

Santarelli, Enrico; D'Altri, Samuele

**Working Paper**

## The Diffusion of E-commerce at the Firm Level: Theoretical Implications and Empirical Evidence

Quaderni - Working Paper DSE, No. 428

**Provided in Cooperation with:**

University of Bologna, Department of Economics

*Suggested Citation:* Santarelli, Enrico; D'Altri, Samuele (2001) : The Diffusion of E-commerce at the Firm Level: Theoretical Implications and Empirical Evidence, Quaderni - Working Paper DSE, No. 428, Alma Mater Studiorum - Università di Bologna, Dipartimento di Scienze Economiche (DSE), Bologna,  
<https://doi.org/10.6092/unibo/amsacta/4870>

This Version is available at:

<https://hdl.handle.net/10419/159269>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*



<https://creativecommons.org/licenses/by-nc/3.0/>

# **The Diffusion of E-commerce at the Firm Level: Theoretical Implications and Empirical Evidence<sup>°</sup>**

by

**Enrico Santarelli\***

Università di Bologna – Dipartimento di Scienze Economiche  
Strada Maggiore, 45; I-40125 BOLOGNA; ITALY

**Samuele D’Altri**

Università di Bologna – Facoltà di Scienze Statistiche

## **Abstract**

As a specific institution of distributive trades, e-commerce displays similarities with retail stores and mail order companies. As well as providing theoretical support for the assumption that e-commerce is a way to sell certain goods and services at prices potentially lower than those of traditional distributive channels, this paper analyses its inter-firm diffusion among a sample of firms (mostly SMEs) in Italy. The paper has three main purposes.

Firstly, it challenges the view of e-commerce as a “technological revolution”, by pointing out its nature as a cost-minimizing marketing channel. In particular, it shows how, under certain circumstances, e-commerce is a source of transaction cost advantages analogous to those yielded by mail order business.

Secondly, the paper identifies the circumstances under which e-commerce sales might achieve a significant level of penetration among those SMEs that would otherwise incur high costs in organizing a proprietary distributive channel.

Thirdly, the paper employs a unique data set of Italian manufacturing, service, and hospitality firms (nearly 90% of them with fewer than 100 employees) to estimate a diffusion model based on the logistic curve. According to the estimates, by the fourth quarter of 2003 nearly 50% of the population of firms in the geographical area surveyed will have introduced e-commerce among their marketing channels.

\* Corresponding author. E-mail: [santarel@spbo.unibo.it](mailto:santarel@spbo.unibo.it) Fax: 0039 051 2092631

**JEL codes:** L23, L81, O31.

**Keywords:** e-commerce; mail order; SMEs; technology diffusion

**This version: 14 November 2001**

---

<sup>°</sup> Although the paper is a joint effort, Sections 3 and 4.2 can be attributed to Samuele D’Altri, the remaining Sections to Enrico Santarelli. D’Altri gratefully acknowledges financial support from Assindustria Rimini, Santarelli from MIUR (Cofinanziamento 2000). A previous version was presented at the 5<sup>th</sup> ERC/METU International Conference in Economics (Ankara, September 10-13, 2001). We thank the audience, and in particular Zoltan Acs and William Easterly, for helpful suggestions; and Roberta Piergiovanni for her useful comments on previous versions of the paper.

## 1. Introduction

Despite rapid growth experienced in recent years, e-commerce sales account for a very small share of total transactions. As a matter of fact, electronic transactions in either retail (B2C) or wholesale (B2B) markets are still in their infancy, with B2B representing approximately 80 per cent of all electronic sales (International Data Corporation, 2000). Thus, even if the *media* still emphasize the magical benefits that B2C will bring in everyday life, electronics sales are expected to exert their strongest impact on vertical relations among firms. In this connection, B2B will grow even faster than B2C over the next few years, owing to the migration of supply chain management from closed Electronic Data Interchange (EDI) networks<sup>1</sup> to the Internet. For these reasons, too, “the spectacular bursting of the Internet bubble has led some to question the very importance of the net” (The Economist, 2001, p. 7). Yet although some of the early claims about the Internet were certainly mistaken, the potential impact of e-commerce on the overall economy is largely unexplored. Accordingly, more in-depth analysis of this device from both a theoretical and an empirical perspective is needed, particularly as regards what David Audretsch and Roy Thurik (2001) call the shift from the managed to the entrepreneurial economy.

This paper has three main purposes. Firstly (section 2.1), it challenges the commonly accepted vision of e-commerce as a “technological revolution”, pointing out its close connection with traditional mail-order retail channel. Secondly (Section 2.2), it identifies the circumstances under which e-commerce sales might achieve a significant level of penetration among those SMEs which would otherwise incur high costs in organizing proprietary distributive channels, and which might benefit from disintermediating and dealing directly with their customers, either in the business or the consumer sectors. Thirdly (Sections 3 and 4), it employs a unique data set of manufacturing, service, and hospitality firms (most of them small and medium sized) located in the *Emilia-Romagna* region of Italy to estimate an infra-sectoral diffusion model based on the logistic curve for the case of the e-commerce distributive channel.

