

Collaborating to manage performance trade-offs: How fire departments preserve life and save property

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Research Summary: We examine how formal collaboration allows organizations to resolve performance trade-offs that cannot be resolved informally. The theory is tested on U.S. fire departments, which pursue goals that sometimes conflict: reducing casualties and saving property. By relying on intrinsic motivation, informal collaboration reduces casualties and saves some property above what departments can achieve alone. Formal contracts are needed to achieve additional performance improvements on the goal of saving property. Contracts improve performance above what is accomplished informally by compelling collaboration even under casualty risk. Prior studies of collaboration that do not account for *ex ante* informality or performance trade-offs may misstate the impact of collaboration on organization performance.

Management Summary: Like many organizations, U.S. fire departments pursue multiple goals that sometimes conflict. For fire departments, these goals are reducing casualties and saving property. Goal conflict arises when firefighter lives are put at risk to save property. To improve performance on both goals, fire departments often collaborate with neighboring departments in nearby jurisdictions. In this paper, we examine how performance on both goals improves when departments collaborate informally through handshake agreements. However, performance in saving property—the goal that is less intrinsically motivating for firefighters—improves even more when the collaborating departments implement a formal contract. At the same time, casualties increase slightly. This is because a contract creates an obligation for an assisting department to save property even under a risk to firefighters' lives. The analysis shows how formal contracts are implemented to resolve trade-offs that cannot be

resolved informally. We conclude that the performance improvements associated with collaboration may be quite different than the improvements that follow the implementation of formal contracts. This is because contracts may deal only with marginal trade-offs between the goals of the collaborators.

KEY WORDS

alliances, collaboration, contracting, informality, performance

I promise concern for others. A willingness to help all those in need. I promise courage—courage to face and conquer my fears. Courage to share and endure the ordeal of those who need me. I promise strength—strength of heart to bear whatever burdens might be placed upon me. Strength of body to deliver to safety all those placed within my care. I promise the wisdom to lead, the compassion to comfort, and the love to serve unselfishly whenever I am called.

—A Firefighter's Pledge

1 | INTRODUCTION

How do collaborating organizations achieve their best joint performance? The answer depends on whether the collaboration takes the form of an informal understanding or a formal contract because each has different costs and benefits (Argyres, Bercovitz, & Mayer, 2007; Gil, 2013; Gulati & Nickerson, 2008; Li, Poppo, & Zhou, 2010; Poppo & Zenger, 2002; Reuer, Zollo, & Singh, 2002). In general, an informal arrangement is less costly, but does not confer the same benefits as a formal contract. Despite the importance of collaboration, several empirical challenges have made difficult the testing of theory regarding the performance consequences of informal and formal agreements, and of the transition from informality to formality.

This study seeks to address this gap in the literature. We begin by theorizing that informal collaboration may be sufficient to improve performance meaningfully, and that the costly step from informality to formality is only necessary when partners seek further increments to performance that require the resolution of trade-offs between shared goals. We show that the performance consequences of formal agreements may be inaccurately assessed if, first, the assessments do not consider the multiple simultaneous objectives of partners; and, second, they do not consider antecedent informal partnerships.

Two observations shape our investigation. First, organizations pursue multiple goals that may not be equally intrinsically motivating (Grant, 2007; Latham & Pinder, 2005)—a problem intensified by the separation of interests across partnering organizations (Lawrence & Lorsch, 1967; Meyer, 2002). Second, informal collaboration between separate organizations often begins prior to formal contracting. Scholars note that we have not exhaustively studied the performance consequences of a

transition from informal to formal agreements (Cao & Lumineau, 2015; McEvily, Soda, & Tortorillo, 2014).

Building on the work-motivation literature (Deci & Ryan, 2000; Grant, 2007, 2008; Grant & Berry, 2011), we conceptualize a formal contract as compelling personnel to engage in organizational activities that enact goals even when those goals are not intrinsically motivating. This is because formality improves alignment on goals *ex post* (Gottschalg & Zollo, 2007; Grant, 2007). We argue that when formal contracts are implemented among previously informal collaborators, they deal primarily with trade-offs between objectives; and when formal contracts are implemented among noncollaborators, they drive performance mainly on less intrinsically motivated objectives.

We test the theory on a panel dataset describing collaboration among U.S. fire departments between 1999 and 2010. Our approach exploits exogenous industry-wide changes that occurred just prior to the period of observation and that led to an increase in the incidence of collaboration between neighboring U.S. fire departments from 3 to 54%. The analysis identifies how transitions from informal to formal agreements over this period shaped performance outcomes on two shared goals: reducing casualties and saving property, the first of which is more intrinsically motivating than the second.

We evaluate the increment to performance in both reducing casualties and saving property that occurs with informal and formal collaboration. The U.S. fire department context is ideal for identifying how contractual formality influenced the resolution of trade-offs in shared goals. Informal collaboration among neighboring departments under “handshake agreements” is common and extensive. Formal collaboration rests on a written agreement that stipulates the specific duties to help each other. Thus, formal collaboration is a significant step beyond informal collaboration. Importantly, performance achievement—the quantum of casualties or property saved—is not contractible. Formal contracts do specify the conditions of when and where to show up, which creates a clear and binding obligation that previously did not exist. There is little variation in formal contract terms across U.S. fire departments.

The identification strategy relies on panel data and a difference-in-differences framework using individual fixed effects, variation in the timing of adoption, and a matching process to incorporate a control group of untreated units. The research design accounts for fixed structural differences among partner combinations, temporal shocks, and performance trends that may be correlated with both collaboration choices and gains. An advantage of this setting is that it is unencumbered by simultaneous developments that often impede clear identification in other settings, such as competition between partners, inconsistent performance assessment, endogenous changes in organizational boundaries, shifting reputations, changing norms, and changing terms of competition as agreements are implemented.

We find that, upon first collaborating, informal agreements improve performance meaningfully on both the more intrinsically motivated objective of preventing casualties and the less intrinsically motivated (although related and important) objective of saving property. Empirically, informal agreements are tied to 340 fewer casualties and \$3.5B in less property damage annually. Subsequently adding formal contracts to previously informal collaborations improves performance on the less intrinsically motivated goal, that is, saving property, by an additional 6%, but is accompanied by a slight increase in casualties. Furthermore, when a formal contract is adopted “cold,” that is, without any previous informal collaboration between the partners, partners save 60% more property than previously (which is much more than the 36% more property saved by informal collaborators) but casualty reductions are not as great as those achieved informally. In our discussion, we consider how fire departments select collaboration arrangements that suit their circumstances.

The findings of this study call into question prior results that do not consider the impact of *ex ante* informal arrangements on the performance of formal contracts. If only formal arrangements between partners were observable, then assessments of performance improvements would be reported incorrectly because, for previously informal collaborators, formality yields only incremental gains on less intrinsically motivated goals. The incorrect assessment would arise because formal agreements in this situation deal with incremental trade-offs. We argue that many prior studies of formal contracts have not considered the prior informal arrangements of the partners (often because of data limitations), and thus may mistake the performance consequences of collaboration. One important advantage of the fire department context is that we can observe both informal and formal arrangements in a controlled setting. As a result, we are able to assess directly the increments to performance of state transitions between informal agreements and the formal contracts that arise either subsequent to or at the inception of the collaboration.

2 | THEORY

One mechanism for governing an alliance is a *formal contract* (normally written) established either at the onset of collaboration or after an initial informal agreement. Formal contracts generally describe the basic arrangement, including the rights and obligations of both parties as well as the purpose of the alliance (Dyer, Kale, & Singh, 2001; Ring, 2002). Formal contracts introduced into an informal alliance may be used to further align interests (Hennart, 1988; Macneil, 1978; Reuer & Ariño, 2007), address revealed contingencies (Kogut, 1988), facilitate joint decision-making (David & Han, 2004), refine rights and obligations, coordinate activities (Gulati & Puranam, 2009; Reuer et al., 2002) and provide structures for resolving disputes (Lumineau & Malhotra, 2011; Mayer & Argyres, 2004; Reuer & Ariño, 2007).

Formal contracts are costly to negotiate, implement, and enforce. As a result, allying organizations sometimes rely exclusively on the self-enforcing mechanisms of *informal arrangements* to collaborate effectively. Informal governance is emergent, organic, and less costly than formal contracts. Nonetheless, informal arrangements employ powerful mechanisms such as trust among exchange partners (Zaheer, McEvily, & Peronne, 1998), learning to work together (Doz, 1996; Inkpen & Currall, 2004; Vanneste & Puranam, 2010), reputation (Banerjee & Duflo, 2000; MacLeod, 2007), and norms enforced by community members (Greif, 1993). Gibbons and Henderson (2011) argue—similar to Macneil (1978)—that handshake agreements or relational contracts can fill gaps left incomplete by formal contracts.

