THE WHAT, THE WHO, AND THE HOW:
COORDINATION EXPERIENCE AND TEAM PERFORMANCE
IN THE ELECTRONIC GAME INDUSTRY

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Abstract

Team design drives organizational performance in industries in which products are developed by project-based teams. Team members’ expertise in what they do, that is, in the tasks they perform and the hierarchical roles they occupy, is critical to teams’ success. Equally important is the ability to coordinate interdependent activities, which is easier when team members have experience of working with each other. Many project teams change frequently, however, hampering the development of team familiarity. In this paper we study the performance consequences of two alternative coordination mechanisms: shared experience of working within the same firm, and general experience interacting and coordinating within teams. Using data on electronic games development teams, we find that shared firm experience and teaming experience are positively associated with the commercial success of electronic games, and that these effects matter equally for teams with low and high levels of familiarity. Our results matter for the theory of learning and coordination in teams, and for the practice of team design in project-based organizations.
1. Introduction

Teams are the dominant organizational structure in firms in knowledge and creative industries such as high technology, professional services, and media given the project-based nature of their products (Hobday 2000, Sydow et al. 2004). Teams are also increasingly found in traditional industries, where project-based activities such as innovation and new product development have become ever more important (Edmondson and Nembhard 2009), leading to the “projectification” of firms (Midler 1995).

In this context, team composition becomes a fundamental organizational design issue (Cohen and Bailey 1997, Stewart and Barrick 2000), reflecting efforts directed towards mobilizing, integrating, and coordinating the knowledge, expertise, and activities of team members (Faraj and Sproul 2000, Edmondson and Nembhard 2009). So which activities matter for team performance?

Prior research emphasizes several facets of knowledge and expertise associated with superior performance, such as team members’ expertise in what they do: the tasks they perform (Schilling et al. 2004, Reagans et al. 2005) and the hierarchical roles they hold (Huckman et al. 2009). However, team members’ complementary expertise and interdependent activities require an ability to coordinate (Faraj and Sproul 2000), especially for team members holding managerial roles. Recent work shows that when team members are familiar with who is on the team, they coordinate more effectively, leading to better performance (Reagans et al. 2005, Espinosa et al. 2007, Huckman et al. 2009).

High familiarity is not always possible, however. Teams are often fluid, with their composition frequently changing from one project to another (Edmondson and Nembhard 2009, Huckman et al. 2009). This indicates that organizations value the ability to match individual expertise to the project, even when it hampers the development of team familiarity and reduces the associated benefits. How then do teams coordinate their expertise and activities, and to what effect? We propose that teams can coordinate effectively when team members learn how to coordinate, both within and outside the firm.

Individual performance is, to some degree, firm specific (Allison and Long 1990, Huckman and Pisano 2006, Groysberg et al. 2008), since individuals develop familiarity with the tacit knowledge and routines embedded in organizations (Nelson and Winter 1982). Coordination routines are among the managerial and organizational processes that determine firm competitive advantage and team performance (Clark and Fujimoto 1991, Teece et al. 1997, Faraj and Sproul 2000). Consequently, familiarity with firm-specific coordination routines enables lead team members to develop shared firm experience, that is, they learn to coordinate with each other, within the firm. Our data lets us separate learning about firm specific coordination routines from developing task and managerial expertise associated with longer firm tenure by constructing a novel metric that focuses on lead team members’ status as firm insiders or outsiders. We propose that a higher proportion of lead team members with shared firm experience – firm insiders – is positively associated with performance.

Past interactions enable lead team members to develop teaming experience, that is, to learn how to coordinate with others in general (Edmondson and Nembhard 2009). Repeated interactions with the same team members capture both teaming experience and team familiarity. We distinguish between
these effects by measuring the total number of individuals in lead positions with whom team members interacted in the past, rather than the total number of prior interactions with current team members. We propose that team-level teaming experience is positively associated with performance.

The context of our empirical study is the electronic games industry, which is particularly suited to our purposes. The final product, the electronic game, is developed exclusively by teams. Team members typically work in specialized occupational roles—tasks—such as production, game design, art, and programming. These tasks are highly interdependent and require coordination to ensure a game’s success. Team members also occupy various hierarchical positions and perform their duties either in junior roles that involve primarily the execution of task-specific activities, or in lead roles that involve predominantly within-task supervision and coordination of junior team members, and cross-task coordination with other lead team members. This team structure lets us focus on the performance effects of alternative mechanisms for accumulating coordination experience while controlling for within-task experience and team familiarity.

We compiled a dataset that draws on two sources. We use MobyGames, a comprehensive electronic game documentation project, for information about the composition of game development teams. We observe not only the tasks and hierarchical roles that team members worked in, but also the game developer firms they worked for and the individuals they worked with throughout their careers in the industry. This lets us construct a broad range of task-, supervisory-, and coordination-specific measures of experience, both at the individual and the aggregate team level. We then use the NPD database as a source of revenue data—our measure of team performance—for electronic games commercially released in the U.S. between 1995 and 2007.

To our knowledge, this is the first large-sample study that examines the determinants of commercial success for team-developed products and explores the relationship between various dimensions of coordination experience and team performance, complementing firm-specific micro-level studies that focus on operational outcomes of team effectiveness (Faraj and Sproul 2000, Espinosa et al. 2007, Huckman et al. 2009).

Controlling for a wide range of factors, we and find that managerial experience of lead team members, both in supervision and in coordination positively impacts team performance. However, shared firm experience and teaming experience are also significantly associated with higher team performance, and render team familiarity a less-significant coordination mechanism. In other words, a group of experienced team players and/or individuals with knowledge about firm-specific routines make a good team regardless of the extent to which they have worked together previously.