## 2. Transaction costs and the institutional arrangements of distribution

In its most commonly accepted definition, the term e-commerce denotes transactions in which the Internet is used *a)* to establish the terms of trade (price, availability, time to delivery, and the other details of the transaction usually called *coordination costs*) among the participants in a

---

<sup>1</sup> EDI is a standard used for the transmission of information between computers over value-added networks. It requires custom network and dedicated communication links and (sometimes) equipment, which make it much more expensive to use than the Internet.

marketing channel and then *b*) to sell goods and services which can be delivered offline or services which can be “digitized” and delivered online. According to the relevant literature (for a survey, cf. Garicano and Kaplan, 2000), it is still unclear whether e-commerce is a brand new paradigm or a simple, although significant, improvement in the traditional distributive trades. More careful consideration of institutional arrangements in distributive trades may shed some light on this controversial issue.

### *2.1 – E-commerce and mail order<sup>2</sup>: two sides of the same coin?*

In general, e-commerce is a source of transaction cost advantages based on the exploitation of information and communication technologies. In this connection, significant differences in technological features notwithstanding, e-commerce can be likened to a technologically up-to-date version of the mail order business, whose origins (dating to the end of the fifteenth century in Venice<sup>3</sup>) were closely linked with printing and the depiction of products for sale in a catalogue.

The forerunners of the modern mail order catalogue appeared in the mid-nineteenth century America. In 1844, for example, Orvis distributed a catalogue listing a range of fishing supplies and in 1845 Tiffany & Company of Fifth Avenue published a catalogue of “Useful and Fancy Articles” - which offered goods imported from Europe and China. In 1872 A.M. Ward founded the later world-famous company Montgomery Ward and his competitor R.W. Sears started up business in 1886 by sending watches to customers in the Far West. Rapidly growing demand attracted three other large players in the industry: Spiegel, National Bellas Hess and the Chicago Mail Order Company. Towards the end of the century, the Ward catalogue already consisted of 244 pages with thousand of items on offer. From 1897 onwards, Sears (the industry leader, with 43% of mail order sales in 1919) saw circulation of its general catalogue increase from some 318,000 copies to over one million for the spring catalogue of 1904 and over three million for the fall catalogue of 1907. In the 1920s, the American mail-order companies set up a network of stores to be closer to their customers, a trend that was later apparent in Europe as well, where large stores developed mail order departments because of the close link with the general range of goods and a wish to be closer to their customers. Sears and Ward opened retail stores in the 1920s, the purpose being to exploit their purchasing organization more efficiently and to build customer goodwill (cf. Chandler, 1962; Emmet and Jeuck, 1950). Spiegel, Chicago Mail Order and National Bellas Hess opened their stores only in the 1940s, when it was too late to challenge the market leadership of Sears and Ward (cf. Michael, 1994). Because consumers were exhibiting a greater preference for department stores, both Sears and Ward used the capital and the managerial capabilities generated by the mail order

---

<sup>2</sup> The outline history of mail order in this Section is based on EMOTA (2001).

business to develop a widespread network of department stores. This led to a significant contraction in their mail order business, so that by the 1940s department stores had become their predominant marketing channel. Chicago Mail Order and National Bellas Hess exited the market in the 1960s, whereas Spiegel returned exclusively to mail order business (Michael, 1994).

In Western Europe, apart from some specialized companies, mail order grew by virtue of the fact that, unlike the USA, the big department stores developed mail order sections because of the close link with the general range of goods and a desire to provide a new service to their customers. However, mail order really truly expanded after the Second World War, when a huge demand for goods and a distribution system in ruins created the conditions for it to develop apace. As regards Italy, mail order houses only appeared in 1958, when Anna Bonomi created Postal Market in order to introduce a distributive channel that had proved so successful in the United States. Under its new owner Eugenio Filograna, Postal Market is still the market leader in Italy, with approximately 70 per cent of the industry's sales.

It is evident why mail order companies came to fruition in the second half of the nineteenth century: mass-produced consumer goods became available and therefore forced manufacturers find new and bigger markets. This was combined with the growth of the railway network and a regular and relatively cheap mail delivery system, especially as regards parcels. The development of consumer credit facilities, daily and weekly papers, and new printing techniques were the more technical aspects of the developing mail order sector. Today, many successful mail-order houses still operate in several countries (e.g., Spiegel and J.C. Penney in the US, Postal Market in Italy), but the rapid penetration of sales via the Internet (e-commerce, on-line retailing) has prompted some of them to adopt a multi-channel approach<sup>4</sup>. The rejuvenated mail order *channel* is consequently now used by traditional mail order houses, by new companies (such as Amazon.com) started-up *ad hoc* in order to exploit the new technologies, and by a *plethora* of firms (most of them SMEs) which use it for direct sales of the goods/services that they produce. Does this mean that e-commerce is the contemporary version of mail order?

