Essays on intrafirm and interfirm competition

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ABSTRACT

Essays on intrafirm and interfirm competition

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In this dissertation, I examine how interfirm competition affects employees' competitive behaviors. A related literature in social psychology, economics, and management on groups has examined the effects of intergroup competition on group members' competitive behaviors. It finds that intergroup competition typically reduces individuals' tendencies to engage in competitive behaviors against their own group's members and increases their tendency to act against competing groups and their members. However, these studies often apply research designs that may not be suitable for studying interfirm competition and its effects on employees' competitive behaviors. Some of the features in the group-level studies that are uncommon in firms include individuals' inability to pursue membership in competing groups, limitations on their ability to act against their own group members, and one-shot intergroup competitions that do not differ in their psychological importance to the group. Such limitations raise questions about the applicability of the findings from the group competition literature to interfirm competition and its influence on employees' competitive behavior. This dissertation addresses these gaps through a literature review and two empirical papers.

The first paper of my dissertation is a literature review on the intergroup competition literature and the applicability of its findings to interfirm competition and employees' competitive behaviors. In this paper, I conduct a comprehensive review of 90 articles on intergroup competition and its impact on individuals' competitive behaviors, published over the past six decades. I first summarize the theories and methodologies that are often applied in the intergroup competition literature and review the key findings that are likely to apply to interfirm competitions. In addition, I identify and discuss potential avenues for future research concerning the impact of interfirm competition on the competitive behaviors of employees. The key findings of this review are that little work has specifically examined the effect of interfirm competition on employees' competitive behavior and that findings from the intergroup competition literature are unlikely to directly translate to firms due to their more complex social dynamics and incentive structures.

The second paper is a quantitative study, accepted in December 2023 for publication in the Academy of Management Journal[1]. Together with Prof. Hans Frankort and Prof. Paolo Aversa, we study the cross-level effects of firm-level tournaments on employees' competitive behaviors against other individuals internal and external to their firm. We propose a theory of reputational incentives to explain how employees respond differently to competitive threats and opportunities facing their firm. Our theory predicts that employees engage in fewer internal and more external competitive actions when their firm faces competitive threats, and that they engage in more internal and external competitive actions when their firm faces competitive opportunities. Our theory also predicts that employees' responses are stronger when these threats and opportunities are unexpected, such as when the competitors have inferior or superior resources. We test this theory in panel data on the population of motorcycle riders competing in MotoGP from 2004 to 2020. Our results largely support our theory.

The third paper is a quantitative study that examines how the effect of internal competition intensity – i.e., the number of employees in the internal competition – on firm performance depends on the type of competition a firm faces[2]. I argue that the effect depends on whether employees in the internal competition are pursuing internal or external career opportunities, and the amount of attention the competition receives from their current and external employers. Firm competitions that receive significant attention from the current employer reduce the negative effect of internal competition intensity on firm performance by encouraging employees to prioritize the firm's success. In contrast, when firm competition gathers more attention from external employers, employees tend to focus on their individual performance, exacerbating the negative effect of internal competition intensity on firm performance. I test my hypotheses using panel data from the National Hockey League (NHL) for the years 2014-2020. The results support my hypotheses.

Keywords: *competition; incentives; tournaments; career concern; rivalry; competitive dynamics; sports data; MotoGP; NHL*

[1] Hallila, P., Frankort, H., & Aversa, P. 2024. Revving up or backing down? Cross-level effects of firm-level tournaments on employees' competitive actions. ***Academy of Management Journal***, forthcoming: https://doi.org/10.5465/amj.2022.0946.

[2] Earlier versions of the paper have been presented at the 2023 Academy of Management Annual Meeting in Boston, the Competitive Dynamics conference at Imperial College Business School, the Sports Data Workshop at Stockholm School of Economics, and the SEI Research Day for PhD students in London.

1. **INTRODUCTION**

The effect of intergroup competition on individuals' competitive behavior has been extensively studied in psychology, economics, and management (Böhm, Rusch, & Baron, 2020; De Jaegher, 2021; Sheremeta, 2018). Whilst applying different theoretical frameworks, all these research streams arrive at the same hypothesis: Intergroup competition causes individuals to reduce competitive behaviors directed at members of their own group, and to increase such behaviors against competing groups and their members. In the context of a firm, this should mean that employees target competitive behaviors, such as poaching customers (Chan, Li, & Pierce, 2014), sabotage (Lazear, 1989), refusing to collaborate (Drago & Garvey, 1998), or deception (Edelman & Larkin, 2015), less towards colleagues and more towards competing firms and their employees.

However, this multidisciplinary literature has almost exclusively focused on types of groups other than firms, such as minimal (e.g., Bornstein, 1992; Rapoport & Bornstein, 1989), racial (e.g., Sassenberg, Moskowitz, Jacoby, & Hansen, 2007), and work groups (e.g., Baer, Leenders, Oldham, & Vadera, 2010; Hennessy & West, 1999). Consequently, they have applied research designs that exclude at least three common features of firms, which likely affect how employees respond to interfirm competition. First, employees frequently pursue both internal and external career opportunities. Yet, intergroup competition studies tend to examine closed groups, and thus exclude the possibility that individuals can pursue membership in a more desirable group, which employees often do when competing for external career opportunities (e.g., Bornstein, 2003). Second, the groups they study have simpler organizational structures, incentive schemes, and social dynamics than firms, restricting group members' ability to enforce cooperation during intergroup competitions (Chowdhury, Jeon, & Ramalingam, 2016; Goette, Huffman, & Meier, 2012a). Third, they study intergroup competitions which are one-shot events that do not differ in their psychological importance to the group (Doyle, Pettit, Kim, To, & Lount, 2022). In contrast,

interfirm competitions take place over a longer period of time and thus some of the competitions have higher psychological importance to the firm (Chen, Su, & Tsai, 2007; Kilduff, Elfenbein, & Staw, 2010; Livengood & Reger, 2010), which may increase the cost of acting against the firm's best interest. These differences raise questions about the extent to which findings from intergroup competition studies can be applied directly to firms and interfirm competitions.

Therefore, in this dissertation, I ask: *How does interfirm competition affect employees' competitive behavior?* This question has both theoretical and practical importance. Theoretically, it remains uncertain to what extent the findings from intergroup competition studies apply to firms. One might assume that interfirm competition reduces competitive behavior within a firm, yet, as demonstrated in chapters two and three, the opposite can also be true. Therefore, further work is needed to fully understand how employees adjust their competitive behavior in response to interfirm competition. Practically, exploring this research question is crucial as it guides managers on how they can leverage interfirm competition to reduce competition within the firm. For example, framing interfirm competitions as threats may encourage more cooperation among employees, whereas presenting these competitions as opportunities might increase competition within the firm. Thus, a deeper understanding of the relationship between interfirm competition and employees' competitive behavior is needed to avoid unwanted outcomes that may be harmful to the firm.

I explore the overarching research question through three studies. In the first study, I review the literature on intergroup competition to understand how this problem has been addressed in group studies. This paper argues that while many findings from the intergroup competition literature may apply to firms, these studies often employ research designs that omit critical features common in firms, which can influence how employees respond to interfirm competition. In the second and third studies, I address two of the limitations identified in the first study. First, the literature has not considered that individuals have career concerns and thus want to build a

reputation for being a high-performing employee (e.g., Fama, 1980; Holmström, 1999; Miklos-Thal & Ullrich, 2016). Second, while intergroup competition is typically operationalized as situations where groups' outcomes are negatively correlated (e.g., Bornstein, 2003; Deutsch, 1949), firms encounter various types of competition, such as threats and opportunities (e.g., Bothner, Kang, & Stuart, 2007), and face competitors like rivals, which vary greatly in significance to the firms and their employees (e.g., Chen et al., 2007; Kilduff et al., 2010).

By considering these factors, I explain why interfirm competition does not always reduce employees' tendencies to engage in competitive actions against their colleagues. The second study posits that firms' competitive threats reduce employees' tendency to engage in competitive actions against their colleagues. In contrast, firms' competitive opportunities increase their tendency to engage in competitive actions against employees from competing firms. This effect is stronger when the reputational cost or gain is greater, such as when the competitive threat or opportunity arises from or against unexpected competitors, such as those with resource (dis)advantages.

In the third study, I examine the effect of internal competition intensity – defined as the number of employees in a competition – on firm performance, and how this effect varies depending on where the competition occurs (Livengood & Reger, 2010) and against whom the firm is competing (Kilduff et al., 2010). The study argues that interfirm competitions serve as platforms where employees can showcase their abilities to both current and external competitors. Current employers put more emphasis on firm performance and external employers on individual performance when assessing employees' abilities. Current employers tend to place more emphasis on firm performance, while external employers focus on individual performance when assessing employees' abilities. As a result, internal competition intensity becomes less harmful for firm performance when the interfirm competition attracts more attention from the current employer, for example, when the competition occurs in a market important to the firm. In contrast, it becomes

more harmful when the interfirm competition draws significant attention from external employers, such as when the competition receives extensive media coverage.

In this dissertation, I contribute to the literature on intergroup competition in two ways. First, I build on the career concerns theory to propose reputation as a mechanism through which interfirm competition affects employees' competitive behavior (Fama, 1980; Holmström, 1999; Miklos-Thal & Ullrich, 2016). According to this theory, employees compete for career opportunities by building a reputation for possessing superior abilities. Interfirm competition can influence employees' reputation in at least two ways. First, the reputations of the firm and its employees are intertwined (e.g., Bidwell, Won, Barbulescu, & Mollick, 2015; Rider & Tan, 2015). Employees want to be associated with a high-performing firm and avoid being associated with a low performing firm. Thus, they can influence the strength of this association by engaging in competitive actions against both internal and external competitors. Second, interfirm competitions gather both internal and external attention, providing employees with an opportunity to showcase their abilities to current and potential external employers. Particularly, external employers may prioritize hiring the highest-performing employees. Consequently, employees looking for external career opportunities may boost their external reputation by increasing their external visibility at the firm's expense. This theory of reputational incentives is powerful as it can explain both when interfirm competition increases and decreases competition within the firm.

Second, I apply insights from the competitive dynamics (Kilduff et al., 2010; Livengood & Reger, 2010) and organizational ecology (Bothner et al., 2007) bodies of literature to examine interfirm competitions that are not simple dyadic and one-shot events. The prior literature on intergroup competition has largely ignored that groups often compete against multiple competitors over an extended period of time (Doyle et al., 2022). These features are particularly common in interfirm competitions, making it unclear to what extent the prior findings in the intergroup

literature translate to firms. By exploring various types of interfirm competitions, such as threats, opportunities, rivalries, and competition within the firm's identity domain, I enhance our understanding of how interfirm competition affects employees' competitive behavior. Specifically, I show that interfirm competitions that generate threats to the firm and receive more attention from the firm reduce employees' incentives to compete internally. In contrast, interfirm competitions that create opportunities for the firm or receive more external attention function as platforms for employees to demonstrate their abilities, increasing their propensity to compete internally.

2. THE EFFECT OF INTERFIRM COMPETITION ON EMPLOYEES' BEHAVIOR: A REVIEW OF THEORIES AND FINDINGS FROM THE INTERGROUP COMPETITION LITERATURE AND THEIR APPLICABILITY TO FIRMS

ABSTRACT

The effect of intergroup competition on individuals' competitive behaviors has been extensively studied in psychology, economics, and management. The prevailing hypothesis in these disciplines suggests that under intergroup competition individuals are less likely to exhibit competitive behaviors towards their own group members, whilst being more likely to exhibit such behaviors against members of other groups. However, the more complex social dynamics and incentive structures within firms, as opposed to those within simple groups, cast doubt on the direct applicability of this hypothesis to interfirm competition and employee behaviors. Therefore, this article seeks to explore the applicability of the findings in the intergroup competition literature for firms. To achieve this, I conduct a comprehensive review of 90 articles on intergroup competition and its impact on individual competitive behaviors, published over the past six decades. I first summarize the theories and methods applied in the three streams of research on intergroup competition. Subsequently, I discuss the principal findings and how they may apply to firms. I find that issues related to rewards, organizational design, and the nature of the interfirm competition are particularly likely to affect how employees respond to interfirm competition. Finally, I identify and discuss potential avenues for future research based on these three issues.

INTRODUCTION

Firms frequently engage in interfirm competitions, while simultaneously, their employees compete internally for rewards such as promotions and bonuses. While not many studies have examined this issue at the firm level, the effect of intergroup competition on group members' competitive behavior has been extensively studied by a large multidisciplinary body of literature (e.g., Abbink, Brandts, Herrmann, & Orzen, 2010; Bornstein, 2003; Sherif, Harvey, White, Hood, & Sherif, 1961; Tajfel, 1982). The key prediction in this literature is that intergroup competition fosters unity among group members and hostility towards the competing group. Applied to a firm context, this should mean that interfirm competition discourages employees from engaging in competitive behaviors, such as sabotage (Lazear, 1989) and refusing to help (Drago & Garvey,

1998), against their colleagues and encourages them to compete more intensely against competing firms by, for example, poaching their customers (Chan, Li, & Pierce, 2014).

However, existing research predominantly focuses on groups, such as ethnic, work, and minimal groups, (Böhm, Rusch, & Baron, 2020; De Jaegher, 2021; Sheremeta, 2018), that are distinct from firms in at least three crucial ways. First, employees have employment contracts and career ambitions and thus are presented with a different set of individual incentives than those in other groups (Hallila, Frankort, & Aversa, 2024; Holmström, 1999). Second, employees rarely have permanent affiliations with their firms because of their tendency to switch employers (e.g., Bidwell, Won, Barbulescu, & Mollick, 2015; Grohsjean, Kober, & Zucchini, 2016). Finally, firms have more complex social dynamics than other groups due to a wider range of enforcement mechanisms and communication methods (e.g., Chowdhury, Jeon, & Ramalingam, 2016; Goette, Huffman, & Meier, 2012). Because of these differences, it is unclear to what extent the findings of the intergroup competition literature apply to firms and interfirm competitions.

The objective of this literature review is to explore how insights from the intergroup competition literature are applicable to firms. Specifically, it aims to understand how interfirm competition influences employees' competitive behavior against their colleagues and other firms and employees at those firms. To achieve this, I first summarize the predominant theories and methodologies applied in the three main streams of literature on intergroup competition. I then review the findings that are likely to translate to firms. The key finding of this review is that employees' rewards, the firm's organizational design, and the nature of the interfirm competition the firm faces are crucial factors influencing how employees respond to interfirm competition. These factors are significant because they influence the likelihood of winning and the potential magnitude of rewards from interfirm competition. Finally, I will address gaps in previous studies by highlighting factors related to rewards, organizational design, and the nature of the interfirm

competition, which are common in firms but have been largely overlooked in prior studies on groups.

Three recent papers have undertaken reviews of the literature on intergroup competition (Böhm et al., 2020; De Jaegher, 2021; Sheremeta, 2018), but none of them have specifically focused on interfirm competition and its implications for employees' competitive behaviors. Sheremata's (2018) review of group contests focused on a wide range of competitions, such as wars between countries, teams in firms competing for bonuses and competition between political parties. Böhm et al. (2020) reviewed the literature in social psychology on intergroup conflict examining a broad range of groups, such as ethnic and work groups, other than firms. Finally, De Jaegher (2021) reviewed the literature on the common enemy effect. That paper defines a common enemy as an individual, group or external circumstance that causes a threat to two actors and thus brings them together. Thus, they too focus on other forms of groups than firms. In addition, this paper focuses on a different set of articles as only 29 out of the 90 studies in this paper were included in the other reviews[3].

This paper is organized into four sections. In the first section I define interfirm competition and competitive behavior. After that I will summarize the three main streams of research that have studied intergroup competition and its effects on group members competitive behavior against members of their own or competing group. I then review the key findings in this literature and explain how they relate to interfirm competition. Finally, I highlight potential future research opportunities on how interfirm competition can affect employees' competitive behavior.

[3] The overlap with Böhm et al. (2020) is 13% (12 out of 90) and 19% (17 out of 90) for both De Jaegher (2021) and Sheremata (2018).

DEFINITIONS OF INTERFIRM COMPETITION AND EMPLOYEES' COMPETITIVE BEHAVIOR

In this study, interfirm competition is defined as situations where a firm perceives its goal as negatively interdependent to another firm's goal, such that one firm's gain is synonymous with another firm's loss (e.g., Deutsch, 1949). For example, interfirm competition may arise when two companies target the same set of customers or investors. According to this definition, competition is the *situation* that incentivizes actors to engage in competitive actions against competitors rather than the *act* of competing against each other, as, for example, in the competitive dynamics literature (for a recent review, see Chen & Miller, 2012). Also, this definition emphasizes that the existence of interfirm competition depends on managers' and employees' perceptions (Porac, Thomas, & Baden-Fuller, 1989). It is enough that managers perceive that their firm is competing for the same set of customers for there to be interfirm competition. For example, two firms with the same SIC code are in competition if they perceive each other as competitors. Later I will discuss in more detail how interfirm competition caused by a realistic conflict, for example, over a large client (e.g., Bornstein & Rapoport, 1988; Rapoport, Bornstein, & Erev, 1989), differs from that based on managers' perceptions.

Competitive behavior is defined as any action taken by an employee to outperform a competitor, whether internal – such as a colleague – or external – such as another firm or an employee from a competing firm (e.g., Hallila et al., 2024). Examples of competitive behaviors directed at internal competitors include sabotage (Lazear, 1989), refusing to help others (Drago & Garvey, 1998), cheating (Edelman & Larkin, 2015), and increasing effort to outperform them (Lazear & Rosen, 1981). Instead, competitive behaviors against external competitors may involve collaborating with colleagues to outperform an external competitor (Bornstein & Ben-Yossef, 1994), engaging in risk-taking (Bothner, Kang, & Stuart, 2007), exerting additional effort (Majerczyk, Sheremeta, & Tian, 2019), and poaching customers from competitors (Chan et al.,

2014). Therefore, the primary distinction between internal and external competitive behaviors lies in the target of these actions.

OVERVIEW AND METHODS

The goal of the review is to understand how findings from the intergroup literature translate to interfirm competition and its effect on employees' competitive behavior. Thus, I started by searching on the Web of Science for articles that mention intergroup competition or terms associated with it, such as group competition, team games, group contest, team contest, group conflict, intergroup conflict, group incentives, intergroup comparison, or mixed rewards in their title, abstract or keywords[4]. This search yielded a total of 4,339 articles. To ensure a focus on high-quality and impactful research, I then filtered out articles published in journals with a rank below three in the journal ranking by the Chartered Association of Business Schools (ABS). However, I retained articles published in the journal Small Group Research despite its ABS rank of two, due to its prominent position in the field. I then read the abstract of each article and selected those that examined the effect of intergroup competition on individuals' competitive behavior. I only included papers in which the type of intergroup competition and competitive behavior they studied aligned with the definitions I presented in the previous section. This resulted in 66 articles. I further enriched the sample by adding 17 articles that were frequently cited within these studies and 7 articles referenced in the appendix of Hallila et al. (2024), the most recently published article on the topic. The final sample includes 90 articles that are published mainly in psychology, economics, evolutionary biology, and management journals.

[4] The search that I used was: ALL=("intergroup competition" OR "group competition" OR "team games" OR "group contest" OR "team contest" OR "group conflict" OR "intergroup conflict" OR "group incentives" OR "intergroup comparison" OR "mixed rewards" (Topic) and Article (Document Types)).

RESEARCH STREAMS ON INTERGROUP COMPETITION

The literature on intergroup competition broadly falls into three main research streams: Group competition, Team games, and Incentives. While each stream is interconnected, they are distinguished by the theories and the methods they employ. None of these streams specifically focus on firms; however, the groups examined within these streams share several characteristics with firms. Typically, like firms, the groups they examine have group-level goals and group identities, but their social dynamics and incentive structures are simpler than those in firms. The key characteristics of each stream are summarized in Table 1.

Insert Table 1 about here

Group Competition

The Group Competition stream of literature, which is the oldest among the three main research streams, originated in the post-Second World War era (for a review on the history of this research stream see, Hornsey, 2008). Initially, this body of research aimed to understand the causes of conflicts between ethnic groups and how these conflicts could be resolved (e.g., Sherif et al., 1961). Over time, the scope of this literature has broadened to encompass a broader range of groups, such as student (Rabbie & Wilkens, 1971), work (Baer, Vadera, Leenders, & Oldham, 2014; Hennessy & West, 1999), racial (Sassenberg, Moskowitz, Jacoby, & Hansen, 2007), and minimal groups[5] (Abrams, Randsley de Moura, & Travaglino, 2013). Most of the early work was published in psychology, and later the literature expanded to management, particularly to organizational behavior. Because of this, these studies primarily utilize theories from social psychology.

[5] With minimal groups I refer to groups in which group membership is an arbitrary label imposed by the experimenter. For example, participants can be randomly allocated into a red and green group without the label having any real connection to the participant.

Theory - This research stream relies on three theories that build on each other. Social interdependency theory, which is the oldest of the theories and functions as the foundation for the other two theories, aims to explain what constitutes a cooperative (i.e., cooperation) or competitive (i.e., competition) situation (Deutsch, 1949). According to this theory, a competition exists if one actor's progression towards a goal hinders another actor's progress towards their goal. Conversely, the situation is seen as a cooperation if one actor's advancement towards a goal also facilitates another actor's progress towards their goal. Here, 'actor' may refer to an individual, a group, or a firm, and 'goal' to an objective such as securing a promotion, winning a team tournament, or conquering market share. If a competition occurs between groups, then it can result in a cooperation within the groups. This is so because by collaborating with each other, group members can increase their chances of defeating the competing group. Thus, the group members' goals are aligned when the group participates in a competition.

While social interdependency theory provides a clear framework for understanding competitive versus cooperative situations, it remains vague on the factors that cause competitions to emerge, or the specific behaviors individuals engage in these competitions. Realistic group conflict theory, building on social interdependency theory, seeks to address these gaps (Sassenberg et al., 2007; Sherif et al., 1961; Van Bunderen, Greer, & Van Knippenberg, 2018). According to realistic group conflict theory, competition emerges due to groups' conflicting demands over resources, such as money, food, or status, which leads group members to perceive the competing group as a threat. In response, they may exhibit prejudice and hostility towards outgroups, along with ingroup bias, solidarity, and a heightened sense of ingroup identity (Brief et al., 2005). In the context of interfirm competition, this would suggest increased collaboration and cooperation within firms and more frequent competitive activity against competing firms. However, realistic group conflict theory focuses specifically on competition over resources, thus overlooking other sources

of competition, such as those driven by legacy concerns (Kilduff et al., 2016) or the desire to protect a firm's identity (Livengood & Reger, 2010).

Social identity theory extends beyond resource conflicts to explain intergroup competition arising from threats to group identity (Cikara, Botvinick, & Fiske, 2011; Tajfel, 1982; Tajfel & Turner, 1978). It expands on the idea, which was originally proposed in realistic group conflict theory (Sherif et al., 1961), that intergroup competition increases group members' awareness of their group identity (Tajfel & Turner, 1978). Social identity theory suggests that individuals adopt their group's identity and perform social comparisons to other groups. These social comparisons threaten their group identity, leading to prejudice and discrimination against competing groups and ingroup bias towards members of the same group. The distinction between realistic group conflict theory and social identity theory lies in the latter's focus on identity threats rather than resource scarcity as a source of competition. Thus, social identity theory encompasses a wider range of sources of competition. According to the theory, any source of social comparison can give rise to intergroup competition even if the groups are not competing for the same set of resources.

Economists have later extended social identity theory to study the role of identity in firms (Akerlof & Kranton, 2005, 2008). These studies conceptualize social identity as a source of intrinsic motivation that firms can influence with their work practices, thus functioning as a substitute for financial incentives. A common observation in economics is that financial incentives often result in gaming or overfocusing on a single task rather than becoming more productive (e.g., Gibbons, 1998; Holmstrom & Milgrom, 1991). In contrast, a stronger social identity should align employees' incentives and the firm's goals by increasing the amount of utility an employee gains from acting in the firm's best interests (Akerlof & Kranton, 2005). In the context of interfirm competition, fostering a stronger social identity should thus incentivize employees to prioritize the firm's needs over their own.

Methods **–** Most studies on group competition utilize experimental designs where participants are initially randomly assigned to groups. Subsequently, the treatment group is assigned to a competition against another group, while the control group either faces no competition (e.g., Van Bunderen et al., 2018; Yuki & Yokota, 2009) or is in cooperation with another group (e.g., Lee et al., 2012; Rabbie et al., 1974). Individual-level studies often examine decisions that reveal ingroup and/or outgroup biases, such as evaluating the work of other participants (Abrams et al., 2013; Hennessy & West, 1999; Rabbie & Wilkens, 1971; Sassenberg et al., 2007), allocating resources between ingroup and outgroup members (Lee et al., 2012), or exerting effort for the group's benefit (Tauer & Harackiewicz, 2004).

Group-level studies generally adhere to similar designs but focus on broader outcomes like group performance (Goldman, Stockbauer, & McAuliffe, 1977; Julian & Perry, 1967; Mulvey & Ribbens, 1999) and innovation (Baer et al., 2014). These studies typically argue that group competition enhances social cohesion, information sharing, and motivation, which in turn improves group performance. In essence, enhanced group performance is posited as a direct outcome of behaviors, such as information sharing, and attitudes associated with ingroup bias.

In addition, some studies use priming to influence participants' perceptions of group competition. Priming involves reminding participants of a competing group, such as the main rival of their favorite sports team (Abrams et al., 2013; Cikara et al., 2011), without an active competition for a reward between the groups. Thus, priming prompts participants to engage in social comparisons with the other group, leading them to perceive there to be a competition between the groups. This method is especially prevalent in studies grounded in social identity theory, demonstrating that group competition can arise not just from conflicting goals but from perceived threats to the group's identity (Cikara et al., 2011; Yuki & Yokota, 2009). Overall, these studies

support the notion that threats to group identity can induce ingroup and outgroup bias without there being any form of negative reward interdependency.

Team games

The literature on team games expands on the group competition research but diverges in some critical ways in its theories and methodologies (see for a review, Bornstein, 2003). The primary aim of the team games literature is to understand why individuals contribute to their group during intergroup competitions (Bornstein & Rapoport, 1988; Rapoport & Bornstein, 1987; Rapoport et al., 1989). They build on the observation that 'free-riding' – i.e., benefiting from a collective good without participating in its production – is often the rational choice for individuals in a group competition, but despite this, individuals still often decide to cooperate[6] by exerting costly effort on the behalf of their group. For example, a soldier benefits from their army winning a war even without risking their life by directly engaging in battle. However, if all soldiers opt to 'free-ride' by abstaining from fighting, the army would inevitably face defeat. Therefore, soldiers participate in the army to ensure that they have a sufficient number of soldiers to fight the enemy so that they can collectively benefit from winning the war.

Team games studies have been particularly influential in economics (Abbink et al., 2010; Goette, Huffman, & Meier, 2012), social psychology (Rapoport & Bornstein, 1987; Rapoport et al., 1989), and evolutionary biology (Burton-Chellew & West, 2012; Jordan, Jordan, & Rand, 2017; Puurtinen & Mappes, 2009). In economics and psychology, the focal interest lies in understanding how intergroup competition affects individuals' decision to exert effort on behalf of the group, particularly when it reduces 'free-riding.' Instead, evolutionary biologists concentrate on how

[6] In this literature, cooperation means that an individual exerts costly effort on behalf of the group. It does not necessarily imply collaboration, meaning that individuals rely on each other's' efforts to perform a task. For example, an employee could cooperate by working longer hours to finalise their task. But, because they perform the task by themselves, they would not engage in collaboration.

group competition has historically incentivized cooperation among humans to increase their chances of survival and to pass forward their genes. Across these fields, studies have primarily relied on the same economic theories.

Theory **–** Most team game studies are grounded in rational choice and game theory (Bornstein, 2003; Rapoport & Bornstein, 1987). To explain the theory, I will start by describing a simple form of the research design used in team games. Two groups, labeled A and B, each with (*n*) members compete against one another. Members of both groups are given a fixed endowment (*e*) that they can either keep for themselves, termed defection, or contribute to the group, termed cooperation. If the total contribution of group A exceeds that of group B, group A secures a reward (*r*), and vice versa. If the contributions are equal, both groups receive a reward (*s*), where *s* is between 0 and *r*. This competition is played only once, and all members are aware of the parameters *n, e, r*, and s.

The theory posits that individuals act rationally, choosing the option that maximizes their potential reward. Therefore, if contributing offers a greater reward than defecting, rational individuals will opt to contribute. A detailed analysis of the conditions under which this choice is optimal has already been done by Bornstein (2003) and thus a thorough discussion of this is outside the scope of this review. Generally, the decision to contribute hinges on the probability of the contribution enhancing the group's chance of winning, which is a function of parameters *n* and *e,* and the size of the potential reward, which is a function of parameters *e, r* and *s*.

Methods **–** Most research on team games employs the Intergroup Public Goods Game (IPG) (Rapoport & Bornstein, 1987) or a variant of it as the research design (e.g., Bornstein, 1992; Bornstein, Budescu, & Zamir, 1997; Halevy, Bornstein, & Sagiv, 2008). In the IPG, participants receive a number of tokens (*e*) and are randomly assigned into two competing groups. Typically, these are minimal groups that do not carry any additional meaning to the participants and

participants do not have any forms of social relationships with each other. Participants must then decide whether to cooperate by allocating some of their tokens to benefit their group, to defect by keeping the tokens for themselves, or in more recent studies, to act in a hostile manner by sacrificing their own tokens to reduce the opposing group's resources, termed aggression (Halevy et al., 2008; Halevy, Weisel, & Bornstein, 2012). After all decisions are made, the group with the highest total contribution wins a team reward. Typically, the reward is a step-level public good, which is awarded only to the winning group regardless of their margin of victory (Bornstein, 2003). These competitions usually occur just once, though some studies feature multiple rounds (e.g., Abbink et al., 2010; Bornstein & Erev, 1994).

The choices available to participants – cooperation, defection, or aggression – are only loosely related to real-world competitive actions. For example, defection could be seen as an internal competitive action since it maximizes an individual's rewards relative to their teammates. However, it is also a form of 'free-riding,' a behavior which is driven more by self-interest or a lack of motivation rather than ambitions to compete for internal rewards. Consequently, the applicability of team game studies to real-world settings, particularly within firms, remains uncertain. These studies are better suited to shedding light on the level of effort employees might exert under interfirm competition, rather than directly informing what employees aim to achieve with the change in their effort.

Incentives

Much of the literature on incentives has taken place in the economics and organizational behavior bodies of literature. This body of research primarily seeks to understand how group competition can enhance individual (Andersson, Huysentruyt, Miettinen, & Stephan, 2017; Majerczyk et al., 2019) or group performance (Beersma et al., 2009; Nalbantian & Schotter, 1997) and behaviors linked to performance, such as increased speed and accuracy (Barnes, Hollenbeck,

Jundt, DeRue, & Harmon, 2011; Beersma et al., 2003). In these studies, individuals compete for individual and group rewards that are distributed based on relative performance. The degree to which individuals focus on tasks that primarily affect their individual performance, and consequently their chances of winning an individual reward, is then interpreted as a stronger focus on internal competition. Thus, whilst the incentive literature does not directly examine individuals' competitive behavior, it provides valuable insights into how they choose to distribute their efforts between the two competitions and the performance effect of this choice.

Theory – The strong emphasis on performance and outcomes directly linked to it sets the incentives literature apart from the research on group competition and team games, both of which primarily focus on ingroup and outgroup bias and 'free-riding.' Yet, it frequently employs similar theoretical frameworks to those used in the group competition and team game literatures. Particularly two theories are commonly employed in the incentive literature. Organizational behavior scholars tend to build on social interdependency theory (e.g., Baer, Leenders, Oldham, & Vadera, 2010; Beersma et al., 2009; Johnson et al., 2006) and economists on tournament theory (e.g., Majerczyk et al., 2019; Nalbantian & Schotter, 1997; Sutter & Strassmair, 2009). Given that social interdependency theory has already been discussed in the section on group competition, I will focus exclusively on explaining tournament theory here.