The existence of an informal relationship prior to formal contracting may influence the contract in several meaningful ways. Through informal collaboration, partners may create relationship-specific assets (such as trust, norms, communication patterns, shared and common knowledge, etc.) that both reduce the cost of contracting and increase the efficacy of the contract by, for instance, narrowing the scope of what must be specified.¹ The purpose of the formal contract may be to deal specifically with issues that cannot be managed informally. Once collaboration is underway—regardless of whether a formal contract is established—informal relationships and practices are present throughout dealings between partners (Baker, Gibbons, & Murphy, 2002; Gil, 2013). For simplicity, we refer to collaborations that are exclusively informal as “informal,” and those that are both formal and

¹Generally, full integration between separate organizations may arise in such situations, but full integration does not occur in even a single instance among fire departments during the period covered by our analysis. As a result, we can separate the effect on performance from the effect of control.

informal (or, when applicable, exclusively formal) as “formal.” Thus, collaborations between separate organizations are described herein as either formal or informal.²

All collaboration agreements—whether informal or formal—shape partner behavior to achieve specific organizational goals. In many instances, these goals may conflict. We draw attention to two types of goal conflict: first, conflicts that arise from the presence of qualitatively different objectives within the same organization; second, conflicts that arise between partners. In the context of our study, we postulate that all fire departments, bound by the firefighter's code, share the objective of reducing casualties, and that all share by jurisdictional mandate the objective of saving property. The firefighter's code of conduct quoted as the lead to this paper reflects that reducing casualties is more intrinsically motivated among firefighters than saving property. As a result, aligning incentives to save property is more expensive. Furthermore, the jurisdictional mandate to save property is not applicable outside the turf of the home department. Thus, both types of goal conflict arise: first, within departments faced with the risk of firefighter casualties under deployments to save property, and, second, when collaborators are deployed into neighboring jurisdictions.

Regarding the first type of conflict, trade-offs between objectives are not unique to fire departments. Organizations almost always pursue multiple goals at the same time (Meyer, 2002). Research in the field of strategic management has long considered how intra-organizational trade-offs shape realized performance. For instance, managers may not pursue revenue that is not immediately profitable (Zhang & Gimeno, 2010). Furthermore, not all organizational goals are equally motivating and in turn influence the effort and choice of activities undertaken by workers (Latham & Pinder, 2005). In particular, when one goal is more intrinsically motivating than another, then managers may face difficulties in compelling employees to pursue the less motivating goal with vigor and commitment—a condition made more severe when trade-offs between the goals exist. If there is a higher cost to alignment on less intrinsically motivating goals (as compared to more intrinsically motivating goals), then partners may formally contract to compel their pursuit.

Regarding the second type of goal conflict, allied fire departments may put different relative emphases on reducing casualties and saving property in their jurisdictions as compared to their partners' jurisdictions. The difference is particularly strong if a fire department activates a partnering department with no obligation to save property in the jurisdiction of the fire. In this situation, the fire chiefs, acting as managers, must deal with conflict between the first department's goals of saving both life and property and the partnering department's goal to reduce casualties.

This kind of separation of interests creates a variety of challenges. Opportunism arises when the costs of pursuing joint goals are borne by each of the partners asymmetrically. In such a case, a formal contract may be required to achieve alignment. Even when the goals of partnering organizations are aligned, performance of the alliance may be impeded by a lack of commitment or by complex interdependencies (Gulati & Singh, 1998). In such situations, organizations may select governance structures to resolve the different priorities of partners (Aggarwal, Siggelkow, & Singh, 2011; Ring & Van de Ven, 1992).

A literature has developed on how informality versus formality aligns interests (Gil, 2013; Gulati & Nickerson, 2008; Gulati & Puranam, 2009; Poppp & Zenger, 2002; Ryall & Sampson, 2009) but, in part because of data limitations, studies in this line have not fully considered either conflicts among multiple goals or differences in intrinsic motivation to achieve goals. Much of the research in this line has focused on tying variation in the content of contracts to performance—

²In the fire department setting, we do not encounter instances of reversion from formal partnerships to informal arrangements upon expiration of contracts, although such transitions could arise in other settings.

relying on contractual detail to identify the degree of formality and leaving implicit the level of informality.

Prior literature also has examined the performance consequences of governance mechanisms in collaborations between organizations. These studies tend to focus on the most immediate goals of collaboration rather than the ultimate goals of each ally. For instance, Poppo and Zenger (2002), Mohr and Spekman (1994), Saxton (1997), Lui and Ngo (2004), and Cai and Yang (2008) examine the satisfaction of partners with collaboration. A related but separate stream of work by Cavusgil, Deligonul, and Zhang (2004), Lui, Wong, and Liu (2009), and Zhou and Xu (2012) examines self-interested behavior in collaborations. Malhotra and Lumineau (2011) and Corts and Singh (2004) examine renewal of alliances, while Gulati (1995) and Westphal and Zajac's (1995) examine information sharing. A smaller literature examines the consequences of alliances for specific behavior: Zaheer et al. (1998), Cannon, Achrol, and Gundlach (2000), Gulati and Sytch (2007), and Cai and Yang (2008).

We build on this work by examining the consequences of governance choice for the ultimate and primary goals of fire departments (i.e., life and property saved). The psychology literature on work motivation provides a framework for analyzing the mechanisms linking different forms of collaborative agreements with different performance objectives (see Latham, 2011 and Supporting Information Figure A.A.1). Work satisfies various human needs (Latham & Pinder, 2005). Some needs are satisfied by the act of work itself, and thus are intrinsically motivated, while other needs are satisfied by the rewards of work, such as compensation and friendship. Thus, the detailed relationships between needs and work must be considered in a system of motivation. Organizational mechanisms regulate the behaviors undertaken to achieve rewards by anticipating how tasks discriminate between different needs. In firefighting, job design is shaped by a system of motivation that applies across departments. This system is governed by institutions such as the National Fire Protection Association and the "brotherhood." Within this context, collaborative relationships between departments determine when departments will deploy resources together but not the intensity of effort that each collaborating firefighter brings to each incident.

How do collaborative arrangements evoke consummate performance? When organizational goals are derived from the individual's extrinsic motivations (e.g., financial rewards), then the organization must intervene to create incentives for the individual, but when goals reflect the individual's intrinsic motivations, then the effort may arise without strong incentives. Many activities are intrinsically motivating for workers, and some may be relatively more intrinsically motivating than others. Grant (2007, 2008) analyzed several activities in firefighting and other contexts in which employees "go above and beyond the call of duty" to understand why and when workers are more intrinsically motivated to perform well in the absence of extrinsic rewards. Analysis in these papers focuses on intrinsic motivation, job satisfaction, and the desire to positively impact other people (i.e., prosocial motivation). When tasks are filled with meaning, workers are more dedicated and helpful (Grant, 2008). Workers also are driven to contribute to "worthwhile goals...by the desire to earn social esteem...or reinforce identity" (Rebitzer & Taylor, 2011).

In our setting, formal contracts compel workers to show up to their partners' fires as if they are their own. Once obliged to show up under the authority of a formal commitment, the work of individual firefighters is the same as it would be in their own jurisdictions. Formal contracts often include language intended to express this good faith. Moreover, the alignment of interests between the individual firefighter and the department itself is very tight. The ways that firefighters work together are governed almost entirely by well-established and common norms, trainings, and standards of practice elaborated through the "brotherhood" and the National Fire Protection Association. Formal contracts between partnering departments commit employees into situations where various work tasks are intrinsically motivated to varying degrees. Differential firefighter effort across incidents arises primarily from intrinsic motivations.

Hedonic intrinsic rewards (e.g., enjoyment, identity) are well-aligned with the organization through job design (i.e., task significance, knowledge of results). Normative intrinsic rewards arise from belonging to the close social community of co-committed firefighters.

Different incident goals evoke different intrinsic motivations. For example, firefighters are more intrinsically motivated to protect civilians and each other from injury and death than to protect property from being damaged. By extension, less intrinsically motivated goals may require organizations to employ mechanisms to increase motivation to achieve better outcomes. For example, firefighters may not be motivated to speed toward property fires when no lives are at risk. The goal of saving property is further complicated because it may trade against the more intrinsically motivated goal of preventing casualties because firefighters may be put at risk of injury and even death in trying to save property from fire. Of course, these goals are not always in direct contention. Casualties are relatively rare and arise in only 1.5% of fire runs in contrast with the property damage that occurs in 25.5% of fire runs, but because casualties and property are *sometimes* in contention, collaborating organizations must develop decision rules for managing the trade-offs that may arise between them.

How does the form of agreements between fire departments affect their ability to accomplish simultaneously these different objectives? Informal agreements are diffuse, understood, and enforced by norms, relationships, and the need for smooth relations in the future. In contrast, formal agreements are specific, agreed upon, and are enforceable by legal authorities (i.e., the courts). Formal contracts provide the recourse of more external controls, although using the courts to resolve disputes is costly. Most formal contracts are self-enforcing for this reason alone. That is, the presence of the legal system to enforce a legally binding contract is often sufficient to ensure that contract parties comply with their agreements without court intervention. By contrast, self-regulating mechanisms tend to dominate under informal arrangements.