The new communication technologies that permit the widespread diffusion of e-commerce - which enables better and more direct communication and dialogue between sellers and customers - are similar in principle to the railway network that permitted the development of mail order in the nineteenth century. To some extent, they have engendered a de-maturity process (as defined by Abernathy and Utterback, 1975) in the mail order business which stems from the availability of this faster communication network.

---

<sup>3</sup> Curiously, in the same period it was also introduced in Venice the use of notation @, employed as a measure of weight.

<sup>4</sup> For example, Postal Market is now market leader in Italy in the e-commerce business.

Hence, more than a revolution, e-commerce seems to be the result of the adoption of the new, pervasive information and communication technology within a traditional institutional framework. The main difference is that the modern communication equipment available to producers, retailers and consumers is easy to handle, not too cumbersome, and substantially inexpensive. At this point, one may answer the question asked above by saying that e-commerce is the *most recent* development in the mail order trade, one able to revitalize this retailing institution.

## 2.2 – A transaction costs approach to e-commerce

As shown by most students of marketing, transaction costs also include establishment of the terms of trade among the participants in a marketing channel (cf. Stern and El-ansary, 1982). It is therefore a useful device for analysis of how firms choose among alternative distributive channels. In this connection, one can either treat the problem in terms of consumer substitution behavior among distributive channels (Ward, 2001) or simply employ transaction costs theory (Williamson, 1985) in assuming that both e-commerce and mail order yield *coordination costs* advantages (Garicano and Kaplan, 2000) and perform better when the density of customers is low (Michael, 1994). In what follows, we take the second line of investigation. Thus, coordination cost advantages arise since:

- a) Both mail order and e-commerce reduce a buyer's cost of finding suppliers because searching for products and comparing prices on the Internet (catalogues) is less costly than visiting retail stores and making phone calls;
- b) The Internet (and the catalogues received in the mail) provide buyers with better information about product characteristics, including prices and availability.

In turn, advantages associated with the density of customers in a given geographical area are identified in the following circumstances:

- 1) On the customers' side, when they are faced by significant transport costs in reaching the location of the seller (as is typically the case in rural areas), they draw advantage from online (or postal) information on the goods/services that they are interested in purchasing. In this case, the purchase price paid by the customer includes a payment for descriptive information (i.e., the online/offline catalogue) that should be significantly lower than the transport costs that s/he would incur by going to inspect and physically handle the good/service in the retail store;
- 2) On the sellers' side, a low density of the customers is an argument in favour not only of sending them an online catalogue, but also of using guaranteed overnight carriers for

shipments in all cases in which the goods/services sold cannot be “digitized” and delivered online. In this way, a larger proportion of customers can be reached at a relatively low cost and the seller is more likely to gain control of a much wider potential market than that associated with a traditional retail store. This because the seller can serve a large market from a central location without building a widespread retail channel composed of a number of stores. Of course, when the density of the customers exceeds a certain threshold the combined costs of using the Internet and guaranteed overnight carriers may be greater than those of building and maintaining a retail channel comprising several stores.

More general considerations can be put forward as regards the *characteristics of the goods/services* sold:

- i) e-commerce (but not mail order) is more efficient than other forms of distribution when the goods/services involved in the transaction can be digitized and delivered online, as in the case of software, music, and financial brokerage services. This is the only circumstance in which e-commerce can be regarded as a major process innovation. In all other cases it is merely a way to speed up the exchange of information between suppliers and customers;
- ii) e-commerce (as well as mail order) may be associated with lower distribution costs in the case of *search goods*, or of those goods and services which do not require much information to the customer. Otherwise, e.g. in the case of *experience goods*, if information on the goods/services can only be obtained by direct inspection or consumption (as is the case, for example, with new perfume, a soap, or a restaurant meal), customers prefer to travel to one or more stores so that e-commerce is no longer a viable solution<sup>5</sup>.