The rest of the paper is organized as follows. First, we review the theoretical arguments and empirical evidence about experience and team performance, and develop our hypotheses. We then describe the electronic game industry and the data used in this study. The empirical methodology and a discussion of our results follow. We conclude with a discussion of the managerial implications of our findings, and provide directions for future research.
2. Experience and team performance

A long line of research in social psychology and management studies the determinants of group effectiveness (Campion et al. 1993, Cohen and Bailey 1997). Following McGrath (1984) and Hackman (1987), these are grouped into (a) organizational factors, such as reward and information systems (Gladstein 1984, Hackman 1987, Guzzo and Shea 1992) and organizational experience (Reagans et al. 2005, Ethiraj et al. 2005, Groysberg and Lee 2008); (b) task design characteristics such as autonomy, participation, and interdependence (Cummings 1978, 1981, McGrath 1984, Hackman 1987, Guzzo and Shea 1992, Stewart and Barrick 2000); and (c) team composition (Hackman 1987, Hackman et al. 2000), referring to diversity (Ancona and Caldwell 1992, Eisenhardt and Tabrizi 1995) and expertise or experience (McGrath 1984). According to this literature, individual-level and team-level expertise are the result of cumulative, object-specific learning and experience, and the focus has been on task and managerial role experience, as well as team familiarity.¹ This provides the basis for our first three hypotheses.

Task Experience

Division of labor and the resulting specialization is an important driver of individual and organizational performance. Practice helps individuals accumulate task experience by exploring various approaches to performing tasks, selecting the ones that yield better results, and perfecting them. Experience results in fewer errors and faster completion times (Delaney et al. 1998), and improved quality and functionality when tasks involve the development of innovative products. Empirical evidence supports the idea that task experience leads to improved individual and team performance (Anzai and Simon 1979, Littlepage et al. 1997, Schilling et al. 2003). For example, Reagans et al. (2005) found that the number of times an individual team member performed a total joint replacement procedure reduced its completion time. Huckman et al. (2009) found that the task experience of junior-level software engineers is positively and significantly related to various operational performance measures. Thus, following the existing literature, we propose:

HYPOTHESIS 1 (H1). Team-level task experience is positively associated with team performance.

Managerial (Role) Experience

In a development of the task-experience concept, Huckman et al. (2009) distinguish between hierarchical positions/roles and introduce the concept of role experience. On software development teams, project engineers fulfill junior roles, mainly programming, while project managers in senior roles are primarily responsible for supervising and coordinating project engineers and interacting with clients. Role experience recognizes the difference between junior and senior roles, and captures

¹ There is a broad literature on learning at the organizational level. See, for example, Dutton and Thomas (1984), Argote et al. (1990), or Pisano et al. (2001).
experience pertaining to the specific activities associated with a hierarchical position. Indeed, Huckman et al. (2009) find that a project manager’s role experience is positively related to a number of operational performance measures. Hypothesis 2 summarizes this idea:

**HYPOTHESIS 2 (H2).** Team-level managerial experience is positively associated with team performance.

**Team Familiarity and Coordination**

To effectively accomplish team goals, team members have to coordinate their expertise and interdependent activities. In this context, *team familiarity* has been studied widely (Goodman and Leyden 1991, Gruenfeld et al. 1996, Littlepage et al. 1997). Prior literature suggests that improved coordination can be achieved by “knowing who knows what,” that is, by being aware of the expertise of other team members, and by developing “transactive memory” related to those members (Liang et al. 1995, Moreland et al. 1996, Reagans et al. 2005). Empirical evidence supports the notion that team familiarity facilitates coordination, subsequently enhancing team performance (Faraj and Sproul 2000, Reagans et al. 2005, Huckman et al. 2009). Our final hypothesis based on existing research formalizes this relationship:

**HYPOTHESIS 3 (H3).** Team familiarity is positively associated with team performance.

**Shared Firm Experience, Coordination, and Team Performance**

Most products and services involve the execution of numerous specialized tasks that have to be coordinated and integrated. Consequently, firms develop organizational and managerial process routines that enhance the coordination and integration of these tasks, particularly since these routines can be sources of competitive advantage (Teece et al. 1997). Organizational and managerial process routines appear especially important in project-based organizations, where teams are the structures that fulfill organizational goals (Hobday 2000, Edmondson and Nembhard 2009), and where coordination between team members is essential (Faraj and Sproul 2000). Coordination can be achieved through team familiarity (Reagans et al. 2005, Huckman et al. 2009). Yet, there exists extensive evidence that individual performance is, to some extent, organization specific (Huckman and Pisano 2006, Groysberg et al. 2008). This implies that familiarity with tacit knowledge and organizationally embedded routines, including coordination routines (Clark and Fujimoto 1991),

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2 In addition, team familiarity can lead to “psychological safety” (Edmondson 1999) and trust (McEvily et al. 2003), increasing members’ willingness to engage in relationships and share information.

3 Organizational process routines comprise work process routines, referring to the flow of activities that result in the organization’s final products and services, and behavioral process routines, referring to hard to codify behavior patterns that reflect an organization’s way of acting and interacting, that is, decision-making, communicating, and learning. Managerial process routines refer to similarly hard to codify activities such as setting organizational goals, communicating, convincing, and motivating individuals through negotiation to ensure their cooperation in working to fulfill these goals (Garvin, 1998).
enables lead team members to learn how to coordinate with each other within the firm, providing an alternative coordination mechanism to team familiarity.4

Given the tacit nature of organization-specific routines guiding the interactions between lead team members, including coordination routines, employees become familiar with them through shared firm experience, that is, through joint employment with the firm. The average tenure of lead team members is a natural proxy for firm experience but it suffers from two important drawbacks. First, it fails to distinguish between firm insiders and outsiders, and their shared firm experience: low average tenure might reflect teams where all members have low firm tenure, but shared firm experience; or it might reflect mixed teams with zero-tenure outsiders and long-tenure insiders, but low shared firm experience. Second, as noted in prior literature (Huckman et al. 2009), tenure is likely to conflate shared firm experience with task and managerial role experience, since individuals must accumulate task experience to achieve managerial roles, and then accumulate experience related to those roles. Consequently, to separate task and managerial role experience from learning about firm-specific coordination routines, we construct a metric that captures lead team members’ status as firm outsiders or insiders, and thus their shared firm experience. Accordingly, we propose:

**HYPOTHESIS 4A (H4A).** A higher proportion of lead team members with shared firm experience – firm insiders - is positively associated with performance.