Informal agreements are sufficient to regulate behavior when intrinsic motivation arises. In contrast, formal contracts are worth employing to achieve better departmental outcomes when goals are not sufficiently motivating. Entering into a costly contracting process may not be worthwhile if members of the organizations are sufficiently motivated by the *spirit of the agreement* to perform to the best of the organization's capabilities. On the other hand, contracting may be necessary and justified when the *letter of the agreement* motivates performance more fully. Both informally and formally allied organizations have the capacity to deliver performance to their maximum capability, and yet each type of arrangement may lead to a different resolution of goal conflict. Following Deci and Ryan (2000) and related scholarship on work motivation (Grant, 2008; Latham, 2011), we stipulate that informally allied organizations resolve trade-offs between more-aligned and less-aligned goals to favor improvements on more intrinsically motivated goals. This occurs because informally allied organizations by definition do not commit contractually to the pursuit of less intrinsically motivated goals when performance on the more intrinsically motivated goal would be jeopardized.³

Among organizations with a history of informal collaboration, relational enforcement mechanisms are also relevant. These mechanisms include trust, mutual knowledge and understanding as well as the shadow of continued future dealings (Inkpen & Currall, 2004; MacLeod, 2007; Vanneste & Puranam, 2010; Zaheer et al., 1998). The operation of these mechanisms must be consistent over time in the absence of a formal contract precisely because self-determination directs members to pursue more- over less-intrinsically motivated goals. Formal contracts can impede the smooth collaboration by creating rigid obligations that are costly to uphold. For goals that intrinsically motivate partners, formal contracts are less desirable and effective. Thus, we predict that:

³Of course, general social norms, professional standards, and the legal environment still regulate collaborative behavior in pursuit of less intrinsically motivated goals under informal agreements.

Hypothesis 1: Organizations with *no prior history* of collaboration that enter into informal collaborations improve performance on more intrinsically motivated goals *more powerfully* than those that enter into formal collaborations.

Formal contracts specify the precise obligations of parties under various contingencies. Because formal contracts are negotiated, they are suited to the achievement of performance gains on less intrinsically motivated goals. The processes of implementing a formal contract (i.e., negotiations, technical systems, protocols and procedures, etc.) establish behavior aligned with the pursuit of less intrinsically motivated goals as obligations enforceable by parties external to the arrangement (Meyer & Allen, 1997). In this way, formal contracts reduce self-determination of activities that would on their own produce behaviors that favor performance on more intrinsically motivated goals. Thus, we predict that:

Hypothesis 2: Organizations with *no prior history* of collaboration that enter into informal collaborations improve performance on the less intrinsically motivated goals *less powerfully* than those that enter into formal collaborations.

Informal collaborators that work together may eventually formalize their relationship to achieve further improvements to performance on less intrinsically motivated goals above what can be achieved informally. Formality specifies the obligations of the parties to pursue the less intrinsically motivated goal even when the pursuit may create the risk—however small—of diminished performance on the more intrinsically motivated goal. This balancing in favor of the less intrinsically motivated goal may be desirable because realized detriments to performance on the more intrinsically motivated goal are improbable, such as when fire departments face casualties or firms face bankruptcy. The external regulation of behavior achieved through written contracting may yield improved performance via several mechanisms. For instance, the process of negotiating formal terms may itself constitute a clarification of the goals (Ethiraj & Levinthal, 2009) by increasing attention and psychological commitment (Meyer & Allen, 1997). Thus, we predict that:

Hypothesis 3: Organizations with *a prior history* of informal collaboration that enter into formal collaborations improve performance on the less intrinsically motivated goal but not the more intrinsically motivated goals.

An argument raised by motivational theorists is that contracts may dampen intrinsic motivation by inserting specific claims, instructions, priorities, and requirements into collaborative arrangements. Formal contracts have been shown to crowd out interpersonal trust, thereby undermining the intrinsic motivation to cooperate by reducing goodwill in working relationships (Cavusgil et al., 2004; Malhotra & Murnighan, 2002). If these specificities run deep, then they can dampen intrinsic motivation to collaborate creatively and organically *ex post*. When the trade-off between goals is likely to bind, the transition from no collaboration to informal arrangements (prior to the implementation of a formal contract) builds relationships and encourages performance on the more intrinsically motivated goal that endures even after the formal contract is implemented. In other words, the initial informal arrangement allows the collaborators to subsequently achieve better performance under the formal contract. By contrast, among potential collaborators for which a trade-off between goals is less likely to bind, performance under the word of the contract may approximate the highest achievable performance. Thus, informal relationships and formal contracts may provide redundant mechanisms to encourage cooperative behavior (Huber, Fischer, Dibbern, & Hirschheim, 2013; Yang, Su, & Fam, 2012). This occurs because poor performance on the more intrinsically motivated goal is only loosely connected to actions taken to achieve better performance on the less intrinsically motivated goal. In

such instances, the effective purpose of the collaboration is to improve performance on less intrinsically motivated goals. Prior research also shows that informal relationships can reduce the effectiveness of formal contracts by encouraging less enforcement (Antia & Frazier, 2001; Wang, Yeung, & Zhang, 2011). As a result, we predict that:

Hypothesis 4: Formal contracts improve performance on less intrinsically motivated goals *more* for organizations *with no prior history* of informal arrangements than for those *with a prior history* of informal arrangements.

These hypotheses account for a subset of (a) possible paths into and out of a formal contracting relationship (Figure 1), (b) aspects of organization performance (only a relative comparison of two), and (c) comparisons to be made among relationships. We focus on this subset because it is far more tractable theoretically, and because this subset is relevant to all organizations that enter into formal collaborations. Many never retreat and if they do it is often for a wide range of reasons and in a wide range of manners worthy of further study in subsequent research.

3 | EMPIRICAL SETTING

In the United States, more than 26,000 fire departments operate under the authority of municipal and county governments to protect life and property from fires and other hazards. Each department is independent from others, and has full discretion over its own resources and commitments. Because firefighters in the United States are required to be community members, the goals of individual firefighters are closely aligned with those of the communities they serve.

Comparisons of performance before and after the onset of collaborative arrangements between U.S. fire departments are unencumbered by simultaneous developments that often impede clear identification in other settings. First, boundaries are stable and independent of collaboration choices. Compared to other types of organizations, fire departments are relatively free of the complications of

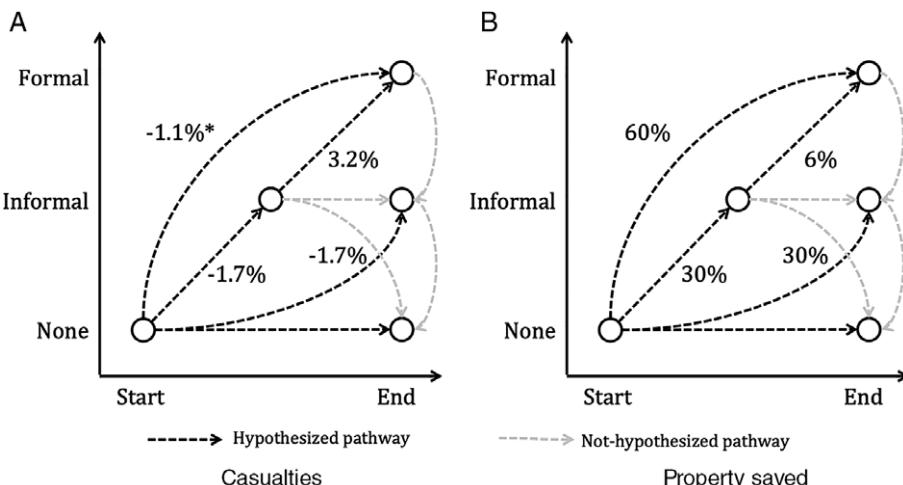


FIGURE 1 Increments to performance. Each panel depicts the increments to performance of the state transitions estimated in Table 3 using the elasticity interpretation for semi-logarithmic models. The y-axis represents the form of collaboration, the x-axis represents the state over time, and the circle represents a department pair in each state-period combination. Increments are relative to the baseline of no collaboration at both the state and end periods. *Not statistically different from zero

organizational survival and mergers. Second, the U.S. *Fire Administration* (USFA) under the *National Fire Incident Response System* (NFIRS) measures the performance of all fire departments in both reducing casualties and saving property by incident using a consistent approach. This enables comparable assessments on multiple aspects of performance. Third, the implementation of collaboration arrangements is uncomplicated by competitive pressures on the partnership common to private-sector collaborations.

Fire departments collaborate only with neighboring departments. On average, each department in our sample has 5.4 neighbors close enough to be eligible collaborators.⁴ The unit of analysis is the department-pair-year. The data include only those pairs for which information is available over the entire 12-year period. A total of 2,888 unique departments and 186,432 pair-years are represented with no duplication from reversal of partners' names.