Thus, even from a theoretical perspective, e-commerce can be likened to the traditional mail order channel. In this connection, one cannot rule out *a priori* that e-commerce will be overtaken by traditional institutional arrangements as market and technological conditions change and its cost advantage is eroded. In particular, it is highly likely that *a)* as the population density increases and the information required by customers increases as well, retail stores will still enjoy a transaction cost advantage over e-commerce; *b)* firms already using the e-commerce channel for their sales will introduce (and/or strengthen if it is already in use) a more traditional retail channel, the rationale being the same as that followed earlier by the mail order houses, i.e. in order to exploit their

---

<sup>5</sup> As aptly argued by Klein (1998), under certain circumstances e-commerce might turn *experience goods* into *search goods*, by using multimedia capabilities of the web to permit online experience.

purchasing organization more efficiently and to increase their visibility among potential customers;  
c) e-commerce will never acquire a significant share of the market in the case of *experience goods* which cannot be inspected directly via the Internet.

### *2.3 – SMEs and the potential benefits of e-commerce*

The wave of corporate downsizing that has involved most OECD countries in recent decades has given rise to a shift in the industrial structure away from large firms and towards SMEs. Consequently, SMEs are likely to represent the engine of growth in the emerging entrepreneurial economy (Audretsch and Thurik, 2001), in which new knowledge is the crucial input to economic activity.

As regards e-commerce, conditional on the availability of the knowledge base and the skills needed to deal with the information and communication technologies, SMEs may in general benefit from adopting it to reduce their market entry and distributive costs, and to reach a higher number of potential customers. In particular, SMEs which would otherwise incur high costs in organizing a proprietary distributive channel may benefit from disintermediating and dealing directly with their customers, either in the business or consumer sectors. This also implies that the traditional dilemma between developing a proprietary distributive channel and resorting to the services of a specialized dealer can be overcome by using a more flexible and low cost distributive channel. For example, a small firm specialized in the production of goods typical of a certain area (examples in the food industry being *Culatello di Zibello* and *Lardo di Colonnata* in the Italian provinces of Parma and Massa Carrara) may enlarge its customer base far beyond the narrow borders of the area; and do so without incurring the high cost of building a distributive channel covering all the areas/countries in which it wants to export its product or hiring the services of specialized dealers. In this manner, a traditional cost disadvantage with respect to larger firms disappears, and the small firm is in the position to compete with its larger counterpart.

In fact, most SMEs are faced with the problem of developing an efficient retail channel. In this respect, e-commerce represents a relatively low cost alternative to any other solution, and efficiently serves the purpose of enabling the firm to reach a significant number of customers without having to invest heavily in the development of a marketing channel. The problem remains, however, that in those sectors in which such costs advantages are higher from a theoretical viewpoint (namely, software, financial and brokerage services, etc.) there is a tendency towards concentration in the real economy which *per se* reduces the likelihood of SMEs growth. However, this mostly concerns the well known trade-off between the gains in efficiency brought about by increased concentration and the gains in terms of competition and economic democracy which can



be achieved through decentralization (Williamson, 1968). As such they fall within the field of antitrust legislation and practice<sup>6</sup> more than in that of the identification of the optimal distributive channel.

### **3. The Internet and the adoption of e-commerce among a sample of firms: a descriptive analysis**

In Italy, e-commerce accounts for a very small share of total sales, and the number of buyers using the Internet is less than 1 per cent of the working age population<sup>7</sup> (Coppel, 2000). Nevertheless, between 1995 and 2000 the number of domains registered for electronic transactions grew from 10 to 1040 (ANCE, 2000), thereby confirming that this new marketing channel is attracting increasing interest among retail and wholesale sellers. At the regional level, Emilia-Romagna ranks fifth among Italian regions in terms of total number of e-commerce sites, with a 47 per cent growth between 1999 and 2000. Emilia-Romagna is one of the most economically advanced Italian regions and is characterized by the widespread diffusion of SMEs, most of which are localized in industrial districts. For these reasons, the territory comprising the Province of Rimini and the Republic of San Marino, both located in the southeastern area of this region, is ideal for the study of the diffusion of e-commerce among SMEs. We shall therefore focus on a sample of firms, most of them with fewer than 100 employees and with their headquarters in Rimini or San Marino: 1,214 SMEs in the manufacturing, service, and hospitality sectors that by the beginning of 2000 were already connected to the Internet. The interviews were carried out via e-mail and 128 (11% of those included in the sample) firms returned the questionnaires. Among them, 109 (85.2%) turned out to have set up a web site, although this does not imply that they were using e-commerce capabilities. Only 19 firms (14.8%) declared to have already introduced e-commerce, or that they will do that by the end of 2001.

As shown by Table 1, nearly 45 per cent of the respondents were micro-firms with fewer than 10 employees, and the large majority of firms (89.8) have less than 100 employees. However, the crucial role of SMEs in the diffusion process emerges more clearly by looking at the cross tabulation between year of initial adoption and size class of the adopting firm reported in Table 2. In effect, the diffusion process originates from firms in the smallest size class, followed by those having between 10 and 49 employees. At the end of 2000 (i.e. four years after the beginning of the diffusion process in the relevant territory) none of the large firms with more than 100 employees

---

<sup>6</sup> And, in general, in that of public constraints on the freedom of firms to contract.