An intriguing question is whether shared firm experience enhances the effectiveness of interaction and coordination in a general manner, or if it is especially valuable in specific contexts. In particular, it is conceivable that shared firm experience can serve as a substitute for team familiarity. This implies that team members that draw on a shared set of organizational and managerial process routines can collaborate effectively even when they have not worked together before, but are not better collaborating in the presence of high team familiarity. In this case, the effect of shared firm experience would vary according to the degree of team familiarity, leading to our next hypothesis:

**HYPOTHESIS 4B (H4B).** The positive effect of shared firm experience is stronger for teams with low levels of team familiarity.

**Teaming Experience, Coordination, and Team Performance**

In project-based organizations, team membership changes from one project to another (Faraj and Sproul 2000, Edmondson and Nembhard 2009), which hinders the development of team familiarity. At the same time, however, changes in team composition and collaboration partners help team

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members to develop *teaming experience* (Edmondson and Nembhard 2009), that is, an ability to work well in any team and with any partner, rather than only on teams featuring familiar partners.


General teaming experience can therefore be a mechanism to develop interaction routines that promote effective coordination of intra-team activities, such as establishing psychological safety (Edmondson 1999), conflict resolution mechanisms, or priorities in allocating resources.

Teaming experience can result both from repeated interactions with the same individuals and from interactions with different ones. Repeated interactions lead to familiarity with a particular lead team member and thus might yield benefits distinct from the ones arising from interactions with different lead team members. Consequently, to distinguish between partner-specific familiarity and general partnering experience, we construct a metric of teaming experience that captures the total number of individuals in lead positions with whom lead team members interacted in the past, rather than the total number of prior interactions. We accordingly propose:

**HYPOTHESIS 5A (H5A).** Team-level teaming experience is positively associated with performance.

Similar to the case of shared firm experience, teaming experience, that is, the ability to interact effectively in any team, may be particularly useful in situations when the team consists mostly of unacquainted members. In essence, teaming experience may substitute for team familiarity, so that previously unacquainted team members can still collaborate effectively when they have high teaming experience, while familiar team members rely mostly on knowing each other to achieve effective coordination. We summarize this as:

**HYPOTHESIS 5B (H5B).** The positive effect of teaming experience is stronger for teams with low levels of team familiarity.

3. **Empirical Context**

**The Electronic Game Industry**
The empirical context of our study is the electronic game industry. We briefly sketch the evolution of the industry with an emphasis on technological change and its impact on the composition and size of game development teams.

Although the first electronic game was created in 1952 at the University of Cambridge, the electronic game industry began to take shape with the invention of cartridges in 1976 by Fairchild Camera & Instruments, the launch of the Atari Video Computer System/2600, and the introduction of personal computers. The separation of hardware (game consoles or personal computers) and software (electronic games) extended the hardware life cycle as consumers could buy additional games; it also created a market for independent game developers and publishers. A developer creates and codes a game, whereas a publisher finances the game, manages the relationship with retailers and console providers, and packages and markets the game to consumers (Williams 2001). In the first generation of video game systems, development costs ranged from $1,000 to $10,000 and the development team consisted of a few individuals (Hight and Novak 2008), with game designers and programmers being the most important as graphics were simple. After years of rapid growth, the home electronic game market crashed in 1983 due to an oversupply of low quality, unoriginal games (Genakos 2001).

The industry reemerged with the introduction of the Nintendo Entertainment System in 1985. To ensure the quality of games launched for its platform, Nintendo adopted a “walled garden” strategy whereby its consoles rejected every game cartridge that was not licensed by Nintendo. Ever since, no one could develop and legally publish a game without the consent of the hardware manufacturer.

In 1989, Nintendo revolutionized the industry again by introducing the first portable game console with interchangeable games, the Nintendo Game Boy. Although there were several players in the console and handheld market, Nintendo remained the clear industry leader until 1995. The typical game budget then varied from $50,000 up to $1,000,000 (Hight and Novak 2008), and game developers formed larger teams, ranging typically from 6 to 20 individuals.

The next stage of industry development began in 1995, when Sega and Sony introduced the first hardware devices using compact discs as storage medium, enabling game developers to create more complex games. Sony’s PlayStation was the first console supporting 3D graphics. The introduction of 3D graphics elevated the importance of artists on the team to that of designers and programmers, as different art specialists like object or environment modelers were needed to create a distinct look for a game. Game budgets increased to a range of $5 million to $30 million, and team sizes ranged on average from 30 to 80 individuals (Hight and Novak 2008). Sony, which entered the market in 1995, dominated it until 2005 with both the PlayStation and its successor, PlayStation 2.

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5 The electronic game industry includes both video and computer games. Video games are developed for dedicated game consoles, such as PlayStation or Xbox, while computer games are developed for personal computers. Other types of electronic games include browser games and phone games (Novak 2008).

6 This section draws on Kent (2001).
The latest development in the electronic game industry occurred in 2005 when Microsoft started a new generation of consoles with the Xbox 360, followed by Nintendo’s Wii and Sony’s PlayStation 3 in 2006. As these consoles include Internet connectivity, the computer and video game segments converged, leading to a new type of electronic game, so-called Massively Multiplayer Online Games (MMOG) that host hundreds of thousands of people playing simultaneously in a virtual world. Development teams for MMOG such as World of Warcraft can involve up to 400 individuals.