An important feature of the setting is that it allows us to incorporate into the analysis pairs of departments that do not collaborate, that is, eligible collaborators that did not implement either informal or formal collaborative agreements. This feature is crucial to identification as it allows us to conduct a difference-in-differences analysis in which we examine how the performance of collaborators changed as compared to matched pairs. To accomplish the matching, we first identify, for each collaborating pair, a neighbor that did not collaborate with one of the two members, with the member taken at random from among the two collaborators. After identifying a match for each collaborating pair in each year (except in rare instances where no noncollaborator existed), we then form a sample consisting of both "treated" units (i.e., pairs of departments that collaborate whether informally or formally in the observation window) and "untreated" units (i.e., closely comparable pairs of departments that do not collaborate). Our treatment is the timing of the change in informal and formal collaboration, and so we are able to interpret our results as average treatment effects.⁵ Accordingly, in our analysis, we account for all fires occurring in the jurisdictions of both departments in the pair—prior to collaboration, after informally collaborating, and after formally contracting—in assessing the performance of the pair. This is because collaborating departments have the capacity to allocate resources across all their incidents.

In 1999, the first year for which data is available, 3% of our sample collaborated informally while fewer than 0.1% collaborated under a formal contract (Table 1). In the subsequent 12 years, a wave of collaboration motivated by four exogenous shocks took hold, so that by 2010, 31% of neighboring departments collaborated informally; 10% collaborated formally with no prior history of informal collaboration; and 14% had made the transition from informal to formal collaboration.

The first exogenous shock was the emergency response to the terrorist attacks upon the United States on September 11, 2001 (the "9/11 attacks"), which clarified the intrinsic motivations of firefighters and raised awareness about the benefits of both informal and formal collaborative agreements.

Second, in 1997, the *National Fire Protection Association*—the organization responsible for "consensus codes and standards intended to minimize the possibility and effects of fire and other risks"—released an update to the *Standard for Fire Department Occupational Safety and Health* (National Fire Protection Association 1500) that incorporated a provision referred to as "two-in, two-out" (TITO). This provision stipulated that, for any two firefighters actively engaged in a fire event,

⁴We define neighbors (i.e., eligible collaborators) to be headquartered no more than 15 miles away, which is the 95th percentile of distance between departments that work together either informally or formally; the results are robust to alternative distances (see Horwitz, McEvily, & McGahan, 2016).

⁵In other words, our results estimate the average effect in the population rather than the average treatment effect among only treated pairs. Please see Supporting Information Appendix S1 for additional information the matching procedure and on the nature of formal contracts.

TABLE 1 Collaboration among neighboring pairs

	Collaboration		Formal	
	No collaboration	Informal	After no collaboration	After informal collaboration
1999	97%	3%	0%	0%
2000	94%	5%	1%	0%
2001	84%	12%	3%	1%
2002	80%	15%	3%	2%
2003	73%	19%	5%	3%
2004	68%	21%	6%	5%
2005	64%	23%	6%	6%
2006	60%	25%	7%	8%
2007	56%	27%	8%	9%
2008	53%	28%	9%	11%
2009	49%	29%	9%	12%
2010	46%	31%	10%	14%

two different firefighters should be on-scene ready to provide relief. TITO was adopted as a *U.S. Occupational Safety and Health Administration* regulation in 1998. TITO placed an immediate burden on all departments to increase the number of personnel onsite at all fires. One way to comply without substantially raising costs was by collaborating with nearby departments.

The third structural change that occurred was that the cost of implementing both informal and formal agreements was reduced through Emergency 911 calling systems. Beginning in the early 1990s, county and regional 911 call-centers were established to receive emergency calls and to deliver dispatch messages to all departments in their areas. This centralization made it possible to collaborate without a substantial technological investment.

In the fourth structural change, the *Insurance Service Office*—the organization charged with rating fire departments and their municipalities for setting insurance premiums on property—revised its ratings schedule in 1997 to credit departments with collaboration agreements and thus lower insurance premiums in their jurisdictions.⁶

As the result of these four exogenous institutional changes, fire departments across the United States increased collaboration. By examining the period of transition in which departments reconsidered and often altered governance over their relationships with neighboring departments, it is possible to identify how collaboration unfolded.

4 | SAMPLE

The sample is drawn from the USFA's NFIRS database, which the NFIRS website describes as “the world's largest, national, annual database of fire information.” The database is constructed by compiling reports that are submitted by fire departments every time an incident occurs. The standardized

⁶The Insurance Service Office (ISO) conducts reviews of all U.S. Fire Departments and assigns them a score to summarize their capacity to address fires in their jurisdictions. So, departments are credited for demonstrating capabilities, resources, and plans of various kinds according to published schedules. With the change in the ISO schedule noted in the paper departments that collaborated informally with their neighbors began to be credited for doing so. Additionally, departments that have formal agreements to collaborate are further credited. The ISO evaluations are used by insurers to set property insurance rates.

reporting system was setup by the USFA in conjunction with the passage of the *Federal Fire Prevention and Control Act of 1974* (P.L. 93-498) a law resulting from the *National Commission on Fire Prevention and Control* tasked with understanding fire loss at the national level in 1973. We began with all NFIRS data between 1999 and 2010.

We then formed a strongly balanced sample of 8,410 pairs that worked together at least once in the sample window using identifiers provided within the NFIRS reporting scheme. A focal department was randomly selected from each pair and then matched with all noncollaborating departments within a 15-mile radius. From this set of focal departments and all feasible neighbors, a random pair was matched with the balanced sample. This yielded an additional 7,126 pairs—fewer than the original 8,410 because not all focal departments had at least one feasible neighbor and so were not paired. The final sample for analysis is 186,432 pair years including 15,536 unique pairs of neighboring departments, 2,888 unique focal departments or about total of 11% of all U.S. departments.

5 | MEASURES

5.1 | Dependent variables

The NFIRS measures casualties using an index of severity for each occurrence. It also measures the dollar value of property saved at each fire incident. Accordingly, our measure of *Casualties* is the index associated with all fires in the jurisdictions of the neighbors in the pair in a particular year. The index is calculated as the dot product of casualties and the ordinal assessment of seriousness for each casualty ranging from least to most serious where one indicates a minor injury and five indicates death. To assess property saved, the amount of property damaged must be compared with the amount of property that was at risk of loss in a particular fire. We construct this measure by comparing the damage to the property at risk of loss in a fire. *Property saved* is the U.S. deflated dollar value of property and contents at risk minus the value that was lost as a result of the fire or hazard. For each department-pair-year, this is the collective total loss for each department in the pair. On average, each pair protected \$17.9 million in property with a property loss of \$1.4 million. For both dependent variables, we use the sum of casualties for both departments in a given year on all incidents. This is because, first, collaboration has consequences for all of a department's incidents and, second, to facilitate comparisons of performance before and after collaboration, and, third, to facilitate comparisons with noncollaborators in the matched sample.

5.2 | Explanatory variables

We identify with a vector of dummy variables the state of governance for each department-pair-year as one of the following: informal; formal after informal; formal after no collaboration; and no collaboration. From the state indicators, it is possible to determine the evolution of the governance for each pair from prior to the start of collaboration if it occurs. We note that this is a departure from the literature in two main ways. First, we do not measure formality with contractual detail (i.e., normally count of clauses). These data are not available for this sample; however, it is also not necessary even if available because these contracts are highly homogeneous across units because of what they are intended to accomplish—get everyone to show up when and where promised. Second, we measure informal collaboration in the absence of a contract.

5.3 | Control variables

Although fire departments conduct similar activities with similar types of resources, there are major differences across departments in the demand for fire services. The risk profile of a department affects both the propensity to collaborate and its performance. Many material differences are observable: in particular, heterogeneity in the size and location of the jurisdiction as well as the kind of incidents faced. To control for these differences we include controls for four distinct categories of incidents: the number of *outdoor fires*, *residential fires*, *other structure fires*, and *hazardous material (HAZMAT) runs*. We also control for variation in demand assessed by and *run variability* over time. To control for heterogeneity in the quantity and allocation of resources available to deal with the demands of formal partners, we include controls for the number of *personnel* in the department pair and the number of *fire engines* (i.e., apparatus, cars). Additionally, unobservable idiosyncratic features of each department—such as the relative position, differences in building type, average weather conditions—can similarly confound the relationships of interest. We address these differences in large part with fixed effects and matching, as described below. Please see Table 4 for descriptive information on all variables in the dataset. This table describes the database in detail and particularly the exclusion of the incidents in Worcester, Massachusetts, on December 3, 1999, and in New York City on September 11, 2001. Please see Supporting Information Table A.B.6 which includes a correlation matrix for all variables.