Tournament theory posits that actors, which can be individuals, teams, or firms, compete for a prize awarded based on their relative performance (Connelly, Tihanyi, Crook, & Gangloff, 2014; Lazear & Rosen, 1981). The theory assumes that actors are rational and their effort is influenced by both the size of the prize and their probability of winning. The size of the prizes typically escalates with rank, creating a *prize spread* that motivates teams by increasing the difference between the rewards for winning and losing. However, a larger prize spread can also reduce the efficiency of the tournament by increasing the total payouts. Additionally, the actors' incentives to

exert effort are shaped by their 'win percentage' – the likelihood of securing the larger reward. This probability depends on the number of competitors, the actor's efforts, and capabilities. Also, random factors such as weather conditions in sports tournaments or market conditions in team tournaments affect actors' win percentage. But because all actors are uniformly affected by random noise, it does not affect their incentives to exert effort. Generally, actors are more motivated to increase their effort only if it boosts their chances of winning a larger prize (Ai, Chen, Mei, Ye, & Zhang, 2023; Majerczyk et al., 2019; Nalbantian & Schotter, 1997). Tournaments provide little to no incentives if actors are guaranteed to win or have no chance of winning (Miklos-Thal & Ullrich, 2016).

Methods – The incentive literature utilizes a variety of research designs, including lab and field experiments, as well as analysis of archival data. The tasks that have been studied in the lab experiments vary widely, ranging from building a toy castle (Young, Fisher, & Lindquist, 1993) and playing tower defense games (Beersma et al., 2003; Johnson et al., 2006; Pearsall, Christian, & Ellis, 2010) to generating ideas in an innovation contest (Baer et al., 2010; Chen, Williamson, & Zhou, 2012). Additionally, many studies use a simplified effort choice task where participants select their level of effort without performing any physical activity (e.g., Andersson et al., 2017; Nalbantian & Schotter, 1997; Sutter & Strassmair, 2009).

The field experiments typically examine the effect of implementing a team tournament in a firm or a platform on team performance. The main difference between the lab and field experiments is that the field experiments tend to use real groups, such as retail chains (Delfgaauw, Dur, Onemu, & Sol, 2022), instead of minimal groups. Real groups tend to have more complex social dynamics and more effective mechanisms, such as peer pressure and punishments, that can be used to enforce cooperation (Chowdhury et al., 2016; Goette, Huffman, & Meier, 2012). This makes field

experiments particularly relevant for studying behaviors in environments that closely mimic actual firms, as opposed to the more controlled settings of minimal groups in labs.

Finally, some studies leverage archival data to assess the impact of intergroup competition on individuals' competitive behaviors (Chan et al., 2014; Hallila et al., 2024). These studies differ from experimental approaches primarily in two ways. First, the intensity of the intergroup competition changes endogenously as a consequence of firms' competitive responses. For example, in Chan et al. (2014) the level of competition sales counters face depends on the employees who are working on the current shift, which is determined by the competing firms. Second, the groups compete against multiple competing groups like in interfirm competitions. While these studies offer insights into naturally occurring competition, they lack the controlled randomization of treatment typical in experimental designs.

APPLICATIONS OF GROUP COMPETITION TO INTERFIRM COMPETITION

While none of the research streams directly examine the effects of interfirm competition on employees' competitive behaviors, they collectively imply that such competition should lead employees to compete less internally with their colleagues and more externally against competing firms and their employees. The prevailing theory suggests that employees should be willing to exert effort on behalf of their firm in the interfirm competition if doing so results in greater rewards for them. Therefore, the *likelihood* and *magnitude* of the rewards from defeating an interfirm competitor determine how employees respond to interfirm competition.

Thus, I organized the articles in this review into three categories – i.e., *Rewards*, *Organizational Design*, and *Nature of Interfirm Competition* – that affect the *likelihood* and the *magnitude* of the rewards from defeating an interfirm competitor. In addition, these categories include features that are common in firms, and firms can often influence these features through their decision-making. Consequently, these categories include features that are common in both

the types of groups that have been studied in the prior literature and firms. Therefore, these categories are well suited for explaining which of the findings of the intergroup competition literature are most likely to apply to firms.

Rewards

Both firm and individual rewards can influence how employees respond to interfirm competition. I define firm rewards as those whose value is linked to the outcomes of interfirm competitions. In contrast, the value of individual rewards is tied to employees' individual performance. The two types of rewards are often tied to each other and thus are not fully distinguishable from each other. For example, the number of stock options an employee receives depends on their individual performance, yet the value of each option depends on the firm's stock price, which in turn is influenced by the firm's performance in interfirm competitions.

Furthermore, individual and firm rewards often function as substitutes for each other because pursuing each type of reward may require a different set of actions. For example, helping one's colleagues can improve firm performance, but might also increase the probability of being outranked by a colleague in an internal tournament for a promotion (e.g., Lazear, 1989). Thus, often changes in firm rewards influence how employees compete for individual rewards, and vice versa. I will elaborate further on this when discussing the effects of combining firm and individual rewards.

Firm rewards **–** Interfirm competitions do not need to be tied to financial rewards for them to influence employees' competitive behavior. Several studies on groups indicate that merely providing performance feedback about a competing group can boost intra-group cooperation (Böhm & Rockenbach, 2013; Burton-Chellew & West, 2012; Tan & Bolle, 2007). Such feedback poses a threat to individuals' group identity and increases salience its salience in their minds. The threat prompts them to contribute more toward their group's success to protect their group identity

by outperforming their competitor. This suggests that firms must not tie employees' rewards to interfirm competition for employees to respond. Instead, non-financial motivators, like benchmarking against competitors, can be sufficient to alter employee behavior by threatening their firm identity and, consequently, influencing their competitive actions.

Moreover, performance feedback not only triggers competition but can also amplify employees' responses to interfirm competition (Gjedrem & Kvaløy, 2020; Young et al., 1993). Performance feedback increases employees' awareness of their firm's performance relative to its peers, highlighting the risk of losing out on a firm reward. Consequently, employees are more likely to experience status concerns (Gjedrem & Kvaløy, 2020; Ouwerkerk, De Gilder, & De Vries, 2000) and to apply peer pressure on their colleagues to incentivize them to protect the firm (Huang & Murad, 2021). Thus, combining performance feedback with interfirm competition can motivate employees to exert more effort (Gjedrem & Kvaløy, 2020; Halevy, Chou, Cohen, & Bornstein, 2010), especially in close competitions (Young et al., 1993).

Non-financial rewards can also come in the form of reputational gains and losses (e.g., Hallila et al., 2024). With reputation, I refer to employers' beliefs about an employee's future productivity (Holmström, 1999). Employees' reputation is tied to their firm's performance. For example, employees that have previously worked for more prestigious companies receive better job opportunities later in their careers (Bidwell et al., 2015; Rider & Negro, 2015). Consequently, to ensure that they will benefit from the firm's reputation, employees will target their competitive actions at employees at competing firms instead of their colleagues if their firm's market position is under threat (Hallila et al., 2024).

However, employees may not respond to firm-level opportunities in the same way as to threats. Reputational rewards are distributed based on how strongly an employee is associated with the firm's success (e.g., Ethiraj & Garg, 2012; Uhlmann & Barnes, 2014). Because of this,

employees need to play a visible role in the interfirm competition to receive reputational gains from the firm's success. Consequently, employees are more likely to engage in competitive actions against their colleagues and employees at competing firms to increase their visibility and thus strengthen the association between their contributions and the firm's success in the interfirm competition (Hallila et al., 2024).

Individual rewards **–** Individual rewards, such as promotions and bonuses, affect how employees balance between their own and the firm's interests. Research in organizational behavior suggests that mixed incentives – the combination of individual and firm rewards – play a critical role in shaping employees' responses to interfirm competition (e.g., Barnes et al., 2011; Beersma et al., 2003; Pearsall et al., 2010). These studies examine individuals who compete simultaneously for team and individual bonuses, each awarded based on relative performance. Team rewards should incentivize cooperation, while individual rewards aim to reduce 'free-riding' behaviors (Bornstein, 1992; Gunnthorsdottir & Rapoport, 2006). Theoretically, this combination should offer firms the optimal balance between promoting cooperation whilst discouraging 'free-riding.'

However, empirical evidence on the effect of mixed incentives on team performance is inconsistent. Studies suggest that while mixed incentives can lead to increased effort (Majerczyk et al., 2019) and enhanced information sharing among team members (Pearsall et al., 2010), they also result in tasks being completed more quickly but with less accuracy (Barnes et al., 2011; Beersma et al., 2003). Additionally, collective decision-making processes under mixed incentives tend to be slower (Bornstein & Gneezy, 2002; Bornstein, Kugler, Budescu, & Selten, 2008), trust levels among team members are lower (Ferrin & Dirks, 2003), and the frequency and efficiency of collaboration diminish (Barnes et al., 2011). These outcomes suggest that the net benefit of mixed incentives remains ambiguous, with studies reporting both positive (e.g., Gunnthorsdottir & Rapoport, 2006; Majerczyk et al., 2019; Pearsall et al., 2010) and negative effects (e.g., Barnes et

al., 2011; Bornstein & Gneezy, 2002). Therefore, it seems clear that individual rewards will affect employees' response to interfirm competition. However, it remains unclear what this response is and under which circumstances employees will respond to mixed incentives in a way that improves firm performance.

Some research has been conducted into the circumstances under which combining the two forms of rewards may or may not benefit the firm. The key finding has been that the order of implementation of the types of rewards determines their effectiveness. Transitioning between reward systems can pose significant challenges to firms (Beersma et al., 2009; Johnson et al., 2006; Nalbantian & Schotter, 1997). Why this is the case is best explained by structural adaptation theory, which argues that moving from an organized system to a more disorganized system is more difficult than the other way around. Firms accustomed to firm rewards tend to develop efficient collaborative routines and a culture of trust, making them more adaptable to incorporating individual incentives. In contrast, firms that have originally relied heavily on individual rewards may not benefit from adding firm rewards to the same extent due to entrenched competitive behaviors and lower initial levels of trust. For example, employees may not trust others will cooperate and thus simply neglect the firm reward. This insight implies that there is some form of path dependency when it comes to rewards. Firms that are founded in markets with fierce competition or rely heavily on firm rewards, such as stock options or performance bonuses tied to firm metrics, may be better at developing routines for collaboration and consequently find it easier to transition into mixed incentives.

Organizational design

Organizational design elements, such as coordination mechanisms within the firm and employee selection, influence how employees respond to interfirm competitions. Coordination mechanisms, such as punishments and hierarchies, can be strategically employed to increase the

cost of defection, thereby promoting cooperation and discouraging destructive competitive behavior during interfirm competitions. Also, through selection and hiring employees with a certain set of characteristics, firms can choose to employ those individuals that gain utility from cooperating when their firm is facing competition. Thus, to employ the correct individuals, firms must know how individual level characteristics, such as values and gender, affect employees' response to interfirm competition.

Coordination mechanisms **–** Employees can be reluctant to cooperate during an interfirm competition because they are guaranteed a reward from the interfirm competition regardless of their effort (Bornstein, 1992; Bornstein & Rapoport, 1988) and, especially in larger firms, their effort has a trivial effect on their firm's overall success (Wageman & Baker, 1997). Consequently, firms must enforce cooperation by increasing the cost of 'free-riding.' Common enforcement mechanisms include punishments, internal communication, and hierarchical organizational structures.

The role of punishments in team games has been extensively studied in economics (Goette, Huffman, & Meier, 2006) and evolutionary biology (Gneezy & Fessler, 2012; Sääksvuori, Mappes, & Puurtinen, 2011). In interteam competitions, team members need to cooperate for their team to have a chance of winning. Thus, they inflict costs in the form of punishments on defectors (Benard, 2012; Gneezy & Fessler, 2012), to incentivize more cooperation (Abbink et al., 2010). Typically, punishing imposes also a cost on the punisher (Gneezy & Fessler, 2012). Yet, because punishments increase the team's chance of winning, team members are willing to bear that cost (Sääksvuori et al., 2011). Therefore, the use of any form of financial punishment, such as sanctions due to a poor performance review, is likely to cause employees to compete less internally and potentially more externally when facing interfirm competition.

Moreover, studies indicate that punishments do not necessarily need to be explicit to incentivize cooperation. Punishments are often social and come in the form of guilt (Burton-Chellew, Ross-Gillespie, & West, 2010; Puurtinen & Mappes, 2009). Guilt means that individuals believe that they will let others down if they defect (Charness & Dufwenberg, 2006). Although social punishments may not be as impactful as financial ones, they are easier to implement because they are typically enforced through peer pressure and do not require a deliberate organizational system, such as a performance review. Therefore, social punishments can play a crucial role in promoting cooperation during interfirm competitions.

One way to increase the use and cost of social punishments is to introduce more frequent and significant interactions among peers. Team game experiments have shown that communication among teammates can promote cooperation (e.g., Bornstein, Rapoport, Kerpel, & Katz, 1989; Goren & Bornstein, 2000; Rapoport & Bornstein, 1989; Sutter & Strassmair, 2009) by increasing trust in the team (Bornstein & Rapoport, 1988), reinforcing the group identity (Cason, Sheremeta, & Zhang, 2012), and highlighting differences between the ingroup and outgroup (Bornstein, 1992). However, while in-team communication promotes cooperation, it does not necessarily promote more competitive behavior against other teams (Halevy et al., 2008). This may be because cooperation, which is seen as a defensive action, requires less enforcement than more aggressive strategies that are perceived as attacks against the firm's competitors (De Dreu & Gross, 2019; De Dreu et al., 2016). Thus, within-group communication may not be a strong enough enforcement mechanism to overcome individuals' reluctance to participate in attacks. Instead, firms may need to use stronger forms of enforcement like financial punishments in these types of interfirm competitions.

Finally, the level of hierarchy within a firm can also influence how employees respond to interfirm competition. The organizational design literature argues that hierarchies are used to

resolve conflicts between employees by allowing issues to be escalated to a manager at a higher level with more authority (Lawrence & Poliquin, 2023; Lee, Ilseven, & Puranam, 2023). For example, if two employees at the same level within the hierarchy cannot agree on an issue, they can escalate this to their manager who then resolves the disagreement. A logical conclusion from this is that hierarchies can improve a firm's ability to enforce cooperation during interfirm competitions.

However, empirical studies on groups find that hierarchical groups are more likely to have internal power struggles and, ultimately, may perform worse during intergroup competitions (Maner & Mead, 2010; Mead & Maner, 2012; Van Bunderen et al., 2018). Such competitions can limit available resources within a firm, prompting members to guard their individual resources more fiercely. Contrary to the theoretical benefits of hierarchical structures suggested in the organizational design literature, hierarchies may actually intensify internal competition during interfirm competition, especially if it threatens the firm's access to resources.

Individual characteristics **–** The positions within an organization where firms place certain employees, as well as which employees are hired and employed by firms, influence how the firm is affected by interfirm competition. Studies have shown that employees in leadership roles often react defensively to intergroup competition due to concerns about retaining power (Fodor, 1985; Maner & Mead, 2010). Under threat, leaders may make suboptimal decisions for the group, such as sidelining highly skilled but threatening group members (Maner & Mead, 2010) or increasing control over them (Mead & Maner, 2012). Yet, intergroup competition has been found to reduce leaders' concerns over their position (Rabbie & Bekkers, 1978) and thus reduce their tendency to engage in harmful behaviors that aim to secure their power within the group (Maner & Mead, 2010; Mead & Maner, 2012). Also, individuals who are perceived to be more indispensable to their group

increase their effort more than others during intergroup competitions (Hüffmeier & Hertel, 2011), implying that leaders may be motivated more than others by such competitions.

Moreover, the values employees hold also significantly influence their reactions to interfirm competition. Organizational behavior scholars and economists have extensively discussed the role of values, which firms can shape through, for example, their culture, work practices, and incentives. Prosocial values enhance concern for others, while pro-self values result in a greater focus on personal power and achievements. The values individuals adopt affect their group identification. Those with prosocial values exhibit greater in-group bias (Andersson et al., 2017; Probst, Carnevale, & Triandis, 1999) and exert more effort during intergroup competitions (Böhm, Rothermund, & Kirchkamp, 2013; De Dreu, 2010; Lee et al., 2012).

Although stronger prosocial values increase individuals' willingness to contribute to the group, it remains unclear whether they also promote competitive behavior against competing groups. While some evidence suggests that individuals with pro-social values do not show more outgroup bias (De Dreu, 2010), other findings indicate that prosocial values may intensify efforts to maximize differences between their own and competing groups during competitions (Böhm et al., 2013). Therefore, instilling prosocial values within a firm should promote cooperation, though it may not increase competitive behavior against competing firms.

Furthermore, several studies have observed differences in behavior and selection between men and women in intergroup competitions. Men typically exhibit more in-group favoritism (Yuki & Yokota, 2009) and increase their contributions to their group more than women during these competitions (Van Vugt, Cremer, & Janssen, 2007). Additionally, all-male groups experience an increase in performance in creative tasks under competition, whereas all-female groups tend to perform worse (Baer et al., 2014). Therefore, men are generally more motivated by interfirm

competition, an idea also suggested by a recent review on interpersonal competition (To, Kilduff, & Rosikiewicz, 2020).

Regarding the selection into competitive environments, men, particularly those with dominant facial characteristics, are more likely to be chosen to participate in groups facing competition (Hehman, Leitner, Deegan, & Gaertner, 2015; Van Vugt & Spisak, 2008). Thus, firms that face fierce interfirm competition may prefer hiring men over women. Furthermore, some studies indicate that men are more inclined to enter into competitive settings than women (Flory, Leibbrandt, & List, 2015; Gneezy, Leonard, & List, 2009; Niederle & Vesterlund, 2007). However, these studies examine selection into interpersonal competition and not interfirm competition. Other research suggests no significant gender differences, or that women are more likely to enter team competitions (Dargnies, 2012; Healy & Pate, 2011). These studies examine individuals' decisions to enter a team tournament in which individuals' rewards are based entirely on the team's relative performance. This, however, would represent an extreme form of interfirm competition as firm rewards are typically only a small part of individuals' total compensation. Hence, while it seems plausible that men are more likely to join firms operating in competitive environments, the extent of this tendency remains uncertain.

Nature of Interfirm Competition

So far, I have conceptualized interfirm competition as simply a consequence of negative reward interdependency between firms (e.g., Deutsch, 1949). Yet, interfirm competition is often not only a consequence of negative reward interdependency, but instead, the competitive dynamics literature has shown that firms can face a variety of different types of competition (e.g., Kilduff, Elfenbein, & Staw, 2010; Livengood & Reger, 2010). These interfirm competition studies highlight that the firm's role within the competition and the type of competitors it faces may significantly influence employees' response to interfirm competition. These factors alter both the magnitude and

the nature of the rewards linked to competitive outcomes by increasing the psychological stakes in the competition.

Roles in the competition – The literature on team games within evolutionary biology has shown that individual responses to intergroup competition vary depending on their group's role (De Dreu et al., 2016; Weisel & Zultan, 2016). Groups can either be perceived as attackers, aiming to seize opportunities, or defenders, focusing on protecting existing resources or, in the case of firms, market share. The incentive to prioritize group goals is generally weaker when attacking, which is typically framed as seeking a gain, compared to defending, which is framed as preventing a loss. Since losses tend to affect individuals more significantly than equivalent gains, defensive roles lead to stronger responses to intergroup competition. Consequently, when acting as defenders, individuals are more likely to decrease competitive activities against their own group members (Hallila et al., 2024), exert more effort (Hong, Hossain, & List, 2015) and increase cooperation (De Dreu et al., 2016, 2016).

In contrast, when groups take on an attacking role, group members experience less pressure to conform to the group's norms. Consequently, they may exert less effort (De Dreu & Gross, 2019) and engage more frequently in competitive actions against other group members to improve their position within the group (Hallila et al., 2024). To discourage these behaviors, groups are forced to rely more on punishments as an enforcement method when acting as attackers rather than defenders (De Dreu, 2010; De Dreu et al., 2016). For example, during wartime, attacking nations may impose punishments, such as imprisonment, on individuals perceived as defectors because they are avoiding military service (Vasilyeva, 2022). In contrast, defending nations rarely need to rely on such drastic measures to ensure their citizens' cooperation during a war.

Determining whether a firm is perceived as an attacker or defender is not always straightforward (Hallila et al., 2024). Often, there is no objective measure to classify a firm

definitively in one role or the other. In such cases, firms can benefit from strategic framing. Studies have demonstrated that individuals react to intergroup competition as though their group is defending against a threat, even when this threat is merely a result of framing (Hong et al., 2015; Weisel & Zultan, 2016, 2021). Therefore, by framing an interfirm competition as a threat, for example in town hall discussions or internal newsletters, firms may garner the benefits associated with being perceived as a defender.

Additionally, employees' responses to interfirm competition can also be influenced by whether their firm is viewed as an underdog or a favorite (Doyle, Pettit, Kim, To, & Lount, 2022; Hallila et al., 2024). This literature, which has predominantly studied groups and teams, defines underdogs as groups that are expected to lose a competition and favorites as those that are expected to win the competition. Performance expectations increase the psychological stakes in the competition. Underdogs are fueled by the desire to prove others wrong by outperforming the low expectations that are set on them (Nurmohamed, 2020). Thus, underdogs compete more fiercely (Doyle et al., 2022) and exert increased effort when they believe beating the favorite is achievable (Lount Jr, Pettit, & Doyle, 2017). However, being an underdog must not result in employees competing less internally. For example, Hallila et al. (2024) find that MotoGP riders engage in more competitive actions against their teammates when their team has the opportunity as an underdog to outrank competing teams with superior resources.

Conversely, favorites often face greater pressure to defend their position and avoid the embarrassment of not meeting expectations (Dai, Dietvorst, Tuckfield, & Milkman, 2018). This pressure can lead favorites to concentrate their competitive efforts on external competitors rather than internal ones (Hallila et al., 2024), compete more aggressively (Doyle et al., 2022), adopt more offensive-minded strategies (Bartling, Brandes, & Schunk, 2015), and increase effort (Lount Jr et al., 2017). Hence, firms might gain strategic advantages by framing themselves appropriately as

either underdogs or favorites in interfirm competitions. A notable example of this type of framing is Apple's iconic Super Bowl commercial inspired by the novel '1984,' which positioned Apple as an underdog challenging IBM's dominance in the PC market (Austerlitz, 2024). This ad also coincides with the time when Apple started gaining market share from IBM.

Competitor type – Several studies have demonstrated that the specific competitors firms face, significantly influence employees' responses to interfirm competition. Particularly, competing against a firm's rival has been shown to affect employees' competitive behavior (Kilduff et al., 2010). A rival is "a specific, identifiable opponent with whom the focal actor has an existing subjective relationship that drives significance, independently of the current situation" (Kilduff, 2019: 777). For example, the rivalry between GM and Ford carries greater significance to the two firms than simply competing for market share. Rivalries develop over time when firms are similar and engage in repeated and evenly matched competitions (Kilduff et al., 2010). Consequently, competitions against a firm's rivals are not perceived as one-shot independent events but as part of a prolonged narrative, heightening the psychological stakes of each contest (Converse & Reinhard, 2016). Thus, the primary goal in a rivalry is not to gain resources, but to beat the opponent by any means necessary (Kilduff, Galinsky, Gallo, & Reade, 2016).

Several studies have found that rivalries affect employees' tendency to engage in competitive behaviors that are targeted at rivals or other external non-rival competitors. Employees exert more effort (Kilduff et al., 2010), take more risks (To, Kilduff, Ordoñez, & Schweitzer, 2018), and are more likely to engage in unethical behavior (Kilduff et al., 2016) when they face an interfirm rival in head-to-head competition. Additionally, rivalries can lead to spillover effects: a high-performing rival may enhance employees' motivation in competitions against non-rivals (Pike, Kilduff, & Galinsky, 2018) and witnessing a rival's defeat can elicit *schadenfreude* – i.e., experiencing pleasure for a rival's misfortune (Cikara et al., 2011). Furthermore, simply being reminded of a

rival can prompt individuals to adopt more aggressive strategies (Converse & Reinhard, 2016) and display a reluctance to assist members of the rival group (Weisel & Böhm, 2015). Therefore, rivalries increase employees' competitive activity against both rival and non-rival competitors. However, it remains unclear whether rivalries also affect their competitive behavior against their colleagues, a point to which I will return in the next section.

FUTURE DIRECTIONS

While many insights from the prior literature are relevant to firms, there are significant differences between firms and other types of groups that remain underexplored. In this section, I will address key gaps in the research designs and areas of focus of earlier studies and propose ways for tackling these issues in future research. The discussion is organized around the three main categories – rewards, organizational design, and the nature of interfirm competition – in the previous section.

Rewards

As noted earlier, firm rewards must not be financial for employees to respond to interfirm competition. Social and reputational rewards can also significantly impact their behavior. Social rewards, like those arising from social identity threats due to social comparisons to competing groups, have been widely discussed in the literature (e.g., Gjedrem & Kvaløy, 2020; Tan & Bolle, 2007). However, reputational incentives have received significantly less attention. In fact, Hallila et al. (2024) is the only paper included in this review that studies reputational incentives. There is often a link between a firm's reputation and its employees' reputations (e.g., Bidwell et al., 2015; Rider & Negro, 2015), where an improvement in the firm's performance during interfirm competitions can enhance its reputation. The enhanced firm reputation can then carry over to its employees, resulting in more lucrative career opportunities to them (Holmström, 1999; Miklos-

Thal & Ullrich, 2016). Consequently, employees are motivated to engage in behaviors that bolster their firm's relative performance.

Reputational incentives, however, differ from financial incentives in some key ways. First, while financial rewards like bonuses or stock options are directly tied to an individual's performance and are contractually enforced, reputational gains are not necessarily performance based. Instead, employees who are most strongly associated with their firm's performance tend to benefit the most from its achievements or suffer from its failures (e.g., Hallila et al., 2024). Of course, these associations can be simply a consequence of strong individual performance. However, other factors, such as status, visibility, and position within the firm, may also affect the strength of the association between employees and their firm's performance. Future studies could explore which characteristics most strongly connect an employee's reputation to their firm's performance and how this connection influences their response to interfirm competition.

Second, employees are motivated not only by opportunities within their current firm but also by career opportunities at other firms. For instance, academics often compete for positions at other institutions. However, most empirical research applies research designs with closed groups in which participants cannot seek opportunities in other groups (e.g., Abbink et al., 2010; Bornstein et al., 1989; Goette, Huffman, Meier, et al., 2012). Thus, the research designs deployed in the group competition studies do not accurately reflect real-world dynamics where interfirm competition can function as a platform for employees to showcase their abilities to external recruiters. For example, employees with prominent roles or strong performances during interfirm competitions that receive a lot of media attention may experience a larger boost to their external reputation (e.g., Uhlmann & Barnes, 2014). Hence, interfirm competition might intensify internal competition among employees by intensifying the competition for who gets to be in the "spotlight." Recognizing the

role of external career ambitions is crucial for understanding the full scope of interfirm competition's effects on employee behavior.

Organizational Design

Several aspects related to firms' incentive designs, social dynamics, and work structures have been largely overlooked in the prior literature. First, the role of competitive actions – defined as 'targeted, specific, and observable moves that individuals make with the goal of enhancing their relative position' (Hallila et al., 2024: 3) – has received little attention. Most research designs do not allow individuals to take actions that directly improve their position at the expense of a competitor. For example, in team game studies, actions such as cooperation and defection are not targeted towards other group members and do not enhance the participant's standing within the group (e.g., Bornstein, 1992; Bornstein et al., 1989; Rapoport & Bornstein, 1989). Consequently, participants lack incentives to enhance their relative position within the group.

However, tournament-based rewards like promotions, which are prevalent in firms (Eriksson, 1999; Lazear & Rosen, 1981), create strong incentives for employees to outperform their colleagues by engaging in internal competitive actions, such as by poaching customers (Chan et al., 2014) or sabotaging their work (Lazear, 1989). It remains unclear whether interfirm competition reduces or intensifies employees' tendencies to engage in such behaviors. While excelling in internal rankings during interfirm competition could be advantageous, as a higher rank may allow employees to claim more credit for the firm's success, overly aggressive competitive activity against colleagues might be perceived as selfish and counterproductive. Thus, more future studies can examine how interfirm competition affects employees' tendency to perform competitive actions against their colleagues.

Second, little scholarly attention has been devoted to understanding the role of employment contracts during interfirm competition (Hallila et al., 2024). Employees on non-permanent

contracts, such as temporary workers, interns and contractors, have only a temporary membership with the firm. Consequently, they are less influenced by the firm's social norms and less susceptible to internal punishments. For example, compared to real groups, minimal groups are worse at enforcing cooperation within the group due to their group members' weaker identification with the group (Chowdhury et al., 2016; Goette, Huffman, & Meier, 2012). Similarly, employees on non-permanent contracts are only temporary members who do not identify as strongly with the firm. Hence, they should not respond to interfirm competition as strongly as other employees. In contrast, they may even perceive the interfirm competition as an opportunity to enhance their personal reputation by showing that they have superior abilities compared to permanent members of the firm (e.g., Hallila et al., 2024).

Finally, the application and effectiveness of punishments within firms during interfirm competition need further investigation. While past studies have noted that punishments can be financial or social, none of the studies included in this review applied a research design in which participants can engage in both forms of punishment. For example, in team game studies participants can only apply financial punishments on their peers (Abbink et al., 2010; Gneezy & Fessler, 2012; Goette, Huffman, Meier, et al., 2012). Therefore, it remains unclear how the use and effectiveness of different forms of punishment depend on the type of competition the firm faces. An emerging stream of studies in evolutionary biology suggests that enforcing cooperation is more difficult when the group is an attacker compared to when they are a defender (De Dreu & Gross, 2019; De Dreu et al., 2016). It may be that social punishments, such as peer pressure, are ineffective when the firm is framed as an attacker, in which case it would be crucial for the firm to develop stronger forms of punishment, such as financial sanctions. Therefore, more research is needed to understand when firms must develop alternative methods of punishment to enforce cooperation during interfirm competitions.

Nature of Interfirm Competition

There are several opportunities to leverage insights from interfirm competition studies to better understand employees' competitive behaviors under interfirm competition. Particularly, the bodies of literature on competitive dynamics (Chen, 1996; Chen & Miller, 2012) and organizational ecology (e.g., Baum & Mezias, 1992; Bothner et al., 2007) may provide valuable new perspectives on this problem. Competitive dynamics scholars have long highlighted that where the interfirm competition takes place (Livengood & Reger, 2010) and against whom the firm competes (Chen, Su, & Tsai, 2007; Kilduff, 2019) influences firms' competitive behavior by increasing the psychological stakes of the competition. These studies find that the nature of interfirm competition can affect a firm's level of competitive aggressiveness (e.g., Chen et al., 2007; Kilduff et al., 2010). Similarly, employees' response to the interfirm competition may depend on who it is against and where it takes place. For example, employees may experience greater peer pressure and guilt if the psychological stakes in the interfirm competition are higher. In contrast, competitions that receive more media attention can function as opportunities for employees to bolster their individual reputations, potentially at the cost of their firm. Thus, the specific type of competition firms face could influence their employees' competitive behavior.

Particularly, the rivalry literature presents several interesting research opportunities. Past studies have shown that employees compete more aggressively against rivals (Kilduff et al., 2010, 2016; To et al., 2018). Yet, little attention has been devoted to studying how rivalries affect competition within a firm. One could expect that rivalries reduce competition within the firm by causing a threat to employees' social identity. However, rivalries have been found to cause employees to adopt a promotion mindset (Converse & Reinhard, 2016; To et al., 2018). A promotion focus increases individuals' eagerness to pursue accomplishments and to avoid errors of omission – i.e., to miss out on opportunities (Crowe & Higgins, 1997). Thus, if employees have

career ambitions, for example, because they are in close competition for a promotion, they may perceive the rivalry as an opportunity to boost their reputation. In that case, rivalries might actually reduce collaboration and increase competitive behavior against others in the firm.

Moreover, most studies apply research designs in which groups engage in dyadic competitions. Yet, as the organizational ecology literature suggests, firms often compete against multiple competitors at the same, in which case the intensity of interfirm competition is a function of the density of firms in a market (Baum & Mezias, 1992; Bothner et al., 2007). Density based competition can affect employees differently because in that case there is not a single identifiable opponent that represents a threat to the firm. Instead, the threat is more subtle and thus may be less effective in incentivizing cooperation within the firm. So far, only one study has examined the effect of density based interfirm competition on employees' competitive behavior (Hallila et al., 2024). Thus, there are ample opportunities for further studies to explore how employees respond to the competitive pressures from multiple firms concurrently posing threats.

