385	186	494	13.464%	52.894%	247
2010	385	233	338	13.153%	54.835%	8
2011	385	250	231	13.298%	28.125%	3
2012	385	249	236	13.291%	28.534%	7
2013	385	246	256	13.264%	27.550%	27
2014	385	249	237	13.290%	28.370%	5
2015	385	241	267	13.249%	27.368%	39
2016	385	240	275	13.238%	28.057%	3
2017	385	239	275	13.238%	27.941%	5

Figure 8: Improving Academic Outcomes Subnetwork, 2017

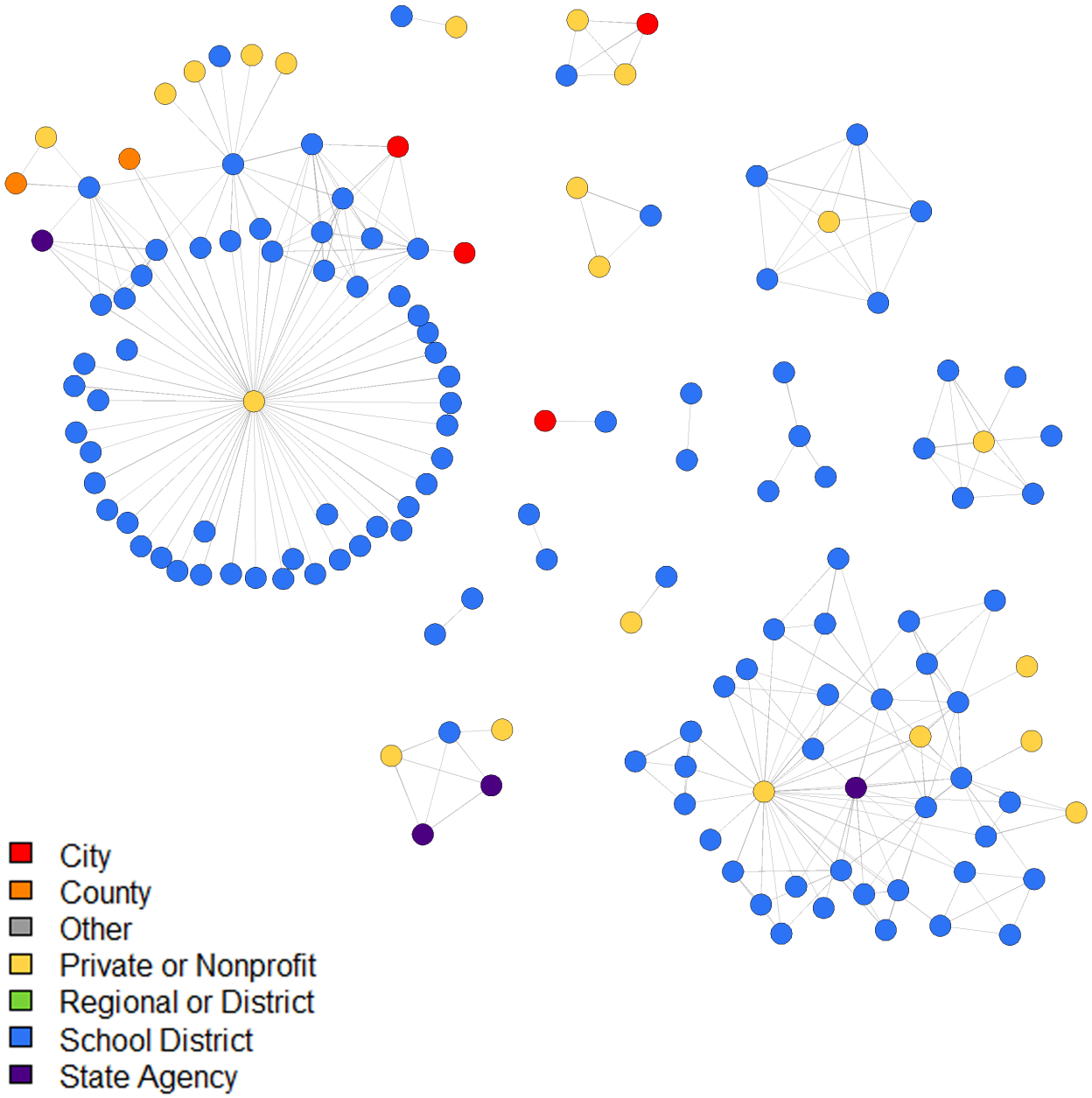
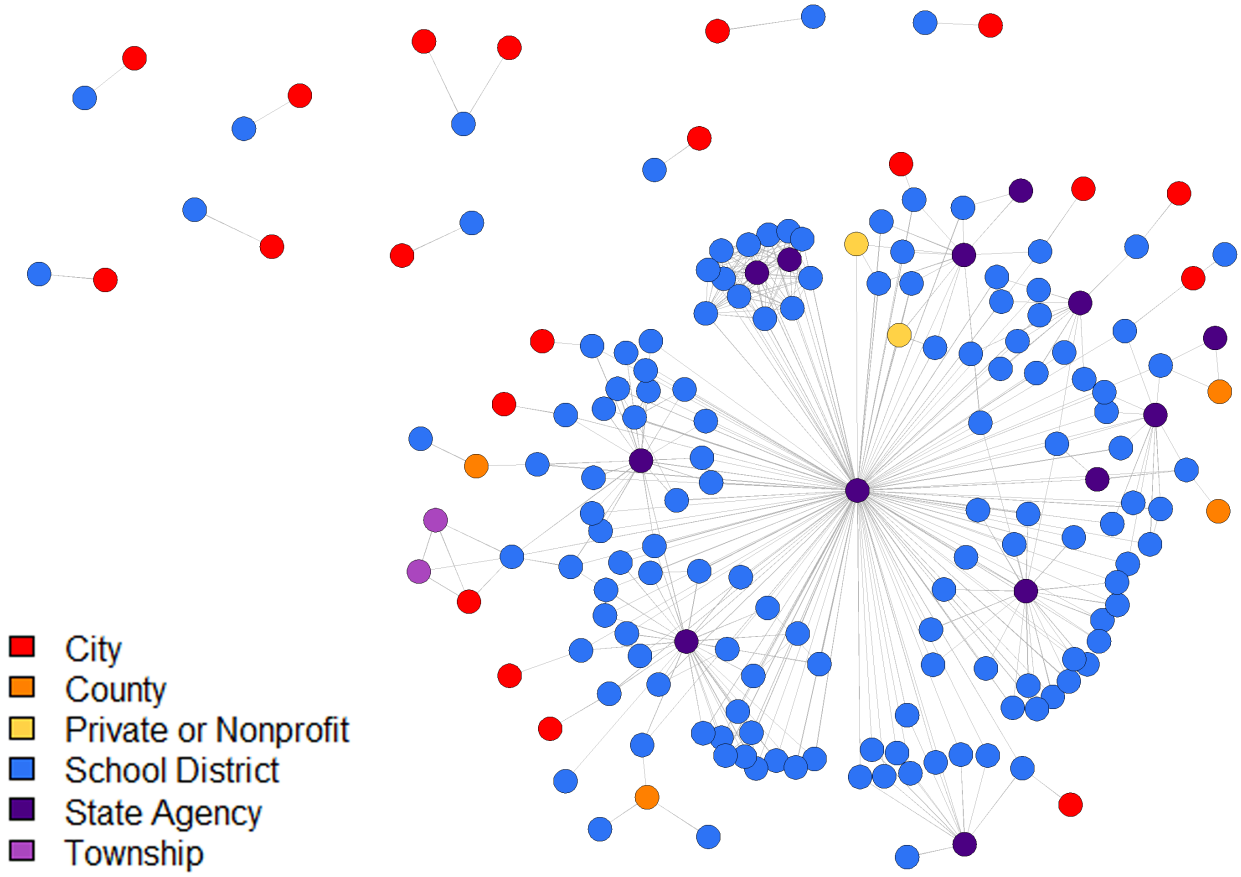


Table 10: Student Discipline Subnetwork Descriptive Statistics

Year	*Node Count*	*Isolate Count*	*Edge Count*	*Centralization*	*Transitivity*	*Newly-Filed ILAs*
1993	390	390	0	0.000%	0.000%	0
1994	390	390	0	0.000%	0.000%	0
1995	390	385	4	0.511%	100.000%	2
1996	390	385	4	0.511%	100.000%	0
1997	390	385	4	0.511%	100.000%	0
1998	390	385	4	0.511%	100.000%	0
1999	390	371	14	1.015%	23.077%	11
2000	390	369	15	1.014%	23.077%	3
2001	390	366	17	1.011%	21.429%	5
2002	390	366	17	1.011%	21.429%	1
2003	390	365	18	1.010%	20.000%	3
2004	390	243	382	33.085%	17.529%	247
2005	390	238	389	33.593%	17.158%	62
2006	390	233	396	33.842%	16.954%	20
2007	390	227	420	34.844%	16.457%	24
2008	390	215	479	36.832%	15.773%	43
2009	390	220	479	36.832%	15.928%	26
2010	390	218	487	37.339%	15.625%	20
2011	390	218	497	37.584%	15.173%	29
2012	390	219	482	36.312%	15.754%	15
2013	390	219	463	35.562%	16.100%	1
2014	390	220	431	34.829%	16.509%	4
2015	390	215	429	34.832%	16.474%	11
2016	390	214	428	34.833%	16.466%	3
2017	390	209	430	34.572%	16.638%	9

Figure 9: Student Discipline Subnetwork, 2017



or private sector, for example, could potentially operate in fundamentally different ways relative to collaborations that only involve other school districts. However, these interdistrict networks will not be examined in this dissertation because an overwhelming majority of the ILAs that aim to improve academic outcomes or strengthen student discipline involve forming ties with community colleges, state agencies, and city police departments.

This chapter's quantitative analyses rely on four district-level academic performance variables and two student discipline outcome variables. Academic performance will be measured using: (1) the number of high school graduates; (2) math and (3) reading proficiency rates, or the number of students considered proficient in math and reading divided by the number of students tested; and (4) average ACT composite scores. Student discipline outcome will be measured via: the district's (5) average daily attendance rate; and (6) reported suspension and expulsion rates.

5.2 Methodology and Models

The within-district effects of ILA network engagement on student outcomes are estimated below via a series of panel regressions (see Tables 11 through 16). For each subnetwork year, each school district's active agreement count, degree centrality, tie strength, average duration of active ties, and ego network transitivity was calculated. All independent and control variables are lagged by one school year (i.e., each model predicts outcomes in the next school year). The enrollment, spending per student, and teacher salary variables were log-transformed. The models are specified to include fixed effects to control for year- and district-specific effects, as each school district has its own set of unobserved individual charac-

teristics. Given the clustered nature of the data, all reported standard errors were calculated using double-clustering robust covariance matrix estimators (Cameron, Gelbach, & Miller, 2011; Cameron & Miller, 2015; Thompson, 2011).

Since nearly 90% of the agreements that compose the academic outcome subnetwork primarily affected high school students (e.g., earning dual credit from community colleges and enrolling in high school classes at Central Campus), outcome models with standardized test scores as its dependent variable were estimated using all grades levels and with only high school grade levels. The math and reading proficiency models reported below rely on dependent variable data from students in grades 9 through 12 and exclude ILAs that do not principally affect high school students. Models that include all ILAs from the improving academic outcomes subtopic, and use standardized exam data from all grade levels, are included in the appendix (see Tables A2 through A5).

In the context of this analysis, a network isolate refers to a participant that is involved in zero active agreements; isolates are included for each network-year slice examined in this dissertation, enabling accurate network-wide descriptive statistics. However, isolates are excluded from the panel regression models below, due to having missing values for the ego network transitivity variable. This reduces the number of observations relative to models that only include control variables (where data is available for all school districts). Recall from Chapter 2 that an ego network refers to the network that forms around a particular actor (Crossley et al., 2015). Since ego networks by definition do not exist for isolates, ego network transitivity measures are not applicable. For reference, models that rely on modified panel data where all missing ego network transitivity metrics are replaced with zeroes can be found in the appendix (see Tables A6 through A11).