6 | METHODS

The following estimating equation is used to capture state differences and performance changes.

$$Y_{ijt} = \alpha I_{ijt} + \beta F_{ijt}^{NI} + \delta F_{ijt}^I + X' \boldsymbol{\theta} + \eta_{ij} + \tau_t + \varepsilon_{ijt}. \quad (1)$$

In Equation (1), the performance Y_{ijt} of the pair composed of a focal department i and alter j in period t is defined as a linear function of an indicator of informal collaboration (I_{ijt}), an indicator for formal collaboration after *not* collaborating informally (F_{ijt}^{NI}), and an indicator for formal collaboration after collaborating informally (F_{ijt}^I). The omitted state is of no collaboration. These indicators, which vary by department pair, allow us to measure changes in the state of collaboration between pairs, and thus serve as our treatment variables. Because state changes vary over time across pairs, the indicator variables collectively capture the exhaustive set of before and after conditions depicted in Figure 1 as they occurred over the 11-year window of observation. The control variables are denoted by vector X with fixed effects for individual focal-alter department pairs (η_{ij}) and temporal shocks (τ_t). For models where Y_{ijt} is measured with casualties we include a dummy variable for when casualties equal to zero.⁷ All other unobserved variables are captured by in the residual term ε_{ijt} . The estimated coefficients $\boldsymbol{\theta}$, α , β , and δ can be interpreted as follows. The coefficient α is the effect on performance of transitioning from no collaboration to an informal agreement. The coefficient β is the effect on performance of transitioning from no collaboration to a formal contract. And the coefficient δ is the effect on performance of transitioning from informal to formal collaboration.

⁷Because casualties are naturally measured as count data and so have a skewed distribution, we followed the approach introduced by Pakes and Griliches (1980) and more recently used by Acemoglu and Linn (2004) to approximate the function with a linear model that can be estimated using Ordinary Least Squares. In their application, Acemoglu and Linn (2004) introduce a dummy variable that equals 1 to the control vector when their dependent variable is equal to zero for the “advantages of simplicity and flexibility.” Because we are estimating and evaluating the effects on two different dependent variables, this approach brings the advantage of comparability across models (as compared to the assumption of a Poisson distribution) which is integral to the analysis.

The individual fixed effects address large classes of potentially problematic omitted variables, including geographic topography, infrastructure quality (i.e., roads and bridges), and demographic and social features related to wealth and property. The influence of period-specific shocks that affect all pairs is captured by period dummies τ_t . To avoid dropped observations, we transformed both dependent variables using a logarithmic function after incrementing the natural measure by one. This is important for preserving the panel structure of the data.

The model isolates the effects on performance that occur as organizations enter into relations and as they evolve dynamically over time through alternate pathways to deliver a difference-in-differences estimate of the stipulated relationships.⁸ The first difference between the pre- and post-treatment states removes the fixed unobservable differences between department pairs. The second difference assesses variation between the treated and control units. Identifying the effect of the treatment on performance relies on the assumption that collaboration state changes are exogenous to changes in performance.

To make valid causal inferences under this design, we must assume that error terms are strictly exogenous conditional on observables. We also must assume there is no difference between pre-treatment observation and control unit other than the treatment states. In this way, we impose a restriction on the correlation between the explanatory variables and the error term in any time period. We support the validity of the exogeneity assumption in several ways: first, through a case matching procedure to establish reliable changes in baseline performance over time; inclusion of controls for pair-specific variables that are potentially confounding and change over time; and inclusion of controls for fixed differences among pairs over time, and temporal shocks that affect all pairs; second, through robustness checks including the assessment of pre-treatment performance trends and sensitivity analysis of results to different control structure assumptions.

The first of these validating procedures involves matching each treated pair with a random partner from the set of eligible noncollaborators in the decade under observation. The sample is conservative in that it includes eligible noncollaborators rather than only pre-collaborators (who might anticipate improved performance from collaboration). This design significantly reduces the problems associated with pre-treatment trends. It also significantly reduces selection effects that might arise if poorly performing departments tend toward collaboration. This is because the matching procedure controls for pre-collaboration performance differences.

In our robustness analyses, which are reported in Supporting Information Appendix S1, we present the finding of no differences among treated and untreated pairs in pre-treatment performance. Thus, the assumption of exogeneity in our model (i.e., after the inclusion of the matched pairs and of the various controls) is supported.

7 | RESULTS

To facilitate exposition, Table 2 summarizes all hypotheses, their associated predictions and empirical tests, and the estimates of relevant statistics, and Table 3 reports estimates of Equation (1). The first three columns describe how collaboration reduces casualties, and the final three columns describe how collaboration saves property. Columns (1) and (4) exclude controls while columns (2) and (5) include them. Columns (3) and (6) present the estimates that would arise if prior informal agreements were not considered in an analysis of the formal contracts between departments. We

⁸See the Supporting Information Appendix S1 for the application of Imbens and Wooldridge (2007) to the empirical specification and setting of this paper.

TABLE 2 Summary of hypotheses and results

Hypothesis	Intrinsic motivation of outcome	Prediction	Statistical test results	
			Point estimates	Joint hypothesis
1	High (i.e., saving lives)	$\alpha > \beta$	Reject $\alpha = 0$ Cannot reject $\beta = 0$	$F = 0.22$ Prob $> F = 0.63$
2	Low (i.e., saving property)	$\alpha < \beta$	Reject $\alpha = 0$ Reject $\beta = 0$	$F = 5.10$ Prob $> F = 0.02$
3	Low	$\delta > 0$	Cannot reject $\delta = 0$	n/a
	High	$\delta = 0$	Reject $\delta = 0$	
4	Low	$\beta > \delta$	Reject $\beta = 0$ Reject $\delta = 0$	$F = 2.33$ Prob $> F = 0.13$

n/a: not applicable.

interpret all results using a log–log elasticity approximation rather than the proportional impacts approach (Kennedy, 1981). We made this choice because it is more conservative. The results are qualitatively the same with the same implications for theory under each approach.

The results in the first two columns of Table 3 suggest that the effects of various types of collaborative arrangements on the more intrinsically motivated goal of reducing casualties are sensitive to the inclusion of controls that represent the quantity and distribution of fires by type and the nature of the firefighting resources held in each jurisdiction. This result and the low p -values on the controls (i.e., all are less than 0.001) together suggest that collaborators select the level of formality in their arrangements to reflect the types of fires that are prevalent in their jurisdictions and the resources available to each partnering department.

The estimate in column (2), which includes controls, indicates that casualties are lower among informal collaborators as compared to pairs that do not collaborate. Formal collaborators with no prior history of informal collaboration likely have no statistically meaningful improvement in casualties when compared to pairs that do not collaborate with a large p -value on the estimate of 0.39. In addition, department pairs that formally contract after a history of informal collaboration have *higher* casualties (a point estimate suggesting 1.5% more casualties) than pairs that do not collaborate and than pairs with informal collaborations although the evidence is not statistically compelling with a large p -value of 0.21. These results lead to our conclusion that informal collaboration improves performance more than formal contracts on the more intrinsically motivated goal of reducing casualties.

Panel A of Figure 1 summarizes the magnitudes of the results. Compared to noncollaborators, neighboring pairs achieve 1.7% fewer casualties on average after collaborating informally, which implies 340 fewer casualties in the United States each year. The effect is statistically meaningful with a 95% confidence interval between -3.0 and -0.5% . This improvement in reducing casualties is significantly greater than the results achieved by noncollaborators that move directly into formal arrangements, where no significant reduction in casualties occurs. As predicted in Hypothesis 1, organizations with no prior history of collaboration that enter into informal collaborations improve performance on the more intrinsically motivated goal more intensively than those that enter into formal collaborations. The estimated coefficient on informal collaboration in model (2) of Table 3 is economically and statistically meaningful while the estimated coefficient on formal collaboration with no prior informal collaboration is neither. We also tested whether the difference in these coefficients was equal to 0; however, with this joint hypothesis test we are pushing the limits of our dataset. Specifically, because of the large confidence interval around the latter coefficient from -3.6 to 1.4% the difference in coefficients is difficult to establish yielding a large p -value of 0.63.

TABLE 3 Performance of fire department pairs

	Casualties			Property saved		
	(1)	(2)	(3)	(4)	(5)	(6)
Explanatory variables						
Informal collaboration	0.003 (0.007)	-0.017 (0.007)		0.67 (0.072)	0.3 (0.065)	
Formal collaboration						
After no collaboration	0.029 (0.013)	-0.011 (0.013)		1.308 (0.134)	0.603 (0.125)	
After informal collaboration	0.053 (0.012)	0.015 (0.012)		0.897 (0.123)	0.362 (0.112)	
After either collaboration state			0.015 (0.008)			0.288 (0.080)
Control variables						
Outside fires	0.037 (0.004)	0.037 (0.004)			-0.562 (0.043)	-0.560 (0.043)
Residential fires	0.176 (0.004)	0.176 (0.004)			1.001 (0.037)	1.004 (0.037)
Other structure fires	0.074 (0.003)	0.074 (0.003)			0.566 (0.030)	0.574 (0.030)
HAZMAT runs	-0.037 (0.002)	-0.037 (0.002)			1.31 (0.018)	1.314 (0.018)
Run variability	0.135 (0.004)	0.135 (0.004)			-0.596 (0.029)	-0.593 (0.029)
Personnel	-0.007 (0.004)	-0.007 (0.004)			0.489 (0.033)	0.486 (0.033)
Fire engines	0.014 (0.003)	0.013 (0.003)			0.165 (0.028)	0.166 (0.028)
1(casualties = 0) ^a	-1.91 (0.004)	-1.86 (0.004)	-1.860 (-0.004)			
Observations	186,432	181,503	181,503	186,432	181,503	181,503
# pairs	15,536	15,536	15,536	15,536	15,536	15,536
R ²	0.657	0.749	0.749	0.201	0.371	0.371

Note. Robust SEs clustered on the pair in parentheses. All models include pair and year fixed effects. HAZMAT: hazardous material.

