



Not all scientists pay to be scientists: PhDs' preferences for publishing in industrial employment[☆]



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ABSTRACT

It is often assumed that academically trained scientists have a strong taste for science and are willing to “pay” for the ability to openly disclose their research results. However, little is known regarding how scientists considering jobs in industrial R&D make trade-offs between positions that allow publishing on the one hand and positions that do not allow publishing but offer higher pay on the other. Using data on over 1900 science and engineering PhD candidates about to enter the job market, we find that while some are unwilling to give up publishing at virtually any price, over one third of those most likely to seek positions in industrial research are willing to forego publishing for free. We develop a simple model of the “price” scientists assign to publishing in firms and explore potential sources of heterogeneity empirically. We find that the price of publishing increases with individuals' preferences for various benefits from publishing such as peer recognition and contributing to society, but it decreases with their preference for money. Scientists who believe themselves to be of high ability and who train at top tier institutions have a higher price of publishing. Yet, they are more expensive to hire (not less) even if publishing is allowed. We discuss implications for research on the economics of science and on compensating differentials, for managers seeking to attract and retain academically trained personnel, and for firms considering their participation in open science.

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1. Introduction

A large stream of innovation research rests on the notion that scientists have a strong desire to participate in “open science” by disclosing and disseminating their research results to the broader scientific community. For example, early work has highlighted potential conflicts between scientists' taste for science and the closed commercial logic of the private sector (Kornhauser, 1962; Miller, 1967; Ritti, 1968). More recent research has suggested that firms may gain a range of benefits from allowing their scientists to participate in open science. In particular, firms adopting open science policies may be better able to attract and retain academically trained scientists (Penin, 2007; Simeth and Raffo, 2013) and they may even be able to extract a wage discount from scientists

who are willing to give up pay in exchange for opportunities to engage in open science (Stern, 2004; Gans et al., 2010). Stern (2004), for example, showed that R&D positions that offered a science-oriented environment also offered lower wages, concluding that scientists “pay” to be scientists.²

By focusing on characteristics that appear to distinguish scientists from other professionals – such as their taste for science – most of the prior literature has implicitly treated scientists as a homogenous group. Recent research, however, has challenged this simplistic view by demonstrating significant heterogeneity among scientists (Owen-Smith and Powell, 2001; Roach and Sauermann, 2010; Agarwal and Ohyama, 2013). We contribute to this growing stream of work by examining the degree to which scientists differ in the price they assign to publishing opportunities in industrial R&D and by exploring why some value publishing more than others. Insights into these questions have important implications for research on scientific labor markets, for managers seeking to attract

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² The notion of “open science” policies may capture a wide range of aspects, including publishing, conference attendance, industry-academia collaborations, etc. In this paper, we focus on publishing as a particularly salient aspect.

and retain highly educated employees, and for firms considering the adoption of open science policies.

We conceptualize the *price of publishing* as the additional amount of pay that a given scientist requires to make him indifferent between accepting an industrial R&D position that restricts publishing and one that allows it. Drawing on a survey of over 1900 science and engineering PhD candidates preparing to enter the job market, we measure the price of publishing at the level of the individual by eliciting respondents' reservation wages for hypothetical industrial R&D positions that differ only with respect to whether or not they allow publishing. This approach enables us to characterize the full distribution of the price of publishing in a given cohort of PhDs across a broad range of fields. As such, we complement prior work that has focused on average equilibrium compensating differentials emerging in the labor market or that has used smaller and narrower samples (Stern, 2004; Stuart and Liu, 2010).³ The survey instrument also provides a rich set of measures that allow us to explicitly examine which particular scientists place a higher value on publishing than others. As such, we expand upon prior work that has demonstrated heterogeneity across scientists and has discussed its implications, but remains largely silent as to the underlying sources of this heterogeneity (Roach and Sauermann, 2010; Agarwal and Ohyama, 2013). Perhaps most interestingly, the data allow us to examine the reasons *why* scientists value the opportunity to publish, complementing prior conceptual discussions of the different functions of publishing in the institution of science with unique empirical insights from scientists' perspective.

While some PhDs conform to the stereotype and place a high value on the opportunity to publish when working in industrial R&D, we observe considerable heterogeneity in the price of publishing, with many scientists willing to forego publishing "for free". Moreover, we find that the price assigned to publishing opportunities in firms is significantly lower for those scientists who aspire to positions in industry than for those who would prefer to work in academia. Indeed, a full 37% of those who prefer an industry position price publishing at zero, compared to 12% among those who prefer academic employment. As such, those scientists most likely to enter the private sector appear to place a lower value on publishing than the typical scientist portrayed in prior work.