Table 11: Panel Models, High School Graduate Counts (Logged)

Active Agreement Count	0.003		0.001
	(0.008)		(0.004)
Degree Centrality	−0.011		0.001
	(0.013)		(0.005)
Tie Strength	0.010*		0.0001
	(0.006)		(0.002)
Average Duration of Active Ties	−0.009		0.002
	(0.008)		(0.004)
Ego Network Transitivity	0.032		0.023
	(0.059)		(0.029)
Enrollment (Logged)		0.871***	1.047***
		(0.054)	(0.089)
Female		−0.002	−0.002
		(0.002)	(0.003)
Non-White		−0.002	−0.004
		(0.002)	(0.004)
Free- or Reduced-Price Lunch		−0.001	0.002
		(0.001)	(0.003)
Spending per Student (Logged)		0.189**	−0.057
		(0.080)	(0.077)
Student-to-Teacher Ratio		−0.007*	−0.033***
		(0.004)	(0.009)
Teacher Salary (Logged)		0.136	0.238*
		(0.089)	(0.135)
Teacher Experience		0.0004	−0.001
		(0.003)	(0.007)
Advanced Teachers Ratio		0.001*	0.001
		(0.001)	(0.001)
District and Year Fixed Effects	✓	✓	✓
School Districts	177	333	177
Years	16	16	16
Observations	1311	4993	1311
Within-District R^2	0.024	0.255	0.245

Note: *p<0.1; **p<0.05; ***p<0.01
Double clustered-robust standard errors in parentheses.

Table 12: Panel Models, Average ACT Scores

Active Agreement Count	0.100		0.028
	(0.126)		(0.127)
Degree Centrality	−0.098		0.011
	(0.278)		(0.277)
Tie Strength	−0.002		−0.032
	(0.241)		(0.225)
Average Duration of Active Ties	0.020		0.021
	(0.098)		(0.089)
Ego Network Transitivity	0.784		0.681
	(0.651)		(0.659)
Enrollment (Logged)		1.294***	1.428**
		(0.209)	(0.615)
Female		−0.022	0.006
		(0.025)	(0.040)
Non-White		0.005	0.021
		(0.011)	(0.032)
Free- or Reduced-Price Lunch		−0.005	0.0003
		(0.006)	(0.012)
Spending per Student (Logged)		0.780***	1.091***
		(0.254)	(0.383)
Student-to-Teacher Ratio		0.008	0.067*
		(0.041)	(0.036)
Teacher Salary (Logged)		−0.462	1.648
		(1.169)	(1.910)
Teacher Experience		0.033	0.049**
		(0.034)	(0.023)
Advanced Teachers Ratio		0.008	0.010*
		(0.006)	(0.005)
District and Year Fixed Effects	✓	✓	✓
School Districts	117	333	117
Years	6	6	6
Observations	550	1664	550
Within-District R^2	0.004	0.02	0.042

Note: *p<0.1; **p<0.05; ***p<0.01
Double clustered-robust standard errors in parentheses.

Table 13: Panel Models, High School Math Proficiency

Active Agreement Count	−0.021		0.030
	(0.230)		(0.259)
Degree Centrality	0.456*		0.452*
	(0.236)		(0.269)
Tie Strength	−0.188		−0.209
	(0.126)		(0.145)
Average Duration of Active Ties	0.409**		0.389**
	(0.166)		(0.170)
Ego Network Transitivity	−0.482		−1.066
	(1.944)		(2.005)
Enrollment (Logged)		−0.748	−1.339
		(1.026)	(3.766)
Female		0.007	0.163
		(0.080)	(0.193)
Non-White		−0.022	−0.127
		(0.076)	(0.194)
Free- or Reduced-Price Lunch		−0.180***	−0.129*
		(0.044)	(0.077)
Spending per Student (Logged)		2.552	4.704*
		(1.725)	(2.725)
Student-to-Teacher Ratio		−0.125	0.469
		(0.136)	(0.334)
Teacher Salary (Logged)		−2.461	−8.391
		(3.144)	(8.853)
Teacher Experience		0.099	0.145
		(0.095)	(0.154)
Advanced Teachers Ratio		0.044*	0.045
		(0.024)	(0.033)
District and Year Fixed Effects	✓	✓	✓
School Districts	175	333	175
Years	12	12	12
Observations	1134	3495	1134
Within-District R^2	0.009	0.014	0.022

Note: *p<0.1; **p<0.05; ***p<0.01
Double clustered-robust standard errors in parentheses.

Table 14: Panel Models, High School Reading Proficiency

Active Agreement Count	−0.383*		−0.423**
	(0.219)		(0.209)
Degree Centrality	0.794***		0.873**
	(0.303)		(0.343)
Tie Strength	−0.058		−0.012
	(0.130)		(0.166)
Average Duration of Active Ties	0.603***		0.617***
	(0.200)		(0.213)
Ego Network Transitivity	0.420		−0.0004
	(1.295)		(1.411)
Enrollment (Logged)		0.533	2.686
		(1.778)	(4.240)
Female		−0.016	0.070
		(0.073)	(0.212)
Non-White		−0.124	−0.350*
		(0.117)	(0.196)
Free- or Reduced-Price Lunch		−0.161***	−0.042
		(0.050)	(0.048)
Spending per Student (Logged)		1.449	3.264
		(1.939)	(4.297)
Student-to-Teacher Ratio		−0.122	−0.199
		(0.181)	(0.344)
Teacher Salary (Logged)		7.205	−11.460**
		(5.744)	(5.062)
Teacher Experience		−0.104	0.033
		(0.107)	(0.235)
Advanced Teachers Ratio		0.040*	−0.033
		(0.023)	(0.042)
District and Year Fixed Effects	✓	✓	✓
School Districts	175	333	175
Years	12	12	12
Observations	1134	3495	1134
Within-District R^2	0.015	0.012	0.026

Note: *p<0.1; **p<0.05; ***p<0.01
Double clustered-robust standard errors in parentheses.

Table 15: Panel Models, Suspension and Expulsion Rate

Active Agreement Count	−4.726**		−4.285***
	(2.044)		(1.608)
Degree Centrality	0.574		1.125
	(1.381)		(1.205)
Tie Strength	0.901		0.618
	(1.046)		(0.813)
Average Duration of Active Ties	−0.590		−0.702*
	(0.433)		(0.408)
Ego Network Transitivity	−12.054		−7.970
	(7.423)		(5.584)
Enrollment (Logged)		0.357	2.718
		(1.194)	(2.513)
Female		−0.083	−0.014
		(0.063)	(0.145)
Non-White		−0.193	−0.497*
		(0.141)	(0.274)
Free- or Reduced-Price Lunch		−0.033	0.024
		(0.038)	(0.060)
Spending per Student (Logged)		1.103	1.326
		(1.349)	(2.294)
Student-to-Teacher Ratio		0.051	0.122
		(0.105)	(0.253)
Teacher Salary (Logged)		3.816	24.034***
		(3.238)	(8.664)
Teacher Experience		−0.001	0.106
		(0.084)	(0.215)
Advanced Teachers Ratio		0.015	0.0001
		(0.020)	(0.046)
District and Year Fixed Effects	✓	✓	✓
School Districts	141	333	141
Years	9	9	9
Observations	1061	2662	1060
Within-District R^2	0.04	0.008	0.077

Note: *p<0.1; **p<0.05; ***p<0.01
Double clustered-robust standard errors in parentheses.

Table 16: Panel Models, Attendance Rate

Active Agreement Count	−0.291**		−0.309**
	(0.120)		(0.127)
Degree Centrality	−0.120		−0.157**
	(0.073)		(0.070)
Tie Strength	0.147**		0.152**
	(0.058)		(0.064)
Average Duration of Active Ties	0.025		0.015
	(0.037)		(0.034)
Ego Network Transitivity	−0.790		−0.906
	(0.598)		(0.581)
Enrollment (Logged)		−0.386**	−1.021***
		(0.187)	(0.346)
Female		0.010	−0.013
		(0.012)	(0.029)
Non-White		0.009	0.021
		(0.009)	(0.016)
Free- or Reduced-Price Lunch		−0.015***	−0.024***
		(0.005)	(0.007)
Spending per Student (Logged)		0.004	−0.162
		(0.182)	(0.284)
Student-to-Teacher Ratio		−0.028**	−0.035
		(0.013)	(0.036)
Teacher Salary (Logged)		1.831***	1.208
		(0.705)	(1.182)
Teacher Experience		−0.034**	−0.062**
		(0.014)	(0.028)
Advanced Teachers Ratio		0.001	0.005*
		(0.002)	(0.003)
District and Year Fixed Effects	✓	✓	✓
School Districts	141	333	141
Years	9	9	9
Observations	1061	2662	1060
Within-District R^2	0.006	0.021	0.04

Note: *p<0.1; **p<0.05; ***p<0.01
Double clustered-robust standard errors in parentheses.

5.3 Results and Analysis

Overall, this dissertation's hypotheses do not find strong support of its expectations concerning the relationship between the five selected social capital network metrics and improved student outcomes. Except for the average duration of active ties, none of the independent variables were statistically significant ($p < 0.1$) predictors for more than two district-level student outcomes (see Table 17).

Academic Performance

None of the independent variables of interest were significant predictors of high school graduate counts (see Table 11) or ACT scores (see Table 12).

Degree centrality exhibited a positive effect on high school student standardized exam proficiency rates ($p < 0.05$), with each one-unit increase in degree centrality (i.e., an additional tie) improving math and reading proficiency rates by 0.452% and 0.873%, respectively (see Tables 13 and 14). The average duration of active ties was similarly positive and significant: a one-unit increase in average active tie duration (measured in years) improved math proficiency rates by 0.389% ($p < 0.05$) and reading proficiency rates by 0.617% ($p < 0.01$).

The coefficient for the number of active agreements harmed reading test scores; each additional ILA decreased proficiency rates by 0.423% ($p < 0.05$). However, this effect size is smaller than that of degree centrality and average active tie duration. School districts wishing to optimize their standardized test scores should consequently aim to be active in a low number of ILAs with many collaborators (i.e., high degree centrality) over long periods of time (i.e., high average duration of active ties).

Student Discipline

Active ILA count and average active tie duration both reduced suspension and expulsion rates (see Table 15). Each additional active agreement reduced removals by 4.285% ($p < 0.01$), while each one-year increase in average active tie duration reduced a district's removal rate by 0.702% ($p < 0.1$).

Unexpectedly, district attendance rates are harmed by increases in the number of active agreement and degree centrality (see Table 16). Each additional active agreement decreases attendance rate by 0.309% ($p < 0.05$), and each additional degree increase (i.e., each additional tie) decreases attendance rate by 0.157% ($p < 0.05$). Attendance rates are improved by increases in tie strength, however; a one-unit increase in tie strength improves attendance rates by 0.152% ($p < 0.05$).

Summary of Results

Chapter 2 suggested that school districts who form ties with external organizations forge multiple channels of communication and are consequently exposed to a greater variety of information and expertise. The application of this knowledge, combined with the accumulation of experience over time, ultimately yields benefits for students. This argument, however, did not find strong support in the findings.

Hypothesis 1 (increases in the number of agreements a school district is actively participating in will improve student outcomes over time) found support with respect to student suspension and expulsion rates ($p < 0.01$). Recall that the broad discipline topic is composed of ILAs that enable school-based supervision programs overseen by the state's

juvenile court system and facilitate coordination with local police departments to install police officers in schools. Establishing relationships with these different actors (i.e., the state and/or local police departments) to place liaison officers and/or SROs on campus (i.e., higher active agreement count) yielded modest discipline-related gains.

Hypothesis 2 (increases in school district degree centrality will improve student outcomes over time) found support with respect to high school standardized exam proficiency rates, for both math and reading ($p < 0.05$). With ITBS and ITED scores almost certainly being the most visible performance metrics for public schools in Iowa, districts are focused on acting strategically to maximize those measures. One such strategy would be to prioritize forming ILA ties with organizations capable of improving those metrics. Suppose that an Iowa school district did not offer calculus or advanced English classes to their high school students; its superintendent may be incentivized to strike an agreement with several nearby school districts to pool resources and jointly operate an academy aimed at offering more rigorous academic coursework. Such an academy would benefit all of the school districts involved.

Hypothesis 3 (increases in the number of active relationships a school district is a part of will improve student outcomes over time) found support with respect to attendance rates ($p < 0.05$). The results yielded by the models predicting attendance rates should be treated with a dose of skepticism, however, due to enrollment and historical trends. In 2017, only eight of the 333 school districts reported their enrollment to be above 10,000 students; for the vast majority of Iowa public schools, a 0.5% change in district-wide attendance rate would amount to a dozen or fewer students. Further, there is scarce variation for the attendance rate models to explain, as Iowa public schools have historically enjoyed very low truancy

rates; across all school districts and across time, attendance rates average 95.504%, leaving little room for appreciable improvement.