<sup>7</sup> Which is very small when compared to the European average of 7%, and to the 15% and 10% of UK and Germany respectively.

had introduced e-commerce among their marketing channels yet, although three of them declared the intention to adopt e-commerce within 6 months from the time of the interview.

*Table 1 – Size distribution (employment) of the responding firms*

<b>Size classes</b>	<b>No. of firms</b>	<b>%</b>	<b>Cumulative %</b>
Fewer than 10	57	44.9	44.9
10-19	21	16.5	61.4
20-49	26	20.5	81.9
50-99	10	7.9	89.8
More than 100	13	10.2	100.0
<b>Total*</b>	<b>127</b>	<b>100.0</b>	<b>100.0</b>

\* 1 firm did not provide information on the size of its workforce.

*Table 2 – Year of adoption and size class of the adopting firms*

	<b>Less than 10</b>	<b>10 - 19</b>	<b>20 - 49</b>	<b>50 - 99</b>	<b>More than 100</b>
<b>1997</b>	3				-
<b>1998</b>	1	2	3		-
<b>1999</b>	1	1	1	1	-
<b>2000</b>	3		2	1	-

The firms were first asked to define the *main* reasons for creating a web site (Table 3). Only a few of them (2.6%) stated that a web site was a first step towards adoption of e-commerce, whereas a large majority (58.4%) cited the need for more visibility among potential customers as the main factor influencing the decision to create a web site. The firms were then been asked to define their attitude towards the adoption of e-commerce solutions.

*Table 3 – Main determinants of the decision to adopt a web site*

Increase visibility	58.4 %
Develop online catalogues	21.4 %
Improve the quality of the services supplied to customers	16.2 %
<b><i>Develop an e-commerce channel</i></b>	<b>2.6 %</b>
Imitate competitors	1.3 %

Although only 19 firms had already adopted e-commerce at the time of the interview (December 2000), more than 30 per cent declared that they were interested in the capability<sup>8</sup>, whereas more than 50 per cent were uninterested in it or had never heard about it (!) (Table 4). Thus, e-commerce is not on the agenda of most firms with web sites, the latter being perceived as relatively low cost promotion vehicles for their business. In this regard, a large proportion of web sites can be taken to

<sup>8</sup> Of these, 24.2% declared their intention to adopt e-commerce within 6 months from the time of the interview, and 57.6% within 12 months.

be online windows used by firms to increase their visibility and to signal their presence in the market to potential customers.

*Table 4 – Firm’s attitude towards e-commerce*

The firm has already adopted an e-commerce solution	17.4 %
The firm intends to adopt an e-commerce solution as soon as possible	30.3 %
The firm is not interested in adopting an e-commerce solution	49.5 %
The firm is unaware of the existence of e-commerce	2.8 %

Requested to indicate their preferred e-commerce solution, 22 per cent of firms answered B2B, 44 per cent B2C, and the rest both solutions. The popularity of B2C is rather surprising (although it probably reflects over-representation of hotels in our sample), since as recently as in 1999 its penetration rate was substantially insignificant in Italy, with total sales representing 0.09 per cent of retail sales as a whole (Coppel, 2000). Among firms that have already introduced e-commerce, less than 6 per cent derive more than 50 per cent (and more than 50% less than 15%) of their total sales from this marketing channel (Figure 1).

As a rough measure of the intra-firm diffusion of the new marketing channel, these data confirm that, at the present stage of development, e-commerce is not a substitute for established marketing channels. Although approximately half of the responding firms perceive its introduction as a step that will sooner or later be necessary, they apparently do not regard e-commerce as a *panacea* for their competitiveness.

The 109 firms that have created web sites were then asked to indicate the main problems that they encountered in setting up an e-commerce service (Table 5). Most of them turned out to be unaware of the existence of secure servers enabling the use of encrypted information on credit card data. Thus, 26.3 per cent of respondents identified “security” as the main problem faced in development of their e-commerce solutions. Also significant was the importance attributed to the costs of managing e-commerce (25.0% of respondents), as well as to the shortage of skilled human capital (20%), the lack of familiarity among customers with the new distributive channel (10%), and the scant protection of privacy (10%). Significantly, only in a few cases (2.5%) had firms experienced no problems in implementing their e-commerce solution.

Finally, firms were asked to identify the main advantages of e-commerce (Table 6). The most frequent answers concerned customer relations, with 19 per cent of firms stating that they had increased their number of customers after adopting the e-commerce solution, 18.7 per cent saying that the device enabled them to enter in new markets, and 17.6 per cent identifying the most important benefit as faster communication with their customers. Only 3 per cent of the responding firms had gained no benefit from adopting an e-commerce solution.