In 2007, the electronic game industry experienced a growth rate of 43%, reaching total sales of $18 billion. The same year, software sales grew at a rate of 28%, reaching $9.5 billion (NPD 2008), on par with the $9.6 billion in U.S. box office receipts for the same year (MPAA 2009).

**Game Development Teams**

As mentioned above, the composition and size of game development teams evolved in tandem with technological changes and the accompanying increase in game complexity. After 1995, four main occupational tasks were found on a typical development team: producer, game designer, artist, and programmer (Chandler 2009). Increases in team size also resulted in the hierarchical separation of the team into lead and non-lead members, with lead members fulfilling mostly supervisory and managerial roles and non-lead members involved mostly in implementation.

Producers focus on managing and tracking the game development process, and ensure that a game is released on time and within budget. They work closely with lead team members involved in game design, art, and programming, and mediate between the development team, the development studio management, and the publisher (Chandler 2009). Sometimes the coordination of the lead team is split between a producer, who is in charge of administrative coordination, and a project leader, who is in charge of the creative coordination of lead members, and who ensures the cohesiveness of the story, appearance, and playability of the game.

Game designers develop the main story, characters, and levels, and set the rules of the game (Novak 2008). To create compelling and immersive game play, designers work closely with artists and programmers to determine how to use art and technology to bring the game to life (Chandler 2009). In effect, the game designer is “the keeper of the vision of the game” (Novak 2008).

Artists create the concept art and graphical assets of the game, such as characters, vehicles, and buildings. Their tasks include drawing, modeling, texturing, and animation. Artists work with designers on what assets are needed, and with programmers on how to use the technology effectively to support the art production (Chandler 2009).

Programmers create the game code and develop tools for designers and artists (Novak 2008). As the goal of the game development process is to create entertainment software, game engineering differs strongly from business software engineering in that game engineers must be able to work well with both creatives and other programmers to realize the vision of the game (Chandler 2009).
In addition to the four main roles mentioned above there are other tasks involved in the game development process like audio design, game testing, and quality assurance. However, these tasks are typically outsourced (Novak 2008) and thus are not part of our study.

The hierarchical structure of the team depends on the complexity of the game and the overall structure of the development studio. For a simple game or a small developer, the same team member can fulfill multiple roles, whereas in the case of a complex game or a larger developer, each team member occupies a single, clearly defined role. Figure 1 shows the typical organizational chart for a game project of moderate or high complexity. The typical team is run by a project leader, a producer, and by directors of game design, art, and technical/programming. Directors are responsible for setting the creative, artistic, and technological standards for the game, and they are in charge of the overall coordination across tasks. Directors are supported by lead team members who ensure that standards are maintained throughout the development process (Chandler 2009). They act as intermediaries between the directors and the rest of the team, and they are in charge of day-to-day supervisory and coordination activities within and across tasks.  

As our focus is on the coordination of expertise and activities across and within tasks, and as coordination is typically carried out by team members in managerial positions, we restrict our attention to individuals who hold director, project leader, producer, and lead positions for game design, art, or programming on game development teams.

4. Data
We use two different sources for our dataset: the MobyGames and NPD databases. MobyGames is the world's largest and most detailed video game documentation project, containing comprehensive information on more than 16,000 games published between 1972 and 2009. All information was provided by site users on a voluntary basis. To ensure accuracy MobyGames has a strict set of coding instructions and requires all entries to be peer reviewed before they are published. For all games featured in MobyGames we have information on the genre, platform, and release date, and the individuals and firms that developed and published the game (credits). We use the dataset from the beginning of the industry in 1972 up to 2007 to develop our independent variables.

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7 To deepen our understanding of the development process and the work of the lead group we conducted in-depth interviews with leading people in the industry. Our interviewees worked in different occupational tasks (such as game designer and producer) and both in large (such as Electronic Arts and Ubisoft) and small firms.
The MobyGames data is matched with revenue data by NPD, a market research firm that has covered the electronic game industry since 1995. NPD’s retail tracking service monitors U.S. retail sales of electronic games and consoles, covering all distribution channels, including online sales. Combining both datasets yields 4,331 unique games for which we have complete information on credits and revenues. We control for developer and publisher performance in the two years prior to the introduction of the focal game, which results in a loss of about 1,700 developer observations and 170 publisher observations due to missing data. Controlling for the size of the developer firm in the two years before a game’s release leads to an additional loss of about 200 observations. Thus, our final sample consists of 2,181 games.

**Dependent variable**

The dependent variable revenue is the natural logarithm of game revenues generated in the first year after its release. We focus only on the first year as, contrary to most new products and technologies following an S-shaped diffusion path, the sales pattern of an electronic game is best described as L-shaped. Thus, an average game in our sample will make more than 80% of its revenues in the first twelve months after its introduction (see Figure 2).

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**INSERT FIGURE 2 ABOUT HERE**

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We use the natural logarithm to reduce skewness in the revenue data because the electronic game industry, like many other creative industries, is hit driven. While so-called blockbuster games like “Grand Theft Auto: San Andreas” or “Super Mario 64” each generated more than $300 million in the U.S. alone, revenues of other games were a small fraction of that (see Figure 3).

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**INSERT FIGURE 3 ABOUT HERE**

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**Independent variables**

Five experience-related explanatory variables are of central interest to our study: task experience, managerial experience, team familiarity, shared firm experience, and teaming experience. Each variable is measured at the lead team level, which comprises all members that work as directors,

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8 The NPD database has been used by other researchers (Shankar and Bayus 2003, Venkatraman and Lee 2004, Clements and Ohashi 2005, Stremersch et al. 2007).

9 Online sales are covered as their importance has grown. However, because Wal-Mart stopped providing data to all research companies in 2002, NPD projects Wal-Mart sales after 1992.

