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Specific and general information sharing among competing academic researchers

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ABSTRACT

We examine information sharing among academics during the research process and show it is context dependent because of differences in trade-offs. When researchers respond to specific requests for information or materials, potential future reciprocity is weighed against the current loss of competitiveness, while general sharing intermediate results in an open forum is driven by the need for feedback versus potential misappropriation. We formally model these trade-offs and empirically test for differences using a survey of German and UK bio-scientists. Increased competition has a negative impact on sharing in both contexts. But career stage has an effect only on specific sharing with untenured faculty less likely to share. Further, scientists in larger teams are more likely to share specifically, but less likely to share generally. The importance of patents for one's reputation reduces sharing in both contexts, but the effect is greater for general information sharing.

1. Introduction

Information sharing is critical to scientific progress, so much so that the Mertonian norm of unconditional sharing of knowledge is considered one of the defining features of academic life (Merton, 1973). In principle, this norm is enforced by a priority-based scientific reward system in which the first person to discover a result gets whatever "prize" is associated with discovery (Dasgupta and David, 1987; Stephan, 1996). There is a tension, however, between communal sharing and the competitive incentives for researchers during the research process itself (Hagstrom, 1965, 1974; Dasgupta and David, 1994; Murray and O'Mahony, 2007). This tension along with incentives created by the commercial potential of academic research has made restrictive sharing a common problem and heightened interest in information sharing among academic researchers (Blumenthal et al., 1996; Cohen and Walsh, 2008; Murray, 2010).

We examine, theoretically and empirically, what drives competing academic researchers to share information during the research process. We consider two important contexts: *specific sharing*, where researchers share information about their work privately in response to a request and *general sharing*, where a researcher shares new, unpublished results publicly. Common examples of the former include sharing data, materials (such as cell line or mice), and information about techniques or details not released publicly. General sharing includes presentations, webpostings, and working papers.

While the communal desire for information sharing is universal, particularly among public funding agencies (e.g., NSF, 2011; NIH, 2013), factors that encourage sharing in one context may not in another. In fact, we show that sharing can be highly context dependent because of differences in individual trade-offs and incentives. Our formal modeling allows us to characterize these trade-offs and set up an empirical test for differences in specific and general sharing.

In specific sharing, a researcher who shares in response to a request from another bears the cost of preparing materials or documentation, but also, by providing access to the information, the researcher increases the probability that someone else will solve her research problem first. There is a potential benefit, but only in the future, and only if the requesting scientist has information of value and reciprocates. Hence, sharing depends on the likelihood of future reciprocity and the level of competition. In general sharing, a researcher who shares new results can gain immediate feedback, particularly if the audience includes researchers who have solved complementary parts of the problem. However, as with

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specific sharing, she increases the probablity someone else will win the prize for solving the problem. General sharing also has the benefit of providing credit, but only if the work is acknowledged. Unknown researchers in the audience may use the information without acknowledgment unless they risk independent verification or have a strong belief in the norms of open science. Important factors of sharing in this context are the value of feedback, beliefs about acknowledgment, and the level of competition.

The empirical analysis uses a survey of bio-scientists in Germany and the United Kingdom which provides individual level data on willingness to share in specific and general contexts. The survey also includes information on the respondents' perceptions of the level of competition in their field and demographic information such as career stage, the extent to which their research is basic, and the size of their research team. Our econometric analysis suggests that, except for three regressors (most notably the level of competition), what drives researchers to share information differs markedly. For example, we find members of larger teams are more likely to engage in specific sharing but less likely to share generally. Intuitively, economies of scale in larger teams reduce the cost of sharing in the context of specific sharing. With regard to general sharing, researchers in larger labs have a larger built-in network of colleagues for immediate feedback so that general sharing is less valuable, ceteris paribus. Moreover, in specific sharing, we find tenured faculty are more likely to share than untenured; in general sharing, tenure has no effect. This is consistent with the importance of future gains from reciprocity in specific sharing since untenured faculty may not be in a position to share in future periods.

To our knowledge, this is the first study to formally model academic information sharing in these two contexts. Despite evidence that academics withhold information, there has been little theory to guide our understanding (Blumenthal et al., 1996; Campbell et al., 2002). With few exceptions, the theory has focused on firms (Von Hippel, 1987; Anton and Yao, 2002, 2004; Lerner and Tirole, 2002; Gächter et al., 2010; Baker and Mezzetti, 2005; Hellmann and Perotti, 2011; Gans et al., 2011; Gill, 2008; Stein, 2008). The studies of academics focus on different issues, such as the trade-off between secrecy and publication (Mukherjee and Stern, 2009; Gans and Murray, 2010) or the impact of academic misconduct on research and publication decisions (Hoover, 2006; Lacetera and Zirulia, 2011). In contrast, we focus on sharing during the research process.