Finally, most studies examine intergroup competitions that resemble interfirm competition in the product market. However, firms also compete in the factor market for resources and inputs (Markman, Gianiodis, & Buchholtz, 2009). The two types of competition may be perceived differently by employees as the latter has a greater impact on the resources available to employees. It may be that interfirm competition in the factor market does not unite employees. Instead, it can increase their concerns over accessing resources, resulting in more frequent internal conflicts (e.g., Van Bunderen et al., 2018). Factor market competition is conceptually closest to the intergroup competitions that have been studied in realistic group conflict theory. Thus, future studies could apply the insights from realistic conflict theory to examine how employees adjust their competitive behavior to factor market competition.

CONCLUSION

Intergroup competition and its impact on individuals' competitive behavior have been extensively studied across psychology, economics, and management disciplines. However, these studies often focus on groups with less complex social dynamics, and incentive structures than those found within firms. This review provides a comprehensive overview of the predominant streams of literature on intergroup competition, explores how these insights may apply to firms, and proposes directions for future research. It is intended to serve as an entry point for those interested in understanding the nuances of interfirm competition and its effects on employees' competitive behaviors. Although many of the findings are likely to apply to firms, much is still left to be explored.

Table 1. Summary of Streams of Literature

	Group competition	Team games	Incentives
Original research question	What causes conflicts between ethnic groups?	Why do individuals exert costly effort in-behalf of their group in an intergroup competition?	How can group competition be used to improve employee and/or group performance?
Key references	Deutsch (1949), Sherif et al. (1961), Tajfel & Turner (1978)	Abbink et al. (2010), Bornstein (1992), Rapoport & Bornstein (1987),	Beersma et al. (2003), Nalbantian & Schotter (1997)
Key theories	- Social interdependency theory - Realistic conflict theory - Social identity theory	- Game theory - Rational choice theory	- Social interdependency theory - Tournament theory
Key prediction	Intergroup conflict increases ingroup and outgroup bias.	Intergroup competition increases cooperation, reduces free-riding and potentially increases outgroup hostility.	Group competition increases individual and group performance.
Key outcomes studied	- Ingroup and outgroup bias - Team and individual effort - Coordination and social cohesion within the group	- Cooperation/contribution to group - Outgroup hostility	- Individual and team performance - Individual behaviors associated with performance (e.g., accuracy, speed, helping, competitive actions etc.)
Why individuals participate in the group competition?	- Defend their group's resources or identity - Avoid punishment from ingroup members	- Maximize their welfare by winning a team reward - Avoid punishment from ingroup members	- Maximize their welfare by winning a team reward
Common methods	- Minimal and real group experiments	- Intergroup public goods game - Intergroup prisoners' dilemma	- Lab experiments (e.g., Command and control simulation) - Field experiments - Archival data
Group types	- Minimal groups - Real groups	- Minimal groups - Real groups	- Teams - Natural groups

3. REVVING UP OR BACKING DOWN? CROSS-LEVEL EFFECTS OF FIRM-LEVEL TOURNAMENTS ON EMPLOYEES' COMPETITIVE ACTIONS[7]

ABSTRACT

The tournament literature has typically traced employees' competitive actions to characteristics of individual-level career tournaments. Yet such individual-level tournaments usually transcend firms that themselves compete in a firm-level tournament. We study the cross-level implications of a firm-level tournament for the competitive actions that constituent employees undertake against other individuals internal and external to their firm. We propose a theory of individual reputational incentives, which predicts that a firm's competitive threats decrease its employees' internal competitive actions yet increase their external competitive actions, while a firm's competitive opportunities increase employees' internal and external competitive actions. The theory also predicts that these effects are the largest when a firm faces potential unexpected losses or gains in its standing, such as when the firm experiences competitive threats from resource-disadvantaged firms, or competitive opportunities against resource-advantaged firms. In panel data on the population of motorcycle riders competing in MotoGP from 2004 to 2020, we examine these hypotheses using overtakes to measure riders' internal and external competitive actions. Our findings reveal how riders adjust their internal and external overtakes based on their team's competitive threats and opportunities, and on the relative resource endowments of the teams supplying such threats or opportunities.

INTRODUCTION

Concerned with achieving desirable career-related rewards, employees tend to engage in competitive actions against other individuals both internal and external to their firm. For example, they may encroach on others' spheres of influence (Baum, Bowers, & Mohanram, 2016) or poach their clients (Chan, Li, & Pierce, 2014). Such career tournaments, in which individuals seek to enhance their relative position (Lazear & Rosen, 1981; Rosen, 1986), almost everywhere transcend firms that themselves compete in a firm-level tournament. Indeed, firms widely pursue things such as market share (Ferrier, Smith, & Grimm, 1999), critical contracts (Mihm, Sting, & Wang, 2015), or favorable spots in relevant rankings (Rindova, Martins, Srinivas, & Chandler, 2018).

[7] This chapter is based on the following publication: Hallila, P., Frankort, H., & Aversa, P. 2024. Revving up or backing down? Cross-level effects of firm-level tournaments on employees' competitive actions. ***Academy of Management Journal,*** forthcoming: https://doi.org/10.5465/amj.2022.0946.

Yet while the nesting of individual-level career tournaments in firm-level tournaments is a near-ubiquitous organizational reality, the prior tournament literature has mostly traced employees' competitive actions to characteristics of the individual-level tournament, such as the spread of rewards across tournament levels (Connelly, Tihanyi, Crook, & Gangloff, 2014; Dechenaux, Kovenock, & Sheremeta, 2015). To date, it has not examined the possible cross-level consequences of a firm-level tournament for the competitive actions of constituent employees, who themselves strive for career-related rewards. A firm's standing may have important implications for employees' careers, however (e.g., Bidwell, Won, Barbulescu, & Mollick, 2015; Rider & Tan, 2015). Thus, closer attention to the cross-level effects of firm-level tournament dynamics seems critical for a more complete understanding of employees' internal and external competitive actions.

Of course, a large and multidisciplinary body of research has examined how individuals' behaviors may depend on whether their group (e.g., a firm) competes with other groups (Böhm, Rusch, & Baron, 2020). This research has long emphasized the 'common-enemy effect,' which holds that common enemies unite the members of a group (De Jaegher, 2021). At first blush, its natural prediction here would be that employees engage less in internal and more in external competitive actions when their firm faces more intense competition in a firm-level tournament (e.g., Halevy, Bornstein, & Sagiv, 2008). However, this prediction may not follow so neatly because the nesting of career tournaments in firm-level tournaments is different in two potentially consequential ways. First, the vertical nature of tournaments implies a sharp distinction between competitive threats from lower-ranked firms and competitive opportunities against higher-ranked firms (e.g., Bothner, Kang, & Stuart, 2007). In the common-enemy literature, the implications of these distinct kinds of group-level competition for individual behaviors remain underdeveloped.[8]

[8] In Appendix A, we review 35 studies of the relation between intergroup competition and individual attitudes and behaviors, spanning the period from 1961 to 2019. We coded how they conceptualized group-level competition. About half the studies did not specify whether a group faced competition due to the threat of loss or the opportunity for gain.

Second, employees' career concerns could occasionally lead them to engage fiercely in both internal and external competitive actions (e.g., Lazear, 1989). Yet career concerns play little conceptual role in the common-enemy literature and, perhaps therefore, its empirical designs tend not to allow individuals to act simultaneously against members of both their own and other groups.[9]

Accordingly, our objective is to theorize and examine how a firm's competitive threats and opportunities in a firm-level tournament affect the internal and external competitive actions of its employees, who are concerned with their future careers. Drawing from the career-concerns literature (e.g., Borland, 1992; Fama, 1980; Holmström, 1999; Miklós-Thal & Ullrich, 2016), we propose a theory of individual reputational incentives, according to which employees will compete more fiercely if they expect that specific competitive actions help them sustain or improve their reputation. Yet they may hold back in situations in which they anticipate that such actions could hurt their reputation. Our theory predicts that a firm's *competitive threats* decrease its employees' internal competitive actions but increase their external competitive actions, while a firm's *competitive opportunities* increase employees' internal and external competitive actions. The theory also predicts that these effects should be larger when a firm faces potential unexpected losses or gains in its tournament standing, such as when the firm experiences competitive threats from resource-disadvantaged firms, or competitive opportunities against resource-advantaged firms.

We test our hypotheses in original panel data on the population of riders competing in MotoGP during a 17-year period, from 2004 to 2020. MotoGP is the leading championship in professional motorcycle racing, in which riders have individual career concerns yet all are also

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The other half alluded to the outcome of interest as either a potential loss or a potential gain. Nevertheless, in most such studies the competing groups acted from a position of parity. Thus, even in that research threats or opportunities derived from the framing of the outcome rather than groups' relative standings in a dynamic tournament.

[9] The common-enemy literature has achieved much of its empirical traction through team games, such as the intergroup prisoner's dilemma-maximizing difference game (see Appendix A). Individuals must typically decide whether to contribute all or part of a fixed endowment to benefit their own group and/or harm another group.

employed by teams that compete in a firm-level tournament. The transparent nature of competition in MotoGP means we can use overtakes as a consistent measure of riders' internal and external competitive actions. By 'overtake,' we mean a rider's act of passing another rider on the racetrack. MotoGP teams are clearly differentiated by their resource endowments, which also allows us to perform persuasive tests of the moderating role of teams' resource (dis)advantages.

This article advances the tournament literature by challenging prior accounts tracing employees' competitive actions exclusively to characteristics of an individual-level career tournament. It argues and shows that employees' internal and external competitive actions may also respond to characteristics of a firm-level tournament in which the career tournament is nested. We also add to the literature on common-enemy effects, by offering a theory and empirical evidence of employees' competitive behaviors that account both for vertical differentiation among competing firms and for individual career concerns.

FIRM-LEVEL TOURNAMENTS AND EMPLOYEES' COMPETITIVE ACTIONS

Individuals employed by a firm are commonly part of some implicit or explicit tournament, through which they strive to improve performance relative to other individuals, with the objective of increasing their own career-related rewards (Lazear, 1989; Lazear & Rosen, 1981; Rosen, 1986). Rewards may be internal or external, and can include additional pay, resources, recognition, bonuses, promotions, or a role with a more desirable employer (e.g., Miklós-Thal & Ullrich, 2016; O'Neill & O'Reilly, 2010; Rosenbaum, 1984). These individual tournaments typically transcend firms, in that they comprise all the individuals in a market competing for particular career-related rewards, whether inside or outside of their current firm.

An employee's competitive actions represent one important way to attempt to progress in an individual tournament. By 'competitive action' we mean any targeted, specific, and observable move that individuals make, with the goal of enhancing their relative position. Thus, competitive

actions threaten and may ultimately come at the expense of others. Examples of competitive actions could be poaching others' clients (Chan et al., 2014), encroaching on others' spheres of influence (Baum et al., 2016), or deceiving (Edelman & Larkin, 2015), sabotaging (Charness, Masclet, & Villeval, 2014), or refusing to help others (Drago & Garvey, 1998), with the specific objective of gaining a relative advantage. An individual may perform both *internal* competitive actions against colleagues and *external* competitive actions against the employees of other firms. For example, salespeople may poach the existing or potential clients of colleagues (an internal competitive action), yet also ones of salespeople employed elsewhere (an external competitive action). Employees' amount of effort can fluctuate over time (e.g., Frankort & Avgoustaki, 2022), so we assume that internal and external competitive actions can vary independently.

A substantial empirical literature on individual tournaments has examined the effects of tournament characteristics on the behavior of tournament participants. Some studies suggest that a larger spread of rewards across tournament levels elicits more individual effort (e.g., Audas, Barmby, & Treble, 2004; DeVaro, 2006). When the reward spread is larger, individuals may also take more risks (Becker & Huselid, 1992), be less inclined to help their colleagues (Drago & Garvey, 1998), and they may engage in sabotage behaviors (Harbring & Irlenbusch, 2011). Other studies show that interim rankings in a tournament's performance distribution affect individuals' risk-taking behaviors. For example, occupants of low or intermediate ranks may be more prone to undertaking risky actions (e.g., Brown, Harlow, & Starks, 1996; Genakos & Pagliero, 2012). Risky competitive behaviors have also been linked to whether other competitors are near an individual's interim rank position, so that the individual may imminently lose or advance his or her standing (Bothner et al., 2007). Taken together, the available tournament literature would overwhelmingly imply that employees' behaviors, including their competitive actions, can be traced to antecedents internal to the individual tournament (Connelly et al., 2014; Dechenaux et al., 2015).

However, individual tournaments usually transcend firms that are themselves part of a collective, firm-level tournament. Just as employees care about their position relative to other individuals, so do firms care about their position relative to other firms. For example, firms may strive to become or remain a market leader (Ross & Sharapov, 2015) and to increase their market share (Ferrier et al., 1999), or they may contend for critical supply contracts (Mihm et al., 2015). Also, a broad variety of entities, including investment banks (Bidwell et al., 2015), law firms (Rider & Tan, 2015), and private universities (Askin & Bothner, 2016), engage in competition for favorable spots in relevant rankings and league tables (Espeland & Sauder, 2007; Rindova et al., 2018). Finally, most sports leagues are by design rank-order contests among teams (Szymanski, 2003). Thus, tournaments among individuals are usually nested in tournaments among firms.

Employees tend to be particularly aware of firm-level tournaments if good performance in such tournaments is relevant to current and prospective employers. Employees' awareness of the dynamics of a relevant firm-level tournament can derive from various factors. For example, their job might require employees to be proactive in staying informed because of the value attached to tournament standings by an industry's key constituents, such as investors, customers, or suppliers (Pollock & D'Adderio, 2012; Rindova et al., 2018). Also, employees may have arrived with a keen eye on the firm-level tournament because of their desire to work for a firm of good standing (Bidwell et al., 2015), or because they were hired for their potential to help sustain and enhance the firm's standing (Espeland & Sauder, 2007).

Despite the almost ubiquitous organizational reality of firm-level tournaments and employees' awareness of such tournaments, little attention has been paid to the cross-level implications of a firm-level tournament for the competitive actions of constituent employees, who themselves strive for career-related rewards as participants in an individual tournament. From their extensive review of the tournament literature, Connelly et al. (2014: 38) even concluded that they

"*did not find tournament theory research employing multiple levels [of] analysis*" at all. We will argue that a concern for the potential dynamics of a firm's tournament standing may enter an employee's decision calculus, so that competitive intensity in a firm-level tournament can influence employees' competitive actions.

Individual Reputational Incentives and Firm-Level Tournaments

Our argument centers on the notion of individual reputational incentives. Success in an individual tournament—for example, through higher pay, a promotion, or more desirable employment—depends critically on assessments of an individual's functioning by current and/or prospective employers. Beyond objective individual measures, such assessments necessarily and often purposely rely on broader, possibly subjective judgments of behavior and performance (Gibbons, 1998). By implication, employees will be concerned with (prospective) employers' beliefs about their behavior and performance, which here we refer to as an employee's 'reputation,' ultimately from a concern for their future career (Fama, 1980; Holmström, 1999; Miklós-Thal & Ullrich, 2016). Such a concern for reputation generates implicit 'reputational incentives,' meaning incentives to pursue positive and avoid negative perceptions by others. Through this lens, one should see individuals *deploy* competitive actions in situations in which they expect that doing so helps them sustain or improve their reputation. Instead, one should observe that individuals *refrain* from competitive actions where they expect that such actions would hurt their reputation.

This simple yet powerful idea of career-related reputational concerns is one of the cornerstones of the literature on individual-level career tournaments (Borland, 1992). We argue that it naturally implies that a *firm-level* tournament can influence employee behaviors to the extent only that such a higher-level tournament affects reputational incentives. How would that happen? Employees can reasonably expect that a relevant firm-level tournament will provoke judgments regarding the degree to which they consider the firm's interests and contribute to its standing

(Arvey & Murphy, 1998). Also, employers likely factor the standing of an employee's current firm into their perceptions of that individual's ability (Bidwell et al., 2015; Rider & Tan, 2015). Thus, employees' reputations depend on their firm's standing, and on their being seen to elevate and not endanger its standing. So construed, it is reasonable to imagine that the firm-level tournament may at times lead individuals to compete more fiercely if they expect that specific competitive actions help sustain or improve their reputation. Yet it may also lead individuals to hold back if they anticipate that certain competitive actions on balance can be perceived as harmful or undue.

Competitive Threats and Opportunities in Firm-Level Tournaments

We focus on two key dimensions of competitive intensity in a firm-level tournament—namely, a firm's competitive threats and opportunities—and how these affect the internal and external competitive actions of constituent employees. Convergent with work in organizational ecology, we view firm-level competitive intensity as 'localized,' meaning that a firm's competitive threats and opportunities derive from other firms occupying its neighborhood in the firm-level tournament (e.g., Baum, 1999; Baum & Mezias, 1992; Bothner et al., 2007). Specifically, we will say that a 'competitive threat' exists when, at a specific moment in time, another firm can surpass a focal firm's position in a contextually relevant tournament. Instead, a 'competitive opportunity' exists when, at a specific moment in time, the focal firm can surpass another firm's position in that tournament. Thus, a competitive threat implies a firm's potential loss in standing while a competitive opportunity implies its potential gain. Also, because competition in the tournament is zero-sum, one firm's competitive threat (and so potential loss) is another's competitive opportunity (and so potential gain). Finally, a firm's competitive threats and opportunities increase with the respective numbers of other firms that can surpass the focal firm, or that the focal firm can surpass.

Competitive threats. When faced with threats, individuals tend to focus on avoiding and dissociating from possible losses (Bolino, Long, & Turnley, 2016; Higgins, 1997). Thus, an

increase in a firm's competitive threats should progressively lead employees to modify their behaviors to *avoid reputational losses*. Employees limit reputational losses to the extent their firm retains its standing, yet also by being seen to contribute to protecting the firm's standing. On this logic, we will argue that a firm's competitive threats will motivate its employees to increase external competitive actions yet decrease internal competitive actions.

Increased competitive threats imply an increased probability that a firm loses its standing. A firm's loss in standing may directly lower employees' reputations in the eyes of their employer. Yet it can also influence employees' labor-market reputations because prospective employers likely adjust downwards their beliefs about the abilities of the firm's employees (Fama, 1980; Rider & Negro, 2015; Sutton & Callahan, 1987).[10] Due to the zero-sum nature of tournaments, such belief updating also implies that the market adjusts upwards its beliefs about the abilities of the employees of other firms surpassing the focal firm. Thus, the individual reputational risks associated with a firm's competitive threats generate incentives for employees to engage in external competitive actions that help fend off competing firms. Such incentives strengthen the higher the level of competitive threat a firm faces.

By deploying external competitive actions, employees can be seen to contribute to protecting their firm's standing. They can also be seen to contribute by refraining from actions that may be perceived as damaging the firm's ability to fend off threats. Employees conceivably anticipate that internal competitive actions, which can involve a refusal to help others (Drago & Garvey, 1998) or sabotage (Charness et al., 2014), may be perceived as damaging when their firm is under threat. Thus, if a potential loss materializes, then employees who were seen to engage extensively in internal competitive actions may struggle to justify their efforts away from external threats, even

[10] An employee's reputations in the eyes of their current and prospective employers may be mutually reinforcing. For example, if an employee's external reputation suffers, then so could their internal reputation because a decrease in outside options might reduce the employee's ability to signal their value (e.g., Lukesch & Zwick, 2023).

if they also engaged in external competitive actions. Such employees run a greater reputational risk because they will find it more difficult to dissociate themselves from the loss, meaning they are more likely seen as blameworthy (e.g., Crant & Bateman, 1993).[11]

Moreover, when their firm's standing and so their own reputation is under threat, an individual's colleagues may not be keen to become entangled in internal conflicts. Such conflicts diminish their prospects of being perceived as defenders of the firm's standing and so the employer might then extend the attribution of a decline in the firm's standing to these implicated colleagues too. Thus, other employees may relay internal competitive actions initiated by a colleague to the employer, for example, through peer evaluations (Arvey & Murphy, 1998) or informal channels (Kurland & Pelled, 2000), which would further damage the colleague's reputation. These arguments suggest that an increase in competitive threats, and so a higher probability of a firm's positional loss, should reduce an employee's propensity to engage in internal competitive actions.

> ***Hypothesis 1a:*** *An increase in a firm's competitive threats decreases the rate at which an employee engages in internal competitive actions.*

The arguments also suggest that an increase in competitive threats will increase an employee's propensity to engage in external competitive actions, though subject to two conditions. First, an employee's task domain must permit direct or indirect interaction with external actors. Second, an employee must believe that acting against such externals can credibly decrease the risk that a firm loses its standing. These conditions occur in diverse settings. Sales employees can have both an impact on performance and the ability to target (the existing or potential clients of) peers at competing firms (e.g., Chan et al., 2014). And in settings such as mutual funds (Kacperczyk, Beckman, & Moliterno, 2015), security analysis (Baum et al., 2016), venture capital (Sorenson &

[11] Consistent with this reputational argument, for example, Pfann (2006) showed that in distressed firms, employees with a less favorable reputation may have inferior career prospects. Rider and Negro (2015) found that the same may be the case for individuals who are seen to be more closely associated with a firm's failure.

Stuart, 2001), or professional services (Empson, Muzio, Broschak, & Hinings, 2015), individual actions and indicators of firm standing can be closely coupled and, through direct and indirect connections, an employee's activities have the potential to intersect with those of externals. Finally, in team-based sports, interaction with competitors and a link of individual action to team-level tournament performance are essentially given (Fonti, Ross, & Aversa, 2023).

> ***Hypothesis 1b:*** *An increase in a firm's competitive threats increases the rate at which an employee engages in external competitive actions.*

Competitive opportunities. While evidence suggests that individuals focus on avoiding and dissociating from possible losses when faced with threats, they focus on achieving and associating with possible gains when faced with opportunities (Bolino et al., 2016; Higgins, 1997). Thus, while attempting to avoid reputational losses when their firm is under threat, employees will progressively modify their behaviors to *achieve reputational gains* when their firm's competitive opportunities increase. Increased competitive opportunities imply a greater probability that a firm enhances its standing, which could lead both current and prospective employers to adjust upwards their beliefs about the abilities of the firm's employees (Bidwell et al., 2015; Fama, 1980; Rider & Tan, 2015). Thus, the prospect of an improved individual reputation generates incentives for employees to engage in external competitive actions to help surpass competing firms, and more so the higher the level of competitive opportunities.

Employees can gain in reputation if their firm improves its standing. Yet an employee's reputation should improve more if they have worked to associate themselves with, and thus can claim credit for, such an improvement (Graham & Cooper, 2013; Weiner, 1995). In the case of a firm's competitive threats, employees will be cautious to avoid bad impressions that would limit their ability to dissociate from a possible loss, especially if the threats are many and so the probability of losses is larger (Hypothesis 1a). However, in the face of their firm's competitive

opportunities, employees should be eager to stand out. They can do this by deploying external competitive actions, yet may also attempt to gain an advantage over colleagues through internal competitive actions. Indeed, if a potential opportunity leads to a firm's better standing, then the reputations of employees who are seen to have led the charge to "bring home the win" may improve most (e.g., Ethiraj & Garg, 2012; Uhlmann & Barnes, 2014). This increased propensity to engage in internal competitive actions will be reinforced by an employee's concern that their colleagues might also deploy internal competitive actions to enable *them* to claim credit for the firm's improved standing (Lazear, 1989).

Together, these arguments suggest that an increase in competitive opportunities, and so an increased probability of a firm's positional gain, should increase an employee's propensity to engage in both internal and external competitive actions.

> ***Hypothesis 2a:*** *An increase in a firm's competitive opportunities increases the rate at which an employee engages in internal competitive actions.*
>
> ***Hypothesis 2b:*** *An increase in a firm's competitive opportunities increases the rate at which an employee engages in external competitive actions.*

Expected or Unexpected? The Moderating Role of Firms' Relative Resource Endowments

Thus far, we have argued that the competitive threats and opportunities a firm faces in a firm-level tournament influence its employees' reputational incentives, which in turn determine the locus and intensity of their competitive actions. But not all competitive threats and opportunities are created equal. If threats and opportunities have their cross-level effects through employees' reputational incentives, then the effects in Hypotheses 1a and 1b should be larger in situations in which competitive *threats* contain the potential for relatively larger *losses* in employees' reputations. And the effects in Hypotheses 2a and 2b should be larger in situations in which competitive *opportunities* contain the potential for relatively larger *gains* in employees' reputations. We will argue that such situations emerge when a firm faces potential *unexpected*

downward or upward changes in its tournament standing.

Potential changes in standing in a firm-level tournament, which derive from a firm's competitive threats and opportunities, vary in the extent to which they conform to the prior expectations of the tournament participants. These expectations serve as reference points, relative to which firms evaluate the dynamics of their own and other firms' standing (Bartling, Brandes, & Schunk, 2015; Dai, Dietvorst, Tuckfield, Milkman, & Schweitzer, 2018; Doyle, Pettit, Kim, To, & Lount Jr., 2022; Nurmohamed, 2020). A firm's downward or upward movements in the tournament may be 'expected' in the sense that they resonate with prior expectations. Yet these movements might also be 'unexpected' to the extent they violate prior expectations. If the probability increases that a firm faces relatively unexpected movements in its standing, then the attention to its employees' behaviors will be greater (e.g., Coates, Humphreys, & Zhou, 2014) and more deliberate (e.g., Feldman, 1981; Weiner, 1985). Also, if potential unexpected movements materialize, then (prospective) employers likely make more significant updates to their beliefs about the abilities of the firm's employees.[12] Thus, employees' reputations will be more sensitive to possible unexpected rather than expected movements in their firm's standing. It follows that the potential for their firm's unexpected movements should most strongly influence employees' reputational incentives, and hence their internal and external competitive actions.

What determines expectations in a firm-level tournament? We propose that firms' relative resource endowments are a critical determinant. By 'resource endowments,' we mean the levels of tangible and intangible assets tied semi-permanently to a firm (Dierickx & Cool, 1989; Wernerfelt, 1984). Tangible assets include things like financial capital and facilities, while intangible assets

[12] The more unexpected a firm's movement in standing, the greater the contrast of such movement with an observer's prior expectations. Thus, convergent with common models of reference dependence (e.g., Bartling et al., 2015) and learning (e.g., Bayesian updating; see Cyert & DeGroot, 1987), an observer's beliefs should update more following less rather than more expected movements.

include such things as knowledge, capabilities, skilled personnel, a strong brand, and prestige in the industry. Tangible and intangible assets can be mutually reinforcing, so resource endowments often create clear categorical distinctions among the firms in an industry (e.g., Benjamin & Podolny, 1999; Castellucci & Ertug, 2010; Fombrun & Shanley, 1990). For example, the Big Four are viewed as resource advantaged in accounting, as are the MBB firms in management consulting, the Magic Circle firms in UK corporate law, or the factory racing teams in MotoGP, our empirical context (see 'Empirical Setting'). Resource-advantaged firms are typically the "favorites" expected to perform or rank well, while resource-disadvantaged firms are often the "underdogs" expected to perform or rank poorly in comparison (Chen, Ham, & Lim, 2011; Doyle et al., 2022).

If firms' relative resource endowments create the expectations, then when are a firm's potential movements in its tournament standing most unexpected, and so when are its employees' reputational incentives strongest? The answer depends on whether movements would concern potential losses in standing due to competitive threats, or potential gains in standing due to competitive opportunities. First, potential losses in standing are relatively more expected if competitive threats derive from firms with resource endowments that are similar or superior to the endowments of the focal firm. Yet such potential losses would be least expected if they derive from firms that are resource disadvantaged relative to the focal firm. This occurs as soon as underdogs exert competitive threats on a favorite, meaning they somehow managed to come close enough to surpass the favorite's tournament position despite resource disadvantages. Thus, competitive threats imply the greatest potential for employees' reputational loss, and so they create the strongest reputational incentives, if the firms exerting the threats are resource disadvantaged.

> ***Hypothesis 3a:*** *A firm's competitive threats decrease the rate at which an employee engages in internal competitive actions more if the firms supplying such threats have relatively inferior (rather than similar or superior) resource endowments.*

Hypothesis 3b: *A firm's competitive threats increase the rate at which an employee engages in external competitive actions more if the firms supplying such threats have relatively inferior (rather than similar or superior) resource endowments.*

Second, potential gains in a firm's standing are relatively more expected if competitive opportunities derive from firms with resource endowments that are similar or inferior to the endowments of the focal firm. Yet such potential gains would be least expected if they derive from firms that are resource advantaged relative to the focal firm. This occurs as soon as the focal firm is the underdog facing a competitive opportunity against a favorite, meaning that despite resource disadvantages, the firm managed to approach enough to surpass the favorite's position in the firm-level tournament. Thus, competitive opportunities imply the greatest potential for employees' reputational gain, and so they create the strongest reputational incentives, if the firms against which the focal firm faces competitive opportunities are resource advantaged.

Hypothesis 4a: *A firm's competitive opportunities increase the rate at which an employee engages in internal competitive actions more if the firms supplying such opportunities have relatively superior (rather than similar or inferior) resource endowments.*

Hypothesis 4b: *A firm's competitive opportunities increase the rate at which an employee engages in external competitive actions more if the firms supplying such opportunities have relatively superior (rather than similar or inferior) resource endowments.*

DATA AND METHOD

Empirical Setting

We use MotoGP as our setting because it offers considerable traction for testing hypotheses regarding employees' competitive actions. Founded in 1949 by the Fédération Internationale de Motocyclisme (FIM), MotoGP is the world's leading championship in professional motorcycle racing. MotoGP features different firms (i.e., racing teams) whose riders compete in yearly tournaments comprised of 16 to 19 circuit races across sometimes as many countries. The series accounts for a yearly turnover of well over $100m and is broadcast in about 200 countries to more than 400m viewers. Many teams are owned by major original equipment manufacturers (OEMs),

such as Ducati, Honda, Kawasaki, Suzuki, and Yamaha. They deploy high-tech prototype motorbikes—the fastest racing bikes in the world that can reach speeds of 220 mph—making MotoGP the pinnacle of professional motorcycle racing, and a competitive ground for OEMs to develop and showcase their technological innovations. Riders receive points based on their arrival order in the final tally of a race, and these points count towards the season totals that determine a rider's final ranking. Teams typically have two or three riders, and riders' combined points total in turn determines the ranking of their team in the Team Championship.

Various characteristics of this setting make MotoGP particularly well suited for examining our research question. First, due to the nested nature of the tournament—individual riders and their teams both compete for a championship—riders consider both individual and team performance. On the one hand, riders compete for an individual championship. Riders also compete for recognition as top rider in the team, or 'primus inter pares,' as is widely recognized: "*Your teammate is your first rival (…) Everyone in the motorsport world knows, from the riders or drivers themselves to the millions of fans around the globe, beating your teammate is the number one priority*" (motogp.com, 2021). By outcompeting their team members, riders secure their jobs and may obtain more favorable contractual conditions. Outcompeting individual riders leads to a higher final position in the Riders' Championship, which can be associated with trophies, global popularity, greater monetary awards, and sponsorship deals. On the other hand, racing teams compete for a Team Championship. Reaching a higher final position in the Team Championship is associated with more prize money, sponsorships, and business opportunities for the firms, often worth millions of dollars. The importance of the individual tournament supplies a conservative test of the cross-level effects of the firm-level tournament.

Second, riders interact with both internal and external competing riders and can engage in visible competitive actions against those riders, in service of both their individual and team's

performance. The public broadcasting of MotoGP races allows us to track such internal and external competitive actions with a level of precision and comprehensiveness that would be nearly impossible to achieve in any traditional organization. Specifically, overtaking—i.e., a rider's act of catching up with and passing another rider on the racetrack—represents the quintessential competitive action in MotoGP, which can be observed in a consistent way for every rider across the entire season. An overtake can be achieved either by accelerating faster than the rider ahead on a straight, or by braking later than the rider ahead when approaching a turn.

Third, unlike some other motorsports, such as Formula 1 (Piezunka, Lee, Haynes, & Bothner, 2018) or NASCAR (Bothner et al., 2007), top-down race strategies play no role in MotoGP. Race strategist roles do not exist, riders do not have continuous radio communications with their team during the race and rarely make pit stops, and no race strategy is imposed by a team. All riders are free to pursue their best possible race performance. Thus, overtaking ultimately reflects riders' own decision-making. Specialist media confirm this aspect: "*MotoGP races are less about strategy, more about race craft…Unlike in Formula 1, strategy doesn't really play a big part [in] MotoGP. When the lights go out, it's usually up to the riders' styles*" (Longman, 2020).