^a Accounts for inflation of larger number of zero values for casualties variable.

The results for the transition among informal collaborators that subsequently elect to collaborate formally suggest an increase in casualties by an additional 3.2% over the previous reductions from informally collaborating. This last result naturally raises the question: Why would informal collaborators make the transition to formal collaboration if casualty rates are higher after the transition? The answer lies in the results on property savings.

Columns (4) and (5) of Table 3 report on the estimated relationships between the formality of collaboration and property savings. Similar to the estimates for casualties, the estimates for the explanatory variables are sensitive to controls representing the nature of incidents and of firefighting resources. When controls are excluded, the estimated coefficients on explanatory variables are greater than when controls are included. Given that the controls appear to have a statistically meaningful impact on the explanatory variables, the differences in the coefficients on the explanatory variables in

TABLE 4 Descriptive statistics

	Mean	SD	Min	Max
Dependent variables				
Property saved ^a	17,983,035	127,373,669	0	4,425,317,888
Property value at risk	19,029,959	128,548,703	0	4,454,861,824
Property damage	1,433,345	6,586,900	0	405,434,496
Casualty index ^b	14.82	53.31	0	2,663
Firefighters	8.56	30.64	0	1,788
Civilians	6.76	25.21	0	881
Explanatory variables				
No collaboration	0.687	0.464	0	1
Informal collaboration	0.198	0.398	0	1
Formal collaboration	0.115	0.319	0	1
After no collaboration	0.055	0.228	0	1
After informal collaboration	0.060	0.237	0	1
Control variables				
Outside fires	91	222	0	7,047
Residential fires	42	105	0	4,110
Other structure fires	26	37	0	857
HAZMAT runs ^c	117	234	0	7,168
Run variability ^d	16	35	0	3,799
Personnel	109	165	2	3,742
Fire engines	71	133	1	3,014

FEMA: Federal Emergency Management Agency; HAZMAT: hazardous material.

^aThe property saved variable is difference between the assessed value of the property at risk and the value of the loss to property and contents in deflated U.S. dollars. The maximum value of \$4.4 billion is for partnerships in Portland, OR in a year in which there were several incidents involving large institutional properties, manufacturing facilities, and residential complexes. It is not uncommon in geographic centers with these types of properties for there to be multiple incidents with very large values at risk although these incidents are out in the long tail of the distribution.

^bThe casualty index represents deaths and injuries as reported by FEMA on a 5-point scale in which a 5 represents a firefighter or civilian death and a 1 represents a minor injury such as a sprained ankle. The maximum value of 2,663 appears for two observations: Fitchburg-Worcester in 1999 and Milford-Worcester in 1999. The casualty index for Worcester was extraordinarily high in 1999 because of 6 deaths and 399 injuries at the tragic five-alarm cold storage warehouse fire on December 3, 1999, as well as a large number of other fires in Worcester during the year. Please note that FEMA excludes data for fires in New York City on September 11, 2001; as a result, the New York City Fire Department is not included in the analysis as data for all 12 years under study are not represented.

^cHAZMAT runs are not fire runs but are fire department runs and thus are included.

^dRun variability describes the concentration of fires across the pair and is measured as the average of the SD of daily fire frequency for the two members of the pair. High run variability indicates that the departments had sporadic episodes of multiple fires while low run variability indicates that the departments had regular occurrences of fires.

columns (4) and (5) again suggest strong selection as department pairs enter agreements that reflect their circumstances and goals.

Panel B of Figure 1 is constructed to report the magnitude of differences in the coefficients for assessment of Hypothesis 2. When department pairs that had not previously worked together initiate collaboration with an informal agreement, the goal of saving property improves by 30%, while those that initiate collaboration with a formal contract improve performance on this goal by 60%. Both estimates have a *p*-value of less than 0.001. Organizations with no prior history of collaboration that enter into informal collaborations improve performance on the less intrinsically motivated goal less intensively than those that enter into formal collaborations. Moreover, when we test the joint hypothesis on the difference in coefficients, we obtain a *p*-value of 0.02, which suggests that the null of no difference arises in only 2 out of 100 trials.

The 6% improvement achieved through formal contracting after informal collaboration addresses why formal contracts are valuable despite their implications for casualties: informal collaborators may enter into formal agreements despite higher casualty rates in order to save property. In other words, these coefficients provide economically and statistically meaningful evidence in support of Hypothesis 3. Organizations with a prior history of informal collaboration that enter into formal collaborations improve performance on the less intrinsically motivated goal but not the more intrinsically motivated goal.

The comparison of magnitudes in Figure 1 also demonstrates that neighboring departments that move from informal collaboration to formal contracts improve property savings less than partners that collaborate formally from the outset. These results are aligned with the idea that partners that escalate toward formality sequentially may be managing complex trade-offs more intensively. The statistical evidence supports Hypothesis 4. The improvement to performance on the less intrinsically motivated goal is greater for formal collaborators with no prior history of informal collaboration than for those with a prior informal arrangement. The test of the joint hypothesis of that the difference in coefficients differs from zero yields a *p*-value of 0.13. While this is not statistically strong, the point estimate considered alone suggests an economically meaningful difference.

Taken together, these results suggest that the two paths to formal collaboration involve different types of trade-offs and objectives. In the simple case where noncollaborators move directly into a formal contract, the improvement to property savings is dramatic at 60% despite the absence of any reduction in casualties. The more complicated path into formal collaboration involves two steps: First from no collaboration into an informal arrangement, and then from the informal arrangement into a formal contract. The overall improvement in property savings across this complex chain is 36% and is accompanied by cumulative reduced performance of 1.5% on the more intrinsically motivated goal of reducing casualties. Neither of these figures compares favorably with the 60% improvement in property savings obtained on the other path; however, the initial improvement in casualties followed by a deterioration suggests partners may privilege the intrinsically motivating goal.

8 | DISCUSSION AND ROBUSTNESS

8.1 | Scholars must account for the progression into a formal agreement

Our findings have important implications for researchers in the fields of strategic management and organization theory. Specifically, they suggest that studies which examine the relationship between formal contracting and performance may significantly misstate the importance of collaboration: first by neglecting improvement arising from informal collaboration alone, and second by failing to account for differences in the paths to performance selected by collaborating pairs. To test for these possibilities, we ran an additional analysis.

We report this analysis in columns (3) and (6) of Table 3 which includes results that would be obtained in our data if previous informal agreements were not accounted for. This analysis demonstrates powerfully that spurious results would be obtained if informality, as an antecedent and alternative to formal agreements, were not considered. Column (3) reports results for casualties regressed on formal contracts. The coefficient on formal collaboration takes a small positive value with a *p*-value of 0.08—contrary to the results found in column (2). This is misleading to observers who would conclude that formal collaboration raises casualties. The core underlying reason for the difference in the estimate is that, among those organizations that formally collaborate, the level of casualties is previously reduced by informal arrangements. Thus, a comparison of post-contractual with pre-contractual

performance on casualties attributes a large increase to the formal agreement without accounting for the fact that the pre-contractual performance had itself been improved by informal collaboration.

Similarly, column (6) points to the spurious conclusions that would arise were property savings associated with only formal contracts. Such an assessment would significantly underestimate the influence of collaboration because the comparison would not account for the pre-contractual improvement in property savings arising from informal arrangements. An analysis of the effect of formality on performance that omitted considerations of informality would not reveal how collaborations of different types yield offsetting improvements on more intrinsically motivating and less intrinsically motivating goals.

8.2 | Alternative explanations

The results of our main analysis suggest that fire departments that are allied informally may subsequently engage in formal contracting despite the potential incremental detriment to goal of reducing casualties. The move from informal to formal arrangements allows such departments to achieve a large increase in the less intrinsically motivated objective (i.e., saving property) despite the minor reduction to the more intrinsically motivated objective (i.e., preventing casualties). We conjecture that such a trade-off arises principally from an increase in firefighter rather than civilian casualties. To investigate this mechanism, we estimated the main specification with two alternate measures for casualties that distinguish between casualties of civilians and firefighters. The results indicate that formal contracts compel departments to undertake activities that place their firefighters (rather than civilians) at greater personal risk in order to save incrementally more property than they would choose to save under an informal arrangement.⁹ The mechanism is affirmed in the analysis.

We conduct another robustness analysis that addresses an alternative explanation to the performance trade-off hypothesis advanced by our theory. Does declining performance among informally allied partners lead to formal contracting? To answer this question, we analyzed whether formal contracting occurred in the wake of performance deterioration among informal collaborators.¹⁰ The analysis yielded no evidence of pre-treatment changes in department performance; in other words, we have no evidence that formal contracts are pursued primarily by poorly performing partnerships governed by informal alliances. Therefore, this analysis confirms the common trends assumption of the difference-in-differences framework employed.

