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The strength of direct ties: Evidence from the electronic game industry

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ABSTRACT

We analyze the economic effects of a developer's connectedness in the electronic game industry. Knowledge spillovers between developers are likely to be of special relevance in this knowledge-intensive and regionally concentrated industry. We calculate social network measures for a developer's connectedness to other developers at multiple points in time. In a regression in which we exploit within-career variation in social network measures, we find that the number of direct ties a developer has to other developers has a strong effect on both a game's revenues and critics' scores. The quality of indirect ties makes no additional contribution to the game's success.

1. Introduction

The importance of knowledge spillovers has been emphasized in both the regional context (Jacobs, 1969) and in the growth context (Lucas, 1988, 2009). Knowledge spillovers result when people interact and learn from each other in a way which is not priced on the market.[3] When describing an actor's social interactions, Granovetter (1973, 1983) distinguishes between individuals' strong ties and weak ties. In a close network in which actors are directly connected by strong ties, everyone knows everyone else and knowledge is quickly shared. Some shared past experience or face-to-face contact is necessary to establish close networks, which are based on trust between individuals.[4] By contrast, a wide network that indirectly but weakly connects actors in a network to outside actors offers new opportunities for knowledge inflow; further, "whatever is to be diffused can reach a larger number of people, and traverse greater social distance" (Granovetter, 1983, p. 1366). Despite the plausibility of these arguments, it is difficult to empirically identify the economic effects of social interaction since individuals might select into networks on the basis of unobserved characteristics that themselves affect economic outcomes, leading to the possibility that the economic effect of these unobserved characteristics are erroneously attributed to social interactions.[5]

Using measures from social network analysis, we study the economic effects of a developer's connectedness in the electronic game industry.[6] Typically, an electronic game is created by a team of developers.[7] The electronic game industry is an ideal microcosm in which to study the economic effects of a developer's connectedness because it is a highly knowledge-intensive and regionally concentrated industry. Thus, knowledge spillovers via developer networks are likely to be very relevant. We use the "degree centrality" measure to count a developer's direct connections to other developers. A direct connection is defined as forming when two or more parties have worked

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[3] Durlauf (2004) offers a comprehensive survey of the theoretical and empirical literature on group behavior. For a recent survey that focuses on peer effects in schools, see Sacerdote (2011).

[4] The importance of trust is especially emphasized in the literature on social capital (Coleman, 1990; Putnam, 2000). Sobel (2002) and Durlauf (2002) provide critical literature reviews.

[5] Furthermore, close networks in which actors are directly connected by strong ties are often localized, e.g., within a neighborhood or firm. Members of a network then also share the same environment and it is difficult to disentangle contextual effects of the environment from network effects. For a general discussion on the empirical identification of endogenous social effects, see Manski (1993, 2000).

[6] For a review of social network analysis, see Freeman (2006).

[7] Commercial and academic research, also, is typically done by teams (cf. Fershtman and Gandal (2011) for open-source projects and Goyal et al. (2006) for co-authorships in academia).

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on a project jointly, i.e., have gained common experience. Degree centrality thus measures how many strong ties a developer has. The "closeness centrality" measure is the inverse of the average number of intermediate actors necessary to connect a developer to any other developer.[8] Given the number of direct ties, closeness centrality thus measures how easy it is for a developer to make contact with any other developer in the network with whom he or she has no common experience. In other words, conditional on the number of direct ties a developer has, closeness centrality measures the quality of a developer's indirect ties.

We compiled our unique dataset on the electronic game industry from two sources. We use MobyGames, a comprehensive electronic game documentation project, as a source of information about the members of game development teams. These data allow us to calculate both the degree centrality measure and the closeness centrality measure for a developer at any point in time since 1972 at which he or she was involved in a project. We can thus trace the evolution of a developer's network along his or her career. We link these social network measures with revenue information from the NPD database, which includes information for every electronic game commercially released in the United States between 1995 and 2007. Along with revenue, we also use critics' scores from MobyGames as an alternative indicator of a game's success.