Fourth, while overtakes can benefit riders, the competitive action of overtaking also carries major risks and potential costs. Racing in MotoGP occurs at high speeds of up to 220 mph and riders are protected only by a leather suit and a helmet. This makes overtakes risky as they could result in a race-ending accident for both the riders and their opponent, often accompanied by severe injuries that may force riders to sit out multiple races, damaging their championship run. Thus, while overtaking is a key competitive action in MotoGP, the risks involved mean that riders are expected to use their judgement to decide if, when, how, and who to overtake. Overtaking a teammate can also risk the team's overall performance. For example, Andrea Iannone attempted to overtake his teammate, Andrea Dovizioso, during the last lap of the Grand Prix in Argentina in

2016. Both riders fell and the team failed to secure a top position in the Team Championship.[13]

Fifth, teams in MotoGP are divided into two groups: Factory teams and satellite teams. The former hold far-superior resource endowments. The distinction is well known in MotoGP, widely discussed in the media (e.g., Allison, 2020; Patterson, 2022), and it explains why competing for a factory team is riders' ultimate career objective: "*The goal of every rider is to try to go in a factory team and then try to win with that bike.*" (Luca Marini, Ducati satellite team rider, quoted in McLaren, 2023).[14]

What are the resource differences? Factory teams are owned by major motorcycle OEMs and so they compete with large budgets of around $30m per year, offer higher salaries to riders, and deploy cutting-edge bikes that a dedicated R&D racing unit develops and upgrades through the season. Instead, satellite teams are private teams endowed with smaller budgets of around $15m per year and lacking the capabilities to design or manufacture motorcycles. Thus, they often lease off-the-shelf motorcycles from factory teams and rebrand them to fit with their own team's colors. Also, sometimes satellite teams purchase previous year's bike models, for which no further upgrades are even available. Due to manufacturing capabilities, factory teams also design, produce, and deploy component and technological upgrades during the season. In rare cases in which satellite teams have supply contracts that include the provision of some component upgrades, factory teams might deliver those only several races after they have implemented them in their own bikes. Intangible assets also distinguish factory from satellite teams. The former enjoy superior status, fan base, and visibility, which endows their riders with greater stardom and better

[13] This accident happened when the Ducati team experienced many competitive threats, mostly from teams with inferior resources. The arguments underlying Hypotheses 1a and 3a suggest that such a high level of competitive threat may render internal competitive actions reputationally costly, especially if the firm ultimately fails to achieve a desirable ranking. Consistent with this argument, the accident caused major frictions and it might have been among the reasons for why the Ducati team terminated Iannone's contract at the end of the season (Patterson, 2020).

[14] Appendix B provides more quotes showing that differences between factory and satellite teams are known.

sponsorships. Finally, factory teams can demand higher commitment and performance from their suppliers—a phenomenon also seen in Formula 1 (Castellucci & Ertug, 2010).

Sixth, related to the previous distinction, riders are not only aware in general which other riders race for a factory or satellite team; they are tuned to distinctions among their competitors during the heat of a race. This happens through direct observation of team colors on bikes and the (nick)names of riders stitched onto the backs of their racing suits. Moreover, each lap riders can receive information through pit boards shown by their teams. These boards indicate laps remaining, who is the preceding rider, who is the following rider, and what are the time gaps with them. Such boards may also indicate if specific riders (e.g., close rivals) dropped out of the race due to a crash or technical problem (Box Repsol, 2022). Dropouts may even be noticed through information on the pit boards of other riders, or because pit boards for exiting riders disappear. Also, some incidents elicit warning flags and lights along the circuit that may require all riders to slow down and refrain from overtaking. This might give them a chance to see the scene of an accident or look at live monitors along the track. Thus, all throughout a race, riders are (keen to be) aware of the identities of others on the track, and their affiliations to factory or satellite teams.[15]

Sample

We constructed an original panel data set at the rider-lap level, using data on the population of MotoGP races from 2004 to 2020 collected from motogp.com, MotoGP's official database. Each circuit is divided into four sectors, and the database includes lap-by-lap, sector-level data for all races, and detailed data on rider and team characteristics. We began by omitting laps for which sector data were missing due to measurement problems during the race (e.g., a lack of signal). Such problems occur at random, meaning they are unrelated to competitive threat, opportunity, or riders' competitive actions. Thus, omitting these observations does not bias the estimates in or against our

[15] Appendix C provides more context underlining that riders know who is ahead and around on the track.

favor. Next, from a total of 134,011 rider-lap observations on 135 riders, we excluded 29,405 rider-laps in which a rider had no teammates in the race, as such a rider would not have the opportunity to undertake internal competitive actions. A rider might have had no teammates in the race, for example, if teammates interrupted the race due to a crash or a mechanical issue. The resulting final data set consists of 104,606 rider-lap observations involving 125 distinct riders.

Dependent Variables: Internal and External Competitive Actions

We use overtakes to measure a rider's competitive actions. Overtakes are well suited to measure competitive action because they reflect a targeted, specific, and observable move that is aimed at enhancing the rider's position relative to one or more internal or external competitors. Thus, to test Hypotheses 1a, 2a, 3a, and 4a, we operationalize *Internal overtakes* as the number of times a rider overtakes teammates during a focal lap. To test Hypotheses 1b, 2b, 3b, and 4b, *External overtakes* is the number of times the rider overtakes other teams' riders during a focal lap.

Compared to other motorsport settings, such as Formula 1 (Piezunka et al., 2018), NASCAR (Bothner et al., 2007), or Le Mans (Aversa & Guillotin, 2018), overtakes may occur more frequently in motorcycle racing because motorcycles are narrower than cars and accelerate faster. Thus, to measure overtakes for our two dependent variables, we exploited the fact that MotoGP publishes granular sector-level data, rather than the coarser lap-level data common in most other motorsport settings (e.g., Formula 1). We considered an overtake to have occurred when a rider was behind another rider at the start of a sector, yet ahead of that other rider at the end of the sector. This way, we identified a rider's number of overtakes during a lap by first counting overtakes at the sector level—against teammates or external riders, respectively—and then summing the overtakes across a lap's four sectors.

Independent Variables

Competitive threat and opportunity. We measure competitive threat as the number of teams that can pass the focal team in the competition ranking during a race. Instead, we measure competitive opportunity as the number of teams that the focal team can pass in the competition ranking during a race. These measures follow the spirit of Bothner et al.'s (2007) measures for 'crowding from below' and 'crowding from above.' They are well suited here for their consistency with our conceptual definitions of competitive threat and opportunity. Moreover, Bothner et al. (2007) implemented their measures in NASCAR, another motorsport setting, while others also implemented measures of crowding from below or above in sports settings, such as golf (Miller, Pastoriza, & Plante, 2019) and American football (To, Kilduff, Ordoñez, & Schweitzer, 2018).

We begin by obtaining the total number of points P of focal team *i* and each other team *j* at the start of a race—i.e., P_{ir-1} and P_{jr-1}, where *r* indexes the race number in the season. Next, for the start of each lap *t* in race *r*, we calculate two versions of the 'striking distance,' S_{jirt} and S_{ijrt}. The former captures the difference between the maximum number of race points that a team *j* can still collect in race *r* and the minimum number of points the focal team *i* will collect if its riders finish the race yet place last. Instead, the latter is the difference between the maximum number of race points that focal team *i* can still collect in race *r* and the minimum number of points another team *j* will collect if its riders finish the race yet place last. Typically, teams have two riders in the race, which means that the maximum number of available points is 45 (i.e., 25 + 20 for first and second place, respectively), but this drops to 25 if one of the riders exits the race. Also, 15 riders are guaranteed at least one point by finishing the race, so if the total number of riders drops below 16, all teams are guaranteed at least one point by finishing the race, provided a team still has at least one rider in the race at the finish.

From here, we calculate the variables to test Hypotheses 1a/b and 2a/b. *Competitive threat* to team *i* at the start of lap *t* in race *r* is calculated as follows:

$$CT_{irt} = \sum_{j=1}^{J} D_{ji}, \text{ where } D_{ji} = 1 \text{ if } 0 \leq P_{ir-1} - P_{jr-1} \leq S_{jirt}, \text{ and } D_{ji} = 0 \text{ otherwise. (1)}$$

Thus, competitive threat enumerates the number of teams ranked *below* the focal team in the competition ranking, yet still within sufficient proximity to be able to surpass the focal team in that ranking during a race. Similarly, we calculate the variable *Competitive opportunity* of team *i* at the start of lap *t* in race *r* as follows:

$$CO_{irt} = \sum_{j=1}^{J} D_{ji}, \text{ where } D_{ji} = 1 \text{ if } 0 \leq P_{jr-1} - P_{ir-1} \leq S_{ijrt}, \text{ and } D_{ji} = 0 \text{ otherwise. (2)}$$

Thus, competitive opportunity enumerates the number of teams ranked *above* the focal firm in the competition ranking, yet still within sufficient proximity for the focal team to be able to surpass them in that ranking during a race.

For clarity, our measurement of competitive threat and competitive opportunity departs from Bothner et al. (2007) in two ways. First, consistent with our theory, we calculate our measures at the firm rather than individual level. Thus, striking distance is not just a function of the number of riders in the race but also the distribution of riders across teams. Second, we update our measures from lap to lap rather than from race to race. Thus, we assume that riders are aware of changes in firm-level competitive intensity during a race. This assumption is realistic because riders learn about dropouts through a variety of channels, including pit boards shown to them each lap (see 'Empirical Setting' and Appendix C). Also, riders know which teams supply competitive threats and opportunities at the start of a race. Such competing teams are more salient to riders, meaning dropouts from these rather than other teams are even more likely to be noticed.[16]

Competitive threat and opportunity by relative resource endowments. To test Hypotheses 3a/b and 4a/b, we differentiate competitive threat and competitive opportunity by the relative resource endowments of the teams supplying such threats or opportunities. Specifically, we

[16] Appendix D instead uses measures of competitive threat and opportunity updating from race to race. Still, riders closely monitor the playing field *during* a race, so the correct approach is to update measures from lap to lap.

subdivide both *Competitive threat (CT)* and *Competitive opportunity (CO)* into three components, each which we allow its own slope based on other teams' resource endowments relative to the focal team. We establish relative resource levels by distinguishing between factory teams with relatively superior resources and satellite teams with relatively inferior resources (see 'Empirical Setting'). Typically, similar numbers of factory and satellite teams participate during a season.

Satellite teams can experience competitive threats from, and opportunities against, teams with similar or superior resources. Factory teams can experience competitive threats from, and opportunities against, teams with similar or inferior resources. Thus, we define *CT (inferior resources)* as the number of satellite teams that can pass a focal factory team in the competition ranking at the start of a given lap. *CT (similar resources)* is the number of satellite (factory) teams that can pass a focal satellite (factory) team in the competition ranking at the start of a given lap. *CT (superior resources)* is the number of factory teams that can pass a focal satellite team in the competition ranking at the start of a given lap.

Instead, *CO (inferior resources)* is the number of satellite teams that a focal factory team can pass in the competition ranking at the start of a given lap. *CO (similar resources)* is the number of satellite (factory) teams that a focal satellite (factory) team can pass in the competition ranking at the start of a given lap. *CO (superior resources)* is the number of factory teams that a focal satellite team can pass in the competition ranking at the start of a given lap.

Control Variables

Rider-level control variables. In all equations, we include several controls at the individual rider level. Frequent competitive actions in the past may predict competitive actions in the future. Thus, we control for previous internal or external overtakes by adding four variables. In all equations for internal overtakes, we add the variable *Previous internal overtakes (race)*, which is calculated as the number of overtakes the focal rider has conducted against a teammate during the

race prior to the focal lap, and *Previous internal overtakes (season)*, which is the number of overtakes against their teammate/s during the season before the start of the focal race. Similarly, we include in equations for external overtakes the variables *Previous external overtakes (race)* and *Previous external overtakes (season)*. These are powerful controls because they absorb otherwise unobserved time-varying heterogeneity at the rider level (Heckman & Borjas, 1980).

We add four controls for individual-level competitive threat and opportunity. Specifically, *Rider internal threat*, *Rider external threat*, *Rider internal opportunity*, and *Rider external opportunity* capture whether a focal rider experiences competitive threats by, or opportunities against, internal or external riders in the Riders' Championship. Riders who are more prone to taking risks may also be more likely to attempt overtakes. Thus, we control for the rider's risk propensity through the variable *Risk taking*, which captures the average number of times per driven race that a rider crashed during the 12 months prior to the focal race. We add a variable *No previous races in past year* to distinguish between riders who had no crashes because they did not race in MotoGP in the past year and riders who did race yet without crashing. Finally, more experienced riders may have superior overtaking skills. Thus, we control for a rider's *Experience*, calculated as the number of MotoGP races in which the rider has participated before the start of the focal race.

Race-level control variables. We also include two race-level variables in our models. We control for weather conditions through the variable *Wet weather*, a dummy set to '1' if a race was driven partially or fully under wet weather conditions, and '0' otherwise. Under wet weather the slippery track can cause riders to make mistakes and riders may be more likely to make pit stops to change tires. Both increase the probability of overtakes. In addition, we control for the possibility that riders' propensity to overtake others might change during the season (Bothner et al., 2007). For example, the closer the riders are to the resolution of the season's competition, the more

pressure they may experience to defend or improve their position. Thus, we control for *Season stage*, which is the race number in a season divided by the total number of races in that season.

Fixed effects. Apart from the above control variables, we include six sets of fixed effects in our equations. First, rider fixed effects account for stable differences in riders' abilities and other stable sources of rider-level heterogeneity. As detailed under 'Estimation' below, we capture rider fixed effects through a conditional fixed-effects approach. Second, studies have shown that interim rank position can affect competitive behaviors (e.g., Genakos & Pagliero, 2012). Thus, we control for rank effects by including fixed effects for individual and team rank in the season's tournament at the start of the focal race. Third, because each race begins from a standing start, riders are closer to each other during the early stages of the race and so overtakes are more common earlier rather than later in the race. Thus, we include lap fixed effects to control for differences in overtaking behaviors attributable to race stage. Fourth, fixed effects for racing teams control for any stable differences across teams—for example, in their proclivity for internal competitive actions.[17] Fifth, we account for idiosyncratic differences across circuits by including fixed effects for racetracks. Finally, year fixed effects control for temporal changes in such things as technology, regulation, or tournament size.

Estimation

Our dependent variables are count variables and so we estimated all models using a robust Poisson quasi-maximum likelihood (QML) estimator with conditional fixed effects pertaining to riders (Wooldridge, 1999). As is well known, the Poisson maximum likelihood estimator does not require assumptions about the variance of the dependent variable, provided only that the

[17] With one exception, team fixed effects also account for whether a rider's team is a factory or a satellite team. The exception is Gresini Racing, which changed from being Honda's satellite team to Aprilia's factory team in 2015. Once we add a separate indicator to our models for whether a rider's team is a factory or a satellite team, all our results fully replicate and the additional dummy fails to reach statistical significance.

conditional mean is correctly specified (Cameron & Trivedi, 2010; Wooldridge, 1999). Thus, deviations from the Poisson process, in which the conditional mean is equal to the conditional variance, do not influence the consistency of the point estimates. Such deviations may of course affect standard errors, yet this is addressed easily by obtaining standard errors from robust estimates of the variance-covariance matrix.

The robust Poisson estimator is superior to alternatives because its estimates are consistent under weak assumptions. It also accommodates auto-correlated error terms and conditional heteroscedasticity. Conditional fixed effects estimation requires that observations are discarded on riders who have no variation on the respective dependent variables. This requirement accounts for slight decreases in the number of observations relative to the full sample. To evade simultaneity and concerns of reverse causality, we predict overtakes during a focal lap as a function of competitive threat and opportunity at the beginning of that lap.

RESULTS

Table 1 presents summary statistics and bivariate correlations for all variables in the analysis (Appendix E shows basic OLS representations of the correlations involving the key variables). Correlations are modest in most cases, and unreported multivariate assessments suggest that collinearity is of limited concern. Average variance inflation factors (VIFs) are well below the common threshold of 10 (Kennedy, 2003: 213). Still, *Season stage* predictably has high VIFs, yet estimates of models without this control showed evidence of an omitted variable bias. This is consistent with the substantive importance of season progression in determining the probability of risky actions and the average decrease in competitive threat and opportunity as a season unfolds. Thus, we align with Bothner et al. (2007), Piezunka et al. (2018), and To et al. (2018) and retain season stage. In one of our robustness checks, we will use matching to break the connection of season stage to competitive threat and opportunity.

Insert Table 1 about here

Main Effects: Hypotheses 1a/2a and 1b/2b

Table 2 presents conditional fixed-effects Poisson QML estimates of *Internal overtakes* (Models 1-4) and *External overtakes* (Models 5-8) to test Hypotheses 1a/2a and 1b/2b. Model 1 shows estimates of the baseline model for *Internal overtakes* including only control variables. *Rider internal threat* and *internal opportunity* are statistically significant ($p < 0.01$), with comparable positive coefficients. Thus, both the internal competitive threats experienced and exerted by a rider predict internal overtakes. *Rider external opportunity* is also significant ($p < 0.05$), with the negative coefficient suggesting that internal overtakes are less likely when the rider experiences external opportunities in the individual tournament. Both variants of *Previous internal overtakes* fail to reach statistical significance, possibly suggesting that residual time-varying heterogeneity at the rider level might be limited (Heckman & Borjas, 1980). At the race level, *Wet weather* is significant ($p < 0.01$) with a positive coefficient, indicating that overtakes against teammates occur more frequently during races driven under wet weather conditions, as expected.

Insert Table 2 about here

Model 2 adds the independent variable *Competitive threat* to the baseline. Consistent with Hypothesis 1a, the coefficient for *Competitive threat* is negative ($b = -0.0355$) and statistically significant ($p < 0.05$). In terms of magnitude, the point estimate implies that a one-standard deviation increase in *Competitive threat* is associated with a 9% decrease in a rider's internal overtakes (i.e., a multiplicative factor of $exp[-0.0355 * 2.65] = 0.91$).[18] How does this compare to

[18] To simulate effects true to the fixed-effects nature of our estimates, we standardize effect-size calculations to within-rider standard deviations (Mummolo & Peterson, 2018).

other variables in Model 2? Respective one-standard deviation reductions in *Rider internal threat*, *Rider internal opportunity*, and *Wet weather*, and a similar increase in *Rider external opportunity*, are associated with 12% (*exp*[0.2784 * -0.45] = 0.88), 13% (*exp*[0.3062 * -0.44] = 0.87), 12% (*exp*[0.4134 * -0.32] = 0.88), and 4% (*exp*[-0.1370 * 0.31] = 0.96) decreases in a rider's internal overtakes. Considering error margins, these standardized effect sizes all appear rather similar.

Model 3 alternatively adds the independent variable *Competitive opportunity* to the baseline. The coefficient is positive, yet it fails to reach statistical significance and so is consistent with both positive and negative true effects of *Competitive opportunity*. Thus, we find insufficient evidence to support Hypothesis 2a. Model 4 adds both threat and opportunity variables together, which reveals results convergent with the partial models.

Next, Models 4-8 have *External overtakes* as their dependent variable. Model 5 shows estimates of the baseline model including only control variables. At the rider level, *Previous external overtakes (race)* and *Rider external threat* are significant ($p < 0.01$), both with a positive coefficient. At the race level, *Wet weather* is again significant ($p < 0.01$) with a positive coefficient. Model 5 adds the independent variable *Competitive threat* to the baseline model. Consistent with Hypothesis 1b, the coefficient for *Competitive threat* is positive ($b = 0.0102$; $p < 0.1$). Model 7 instead adds *Competitive opportunity* to the baseline. Consistent with Hypothesis 2b, it has a positive coefficient and is significant ($b = 0.0253$; $p < 0.01$). Model 8 adds both independent variables together, which reveals results similar to the partial models.

In terms of magnitude, the point estimates of Model 8 imply that a one-standard deviation increase in *Competitive threat* is associated with a 4% increase in a rider's external overtakes (i.e., a multiplicative factor of *exp*[0.0147 * 2.65] = 1.04). For *Competitive opportunity*, that effect is 7% (*exp*[0.0278 * 2.57] = 1.07). For comparison, one-standard deviation increases in *Rider external threat*, *Wet weather*, and *Season stage* are associated with 3% (*exp*[0.0787 * 0.32] = 1.03),

17% (*exp*[0.5017 * 0.32] = 1.17), and 10% (*exp*[0.3190 * 0.29] = 1.10) increases in a rider's external overtakes. Especially the effect of wet weather is large in comparison, mostly because pit stops are over five times as likely during wet races. A pit stop requires a rider to leave the track, enter the pit lane, and come to a complete standstill. This may allow riders just behind yet still on the track to 'overtake' without the usual risks.

Moderating Effects: Hypotheses 3a/4a and 3b/4b

Table 3 presents conditional fixed-effects Poisson QML estimates of *Internal overtakes* (Models 1-3) and *External overtakes* (Models 4-6) to test Hypotheses 3a/4a and 3b/4b. Model 1 tests Hypothesis 3a, which posits that competitive threats from resource-disadvantaged firms will have the largest negative effect on internal competitive actions. *CT (inferior resources)* has a negative coefficient (b = -0.0582) and is statistically significant ($p < 0.01$). The coefficients for *CT (similar resources)* and *CT (superior resources)* are statistically indistinguishable from zero. Statistical tests of differences among the coefficients, reported towards the bottom of Table 3, show that the coefficient for *CT (inferior resources)* is statistically different only from that for *CT (superior resources)*, but not that for *CT (similar resources)*. Therefore, the estimates in Model 1 partially support Hypothesis 3a. The reduction in internal competitive actions is more pronounced when competitive threat derives from teams equipped with inferior rather than superior resources.

Insert Table 3 about here

Model 2 tests Hypothesis 4a, which posits that competitive opportunities against firms with superior resources will have the largest positive effect on internal competitive actions. The model shows that *CO (superior resources)* has a positive coefficient ($b = 0.0861$) and is statistically significant ($p < 0.01$). The coefficients for *CO (similar resources)* and *CO (Inferior resources)* are indistinguishable from zero. The relevant tests show that the coefficient for *CO (superior*

resources) is statistically different from, and larger than, that for both *CO (similar resources)* and *CO (inferior resources)*. Therefore, the estimates in Model 2 fully support Hypothesis 4a: Competitive opportunity against teams with superior resources generates more internal competitive actions compared to opportunities against teams with similar or inferior resources. Model 3 includes both sets of variables for competitive threat and opportunity, revealing patterns of coefficients that are generally similar to the partial models.

Model 4 instead tests Hypothesis 3b, which posits that competitive threats from resource-disadvantaged firms will have the largest positive effect on external competitive actions. *CT (inferior resources)* has a positive coefficient ($b = 0.0159$) and is statistically significant ($p < 0.05$). The coefficients for *CT (similar resources)* and *CT (superior resources)* are not statistically significant. Also, the relevant tests show that the coefficient for *CT (inferior resources)* is not statistically different from that for either *CT (similar resources)* or *CT (superior resources)*. Thus, this partial model does not strictly support Hypothesis 3b, even though the estimated coefficients are consistent with that hypothesis.

Model 5 tests Hypothesis 4b, which posits that competitive opportunities against resource-advantaged firms will have the largest positive effect on external competitive actions. The model shows that *CO (superior resources)* has a positive coefficient ($b = 0.0279$) and is statistically significant ($p < 0.05$), yet so are the coefficients for *CO (similar resources)* and *CO (Inferior resources)*. The relevant statistical tests do not reveal noteworthy distinctions among the three coefficients. Thus, this partial model does not support Hypothesis 4b.

Model 6 includes both sets of variables for competitive threat and opportunity. Unlike the partial models, the statistical tests based on the full specification are now more consistent with both Hypotheses 3b and 4b. With respect to Hypothesis 3b, they suggest that the increase in external competitive actions is more pronounced when competitive threat derives from teams equipped with

inferior rather than superior resources. With respect to Hypothesis 4b, they instead suggest that the increase in external competitive actions is more pronounced when competitive opportunities derive from teams equipped with superior rather than inferior resources.

ADDITIONAL ANALYSES

Basic Robustness

We examine the robustness of our findings through several additional tests. Results for these tests and more detail are available in the Appendix. First, earlier we alluded to correlations between season stage and competitive threat and opportunity, our key variables. Such correlations might produce inferences about, say, competitive threat based on observations with many competitive opportunities early in the season compared to 'extreme' counterfactual observations instead facing few competitive opportunities late in the season. Thus, to test Hypotheses 1a/b and 2a/b, we also generate estimates in samples matched through coarsened exact matching (Iacus, King, & Porro, 2012). The resulting coefficients supply even stronger evidence consistent with our predictions (see Appendix F).

Second, in our main analyses we discarded 29,405 rider-lap observations pertaining to riders without teammates in the race because a scope condition of our theory is that the opportunity for internal competitive actions must exist. The same assumption is not required if we were narrowly interested only in riders' *external* competitive actions. Thus, we also used the full sample of 134,011 observations to estimate models predicting external overtakes with and without controls for the number of teammates in the race. The coefficient estimates, shown in Appendix G, are again much like the ones in Tables 2 and 3.

Third, opportunities for overtaking, and thus the number of overtakes, may vary mechanically with the number of riders on the track. Our models absorb virtually all the variance in the number of external riders on the track (see Appendix H). The number of teammates is more

idiosyncratic. Thus, we re-estimate models predicting *Internal overtakes*, while including a dummy variable for whether a rider had two (rather than one) teammates in the race. All our results fully replicate (see Appendix H, Table H1, Models 1 and 2). Next, the closer a rider is to the rider ahead, the greater their opportunity to overtake during a lap. We estimate equations holding constant the time difference to the nearest internal or external rider ahead at the beginning of the lap. All our results again fully replicate (see Appendix H, Table H1, Models 3-6).

Relatedly, internal and external overtakes may be linked. For example, if an external rider is the first rider ahead at the start of a lap, then an external overtake may be more likely than an internal overtake during that lap. In additional estimates, we include a variable for whether an external rather than an internal rider was first ahead at the start of a lap (see Appendix H, Table H2). This additional variable leaves our main inferences intact. We also estimated simultaneous-equation models that jointly predict a rider's internal and external overtakes (see Appendix I). Such an approach explicitly treats a rider's internal and external overtakes as interrelated. Estimates are again very similar to those in Tables 2 and 3.

Analyzing Individual Overtake Opportunities

In Appendix H, our attempts to separate the competitive action of overtaking from potentially correlated mechanical variation in overtake opportunities have been at the rider-lap level. Yet it is hard to know how much residual variation in opportunities remains within laps, and so how much remaining potential exists for confounding. Thus, we also implement a supplementary design, by studying individual overtake opportunities.[19] Specifically, we ask: Given *one specific rider* ahead, does a focal rider overtake *that specific rider*, as a function of competitive threat and opportunity of the focal rider's team, and whether the specific rider ahead is a teammate or an external? Such

[19] We are grateful to the Associate Editor for suggesting this empirical approach.

a design constrains the set of possible overtakes to '1' for all observations: Each observation simply represents one individual overtake opportunity (internal or external).

The rider immediately ahead on the track can change continuously, as can the conditions under which they are ahead. Ideally, then, we would sample at random from this practically infinite population of overtake opportunities. Unfortunately, MotoGP only releases information for four specific moments during each lap: The ends of the lap's respective first, second, third, and fourth sectors. Thus, the approach we take is to code who is immediately ahead of a focal rider at the start of a sector, and whether the focal rider has overtaken the rider initially ahead by the end of that sector. With four sectors per lap, the resulting sample contains 418,424 rider-sector observations of overtake opportunities (i.e., 104,606 rider-laps times 4 sectors). This sample might be called 'systematic,' in that it includes observations for all riders, all laps, all races, and all years on a sector-by-sector basis. Yet through available data we have no way of knowing whether the nature of opportunities exhibits patterns within sectors. Thus, we cannot establish how representative our systematic sample is of the population of overtake opportunities.[20]

With that caveat in mind, how do we analyze the sample? The dependent variable is a dummy variable for whether by the end of a sector, a focal rider has overtaken the rider who was immediately ahead at the start of that sector. For Hypotheses 1a/b and 2a/b, the independent variables are competitive threat or opportunity, interacted with *External rider ahead*, a dummy variable for whether the rider immediately ahead is an external rider. For Hypotheses 3a/b and 4a/b, we partition the coefficients of competitive threat/opportunity at levels of relative resources into ones pertaining to an internal rider ahead and ones pertaining to an external rider ahead (Yip &

[20] Even if we watched all races across all the years in our data (e.g., through https://www.youtube.com/@motogp), we would not be able to code a random sample of overtake opportunities. Only few riders are on-screen at any one time. Also, in-race rankings are not always shown on-screen. And when they are, they may not update in real time.

Tsang, 2007). All models include sector and unconditional rider fixed effects, over and above sets of rider- and race-level controls, and the vectors of other fixed effects as in Tables 2 and 3.

The large number of fixed effects would produce well-documented biases in estimates of logistic regression models (Beck, 2020; Lancaster, 2000). Thus, we use OLS with robust standard errors to generate estimates of the linear probability model (LPM). Timoneda (2021) shows that estimates of the LPM with fixed effects are more accurate than nonlinear specifications when the binary outcome variable has a mean between zero and 0.25. Our data satisfy this condition. In our sample, the probability that a rider ahead at the start of a sector is overtaken is 0.035, meaning an overtake opportunity is seized one in 28 or so cases, on average (i.e., 1 / 0.035 = 28.57).

Insert Table 4 about here

Table 4 shows the estimates. Consistent with Hypotheses 1a and 1b, Model 1 shows coefficients suggesting that competitive threat decreases the probability that a rider overtakes a teammate, while increasing the probability he overtakes an external. Model 2 shows that competitive opportunity predicts a greater overtake probability, apparently regardless of whether the rider ahead is a teammate or an external. This finding is consistent with both Hypotheses 2a and 2b. Model 3 shows coefficient signs and relative magnitudes that largely converge with the results for Hypotheses 3a/b and 4a (but not Hypothesis 4b) in Table 3. We return to these supplementary estimates, and their relation to our main estimates, in the Discussion section.

Do Contractual Conditions Matter?

To this point, we have implicitly assumed that all individuals respond in similar ways to the competitive threats and opportunities facing their firm. This assumption is reasonable if individuals are comparable on dimensions relevant to their competitive actions. Yet organizational reality might be more complex (Cappelli & Keller, 2013). Firms are typically home to a mix of permanent

employees and others whose contract is up for possible renewal; interns or agency workers; and individuals voluntarily or involuntarily on their notice period. Scholars have long noted the potential incentive effects of such diverse contractual conditions (e.g., Engellandt & Riphahn, 2005; Klotz, Swider, Shao, & Prengler, 2021; Stiroh, 2007). Thus, reverting to the rider-lap level of analysis, we examine whether contractual differences affect riders' competitive actions in response to the competitive threats and opportunities facing the team they represent.[21]

Insert Table 5 about here

We hand-collected data on contractual conditions for each rider at every point in time from 2004 to 2020. Table 5 shows how we define contractual conditions in the context of MotoGP. Appendix J supplies detail about data sources and measurement, and shows estimates adjusting for the main effects of contractual conditions (Table J2). None deviate in spirit from the results in Tables 2 and 3. Table 6 shows estimates of models predicting internal and external overtakes, in which we interacted *Competitive threat* and *Competitive opportunity* with each of four alternatives to permanent employment. Thus, the coefficients on the interaction terms express differences in responses to competitive threat or opportunity between riders under the specified contractual condition relative to permanent riders.

Insert Table 6 about here

Three broad patterns stand out. First, none of the estimates suggest riders whose contract is up respond differently to competitive threats or opportunities,[22] perhaps because such riders have

[21] For transparency, we note that the analyses in this section are post-hoc. We decided to perform the additional coding and analyses following an exchange with one of the anonymous reviewers, for which we are grateful.
[22] However, consistent with Stiroh (2007), the main effects of *Contract up* are persistently positive and statistically significant in Models 5-8 predicting *External overtakes* (see also Appendix J, Table J2, Models 3 and 4).

incentives to serve their team for as long as they receive no signal their contract would not be renewed. At that point, their contractual condition would change to 'involuntary notice.' Second, replacement riders overtake more internally and externally when their host team faces competitive threats, and more internally when the team faces competitive opportunities. Maybe replacement riders are keen to signal their skills relative to incumbents, hoping to secure a permanent contract.[23] Third, employees on notice engage in more internal overtakes under firm-level competitive intensity, and ones involuntarily on notice also engage in fewer external overtakes. These patterns could reflect riders' lesser identification, and possible disgruntlement, with their teams.