Extending this analysis we ask: Do improvements in performance compel formal contracting especially by informal partners? We find that contracting is tied to a discontinuous performance improvement and so do not find support for this form of reverse causality. We conducted similar analysis to assess the time trends in the impact of informally collaboration on casualties and property saved.¹¹ The same pattern holds. For property savings there is no discernable pre-treatment trend and there is a discontinuous increase. For casualties which are rare, the overall effect is difficult to distinguish from noise. Taken together, there is no evidence of reverse causality.

Finally, we consider self-selection among fire departments onto one of the four transition paths that arise over the time period we study. Different incidents may be more or less susceptible to

⁹The results are presented in Supporting Information Table A.B.1. Since casualties are relatively rare, partitioning the results in this manner attenuates the estimates; however, a robust finding emerges in model (3): formal agreements on the less intrinsically motivated goal of property saving increases casualties among firefighters. This evidence is consistent with the general argument.

¹⁰To investigate this possibility we measured pre-treatment trends using semi-parametric regression of performance over time. This approach is explained and the results presented in Supporting Information Figures A.B.1 and A.B.2.

¹¹Supporting Information Figure A.B.3 plots the spline for informal collaboration depicting in Panel A the results for the property saved regression and in panel B the results for the casualties regression.

collaboration and so affect gains to collaboration. While we do not have comprehensive data on the characteristics of fire departments that select each path, we do have some information on systematic differences (Supporting Information Table A.B.2). Notable, for instance, is that pairs that formally collaborate face slightly larger incident loads by about 10% on average as compared with all other pairs. These patterns, in conjunction with the results in Table 3, suggest that selection occurs among departments in their choices to collaborate, when, and under what form. Departments with greater demands and fewer departmental resources to meet those demands look to formal contracts to ensure support of their partners while for departments with relatively lighter demands and larger firefighting resources informal agreements are sufficient. Of course, we control for these sources of heterogeneity in our analysis, but much more study is required to relate differences in characteristics to performance trade-offs.

8.3 | Generalizability and scope conditions

The objective of this paper is to propose and validate theory on how contractual considerations affect performance when multiple organizational goals are at stake and when relationships unfold over time. The analysis suggests that the relative intrinsic motivation of organizational goals must be considered in an analysis of informal and formal arrangements. Because the scope for opportunism may be greater for firms than for fire departments, particular nuances may arise in other settings that may make goal motivation even more important. A strength of our analysis is in the identification of the stipulated relationships in the unique setting of fire departments, but a weakness is that we cannot study how competition and profit-seeking mediate the relationships we observe. Similarly, an important feature for identifying effects in the empirical setting of this study is that the pattern of motivation among most firefighters is consistent across organizations. This may not hold in other settings, however. For instance, in many business settings, the goals of individual employees may depend on their roles in a hierarchy, a unit, and/or a profession, to name only a few possibilities. Even though the consistency of alignment in our setting is a strength for identification purposes, variation in alignment should be considered when applying the theory to other settings.

Our analysis builds on prior research that considers informal and formal ties between organizations to be either complements or substitutes (e.g., Poppo & Zenger, 2002). Rather than arguing for a particular position on their interaction, we highlight two understudied conditions to shed light on *when* they are complements and *when* they are substitutes. First, informality may yield sufficient improvements in performance so as to render costly formal contracts as unnecessary. Under such circumstances, informal and formal arrangements are substitutes. Second, formal contracting may be required to achieve less intrinsically motivated performance benefits despite negotiation and execution costs. In this situation, informal relationships and formal contracts may arise simultaneously as complements; in such instances, informal arrangements may either limit the necessary scope of formal contracts, thus lowering their costs, or improve the performance benefits of contracts. This suggests scope for future research. Similarly, the departments that we observe do include a mix of professional and volunteer personnel for which there are differences in extrinsic motivation to perform through pay and promotion. Future study can exploit this variation.

This research represents a first step in a larger agenda to analyze important contingencies that shape the performance of networks of potential partners over different configurations. Our analysis identifies important performance differences associated with the form of the relationship between pairs. Subsequent research will examine specific sources of endogenous selection into formal or informal collaboration raised by this analysis including the state of other relationships around a pair (Horwitz et al., 2016).

9 | CONCLUSIONS

Scholars in the fields of organizational theory and strategy have long studied the impact on performance of informal collaborations and formal contracts, but they have rarely studied informality and formality as alternative governance approaches for managing trade-offs among multiple objectives. The analysis in this paper suggests that informality and formality are sometimes complements and sometimes substitutes. The difference arises as neighboring fire departments that are candidates for cooperation consider trade-offs in performance goals. Such trade-offs arise from broad, complex, and systematic differences in the character of the fire hazards faced by departments, and in the firefighting resources available to each potential partner. The critical finding is that these differences shape the performance outcomes that fire departments pursue. Informal contracts are particularly important to the achievement of performance on the more intrinsically motivated goal of reducing casualties, while formality appears better suited to performance on the less intrinsically motivated goal of saving property. Organizations that first ally informally and subsequently engage in a formal contract demonstrate behavior consistent with attempts to balance complex trade-offs between more intrinsically motivated and less intrinsically motivated goals. Our analyses demonstrate that consideration of only formal arrangements may lead to erroneous conclusions about performance improvements.

Further research on these issues is crucial for advancing our understanding of the ways in which formal contracts influence organizational performance. First, extensions to other settings will reveal important contingencies that are not evident among fire departments, such as evolution in the nature of performance objectives, and alternatives to contracting such as mergers. Second, the psychological underpinnings that give rise to goal hierarchies are central to the effectiveness of collaboration. Additional research is warranted on the implications for organizations of intrinsically motivating goals. When does the introduction of less intrinsically motivated goals diminish performance on more intrinsically motivated objectives, and when and how can such trade-offs be mitigated? Third, the evidence in the analysis of two major paths to formal contracting suggests that underlying structural vulnerabilities among organizations lead to categorical differences in goal definition. Much more research is required on these vulnerabilities and their implications. Finally, the analysis illustrates the insights available through the application of theory designed to explicate private-sector arrangements to public-sector management problems.