10 The sample construction process leaves us with games that are slightly more commercially successful compared to the overall sample (see Appendix A.1).
project leaders, producers, and lead team members in game design, art, or programming. While we have revenue data only for games released between 1995 and 2007, all team variables are constructed based on the MobyGames database, which allows us to track the entire careers of lead team members, from their entry into the industry until 2007.\textsuperscript{11}

**Task Experience.** *Task experience* is measured as the number of times a lead designer, artist, or programmer worked in his/her respective task before being promoted into a lead position. As project leaders and producers do not work in a specific occupational task we do not take them into account to build this measure. We average the individual task experience of relevant lead team members to construct our team-level metric. Task experience is designed to capture team members’ experience with one aspect of *the what*: the specific activities of junior team members within the occupational task they manage.

**Managerial Experience.** *Managerial experience* is measured as the average number of people supervised in previous projects by lead team members. For lead designers, artists, and programmers we take the number of non-lead team members in the respective tasks, while for project leaders and producers we take the size of the previously coordinated lead teams. Again, we average the individual managerial experience of lead team members to construct our team-level metric. Managerial experience also captures lead team members’ experience with *the what*, represented, here by the within-task supervisory and coordination activities they perform.\textsuperscript{12}

**Team Familiarity.** We construct *team familiarity* similarly to Reagans et al. (2005) and Huckman et al. (2009), calculating the number of times each pairing of lead team members $i$ and $j$ have worked together on a game in lead positions over the past six years.\textsuperscript{13} We sum this value, $PW_{ij}$, over every unique dyad, and divide the sum $\sum_{i=1}^{N} \sum_{j=1}^{N} PW_{ij}$ by the number of all possible dyads, $N^*(N-1)/2$, where $N$ is the size of the lead team. We differ from prior work in that the data allows us to observe dyads not only within the focal firm but also across firms in the entire industry. *Team familiarity* is designed to capture team members’ experience with *the who*, that is, with other members of the team with whom they coordinate activities.

**Shared Firm Experience.** *Shared firm experience* is computed as the share of lead team members that have already worked within the game developer firm, that is, the share of firm insiders.

\textsuperscript{11} Left-censoring should not be a problem in our study as the rapid technological progress implies a natural fluctuation of workers in the industry as their skills become obsolete.

\textsuperscript{12} In our setting, where cross-task coordination is particularly important, this definition more accurately captures within-task supervisory and coordination experience. A measure that counts the number of times a team member worked in a lead position (Huckman et al. 2009) is highly correlated with the total number of individuals in lead positions that the team member worked with in the past, thus, failing to distinguish between managerial experience related to within-task coordination and managerial experience related to cross-task coordination.

\textsuperscript{13} In line with prior literature, we aim to allow lead team members the possibility of working together on at least three different projects. Given that most electronic games take between one and two years to develop, we consider a six-year window in constructing our team familiarity measure.
As mentioned in Section 2, we use this particular definition as opposed to one based on the average firm tenure of lead team members to capture team members that might be unfamiliar with firm-specific coordination routines, and to avoid confounding shared firm experience with task and role experience, which are also accumulated during an individual’s tenure with a firm.

**Teaming Experience.** Teaming experience is computed as the total number of individuals in lead positions that a lead team member has worked with in the past, and we average the individual teaming experience of lead team members to construct our team-level metric. In constructing our measure, we abstract from repeated interactions to distinguish teaming experience from team familiarity that arises from repeated interactions with the same individuals.

Both shared firm experience and teaming experience are designed to capture team members’ experience with the how, that is, with mechanisms to coordinate within the firm or in general.

Table 1 summarizes our independent variables.

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**Control and indicator variables**

We control for a range of team-, developer-, publisher-, and game-specific characteristics that may affect the commercial success of a game.

As already mentioned, the size of the development team varies with the complexity of the game. Larger teams have more lead members. Therefore, we control for lead team size, defined as the number of people in a lead position in the game.

As larger developers might be more successful, we control for developer size defined as the number of employees that worked in all hierarchical positions as producers, project leaders, designers, artists, or programmers for the developer during the two years before a game’s release.

There are numerous developer- and publisher-specific factors that drive the commercial success of a game, such as culture or routines that we do not observe. However, such factors are likely to be reflected in the past commercial success of developers and publishers. Consequently, we construct the variables developer performance and publisher performance, defined as the natural logarithm of revenues of the developer and, respectively, the publisher, in the two years before a game’s release.

Some firms have both a game-developing and a publishing arm. To capture potential coordination benefits arising from such a relationship, we construct a dummy variable, vertical integration, which we set to one if the developer and the publisher belong to the same firm, and zero otherwise.

Some games use copyrighted content from outside sources, such as books, movies, or sports. To account for the possibility that the visibility of a name or brand in another field drive the commercial success of electronic games, we construct a dummy variable, licensed game, which takes on value one if the game includes licensed content and zero otherwise.
Sports or action games are more popular than educational games, and are expected to be more successful commercially. Accordingly, we use indicator variables for the genre of the game. Most games fall into more than one genre; these games will have multiple genre indicators with value one.

Similarly, PlayStation 2 was a more popular game console than Sega Dreamcast, and games developed for more popular platforms may sell better. Accordingly, we include platform dummies in our analyses.

Due to the industry’s high seasonality, with a peak in demand between Thanksgiving and Christmas, we include a dummy variable, holiday season, which takes on value one if the game is released in November or December, and zero otherwise.

Game sales may be determined not only by within-year seasonality, but also by longer-term macroeconomic and technological factors. We include year fixed effects to control for this.

Finally, given the large-sample, multi-year, multi-firm nature of our data, we include developer-level fixed effects to control for unobserved, time-invariant across developers.

Descriptive statistics and correlations between variables are presented in Table 2. Multicollinearity is not a concern, indicating that our measures provide clear conceptual definitions for the different types of experience we intended to capture.