DISCUSSION

This article sought to examine how competitive intensity in a firm-level tournament has cross-level effects on the locus and intensity of employees' competitive actions. We drew from the career-concerns literature (e.g., Borland, 1992; Fama, 1980; Holmström, 1999; Miklós-Thal & Ullrich, 2016) to propose a theory of individual reputational incentives. This theory supplied four sets of hypotheses for how employees adjust their internal and external competitive actions in response to the intensity and nature of their firm's competitive threats and opportunities. We examined the hypotheses in panel data on riders competing in MotoGP, using overtakes to measure individual competitive actions. Our findings suggest that riders systematically adjusted their internal and external overtakes based on their team's competitive threats and opportunities in the team-level tournament, as well as the relative resource endowments of the teams supplying such threats or opportunities.

Contributions

[23] This dynamic may be particularly acute in MotoGP because replacement riders can find themselves at a sharp status boundary: They often compete in lower-status competitions, such as Superbike or Moto2, and suddenly have a time-limited opportunity to show off their skills in MotoGP, the leading championship. Thus, replacement riders have a rare shot at accessing the suite of benefits associated with permanent membership in the highest-status tournament.

Though career tournaments are usually nested in firm-level tournaments, the tournament literature would mostly trace employees' competitive actions exclusively to characteristics of individual-level tournaments (Connelly et al., 2014; Dechenaux et al., 2015). Also, through antecedents such as reward spread and interim rank position, prior work mainly offers predictions regarding the *intensity* of competitive actions (e.g., Brown et al., 1996; Drago & Garvey, 1998). It says little about the *locus* of such actions—e.g., how employees choose whether to engage in internal versus external competitive actions. We challenge and complement such prevailing accounts, on the back of evidence that a firm's standing may have important implications for its employees' careers (e.g., Bidwell et al., 2015; Rider & Tan, 2015). Specifically, we advance the tournament literature by arguing and showing that the locus and intensity of employees' competitive actions may respond to characteristics of the firm-level tournament in which the career tournament is nested.

In the spirit of prior work calling for more systematic attention to the multilevel nature, and cross-level effects, of organizational phenomena (e.g., Hitt, Beamish, Jackson, & Mathieu, 2007), we think our multilevel approach to tournaments represents an important step forward. Our theory explicitly allows employees to consider how the dynamics of a higher-level tournament shape their reputational incentives. This way, it directly offers sharp predictions regarding not just the intensity but also the locus of competitive actions. Thus, a multilevel perspective can change the way we understand and study employees' behaviors, including their decisions to deploy competitive actions, by helping to explain more of the observed heterogeneity among such behaviors.

To probe our reputational mechanism, we examined how the cross-level tournament effects differed by whether competitive threats and opportunities implied the potential for relatively unexpected losses or gains in a firm's standing. Expectations, we argued, depend on the relative resource endowments of the firms supplying the threats or opportunities. This argument builds on

and resonates with a nascent body of work on the role of underdogs and favorites in creating expectations in individual-level tournaments (e.g., Bartling et al., 2015; Chen et al., 2011; Dai et al., 2018; Doyle et al., 2022; Nurmohamed, 2020). Complementing such studies, we elucidated how expectations may derive from a higher-level tournament, and thus can moderate the cross-level spillovers of firm-level threats and opportunities to employees' competitive actions. Consistent with the mechanism of individual reputational incentives, our findings hint at a fundamental asymmetry in the determinants of employees' competitive actions. Concerned with their reputations and careers, employees would strive to stand out among colleagues if their firm managed to surpass one or more favorites. But they would rather act to evade blame if one or more underdogs managed to surpass their firm.

Apart from its contribution to the tournament literature, our study also adds to the multidisciplinary literature on common-enemy effects (Böhm et al., 2020; De Jaegher, 2021). Specifically, we exploited two sources of difference between our question and the typical problem studied in the common-enemy literature (see Appendix A). First, the common-enemy literature has tended to view groups as competing when their outcomes are negatively correlated (e.g., Bornstein, Gneezy, & Nagel, 2002). This view is generally consistent with firms competing for a higher rank in a firm-level tournament. Yet the vertical nature of tournaments draws attention to the direction of competition. Though the common-enemy literature recognizes that individuals might contribute to an intergroup competition to fend off threats or exploit opportunities (e.g., De Dreu et al., 2010; Niou & Tan, 2005), it has underemphasized the behavioral implications of such directionality. Differently, we make a key conceptual and empirical distinction between competitive threats from lower ranks and competitive opportunities against higher ranks. This critical distinction helps uncover how the direction of firm-level competition may have implications for employees'

competitive actions, allowing us to offer a richer and more complete representation of behavioral dynamics in nested tournaments.

Second, the common-enemy literature has paid no particular conceptual attention to individual career concerns. Thus, in its empirical designs, internal competitive actions are not usually among the options available to group members. Organizational reality is different because many employees have career concerns, which might potentially create situations in which they engage fiercely in both internal and external competitive actions (e.g., Lazear, 1989). We contribute by making career-related reputational incentives the core of our theory of employee behavior in nested tournaments, and by allowing employees to make separate decisions about internal and external competitive actions. This way, our theory accounts for a richer variety of behaviors, in which employees may engage to either avoid reputational loss or achieve reputational gain.

Beyond contributing to the tournament and common-enemy literatures, we think that our post-hoc analysis of contractual conditions also generates valuable insights and opportunities. For example, our exploratory findings foreshadow how employee-level differences may elicit heterogeneous responses to the competitive threats and opportunities of a firm. Such possible effects require more attention.[24] Also, the opportunity for career advancement faced by interns or agency workers (replacement riders, in our setting) may derive from yet another tournament, in which the desire to switch from a lower-status to a higher-status tournament (e.g., from Superbike to MotoGP) supplies effort incentives (e.g., Moliterno, Beck, Beckman, & Meyer, 2014). Future research might pursue this line of argument. It could consider the position of a firm-level tournament in a

[24] Barring proprietary data, in more traditional organizations it seems nearly impossible to collect systematic and longitudinal data on, for example, who is on voluntary or involuntary notice. Sports settings, such as MotoGP, are appealing because they may allow observers to move beyond binary distinctions (e.g., permanent versus temporary employees) and track a broader range of contractual conditions (e.g., Table 5) over extended time periods.

hierarchy of tournaments, vertically differentiated by the relative status of the tournament in which the host firm participates.

Application beyond MotoGP

Our empirical analyses exploit rich field data from MotoGP, a novel and exciting setting that allowed us to measure consistently, and distinguish sharply between, employees' internal and external competitive actions. In more traditional organizations, such actions have been hard to observe directly, and measure with granularity and precision. One might reasonably ask how far our theory would extend to more conventional business environments (Fonti et al., 2023). Generally, we believe that the key scope conditions of our theory are prevalent in numerous settings beyond MotoGP. Nested tournaments are widespread. Employees often find themselves directly or indirectly intersecting with externals working for other firms. And the competitive actions of diverse kinds of employees can have meaningful effects on relevant metrics at the firm level.

Consider how some of our findings would translate to investment banking. Like riders in MotoGP, investment bankers compete as individuals for promotions and recognition, and are members of firms themselves vying for high ranks in a league table. Such bankers must decide whether to compete for deals against colleagues and/or external bankers working for competing firms. Our results suggest that when more other banks pose a credible threat to a focal bank's rank in the league table, a banker is less likely to compete for deals against colleagues and more likely against external bankers. Yet when the bank can dethrone a better-resourced competing bank, the banker may end up competing against both colleagues and externals. Also, the employer may be able to direct bankers' actions by strategically highlighting the threats from underdogs or the opportunities against favorites. Overall, our theory and findings can improve awareness of the possible cross-level implications of firm-level tournaments for employee behaviors.

Limitations and Future Research

Two differences stand out across our main and supplementary analyses (Tables 2 and 3 vs. Table 4). First, while no evidence exists that competitive opportunity affects internal overtakes in the main analysis, Hypothesis 2a finds some support in the supplementary analysis. Second, Hypothesis 4b is supported in the main analysis, yet in the supplementary analysis we find no evidence that competitive opportunities against favorites have stronger effects on external overtakes. For comparison purposes, we show both analyses because they make slightly different assumptions. In the main analysis, we count overtakes on a lap-by-lap basis. This design gives us a population of observations and allows for differences across riders in the number of overtake opportunities they create. This is beneficial if one assumes, as we have, that the endogenous creation of opportunities might be among the mechanisms through which overtakes emerge.[25] Instead, in the supplementary analysis we observe the competitive action of overtaking on an opportunity-by-opportunity basis. This design differs by holding constant the number of overtake opportunities, which is ideal if one wishes to isolate the actual overtake. Limited by available data, such a design unfortunately gave us a coarser (though larger) sample of observations. Our view is that both designs have their own merit in MotoGP. In other contexts, scholars must choose empirical designs matching the scope of their specific competitive actions of interest.

Next, the mere fact that our key theoretical scope conditions apply both in MotoGP and in more traditional organizations does not mean that MotoGP lacks idiosyncratic features that could limit the broader application of our empirical findings. Indeed, while the scope of MotoGP is excellent for examining our hypothesized effects, it also has limitations that must be acknowledged. In the remainder, we will discuss six such limitations and suggest directions for further research.

First, competitive threats and opportunities in MotoGP are observable and all participants

[25] Of course, valid inferences from such a design still require that confounding *exogenous* variation in overtake opportunities is held constant, an issue we probe in Appendix H.

share a common understanding of what constitutes competition. The concomitant measurement accuracy allowed us to test our hypothesized relations, yet in other settings competitive threats and opportunities may be more difficult to discern. This could be, for example, because firms or their employees may be idiosyncratic in their appraisal of competitive threats and opportunities (Porac, Thomas, & Baden-Fuller, 1989; McMullen, Shepherd, & Patzelt, 2009). Thus, ample scope exists for incorporating cognitive conceptions of competition into studies of the relation between competitive threats and opportunities and employees' competitive actions.

Second, and related to the previous point, competitive actions in MotoGP are both internally and externally transparent. Every move on the racetrack is immediately observable by colleagues and a broad range of external actors, including the riders and other employees of other racing teams, industry executives, sponsors, sport federation officials, media, and fans. Such transparency and contiguity influences riders' behaviors and makes the formation of individual reputations in the minds of current and prospective employers a virtually instantaneous and synchronous process. In more traditional organizations, learning about employees' competitive actions can be more difficult. Thus, reputation formation may be a slower process and internal and external reputations may move out-of-sync. Also, employees may purposely try to hide their competitive actions (e.g., Zhong & Li, 2023). Thus, it seems necessary to examine the transparency of actions as a strategic lever that employees can use to manipulate the perceptions of different audiences in distinct ways.

Third, riders in MotoGP have equivalent roles within their firm. Such homogeneity is a strength for our purposes. For example, by design it allows us to rule out differences among employees in formal power or authority as a possible explanation for internal competitive actions (e.g., Van Bunderen, Greer, & van Knippenberg, 2018). Yet due to organizational structure and size, roles tend to vary widely within as well as between firms. Given such heterogeneity, and its potential to influence the propensity to engage in internal and external competitive actions, possible

extensions of our analyses in other empirical settings must pay close attention to employee roles. Also, research might probe differences in the reputational implications of internal competitive actions depending on whether they are targeted laterally or vertically—up or down the hierarchy.

Fourth, we consistently captured employees' internal and external competitive actions using overtakes on the track. While again a strength for our purposes, more traditional settings are characterized by a broader range of more nuanced competitive actions and, possibly, greater variation in their intensity. Moreover, in such other settings competitive actions might differ in their nature depending on whether they are internal or external, or whether they serve to avoid reputational loss or achieve reputational gain. For example, employees who feel threatened might mislead others, while ones anticipating recognition might gain clients through creative approaches to their jobs (Steinhage, Cable, & Wardley, 2017; To, Kilduff, & Rosikiewicz, 2020). Such distinctions in the nature of competitive actions deserve attention in nested tournaments.

Fifth, collaboration and competition are clearly separated in MotoGP. The riders of a team collaborate off the track, for example, by sharing experiences between races with their bikes. Yet on the track they compete. When discussing the relation to his teammate, MotoGP rider Francesco Bagnaia emphasized this sharp contrast: "*It's now essential to collaborate and develop the bike at its best. Then, on the track, when it's time to race, everyone will fend for themselves*" (Piazza, 2022). Such contrast also exists elsewhere. For example, investment bankers compete with colleagues to close deals yet may collaborate in internal projects or hiring decisions. The separation of collaboration and competition is a distinctive strength in our setting because it allowed us to capture the variation in competitive actions not confounded by considerations regarding collaboration. Yet questions emerge as to whether and how our findings might carry over to settings in which collaboration and competition coexist—e.g., where critical tasks are strongly interdependent rather than independent, yet incentives are at least partly individualized. Thus,

future research may examine our cross-level theory in settings in which internal competition cannot readily be separated from collaboration.

Finally, MotoGP is governed by relatively clear and detailed formal rules. These rules and the sanctions they imply are applied almost instantaneously if a rider engages in prohibited behaviors on the racetrack. Deviance may be easier to conceal and is more likely (though by no means guaranteed) to be met with impunity in more traditional organizations. Also, the formal rules of MotoGP update on a rhythm, typically once per year and usually between seasons. Thus, riders and teams can rely on a stable set of rules for the entirety of a yearly tournament and will pattern their behaviors accordingly. Elsewhere, regulations may change in less predictable ways and informal behavioral norms may play a more important governing role. Future studies should consider settings in which regulations change less predictably, or where they play a more limited role in shaping competitive interactions among firms and constituent employees.

CONCLUSION

Using granular field data, we have examined how a firm's competitive threats and opportunities have cross-level behavioral implications, by affecting the locus and intensity of its employees' competitive actions. The combined findings largely resonate with our theory of individual reputational incentives, in which employees consider the potential dynamics of their firm's tournament standing to decide on their individual competitive actions against colleagues or externals. We hope our work will 'fast-track' future research on the multilevel antecedents of employees' internal and external competitive actions. Much remains to be discovered.

TABLE 1
Summary Statistics and Bivariate Correlations (N=104,606)

		Mean	*SD*	Min.	Max.	1	2	3	4	5	6	7	8	9
1	Internal overtakes	0.02	0.13	0	2									
2	External overtakes	0.21	0.66	0	17	0.19								
3	Competitive threat	2.22	2.70	0	13	0.00	0.03							
4	Competitive opportunity	2.06	2.70	0	13	0.01	0.04	0.64						
5	CT (inferior resources)	0.66	1.49	0	11	0.00	0.01	0.58	0.32					
6	CT (similar resources)	1.18	1.57	0	10	0.00	0.03	0.83	0.54	0.16				
7	CT (superior resources)	0.38	1.01	0	6	0.00	0.02	0.53	0.40	-0.17	0.42			
8	CO (inferior resources)	0.45	1.27	0	11	0.00	0.02	0.39	0.55	0.62	0.16	-0.13		
9	CO (similar resources)	1.08	1.53	0	10	0.01	0.04	0.52	0.87	0.21	0.48	0.35	0.26	
10	CO (superior resources)	0.53	1.14	0	6	0.00	0.02	0.39	0.59	-0.21	0.47	0.63	-0.16	0.43
11	Previous internal overtakes (race)	0.26	0.51	0	5	-0.01	-0.06	-0.04	-0.03	-0.03	-0.03	-0.02	-0.03	-0.02
12	Previous internal overtakes (season)	2.66	2.76	0	19	0.03	0.00	-0.41	-0.36	-0.25	-0.32	-0.22	-0.19	-0.30
13	Previous external overtakes (race)	3.37	3.10	0	29	-0.04	-0.09	0.02	0.05	0.00	0.02	0.02	0.02	0.05
14	Previous external overtakes (season)	35.04	26.87	0	142	0.01	0.02	-0.48	-0.44	-0.30	-0.40	-0.21	-0.22	-0.37
15	Rider internal threat	0.34	0.47	0	1	0.01	0.01	0.34	0.40	0.20	0.28	0.19	0.24	0.33
16	Rider external threat	0.85	0.35	0	1	0.00	0.04	0.27	0.21	0.16	0.22	0.13	0.11	0.17
17	Rider internal opportunity	0.34	0.47	0	1	0.01	0.00	0.34	0.40	0.20	0.28	0.19	0.24	0.33
18	Rider external opportunity	0.85	0.36	0	1	-0.01	0.03	0.23	0.27	0.12	0.19	0.13	0.14	0.23
19	Risk taking	0.08	0.11	0	1	-0.01	0.01	0.04	0.05	-0.02	-0.01	0.15	0.04	0.00
20	No previous races in past year	0.02	0.14	0	1	0.00	0.00	0.16	0.18	0.01	0.15	0.18	0.05	0.17
21	Experience	77.04	65.75	0	354	0.01	-0.01	-0.05	-0.12	0.11	-0.11	-0.13	0.05	-0.11
22	Wet weather	0.12	0.33	0	1	0.02	0.07	-0.04	-0.04	-0.03	-0.02	-0.02	-0.04	-0.02
23	Season stage	0.53	0.29	0.0526	1	0.00	-0.01	-0.65	-0.59	-0.40	-0.55	-0.30	-0.30	-0.51

		10	11	12	13	14	15	16	17	18	19	20	21	22
10	CO (superior resources)													
11	Previous internal overtakes (race)	-0.01												
12	Previous internal overtakes (season)	-0.23	0.13											
13	Previous external overtakes (race)	0.03	0.22	0.01										
14	Previous external overtakes (season)	-0.30	0.03	0.60	0.09									
15	Rider internal threat	0.22	0.02	-0.09	0.02	-0.20								
16	Rider external threat	0.14	-0.05	-0.19	0.07	-0.09	0.14							
17	Rider internal opportunity	0.22	0.04	-0.15	0.01	-0.28	-0.14	0.12						

18	Rider external opportunity	0.18	-0.06	-0.21	0.06	-0.09	0.12	0.31	0.15					
19	Risk taking	0.08	-0.04	-0.04	0.02	0.06	-0.02	0.11	-0.01	0.12				
20	No previous races in past year	0.15	0.00	-0.14	0.00	-0.19	0.05	-0.02	0.10	0.06	-0.10			
21	Experience	-0.20	0.04	0.15	0.00	0.08	0.02	-0.08	-0.09	-0.14	0.01	-0.14		
22	Wet weather	-0.03	0.09	-0.01	0.26	-0.01	-0.02	0.01	-0.02	0.01	0.00	-0.02	-0.01	
23	Season stage	-0.40	0.02	0.58	-0.01	0.76	-0.34	-0.26	-0.34	-0.18	0.05	-0.07	0.05	-0.04

TABLE 2
Conditional Fixed-Effects Poisson QML Estimates of Overtakes: Hypotheses 1a/b and 2a/b

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DV:	**Internal overtakes**				**External overtakes**			
Hypotheses:	**Controls**	**H1a**	**H2a**	**H1a/H2a**	**Controls**	**H1b**	**H2b**	**H1b/H2b**
Competitive threat		-0.0355**		-0.0345**		0.0102*		0.0147**
		(0.0153)		(0.0153)		(0.0056)		(0.0059)
Competitive opportunity			0.0122	0.0071			0.0253***	0.0278***
			(0.0159)	(0.0158)			(0.0075)	(0.0075)
Previous internal overtakes (race)	0.0204	0.0197	0.0202	0.0196				
	(0.0834)	(0.0841)	(0.0835)	(0.0841)				
Previous internal overtakes (season)	0.0102	0.0096	0.0105	0.0098				
	(0.0187)	(0.0188)	(0.0187)	(0.0188)				
Previous external overtakes (race)					0.0585***	0.0584***	0.0583***	0.0582***
					(0.0042)	(0.0042)	(0.0042)	(0.0042)
Previous external overtakes (season)					-0.0006	-0.0006	-0.0005	-0.0006
					(0.0007)	(0.0007)	(0.0007)	(0.0007)
Rider internal threat	0.2664***	0.2784***	0.2616***	0.2754***	0.0254	0.0220	0.0133	0.0071
	(0.0711)	(0.0708)	(0.0711)	(0.0708)	(0.0268)	(0.0264)	(0.0275)	(0.0267)
Rider external threat	-0.0490	-0.0351	-0.0443	-0.0326	0.0783**	0.0737*	0.0848**	0.0787**
	(0.0739)	(0.0752)	(0.0742)	(0.0751)	(0.0373)	(0.0377)	(0.0372)	(0.0380)
Rider internal opportunity	0.2939***	0.3062***	0.2882***	0.3026***	-0.0045	-0.0088	-0.0184	-0.0262
	(0.0753)	(0.0747)	(0.0760)	(0.0753)	(0.0216)	(0.0215)	(0.0219)	(0.0215)
Rider external opportunity	-0.1643**	-0.1370*	-0.1674**	-0.1395*	-0.0344	-0.0433	-0.0481	-0.0624
	(0.0820)	(0.0780)	(0.0832)	(0.0794)	(0.0337)	(0.0347)	(0.0363)	(0.0381)
Risk taking	-0.2958	-0.2645	-0.3039	-0.2698	-0.1955	-0.1999	-0.2040	-0.2116
	(0.3957)	(0.3925)	(0.3950)	(0.3924)	(0.1350)	(0.1347)	(0.1348)	(0.1343)
No previous races in past year	-0.1182	-0.0990	-0.1264	-0.1045	-0.1022	-0.1084	-0.1149*	-0.1249*
	(0.1893)	(0.1894)	(0.1913)	(0.1913)	(0.0663)	(0.0662)	(0.0658)	(0.0657)
Experience	0.0039	0.0043	0.0041	0.0043	0.0008	0.0007	0.0010	0.0009
	(0.0039)	(0.0038)	(0.0039)	(0.0039)	(0.0009)	(0.0009)	(0.0009)	(0.0009)

Wet weather	0.4123***	0.4134***	0.4116***	0.4129***	0.5047***	0.5036***	0.5034***	0.5017***
	(0.0612)	(0.0614)	(0.0611)	(0.0612)	(0.0248)	(0.0249)	(0.0249)	(0.0251)
Season stage	0.2607	0.0606	0.3195	0.1017	0.0772	0.1455	0.2086*	0.3190**
	(0.2882)	(0.2966)	(0.3117)	(0.3237)	(0.0991)	(0.1093)	(0.1129)	(0.1297)
N (rider-laps)	104,146	104,146	104,146	104,146	104,566	104,566	104,566	104,566
N (riders)	103	103	103	103	121	121	121	121
Log pseudolikelihood	-7750	-7748	-7750	-7748	-48329	-48327	-48316	-48312

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Conditional fixed effects pertain to the rider level. All models include vectors of fixed effects for rider rank at the start of the race, team rank at the start of the race, and lap numbers, teams, racetracks, and calendar years.

TABLE 3
Conditional Fixed-Effects Poisson QML Estimates of Overtakes: Hypotheses 3a/b and 4a/b

	(1)	(2)	(3)	(4)	(5)	(6)
DV:	**Internal overtakes**			**External overtakes**		
Hypotheses:	**H3a**	**H4a**	**H3a/H4a**	**H3b**	**H4b**	**H3b/H4b**
CT (inferior resources)	-0.0582***		-0.0412*	0.0159**		0.0273***
	(0.0225)		(0.0234)	(0.0077)		(0.0093)
CT (similar resources)	-0.0331		-0.0354	0.0090		0.0128
	(0.0248)		(0.0248)	(0.0080)		(0.0082)
CT (superior resources)	0.0198		0.0076	0.0007		0.0006
	(0.0361)		(0.0380)	(0.0147)		(0.0158)
CO (inferior resources)		-0.0047	0.0051		0.0243**	0.0180*
		(0.0323)	(0.0350)		(0.0102)	(0.0100)
CO (similar resources)		-0.0065	-0.0127		0.0250**	0.0281***
		(0.0201)	(0.0194)		(0.0100)	(0.0099)
CO (superior resources)		0.0861***	0.0659*		0.0279**	0.0411***
		(0.0333)	(0.0357)		(0.0115)	(0.0135)
Control variables	Y	Y	Y	Y	Y	Y
CT (inferior) - CT (similar)	-0.0251		-0.0058	0.0069		0.0145
CT (inferior) - CT (superior)	-0.0780***		-0.0488	0.0152		0.0267*
CO (superior) - CO (similar)		0.0926**	0.0786**		0.0029	0.0130
CO (superior) - CO (inferior)		0.0908***	0.0607*		0.0036	0.0231**
N (rider-laps)	104,146	104,146	104,146	104,566	104,566	104,566
N (riders)	103	103	103	121	121	121
Log pseudolikelihood	-7746	-7746	-7744	-48325	-48316	-48309

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Consistent with our hypotheses, tests of differences between coefficients are one-tailed. Conditional fixed effects pertain to the rider level. All models include time-varying controls, and vectors of fixed effects for rider rank at the start of the race, team rank at the start of the race, and lap numbers, teams, racetracks, and calendar years.

TABLE 4
Fixed-Effects Linear Probability Estimates of Whether a Rider Exploits a Specific Overtake Opportunity

	(1)	(2)	(3)
Hypotheses:	**H1a/H1b**	**H2a/H2b**	**H3ab/H4ab**
Competitive threat (CT)	-0.0006**	-0.0001	
	(0.0003)	(0.0002)	
Competitive opportunity (CO)	0.0004**	0.0005*	
	(0.0002)	(0.0003)	
Internal rider ahead (Internal)		*Omitted category*	
External rider ahead (External)	0.0057***	0.0073***	0.0068***
	(0.0010)	(0.0010)	(0.0011)
CT × External	0.0007***		
	(0.0002)		
CO × External		-0.0001	
		(0.0002)	
CT (inferior resources) × Internal			-0.0012*
			(0.0007)
CT (similar resources) × Internal			-0.0010
			(0.0007)
CT (superior resources) × Internal			-0.0004
			(0.0012)
CO (inferior resources) × Internal			0.0003
			(0.0009)
CO (similar resources) × Internal			0.0018**
			(0.0007)
CO (superior resources) × Internal			0.0021**
			(0.0011)
CT (inferior resources) × External			0.0007**
			(0.0004)
CT (similar resources) × External			0.0002
			(0.0003)
CT (superior resources) × External			-0.0005
			(0.0005)
CO (inferior resources) × External			0.0001
			(0.0004)
CO (similar resources) × External			0.0004
			(0.0003)
CO (superior resources) × External			0.0005
			(0.0005)
Control variables	Y	Y	Y
R-squared	0.0502	0.0502	0.0503

Notes: N=418,424 rider-sectors. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All models include time-varying controls, and vectors of fixed effects for riders, rider rank at the start of the race, team rank at the start of the race, and lap numbers, sector numbers, teams, racetracks, and calendar years.

TABLE 5
Contractual Conditions and MotoGP Equivalents

Generic contractual condition	MotoGP equivalent	Variable name
Permanent employee	Rider has a contract with his team for at least the current and next season	(Omitted category)
Temporary employee	Rider has a contract with his team only for the current season, and has not (yet) signed a contract with any team for the next season	Contract up
Intern/agency worker	Rider is a replacement rider, usually from outside of MotoGP	Replacement
Employee voluntarily on notice	Rider has announced his retirement, or he has signed a contract with a different team (inside or outside of MotoGP) for the next season before his current team announced a new roster	Voluntary notice
Employee involuntarily on notice	Rider's team has announced a new roster for the next season that does not include him, or the team has announced its exit from MotoGP	Involuntary notice

TABLE 6
Conditional Fixed-Effects Poisson QML Estimates of Overtakes: Effects by Contractual Conditions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DV:	**Internal overtakes**				**External overtakes**			
Competitive threat (CT)	-0.0417*	-0.0364**	-0.0360**	-0.0319**	0.0152	0.0138**	0.0143**	0.0138**
	(0.0216)	(0.0153)	(0.0150)	(0.0150)	(0.0100)	(0.0060)	(0.0059)	(0.0059)
Competitive opportunity (CO)	-0.0082	0.0079	0.0131	0.0044	0.0375***	0.0284***	0.0279***	0.0306***
	(0.0227)	(0.0159)	(0.0159)	(0.0157)	(0.0091)	(0.0074)	(0.0075)	(0.0077)
CT × Contract up	0.0150				-0.0027			
	(0.0254)				(0.0107)			
CT × Replacement		0.1562**				0.0448*		
		(0.0705)				(0.0244)		
CT × Voluntary notice			0.1334*				0.0023	
			(0.0757)				(0.0208)	
CT × Involuntary notice				-0.0637				0.0193
				(0.0552)				(0.0180)
CO × Contract up	0.0239				-0.0132			
	(0.0213)				(0.0095)			
CO × Replacement		0.1150*				0.0292		
		(0.0628)				(0.0266)		
CO × Voluntary notice			-0.1194				0.0331	
			(0.0801)				(0.0221)	
CO × Involuntary notice				0.1210***				-0.0434**
				(0.0439)				(0.0180)
Contract up	-0.0429	0.0431	0.0428	0.0357	0.0939***	0.0578**	0.0575**	0.0571**
	(0.0815)	(0.0713)	(0.0706)	(0.0705)	(0.0273)	(0.0270)	(0.0269)	(0.0268)
Replacement	-0.0361	-0.5146*	-0.0185	-0.0333	0.0211	-0.0977	0.0255	0.0224
	(0.1994)	(0.3086)	(0.1986)	(0.2003)	(0.0920)	(0.1094)	(0.0907)	(0.0907)
Voluntary notice	0.0248	0.0315	-0.0503	0.0216	0.0119	0.0168	-0.0335	0.0156
	(0.1177)	(0.1165)	(0.1361)	(0.1180)	(0.0439)	(0.0437)	(0.0567)	(0.0441)

Involuntary notice	0.0358	0.0192	0.0314	-0.0665	0.0223	0.0239	0.0255	0.0579
	(0.1202)	(0.1210)	(0.1204)	(0.1617)	(0.0438)	(0.0422)	(0.0430)	(0.0548)
Control variables	Y	Y	Y	Y	Y	Y	Y	Y
N (rider-laps)	104,146	104,146	104,146	104,146	104,566	104,566	104,566	104,566
N (riders)	103	103	103	103	121	121	121	121
Log pseudolikelihood	-7744	-7742	-7744	-7743	-48304	-48305	-48306	-48304

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The omitted contractual condition is “Permanent”. Conditional fixed effects pertain to the rider level. All models include time-varying controls, and vectors of fixed effects for rider rank at the start of the race, team rank at the start of the race, and lap numbers, teams, racetracks, and calendar years.

