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Searching for information [☆]

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Abstract

This paper provides a search-based information acquisition framework using an urn model with an asymptotic approach. The underlying intuition of the model is simple: when the scope of information search is more limited, marginal search efforts produce less useful information due to redundancy, but commonality of information among different agents increases. Consequently, limited information searchability induces a trade-off between an information source's precision and its commonality. In a "beauty contest" game with endogenous information acquisition, this precision-commonality trade-off generates non-fundamental volatility through the channel of information acquisition.

JEL classification: C65; D80; D81; D83

Keywords: Information acquisition; Information search; Commonality of information; Urn model; Coordination games

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1. Introduction

It is well known that equilibrium outcomes depend on what information agents act upon, and that this information itself is (at least in part) also the result of a choice. Less is known, however, about *how* agents come to learn their information and whether this process influences the type of information that agents choose to observe. In our paper, we address the following questions: How do agents learn when relevant information has to be searched for? How does an agent's search effort translate into the information he learns? How similar is the information that agents learn through search? We provide a microfounded information acquisition technology that answers these questions.

Our framework is based on a simple intuition: the more an agent searches for new information about an unknown fundamental variable, the more likely he is to encounter information that overlaps–and that is therefore redundant–with information already discovered from past searching activities. Similarly, multiple agents who search from the same source of information will face increasing redundancy as more information is collected, thereby increasing the commonality of collected information. This increasing redundancy slows down learning about the fundamental, but speeds up learning about what other agents have learned. This effect is more pronounced when the amount of information that can be squeezed out of the information source (henceforth, the amount of "searchable information") is more limited.

As an example, suppose an investor seeks to gather information for investment in a firm by reading analyst reports. Initially, all the pieces of information he reads in the first analyst report are new and useful. As he reads one report after another, however, the investor may or may not find an additional report to be new and useful. For instance, the report may use exactly the same data for its revenue projections—say, the latest 10-K report—as the other analyst reports the investor has already read. On the other hand, another analyst report may turn out to be useful because it features revenue projections based on different inputs from a recent conference call held by the firm. In this simple example, the odds of benefiting from reading another report depend not only on how much the investor has already learned but also on the availability of information about the firm (e.g., disclosure requirements, analyst coverage, etc.).

We formalize the aforementioned intuition by employing an urn model. Consider multiple agents independently drawing balls with replacement from an urn containing a finite number of balls. Drawing a ball is interpreted as collecting a costly signal through search. Because the collected balls are replaced into the urn, the odds of drawing a previously collected ball increase each time an agent draws a ball from the urn. Drawing a previously collected ball means collecting a redundant (thus uninformative) signal. Of course, the outcome of information search inherits the randomness in the number of non-redundant signals. To overcome this randomness and obtain a tractable framework, we consider the limiting case in which each signal becomes infinitesimally small. In this limit, we derive a smooth and deterministic mapping from search efforts (i.e., the inputs of resources used in the information search) into the precision of each agent's information as well as the correlations among them.

Our framework provides a microfoundation for a commonly used setup in which private signals are imperfectly correlated among agents. When the number of agents is large, we show that an individual agent's (say, agent i's) acquired information, S_i, can be decomposed into three independent components as

$$S_i = \theta + \mu + \eta_i, \tag{1}$$