To identify a causal effect of a developer's connectedness on a game's success, the analysis needs to address a developer's endogenous choice of the project and firm at which she or he works. Given the special features of our data, we can address this issue by including developer, developing firm, and publishing firm fixed effects. The developer fixed effects control for time-invariant unobserved developer characteristics that are correlated with both the developer's connectedness and his or her contribution to a game's success. Of course, some developing firms and publishing firms are more prestigious than others and the best developers might select into prestigious firms' projects. To address this issue, we only compare projects within the same developing and publishing firm by including developing and publishing firm fixed effects. One problem not addressed by the fixed effects framework is the reciprocal nature of social interaction; that is, the social networks of developers working in the same project team are jointly determined. This might introduce a problem when using a developer's contemporaneous social network measures in a regression in which the outcome variable is team success. We solve this problem by controlling for co-developers' social network measures and by lagging our social network measures. However, lagging social network measures ignores the additional value of the developer's contemporaneous connectedness, which may result in an underestimate of social interaction.

Based on more than 150,000 observations, we find a significantly positive effect of a developer's (lagged) degree centrality measure on a game's success. The result is robust to the inclusion of several control variables, including the game genre, release year and month, team size, developer tenure, and co-developers' social network measures. We also find evidence of heterogeneity of this effect between lead and non-lead developers. By contrast, the developer's closeness centrality measure contributes no additional explanatory power. These results suggest that direct ties foster sharing of knowledge and thus strongly contribute to a game's success, whereas the quality of indirect ties has no significant influence on success.

Our paper is closely related to Fershtman and Gandal (2011) who study the social network of open-source projects. The open-source model typically implies that source codes are made freely available to all interested parties. Using cross-sectional data, they construct networks on two levels: the open-source software project level, in order to identify learning effects from working on or studying a particular project, and the developer level, in order to identify learning from interacting with other developers. The latter is the focus of our paper. They find spillovers to be an important determinant of project success at the project level. However, in contrast to our findings, none of the centrality measures are positively associated with project success at the developer level. These differences between our findings and theirs may be due to the fact that the open-source model allows "anonymous" learning from studying the freely available program codes and thus no personal interaction between developers is necessary for the exchange of knowledge. In the electronic game industry, which is predominately based on a proprietary closed model, the exchange of knowledge between developers who do not work on the same project team requires some kind of interaction between developers as program codes are not freely available.

The remainder of the paper is organized as follows. Section 2 briefly describes central features of the electronic game industry. In Section 3, we set out our estimation strategy, introduce our data, and report the results. Section 4 concludes.

2. The electronic game industry

The electronic game industry encompasses both video and computer games. Video games are developed for game or handheld consoles; computer games are developed for personal computers. In 2010, the electronic game industry had total sales of US$ 15.6 billion. There are two main players on the software side of the electronic game industry: developing firms, which design, create, and code the game, and publishing firms, which provide financing, packaging, marketing, and manage relationships with retailers and console providers. Developing and publishing firms are highly concentrated geographically, as evidenced by the regional clustering of firms in Montréal, Canada (Cohendet et al., 2010). Due to government grants, tax allowances, and its bilingual, multicultural workforce's reputation for creativity, Montréal is one of the most important sites for the electronic game industry, home to more than 40 developing firms.

Comparable to commercial and academic research and other product development projects, games are developed by teams. In the electronic game industry, a development team typically includes four main disciplines: producer, game designer, artist, and programmer (Chandler, 2009). Producers manage and track the game development process and ensure that the game is released on time and within budget. Game designers develop the main story, characters, and levels, and devise the game's rules (Novak, 2008). Artists create the concept art and graphics. Their tasks include drawing, modeling, texturing, and animation (Chandler, 2009). Programmers write the game's code and develop tools the designers and artists need for their work (Novak, 2008). Other parts of the game development process include audio design, game testing, and quality assurance, but these tasks typically are outsourced (Novak, 2008). We focus on producers, game designers, artists, and programmers when building our social network measures as these positions interact substantially during game creation.

The composition and size of game development teams has changed dramatically over time. In the early years of the industry, a game development team usually consisted of two people: one who conceived the game idea and one who wrote the code for the game. However, several technological changes, such as the introduction of compact discs as a storage medium in the mid-1990s, allowed developing firms to make games look more realistic and be more immersive.[9] Accomplishing this, however, required the talents of various art and cinematographic specialists. Team sizes increased correspondingly, ranging, on average, from 30 to 80 members (Hight and

[8] For example, let's assume that developer A wants information about a previous project from developer D. A does not know D personally. However, C knows D personally, B knows C personally, and A knows B personally. In this situation, unadjusted closeness centrality is 1/2.

[9] Immersiveness is the quality of feeling like one is in a realistic virtual environment.