APPENDIX TO: REVVING UP OR BACKING DOWN? CROSS-LEVEL EFFECTS OF FIRM-LEVEL TOURNAMENTS ON EMPLOYEES' COMPETITIVE ACTIONS

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APPENDIX A. Review of 35 Studies on Intergroup Competition and Individual Attitudes and Behaviors

	Study	Setting	Findings	Dependent variable(s)	Nature of competition	Level of analysis
	Abbink et al. (2010)	Tullock contest game (n = 259, 14 groups)	- Intergroup competition incentivizes individuals to invest more - The effects of intergroup competition are far greater when group members can punish other group members	Investments by individual	Unspecified	Individual
	Baer et al. (2010)	Idea generation task (n = 280)	- Intergroup competition and team creativity has an inverted U-shape relationship in closed groups - The effects of intergroup competition and membership change on team creativity are mediated by collaboration	Group creativity	Opportunity	Group
*	Benard (2012)	Intergroup prisoner's dilemma game (n = 120–144)	- Intergroup conflicts increase norm enforcement by punishing group members - Intergroup conflict increases contribution to the group even if the outgroup does not actively participate in the conflict	Ingroup punishment Contribution to group	Threat	Individual
	Böhm et al. (2016)	Intergroup prisoner's dilemma-Maximizing difference game (n = 216)	- Individuals take retaliatory actions to defend their ingroup in an intergroup conflict - Individuals use offensive preemptive actions to avoid future losses in an intergroup conflict	Retaliatory actions (defensive) Offensive actions	Threat	Individual
*	Bornstein (1992)	Intergroup public goods and Intergroup prisoner's dilemma (n = 180; in teams of 3)	- Intergroup competition for step-level goods results in more cooperation than intergroup competition for continuous goods - Within team communication is more effective in intergroup competition for step-level goods compared to continuous goods	Contribution (Cooperation)	Opportunity	Individual
*	Bornstein & Ben-Yossef (1994)	Prisoner's dilemma game contrasted with Intergroup prisoner's dilemma game (n = 90)	- Intergroup conflicts increase cooperation within the group	Contribution (Cooperation)	Opportunity	Individual

*	Bornstein et al. (1997)	Various (interteam, n-person, and two-person) chicken games in teams of 2 and 4 (n = 100, team of 2 and 4)	- Individuals cooperate less in the intergroup chicken game compared to n-person and two-person chicken game	Contribution (Cooperation)	Threat	Individual
*	Bornstein & Erev (1994)	Social dilemma (intrateam and interteam) and field experiment (dyads in orange grove) (n = 90)	- Intergroup conflicts increase cooperation within the group	Contribution (Cooperation)	Unspecified	Individual
*	Bornstein et al. (2002)	Minimal-effort game (Van Huyck et al., 1990) (n = 210, teams of 7)	- Intergroup competition increases cooperation	Contribution (Cooperation)	Unspecified	Individual
*	Bornstein & Rapoport (1988)	Intergroup public goods (n = 96, in teams of 3)	- Communication within the group increases cooperation under an intergroup conflict	Contribution (Cooperation)	Opportunity	Individual
*	Bornstein et al. (1989)	Intergroup public goods (n = 240, teams of 3)	- Within group communication increases cooperation under intergroup competition	Contribution (Cooperation)	Opportunity	Individual
	Chan et al. (2014)	Department store sales employees (n = 30,162)	- Sales employees have lower sales performance when competing against high performing peers when the firm uses individual incentives - Sales employees increases discounting when competing against high performing peers when the firm uses individual incentives - High performing peers are more likely to help their peers when the counter uses team incentives	Sales Discounting	Unspecified	Individual
*	De Dreu et al. (2010)	Intergroup prisoner's dilemma-Maximizing difference game (n = 49-75)	- Oxytocin increases cooperation under intergroup competition - Oxytocin does not affect outgroup punishment in intergroup competition	Contribution (Cooperation) Outgroup punishment	Threat	Individual

*	Erev et al. (1993)	Field experiment: Orange picking (n = 48, teams of 4)	- Intergroup competition increases individual effort	Individual effort	Opportunity	Individual
	Goette et al. (2012b)	Prisoner‘s dilemma against members of in- and outgroup (n = 244-281)	- Intergroup competition increases outgroup punishment	Outgroup punishment	Opportunity	Individual
*	Goldman et al. (1977)	Anagram tasks (n = 128 participants; in teams of 2)	- Intergroup competition decreases team performance in high means-interdependent tasks	Team performance	Unspecified	Group
*	Gunnthorsdottir & Rapoport (2006)	Prisoner’s dilemma game contrasted with Intergroup prisoner’s dilemma game (n = 112)	- Intergroup conflicts increase cooperation within the group	Contribution (Cooperation)	Opportunity	Individual
*	Halevy et al. (2012)	Intergroup prisoner’s dilemma contrasted with Intergroup prisoner’s dilemma-Maximizing difference game (n = 240)	- Intergroup conflicts increase cooperation within the group - Individuals are more likely to choose to help the ingroup instead of punishing the outgroup to win an intergroup conflict	Contribution (Cooperation) Outgroup punishment	Unspecified	Individual
*	Julian & Perry (1967)	2 essay questions individually answered (n = 157, teams of 4)	- Intergroup competition increases individual effort and team performance	Team performance	Unspecified	Group
	Majercyk et al. (2019)	Experiment (n =144)	- The combination of within and between tournaments increases employee effort	Contribution (Cooperation)	Unspecified	Individual
*	Maner & Mead (2010)	77–160 participants got assigned the leadership role in an ostensibly team task	- Intergroup competition reduces dominant leaders’ tendency to engage in selfish behavior	Selfish behavior	Threat	Individual
*	Mead & Maner (2012)	87–124 participants got assigned the leadership role in an ostensibly team task	- Intergroup competition decreases leaders’ perception of the level of intrateam threat	Perceived intrateam threat	Unspecified	Individual

*	Mulvey & Ribbens (1999)	LEGO-task (n = 351, in teams of 3)	- Intergroup competition increases team performance	Team performance	Unspecified	Group
	Nalbantian & Schotter (1997)	Experiment in which subjects choose their effort based on a cost function (n = 408)	- Intergroup competition increases the mean effort within a group	Group effort	Unspecified	Group
*	Rabbie et al. (1974)	Labor-management negotiation simulation (n = 123, teams of 3)	- A strong bargaining position creates more cohesiveness within a group engaged in intergroup competition - Individuals feel stronger pressure to conform to group norms when their group has a weak bargaining position in an intergroup competition - Individuals report stronger distaste against the outgroup under intergroup competition	Cohesiveness Pressure to conform Outgroup hate	Unspecified	Individual
*	Rabbie & Wilkens (1971)	Building a tower (n = 72, teams of 3)	- Intergroup competition does not affect individuals' evaluations of in- and outgroup members	Evaluations of others' work	Unspecified	Individual
*	Rapoport & Bornstein (1989)	Intergroup public goods (n = 208, in teams of 3 and 5)	- Communication within the group prior to the game does not necessarily increase cooperation	Contribution (Cooperation)	Unspecified	Individual
*	Rapoport et al. (1989)	Intergroup public goods (n = 72, in teams of 3)	- Within group endowment differences affect individuals' contributions to the group	Contribution (Cooperation)	Unspecified	Individual
*	Rempel & Fisher (1997)	Intergroup conflict simulation (n = 128, in teams of 4)	- Intergroup competition decreases a group's problem-solving effectiveness - Intergroup competition increases group cohesiveness	Group problem solving effectiveness Social cohesion	Threat	Group
*	Sherif et al. (1961)	Simulated camp environment (quasi field-experiment) (n = 24 participants, in 2 teams)	- Intergroup competition increases intragroup solidarity, attraction, cohesion, pride, and emergent leadership - Intergroup competition increases unfavorable attitudes towards the outgroup	Verbal and physical actions revealing outgroup prejudice	Opportunity	Group
	Van Bunderen et al. (2018)	Experiment (n = 267) and Dutch insurance firm (n = 1809)	- The effect of interteam competition on team performance and team power struggles are dependent on the team's power structure	Power struggles Team performance	Threat	Group

*	Van Oostrum & Rabbie (1995)	Laboratory organization: reach agreement on a product (n = 96, teams of 6)	- Competitive intergroup relations result in marginally higher internal group cohesion than cooperative intergroup relations	Group cohesion	Unspecified	Group
*	Van Vugt et al. (2007)	Step-level public-goods game (n = 90–120)	- Men react stronger to intergroup conflicts than women - Men increase their contribution in intergroup conflicts	Contribution (Cooperation)	Unspecified	Individual
*	Van Vugt & Spisak (2008)	Step-level public-goods game (investment task) (n = 50)	- Group members prefer male over female leaders during intergroup competition	Leader preference	Threat	Individual
	Weisel & Böhm (2015)	Intergroup prisoner's dilemma-Maximizing difference game (n = 275-1550)	- Competing against a relational rival decreases individuals' contributions to the ingroup - Individuals punish the outgroup more frequently when the outgroup is a relational rival	Contribution (Cooperation) Outgroup punishment	Threat	Individual

Note: * indicates studies also listed in Appendix A in Van Bunderen et al. (2018).

APPENDIX B. Differences between Factory and Satellite Teams are Known

Substantial differences exist in tangible and intangible assets between factory and satellite teams. This Appendix gives some more context to the fact that these differences are well-known within MotoGP.

First, differences between factory and satellite teams are often mentioned in the media. For example, in an article commenting on the reasons why it is very hard to win a championship using a satellite team's motorcycle, Patterson (2022) reports:

> *"It's a feat that hasn't been achieved since 2001 (...) when Valentino Rossi took his Nastro Azzurro-branded Honda NSR500 to the last title of the two-stroke era, it was technically as a part of a satellite team (...). Since then, others, like Gibernau and Melandri, have come close, finishing second in the championship to Rossi in 2003, 2004 and 2005 for Fausto Gresini's satellite team.*
>
> *"Then there's the issue of resources. You might only see a crew chief and a data engineer sitting next to the rider in their box during practice – and in satellite teams, that's normally all that they've got in their corner, perhaps apart from one engineer from the factory perhaps shared between two riders. But in the factory squads, there's a whole other truck of data experts and number crunchers who you never see, working away behind the scenes all weekend. It's in their computers and strategy meetings that the details that give the final few hundredths of a second are calculated, from fuel consumption to tyre life."*

Second, differences between factory and satellite teams are often mentioned by riders. As in other professional sports, such as NASCAR and Golf (Bothner, Kim, & Smith, 2012), greater tangible and intangible assets can be highly advantageous for teams and their riders. Due to such potential advantages, riders have a strong desire to race for a factory team, and they often express this desire in media interviews. For example, Luca Marini (McLaren, 2023) noted:

> *"The goal of every rider is to try to go in a factory team and then try to win with that bike. We need to perform well on the satellite team to achieve this target (...) You want more gap between the satellite team and factory team. Because when you arrive [in a factory team] you reach your dream to compete in MotoGP for a factory team, you want to have this small gap, this small advantage. Because you make a big effort to arrive there. You show your potential, you sacrifice a lot for a ride there and if you have the same bike as another rider on the satellite team you are not happy."*

And Francesco Bagnaia (Ducati, 2021) similarly noted the following:

> *"As a rider, racing in MotoGP on a Ducati has always been my dream. And now, I am lucky enough to even be in a factory team. I couldn't have asked for more."*

APPENDIX C. During a Race, Riders Know Who is Ahead and Around

The MotoGP grid is composed of a small, elite group of two dozen or so riders who know each other well because they face one another every race and their careers often overlapped in prior series. Thus, riders are generally aware of the composition of the grid and the competing teams. This Appendix gives some more context to the fact that, even in the heat of the race, riders can and are keen to distinguish who is ahead on the track, and know who remains in the race. How do riders know who is ahead and around during the race?

First, riders can use visual cues, such as the colors and patterns on teams' bikes and competitors' racing suits. Each team's bike has its own colors and sponsors, which are identifiable during the race. For example, the factory Honda team is traditionally orange, the factory Ducati team is traditionally red, and the factory Yamaha teams is traditionally blue. Yet their respective satellite teams are white (Honda); white and red (Ducati); and black (Yamaha). Also, riders often have their (nick)names printed on their racing suits, and wear personalized helmets, both which are also identifiable during the race. Here is an example of Valentino Rossi's suit displaying his nickname "The Doctor":

Source: https://www.mcnews.com.au/german-motogp-all-category-preview-and-aest-weekend-schedule/

Moreover, the rider's team can inform the rider of important changes in the race using the pit board. Each lap, team members at the pit wall prepare a pit board showing to the rider (passing on the main straight) such things as which competitor is ahead, which one is behind, and their relative time gaps. In some cases, they also display whether some critical contender left the race (e.g., due to a crash, a disqualification, or a technical issue with his bike). Riders often report looking not just at their own pit boards but also (and sometimes especially) those of their competitors. This is an example of what the display of pit boards can look like:

Source: https://www.mcnews.com.au/german-motogp-all-category-preview-and-aest-weekend-schedule/

Knowing who is ahead and around is critical during the heat of a race because riders use all this information continuously to make decisions and adjust their approach. In a conversation in March 2023, Paolo Ciabatti (Sporting Director at MotoGP Ducati) powerfully illustrated the need for riders' continuous awareness of their competition, using the competitive action of overtaking as an example:

> *"Yes, of course they [the riders] always know which bike and rider they are about to overtake, and it is important they do, as they need to adjust their attack to the competitors' performance and style. For example, if a rider with a slower bike, for example someone racing in a satellite bike, tries to overtake a rider on a factory team, he knows he will probably have to brake much later to compensate the difference in speed and performance of the defending rider, or try to enter faster in the turn, and the factory bike will be hard to be passed on a straight. Also, riders have to know who is the rider ahead, because different riders have different riding styles, and ways to defend and attack. Some break later, others stay closer to the apex in a turn, others again prefer larger trajectories…if you can guess what is the trajectory your opponent will follow, you can try to pass him on another trajectory."*

APPENDIX D. Updating Independent Variables from Race to Race

Table D1 reports point estimates after substituting race-level versions of the independent variables for the lap-level versions in the manuscript. In these models, all other variables are the same as in Tables 2 and 3 in the manuscript, yet we omitted *Previous internal overtakes (race)* and *Previous external overtakes (race)*. These variables are now intermediate outcomes because they occur between the start of the race, when the independent variables update, and the dependent variables—i.e., overtakes during a focal lap. This means inferences based on the coefficients on competitive threat/opportunity in models also conditioning on previous overtakes during the focal race would be biased (e.g., Angrist & Pischke, 2009: Section 3.2.3; Elwert & Winship, 2014; Gelman & Hill, 2007: Section 9.7; Wooldridge, 2005).

Table D1. Conditional Fixed-Effects Poisson QML Estimates of Overtakes: Independent Variables Updated from Race to Race

	(1)	(2)	(3)	(4)
DV:	Internal overtakes		External overtakes	
Hypotheses:	H1a/H2a	H3a/H4a	H1b/H2b	H3b/H4b
Competitive threat (CT)	-0.0413***		0.0082	
	(0.0151)		(0.0067)	
Competitive opportunity (CO)	0.0033		0.0220***	
	(0.0157)		(0.0085)	
CT (inferior resources)		-0.0539**		0.0226**
		(0.0246)		(0.0099)
CT (similar resources)		-0.0399		0.0040
		(0.0245)		(0.0097)
CT (superior resources)		0.0073		-0.0025
		(0.0359)		(0.0178)
CO (inferior resources)		0.0009		0.0150
		(0.0366)		(0.0112)
CO (similar resources)		-0.0112		0.0192*
		(0.0174)		(0.0113)
CO (superior resources)		0.0498		0.0402**
		(0.0362)		(0.0156)
Controls	Y	Y	Y	Y
N (rider-laps)	104,146	104,146	104,566	104,566
N (riders)	103	103	121	121
Log pseudolikelihood	-7747	-7743	-48534	-48530

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

APPENDIX E. OLS Representations of Correlations for Key Variables

Table E1 reports basic OLS estimates of the hypothesized relations, in line with the journal's drive towards greater transparency. All such estimates can be recovered directly from the summary statistics and correlation matrix (Table 1 in the manuscript), some even readily by hand (for example, because $b_{xy} = r_{xy} * s_y / s_x$). Clearly, these basic OLS estimates cannot be used for valid inferences regarding our hypotheses. Indeed, the estimates pool diverse observations across a grand total of 125 riders, 24 teams, 28 racetracks, 17 calendar years, up to 32 laps per race, and up to 19 races per tournament, for a total of 104,606 unique rider-lap combinations. For meaningful inferences, inclusion of appropriate controls to capture such heterogeneity is needed to render point estimates unbiased and consistent, as are appropriate choices regarding the estimator and standard errors.

Table E1. Basic OLS Representations of Correlations without Control Variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DV:	Internal overtakes				External overtakes			
Hypothesis:	H1a	H2a	H3a	H4a	H1b	H2b	H3b	H4b
Competitive threat (CT)	-0.0001				0.0076***			
	(0.0002)				(0.0008)			
Competitive opportunity (CO)		0.0003*				0.0099***		
		(0.0002)				(0.0008)		
CT (inferior resources)			-0.0004				0.0051***	
			(0.0003)				(0.0014)	
CT (similar resources)			0.0003				0.0088***	
			(0.0003)				(0.0015)	
CT (superior resources)			-0.0005				0.0085***	
			(0.0005)				(0.0023)	
CO (inferior resources)				-0.0004				0.0071***
				(0.0004)				(0.0018)
CO (similar resources)				0.0008**				0.0128***
				(0.0003)				(0.0016)
CO (superior resources)				-0.0000				0.0072***
				(0.0004)				(0.0021)
Controls	N	N	N	N	N	N	N	N
N (rider-laps)	104,606	104,606	104,606	104,606	104,606	104,606	104,606	104,606
N (riders)	125	125	125	125	125	125	125	125
R-squared	0.0000	0.0000	0.0000	0.0001	0.0009	0.0016	0.0010	0.0017

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

APPENDIX F. Estimates in Matched Samples

This Appendix shows point estimates for *Competitive threat* and *Competitive opportunity* in samples pre-processed through coarsened exact matching (CEM; Iacus, King, & Porro, 2012). Matching ensures that hypotheses on the key variables are tested using only data for 'treated' and 'untreated' units that are comparable on covariates, both in terms of balance and overlap (Gelman & Hill, 2007: Chapter 10). Thus, it restricts hypotheses tests to the "*region of common empirical support*" (Iacus et al., 2012: 11). In this Appendix, we show estimates in matched samples to test Hypotheses 1a/b and 2a/b. Available matching methods require one individual treatment variable, precluding us from generating interpretable matches to test Hypotheses 3a/b and 4a/b.

We generated separate matched samples for tests of hypotheses on competitive threat and competitive opportunity. These two 'treatments' are count variables that vary between 0 and, respectively, 13 and 17. Therefore, we achieved covariate balance by matching each observation *above* the median for competitive threat/opportunity to one or multiple others *below* the median for competitive threat/opportunity, yet otherwise similar on matching covariates. Our matching procedure specifically addresses correlations among competitive threat, competitive opportunity, and season stage (see Table 1 in the manuscript). The possible imbalance due to such correlations can be adjusted through control variables. Yet imperfect covariate overlap between treated and control groups might still render inferences model-dependent after regression adjustment (King & Zeng, 2006).

To analyze the effects of competitive threat, we match on competitive opportunity and season stage. To analyze the effects of competitive opportunities, we instead match on competitive threat and season stage. We relied on Stata's CEM implementation to algorithmically determine bins for the matching covariates. Matching for competitive threat substantially reduced L1 distance, CEM's global imbalance measure, from 0.54 to 0.28. Matching for competitive opportunity also clearly reduced L1 distance from 0.47 to 0.24. Using the two matched samples, Table F1 shows unconditional fixed-effects estimates that allow proportionate weights to account for differences in the sizes of matching strata. Panel A shows estimates matched for competitive threat. Panel B shows estimates matched for competitive opportunity. The hypothesis-testing results are robust to matching.

Table F1. Unconditional Fixed-Effects Poisson QML Estimates of Overtakes in Matched Samples: Hypotheses 1a/b and 2a/b

Panel A: Matched samples for competitive threat as treatment		
DV:	Internal overtakes	External overtakes
Hypothesis:	H1a	H1b
Competitive threat	-0.0679***	0.0280**
	(0.0236)	(0.0126)
Controls	Y	Y
N (rider-laps)	95,464	95,464
N (riders)	125	125
Log pseudolikelihood	-6823	-41943

Panel B: Matched samples for competitive opportunity as treatment

DV:	Internal overtakes	External overtakes
Hypothesis:	H2a	H2b
Competitive opportunity	0.0356	0.0425***
	(0.0265)	(0.0110)
Controls	Y	Y
N (rider-laps)	100,602	100,602
N (riders)	125	125
Log pseudolikelihood	-6990	-46529

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

APPENDIX G. Full-Sample Estimates of External Overtakes

Table G1 reports point estimates of models predicting *External overtakes* in the full sample, before excluding rider-laps in which a rider had no teammates in the race. We estimated variants omitting (Models 1 and 2) and including (Models 3 and 4) dummy-variable controls for the number of teammates in the race. The omitted category is zero teammates in the race.

Table G1. Conditional Fixed-Effects Poisson QML Estimates of External Overtakes: Full Sample including Riders without Teammates in Race

	(1)	(2)	(3)	(4)
DV:	External overtakes			
Hypotheses:	H1b/H2b	H3b/H4b	H1b/H2b	H3b/H4b
Competitive threat (CT)	0.0189***		0.0194***	
	(0.0052)		(0.0052)	
Competitive opportunity (CO)	0.0281***		0.0285***	
	(0.0071)		(0.0071)	
CT (inferior resources)		0.0304***		0.0309***
		(0.0092)		(0.0092)
CT (similar resources)		0.0161**		0.0165**
		(0.0071)		(0.0071)
CT (superior resources)		0.0111		0.0114
		(0.0130)		(0.0130)
CO (inferior resources)		0.0252***		0.0261***
		(0.0092)		(0.0093)
CO (similar resources)		0.0221***		0.0223***
		(0.0083)		(0.0083)
CO (superior resources)		0.0483***		0.0486***
		(0.0123)		(0.0123)
One teammate in race (0/1)			0.0320	0.0330
			(0.0280)	(0.0278)
Two teammates in race (0/1)			0.0623	0.0608
			(0.0802)	(0.0817)
Controls	Y	Y	Y	Y
N (rider-laps)	133,946	133,946	133,946	133,946
N (riders)	132	132	132	132
Log pseudolikelihood	-60471	-60467	-60470	-60466

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

APPENDIX H. Controlling for Overtake Opportunities

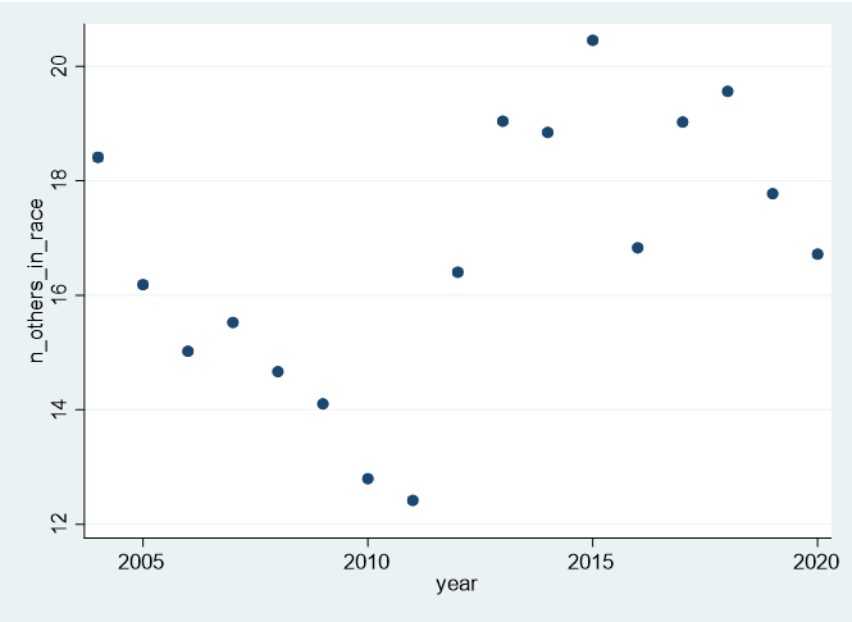
Table H1 reports point estimates after adjusting for overtake opportunities. A rider's opportunities for overtakes may vary, for example, with the number of riders in the race. Usually, a rider has one teammate in the race, yet sometimes they have two. Models 1 and 2 show estimates that adjust for whether a rider has two rather than one teammate/s in the race. The variable has the expected positive coefficient.

Table H1. Conditional Fixed-Effects Poisson QML Estimates of Overtakes: Controlling for Overtake Opportunities

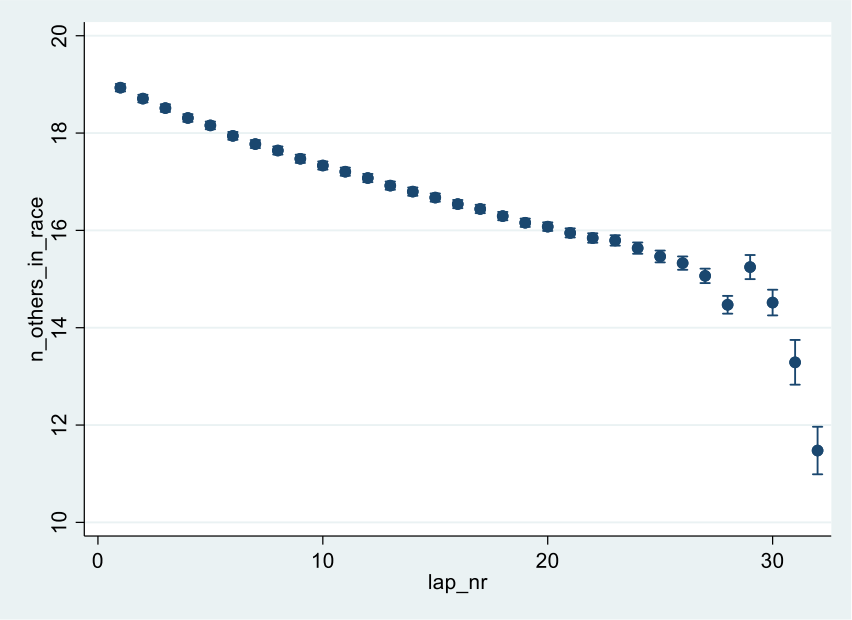
	(1)	(2)	(3)	(4)	(5)	(6)
DV:	Internal overtakes		Internal overtakes		External overtakes	
Hypotheses:	H1a/H2a	H3a/H4a	H1a/H2a	H3a/H4a	H1b/H2b	H3b/H4b
Competitive threat (CT)	-0.0343**		-0.0352**		0.0162**	
	(0.0145)		(0.0153)		(0.0065)	
Competitive opportunity (CO)	0.0110		0.0076		0.0280***	
	(0.0157)		(0.0158)		(0.0080)	
CT (inferior resources)		-0.0458**		-0.0425*		0.0248**
		(0.0220)		(0.0234)		(0.0104)
CT (similar resources)		-0.0330		-0.0360		0.0170**
		(0.0239)		(0.0249)		(0.0085)
CT (superior resources)		0.0048		0.0080		-0.0005
		(0.0379)		(0.0378)		(0.0159)
CO (inferior resources)		0.0164		0.0061		0.0217*
		(0.0344)		(0.0349)		(0.0114)
CO (similar resources)		-0.0097		-0.0121		0.0286***
		(0.0192)		(0.0195)		(0.0100)
CO (superior resources)		0.0598*		0.0654*		0.0348**
		(0.0357)		(0.0357)		(0.0144)
Two teammates (0/1)	1.0888***	1.0806***				
	(0.1046)	(0.1063)				
Distance to teammate ahead			-0.0000***	-0.0000***		
			(0.0000)	(0.0000)		
Distance to external ahead					-0.0899***	-0.0899***
					(0.0144)	(0.0144)
Controls	Y	Y	Y	Y	Y	Y
N (rider-laps)	104,146	104,146	104,103	104,103	104,523	104,523
N (riders)	103	103	103	103	121	121
Log pseudolikelihood	-7703	-7700	-7739	-7735	-47579	-47577

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

By sheer numbers, the risk set of external riders can vary more than the number of internal riders. Yet most such variation is predictably due to (1) the year of the championship and (2) the progression of a race. Regarding (1), some seasons saw fewer teams enter the MotoGP championship. Throughout such seasons, of course, fewer external riders were in the race (n_others_in_race), as shown in a scatter plot of averages binned by calendar year here:



Regarding (2), the average number of riders reduces predictably from earlier to later laps in a race, as shown in a scatter plot of averages binned by lap here:



Both these effects are absorbed by year and lap fixed effects included in all our models. As a result of these and all other relations to existing covariates, an additional lap-varying control for the number of other riders in the race would have a tolerance of about 0.01. This means ~99% of the variation captured by this control is already captured in our models, via a linear combination of existing control variables. Moreover, inclusion of such a variable would increase the average variance inflation factor across the other variables by well over 10%. Taken together, variation in the opportunity set of external riders—in terms of their number—is already fully accounted for through our large number of existing covariates.

A different kind of variance in opportunity exists too, which occurs even if the number of riders in the race is constant. This is the distance to the first internal or external rider ahead on the track, on a lap-by-lap basis. If a rider is close to the rider ahead, their opportunity to overtake during a lap is greater than if the distance is larger, all else equal. One might argue that such distance represents part of the mechanism leading to observed overtakes because part of the competitive action of overtaking is deciding to get closer in the first place. Still, getting close to a rider does not necessarily mean overtaking them because overtaking is a separate decision. To isolate the competitive action of overtaking, Models 3-6 in Table H1 adjust for the distance (in seconds) to the nearest internal or external rider ahead.

Next, internal and external opportunities might be linked, in that an imminent opportunity for an external overtake might preclude such opportunity for an internal overtake, and vice versa. On this intuition, Table H2 shows estimates adjusting for whether, at the start of a lap, an external rider rather than an internal rider was first ahead of the focal rider. The variable has the expected negative sign in models predicting internal overtakes, and the expected positive sign in models predicting external overtakes. Across Tables H1 and H2, our key results are robust.

Table H2. Conditional Fixed-Effects Poisson QML Estimates of Overtakes: Controlling for Affiliation of First Rider Ahead

	(1)	(2)	(3)	(4)
DV:	Internal overtakes		External overtakes	
Hypotheses:	H1a/H2a	H3a/H4a	H1b/H2b	H3b/H4b
Competitive threat (CT)	-0.0335**		0.0134**	
	(0.0148)		(0.0060)	
Competitive opportunity (CO)	0.0069		0.0289***	
	(0.0157)		(0.0076)	
CT (inferior resources)		-0.0418*		0.0289***
		(0.0235)		(0.0090)
CT (similar resources)		-0.0342		0.0119
		(0.0245)		(0.0089)
CT (superior resources)		0.0123		-0.0067
		(0.0374)		(0.0160)
CO (inferior resources)		0.0044		0.0175*
		(0.0353)		(0.0099)
CO (similar resources)		-0.0117		0.0279***
		(0.0191)		(0.0106)
CO (superior resources)		0.0629*		0.0469***
		(0.0355)		(0.0130)
External rider first ahead (0/1)	-0.3297***	-0.3314***	0.4486***	0.4504***
	(0.1242)	(0.1243)	(0.0452)	(0.0451)
Controls	Y	Y	Y	Y
N (rider-laps)	104,146	104,146	104,566	104,566
N (riders)	103	103	121	121
Log pseudolikelihood	-7736	-7732	-48012	-48007

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

APPENDIX I. Simultaneous-Equation Estimates

Table I1 reports point estimates for two simultaneous-equations models that jointly predict the internal and external overtakes for all available rider-laps, in the spirit of Zellner (1962). Model 1 tests Hypotheses 1a/b and 2a/b, while Model 2 tests Hypotheses 3a/b and 4a/b.

Table I1. Seemingly Unrelated Unconditional Fixed-Effects Poisson QML Estimates of Overtakes

	(1)		(2)	
DV:	Internal overtakes	External overtakes	Internal overtakes	External overtakes
Hypotheses:	H1a/2a	H1b/2b	H3a/4a	H3b/4b
Competitive threat (CT)	-0.0345**	0.0147**		
	(0.0153)	(0.0059)		
Competitive opportunity (CO)	0.0071	0.0278***		
	(0.0159)	(0.0076)		
CT (inferior resources)			-0.0412*	0.0273***
			(0.0235)	(0.0094)
CT (similar resources)			-0.0354	0.0128
			(0.0249)	(0.0082)
CT (superior resources)			0.0076	0.0006
			(0.0381)	(0.0159)
CO (inferior resources)			0.0051	0.0180*
			(0.0351)	(0.0100)
CO (similar resources)			-0.0127	0.0281***
			(0.0195)	(0.0099)
CO (superior resources)			0.0659*	0.0411***
			(0.0358)	(0.0135)
Controls	Y	Y	Y	Y
N (rider-laps)	104,606		104,606	
N (riders)	125		125	

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

APPENDIX J. Contractual Conditions

To specify variables capturing riders' contractual conditions (see Table 4 in the manuscript), we hand-collected data on such things as rider retirement announcements, new-rider signings, and replacement riders. We collected the data from motogp.com, MotoGP's official database; from numerous websites broadly covering motorsports (e.g., asphaltandrubber.com, autosport.com, bbc.co.uk, crash.net, gpone.com, motorcyclenews.com, motomatters.com, motorsport.com, roadracingworld.com, speedcafe.com); and from Wikipedia. Table J1 shows selected announcements drawn from the resulting database, which contains close to 1,000 relevant articles.