5. Estimation and Results

Empirical model and estimation methods
To test H1-H3, H4A and H5A, we use generalized least squares (GLS) regression models with developer fixed effects\textsuperscript{14} and standard errors that are robust to heteroskedasticity and arbitrary within-firm serial correlation. We first present our baseline model with the relevant control and indicator variables, and then successively introduce the main independent variables.

We use a series of Chow tests (Greene 2003) to evaluate H4B and H5B. To do so, we first classify all sample teams into three groups depending on their level of team familiarity. If the value of familiarity falls in the lower (upper) quartile of all observations, the team is classified as low (high) familiarity, and as moderate familiarity otherwise. For robustness purposes, we also classify teams based on terciles rather than quartiles.

We then partition shared firm experience into three variables: shared firm experience – low team familiarity, which takes the value of shared firm experience if team familiarity is low, and zero otherwise; shared firm experience – moderate team familiarity, which takes the value of shared firm experience – high team familiarity, which takes the value of shared firm experience if team familiarity is high, and zero otherwise.

\textsuperscript{14} Since we use developer fixed effects, our final sample only includes observations for developers that released at least two games during the sample period.
experience if team familiarity is moderate, and zero otherwise; and shared firm experience – high team familiarity, which takes the value of shared firm experience if team familiarity is high, and zero otherwise. The regression is then repeated by substituting shared firm experience with the newly created variables. The Chow test, and therefore the test of H4B, involves assessing the statistical significance of the differences between the regression coefficients for the newly created variables.

We repeat this procedure and partition teaming experience into three variables also according to the value of team familiarity, and use the corresponding Chow test to test H5B.

Results
We present our main results in Table 3.

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INSERT TABLE 3 ABOUT HERE

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Table 3 Column 1 presents the GLS fixed effects regression of game revenues on our control variables. Most of the control variables are highly significant and carry the expected sign. Specifically, the size of the lead team (lead team size) has a positive and significant (p<0.01) impact on performance, suggesting that complex games that require larger teams generate more revenue.

At the developer level, developer size is insignificant. Developer performance, however, is negative and significant (p<0.01) in the presence of developer fixed effects, indicating mean reversion. That is, even successful developers return to their average past performance. In fact, omitting developer fixed effects we find that developer performance has a positive and significant (p<0.01) impact on the commercial success of a game.\footnote{Results are available from the authors.} Similarly, publisher performance is positive and significant (p<0.01), so that publishers who were successful in publishing games in the past two years are also successful with the focal game. The vertical integration dummy is positive and significant (p<0.05) suggesting that games developed and published by the same firm (in-house) are more successful. Finally, games based on licensed content (licensed game) perform better, while games introduced in November or December (holiday season) do not, potentially due to increased competition arising from the fact that many developers target this season for their releases.

We now report our results for the main independent variables. Column 2 shows that task experience has a positive but insignificant effect on the success of a new game. This may be because the variable measures only the experience of lead team members in a certain task before they get promoted into a lead position, which may matter less to what they actually do in a lead role. Thus, we find no support for H1.
In Column 3 we find that *managerial experience* has a positive and significant (p<0.05) effect on team performance. This supports H2 in line with prior research (Huckman et al. 2009). Note that our metric is based on the average number of team members supervised to separate the effect of within-task supervisory and coordination experience from across-task coordination experience (footnote 11).

*Team familiarity* is introduced in Column 4. This measure of coordination experience has a positive and significant (p<0.05) impact on team performance, providing indicative support for H3.\(^{16}\) However, this result disappears once we introduce shared firm and teaming experience.

**Shared firm experience**

Column 5 adds our first novel measure of coordination experience, *shared firm experience*. The coefficient is positive and statistically significant (p<0.10), indicating that a higher share of firm insiders leads to superior commercial success, supporting H4A. Quantitatively, a reduction of one standard deviation in shared firm experience (.25) results in a 6.6% reduction in expected game revenues, equivalent to about $200,000.

**Teaming experience**

In Column 6 we add our second novel measure of coordination experience, *teaming experience*, and find that it also has a positive and statistically significant (p<0.10) effect. This indicates that team members who work with more individuals over their career can coordinate better with other team members, leading to superior commercial success, in line with H5A. In terms of economic magnitude, an increase of one standard deviation in teaming experience (14.93) results in an 8.96% increase in expected game revenues, equivalent to about $295,000.

**Shared firm experience and teaming experience**

Finally, in Column 7, we include both *shared firm experience* and *teaming experience*. We find that both our measures of coordination experience remain positive and statistically significant (p<0.05), while team familiarity does not, providing further support for H4A and H5A, and rejecting H3. The magnitudes of the expected effects increase slightly: A one standard deviation decrease in shared firm experience results in a 7.23% decrease in average game revenues, equivalent to about $240,000. A one standard deviation increase in teaming experience results in a 10.45% increase in game revenues, equivalent to about $345,000, and similar in magnitude to the effect of managerial experience.

**Differential effects of shared firm experience and teaming experience**

\(^{16}\) In unreported results, we find that the coefficient on this variable is statistically insignificant, while if we introduce the square of team familiarity, we obtain significant coefficients but of opposite signs. Since the two variables are highly collinear, we investigated if this result is driven by outliers and indeed find that dropping the observations with the very highest levels of team familiarity (26 observations) results in a positive and significant coefficient on team familiarity, without the square term. This latter result is reported in Column 4.
To test H4B and H5B we conduct a series of Chow tests reported in Tables 4 and 5. Table 4 Column 1 reproduces Table 3 Column 7 and shows the results for the regression of team performance on all independent variables. We then partition shared firm experience into three variables according to the quartile (tercile) values of team familiarity and report the results in Column 2 (3). For the regression based on the quartile partition, shared firm experience – low team familiarity and shared firm experience – high team familiarity are not significant at conventional levels, while for the regression based on the tercile partition, all variables are significant at the 5% and 10% level, respectively. The coefficients on all variables are positive and, according to the Chow test, not significantly different from each other. This indicates that there is no difference between the impacts of shared firm experience for different values of team familiarity. Hence, we find no empirical support for H4B.