Hypothesis 4 (increases in the average duration of active agreements will improve student outcomes over time) found support with respect to math and reading proficiency rates, as well as suspension and expulsion rates. Overall, school districts reap meaningful benefits from maintaining active ties with external organizations by establishing trust, goodwill, and experience over time (i.e., increasing average tie duration).

As the relationships between school districts and community colleges develop and strengthen, parents and teachers will become more familiar with how to access the resources that are necessary to achieve better performance; programs that aim to bolster academic advancements can be jointly enhanced by a greater variety of instructors; and a higher number of students can be admitted from external districts. Similarly, as the relationships between school districts, local police departments, and the Iowa Department of Human Services deepen, interorganizational knowledge is augmented; all participants learn how in-school officers can best be a positive role model, design and teach crime prevention classes, and assist with resolving conflicts between students.

As per the reasoning above, school districts that participate in the improving academic outcomes ILA subnetwork may be prioritizing standardized test scores above other measures of academic success (e.g., high school graduate counts and average ACT scores). In addition, liaison and school resource officers may be concentrating their efforts on minimizing behavior that leads to suspensions and expulsions, as opposed to spending time attempting to address relatively small truancy problems.

Finally, Hypothesis 5 (increases in the transitivity of a school district's ego network will improve student outcomes over time) did not find any support at all. A higher number of communication channels (e.g., increased transitivity) within network clusters does not necessarily expedite the flow of local community knowledge.

Table 17: Summary of Hypotheses and Results

Hypotheses	*Supported?*
H_1: Active Agreement Count → Improved Student Outcomes	
High School Graduate Counts	—
Average ACT Scores	—
Math Proficiency Rates	—
Reading Proficiency Rates	—
Suspension and Expulsion Rates	✓
Attendance Rate	—
H_2: Degree Centrality → Improved Student Outcomes	
High School Graduate Counts	—
Average ACT Scores	—
Math Proficiency Rates	✓
Reading Proficiency Rates	✓
Suspension and Expulsion Rates	—
Attendance Rate	—
H_3: Tie Strength → Improved Student Outcomes	
High School Graduate Counts	—
Average ACT Scores	—
Math Proficiency Rates	—
Reading Proficiency Rates	—
Suspension and Expulsion Rates	—
Attendance Rate	✓
H_4: Average Duration of Active Ties → Improved Student Outcomes	
High School Graduate Counts	—
Average ACT Scores	—
Math Proficiency Rates	✓
Reading Proficiency Rates	✓
Suspension and Expulsion Rates	✓
Attendance Rate	—
H_5: Ego Network Transitivity → Improved Student Outcomes	
High School Graduate Counts	—
Average ACT Scores	—
Math Proficiency Rates	—
Reading Proficiency Rates	—
Suspension and Expulsion Rates	—
Attendance Rate	—

6 Final Remarks

6.1 Generalizability and Limitations

Due to incorporating into its analyses substantially larger sample sizes, longitudinal rather than cross-sectional observations, and a state-wide geographical scope, the generalizability of this dissertation exceeds that of prior interlocal collaboration network research. However, despite the improvements, this dissertation inevitably suffers from several limitations that, collectively, may explain why the proposed relationships were largely unsupported in the findings.

First, it must be noted that policy domain is of acute importance. The provision of public education may function in fundamentally different ways relative to other service areas, and the types of activities captured by ILAs involving public school districts likely differ from ILAs in other domains. This dissertation only examines ILAs in the domain of public education, and scholars "cannot generalize from single network case studies in one specific sector, agency, or state to other contexts in the public sector" (Isett, Mergel, LeRoux, Mischen, & Rethemeyer, 2011, p. i167). The study of interlocal collaboration benefits from a focused and nuanced approach; researchers must carefully read ILAs to determine what the ultimate goal is, and if plausible connections between the structure of a network built from those ILAs and participant characteristics exist.

On a related note, Iowa is a single state with school districts that are not coterminous with any other political boundary and a relatively homogeneous (and small) population; data derived entirely from a demographically and politically non-representative sample cannot,

without qualifications, be used to draw generalizations about other states or metropolitan areas (though a non-trivial portion of the United States is demographically similar). Perhaps this dissertation's findings would be stronger and more consistent in a denser area of the United States, where geography does not so severely limit the realistic number of potential collaborators.

Finally, despite the volume of education and ILA data that has been made available to the public, data constraints limit the confidence of the findings. The Iowa Department of Education's blunt district-wide statistics "average out" a great deal of student-level variation, and ILAs filed under Chapter 28E do not name the individuals or schools that are involved; only the name of the district is provided. The ILA database suffers from a selection problem of unknown magnitude in the form of informal "handshake" agreements that are not filed with the state government. Though many of these informal arrangements are documented and filed, there are potentially-consequential collaborations that are not, and are naturally absent from the preceding analyses. In addition, ILA networks may affect individual schools or even students within the district differently; given the lack of student-level data, only a district-level analysis was viable, rendering attempts to examine the extent of possible heterogeneous within-district effects futile.

6.2 Future Research

The Network Perspective

Examining governance questions through a networking lens leads to improvements in external validity. It would be remarkably shortsighted to assume that observations of

politics, policy, and administration are truly independent from one another, given that our social, legal, and political worlds are composed of extremely complex, dynamic, and evolving webs of interactions between individuals, bureaucracies, city governments, state governments, nonprofit organizations, private sector firms, and interest groups. Scholarly investigation of governance questions that fail to acknowledge the importance of networks is, to some extent, susceptible to external validity problems.

The network perspective represents the next generation of local government research; it more closely aligns with how the real world operates, offers the potential to consider heretofore unanswerable questions, and may offer conclusions that government officials can apply to improve public policy. All future research in this area should, at a minimum, be mindful of the network perspective.

Considering Bridging and Bonding Roles

A significant portion of the social network analysis literature is concerned with the nature of bridging and bonding. This dissertation placed an emphasis on the properties of direct ties involving school districts and the interconnectedness of ego networks (the latter of which could be conceptualized as bonding structures). However, there are almost certainly other theoretically-important structures that exist in these networks that remain unexamined. For example, this dissertation does not explicitly consider the role that bridges play, which "provide nodes with access to parts of the network that are unreachable by other means" (Easley and Kleinberg, 2010, p. 46). Organizations that serve as network bridges are often an important source of knowledge:

> Local bridges, especially those with reasonably large spans, still play roughly the same role as bridges, though in a less extreme way; they provide their endpoints with access to parts of the network — and hence sources of information — that they would otherwise be far away from. (Easley and Kleinberg, 2010, p. 47)

Within bonding structures (e.g., a close-knit group of school districts and nonprofit organizations), participants become increasingly familiar with the same set of knowledge over time; to gain access to new information, which in turn can be leveraged to ultimately improve performance, scholars should seek to understand the importance of forging relationships with bridge organizations. Future researchers could also conduct brokerage analyses to evaluate the different types of bridging roles that public school districts and their collaborators may play in the education ILA network (Gould and Fernandez, 1989).

Qualitatively Examining Tie Formation, Dissolution, and Relationship Types

The 28E ILA database is replete with opportunities for future scholars to conduct novel qualitative analyses. In the domain of education, this dissertation does not examine the factors that public school districts consider when forming or dissolving collaborative ties via the filing or termination of an ILA. In addition, much about the nature of these ties' remained unstudied; collaborative partnerships — where with joint effort, participants work together to achieve mutually beneficial goals — are substantively different than contractual relationships — where the relationship is transactional in nature (e.g., one organization providing another with a good or service for an agreed-upon price). Prospective interlocal collaboration scholars could augment this literature by integrating data gained from interviews and surveys of

ILA participants. Such data would enable examinations of the differences that exist across relationship types, how they form and dissolve, and whether these variances matter with respect to improving outcomes.

Using this data set to study the potential effects that stem from the involved organizational or institutional forms also remains largely uninvestigated. The collaborations that exist between two or more school districts may be entirely dissimilar from collaborations that involve one school district and several non-district entities; these distinctions may have consequences for student-level outcomes.

Understanding Tie Directionality

Given that this dissertation assumes non-directionality for the selected ILA networks, a relatively straightforward contribution to this literature would involve reading and coding ILAs to obtain tie directionality. In many cases, ILA ties will be reciprocated or symmetrical (e.g., two school districts collaborating to jointly host an academic decathlon), while in others, ties will be clearly unidirectional (e.g., a school district in central Iowa reimbursing DMPS for allowing external high school students to enroll in advanced classes at Central Academy).

Improving the Quantitative Models

As alluded to earlier, integrating other theoretically-important network metrics as predictors is worth exploring (e.g., using different measures of centrality or assigning brokerage scores to school districts for each of the various bridging roles). In addition, the panel linear models estimated in this dissertation could be markedly improved by gaining access

to and leveraging school- or student-level data. Although the ILA metadata provides school district names, in practice it is usually individual schools that are engaging in a collaboration. A close reading of the agreements' text would be required to map the ILA network data to the hypothetical school-level data, but the resulting analysis would represent a vast improvement with respect to granularity.

Assuming data constraints did not exist, the quantitative models could be improved by using data that captures the number of students that are considered at-risk of dropping out of school, and how many of those students remain in school, graduate, and decide to continue their education at a two-year or four-year institution. With respect to student discipline, only the number of students that are suspended or expelled are made available to the public. Ideally, data that reflects all types of discipline could be provided in a disaggregated form (e.g., the number of students that receive detentions, in-school suspensions, out-of-school suspensions, and expulsions).

With respect to the "improving academic outcome" ILA networks examined, future scholars could attempt to estimate the long-term effects that preschool has on academic and discipline outcomes. The numerous ILAs that established preschool programs for four-year-old children were excluded from Chapter 5's analysis; in addition to the focus being placed on high school students, studying the effects that attending preschool has on academic performance and student discipline falls outside the scope of this dissertation. In the future, the accumulation of several decades' worth of data may enable inferences about the long-term consequences of ILA networks in other areas as well.

Finally, alternative quantitative methodologies that explicitly account for geographical proximity would also qualify as a noteworthy contribution. Given the largely rural nature

of the state, organizations in Iowa are particularly limited with respect to the potential number of collaborators.

Evaluating Outcomes of Narrower Subtopic Networks

This dissertation classified ILAs into numerous narrow topics before grouping related ILAs together under a handful of broad topics. Smaller networks could be inferred from these narrow topics and studied in greater detail. For example, network metrics based on ILAs that allow high school students to earn dual credit by enrolling in community colleges (but not other ILAs concerned with improving academic outcomes) could be used to predict academic performance. Beyond standardized test scores, other metrics could be employed to gauge the performance of these narrow subtopic networks (e.g., the percentage of students that decide to enroll in a two-year or four-year college after graduating high school).

Measuring Performance in Other Policy Domains

Above all else, public administration scholars should endeavor to examine other policy domains and begin developing strategies for operationalizing performance in service areas that are prone to measurement difficulty. For example, interorganizational governance networks based on economic development ILAs could be judged on the basis of lower unemployment rates and higher median household incomes, and the performance of police protection and criminal investigation ILA networks could be gauged by the number of reported crimes. With some creative thinking and sufficient data availability, more niche service areas could be examined (e.g., library service ILA networks and improved circulation metrics).

6.3 Potential Policy Implications

Enabling this future work will require researchers to unite in the push toward expanding and improving data availability, both for documentation concerned with interlocal collaborations and for participant attribute data. If network governance researchers can demonstrate that heavily-interconnected service provision and administration networks yield tangible benefits under certain conditions, or discover the tie characteristics that ultimately result in augmented performance or substantive outcomes in specific policy domains, legislatures could act on those conclusions to meaningfully improve policy.

This dissertation's findings suggest that certain network structures are ideal for improving standardized test scores (namely, degree centrality and average active tie duration). The results should encourage government-led efforts to improve the flow of knowledge within education ILA networks by (1) facilitating the formation of ties involving school districts to augment degree centrality and by (2) promoting the maintenance of those ties over time. For example, a state government could sponsor events that encourage school teachers, principals, superintendents, and administrators to meet in person to exchange information or advice (perhaps by hosting or providing funding for annual regional conferences dedicated to interdistrict networking). Alternatively, governments could streamline the processes school districts undergo to learn about what other school districts or education-oriented organizations are doing by creating a central digital repository of information and providing access to all education ILA collaborators.