Table J1. Selected Announcements to Establish Riders' Contractual Conditions

Rider ID	Team ID	Date	URL	Notification type
99	3	14-Nov-2019	https://www.motogp.com/en/news/2019/11/14/jorge-lorenzo-announces-retirement/317873	Rider retirement
5	13	15-Aug-2014	https://www.motogp.com/en/news/2014/08/15/de-angelis-replaces-edwards-at-ngm-forward-racing/164787	Rider retirement
52	16	20-Nov-2013	https://www.crash.net/motogp/news/198427/1/provisional-2014-motogp-entry-list-revealed	Rider retirement
11	8	26-Oct-2013	https://www.motogp.com/en/news/2013/10/26/ben-spies-announces-retirement-from-racing/162906	Rider retirement
4	1	17-May-2016	https://www.motogp.com/en/news/2016/05/17/andrea-dovizioso-confirmed-with-ducati-for-2017-and-2018/201065	Rider signing
93	3	12-Jul-2012	https://www.motogp.com/en/news/2012/07/12/dani-pedrosa-and-marc-m-rquez-to-race-together-in-repsol-honda-team/158975	Rider signing
46	7	19-Jul-2008	https://www.crash.net/motogp/news/81023/1/valentino-rossi-re-signs-with-yamaha	Rider signing
56	27	13-Jan-2004	https://www.motogp.com/en/news/2004/01/13/shinya-nakano-officially-signs-for-kawasaki/135709	Rider signing
38	10	23-Jun-2020	https://www.motogp.com/en/news/2020/06/23/smith-confirmed-for-opening-two-rounds-of-2020/332149	Rider replacing other rider / Reason: doping suspicion
31	7	6-Nov-2020	https://the-race.com/motogp/gerloff-replaces-rossi-in-valencia-practice-at-least/	Rider replacing other rider / Reason: COVID
7	3	16-Jun-2011	https://www.motogp.com/en/news/2011/06/16/dani-pedrosa-has-successful-operation/156045	Rider replacing other rider / Reason: injury
36	1	11-Aug-2009	https://www.motogp.com/en/news/2009/08/11/stoner-out-of-action-for-three-races-kallio-to-join-hayden-in-ducati-marlboro-team/150747	Rider replacing other rider / Reason: health (fatigue)

Using these data, we were able to code reliably the contractual conditions for over 95% of all 104,606 observations. Specifically, for every available rider-lap, we coded whether at that moment in time (no = 0/yes = 1) the rider's contract was up for possible renewal (*Contract up*; mean = 0.53), they were a replacement rider (*Replacement*; mean = 0.04), or voluntarily (*Voluntary notice*;

mean = 0.06) or involuntarily (*Involuntary notice*; mean = 0.08) on notice. A rider-lap scoring zero on all these binary variables would pertain to a permanent rider. In a small number of cases, we did not unambiguously know that a rider was definitely a permanent employee. We still coded them as such, yet also conservatively included a separate dummy variable (*Ambiguous*) for the subset of such cases, so that our estimates would not be biased. The relatively larger mean for *Contract up* reflects that multi-year contracts are not standard in MotoGP. Thus, many riders must vie for a new contract (with their own or any other team) at least at some point during a season.

Table J2 shows estimates adjusted for the main effects of a rider's contractual condition during a specific rider-lap observation.

Table J2. Conditional Fixed-Effects Poisson QML Estimates of Overtakes: Controlling for Contractual Conditions

	(1)	(2)	(3)	(4)
DV:	Internal overtakes		External overtakes	
Hypotheses:	H1a/H2a	H3a/H4a	H1b/H2b	H3b/H4b
Competitive threat (CT)	-0.0339**		0.0145**	
	(0.0150)		(0.0060)	
Competitive opportunity (CO)	0.0095		0.0287***	
	(0.0158)		(0.0075)	
CT (inferior resources)		-0.0411*		0.0264***
		(0.0234)		(0.0096)
CT (similar resources)		-0.0335		0.0137*
		(0.0242)		(0.0081)
CT (superior resources)		0.0055		-0.0019
		(0.0375)		(0.0161)
CO (inferior resources)		0.0052		0.0192*
		(0.0347)		(0.0098)
CO (similar resources)		-0.0084		0.0291***
		(0.0196)		(0.0097)
CO (superior resources)		0.0653*		0.0410***
		(0.0357)		(0.0135)
Contractual condition:				
Ambiguous	-0.2962	-0.2913	0.0275	0.0243
	(0.1884)	(0.1866)	(0.0522)	(0.0518)
Contract up	0.0411	0.0333	0.0560**	0.0565**
	(0.0709)	(0.0721)	(0.0270)	(0.0268)
Replacement	-0.0324	-0.0407	0.0236	0.0252
	(0.2009)	(0.2029)	(0.0912)	(0.0904)
Voluntary notice	0.0257	0.0233	0.0141	0.0150
	(0.1169)	(0.1174)	(0.0440)	(0.0439)
Involuntary notice	0.0263	0.0192	0.0255	0.0249
	(0.1203)	(0.1193)	(0.0432)	(0.0425)
Controls	Y	Y	Y	Y
N (rider-laps)	104,146	104,146	104,566	104,566
N (riders)	103	103	121	121
Log pseudolikelihood	-7746	-7742	-48308	-48305

Robust standard errors in parentheses. The omitted contractual condition is "Permanent".
*** p<0.01, ** p<0.05, * p<0.1

4. THE EFFECT OF INTERNAL COMPETITION ON FIRM PERFORMANCE WHEN COMPETING IN IDENTITY DOMAINS AND AGAINST RIVALS

The literature on intergroup competition suggests that interfirm competition may mitigate the negative effect of internal competitions for career opportunities on firm performance. However, these studies typically examine one-shot intergroup competitions that do not vary in importance to the groups, and focus on groups where members do not have external career ambitions. Therefore, it is unclear whether this hypothesis extends to firms. I study how interfirm competition influences the relationship between internal competition intensity – i.e., the number of employees competing for a fixed number of internal career opportunities – and firm performance. I propose that increased internal competition intensity negatively affects firm performance by leading a greater proportion of the workforce to prioritize their individual performance over the firm's performance. This effect is diminished under interfirm competitions that receive significant attention from the current employer, as these competitions encourage employees to focus more on the firm's performance. Conversely, when interfirm competition draws more attention from external employers, employees are more likely to focus on their individual performance, further damaging firm performance. I test these hypotheses using panel data from the National Hockey League (NHL) covering the years 2014-2020. The results support my hypotheses.

INTRODUCTION

Internal competitions, in which employees vie for career opportunities such as promotions or permanent contracts, can significantly affect firm performance. In these competitions, employees with career concerns exert effort to build a reputation for superior abilities, thereby increasing their chances of securing career opportunities (Fama, 1980; Holmström, 1999; Stiroh, 2007). Since only a limited number of opportunities are available at any time, employees are evaluated relative to their colleagues to determine who secures these opportunities (Miklos-Thal & Ullrich, 2016). Consequently, employees may try to outrank others by avoiding collaborating with them and, in extreme cases, sabotaging their performance (Auriol, Friebel, & Pechlivanos, 2002; Chalioti, 2016; Lazear, 1989). These behaviors are particularly damaging when employees' tasks are interdependent, requiring more collaboration and efficient coordination for the firm to succeed (e.g., Lindenberg & Foss, 2011; Wageman & Baker, 1997). Thus, increasing the internal

competition intensity by including more employees in the internal competition is likely to result in worse firm performance.

These internal competitions are part of an interfirm competition, which shapes how employees compete for career opportunities (Hallila, Frankort, & Aversa, 2024). The effect of interfirm (or group) competition on individuals' willingness to prioritize the collective's interest has been extensively studied in economics, psychology and management (Böhm, Rusch, & Baron, 2020; De Jaegher, 2021). A common prediction in this body of literature is that interfirm competition fosters cooperation by increasing punishments for members acting in self-interest (Abbink, Brandts, Herrmann, & Orzen, 2010; Benard, 2012) and by threatening the collective's – and consequently its members' – access to resources (Bornstein, 1992; Bornstein & Rapoport, 1988) and identity (Ashforth & Mael, 1989; Tajfel, 1978). Naturally, this suggests that interfirm competition should discourage competitive behaviors targeted at colleagues, ultimately reducing the harmful effect of internal competition intensity on firm performance.

However, this body of literature, which often relies on minimal group and team game studies[26], has implemented research designs, such as the intergroup prisoner's dilemma (e.g., Bornstein, 1992), that omit two critical aspects of internal competition in firms. First, it overlooks the locus of employees' career ambitions. Unlike in minimal group and team game studies where individuals cannot switch groups, employees frequently pursue career opportunities outside their firm (e.g., Bidwell, Won, Barbulescu, & Mollick, 2015). Thus, employees must consider their reputations both within and outside their current firm. Second, the literature does not adequately differentiate between the various types of competitions firms face. Minimal group and team game

[26] In minimal group studies the subjects' group membership is an arbitrary label that is randomly imposed by the experimenter (Goette, Huffman, & Meier, 2012a). For example, subjects might be randomly assigned into a red or blue team. Similarly, in team games, group membership is determined in the same random manner (e.g., Bornstein, 1992, 2003). However, the intergroup competition in team games arises from negative reward interdependency rather than solely from a threat to the subjects' group identity, which is often the case in minimal group studies.

studies typically examine one-off competitions lacking broader significance to the group (Doyle, Pettit, Kim, To, & Lount, 2022). In contrast, firms engage in ongoing competitions in markets (Livengood & Reger, 2010) and against specific opponents (Kilduff, Elfenbein, & Staw, 2010), each carrying different weights of importance and attracting varying levels of attention from within and outside the firm. The attention from firms can influence employees' choice to focus on their individual or firm's performance. Interfirm competitions that gather more external attention may become platforms for employees to showcase their abilities for personal gain (Hallila et al., 2024; Uhlmann & Barnes, 2014). An excessive focus on one's personal gains can be particularly damaging when employees' tasks are interdependent (Bachrach et al., 2006; Wageman & Baker, 1997). Therefore, the prevailing prediction may not hold as interfirm competition must not always mitigate the adverse effects of internal competition, but instead it can exacerbate them.

In this study, I ask: '*How does interfirm competition affect the relationship between internal competition intensity and firm performance?'* Drawing from the literatures on career concerns (Holmström, 1999; Miklos-Thal & Ullrich, 2016) and competitive dynamics (Kilduff, 2019; Kilduff et al., 2010; Livengood & Reger, 2010), I develop three hypotheses. First, aligning with existing research, I hypothesize that internal competition intensity decreases firm performance by increasing the number of employees' focusing on their individual performance, thereby decreasing collaboration and increasing coordination errors. Next, I propose that the effect varies based on the level of attention interfirm competition receives from both the current employer and external employers, which is determined by the type of interfirm competition, specifically its location (Livengood & Reger, 2010) and the competitors involved (Kilduff et al., 2010). Attention from the current employer reduces the negative effect of internal competition. In contrast, attention from external employers increases the negative effect of internal competition.

I test my hypotheses using panel data on the population of teams in the National Hockey League (NHL), a popular setting for research on competition (Grohsjean, Kober, & Zucchini, 2016), from 2014 to 2020. I model a team's performance as a function of internal competition intensity – specifically, the number of players competing for a new contract – and the type of interfirm competition. Some of the specific features of the NHL make it an ideal setting for this study. First, players' tasks are highly interdependent and thus they need to collaborate for the team to win (Stuart, 2017; Trevor, Reilly, & Gerhart, 2012). Second, there is fierce internal competition for contracts, driven by the team's fixed salary budget, which restricts teams' ability to renew all their players' contracts. This fosters a competitive environment, similar to that of an internal competition for career opportunities in firms, where players must outperform their teammates to secure new contracts. Third, players receive varying degrees of attention from their current and external employers depending on the location and opponent in the competition. Home games primarily draw local fans and staff attention (Livengood & Reger, 2010), while games against rival teams draw broader attention within the league (Kilduff et al., 2010).

This study contributes to the career concerns literature by exploring how interfirm competition moderates the effect of internal competition density on firm performance (Auriol et al., 2002; Chalioti, 2016; Hallila et al., 2024; Miklos-Thal & Ullrich, 2016). Different types of interfirm competitions receive varying degrees of attention from current and external employers. The source of attention influences employees' decision to enhance their reputation by focusing on either their individual or firm performance. Furthermore, this study adds to the literature on intergroup competition by studying characteristics that are common in firms yet have not been examined in the prior literature (e.g., Barnes, Hollenbeck, Jundt, DeRue, & Harmon, 2011; Bornstein, 1992; Goette, Huffman, Meier, & Sutter, 2012b). Specifically, I show that employees' career concerns and the type of competition firms encounter can alter conventional predictions

about interfirm competition's effects on cooperation. Interfirm competition might not uniformly foster intrafirm cooperation; rather, when competing against rivals, it could actually diminish it. This nuanced perspective contributes to a deeper understanding of the complex dynamics at play in competitive environments.

THEORY AND HYPOTHESES

Internal Competition and Employees' Performance Focus

This study examines the consequences of internal competition intensity in firms with high task interdependency – that is when employee's task performance is highly dependent on others' efforts and skills (Wageman & Baker, 1997). Internal competition intensity is defined as the number of employees occupying similar positions within a firm and competing for a fixed set of career opportunities (Liu, Srivastava, & Stuart, 2016). These career opportunities, which can be internal or external, include promotions, permanent contracts, and job offers for more desirable positions within their current firm or at external firms. Additionally, these competitions are localized among employees vying for the same career opportunities (e.g., Kilduff et al., 2024; Piezunka, Lee, Haynes, & Bothner, 2018). Examples of such competitions include assistant professors competing for tenure (Edelman & Larkin, 2015), temporary employees pursuing permanent contracts (Engellandt & Riphahn, 2005), and players in team sports seeking contract extensions (Beus & Whitman, 2017; Stiroh, 2007) or spots on the national team (Miklos-Thal & Ullrich, 2016).

The career concerns model explains how employees compete for career opportunities in internal competitions (Fama, 1980; Holmström, 1999; Miklos-Thal & Ullrich, 2016). According to this model, the employer's task is to select the winner of the opportunity by identifying the employee with the greatest abilities – i.e., those whom the employer believes will be most productive in the future. To do this, they must first learn about employees' abilities. Because

employees' behaviors are often difficult to observe (e.g., Holmström, 1979), employers learn by making inferences based on employees' current performance. Consequently, employees have implicit incentives to increase their current performance by exerting more effort to build a reputation for possessing superior abilities.

Task interdependencies complicate the precise assessment of individual performance (Alchian & Demsetz, 1972; Uribe, Carnahan, Meluso, & Austin-Breneman, 2022), leading employers to evaluate employees on both their individual and firm's performance. Actions that benefit the firm, like sharing information and helping colleagues, are often hard to quantify and thus go unmeasured. Yet, these actions contribute to firm performance, underscoring its value as an indicator of an employee's ability to function productively within a firm. Thus, employers rely on aggregate level metrics, such as firm performance, to learn about aspects that are unmeasurable at the individual-level (e.g., Aggarwal & Samwick, 2003). Consequently, employers learn about employees' abilities through both their individual and firm performance. The emphasis placed on each performance metric in their assessments can vary. As a result, employees can influence employers' assessments by focusing on either their individual performance or their firm's performance.

Which performance focus employees adopt is crucial, as it influences the types of behaviors they engage in and the amount of attention they devote to anticipating their colleagues' needs (Barnes et al., 2011; Lindenberg & Foss, 2011). An individual performance focus drives employees to engage in actions that highlight their personal contributions (Beersma et al., 2003). For example, salespeople prioritize finalizing deals to boost their personal sales (Chan, Li, & Pierce, 2014), lawyers take on more projects to increase their billable hours (Chatain & Meyer-Doyle, 2017), and players in team sports focus more on scoring goals (Beus & Whitman, 2017). In contrast, a firm performance focus causes employees to pay more attention to the firm's goals and their colleagues'

needs (e.g., Foss & Lindenberg, 2013; Pearsall et al., 2010). Adopting a firm performance focus increases sales employees' tendency to share clients (Lee & Puranam, 2017) and facilitates more effective coordination by fostering a deeper understanding and responsiveness to the needs and actions of others within the firm (Foss & Lindenberg, 2013; Lindenberg & Foss, 2011).

Given that employees' performance focus influences their behavior and allocation of attention, which performance focus do employees in the internal competition adopt? Prior studies suggest that because of greed and fear, employees will adopt an individual performance focus (Barnes et al., 2011). Greed refers to employees' tendency to actively pursue their self-interests and fear concerns the possibility that others may receive credit for their work (Rapoport, 1987; Rapoport & Eshed-Levy, 1989). Individual performance metrics are directly credited to the employee, whereas firm success is attributed to the entire workforce or to only higher-status employees (e.g., Ethiraj & Garg, 2012; Uhlmann & Barnes, 2014). When internal competition intensity is high, the pressure to stand out is greater (Liu et al., 2016). Consequently, the fear of losing credit to others prompts employees to adopt an individual performance focus.

Employees' Performance Focus and Firm Performance

To this point I have argued that employees are more likely to influence employers' assessments by adopting an individual performance focus. Employees adopting an individual performance focus are particularly damaging for firms with high task interdependency. In such firms, effective collaboration and coordination are crucial for firm performance (Alchian & Demsetz, 1972; Wageman & Baker, 1997). Thus, an employee with an individual performance focus is more disruptive to firm performance than one who is focused on firm performance.

Consequently, increasing the intensity of the internal competition results in more employees focusing on their individual performance, reducing the amount of attention devoted to the firm's collective needs. Consequently, employees are worse at anticipating each other's actions,

increasing the number of coordination errors (Beersma et al., 2003) and decreasing collaboration within the firm (Lieberman, Lee, & Folta, 2017). Therefore, together these arguments suggest that intensifying internal competition hurts firm performance if task interdependency is high by increasing the proportion of the workforce prioritizing their individual needs over collective goals.

> ***Hypothesis 1:*** *An increase in the intensity of internal competition decreases firm performance.*

The Moderating Effect of Interfirm Competition

So far, I have argued that internal competition intensity hurts firm performance by increasing the number of employees focusing on their individual performance. A large multidisciplinary literature on intergroup competition suggests that interfirm competition can mitigate this effect by uniting employees against the external competitor (e.g., Böhm et al., 2020; De Jaegher, 2021). Most of these studies build on minimal groups or team games that employ research designs in which subjects are randomly allocated into groups that compete for a financial reward (e.g., Abbink et al., 2010; Bornstein, 1992; Bornstein & Ben-Yossef, 1994). Subjects then need to decide between defecting or cooperating by exerting costly effort on behalf of their group. Typically, subjects opt to cooperate, driven by the desire to protect their social identity (Chowdhury, Jeon, & Ramalingam, 2016), defend the group's access to resources (Sherif, Harvey, White, Hood, & Sherif, 1961; Van Bunderen, Greer, & Van Knippenberg, 2018), avoid peer sanctions (Abbink et al., 2010; Benard, 2012), and increase the chances of securing a larger collective reward (Erev, Bornstein, & Galili, 1993). These findings on minimal groups strongly imply that interfirm competition increases employees' focus on firm performance. Thus, employees in the internal competition should become less disruptive to firm performance when their firm faces competition.

However, findings from minimal group studies often fail to translate directly to real groups due to the latter's more complex social dynamics (Chowdhury et al., 2016; Goette, Huffman, &

Meier, 2012a). Particularly, two aspects prevalent in firms are absent in the research designs of minimal group studies. First, employees are motivated to pursue both internal and external career opportunities (e.g., Bidwell et al., 2015). Because of this, it is crucial for them that external employers also learn about their abilities. External employers have an inferior ability to discern employees' individual contributions in a setting with high task interdependency. Consequently, they are more likely to value strong individual performance that is externally verifiable (e.g., Bidwell, 2011; Kang et al., 2018), incentivizing employees to focus on their individual performance. This is in stark contrast to minimal group studies where participants are unable to switch groups and thus do not face the dilemma of appealing to external groups (or employers).

Second, the nature of competition differs markedly. Minimal group studies often involve one-off contests with no lasting significance beyond immediate financial gains for the winners (Doyle et al., 2022). In contrast, firms engage in interfirm competitions with varying significance to the firm and its competitors and thus attracting varying degrees of attention from them (Kilduff et al., 2010; Livengood & Reger, 2010). The focus and origin of this attention are pivotal; while scrutiny from an employee's current firm might deter actions damaging to the firm's interests, attention from external employers can create opportunities for employees to showcase their abilities. Therefore, interfirm competition must not increase employees' focus on firm performance as the intergroup competition literature suggests. Instead, interfirm competition that gathers more external attention can actually amplify employees' tendency to focus on their individual performance. To explain how attention from current and external employers may vary among different types of interfirm competitions, I build on findings from the competitive dynamics' literature (Chen, 1996; Chen & Miller, 2012).

Interfirm Competition in The Firm's Identity Domain

Some interfirm competitions take place in markets that employers perceive to be closer related to the firm's identity – i.e., their understanding of what are the central, distinctive and enduring aspects of the firm (Dutton & Dukerich, 1991). These markets are known as *identity domains*, defined as the competitive arena that best captures and reinforces the firm's sense of identity in the marketplace (Livengood & Reger, 2010). Identity domains must not be the most financially important markets, but instead they have high psychological value to the firm. Because of this, firms pay more attention, and respond more aggressively to competitive actions targeting these markets.

Consider Volvo as an example of an interfirm competition in a firm's identity domain. Volvo identifies itself strongly with safety (Livengood & Reger, 2010). It is an aspect that they are known for and take great pride in. For example, they highlight on their website that they have been "a leader in automotive safety for decades" ("Safety—Highlights," 2023). A competitor may initiate a competitive attack by launching a car that they advertise as having superior safety features compared to those of a competing model from Volvo. Volvo can respond to this attack by assigning an engineering team to improve the safety of its car. Thus, the employees in that team would be assigned to compete in Volvo's identity domain.

How does then competition within the firm's identity domain impact those in the internal competition? As noted earlier, these markets are of great psychological importance to their current employers due to the close connection with the firm's identity. A potential loss in the firm's identity domain is perceived to be highly damaging to the firm's identity. Thus, the current employer pays close attention to these interfirm competitions and heavily discounts the value of those employees that do not act in the firm's best interests. In addition, being part of the firm's success in its identity domain is likely to be noticed by the employer, resulting in a reputational gain for the employees. Individuals who are in the internal competition are particularly motivated to improve their

reputation to secure a career opportunity. Therefore, they are acutely aware of the costs and benefits tied to interfirm competition, causing them to prioritize the firm's performance more intensely.

In contrast, markets that the focal firm perceives as their identity domain must not be important for other firms (Livengood & Reger, 2010). For example, while Volvo highly values safety, this aspect is not as important to other car manufacturers because it is not closely connected to their identities or a particularly profitable market segment. Consequently, other firms, and therefore external employers, pay less attention to interfirm competitions in their competitors' identity domains[27].

Given that competition in the firm's identity domain gathers more attention from the current employer and less from external employers, employees have stronger incentives to focus on firm performance. A stronger focus on firm performance can lead to increased collaboration, more attention to colleagues' needs, and ultimately, more effective coordination of actions. Thus, adding an employee to the internal competition is less costly when the firm competes in its identity domain. Consequently, when the interfirm competition takes place in the firm's identity domain increasing internal competition intensity is less damaging to firm performance as more total attention is devoted to improving firm performance instead of individual performance.

> ***Hypothesis 2:*** *An increase in the intensity of internal competition is less negatively associated with firm performance when interfirm competition takes place in the firm's identity domain.*

Interfirm Competition Against the Firm's Rival

Some interfirm competitions are more important to a firm not because of the markets they take place in, but because of who the opponents are, such as competitions against rivals. A firm's

[27] If safety were an important market segment for the entire car industry, these interfirm competitions could attract more external attention. In such a scenario, the increase in attention from external employers would outweigh that of the current employer, leading employees to prioritize their individual performance, as explained in the section on rivalry. In my context, identity domains, however, gather significantly more attention from current employers.

rival is "a specific, identifiable opponent with whom the focal actor has an existing subjective relationship that drives significance, independently of the current situation" (Kilduff, 2019: 777). Rivalries emerge as a consequence of high similarity between firms (Porac, Thomas, Wilson, Paton, & Kanfer, 1995), repeated competitions (Reger & Palmer, 1996), and evenly matched competitions over time (Brehm, Wright, Solomon, Silka, & Greenberg, 1983). These factors change the nature of the competition in two ways. First, rivalries are part of a long-running narrative, not just one-shot events (Converse & Reinhard, 2016; Pike, Kilduff, & Galinsky, 2018). Second, the aim of the competition is not simply to gain resources from the opponent but to defeat them by any means necessary (Kilduff, Galinsky, Gallo, & Reade, 2016).

The rivalry between Ford and GM is an example of an interfirm rivalry. Their rivalry got started when GM hired William Knudsen from Ford in the 1920s to beat his old employer (Phelan, 2019). During this rivalry Ford and GM have been continuously launching new cars to beat each other's offerings. The most famous example of this is the Ford Thunderbird, which was called the "Corvette killer" because it was designed to capture market share from GM's most popular sports car, the Corvette. Given that the Corvette and Thunderbird were seen as competing products, those employees that were working on these cars are prime examples of employees that are part of an interfirm competition against their firm's rival.

Like interfirm competitions in the firm's identity domain, competitions against rivals have great psychological value to the firm. Rivalries causes status concerns to the firm, which increases the psychological importance of the competition (Kilduff et al., 2016). Thus, current employers pay more attention to these interfirm competitions (Kilduff, 2019). In addition, due to the extensive media coverage rivalries tend to receive, external employers also pay more attention to rivalries. Past studies have shown that rivalries increase firms' competitive activity (Kilduff et al., 2010; To, Kilduff, Ordoñez, & Schweitzer, 2018) and tendency to engage in unethical behavior (Kilduff et

al., 2016), both of which have been found to result in more extensive media coverage (Rindova, Petkova, & Kotha, 2007). In addition, rivals engage more frequently in media campaigns against each other (Cole & Chandler, 2019), which further increases the amount of attention rivalries receive from external employers.

Although rivalries receive more attention from both current and external employers, employees in the internal competition are more sensitive to attention from external employers. This increased focus on external career opportunities stems from two main factors: the perceived value of such opportunities and the likelihood of successfully acquiring them (e.g., Vroom, 1964). External opportunities are often associated with better compensation, and the broader market of external employers increases the chance of securing such positions. Therefore, rivalries function as a platform for employees to improve their reputation outside the firm. Particularly, those in the internal competition are likely to exploit these opportunities given their strong desire to external career opportunities.

The idea that those in the internal competition respond stronger to rivalries aligns with previous findings from the rivalry and incentives literatures. Past studies on rivalry find that employees adopt a promotion focus when facing their firm's rival (To et al., 2018). Such focus causes them to view the interfirm competition as an opportunity rather than a threat, motivating them to exert more effort (Kilduff et al., 2010), adopt aggressive strategies (Converse & Reinhard, 2016), and engage in unethical behaviors (Kilduff et al., 2016). These behaviors are consistent with the aim of enhancing visibility in competitions against rivals. Similarly, the incentive literature finds that employees respond more strongly to individual incentives than to team incentives (Barnes et al., 2011). For example, Uhlmann and Barnes (2014) find that basketball players collaborate less during playoff games. These games gather more external attention, making a strong individual performance more likely to result in a lucrative external job offer.

These arguments collectively suggest that employees prioritize their individual performance more intensely when their firm competes against a rival. As a result, they are less inclined to collaborate, pay less attention to their colleagues' needs, and ultimately, worse at coordinating their actions with their colleagues. Because these behaviors become more common, the marginal cost of adding an employee to the internal competition increases. Therefore, the intensity of internal competition has a greater negative effect on firm performance when competing against rivals.

> ***Hypothesis 3:*** *An increase in the intensity of internal competition is more negatively associated with firm performance when the firm competes against the firm's rival.*

METHOD

Empirical Setting

I test my hypotheses using data from the National Hockey League (NHL), the top professional ice hockey league in the world and a setting that has been used for research on competition (Grohsjean et al., 2016). The NHL is organized as an annual tournament, starting with an 82-game regular season. The top 16 teams then advance to the playoffs. Teams are organized into two conferences, East and West, each divided into two divisions: Atlantic, Metropolitan, Central, and Pacific. Playoff qualification and most games occur within these divisions, highlighting teams in the same division as primary competitors. Following the regular season, the eight best-performing teams from each conference proceed to the playoffs, an elimination tournament played as a best-of-seven series. Initially, teams compete within their conference, culminating in a final round against the opposing conference's champion for the 'Stanley Cup.'

Teams play with a lineup of 20 players – i.e., 12 forwards, 6 defenders, and two goaltenders – that are divided into four lines of three forwards and three pairs of defenders. The top-performing forwards play in the first or second line, with lower-performing ones in the third and fourth. Typically, the top lines are expected to contribute more offensively and bottom lines more

defensively. Lineups evolve throughout the season due to performance, injuries, and trades, affecting players' positions in the lineup and playing time. Besides active players, teams often have reserves competing for lineup spots and a minor league team of younger players aspiring for major league play, underscoring the continuous competition for a spot in the lineup.

Several features of the NHL make it an excellent setting for this study. First, ice hockey is a team sport, in which players need to collaborate for the team to succeed (Foster & Washington, 2009; Stuart & Moore, 2017; Trevor et al., 2012). The game is fast-paced, and players must coordinate their positioning and movements with their teammates to create and stop scoring chances against and by the opposing team. Thus, players must work well together for the team to succeed, something that is often highlighted by coaches during interviews (Francis, 2021).

Second, the NHL's fixed salary budget and roster size fuel intense internal competition for contracts. The league determines a maximum salary budget, called ‘salary cap,’ that teams cannot exceed under any conditions. For example, for the 2020-2021 season the salary cap was 81.5 million USD and 27 out of 31 teams spent within two million of the maximum salary cap. Because the salary cap is fixed, players must outperform their teammates to acquire a larger portion of the salary budget. For example, in 2021 the Tampa Bay Lightning were unable to retain Blake Coleman because more than half of their salary cap had already been allocated to the top five players, who the team’s management perceived to be more crucial for the team’s future (Amatulli, 2021). Moreover, the salaries resemble a tournament-based reward structure as the top line players are typically rewarded more than 8% of the salary cap, whereas the bottom line players tend to receive less than 2% of the cap. This creates a tournament-style salary structure, further motivating players to outperform teammates.

Third, players can prioritize both individual and team performance. Individual performance is measured using player statistics, such as goals and assists. Scoring goals of course helps the

team, but an excessive focus on individual statistics is damaging to team performance. For example, players often slack off on their defensive duties to save energy for attacking, resulting in more scoring opportunities for the opponent. Conversely, unmeasured but crucial actions like blocking shots, backchecking, closing passing lanes, and screening goaltenders signify team prioritization and often come at significant personal cost. For example, players often get injured when blocking shots and screening opponents' goal tenders. Injuries are costly as they will hurt players' performance and at worst end their careers.

Fourth, competition types can be accurately identified. The theoretical constructs of identity domains and rivalries have strong connections to sports settings. Thus, both types of competitions can be measured using metrics previously applied (Pike et al., 2018) or proposed (Livengood & Reger, 2010) in studies. In contrast, measuring these constructs can be difficult in more traditional settings, such as law firms or consultancies. For example, so far most firm-level studies on rivalries have used data from different sports settings, such as basketball (Kilduff et al., 2010), soccer (Kilduff et al., 2016), ice hockey (Pike et al., 2018), and football (To et al., 2018), precisely because of the challenges in measuring rivalries in non-sports settings.

Sample

I constructed an original panel dataset at the team-game level on the population of regular season games played in the NHL between seasons 2014-15 and 2019-20. During this time period all players' contracts are available, and teams have not yet implemented puck tracking, which was introduced for the 2020-21 season to give more granular data, such as passes and zone entries, on players' individual performance. Thus, teams have access to the same player statistics across all years in the dataset and they have a limited ability to measure different aspects of players' performance.

The game data is collected from NHL's official application programming interface (API) and players' contracts from Capfriendly.com. The NHL API includes play level data on games as well as detailed data on players and teams, whereas Capfriendly.com has data on contracts signed in the NHL. Capfriendly.com is one of the highest quality databases with sports contracts and it is commonly used by large sports broadcasters, such as TSN, ESPN, and the NHL Network. Because Capfriendly.com was missing two contracts, I supplemented the dataset using HockeyZonePlus and War-on-ice.com. The final dataset consists of 14,628 observations of 31 teams across six seasons with no missing values.