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INSERT TABLE 4 ABOUT HERE

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Similarly, Table 5 Column 1 reproduces Table 3 Column 7. In Column 2 (3), we partition teaming experience into three variables according to the quartile (tercile) the value of team familiarity falls in. For the regression based on the quartile partition, all variables are significant at the 10% level, while for the regression based on the tercile partition, only teaming experience – low team familiarity and teaming experience – moderate team familiarity are significant. Again, the coefficients on all variables are positive and, according to the Chow test, not significantly different from each other. This indicates that there is no difference between the impacts of teaming experience for different values of team familiarity. Hence, H5B is not supported.

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INSERT TABLE 5 ABOUT HERE

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6. Discussion and Conclusions

What determines team performance? While this question has received wide attention in management and psychology research, we offer some significant empirical and theoretical contributions facilitated by the unique empirical setting of our study: First, we use a dataset covering a large portion of the electronic games industry over an extended period of time, including game-specific sales figures and development teams. This lets us extend prior work by focusing on commercial rather than operational performance, and by observing team composition and its effect not only within firms, but also across firms and over time. Further, detailed data on the careers of lead team members, including the occupational tasks they handled, the hierarchical roles they fulfilled, the firms they worked for, and
the team members they worked with let us construct various measures of experience that may affect team performance and that earlier studies could not separate.

We first focus on lead team members’ expertise, that is, what they know. We find that their task experience is not associated with a game’s commercial success – our measure of team performance – but that their managerial experience is, which is expected given that lead team members fulfill a role that requires within-task supervisory and coordination skills, rather than implementation skills.

We then investigate the performance impact of lead team members’ coordination experience. In this context, we study team familiarity, that is, whether team members can coordinate their expertise and activities more effectively when they are familiar with who is on the team. In line with prior studies, we find that team familiarity is positively associated with team performance. We capture familiarity between team members based on their prior interactions within the focal firm as well as firms where team members worked together previously.

Our study is distinctive for studying the performance effects of two alternative mechanisms with which team members can coordinate their expertise and activities more effectively, namely by learning how to coordinate within the firm and in general. Firms develop tacit organizational and managerial process routines, including coordination routines, and familiarity with these routines allows team members to coordinate with each other even if they have not worked together before. Indeed, we find that shared firm experience is associated with superior performance. In addition, lead team members can learn how to coordinate more effectively not only by working repeatedly with the same team members, but also by working with a large number of different individuals. We find that teams with high teaming experience, that is consisting of members who have worked with many individuals in the past, display superior performance. Moreover, we find that team familiarity does not substitute for shared firm experience or teaming experience; rather, their positive effect is equally important across all levels of team familiarity.

Several unexplored questions could be addressed in future research. It would be interesting to investigate which routines are most conducive to improved coordination and how firm outsiders can be effectively familiarized with them. Firm-level studies in the spirit of Faraj and Sproul (2000) or Huckman et al. (2009) could address these questions. In addition, learning to coordinate and coordination experience may result from interacting with others, but also from learning from others about coordination. Thus, it would be interesting to examine whether and how coordination experience depends on both the number of different individuals a lead team member has worked with, and on their respective skillsets. Firm-level studies with access to performance evaluations as a measure of quality would provide a first step in this direction. Further, outsiders, i.e. individuals joining a new firm, seem to have a dual effect: On the one hand, they lower team familiarity (which lowers team performance), on the other, they bring individual task and management expertise to the team (which increases team performance). Studying this tradeoff by focusing on the “movers” in the industry would be another interesting line of research.
Our study also has important managerial implications. In particular, if a firm has effective organizational and managerial process routines, including coordination routines, team members could be matched based on criteria other than team familiarity, as shared firm experience is sufficient to achieve effective coordination. Conversely, if a firm does not have established routines, fluid teams might not be lead to superior performance, at least not in the short term. In the long run, however, fluid teams might contribute to teaming experience and thus compensate for short-term performance deficits. This suggests that a long-term vision for the firm, and an awareness of the role of both firm-specific coordination routines and individual-specific teaming experience, is particularly important.
References


NPD. 2008.  


Figure 1
Team Composition

Game Director

Producer

Art Director
  Lead Artist
  Artists

Technical Director
  Lead Programmer
  Programmers

Creative Director
  Lead Game Designer
  Designers
Figure 2
Average Monthly Revenues per Game
Figure 3
Revenues of the 100 Most Successful Electronic Games
Table 1  
Construction of the Main Independent Variables

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<th>Construction of Individual Level Variable</th>
<th>Team Level Aggregation</th>
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<td>Expertise in performing a task.</td>
<td>Number of projects completed as non-lead member in the specific task.</td>
<td>Average of individual levels.</td>
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<td>Expertise in supervising and coordinating a team.</td>
<td>Average number of team members supervised on previous projects as a lead team member.</td>
<td>Average of individual levels.</td>
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<td>Sum of individual levels divided by number of dyads.</td>
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<td>Expertise with firm specific coordination routines.</td>
<td>Worked for the developer on a previous project: YES = 1; NO = 0.</td>
<td>Average of individual levels.</td>
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<td>Number of lead team members worked with on previous projects.</td>
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### Table 2
Descriptive Statistics and Correlations (N=2,181)

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Notes. *, **, *** denote significance at the 10%, 5%, and 1% levels respectively.
### Table 3
**Coordination Experience and Game Revenues**