6.4 Conclusion

Increasingly ill-defined social and economic communities have created an exacerbating dilemma for local governments. The rapid decline of the relevance of political boundaries widens the scope of administrative complexity required to effectively provide residents with public goods and services. Faced with shrinking budgets and increasingly-polarized political environments at higher levels of government, local governments at every level have resorted to collaborating with third parties (i.e., other governments as well as with private sector organizations) to solve this service provision challenge (Milward & Provan, 2000; Salamon, 1981). Intergovernmental and intersector cooperation theoretically allow local governments to provide public services more efficiently (i.e., providing services at a lower cost) at a higher level of quality by benefiting from economies of scale and through the exchange of knowledge.

The dearth of empirical support for the hypothesized relationship between interlocal collaboration and desired policy outcomes represents a significant gap in the literature. Extant research has generally examined a handful of narrow geographic areas, and has measured the performance of interorganizational networks by relying on perceptions of network effectiveness or externally quantitative metrics at just a single point in time. Finally, despite being a critically-important local government service, there are relatively few studies that examine interorganizational networks oriented around public education.

This dissertation contributes to the interlocal collaboration network performance literature by concurrently addressing these limitations. The qualitative and quantitative analyses detailed in Chapters 4 and 5 respectively combined metadata from the Iowa 28E ILA database with school district attribute data sourced from the Iowa Department of Educa-

tion, which included multiple performance variables for all 333 of the state's public school districts.

Does a public school district's participation and position in cross-sector, interlocal education governance networks improve student outcomes? In this dissertation's findings, empirical support for the hypothesized relationships between ILA network metrics and district-level student academic and discipline outcomes was generally found to be weak and inconsistent. Only degree centrality and average active tie duration improved student academic outcomes, and only with respect to high school math and reading proficiency rates.

Appendix

This appendix includes numerous figures and tables that were not included in the main text for the sake of readability. Figures A1 through A10 provide visualizations of the variation that exists in the data for select variables both across time and across the state of Iowa. Figure A11 provides a visualization of the complete ILA education network (i.e., all substantive topics), while Table A1 provides its descriptive statistics.

The models presented in Chapter 5 estimate high school student performance using metrics calculated from the "improving academic outcomes" ILA subnetwork, minus agreements that do not principally concern high school students. The first set of appendix models (Tables A2 through A5) include all ILAs from the improving academic outcomes subnetwork, regardless of grade level. In addition, the standardized exam data used in these math and reading proficiency models include all grade levels, instead of only 10th and 11th grade. The second set of appendix models (Tables A6 through A11) use the same specification as the models presented in Chapter 5 but rely on altered data: for the five independent variables, all missing values were replaced with zeroes.