Figure 1 – Penetration rate of e-commerce at the firm level: % of firms

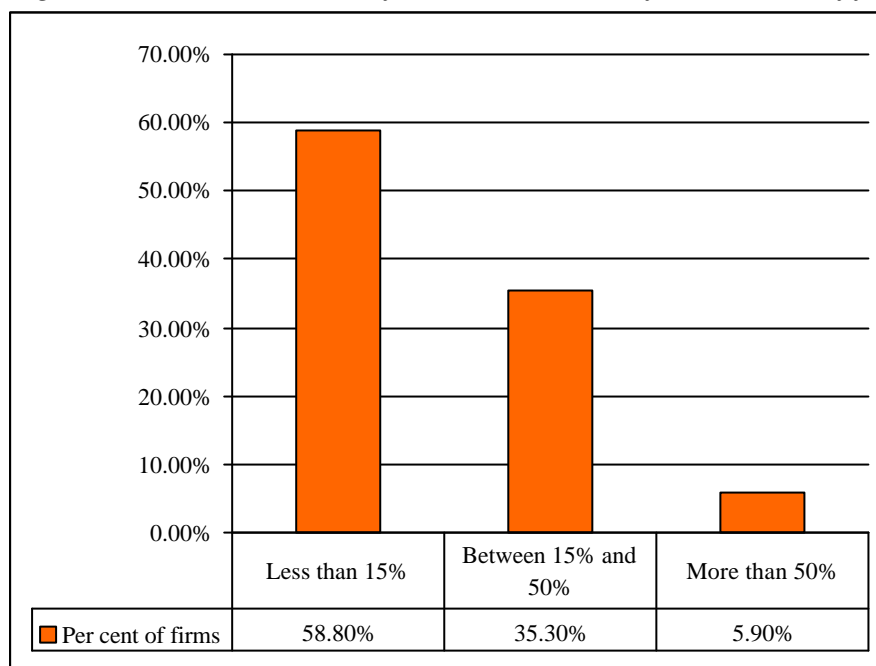


Table 5 – Main problems faced in implementation of an e-commerce solution

Security	26.3 %
High development and management costs	25.0 %
Shortage of skilled human capital	20.0 %
Difficulties experienced by customers	10.0 %
Low privacy protection	10.0 %
Unreliability of the web	6.3 %
None	2.5 %

Table 6 – Main advantages obtained from the implementation of an e-commerce solution

Increased number of customers	19.0 %
Penetration of new markets	18.7 %
Faster communication with customers	17.6 %
Increased flexibility in the supply chain	6.6 %
Competitive advantage over competitors	6.6 %
Possibility to customize products/services	6.2 %
Easy access to the customers' networks	5.9 %
Cost advantage	5.9 %
Easy access to the suppliers' networks	4.8 %
Increased number of suppliers	3.3 %
None	3.3 %
Shorter delivery times	2.2 %

#### 4. Measuring the diffusion of e-commerce: an application of the logistic model

The perceived importance of e-commerce as an alternative distributive channel which emerges from the descriptive analysis suggests that its diffusion pattern among firms in the Province of Rimini and the Republic of San Marino should be investigated more thoroughly. For this purpose, application of a standard logistic model allows the rate of adoption of e-commerce among firms in our sample to be tracked until the diffusion is complete.

##### 4.1 – Theory

By adapting the diffusion model earlier used by Mansfield (1968) and Romeo (1975) to the purpose of the present study, we follow Stoneman (1983) in starting from the equation of the standard logistic curve:

$$(1) \frac{dN_{it}}{dt} = \mathbf{f}_{it} N_{it} \frac{1 - N_{it}}{N_i^*}$$

where  $N_{it}$  denotes the number of firms in the population  $i$  adopting the new technology at time  $t$ ,  $N_i^*$  is the total number of firms that will have adopted the new technology by the end of the diffusion process, and the linear combination  $\mathbf{f}$  measures the speed of diffusion. If one assumes that  $\mathbf{f}_{it}$  includes an error term  $\epsilon_t$ , then equation (1) has the solution

$$(2) N_{it} = \frac{N_i^*}{1 + \exp(-\mathbf{f}_{it} - \mathbf{h})}$$

$$\text{where } \mathbf{h} = \log \frac{N_{i0}}{N_{i0} - N_i^*}$$

##### 4.2 – Empirical results

Estimation of equation (2) requires rewriting of the logistic model in its linear form:

$$(3) \log \frac{N_{it}}{N_i^* - N_{it}} = \mathbf{h} + \mathbf{f}_{it}$$

and then a linear regression using weighted least squares. The weights to be used are  $n_t p_t q_t$ , where  $p_t$  is the proportion of adopting firms  $n_t$  at time  $t$ , and  $q_t = 1 - p_t$ .