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**FIXED EFFECTS**

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<td>0.276</td>
<td>15.94***</td>
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</tr>
<tr>
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<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>2155</td>
<td>0.275</td>
<td>16.24***</td>
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</tr>
<tr>
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<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>2155</td>
<td>0.277</td>
<td>15.50***</td>
<td>0.457</td>
</tr>
</tbody>
</table>

Notes. GLS fixed-effects regression models of game revenues on the average coordination experience of the development lead team. Variables are defined in the text. Regressions include fixed effects for developer, platform, genre, and year. All standard errors are robust to heteroskedasticity and arbitrary within-firm serial correlation. *, **, *** denote significance at the 10%, 5%, and 1% levels respectively.
### Table 4

**Chow Tests for Shared Firm Experience Effects**

**Differentiated by Team Familiarity**

<table>
<thead>
<tr>
<th></th>
<th>(1) 25%</th>
<th>(2) 25%</th>
<th>(3) 33%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TASK &amp; MANAGERIAL EXPERIENCE:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task Experience</td>
<td>0.015</td>
<td>0.014</td>
<td>0.015</td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td>(0.023)</td>
<td>(0.023)</td>
</tr>
<tr>
<td>Managerial Experience</td>
<td>0.007**</td>
<td>0.007**</td>
<td>0.007**</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
</tr>
<tr>
<td><strong>COORDINATION EXPERIENCE:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team Familiarity</td>
<td>0.060</td>
<td>0.087</td>
<td>0.060</td>
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<tr>
<td></td>
<td>(0.076)</td>
<td>(0.097)</td>
<td>(0.092)</td>
</tr>
<tr>
<td>Shared Firm Experience</td>
<td>0.289**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.139)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Team Familiarity</td>
<td></td>
<td>0.258</td>
<td>0.282*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.170)</td>
<td>(0.156)</td>
</tr>
<tr>
<td>Moderate Team Familiarity</td>
<td>0.304**</td>
<td>0.268*</td>
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<tr>
<td></td>
<td></td>
<td>(0.146)</td>
<td>(0.152)</td>
</tr>
<tr>
<td>High Team Familiarity</td>
<td>0.238</td>
<td>0.278**</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>(0.151)</td>
<td>(0.140)</td>
</tr>
<tr>
<td>Teaming Experience</td>
<td>0.007**</td>
<td>0.007**</td>
<td>0.007**</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>F statistic for equal coefficients</td>
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<td>0.230</td>
<td>0.230</td>
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<tr>
<td>No. of Observations</td>
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<td>2155</td>
<td>2155</td>
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<tr>
<td>R²</td>
<td>0.277</td>
<td>0.3</td>
<td>0.3</td>
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<tr>
<td>F Statistic</td>
<td>15.50***</td>
<td>15.51***</td>
<td>15.45***</td>
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<tr>
<td>Rho</td>
<td>0.457</td>
<td>0.457</td>
<td>0.457</td>
</tr>
</tbody>
</table>

**Notes.** GLS fixed-effects regression models of game revenues on the average coordination experience of the development lead team. Variables are defined in the text. Regressions include fixed effects for developer, platform, genre, and year. All standard errors are robust to heteroskedasticity and arbitrary within-firm serial correlation.

*, **, *** denote significance at the 10%, 5%, and 1% levels respectively.
Table 5
Chow Tests for Teaming Experience Effects
Differentiated by Team Familiarity

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25%</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td><strong>TASK &amp; MANAGERIAL EXPERIENCE:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task Experience</td>
<td>0.015</td>
<td>0.014</td>
<td>0.014</td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td>(0.023)</td>
<td>(0.023)</td>
</tr>
<tr>
<td>Managerial Experience</td>
<td>0.007**</td>
<td>0.007**</td>
<td>0.007**</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
</tr>
<tr>
<td><strong>COORDINATION EXPERIENCE:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team Familiarity</td>
<td>0.060</td>
<td>0.080</td>
<td>0.103</td>
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<td></td>
<td>(0.076)</td>
<td>(0.092)</td>
<td>(0.089)</td>
</tr>
<tr>
<td>Shared Firm Experience</td>
<td>0.289**</td>
<td>0.289**</td>
<td>0.297**</td>
</tr>
<tr>
<td></td>
<td>(0.139)</td>
<td>(0.140)</td>
<td>-0.139</td>
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<tr>
<td>Teaming Experience</td>
<td>0.007**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Team Familiarity</td>
<td>0.011*</td>
<td>0.010*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.006)</td>
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</tr>
<tr>
<td>Moderate Team Familiarity</td>
<td>0.007*</td>
<td>0.008*</td>
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<tr>
<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
<td></td>
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<tr>
<td>High Team Familiarity</td>
<td>0.007*</td>
<td>0.005</td>
<td></td>
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<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
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<tr>
<td>F statistic for equal coefficients</td>
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<td>0.39</td>
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<tr>
<td>No. of Observations</td>
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<td>2155</td>
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<tr>
<td>R²</td>
<td>0.277</td>
<td>0.3</td>
<td>0.3</td>
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<tr>
<td>F Statistic</td>
<td>15.50***</td>
<td>15.03***</td>
<td>15.61***</td>
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<tr>
<td>Rho</td>
<td>0.457</td>
<td>0.457</td>
<td>0.458</td>
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</tbody>
</table>

*Notes*. GLS fixed-effects regression models of game revenues on the average coordination experience of the development lead team. Variables are defined in the text. Regressions include fixed effects for developer, platform, genre, and year. All standard errors are robust to heteroskedasticity and arbitrary within-firm serial correlation. * *, **, *** denote significance at the 10%, 5%, and 1% levels respectively.
APPENDIX A

Figure A.1
Figure A.2

![Density plots for Task Experience: Sample Games and All Games](image)
Figure A.3
Figure A.4
Figure A.5

![Graphs showing density distribution of shared firm experience in sample games and all games.](image)
Figure A.6