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Ownership and pricing of information: A model and application to open access

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ABSTRACT

We consider a spillover externality in the use of information. When a person consumes an information source, she enjoys private benefit but also creates social value. Her use of the source enhances society's understanding of it, which is 'in the air' and freely accessible by others, but which decays in quality over time. We ask how efficiently information will be used in the presence of this externality effect under four cases: exogenously given prices, ownership and pricing by a profit-maximizing monopolist, ownership and pricing by a firm restricted by competition or mandate to earn zero profit, and open access. Information is overpriced and underused under both monopoly and zero-profit ownership, and underpriced and overused under open access. However, as the cost falls toward zero, outcomes under zero-profit ownership and open access both tend toward the efficient level, and for-profit monopoly ownership is increasingly inefficient. Potential efficiency gains from open access and zero-profit ownership are therefore greater as advances in technology reduce the costs of delivering information to consumers.

1. Introduction

In many situations we produce output that refers to previous work done by others. In this paper we consider a spillover externality that can arise in the process of consuming an information source to produce output. An individual bears the cost of accessing and using a piece of information, but by using it they not only enjoy the private value of understanding the source but may also create social value by enhancing others' understanding of the source. We present a model that captures this externality, and we apply the model to the question of how we should store, price, and assign property rights to information.

We will consider three broad classes of regime for the ownership of information, and compare the use and pricing of information under each regime to the socially efficient outcome. First, we consider proprietary ownership by a single entity who can make profit. Second, we consider proprietary ownership by a firm that is restricted to earn zero profit, either because they compete with other owners of the information, are a not-for-profit institution, or operate under regulatory enforcement of a zero profit condition. Third, we consider the case in which the information source is freely available to anyone, for example through some repository under an open or online access policy.

In the model consumers arrive one by one in sequence. Each consumer would like to understand an information source, and can choose from two options. The first option is to access and use the original piece of information at a cost, either by paying a price to access the source or having paid for subscription access to it. The second option is to rely on a freely available but imperfect understanding of the original source that is 'in the air'. The tradeoff for a consumer is therefore the cost of accessing the original information source versus the lower quality of the freely available information

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about the source. The key feature of the model is that the quality of information in the air degrades over time: the more consumers in a row who choose the freely available information rather than accessing the original source, the less a subsequent consumer will learn from the freely available information. This general idea of decay in knowledge of the original source could reflect, for example, such specific examples as received wisdom being gradually forgotten as generations pass, a hard copy of information degrading over time, or congestion in learning when there are more learners per teacher. An analogy for the decay concept is the telephone game: a phrase is whispered down a line of people, but as it passes along it becomes garbled, so that the phrase heard by the person at the end of the line may not be at all like the phrase at the beginning.

In this model, is information used efficiently, or it is used too much or too little? Does this depend on who owns and prices the information? Does it depend on whether information is sold for a price per use or under a library subscription setup? How does it depend on the costs incurred by those who store and deliver the information? Consider one concrete example of the idea of the model as a whole. An agency produces a report on a country by researching and referring to original sources, incurring some costs. At this point the agency knows as much about the country as it ever will. Occasionally a need arises for a firm or organization to know something about the country to inform a course of action. The organization can access the agency's report, paying some price or subscription fee, to learn something about the country. Over time the information in the report grows dated and obsolete — it decays — so that when it is consulted it is less useful than it was before. At what point will the agency produce a new report? Does it produce too few or too many? Does it matter whether the agency is public or private?

Later in the paper we will consider an application of the model to the question of whether scientific research should be published by for-profit copyright holders, or instead published under an open access policy or made freely available online. In this interpretation of the model, scientists produce original research. Another researcher, a practitioner, or a member of an institution may seek to use this research to address a problem or inform their own work. If they or their institution subscribe to a journal or database that includes the research, or are willing to pay to access it, or it is available freely online, they can read the research directly. If not, they can rely on the understanding of the research that is in the air as a result of others having used it, perhaps by talking to colleagues or referring to a simplified textbook explanation. The fewer people read the original, the worse the quality of information that is in the air. Should government mandate that publicly-funded research be published freely online or under open access rules? Would the use of information under this regime be more or less efficient than if the information is published for profit?

Since the general idea of the model can be applied to a variety of settings, let us briefly consider some other concrete examples.

Example 1: citations

A researcher is producing a paper. He must decide whether to study a particular prior paper in the field directly, or to rely on a textbook explanation of it. To read the original paper is more costly but will provide him with a better understanding. For him to read the original is socially valuable since subsequent researchers will be able to use his work to improve their own understanding of the original source.

Example 2: research fields

A researcher is choosing the direction of her research agenda. She can choose to make an incremental contribution to an existing strand of research, or to pursue a novel idea. Pursuing the novel idea is more costly, but the reward is greater. If she pursues the novel idea, she creates new opportunities for subsequent researchers to mine the new area.

Example 3: content aggregators

A website creates content for internet users. It can choose whether to engage in original reporting on a topic, or to summarize and aggregate content created by others. Original reporting is more costly but generates more information. If it engages in original reporting, it generates new content which can be discussed and aggregated by other outlets.

Example 4: legal appeals

A court is hearing an appeal of a prior decision. It must decide whether to hear directly from original witness by calling them again, or rely on the record of their original testimony. Calling witnesses to appear again is more costly but gathers better evidence. A court hearing a subsequent case can in turn make use of the testimony collected if the witnesses are called again.

Example 5: legal precedent

A court is hearing a case. It must decide whether to apply a precedent established in a previous case, or to work from first principles. Applying precedent is easier, but may be less accurate since the precedent may have contained errors or be an imperfect analog of the new case. Courts considering subsequent cases will be able to use the new case as precedent in the future.

Example 6: decisions based on evidence

A person is deciding between two options. He must choose whether to evaluate the two options comprehensively, or to rely on a recommendation from a friend. Using the friend's recommendation is quicker, but their tastes may not be a perfect match. If he chooses to do his own research, then when another friend asks him in turn for his recommendation, it will be more informed.

The model we propose is designed to capture the spillover externality that is the common feature of these examples. However, to focus ideas we will return frequently to the application of a 'library' that controls access to an information source by setting prices or subscription fees, and consumers who must decide between paying for the high quality original source, or relying on an imperfect free copy.

First we consider this model when the price to access an information source is exogenous. In general the effect of the spillover externality in the consumption of information causes information to be used inefficiently infrequently: individuals over-rely on free, imperfect, recent information, and too seldom access the costly, higher quality original source, so that the length of 'branches' from the original source is too long. The outcome is more inefficient when the price to access information is higher, and more inefficient when the decay in information quality along branches is smaller. These are equivalent to saying that the outcome