The diffusion of e-commerce among the firms in our database started in the first quarter of 1997. Since the database tracks the diffusion process to the second quarter of 2001, our analysis deals with the first 18 quarters after the date of initial use of the new marketing channel among firms included in the database. For simplicity, we also assume that the diffusion is completed when all the 128 potential adopters have introduced e-commerce among their marketing channels. This implies that  $N_i^* = 128$ . Using information on the exact start-up time of each firm, we empirically derive the values of  $n_t$  needed to construct the weights (Table 7).

In order to be employed as values of  $t$ , the 18 quarters have been numbered in increasing order, so that  $t = 1$  denotes the first quarter of 1997,  $t = 5$  the first quarter of 1998, ... and  $t = 18$  the second quarter of 2001.

*Table 7 – Values of  $n_t$  between 1997 and 2001*

<b>Year</b>	<b>N. of active firms</b>
1997	119
1998	122
1999	127
2000	128
2001	128

Estimation of equation (3) yielded the following results:

$$(4) \ln\left(\frac{N_t}{128 - N_t}\right) = -4.401 + 0.159t$$

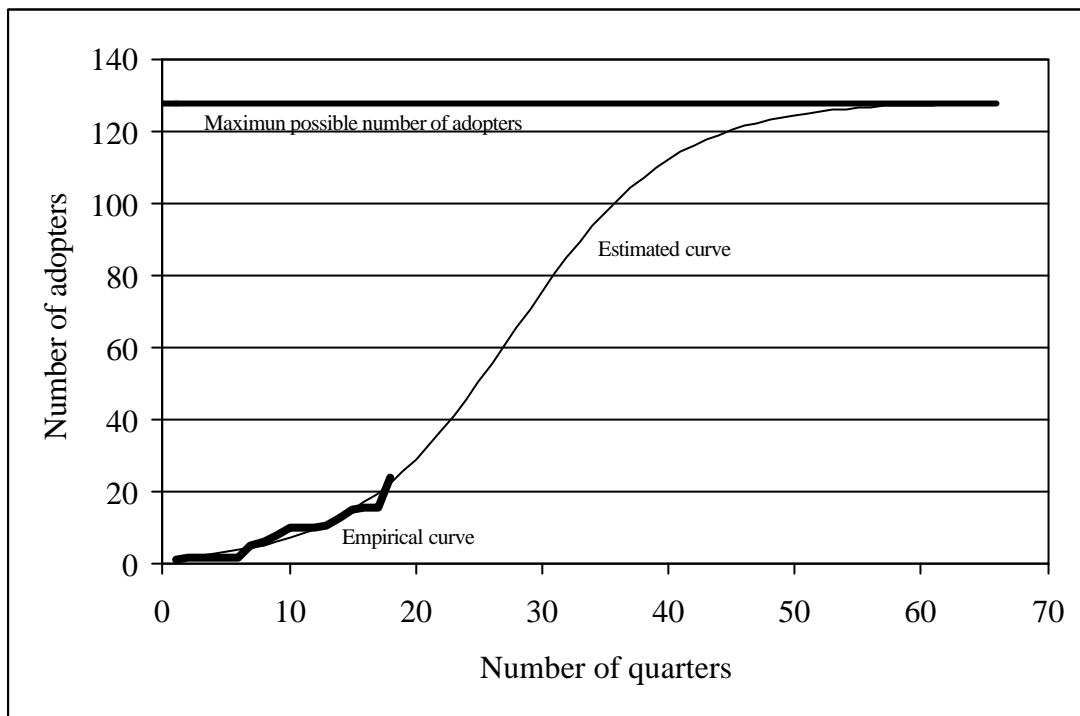
with  $R^2 = 0.916$ . Both coefficients are statistically significant (Sig. = 0,00), although they cannot be taken to be a direct measure of the diffusion rate. However, they can be inserted in equation (2), obtaining the following result

$$(5) N_t = \frac{128}{1 + \exp(-(-4.401 + 0.159t))}$$

and then employed in construction of the estimated curve representing the diffusion path, which in turn can be compared with the empirical path (Figure 2). According to the estimated curve, by

the fourth quarter of 2003 (i.e., 28 quarters after the date of the initial diffusion) nearly 50 per cent of the population of firms in the relevant territory will have introduced e-commerce among their marketing channels, with the share reaching 80 per cent (100 firms out of 128 in our sample) by the first quarter of 2006 and 100 per cent by the end of 2011, when the diffusion is complete.