With respect to empirics, prior work has either aggregated information sharing across contexts or focused solely on specific sharing. For example, Blumenthal et al.'s (2006) study of genetics and other life sciences examines perceived competition and sharing, but it combines information across the contexts we consider into a single variable. Hong and Walsh (2009) and Walsh et al. (2007) examine specific sharing and find that cost, involvement in business, students' ability to publish, and scientific competition decrease sharing and Haeussler (2011) finds expected reciprocity and perceived adherence to the scientific norm of communalism to be important. While this literature compares the behavior of academic and industrial scientists, we are unaware of empirical evidence on sharing of the same individual in specific and general contexts.

Combined, our results have interesting implications for policy. One factor which operates the same way in both models is competition or the value of the prize. This suggests negative unintended consequences for competitions with prizes, as well as a cautionary message for funding agencies to the extent that their funding levels affect the nature of competition. The general sharing model has the interesting implication that journal policies regarding misappropriation have a spillover to sharing during the research process itself. Misappropriation is considered to be a major problem in science (Bailey et al., 2001; Enders and Hoover, 2004; Birnholtz, 2006; Couzin-Frankel and Grom, 2009). We join Lacetera and Zirulia (2011) in our message for more journal attention to these issues.

In the next section, we construct two simple models of specific and general sharing which highlight salient factors in the two context. Section 3 relates the propositions from the theory to empirical measures from the survey and presents the econometric analysis, as well as a discussion of empirical differences in the models. Section 4 provides clarifying remarks and implications for funding agencies and journals.

2. Games of information sharing

In developing the theory, it is important to keep in mind that the two types of sharing in question are not necessarily alternatives. A researcher may share some information privately (e.g., materials, techniques), while sharing other information (e.g., an entire working paper) publicly. Also the appropriate assumptions on timing and identity of the players who receive the information by specific and general sharing are quite different. Accordingly, we construct two models.

To capture the rivalry created by the scientific reward system, we model the situations as games in which researchers are trying to solve a common problem. A complete solution earns a prize, W, such as publication, a Fields Medal or Nobel Prize with academic value and/or it can have commercial value.

In both games, we assume that each researcher has solved a portion of the problem and/or developed materials of use in solving it. If a researcher shares her solution or materials, she makes it easier for the recipient(s) to earn the prize. The information could be materials (cell line, reagents), data or methods (software, lab technique), or intermediate research results.

2.1. Specific sharing

Consider a game played in two periods. In the first, researcher 1 receives a request from researcher 2, and she decides whether or not to share. With probability α, the game continues to the second period and researcher 2 has information of value to researcher 1, in which case researcher 2 must decide whether or not to share. Each researcher's expected payoff is the expected value of the prize plus the asset value of any information or materials gained in exchange minus the cost of the exchange.

The game is "winner take all" so that each researcher gets W with probability less than one.[1] Unilateral sharing by a researcher lowers her/his probability of winning the prize and raises the rival's probability. In the absence of sharing, $x(r_1)$ and $1-x(r_1)$ represent the probability that researcher 1 and 2, respectively, wins the prize where $r_1 \geq 0$ is the amount or quality of researcher 1's information requested by researcher 2. Unilateral sharing by researcher 1 reduces her probability of winning by $\delta_1(e_2,r_1)$ and increases 2's probability by δ_1.[2] We assume that δ_1 is an increasing function of r_1 and 2's ability to exploit the information, $e_2 \geq 0$. The shared information has an asset value $V(e_2,r_1) \geq 0$ regardless of whether researcher 2 wins the prize. $V(e_2,r_1)$ reflects the extent to which

[1] In this model W is fixed, but we have also examined a model with the value of the prize as a positive function of the material shared and the results of interest are qualitatively similar.

[2] Absent competition, the researcher who shares the information would not necessarily reduce his/her own probability of winning. An example would be the case when the recipient uses the same techniques or information for a different problem. But here we focus on competing researchers. Also in a model of sharing among researchers with varying levels of competition, the competition parameter acts much like the W in our model.