



# On the diffusion of electronic commerce <sup>☆</sup>

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## Abstract

This paper analyzes retailers' adoption of e-commerce in a technology adoption race framework. An internet-based firm with no traditional market presence competes with an established traditional firm to adopt the e-commerce technology and sell to a growing number of consumers with on-line shopping capability. The focus of the analysis is on identifying how consumer loyalty, differences in firms' technology and consumers' preferences for the traditional versus the virtual market, and the expansion in market size made possible by the internet can affect the timing and sequence of adoption by firms, as well as the post-adoption evolution of prices. The model's implications are used to discuss empirical evidence on adoption patterns for different product categories and firm types.

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## 1. Introduction

Since early 1990s, the 'electronic commerce' technology has been adopted by many traditional firms and also by new, entirely internet-based firms.<sup>2</sup> Yet, traditional and internet-based firms

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<sup>2</sup> The e-commerce technology can be defined as a technology that allows business transactions based on processing and transmission of digital data on the Internet, in contrast to the traditional business technology, the logistics of which are based on the physical environment.

have exhibited different tendencies to embrace the new technology and the rates of adoption by these two types of firms have varied considerably by product category. In some industries, such as book and CD retailing, purely internet-based firms like [Amazon.com](http://Amazon.com) were successful early adopters. In other industries, such as clothing and apparel, established traditional firms like Gap adopted the technology early. In general, internet-based firms tended to be the first movers. On the other hand, established firms sometimes moved first, but usually they followed, either quickly or with some delay. This delay in the adoption of e-commerce by established firms has drawn attention in the literature.<sup>3</sup> Fear of cannibalizing an existing sales channel or technological incompatibility of the two sales channels may prevent or delay going on-line. Internet-based firms also face obstacles to adoption, such as the lack of an established brand, trust, a loyal customer base, or a network of warehouses and distribution facilities. These adoption patterns pose several questions: How do traditional and new firms differ in their adoption patterns? In what type of environments are we likely to observe early adoption by new or by established firms? Are adoption patterns systematically related to the main differences between traditional and virtual markets? What can be said about inter-industry differences in the diffusion of e-commerce?

We develop a model of the adoption of e-commerce technology by retailers to assess the patterns of adoption. Since the decision of whether and when to adopt is dynamic in nature, the analysis of adoption patterns require a dynamic framework rich enough to incorporate basic differences between traditional and internet-based firms and between traditional and virtual market environments. We use a continuous-time technology adoption model, where at each point in time firms decide whether to adopt the e-commerce technology and then choose prices, given the adoption decisions up to that point. We derive the implications of the model for the timing and sequence of adoption by firms to understand which firm is likely to adopt first, whether the gap between adoption times is large, and how the adoption times depend on the parameters characterizing the traditional and virtual market environments. The predictions of the model can explain observed adoption patterns across firm types and product categories. The result is a simple characterization of market environments that encourages early adoption by established firms and market environments that facilitate early entry by new firms. The tractable model can be applied to other market settings to address questions of adoption.

The structure of the model reflects important differences between traditional and virtual markets, as well as between traditional and internet-based firms. While a long list of such differences can be made, the main elements we consider reflect a desire to maintain analytical tractability and empirical relevance.<sup>4</sup> First, firms' costs and consumers' utility across traditional and virtual markets differ. Potential cost savings can arise in the virtual market from low-cost electronic transactions and diminishing need for inventory, retail space, and labor, as well as elimination of intermediaries. For some goods, convenience of on-line transactions and savings in shopping time and transportation costs may enhance utility, but for other goods, delayed consumption or the inability to inspect the good physically may result in a utility loss. Second, some consumers have a preference for the good sold by the established firm, resulting from the established firm's reputation or from consumers' trust in an established brand name built during the firm's long presence in the traditional market. The importance of such reputation and brand name effects in on-line markets has been emphasized in recent empirical literature.<sup>5</sup> We refer to such brand preference by consumers as "loyalty". Initially, we assume

<sup>3</sup> See, e.g., Alba et al. (1997), Lasry (2002), Lieberman (2002), Zettelmeyer (2000).

<sup>4</sup> We discuss these elements in more detail in Section 2.1.

<sup>5</sup> See, e.g., Smith and Brynjolfsson (2001).

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