Figure A1: Average ACT Scores, 2012 – 2017

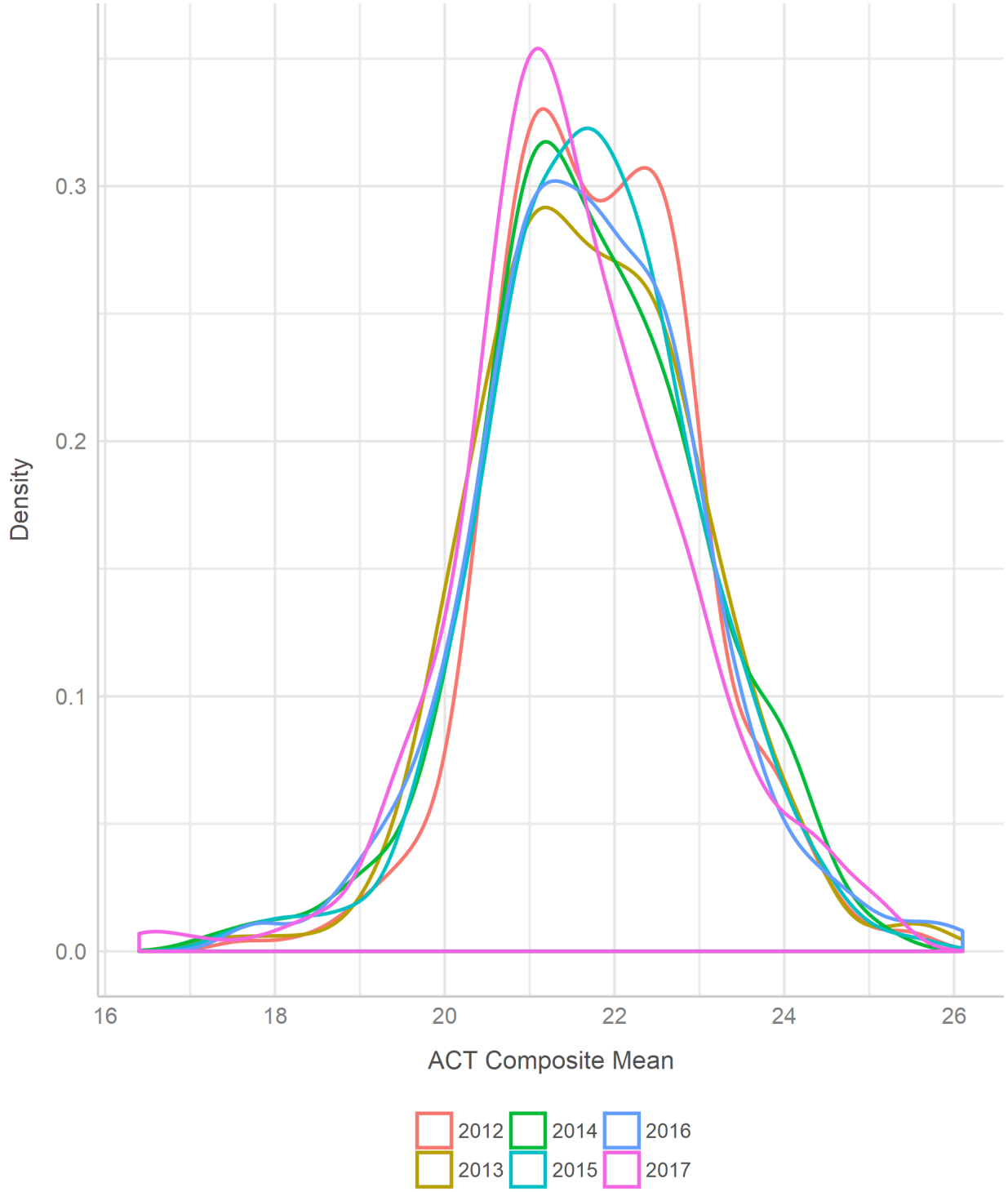


Figure A2: Average ACT Scores, 2017 Map

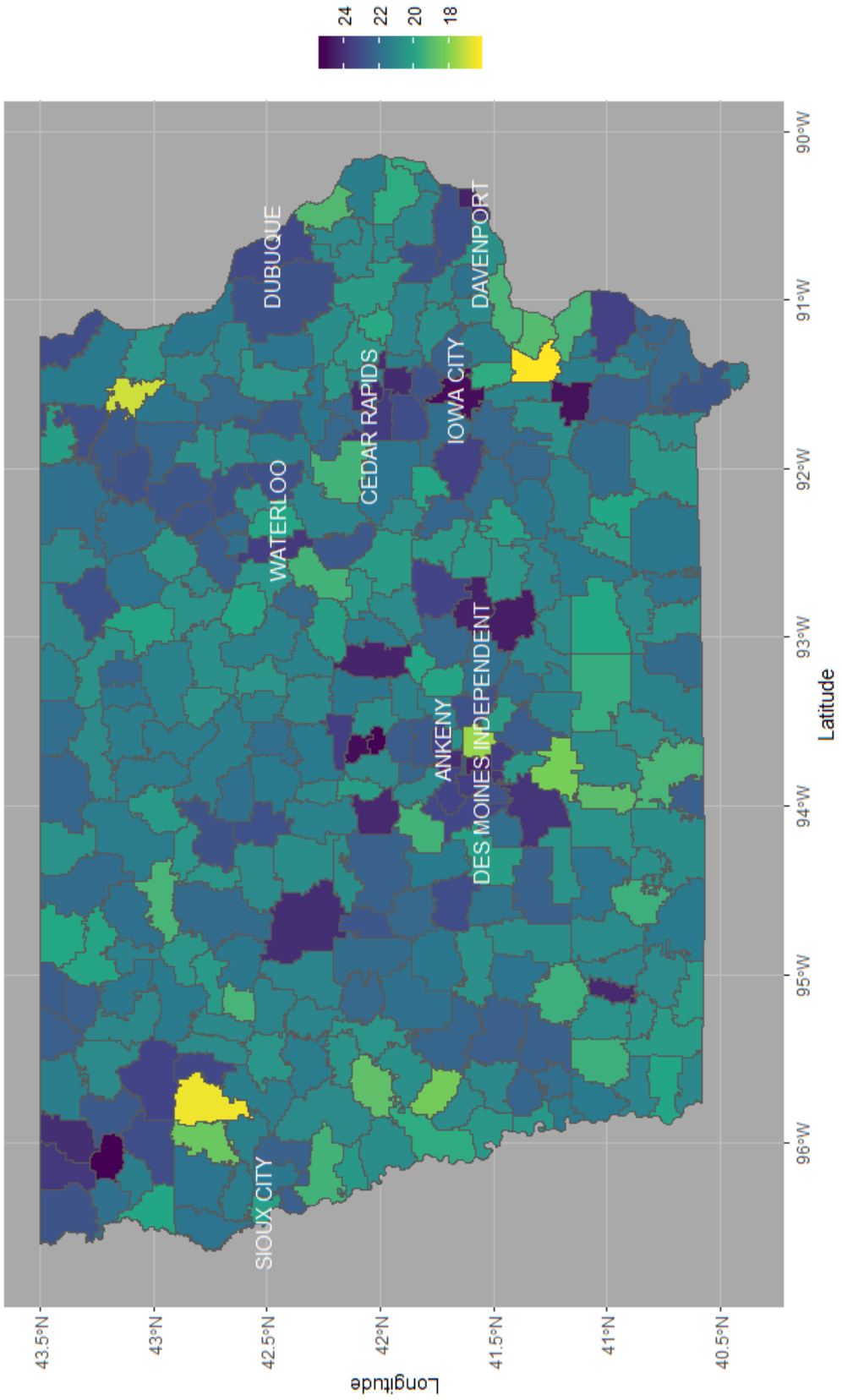


Figure A3: Suspensions and Expulsions to Total Enrollment, 2009 – 2017

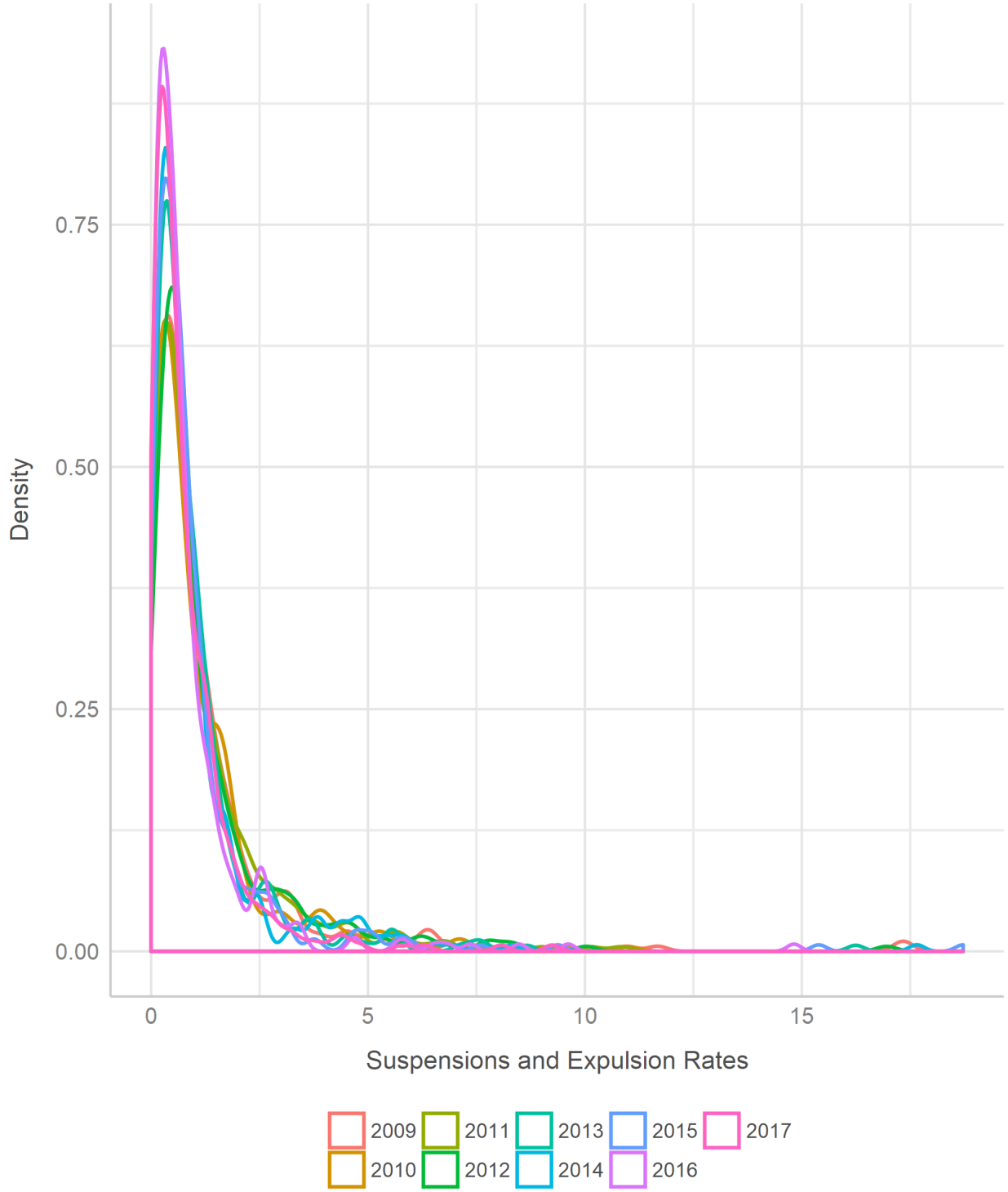


Figure A4: Suspensions and Expulsions to Total Enrollment, 2017 Map

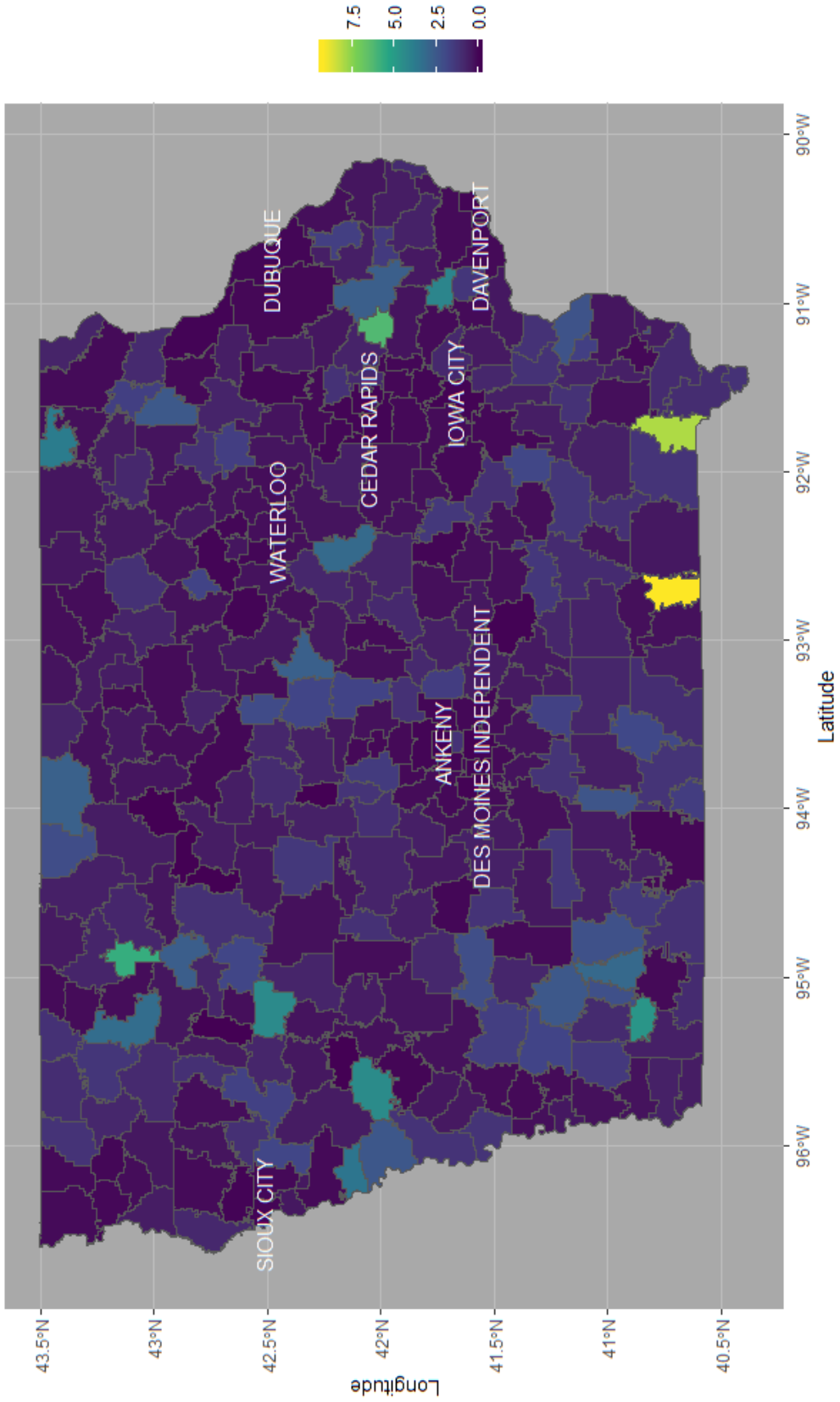


Figure A5: Average Daily Attendance Rate, 2009 – 2017

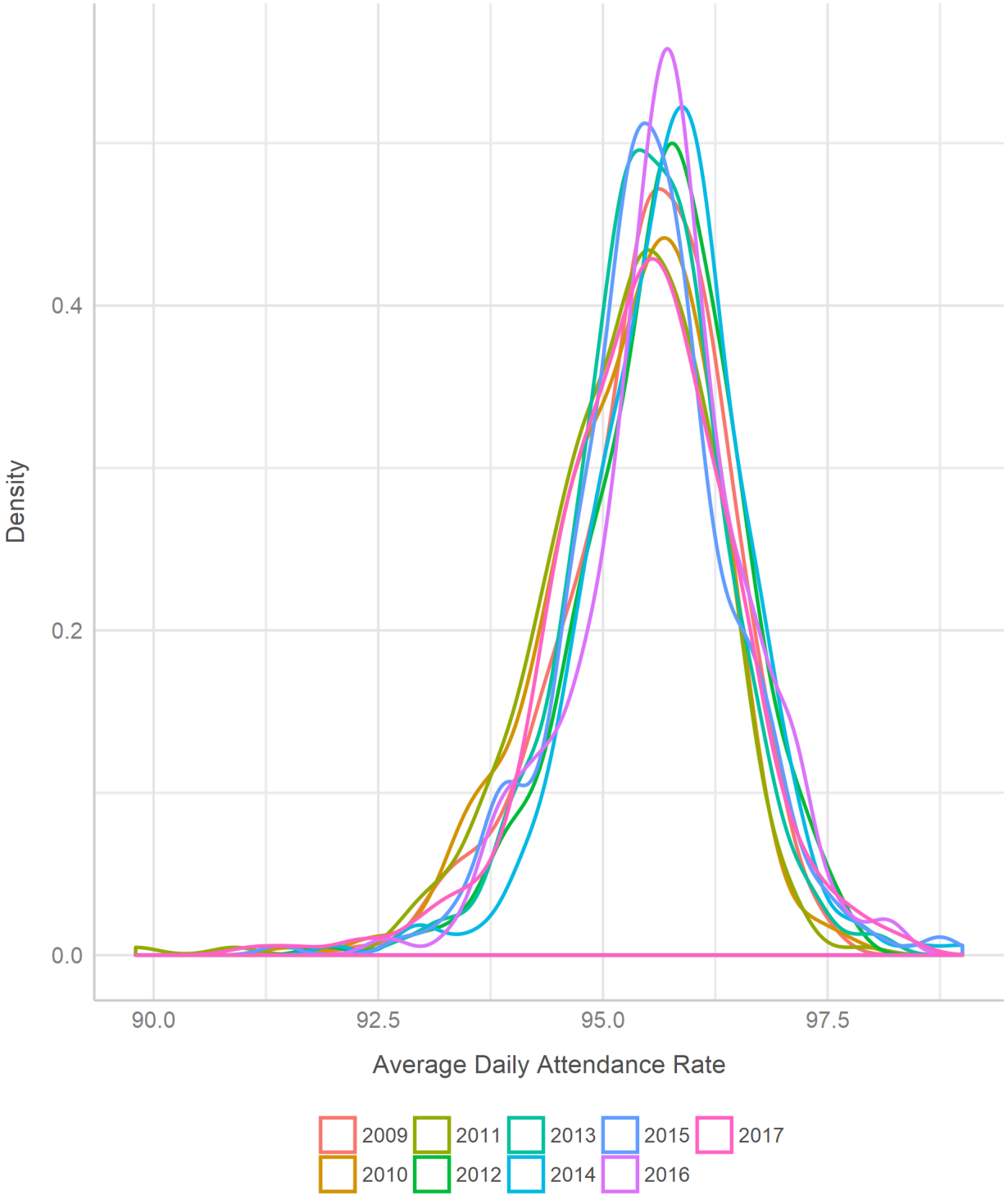


Figure A6: Average Daily Attendance Rate, 2017 Map

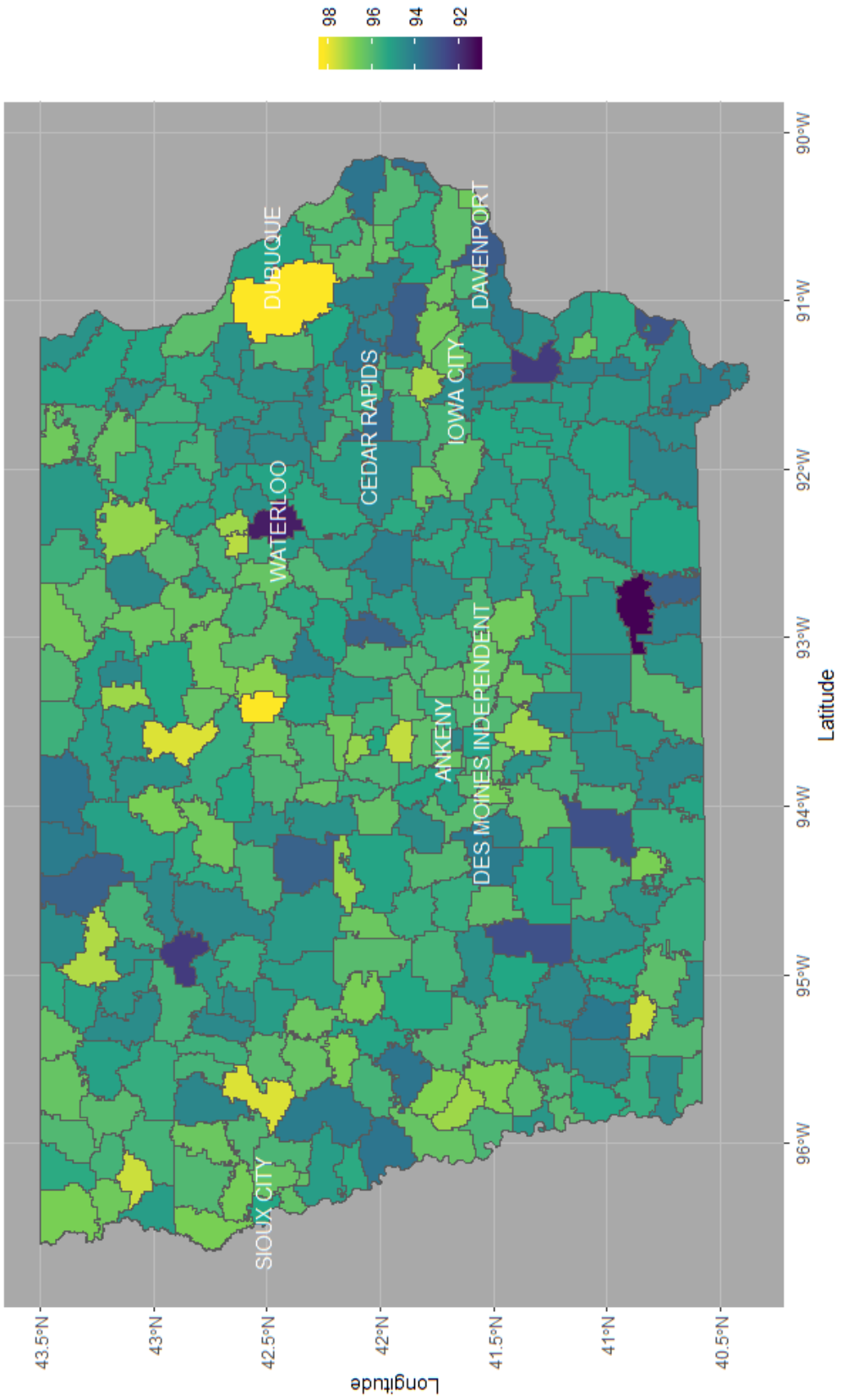


Figure A7: Non-White Students To Total Enrollment, 1997 – 2017

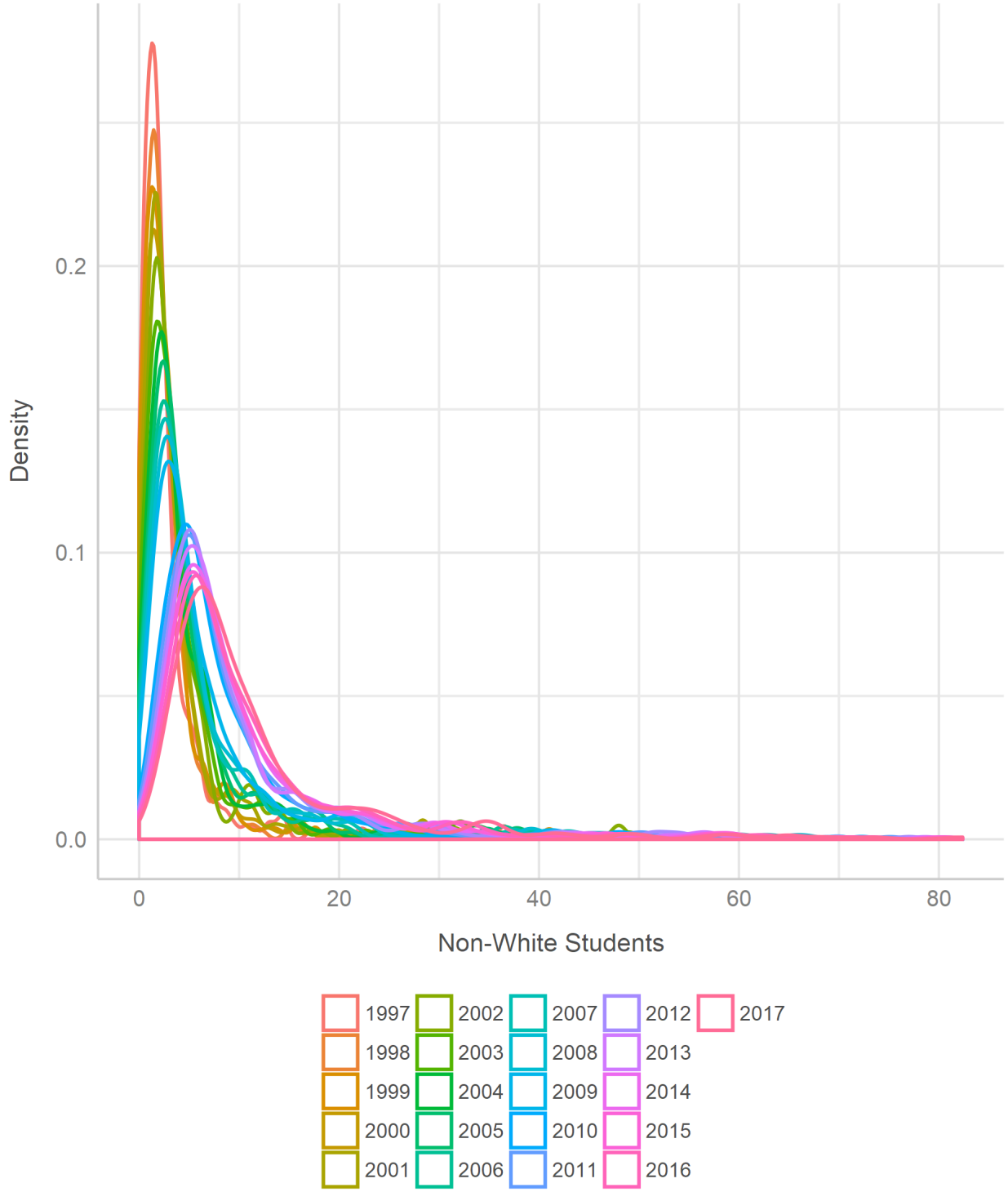


Figure A8: Non-White Students to Total Enrollment, 2017 Map

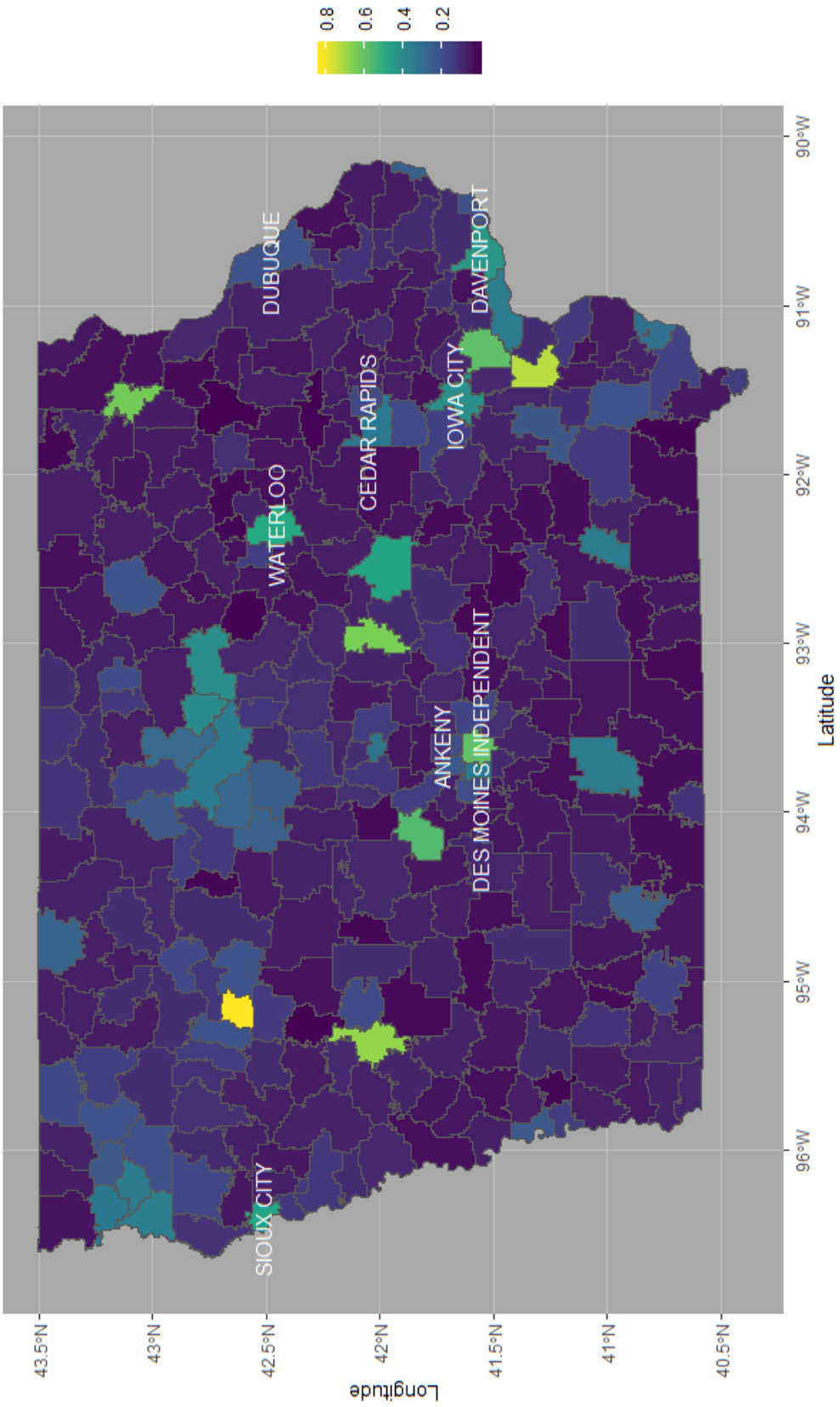


Figure A9: Average Teacher Salary, 2002 – 2017

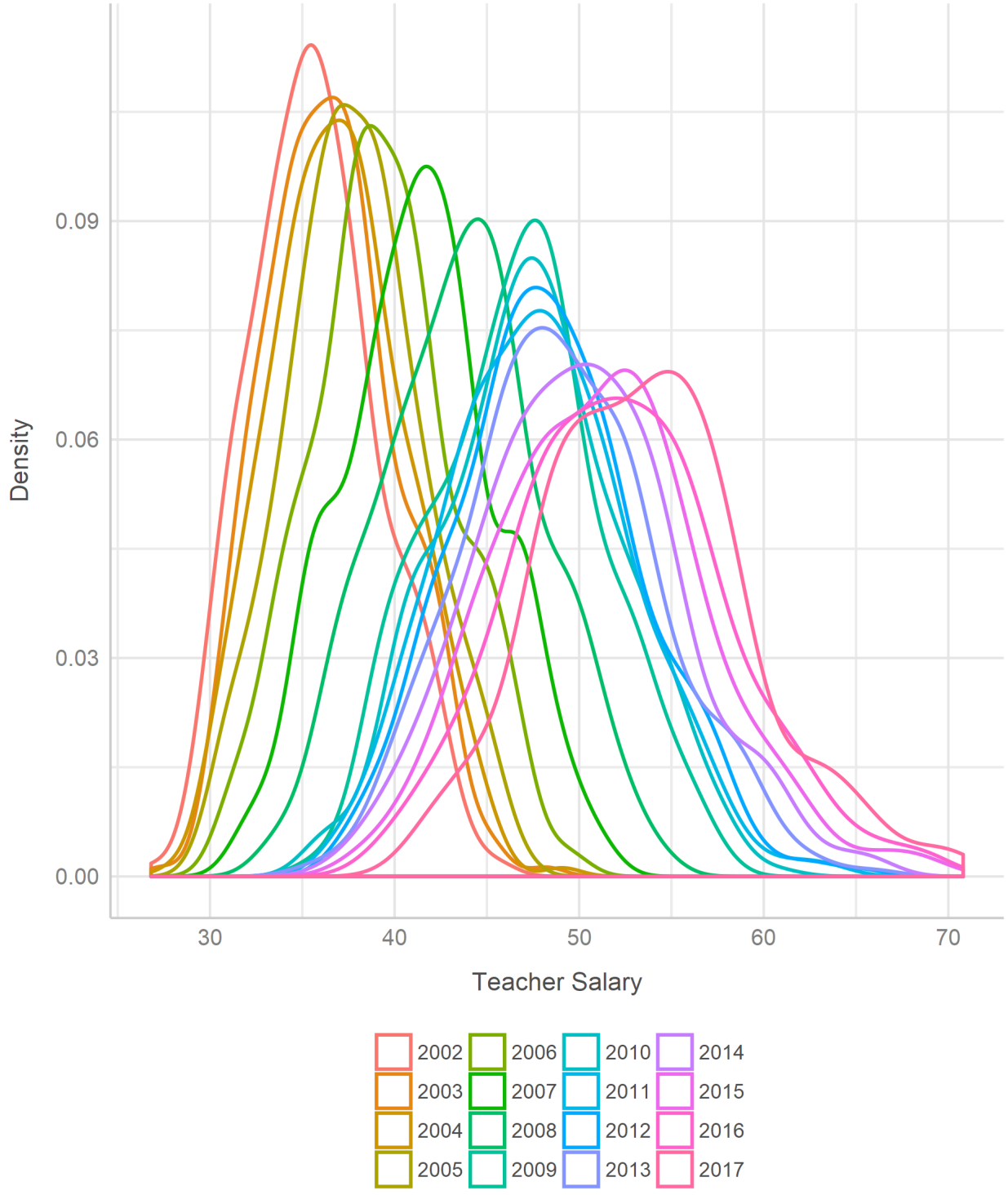


Figure A10: Average Teacher Salary, 2017 Map

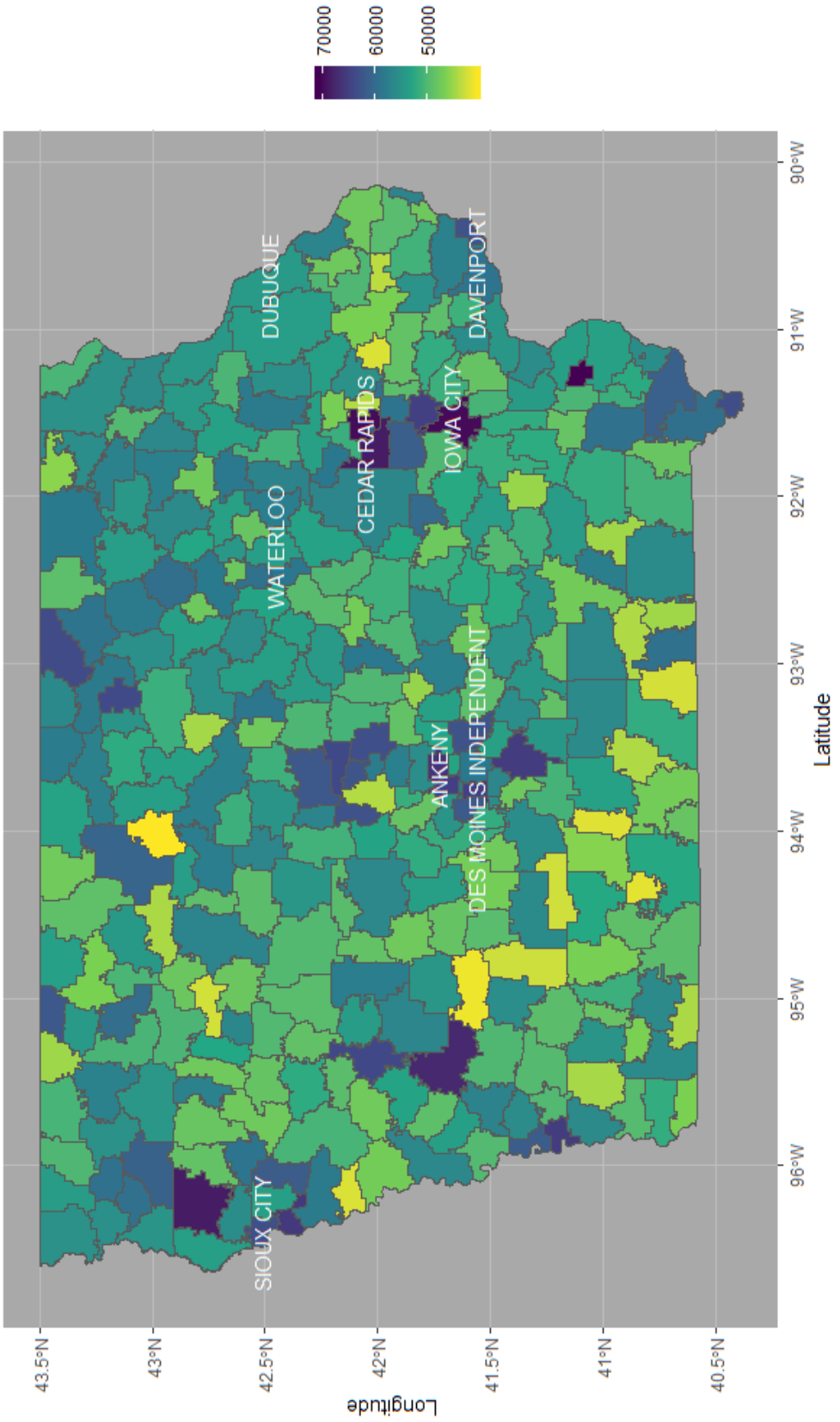


Figure A11: Complete Interlocal Education Network, 2017

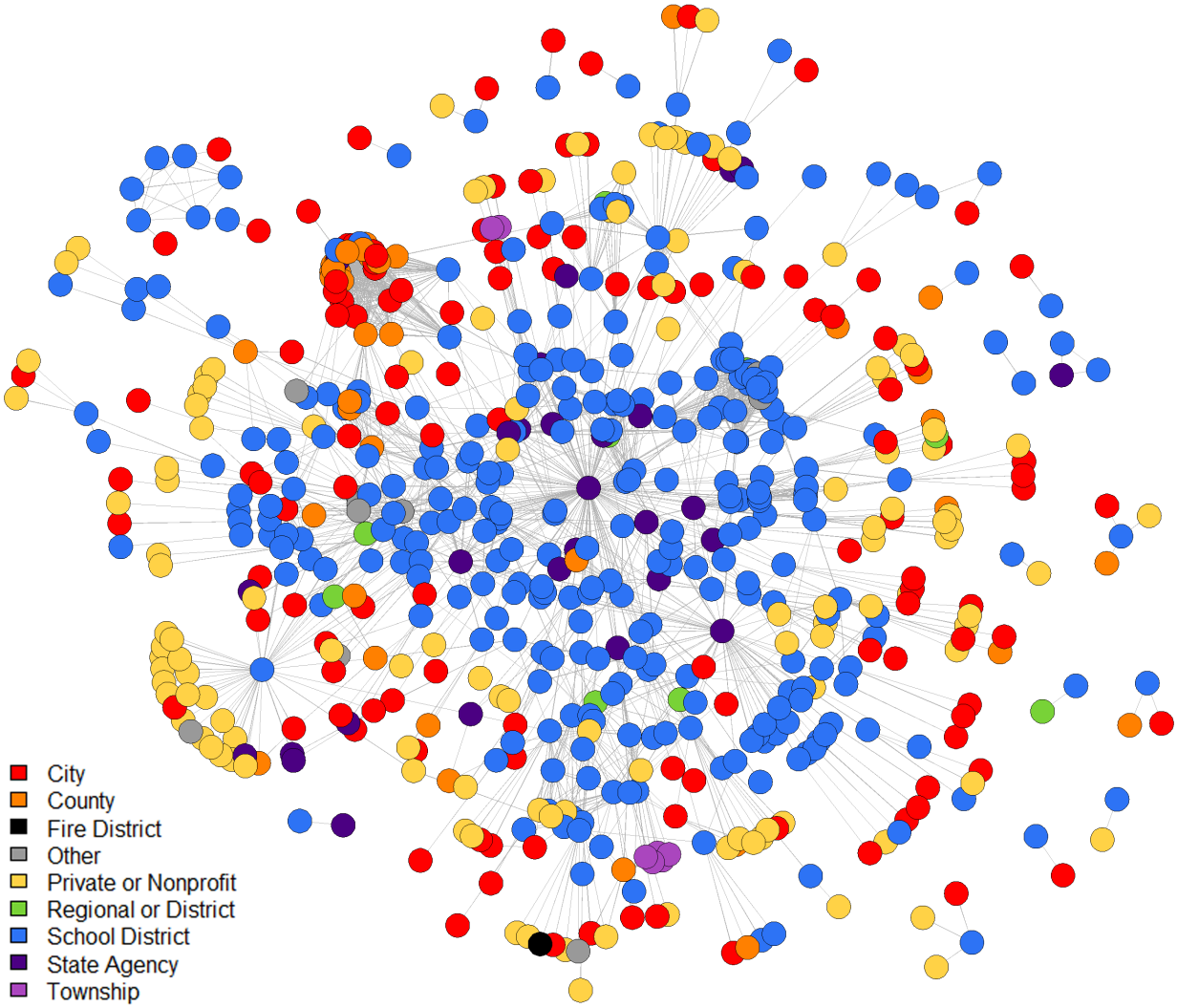


Table A1: Complete Network Descriptive Statistics

Year	*Node Count*	*Isolate Count*	*Edge Count*	*Centralization*	*Transitivity*	*Newly-Filed ILAs*
1993	777	752	23	2.318%	1.899%	21
1994	777	729	38	2.571%	2.985%	19
1995	777	698	78	2.946%	21.932%	21
1996	777	629	134	3.185%	20.079%	57
1997	777	623	144	3.311%	21.005%	11
1998	777	596	188	3.555%	35.381%	19
1999	777	567	262	3.660%	48.649%	37