To gain a deeper understanding of which scientists value publishing more than others, we relate the price of publishing to scientists' preferences for various indirect payoffs from publishing suggested in the prior literature. As predicted, we find that the price of publishing is significantly higher for those scientists with strong preferences for peer recognition or for contributing to the stock of public knowledge. In contrast, the relationship between the price of publishing and scientists' desire for career advancement is weak, possibly suggesting that publications are not seen as a key mechanism for career advancement in industrial R&D. Most interestingly, we also find that the price of publishing is significantly *lower* for those individuals who care strongly about money, likely reflecting that these individuals derive more utility from a given amount of money and need only a small amount of extra pay to compensate

for the lack of publishing opportunities. Examining the relationship between the price of publishing and proxies of ability, we find that scientists with higher self-perceived ability and those from top tier institutions have a higher price of publishing. However, they also expect higher wages irrespective of the publishing regime. As such, they are more expensive to hire than other scientists when they are allowed to publish, and they are disproportionately more expensive when publishing is restricted. Finally, we also observe significant differences in the price of publishing across fields of science and engineering, likely reflecting that publications are more important as a mechanism to disclose research results and as a measure of scientists' performance in some fields than in others.

While only a first step toward understanding the extent and possible sources of heterogeneity among scientists, our results speak to the generalizability of common models of scientists' preferences and provide a foundation for future research to better understand scientists' behaviors and choices. Our findings can also have important implications for science and technology-based firms that seek to attract and retain highly educated employees or that consider the adoption of open science policies for various reasons. Finally, by providing deeper insights into how scientists make trade-offs between publishing and pay, this study has implications for the broader human capital literature that examines compensating differentials and trade-offs between other types of job attributes such as pay and social responsibility (Goddeeris, 1988; Auger et al., 2011), pay and freedom (Aghion et al., 2008), or pay and a desirable work location (Campbell et al., 2012).

In the following section, we provide background on the role of publishing in the scientific system and conceptualize publications as a means toward different ends, implying that scientists may value publishing for a variety of reasons. In Section 3, we describe the data and provide descriptive insights into heterogeneity in the price of publishing and in the reasons for publishing. In Section 4, we build on these insights to develop a model that relates the price of publishing to individual characteristics such as preferences for different potential payoffs from publishing as well as ability. This model guides a more systematic regression analysis of the price of publishing in Section 5. Section 6 discusses implications and opportunities for future research.

2. Background

2.1. The institution of science and publications as a means toward different ends

According to the canonical view, the institution of science entails as one of its key elements a reward system that encourages scientists to quickly disclose new knowledge through publication (Merton, 1973; Dasgupta and David, 1994). This system has advantages to the extent that research results have characteristics of a public good, leading to sub-optimal incentives for research in a traditional market system (Stephan, 2012). Moreover, research findings can provide valuable inputs for follow-on research, suggesting that the open disclosure of knowledge may benefit society by allowing researchers to build on existing knowledge in a cumulative fashion (Nelson, 2004; Sorenson and Fleming, 2004). Thus, the publication-based reward system of science has been interpreted as an institutional mechanism designed to encourage both the production and the diffusion of new knowledge (Stephan, 2012).

Individual scientists, however, may not care directly about publishing per se, but rather about the various indirect benefits that can result from publishing one's research. While we cannot consider all possible types of such benefits, several have been prominently featured in prior work. First, publications are often used as a measure of scientists' research ability or performance and as a predictor of

³ The term "compensating differential" is used widely in the labor economics and human capital literatures to describe the additional amount of money a job pays to offset the absence of a desirable attribute (e.g., publishing) or the presence of an undesirable attribute (e.g., hazardous work conditions) (e.g., Rosen, 1986; Hwang et al., 1992). In prior empirical work, the compensating differential is an equilibrium outcome in the labor market, i.e., it reflects both the supply and the demand side of the labor market. Our focus is on the price each individual scientist assigns to the opportunity to publish, i.e., on the supply side. While compensating differentials observed in the labor market reflect the preferences of the marginal individual and provide limited insights into the preferences of the broader population (Rosen, 1986; Killingsworth, 1987; Aghion et al., 2008), our approach allows us to characterize the distribution of preferences in a cohort of scientists.

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