Dependent Variable: Team Performance

I measure team performance as the number of points the team won in the focal game (Stuart & Moore, 2017; Trevor et al., 2012). The variable *Points* is measured as a count. Teams receive two points for a win, one point for losses on overtime, and zero points for losses on regular time. I chose to use points as the dependent variable instead of wins – a measure previously used in studies on baseball (Bloom, 1999), basketball (Chen & Garg, 2018), and football (Aime, Johnson, Ridge, & Hill, 2010) – because league standings are calculated based on points and thus points eventually decide which teams get to compete for the championship (Stuart & Moore, 2017). Also, *Points* offer a more granular metric than wins, allowing differentiation between narrow overtime losses, which earn one point, and regular losses, which do not. Still, to ensure my findings are not dependent on my choice of dependent variable, I replicate the results using wins as the dependent variable as a robustness test, which is discussed in more detail in the results section.

Independent Variable: Internal Competition Intensity

I measure internal competition intensity as the number of players on the team without a contract for the following season – i.e., players in their 'contract year' (Beus & Whitman, 2017; Stiroh, 2007). Similar to career tournaments, players who are in their contract year compete for a

fixed number of career opportunities – i.e., a contract for next season – by signaling their abilities to their current and external employer (e.g., Miklos-Thal & Ullrich, 2016). NHL teams have a league-mandated salary budget and a fixed number of spots in their lineups. Therefore, only some of the players can win a contract extension at their current team, and larger contracts reduce the budget available for others.

The decision regarding who to keep in the team is based on the relative importance of the players, determined by the coaching staff's, team scouts', analysts', and general managers' perceptions of players' future performance. Teams use a mix of subjective evaluations and analytics to assess players. Similar to firms, teams can only access a limited set of individual performance metrics, such as assists, goals, blocked shots and hits. A more advanced puck tracking system was not introduced until the 2020-21 season, thus teams in my dataset do not have access to more granular metrics, such as passes (Lage, 2021). Using this information, teams must decide which players' contracts to renew and which to release. For example, in 2022, the Colorado Avalanche opted to renew the contract of their first-line winger, Artturi Lehkonen, over their second-line center, Nazem Kadri, due to Lehkonen's superior playoff performance (Dater, 2022). Five years Kadri's junior, Lehkonen was less likely to suffer a decline in performance due to aging.

I calculate the number of players that are in their contract year by first selecting all the players playing for the team in the focal game. I then remove goaltenders as they have a specialized role that is assessed differently from other players. After that, I identify a player to be in the final year of their contract if their current contract ends after the focal season and they have not signed a contract for the following year. Finally, I sum up all the players that are in their contract year to get the intensity of internal competition. I measure it as a count because the number of players in the game lineup is fixed at 18, ensuring the measurement is consistent across all observations.

Moderators

Identity domain. To test Hypothesis 2, I use a dummy variable for *Home games*. Livengood and Reger (2010) suggest that in sports, the team's 'home turf'—their home arena—serves as the equivalent of a team's identity domain. Home games are strongly connected to the team's identity through fan interactions, geographical location, and symbolic elements. First, entertaining fans is a key goal for NHL teams. The fan interactions during games, such as cheering successes and booing failures, imposes additional pressure on players to perform well. Second, the location of home arenas, often close to players' homes, fosters an emotional attachment to the city and its inhabitants, heightening the desire to excel in front of the home crowd. Third, home arenas are filled with symbols of the team's heritage, such as jerseys of significant players and championship banners displayed in the arena's ceiling, alongside personalized locker rooms featuring the team logo and designated seats for each player. Collectively, these elements underscore home games as the competitive arena most closely linked to the team's identity.

Rival. To test Hypothesis 3, I use a dummy variable for opponents the focal team perceives as their rivals. I identify rivals by using the article "*The Most Hated Opponents for Each NHL Team*" from Bleacher Report (Goss, 2012), in which a sports reporter lists the fiercest rivalries for each team. Generally, journalists are good at distinguishing rivalries from traditional forms of competition and thus lists created by them are excellent for identifying rivalries (Kilduff, 2019). In fact, the article I use has previously been used in a study on rivalry in the NHL (Pike et al., 2018).

Although I identify the team's rivals using the same article as Pike et al. (2018), my measurement differs from theirs as it allows teams to have multiple rivals. Pike et al. (2018) examine how a rival's performance in the previous season motivates the focal team to perform better in the next season. Their study design requires them to compare two teams and thus they only consider the team's main rival. Whereas my study design allows teams to have multiple rivals, like Kilduff et al. (2010) and To et al. (2018).

Control Variables

To mitigate potential omitted variable bias, I incorporate several controls. Lower quality players may be more likely to be without a contract for the next season. Thus, teams with more players in their contract year could perform worse due to their inferior human resources. To control for the quality of human resources, I include variables reflecting players' performance in the preceding season. First, players with more individual points – i.e., assists and goals – are considered higher performing (Stuart, 2017). Thus, I add variables for the average number of points the players in the lineup scored in the previous season split by players on the final year of their contract and other players. I measure the variables, *Avg. points per game previous season (Last year)* and *Avg. points per game previous season (Other)*, by dividing the sum of players points by the number of games they played in the previous season. Second, scoring is not the primary objective for all players (Stuart, 2017). For example, defenders' main task is to stop the opposing team from scoring rather than scoring themselves. Consequently, I add a second set of controls based on players' ice times measured similarly to the points variables as *Avg. ice time per game previous season (Last year)* and *Avg. ice time per game previous season (Other)*.

Younger players are more likely to be in their contract year. For example, younger players often receive shorter contracts because there is more uncertainty about their future performance. Hence, teams prefer to offer them shorter contracts, called 'bridge deals,' to gather more information on the players and to better understand their future potential (Gipe, 2018). Thus, teams with multiple last year contracts may be lower performing because they lack experience. To adjust for this, I add controls, *Total career games (Last year)* and *Total career games (Other),* calculated as the total number of games played in the NHL by players on the last year of their contract and other players.

Players on the last year of their contract are more likely to be acquired from "free agency" – i.e., players that are free to move teams during the summer – and thus have less experience playing with the other players on the team. I control for *familiarity* using a measure previously used in the NBA (Ethiraj & Garg, 2012). I calculate familiarity using the following formula:

$$Familiarity = \sum_i^N \sum_j^N RK_{ijk} / \left(\frac{N(N-1)}{2}\right) / (team\ games\ in\ last\ 12\ months), \quad (1)$$

where N is the size of the team's lineup and RK_{ijk} is the number of games in which players i and j played together in the last 12 months for team k.

Moreover, tournament theory suggests that a decrease in collaboration may be caused by larger pay inequalities (Bloom, 1999; Henderson & Fredrickson, 2001; Siegel & Hambrick, 2005) and that the intensity of competition is influenced by the ratio of the number of contestants to rewards (Orrison, Schotter, & Weigelt, 2004). Thus, I include a variable for *prize spread*, calculated as the coefficient of variation, which is the standard deviation of players' salaries divided by the mean of these salaries (Bloom, 1999). Additionally, I account for the size of the reward pool by including a control for the *Remaining budget for the next year*, calculated as the total salary commitments and buyouts divided by the next year's salary cap.

I control for the prior performance of the focal team and its opponents by introducing variables for the average points won per game in the season preceding the focal game (Stuart, 2017). To address the effect of direct competition within the same conference, I use a dummy variable for games against conference teams, reflecting the heightened importance of these matchups due to direct negative interdependencies between the teams' rewards (To et al., 2018).

Finally, I incorporate several fixed effects to the equations. Team and opponent fixed effects control for stable sources of team-level heterogeneity, such as team culture, quality of ownership, and assisting staff. Second, given the motivational effects that ranks have shown to have (Genakos & Pagliero, 2012), I include fixed effects for the team's rank in their conference prior to the game.

Third, season fixed effects control for rule changes in the league and changes in the league's salary cap. Finally, game number fixed effects control for potential changes in the teams' strategy across the season.

Estimation

Because the dependent variable is a count, I estimate all the models using a Poisson quasi-maximum likelihood (QML) estimator with conditional fixed effects pertaining to teams (Wooldridge, 1999). I chose to use this estimator as it is fully robust under only weak assumptions and accommodates auto-correlated error terms, overdispersion, and conditional heteroscedasticity. In addition, I use robust standard errors clustered at the team level to ensure I interpret my results in a conservative way.

RESULTS

Bivariate correlations and descriptive statistics for all the variables are presented in Table 1. Most of the correlations are moderate and thus there are no issues with multicollinearity.

Insert Table 1 about here

Table 2 presents conditional fixed-effects Poisson QML estimates of *Points.* Model 1 includes all the controls and functions as the baseline model. *Home game* has a positive and statistically significant ($p < .001$) coefficient, suggesting that it is a strong predictor of team performance. Controls *Avg. points per game previous season (Last year), Avg. points per game previous season (Other)*, *Avg. ice time per game previous season (Last year),* and *Avg. ice time per game previous season (Other)* all show positive coefficients but are not statistically significant. The lack of significance may be because the other controls already capture the effect of player quality. *Total career games (Last year)* and *Total career games (Other)* have both negative coefficients but only former is statistically significant ($p < .05$). In addition, *Familiarity* is positive

and highly significant ($p < .001$), suggesting that it is a strong predictor of team performance. Both *Coefficient of variance* and *Remaining budget for next year* have negative coefficients. The former has only weak statistical significance ($p < .10$) and the latter is significant ($p < 0.05$). *Team past performance* is positive but does not reach statistical significance. This result is important as it may imply that the model already includes the relevant controls to limit concerns with residual time-varying heterogeneity at the team level (Heckman & Borjas, 1980). Moreover, *Opponent past performance* is, as expected, significant ($p < .001$) with a negative coefficient.

Insert Table 2 about here

In Model 2, I add the independent variable *Internal competition intensity* to the baseline model. I find further support for Hypothesis 1 as *Internal competition intensity* has a negative coefficient ($b = -.0203$) and is statistically significant ($p = .001$). The results imply that a one standard deviation increase in internal competition intensity results in a 3.7% (exp[-.0234 * 1.839] = .963) reduction in team performance. The effect is substantial enough to cause at least one playoff team to miss the playoffs each season within the dataset. For example, in the 2016-17 season a 3.7% drop in performance would have excluded three teams, Ottawa Senators, Montreal Canadiens, and Toronto Maple Leafs, from the playoffs, underscoring the practical significance of these findings. Therefore, Hypothesis 1 is supported.

Model 3 tests Hypothesis 2, which predicts that the negative effect of internal competition intensity decreases when the team competes in its home arena. The interaction term *Internal competition intensity X Home game* is positive ($b = .206$) and statistically significant ($p < .05$). The results suggest that increasing internal competition intensity by one standard deviation decreases team performance by 1.9% (exp[(-.0312 + .0206) * 1.839] = .981) when the game is played in the

team's home arena and by 5.6% (exp[-.0312 * 1.839] = .944) otherwise. These findings show strong support for Hypothesis 2.

In Model 4 I test Hypothesis 3, which predicts that the negative effect of internal competition intensity is greater when facing a rival team. The interaction term *Internal competition intensity X Rival* is negative (b = -.0262) and statistically significant (p < .05). Increasing internal competition intensity by one standard deviation decreases team performance by 7.8% (exp[(-.0179- .0262) * 1.839] = .922) when the team competes against a rival and by 3.3% (exp[-.0179 * 1.839] = .967) otherwise. Therefore, the results support Hypothesis 3. Finally, in Model 5 I include both moderators and the results remain consistent with previous findings.

Robustness Tests

I performed two additional tests to ensure the robustness of my results. First, I estimate the models in Table 2 using fixed effects OLS regression models. I find no meaningful differences in the results in these unreported models. Second, instead of points I used *Wins* as the dependent variable. The variable is a dummy that equals one if the team won the game and otherwise zero. I estimate the models using linear probability models. Although the dependent variable is a dummy, I chose to use linear probability model to avoid issues related to estimating and interpreting results of logit models (Wooldridge, 2007). Also, to account for heteroskedasticity in the error term, I report standard errors that are clustered at the team-level (Angrist & Pischke, 2008).

The models are presented in Table 3. Model 7 includes all controls and functions as the baseline model. I test Hypothesis 1 in Model 8 and find strong support for it (b = -.0132; p < .001). The results suggest that a one standard deviation increase in internal competition intensity reduces the probability that the team wins the game by 2.4% (-.0132 * 1.839 = .0243).

Insert Table 3 about here

Next, I test Hypothesis 2 in Model 10. I find that the interaction term *Internal competition size X Home game* is positive (b = .005) but does not reach statistical significance (p > .10). It may be that even if players in their contract year focus more on team performance when they compete in their team's identity domain, this increase is not large enough to improve the team's chances to win. But instead, the increased focus on team performance may reduce the margin by which the team loses, and thus increases the number of games the team loses on overtime. I test this alternative explanation in Model 11, in which I use as the dependent variable a dummy that equals 1 if the team won at least 1 point – i.e., they lost on overtime or won – and else 0. Now the interaction term *Internal competition intensity X Home game* (b = .0131) is positive and significant (p < .001), suggesting that increasing internal competition intensity results in a 1.0% ([.0131 - .0186] * 1.839 = -.0101) decrease in the probability that the team wins points from the game if the game is played in the team's home arena and a 3.4% (-.0186 * 1.839 = .0342) decrease otherwise. Therefore, I find further support for Hypothesis 2.

In Model 12 I find strong support for Hypothesis 3 as the interaction term *Internal competition intensity X Rival* is negative (b = -.0181) and statistically significant (p < .05). The results suggest that a one standard deviation increase in internal competition intensity decreases the probability that the team wins the game by 5.5% ([-.0116 - .0181] * 1.839 = .0546) if the game is against a rival and by 2.1% (.0116 * 1.839 = .0213) otherwise. Therefore, in sum, the robustness tests support the results from the main analysis.

DISCUSSION

This study examined the effect of internal competition on firm performance during interfirm competitions in the firm's identity domain and against its rivals. Drawing on the literature on career concerns (Holmström, 1999; Miklos-Thal & Ullrich, 2016) and competitive dynamics (Kilduff et al., 2010; Livengood & Reger, 2010), I developed three hypotheses. These hypotheses examine

how the intensity of internal competition affects firm performance depending on the interfirm competition's location and the competitors involved. To test these hypotheses, I analyzed panel data on the population of team games in the NHL. The findings show that internal competition intensity hurts firm performance, and the negative effect is weaker when the interfirm competition occurs within the firm's identity domain. These findings largely align with prior studies on intergroup competition, which find that group competition increases ingroup bias and cooperation within the group (Böhm et al., 2020; De Jaegher, 2021). However, in contrast to prior findings, I find that interfirm competition against a rival exacerbates the negative effect of internal competition intensity on firm performance. Thus, my findings show that interfirm competition must not decrease costly behaviors associated with internal competition but may actually increase employees' tendency to engage in such behaviors.

Contributions

This paper contributes to the literature on career concerns and intergroup competition. The original proposition in the career concerns literature was that employees with career concerns have implicit incentives to improve their reputation by exerting effort (Fama, 1980; Holmström, 1999). Subsequent studies have expanded on this idea, arguing that when career concerns coincide with internal competition, employees might be less inclined to collaborate and may even resort to sabotaging their colleagues to appear more productive (Auriol et al., 2002; Chalioti, 2016). Thus, the increased effort must not be allocated to tasks that enhance firm performance. Diverging from the existing literature, which predominantly relies on formal modeling, this paper empirically investigates how intensifying internal competition by employing more employees with career concerns affects firm performance. My findings align with previous research, showing that NHL teams perform worse when they include a greater number of players on their contract years in their lineup. I argue this to be the case because players on their contract year prioritize their individual

performance over their firm's success. This is particularly damaging to NHL teams' performance given the high level of task interdependency in ice hockey.

Second, I contribute to the career concerns literature by arguing and showing that the nature of the interfirm competition affects how employees with career concerns improve their reputation. Prior work on career concerns has shown that the level of internal competition for career opportunities affects employees' effort (Miklos-Thal & Ullrich, 2016). I add to this by showing that how employees compete for these career opportunities depends on the context in which the internal competition takes place. Specifically, when interfirm competition occurs within the firm's identity domain, it garners more attention from the current employer, incentivizing employees to enhance their reputation by focusing on enhancing the firm's overall performance. Conversely, when the interfirm competition is against external rivals, it tends to attract more external attention, offering employees a platform to showcase their abilities by concentrating on their individual performance. Thus, my theory suggests that how employees with career concerns respond to interfirm competition will depend on which employers pay attention to the interfirm competition and how these employers assess employees' abilities.

Finally, I make two contributions to the intergroup competition literature. First, the intergroup competition literature has not theorized on how group members respond to different types of intergroup competitions (Böhm, Rusch, & Baron, 2020b; Bornstein, 2003; De Jaegher, 2021). In their research designs, intergroup competitions are typically depicted as singular events, triggered by negative reward interdependency, without carrying any additional significance for the group. Thus, their findings may not directly apply to firms and interfirm competitions. The competitive dynamics literature shows that firms frequently engage in competitions within markets or against rivals that hold particular significance for them and their competitors (Kilduff et al., 2010; Livengood & Reger, 2010). Therefore, interfirm competition might either heighten the

scrutiny employees face from their current firm (e.g., Abbink et al., 2010; Goette, Huffman, & Meier, 2012b), especially if the competition occurs in a crucial market (Livengood & Reger, 2010), or provide employees with an opportunity to demonstrate their abilities to external firms if the competition attracts outside attention (Cole & Chandler, 2019; Kilduff et al., 2010). Understanding this distinction is vital for discerning when interfirm competition will mitigate or intensify the adverse impacts of internal competition.

Second, the intergroup competition has mainly studied closed groups in which members cannot move groups. For example, in team game experiments, participants can choose between defecting or contributing, but they are not allowed to pursue membership at a more desirable group (Bornstein, 2003). In contrast, in firm environments, employees often seek external career opportunities (e.g., Bidwell, 2011; Bidwell, Won, Barbulescu, & Mollick, 2015). Consequently, employees aim to enhance their external reputation to boost their chances of securing opportunities outside their current firm. This motivation transforms their perception of interfirm competition from being only a threat to the firm into also, under some circumstances, an opportunity for personal advancement. This shift is crucial as it underscores a significant diference between intergroup and interfirm competition: the opportunity for employees to pursue external employment alters their view of interfirm competition and, accordingly, their responses to it. This distinction provides critical insight into why findings from the intergroup competition literature may not seamlessly apply to firms.

Limitations and Future Research

Given some of the rare characteristics of the NHL, some readers might question the applicability of this study's findings to other settings. However, I believe that the fundamental conditions outlined in this research are prevalent across various industries. In many sectors, employees who perform interdependent tasks often compete for career advancement while

engaging in interfirm competitions that occur in markets or against competitors of varying significance to the firm. Take, for example, the legal profession: lawyers collaborating on cases must also compete against each other for partnerships. Simultaneously, legal battles against other firms represent interfirm competitions that can be in the firm's identity domain or against its rivals. The public nature of these legal disputes, especially when they reach court, allows lawyers to either prioritize their individual performance or the collective success of their firm. A lawyer that is focused on their individual performance might adopt a bold strategy in court that increases the amount of attention they receive from external employers and the media. A prime example of this is the prosecutor in the OJ Simpson trial who forced the defendant to try on the glove found at the crime scene. If this risky strategy had succeeded, the prosecutor would have been most likely seen as the “hero” that won the case. Conversely, a firm-focused lawyer would prioritize collaborative efforts, such as case preparation and strategy development. These dynamics are not unique to law and can also be observed in fields like equity research, investment banking, and engineers in product development teams.

While the findings of this study are applicable to many settings, there are several limitations to consider. In the NHL, the competition for contract extensions is transparent, with contract details being public and frequently discussed in the media. As a result, players are well aware of their internal competitors and can determine the intensity of internal competition accurately. In contrast, in more traditional organizations, employees often lack precise information about who they are competing against for career advancements. Consequently, their understanding of the intensity of internal competition is largely based on personal perceptions and cannot be accurately measured. Future research could investigate the conditions under which employees perceive the intensity of internal competition to be higher.

In Hypothesis 2, I proposed that interfirm competition within the firm's identity domain typically receives more attention from the current employer than from external employers. However, this might not always be the case across different settings. For instance, if the identity domain represents a particularly profitable segment within an industry, it could also attract considerable attention from external employers. Under such circumstances, my theory would suggest that interfirm competition becomes a platform for employees to showcase their abilities, potentially making internal competition more detrimental to firm performance. The validity of this prediction requires further investigation in future research.

Third, the transparent nature of ice hockey allows employers to closely observe players. As a result, players who focus excessively on their individual performance are more likely to be detected and punished in ice hockey than in more traditional organizations, where employee actions might not be as visible. Consequently, ice hockey players might be particularly attuned to avoiding an individual performance focus when it is deemed undesirable by their employers. This suggests that in ice hockey, interfirm competition within the identity domain might have a less significant effect than expected, while competition against rivals could have a more pronounced effect. Future research should investigate how these dynamics play out in environments where employee behavior is less observable.

Finally, this paper focused on internal competitions where intensity is determined by the number of employees competing for a single career opportunity. However, internal competition can also be influenced by other factors, such as the prize spread—the difference in rewards between winners and losers (Lazear & Rosen, 1981). A larger prize spread increases employees' incentives to exert effort to win a reward, but it also causes inequity concerns within the firm. Thus, the main effect of it is different from the way internal competition is conceptualized in this paper.

Nevertheless, further research is necessary to understand how various sources of internal competition interact with different forms of interfirm competition.

CONCLUSION

In this study, using data from the NHL, I examined how the relationship between internal competition intensity and firm performance is influenced by interfirm competition, both within the firm's identity domain and against its rivals. The findings support my theory, indicating that the detrimental impact of internal competition intensity varies depending on the nature of the external competition the firm encounters. I hope this research will inspire further investigations into how interfirm competition shapes internal dynamics within firms.

Table 1. Descriptive Statistics and Bivariate Correlations (N=14,628)

	Mean	SD	Min	Max	1	2	3	4	5	6
1. Points	1.115	0.934	0	2	1					
2. Internal competition intensity	6.432	1.839	1	13	-0.04	1				
3. Home game	0.5	0.5	0	1	0.093	-0.005	1			
4. Rival	0.089	0.284	0	1	0.005	-0.008	-0.001	1		
5. Avg. ice time per game previous season (Other)	1087.029	55.493	864.434	1262.296	0.015	0.147	0.004	-0.005	1	
6. Avg. ice time per game previous season (Last year)	932.18	91.983	434.154	1355.076	0.005	0.075	0.002	0.002	-0.287	1
7. Avg. points per game previous season (Other)	0.507	0.085	0.261	0.808	0.063	0.104	0.002	0	0.362	-0.073
8. Avg. points per game previous season (Last year)	0.363	0.096	0.069	0.759	0.012	0.097	0.008	-0.003	-0.086	0.439
9. Total career games (Other)	4177.25	1123.935	361	8346	0.044	-0.568	0.007	0.013	0.125	-0.082
10. Total career games (Last year)	1873.458	944.276	14	6125	-0.003	0.596	0.004	-0.006	0.136	0.203
11. Familiarity	0.489	0.118	0	1	0.061	-0.156	0.008	-0.008	-0.026	0.081
12. Coefficient of variance	0.734	0.117	0.411	1.241	-0.011	0.155	-0.008	0.002	0.105	-0.314
13. Remaining budget for next year	0.279	0.112	0.026	0.706	-0.07	0.496	0.004	-0.011	-0.115	0.228
14. Team past performance	1.105	0.291	0	2	0.067	-0.066	-0.015	-0.027	0.026	0.006
15. Opponent past performance	1.105	0.291	0	2	-0.07	0.006	0.015	-0.014	-0.007	0.002
16. Same conference	0.626	0.484	0	1	0.004	-0.018	0	0.183	-0.018	-0.005

	7	8	9	10	11	12	13	14	15
7. Avg. points per game previous season (Other)	1								
8. Avg. points per game previous season (Last year)	-0.116	1							
9. Total career games (Other)	0.164	0.004	1						
10. Total career games (Last year)	0.099	0.19	-0.298	1					
11. Familiarity	0.067	0.166	0.275	0.028	1				
12. Coefficient of variance	0.212	-0.29	-0.126	-0.05	-0.278	1			
13. Remaining budget for next year	-0.365	0.167	-0.587	0.322	-0.156	-0.126	1		
14. Team past performance	0.165	0.029	0.118	0.039	0.27	-0.006	-0.205	1	
15. Opponent past performance	-0.009	0.001	-0.018	-0.007	0.038	0.014	-0.003	0.108	1
16. Same conference	-0.012	-0.003	-0.008	-0.026	0.03	0.011	-0.009	-0.006	-0.006

Table 2. Conditional Fixed-Effects Poisson QML Estimates of Points

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5
Internal competition intensity (H1)		-0.0203**	-0.0312***	-0.0179**	-0.0289***
		(0.00693)	(0.00868)	(0.00656)	(0.00848)
Home game	0.156***	0.156***	0.0247	0.156***	0.0245
	(0.0116)	(0.0116)	(0.0546)	(0.0116)	(0.0544)
Rival	0.0172	0.0169	0.0174	0.182*	0.182*
	(0.0272)	(0.0271)	(0.0271)	(0.0816)	(0.0807)
Internal X Home game (H2)			0.0206*		0.0206*
			(0.00826)		(0.00822)
Internal X Rival (H3)				-0.0262*	-0.0262*
				(0.0132)	(0.0131)
Avg. ice time per game previous season (Other)	0.000268	0.000364	0.000363	0.000366	0.000365
	(0.000218)	(0.000218)	(0.000218)	(0.000217)	(0.000217)
Avg. ice time per game previous season (Last year)	0.000112	0.0000986	0.0000979	0.0000993	0.0000985
	(0.000111)	(0.00011)	(0.00011)	(0.00011)	(0.000111)
Avg. points per game previous season (Other)	0.167	0.228	0.228	0.227	0.227
	(0.154)	(0.156)	(0.156)	(0.155)	(0.156)
Avg. points per game previous season (Last year)	0.0487	0.0659	0.0688	0.0681	0.071
	(0.104)	(0.102)	(0.103)	(0.102)	(0.102)
Total career games (Other)	-0.0000287*	-0.0000398**	-0.0000396**	-0.0000399**	-0.0000397**
	(0.0000134)	(0.0000137)	(0.0000136)	(0.0000137)	(0.0000136)
Total career games (Last year)	-0.0000184*	-0.00000304	-0.00000321	-0.00000298	-0.00000314
	(9.13e-06)	(1.01e-05)	(1.12e-05)	(1.01e-05)	(1.01e-05)
Familiarity	0.349***	0.362***	0.360***	0.360***	0.358***
	(0.0778)	(0.0759)	(0.0756)	(0.0752)	(0.0748)
Coefficient of variance	-0.153	-0.102	-0.103	-0.101	-0.102
	(0.0856)	(0.0907)	(0.0909)	(0.0914)	(0.0916)
Remaining budget for next year	-0.326*	-0.228	-0.229	-0.23	-0.23
	(0.139)	(0.142)	(0.142)	(0.141)	(0.142)
Team past performance	0.0392	0.0382	0.0383	0.0375	0.0376
	(0.0487)	(0.0491)	(0.0489)	(0.0491)	(0.0489)
Opponent past performance	-0.111***	-0.112***	-0.112***	-0.112***	-0.112***
	(0.0247)	(0.0246)	(0.0247)	(0.0248)	(0.0248)
Same conference	0.00508	0.00494	0.00484	0.00491	0.00529
	(0.0138)	(0.0138)	(0.0137)	(0.0138)	(0.0137)
Log pseudolikelihood	-19,146	-19,141	-19,147	-19,138	-19,139
N (Team-games)	14,628	14,628	14,628	14,628	14,628
N (Teams)	31	31	31	31	31

Robust standard errors are shown in parentheses. *** p<0.001, ** p<0.01, * p<0.05. Conditional fixed effects pertain to the team level, and all models include vectors of fixed effects for opponent, team rank at the start of the game, season, and game number.

Table 3. Linear Probability Estimates of Wins and No Loss

VARIABLES	Wins Model 7	Wins Model 8	Wins Model 9	Wins Model 10	Not Loss Model 11	Wins Model 12
Internal competition intensity (H1)		-0.0132***	-0.00930**	-0.0157***	-0.0186***	-0.0116***
		(0.00419)	(0.00382)	(0.00547)	(0.00425)	(0.00404)
Home game	0.0870***	0.0868***	0.0870***	0.0533	-0.000831	0.0866***
	(0.00651)	(0.00649)	(0.00648)	(0.0345)	(0.0301)	(0.00645)
Rival	0.00101	0.000824	0.00106	0.000976	0.0160	0.117**
	(0.0156)	(0.0155)	(0.0156)	(0.0155)	(0.0159)	(0.0464)
Internal X Home game (H2)				0.00521	0.0131***	
				(0.00522)	(0.00441)	
Internal X Rival (H3)						-0.0181**
						(0.00737)
Avg. ice time per game previous season (Other)	0.000177	0.000246*		0.000246*	0.000132	0.000247*
	(0.000127)	(0.000130)		(0.000130)	(0.000113)	(0.000129)
Avg. ice time per game previous season (Last year)	4.22e-05	3.80e-05		3.79e-05	3.77e-05	3.83e-05
	(6.04e-05)	(6.02e-05)		(6.03e-05)	(6.65e-05)	(6.04e-05)
Avg. points per game previous season (Other)	0.140	0.160*		0.159*	0.150*	0.158*
	(0.0896)	(0.0887)		(0.0888)	(0.0816)	(0.0881)
Avg. points per game previous season (Last year)	0.0122	0.0314		0.0319	0.0222	0.0328
	(0.0601)	(0.0581)		(0.0583)	(0.0593)	(0.0580)
Total career games (Other)	-8.32e-06	-1.84e-05***	-1.12e-05*	-1.83e-05***	-1.65e-05**	-1.84e-05***
	(5.27e-06)	(6.52e-06)	(6.48e-06)	(6.50e-06)	(7.01e-06)	(6.51e-06)
Total career games (Last year)	-1.07e-05**	2.77e-08	3.04e-06	4.18e-09	-2.91e-06	6.85e-08
	(4.82e-06)	(5.89e-06)	(6.69e-06)	(5.91e-06)	(6.12e-06)	(5.88e-06)
Familiarity	0.182***	0.191***	0.197***	0.190***	0.183***	0.190***
	(0.0432)	(0.0423)	(0.0430)	(0.0422)	(0.0389)	(0.0415)
Coefficient of variance	-0.0614	-0.0317	-0.0191	-0.0318	-0.0513	-0.0303
	(0.0465)	(0.0502)	(0.0497)	(0.0503)	(0.0484)	(0.0507)
Team past performance	0.0276	0.0268	0.0299	0.0268	0.0453	0.0261
	(0.0328)	(0.0331)	(0.0329)	(0.0331)	(0.0293)	(0.0331)
Opponent past performance	-0.0632***	-0.0637***	-0.0633***	-0.0638***	-0.0742***	-0.0633***
	(0.0148)	(0.0147)	(0.0145)	(0.0148)	(0.0133)	(0.0149)
Competitive pressure	-0.0537***	-0.0535***	-0.0540***	-0.0535***	-0.0552***	-0.0535***
	(0.00430)	(0.00423)	(0.00432)	(0.00421)	(0.00444)	(0.00421)
Competitive opportunity	0.0428***	0.0425***	0.0428***	0.0425***	0.0501***	0.0424***
	(0.00655)	(0.00660)	(0.00653)	(0.00659)	(0.00602)	(0.00663)
Same conference	0.000566	0.000476	0.000405	0.000463	0.00568	0.000677
	(0.00885)	(0.00884)	(0.00880)	(0.00883)	(0.00769)	(0.00881)
Constant	0.250	0.241	0.563***	0.257	0.488***	0.231
	(0.174)	(0.174)	(0.0765)	(0.172)	(0.162)	(0.175)
R^2	0.039	0.040	0.039	0.040	0.044	0.040
N (Team-games)	14,628	14,628	14,628	14,628	14,628	14,628
N (Teams)	31	31	31	31	31	31

Robust standard errors are shown in parentheses. *** p<0.001, ** p<0.01, * p<0.05. Conditional fixed effects pertain to the team level, and all models include vectors of fixed effects for opponent, team rank at the start of the game, season, and game number.

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