Dynamics of an Information-Filtering Economy

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Abstract. Our overall goal is to characterize and understand the dynamic behavior of information economies: very large open economies of automated information agents that are likely to come into existence on the Internet. Here we model a simple information-filtering economy in which broker agents sell selected articles to a subscribed set of consumers. Analysis and simulation of this model reveal the existence of both desirable and undesirable phenomena, and give some insight into their nature and the conditions under which they occur. In particular, efficient self-organization of the broker population into specialized niches can occur when communication and processing costs are neither too high nor too low, but endless price wars can undermine this desirable state of affairs.

1 Introduction

Today, we are witnessing the first steps in the evolution of the Internet towards an open, free-market information economy of automated agents buying and selling a rich variety of information goods and services[2, 4, 6, 16, 19, 22]. We envision the Internet some years hence as a seething milieu in which billions of economically-motivated agents find and process information and disseminate it to humans and, increasingly, to other agents. Over time, agents will progress naturally from being mere facilitators of electronic commerce transactions to being financial decision-makers, at first directly controlled by humans and later with increasing autonomy and responsibility. Ultimately, inter-agent economic transactions may become an inseparable and perhaps dominant portion of the world economy.

The evolution of the Internet into an information economy seems as desirable as it does inevitable. After all, economic mechanisms are arguably the best known way to adjudicate and satisfy the conflicting needs of billions of human agents. It is tempting to wave the Invisible Hand and assume that the same mechanisms will automatically carry over to software agents. However, automated agents are not people! They make decisions and act on them at a vastly greater speed, they are immeasurably less sophisticated, less flexible, less able to learn, and notoriously lacking in "common sense". How might these differences affect the efficiency and stability of future information economies?

Previous research in automated economies is equivocal. Under certain assumptions, large systems of interacting self-motivated software agents can be susceptible to the emergence of wild, unpredictable, disastrous collective behavior[13,
14]. On the other hand, a large body of work on market mechanisms in distributed multi-agent environments suggests that efficient resource allocation or other desirable global properties may emerge from the collective interactions of individual agents[1, 3, 5, 8, 10, 11, 15, 17, 21].

Our goal is to understand the dynamic, emergent behaviors — both good and bad — of information economies from an agent's-eye view, and from this to formulate basic design principles that will foster efficient electronic commerce. We pursue this goal by combining analysis and simulation of information economies with concurrent development of an information economy prototype.

In this paper, we focus on a simple model of an information filtering economy, such as might be embedded in a larger information economy. The model is inspired by information dissemination services that can be found on the Internet today, and sets them in an economic context. After introducing the model in section 2, we analyze and simulate its dynamical behavior in section 3, illustrating as we go the promise and the pitfalls inherent in this and similar economies. We conclude with a brief summary of our findings in section 4.

2 Model of the news filtering economy

Fig. 1 represents our information filtering model economy, consisting of a source agent that publishes news articles, C consumer agents that want to buy articles they are interested in, B broker agents that buy selected articles from the source and resell them to consumers, and a market infrastructure that provides communication and computation services to all agents. Each agent's internal parameters (defined below) are printed inside its ellipse. Solid lines represent the propagation of a sample article through broker 1. Broken lines indicate payment, and are labeled with symbols (explained below) for the amount paid.

Fig. 1. Part of an idealized news filtering economy. Only a subset of agents is shown. See text for interpretation of symbols.