2000	777	535	322	4.156%	48.462%	34
2001	777	516	345	4.536%	43.319%	48
2002	777	504	361	4.660%	41.887%	30
2003	777	488	415	4.772%	48.484%	45
2004	777	425	800	16.917%	23.378%	288
2005	777	386	857	17.157%	23.012%	127
2006	777	357	1028	17.229%	30.816%	76
2007	777	308	1282	17.661%	37.934%	77
2008	777	242	1549	18.606%	38.205%	176
2009	777	204	1891	18.493%	41.925%	334
2010	777	203	1831	18.771%	43.905%	93
2011	777	189	1871	18.887%	45.592%	85
2012	777	183	1957	18.212%	49.766%	65
2013	777	179	2000	17.810%	52.472%	70
2014	777	172	2042	17.409%	57.110%	62
2015	777	170	2167	17.367%	58.014%	91
2016	777	149	2290	17.326%	58.516%	57
2017	777	140	2391	17.163%	59.809%	65

Note: The last column sums to 2,008 instead of 2,042 because 34 agreements were filed during the 2018 school year.

Table A2: Full Academic Subnetwork, High School Graduate Counts (Logged)

Active Agreement Count	0.001		0.003
	(0.008)		(0.003)
Degree Centrality	−0.008		0.0003
	(0.012)		(0.004)
Tie Strength	0.010		0.00003
	(0.006)		(0.002)
Average Duration of Active Ties	−0.008		−0.001
	(0.007)		(0.004)
Ego Network Transitivity	0.070		0.046
	(0.048)		(0.029)
Enrollment (Logged)		0.871***	0.980***
		(0.054)	(0.095)
Female		−0.002	−0.001
		(0.002)	(0.002)
Non-White		−0.002	−0.002
		(0.002)	(0.003)
Free- or Reduced-Price Lunch		−0.001	0.001
		(0.001)	(0.002)
Spending per Student (Logged)		0.189**	−0.040
		(0.080)	(0.086)
Student-to-Teacher Ratio		−0.007*	−0.026***
		(0.004)	(0.008)