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REFERENCES

- Acemoglu, D., & Linn, J. (2004). Market size in innovation: Theory and evidence from the pharmaceutical industry. *The Quarterly Journal of Economics*, 119(3), 1049–1090.
- Aggarwal, V. A., Siggelkow, N., & Singh, H. (2011). Governing collaborative activity: Interdependence and the impact of coordination and exploration. *Strategic Management Journal*, 32, 705–730.
- Antia, K. D., & Frazier, G. L. (2001). The severity of contract enforcement in interfirm channel relationships. *Journal of Marketing*, 65(4), 67–81.
- Argyres, N. A., Bercovitz, J., & Mayer, K. J. (2007). Complementarity and evolution of contractual provisions: An empirical study of information technology services contracts. *Organization Science*, 18, 3–19.
- Baker, G. P., Gibbons, R., & Murphy, K. J. (2002). Relational contracts and the theory of the firm. *The Quarterly Journal of Economics*, 117(1), 39–84.
- Banerjee, A. V., & Duflo, E. (2000). Reputation effects and the limits of contracting: A study of the Indian software industry. *The Quarterly Journal of Economics*, 115(3), 989–1017.
- Cai, S., & Yang, Z. (2008). Development of cooperative norms in the buyer–supplier relationship: The Chinese experience. *Journal of Supply Chain Management*, 44(1), 55–70.
- Cannon, J. P., Achrol, R. S., & Gundlach, G. T. (2000). Contracts, norms, and plural form governance. *Journal of the Academy of Marketing Science*, 28(2), 180–194.
- Cao, Z., & Lumineau, F. (2015). Revisiting the interplay between contractual and relational governance: A qualitative and meta-analytic investigation. *Journal of Operations Management*, 33–34, 15–42.
- Cavusgil, S. T., Deligonul, S., & Zhang, C. (2004). Curbing foreign distributor opportunism: An examination of trust, contracts, and the legal environment in international channel relationships. *Journal of International Marketing*, 12(2), 7–27.
- Corts, K., & Singh, J. (2004). The effect of repeated interaction on contract choice: Evidence from offshore drilling. *Journal of Law, Economics, & Organization*, 20(1), 230–260.
- David, R. J., & Han, S. (2004). A systematic assessment of the empirical support for transaction cost economics. *Strategic Management Journal*, 25(1), 39–58.
- Deci, E. L., & Ryan, R. M. (2000). The “what” and “why” of goal pursuits: Human needs and self-determination of behavior. *Psychological Inquiry*, 11(4), 227–268.
- Doz, Y. L. (1996). The evolution of cooperation in strategic alliances: Initial conditions or learning processes? *Strategic Management Journal*, 17(1), 55–83.
- Dyer, J., Kale, P., & Singh, H. (2001). How to make strategic alliances work. *Sloan Management Review*, 42(4), 37–43.
- Ethiraj, S. K., & Levinthal, D. (2009). Hoping for A to Z while rewarding only A: Complex organizations and multiple goals. *Organization Science*, 20(1), 4–21.
- Gibbons, R., & Henderson, R. M. (2011). Relational contracts and organizational capabilities. *Organization Science*, 23(5), 1350–1364.
- Gil, R. (2013). The interplay of formal and relational contracts: Evidence from movies. *Journal of Law, Economics, and Organization*, 29(3), 1–30.
- Gottschalg, O., & Zollo, M. (2007). Interest alignment and competitive advantage. *Academy of Management Review*, 32(2), 418–437.
- Grant, A. M. (2007). Relational job design and the motivation to make a prosocial difference. *Academy of Management Review*, 32(2), 393–417.
- Grant, A. M. (2008). Does intrinsic motivation fuel the prosocial fire? Motivational synergy in predicting persistence, performance, and productivity. *Journal of Applied Psychology*, 93(1), 48–58.
- Grant, A. M., & Berry, J. W. (2011). The necessity of others is the mother of invention: Intrinsic and prosocial motivations, perspective taking, and creativity. *Academy of Management Journal*, 54(1), 73–96.
- Greif, A. (1993). Contract enforceability and the economic institutions of early trade: The Mahgrabi Traders' Coalition. *The American Economic Review*, 83(3), 525–548.
- Gulati, R. (1995). Does familiarity breed trust? The implications of repeated ties for contractual choice in alliances. *Academy of Management Journal*, 38(1), 85–112.
- Gulati, R., & Nickerson, J. (2008). Interorganizational trust, governance choice, and exchange performance. *Organization Science*, 19(5), 1–21.
- Gulati, R., & Puranam, P. (2009). Renewal through reorganization: The value of inconsistencies between formal and informal organization. *Organization Science*, 20(2), 422–440.
- Gulati, R., & Singh, H. (1998). The architecture of cooperation: Managing coordination costs and appropriation concerns in strategic alliances. *Administrative Science Quarterly*, 43(4), 781–814.
- Gulati, R., & Sytch, M. (2007). Dependence asymmetry and joint dependence in interorganizational relationships: Effects of embeddedness on a manufacturer's performance in procurement relationships. *Administrative Science Quarterly*, 52(1), 32–69.
- Hennart, J. (1988). A transaction costs theory of equity joint ventures. *Strategic Management Journal*, 9(4), 361–374.
- Horwitz, J. R., McEvily, W., & McGahan, A. M. (2016). *How the network neighborhood influences partnerships: From handshakes to formal collaboration among US fire departments*. University of Toronto Working Paper.
- Huber, T. L., Fischer, T. A., Dibbern, J., & Hirschheim, R. (2013). A process model of complementarity and substitution of contractual and relational governance in IS outsourcing. *Journal of Management Information Systems*, 30(3), 81–114.

- Imbens, G., & Wooldridge, J. (2007). *What's new in econometrics? Lecture 10: Difference-in-differences estimation*. NBER Summer Institute.
- Inkpen, A. C., & Currall, S. C. (2004). The co-evolution of trust, control, and learning in joint ventures. *Organization Science*, 15(5), 586–599.
- Kennedy, P. E. (1981). Estimation with correctly interpreted dummy variables in semilogarithmic equations. *The American Economic Review*, 71, 801.
- Kogut, B. (1988). Joint ventures: Theoretical and empirical perspectives. *Strategic Management Journal*, 9(4), 319–332.
- Latham, G. P. (2011). *Work motivation: History, theory, research, and practice*. Thousand Oaks, CA: Sage Publications.
- Latham, G. P., & Pinder, C. C. (2005). Work motivation theory and research at the dawn of the twenty-first century. *Annual Review of Psychology*, 56, 485–516.
- Lawrence, P. L., & Lorsch, J. W. (1967). *Organization and environment: Managing differentiation and integration*. Cambridge, MA: Harvard Business School Classics.
- Li, J. J., Poppo, L., & Zhou, K. Z. (2010). Relational mechanisms, formal contracts, and local knowledge acquisition by international subsidiaries. *Strategic Management Journal*, 31(4), 349–370.
- Lui, S. S., & Ngo, H. Y. (2004). The role of trust and contractual safeguards on cooperation in non-equity alliances. *Journal of Management*, 30(4), 471–485.
- Lui, S. S., Wong, Y., & Liu, W. (2009). Asset specificity roles in interfirm cooperation: Reducing opportunistic behavior or increasing cooperative behavior? *Journal of Business Research*, 62(11), 1214–1219.
- Lumineau, F., & Malhotra, D. (2011). Shadow of the contract: How contract structure shapes interfirm dispute resolution. *Strategic Management Journal*, 32(5), 532–555.
- MacLeod, W. B. (2007). Reputations, relationships and contract enforcement. *Journal of Economic Literature*, 45, 595–628.
- Macneil, I. R. (1978). Contracts: Adjustments of long-term economic relations under classical, neoclassical and relational contract law. *Northwestern University Law Review*, 72, 854–906.
- Malhotra, D., & Lumineau, F. (2011). Trust and collaboration in the aftermath of conflict: The effects of contract structure. *Academy of Management Journal*, 54(5), 981–998.
- Malhotra, D., & Murnighan, J. K. (2002). The effects of contracts on interpersonal trust. *Administrative Science Quarterly*, 47(3), 534–559.
- Mayer, K. J., & Argyres, N. S. (2004). Learning to contract: Evidence from the personal computer industry. *Organization Science*, 15(4), 394–410.
- McEvily, B., Soda, G., & Tortoriello, M. (2014). More formally: Rediscovering the missing link between formal organization and informal social structure. *The Academy of Management Annals*, 8(1), 299–345.
- Meyer, J. P., & Allen, N. J. (1997). *Commitment in the workplace: Theory, research, and application*. Thousand Oaks, CA: Sage Publications.
- Meyer, M. W. (2002). *Rethinking performance measurement*. Cambridge, UK: Cambridge University Press.
- Mohr, J., & Spekman, R. (1994). Characteristics of partnership success: Partnership attributes, communication behavior, and conflict resolution techniques. *Strategic Management Journal*, 15(2), 135–152.
- Pakes, A., & Griliches, Z. (1980). Patents and R&D at the firm level: A first report. *Economics Letters*, 5(4), 377–381.
- Poppo, L., & Zenger, T. (2002). Do formal contracts and relational governance function as substitutes or complements? *Strategic Management Journal*, 23(8), 707–726.
- Rebitzer, J. B., & Taylor, L. J. (2011). Extrinsic rewards and intrinsic motives: Standard and behavioral approaches to agency and labor markets. *Handbook of Labor Economics*, 4, 701–772.
- Reuer, J. J., & Ariño, A. (2007). Strategic alliance contracts: Dimensions and determinants of contractual complexity. *Strategic Management Journal*, 28, 313–330.
- Reuer, J. J., Zollo, M., & Singh, H. (2002). Post-formation dynamics in strategic alliances. *Strategic Management Journal*, 23, 135–151.
- Ring, P. S. (2002). The role of contracts in strategic alliances. *Cooperative Strategies and Strategic Alliances*, 1, 145–162.
- Ring, P. S., & Van de Ven, A. H. (1992). Structuring cooperative relationships between organizations. *Strategic Management Journal*, 13(7), 483–498.
- Ryall, M. C., & Sampson, R. D. (2009). Formal contracts in the presence of relational enforcement mechanisms: Evidence from technology development projects. *Management Science*, 55(6), 906–925.
- Saxton, T. (1997). The effects of partner and relationship characteristics on Alliance outcomes. *The Academy of Management Journal*, 40(2), 443–461.
- Vanneste, B., & Puranam, P. (2010). Repeated interactions and contractual detail: Identifying the learning effect. *Organization Science*, 21(1), 186–201.
- Wang, L., Yeung, J. H. Y., & Zhang, M. (2011). The impact of trust and contract on innovation performance: The moderating role of environmental uncertainty. *International Journal of Production Economics*, 134(1), 114–122.
- Yang, Z., Su, C., & Fam, K. S. (2012). Dealing with institutional distances in international marketing channels: Governance strategies that engender legitimacy and efficiency. *Journal of Marketing*, 76(3), 41–55.
- Westphal, J. D., & Zajac, E. J. (1995). Who shall govern? CEO/board power, demographic similarity, and new director selection. *Administrative Science Quarterly*, 40(1), 60–83.

- Zaheer, A., McEvily, B., & Peronne, V. (1998). Does trust matter? Exploring the effects of interorganizational and interpersonal trust on performance. *Organization Science*, 9(2), 141–159.
- Zhang, Y., & Gimeno, J. (2010). Earnings pressure and competitive behavior: Evidence from the U.S. electricity industry. *Academy of Management Journal*, 53(4), 743–768.
- Zhou, K. Z., & Xu, D. (2012). How foreign firms curtail local supplier opportunism in China: Detailed contracts, centralized control, and relational governance. *Journal of International Business Studies*, 43(7), 677–692.

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