*Figure 2 – Diffusion path of e-commerce among a sample of firms*



Of course, this result only implies that, within 14 years from the time a firm in the sample firms adopted e-commerce, all potential adopters will have introduced this technologically advanced distributive channel. Prediction of the share of total sales that e-commerce will represent for each firm requires more in depth analysis of the rate at which e-commerce replaces more traditional distributive channels. At its present stage of development, e-commerce does not represent a substitute for established marketing channels, not even in the case of SMEs.

## 5. Concluding remarks

Challenging the commonly accepted vision of e-commerce as a “technological revolution”, this paper has pointed out its nature as a cost-minimizing marketing channel. In particular, it has shown how, under certain circumstances, e-commerce is a source of transaction cost advantages that do not significantly differ from those of the old-fashioned mail order retail channel which became one of the dominant retailing institutions in the United States during the first half of the twentieth century.

After showing how SMEs may in general benefit from adopting e-commerce as a way to reduce their distributive costs and to reach a higher number of potential customers, the paper has also analyzed its inter-firm diffusion among a sample of Italian firms. To this end, the paper has employed a unique data set of manufacturing, service, and hospitality firms (nearly 90% of them with fewer than 100 employees) located in the *Emilia-Romagna* region of Italy which comprises the province of Rimini and the small Republic of San Marino. According to our analysis, SMEs (and in particular those with fewer than 10 employees) have been the initiator of the adoption process of e-commerce, whereas estimation of a logistic function suggests that by the fourth quarter of 2003 nearly 50% of the population of firms in the relevant territory will have introduced e-commerce among their marketing channels, with the share rising to 80% by the first quarter of 2006. However, of firms that have already adopted e-commerce, fewer than 6% derive more than 50% (and more than 50% less than 15%) of their total sales from this marketing channel.

Thus, e-commerce turns out to be a highly pervasive innovation, although at the present stage of diffusion it does not represent a substitute for established marketing channels. Whether it will overtake the traditional marketing channels employed by business firms is a matter for further research.



## References

- Abernathy, W.J and J.M. Utterback, 1975, "A Dynamic Model of Process and Product Innovation", *Omega*, Vol. 3, No. 6.
- Audretsch, D. and R.Thurik, 2001, "What's New about the New Economy? Sources of Growth in the Managed and the Entrepreneurial Economies", *Industrial and Corporate Change*, Vol. 10, No. 2, pp. 267-315.
- ANCE, 2000, "Regole, caratteristiche, struttura, tendenze dell'offerta commerciale online in Italia", Milano, Associazione dei Servizi e dei Contenuti Multimediali.
- Chandler, A.D., 1962, *Strategy and Structure*, Cambridge (MA), MIT Press.
- Coppel, J., 2000, "E-commerce: Impacts and Policy Challenges", OECD, *Economics Department Working Paper Series*, No. 252, Paris.
- Emmet, B. and J.E. Jeuck, 1950, *Catalogues and Counters: A History of Sears, Roebuck and Company*, Chicago, University of Chicago Press.
- EMOTA (European Mail Order Trade Association), 2001, "Mail Order and Distance Selling", <http://www.emota-aevpc.org/index.html>
- Garicano, L. and S.N. Kaplan, 2000, "The Effects of Business-to-business E-commerce on Transaction Costs", *NBER WP 8017*, Cambridge (MA).
- Klein, L., 1998, "Evaluating the Potential of Interactive Media through a New Lens: Search versus Experience Goods", *Journal of Business Research*, 41 (3), 195-203.
- International Data Corporation, 1999, "Internet Insights, 1999", *The Grey Sheet*, Vol. 33, No. 21-22.
- Stern, L.W. and A.I. El-ansari, 1982, *Marketing Channels*, New York, Prentice-Hall.
- Mansfield, E., 1968, *Industrial Research and Technological Innovation*, New York, W.W. Norton.
- Michael, S. C., 1994, "Competition in Organizational Form: Mail Order Versus Retail Stores, 1910-1940", *Journal of Economic Behavior and Organization*, Vol. 23, No. 3, pp. 269-286.
- Romeo, A. A., 1975, "The Rate of Imitation of a Capital Embodied Process Innovation", *Economica*, Vol. 44, No. 1, pp. 63-69.
- The Economist, 2001, *The Web and the Factory Floor*, E-strategy briefs, May-June.
- Stoneman, P., 1983, *The Economic Analysis of Technological Change*, Oxford, Oxford University Press.
- Ward, M.R., 2001, "Will Online Shopping Compete More with Traditional Retailing or Catalog Shopping?", *Netnomics*, Vol. 3, No. 2, pp. 103-117.
- Williamson, O.E., 1968, "Economics as an Antitrust Defense", *American Economic Review*, Vol. 58, No. 1, pp. 18-36.
- Williamson, O.E., 1985, *The Economic Institutions of Capitalism*, New York, The Free Press.