Teacher Salary (Logged)		0.136	0.164
		(0.089)	(0.146)
Teacher Experience		0.0004	0.002
		(0.003)	(0.007)
Advanced Teachers Ratio		0.001*	0.001*
		(0.001)	(0.001)
District and Year Fixed Effects	✓	✓	✓
School Districts	193	333	193
Years	16	16	16
Observations	1539	4993	1538
Within-District R^2	0.023	0.255	0.23

Note: *p<0.1; **p<0.05; ***p<0.01
Double clustered-robust standard errors in parentheses.

Table A3: Full Academic Subnetwork, Average ACT Scores

Active Agreement Count	0.022		−0.045
	(0.134)		(0.137)
Degree Centrality	0.005		0.042
	(0.153)		(0.143)
Tie Strength	−0.040		−0.010
	(0.080)		(0.088)
Average Duration of Active Ties	0.045		0.047
	(0.094)		(0.084)
Ego Network Transitivity	−0.565		−0.810*
	(0.452)		(0.437)
Enrollment (Logged)		1.294***	1.977***
		(0.209)	(0.531)
Female		−0.022	−0.002
		(0.025)	(0.035)
Non-White		0.005	0.017
		(0.011)	(0.023)
Free- or Reduced-Price Lunch		−0.005	−0.004
		(0.006)	(0.012)
Spending per Student (Logged)		0.780***	0.979***
		(0.254)	(0.311)
Student-to-Teacher Ratio		0.008	0.068**
		(0.041)	(0.032)
Teacher Salary (Logged)		−0.462	0.852
		(1.169)	(1.801)
Teacher Experience		0.033	0.034*
		(0.034)	(0.021)
Advanced Teachers Ratio		0.008	0.011**
		(0.006)	(0.005)
District and Year Fixed Effects	✓	✓	✓
School Districts	136	333	136
Years	6	6	6
Observations	649	1664	648
Within-District R^2	0.003	0.02	0.038

Note: *p<0.1; **p<0.05; ***p<0.01
Double clustered-robust standard errors in parentheses.

