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# The effects of market-enabling Internet agents on competition and prices[1]

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## Abstract

The Internet offers a vision of ubiquitous electronic commerce. A particularly useful feature is the ability to automate the search for price or other information across multiple vendors by using an "agent" to retrieve relevant information. The use of agents has the potential to dramatically reduce buyers' search costs. We develop a framework that suggests that vendors who sell products with many differentiating factors beyond price will tend to accept agents, while vendors of commodities or branded goods will tend to resist them unless they have lower costs than their competitors. Empirically, we found that agents seem to be accepted for differentiated goods, but resisted for more commoditized goods, though not universally. An analysis of prices from one agent shows that 1) a small number of vendors tended to have the lowest prices and 2) while divergence in pricing remains, price dispersion declined over the period studied.

## Introduction

Networks bridge geography, distance and culture, creating new opportunities for interaction and competition. Debate is increasing on how the ongoing digital and communications revolution will change the nature of commerce. The growth of commerce on the Internet has attracted special interest. Being a public network and increasingly ubiquitous, the Internet neatly addresses the problem of connectivity between potential trading partners (Neches, Neches, Postel, Tenenbaum, & Frank, n.d.), extending even to consumers. The existence of multiple vendors for some goods leads to the possibility of a market for those items, in the specific sense of multiple vendors whose prices and offerings are compared for each sale.[2]

Clearly there are many potential obstacles to Internet commerce—the need for security, authentication and payment schemes are frequently mentioned, as are the lack of negotiation protocols or even commonly accepted business practices—but these are rapidly being addressed. Internet sales are expected to continue to increase, following the lead of catalogue and television sales. There are already numerous Internet vendors selling a variety of products, including music CDs, computer hardware and software and a host of others.

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[2] Note that we do not consider as markets a single merchant who stocks multiple products or a "mall" hosting multiple merchants but lacking features for making price or other comparisons across merchants. This definition excludes many self-described markets, such as Industry Net.

The basic argument of this paper is that one approach to developing an Internet marketplace is through the use of an "agent." An agent is a program, simple or intelligent, that operates autonomously to retrieve and process information on a user's behalf (Maes, 1994). In this paper, we focus on the use of agents to support a potential purchase decision. The idea is that a computer program can retrieve (or even negotiate, e.g., Chavez, Dreilinger, Guttman, & Maes, 1997) price, availability, and other product information for a desired good and compare them to identify the vendor with the lowest-cost or best set of features, thus automating part of the purchase process and increasing market efficiency. For example, Andersen Consulting's Bargain Finder agent (Krulwich, 1996), now defunct, took the name and artist of a music CD and retrieved its price from several Internet CD stores with on-line searchable catalogues. This agent quickly identified which vendors carry the CD and facilitated easy price comparisons, key characteristics of an efficient market.

The remainder of the paper is presented in two parts. First, we discuss the function of market-search agents. The distinctive contribution of this paper is a framework for the role of such agents in electronic commerce. This framework is summarized in a payoff matrix showing the outcomes from decisions by vendors to cooperate or resist the use of agents. Analysis of the incentives for participation in an electronic market is a necessary precondition for their development. In this, our goals are similar to those of Reimers (1996), who analyzed the institutional and incentive structure pre-conditions for electronic markets. We use our framework to predict the kind of goods for which agents are likely to be successful.

In the second half of the paper, we compare the predictions of our framework with illustrative examples of buyer's agents for a range of products. We note a prominent counter-example to our predictions, shopper.com. To further explore the framework, we report on an analysis of price data gathered from shopper.com. We use this data to explore the fit between the framework's predictions and empirical observation. In particular, we test a crucial assumption of the framework, that the vendor that has the lowest prices for one product will be cheapest for many ("winner-take-all"). We also examine changes in prices over time to test a common prediction of the electronic commerce literature, that better information leads to convergence of prices (e.g., Bakos, 1991).

## Literature Review

Agents are software programs that operate autonomously to retrieve and process information on a user's behalf (Maes, 1994). Many simple agents are already available to assist in navigation and information retrieval (e.g., O'Leary, 1996). Deployed on the Internet, agents make searching for information easier. Guttman et al. (1998) note that agents can support different stages of a buyer's purchasing process: need identification, product and merchant brokering, negotiation, purchase and delivery, and service and evaluation. Similarly, Jonkheer (1999) provides a model of a transaction to show where agents can make provide assistance. Agents assist buyers because they can retrieve relevant information directly from on-line vendors and present it to a potential buyer in summary form (e.g., Chavez et al., 1997; Doorenbos, Etzioni, & Weld, 1997; Etzioni & Weld, 1995; Yovovich, 1995).

In this paper, we focus in particular on the use of agents to choose a vendor for a particular good, what Guttman et al. (1998) call merchant brokering. Greenwald and Kephart (1999) call such an agent a "shopbot". When such an agent operates across the range of vendors offering a product (what Yovovich (1995) referred to as a buy-side agent, rather than a sell-side agent), it essentially creates an electronic market comprising the offerings of these vendors. Viewing agents as market enablers has the advantage of bringing to bear the extensive literature on markets, electronic and otherwise.

Of course, electronic markets are nothing new. Formal electronic markets have developed for specific goods, such as airline reservation systems, stock markets, as well as electronic markets for electric power (Johnson, 1995), airliner parts (Choudhury, 1997; Malone, Yates, & Benjamin, 1989, p. 167), truck capacity (Steinfield, Kraut, & Plummer, 1995) and even seeds (SeedQuest OnLine, http://www.seedquest.com/). However, agent-enabled markets differ in at least two significant respects.

- First, the Internet is non-proprietary and public, so it is possible for an agent to access prices from a variety of vendors without special technical arrangements. As a result, an agent can create an effective electronic market from the diverse offerings of independent vendors (the "involuntary market" propery), at least in the sense of facilitating the contact between buyer and seller (Bailey & Bakos, 1997; Malone, Yates, & Benjamin, 1987).

- Second, an agent can search vendors in parallel rather than sequentially, thus reducing search costs to zero at the margin (the "zero-marginal-search-cost" property). Of course, even a simple database of prices could have this effect, although creating such a database without the cooperation of the vendors basically requires creating an agent to gather the prices.