Table A4: Full Academic Subnetwork, Math Proficiency

Active Agreement Count	−0.077		−0.038
	(0.111)		(0.105)
Degree Centrality	−0.157		−0.109
	(0.241)		(0.224)
Tie Strength	−0.046		−0.066
	(0.067)		(0.051)
Average Duration of Active Ties	0.032		0.011
	(0.135)		(0.126)
Ego Network Transitivity	−2.062		−2.057*
	(1.419)		(1.180)
Enrollment (Logged)		−0.025	−0.191
		(0.983)	(2.129)
Female		0.071	0.092
		(0.053)	(0.112)
Non-White		−0.066	−0.225***
		(0.059)	(0.085)
Free- or Reduced-Price Lunch		−0.111***	−0.146***
		(0.027)	(0.044)
Spending per Student (Logged)		0.500	−1.376
		(1.311)	(2.489)
Student-to-Teacher Ratio		−0.300***	−0.003
		(0.101)	(0.238)
Teacher Salary (Logged)		4.096*	−1.502
		(2.279)	(4.485)
Teacher Experience		0.026	0.077
		(0.068)	(0.146)
Advanced Teachers Ratio		−0.001	0.031
		(0.015)	(0.019)
District and Year Fixed Effects	✓	✓	✓
School Districts	191	333	191
Years	12	12	12
Observations	1325	3495	1324
Within-District R^2	0.012	0.026	0.053

Note: *p<0.1; **p<0.05; ***p<0.01
Double clustered-robust standard errors in parentheses.

Table A5: Full Academic Subnetwork, Reading Proficiency

Active Agreement Count	−0.110		−0.101
	(0.130)		(0.121)
Degree Centrality	−0.001		0.030
	(0.151)		(0.143)
Tie Strength	−0.067*		−0.058
	(0.038)		(0.044)
Average Duration of Active Ties	−0.258**		−0.265***
	(0.109)		(0.096)
Ego Network Transitivity	−2.284		−2.092
	(2.147)		(1.922)
Enrollment (Logged)		0.672	−0.347
		(1.165)	(1.815)
Female		0.061	0.084
		(0.057)	(0.115)
Non-White		−0.114**	−0.137**
		(0.057)	(0.065)
Free- or Reduced-Price Lunch		−0.071***	−0.077*
		(0.025)	(0.046)
Spending per Student (Logged)		0.850	0.251
		(0.828)	(1.853)
Student-to-Teacher Ratio		−0.243**	−0.164
		(0.097)	(0.182)
Teacher Salary (Logged)		4.798*	1.002
		(2.571)	(3.947)
Teacher Experience		0.040	−0.038
		(0.069)	(0.115)
Advanced Teachers Ratio		−0.013	0.002
		(0.014)	(0.019)
District and Year Fixed Effects	✓	✓	✓
School Districts	191	333	191
Years	12	12	12
Observations	1325	3495	1324
Within-District R^2	0.019	0.022	0.034

Note: *p<0.1; **p<0.05; ***p<0.01
Double clustered-robust standard errors in parentheses.

Table A6: IVs Zero-Imputed, High School Graduate Counts (Logged)

Active Agreement Count	0.012***		0.006**
	(0.004)		(0.002)
Degree Centrality	−0.009		−0.001
	(0.009)		(0.004)
Tie Strength	0.002		−0.002
	(0.005)		(0.002)
Average Duration of Active Ties	0.0002		0.002
	(0.004)		(0.002)
Ego Network Transitivity	0.025		−0.002
	(0.021)		(0.012)
Enrollment (Logged)		0.871***	0.867***
		(0.054)	(0.053)
Female		−0.002	−0.002
		(0.002)	(0.002)
Non-White		−0.002	−0.002
		(0.002)	(0.002)
Free- or Reduced-Price Lunch		−0.001	−0.001
		(0.001)	(0.001)
Spending per Student (Logged)		0.189**	0.187**
		(0.080)	(0.079)
Student-to-Teacher Ratio		−0.007*	−0.007*
		(0.004)	(0.004)
Teacher Salary (Logged)		0.136	0.129
		(0.089)	(0.090)
Teacher Experience		0.0004	0.0005
		(0.003)	(0.003)
Advanced Teachers Ratio		0.001*	0.001*
		(0.001)	(0.001)
District and Year Fixed Effects	✓	✓	✓
School Districts	333	333	333
Years	16	16	16
Observations	4995	4993	4993
Within-District R^2	0.009	0.255	0.256

Note: *p<0.1; **p<0.05; ***p<0.01
Double clustered-robust standard errors in parentheses.

Table A7: IVs Zero-Imputed, Average ACT Scores

Active Agreement Count	0.160		0.126
	(0.126)		(0.119)
Degree Centrality	−0.179		−0.155
	(0.264)		(0.268)
Tie Strength	−0.024		−0.012
	(0.210)		(0.202)
Average Duration of Active Ties	−0.018		−0.012
	(0.028)		(0.027)
Ego Network Transitivity	−0.030		−0.037
	(0.231)		(0.227)
Enrollment (Logged)		1.294***	1.274***
		(0.209)	(0.205)
Female		−0.022	−0.022
		(0.025)	(0.025)
Non-White		0.005	0.006
		(0.011)	(0.011)
Free- or Reduced-Price Lunch		−0.005	−0.005
		(0.006)	(0.007)
Spending per Student (Logged)		0.780***	0.762***
		(0.254)	(0.255)
Student-to-Teacher Ratio		0.008	0.008
		(0.041)	(0.041)
Teacher Salary (Logged)		−0.462	−0.570
		(1.169)	(1.174)
Teacher Experience		0.033	0.033
		(0.034)	(0.034)
Advanced Teachers Ratio		0.008	0.008
		(0.006)	(0.006)
District and Year Fixed Effects	✓	✓	✓
School Districts	333	333	333
Years	6	6	6
Observations	1665	1664	1664
Within-District R^2	0.002	0.02	0.021

Note: *p<0.1; **p<0.05; ***p<0.01
Double clustered-robust standard errors in parentheses.

Table A8: IVs Zero-Imputed, High School Math Proficiency

Active Agreement Count	0.020		0.022
	(0.132)		(0.137)
Degree Centrality	0.199		0.263
	(0.211)		(0.213)
Tie Strength	−0.166		−0.188
	(0.122)		(0.123)
Average Duration of Active Ties	−0.030		−0.058
	(0.096)		(0.094)
Ego Network Transitivity	0.249		0.223
	(0.497)		(0.498)
Enrollment (Logged)		−0.748	−0.384
		(1.026)	(0.979)
Female		0.007	0.007
		(0.080)	(0.081)
Non-White		−0.022	−0.029
		(0.076)	(0.071)
Free- or Reduced-Price Lunch		−0.180***	−0.179***
		(0.044)	(0.044)
Spending per Student (Logged)		2.552	2.832
		(1.725)	(1.731)
Student-to-Teacher Ratio		−0.125	−0.122
		(0.136)	(0.136)
Teacher Salary (Logged)		−2.461	−2.669
		(3.144)	(3.174)
Teacher Experience		0.099	0.117
		(0.095)	(0.094)
Advanced Teachers Ratio		0.044*	0.045*
		(0.024)	(0.024)
District and Year Fixed Effects	✓	✓	✓
School Districts	333	333	333
Years	12	12	12
Observations	3497	3495	3495
Within-District R^2	0.002	0.014	0.016

Note: *p<0.1; **p<0.05; ***p<0.01
Double clustered-robust standard errors in parentheses.

Table A9: IVs Zero-Imputed, High School Reading Proficiency

Active Agreement Count	0.088		0.088
	(0.074)		(0.088)
Degree Centrality	0.094		0.181
	(0.206)		(0.226)
Tie Strength	−0.181		−0.206*
	(0.111)		(0.123)
Average Duration of Active Ties	0.135		0.098
	(0.110)		(0.112)
Ego Network Transitivity	0.463		0.365
	(0.557)		(0.538)
Enrollment (Logged)		0.533	0.928
		(1.778)	(1.821)
Female		−0.016	−0.012
		(0.073)	(0.073)
Non-White		−0.124	−0.112
		(0.117)	(0.121)
Free- or Reduced-Price Lunch		−0.161***	−0.162***
		(0.050)	(0.050)
Spending per Student (Logged)		1.449	1.714
		(1.939)	(1.904)
Student-to-Teacher Ratio		−0.122	−0.123
		(0.181)	(0.182)
Teacher Salary (Logged)		7.205	6.666
		(5.744)	(5.767)
Teacher Experience		−0.104	−0.078
		(0.107)	(0.106)
Advanced Teachers Ratio		0.040*	0.037
		(0.023)	(0.024)
District and Year Fixed Effects	✓	✓	✓
School Districts	333	333	333
Years	12	12	12
Observations	3497	3495	3495
Within-District R^2	0.003	0.012	0.015

Note: *p<0.1; **p<0.05; ***p<0.01
Double clustered-robust standard errors in parentheses.

Table A10: IVs Zero-Imputed, Suspension and Expulsion Rate

Active Agreement Count	−1.642		−1.495
	(1.161)		(1.079)
Degree Centrality	1.868***		1.871***
	(0.595)		(0.605)
Tie Strength	−0.265		−0.339
	(0.618)		(0.590)
Average Duration of Active Ties	−0.262**		−0.241*
	(0.131)		(0.129)
Ego Network Transitivity	−1.094		−0.998
	(1.373)		(1.419)
Enrollment (Logged)		0.357	0.107
		(1.194)	(1.206)
Female		−0.083	−0.085
		(0.063)	(0.063)
Non-White		−0.193	−0.175
		(0.141)	(0.138)
Free- or Reduced-Price Lunch		−0.033	−0.028
		(0.038)	(0.036)
Spending per Student (Logged)		1.103	0.798
		(1.349)	(1.321)
Student-to-Teacher Ratio		0.051	0.031
		(0.105)	(0.105)
Teacher Salary (Logged)		3.816	4.035
		(3.238)	(3.603)
Teacher Experience		−0.001	0.019
		(0.084)	(0.085)
Advanced Teachers Ratio		0.015	0.015
		(0.020)	(0.021)
District and Year Fixed Effects	✓	✓	✓
School Districts	333	333	333
Years	9	9	9
Observations	2664	2662	2662
Within-District R^2	0.018	0.008	0.025

Note: *p<0.1; **p<0.05; ***p<0.01
Double clustered-robust standard errors in parentheses.

Table A11: IVs Zero-Imputed, Attendance Rate

Active Agreement Count	−0.136		−0.149
	(0.115)		(0.118)
Degree Centrality	−0.037		−0.054
	(0.063)		(0.058)
Tie Strength	0.071		0.078
	(0.061)		(0.062)
Average Duration of Active Ties	0.008		0.005
	(0.015)		(0.015)
Ego Network Transitivity	−0.011		−0.046
	(0.149)		(0.152)
Enrollment (Logged)		−0.386**	−0.376**
		(0.187)	(0.182)
Female		0.010	0.010
		(0.012)	(0.012)
Non-White		0.009	0.009
		(0.009)	(0.010)
Free- or Reduced-Price Lunch		−0.015***	−0.015***
		(0.005)	(0.005)
Spending per Student (Logged)		0.004	0.018
		(0.182)	(0.176)
Student-to-Teacher Ratio		−0.028**	−0.028**
		(0.013)	(0.013)
Teacher Salary (Logged)		1.831***	1.879***
		(0.705)	(0.686)
Teacher Experience		−0.034**	−0.035**
		(0.014)	(0.014)
Advanced Teachers Ratio		0.001	0.001
		(0.002)	(0.002)
District and Year Fixed Effects	✓	✓	✓
School Districts	333	333	333
Years	9	9	9
Observations	2664	2662	2662
Within-District R^2	0.001	0.021	0.023

Note: *p<0.1; **p<0.05; ***p<0.01
Double clustered-robust standard errors in parentheses.

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