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Abstract

 Our empirical study aims at identifying the drivers of the implementation of an e-business strategy by firms located in Luxembourg. The setting up of such a strategy is apprehended through the website and the type of strategy through the functionalities available on the Internet. Thus we distinguish an information-oriented strategy from a commercially oriented one. Probit analyses and models derived from count data models are conducted on a dataset of website investments by about 1100 firms located in Luxembourg. Our results show that the sale of online fashionable products like tourism, the ownership of a well-known brand and the follow-up of rivals' behaviours are highly significant determinants of the adoption and development of an e-business strategy. Financial, human and technological resources seem to favour the adoption of such a strategy but have no significant influence on the choice of the strategy pursued. Moreover the use of technologies that make the business process more flexible, public actions that diffuse best practices concerning technologies adoption and being the leader on the market are specific drivers of the deployment of an e-business strategy. Finally, an intense perceived competition negatively influences the decision to invest heavily in e-commerce.

Keywords: e-business strategies, website adoption and investment, right truncated Poisson regression

I. Introduction

Since 2000, the European Union has set up action plans dedicated to the harnessing of the opportunities given by Information and Communication Technologies (ICT) as part of the "Lisbon Strategy" that seeks to make the EU *"the most competitive and dynamic knowledge-based economy in the world"* (Lisbon European Council, 2000, p.2). Through *e*Europe action plans implemented in 2000 and 2002, firms' use of basic ICT like computer and Internet access have grown up to rapidly reach saturation levels[2]. A quick inventory of individuals and enterprises practices of e-commerce usage in the European Union-15 highlights a growing phenomenon. 38% of firms have declared to have ordered products or services online during 2004 at the EU-15 average level[3] against 34% a year earlier. Regarding individuals, in 2004, the EU-15 average was 21%, against 15% a year earlier[4]. Even if individuals

and firms increasingly use the Internet to make purchases, it does not yet result in a large development of online sales by firms. The average rate in the EU-15 is, indeed, about 13% in 2005 against 15% a year earlier.

An understanding of the drivers of e-business strategies of firms is needed to set the right type of policy measures to step up the rate of firms that benefit from the business opportunities offered by Internet. This is particularly important in the case of the Grand Duchy of Luxembourg, which is a leading country in terms of number of firms and individuals that make purchases on the Internet but a country within which firms suffer from a lack of orders receipt. Indeed, during 2004, 40% of firms[5] and 32% of individuals[6] declared to have ordered products or services online. However, only 10% of firms have received orders via the Internet in Luxembourg against 29% in United Kingdom[7]. Moreover, the Grand Duchy is a little country open to international trade, so firms face competition from foreign firms and particularly from firms located in border countries (Germany, Belgium and France).

It is in this context that firms have to implement their e-business strategies set up to obtain added value through ICT use with the aim to improve the operation and the market position of the firm (Porter, 2001). According to Zhu and Kraemer (2005) and Barua, Konana, Whinston and Yin (2001), e-business is the use of *"[…] Internet to conduct or support business activities along the value chain"* (Zhu and Kraemer, 2005, p.61). In this paper, we focus on the development of e-business strategies oriented customers and implemented to obtain added value through higher profit and the shortening of

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[2] In 2002, in European Union-15, 92% of SME and 99% of large firms used computers, while 79% of SME and 97% of large enterprises had an access to the Web (data from the Community survey on "ICT usage by enterprises" conducted in 2002 quoted by Commission of the European Communities, 2003, p.25).

[3] The average rates quoted here refer to firms employing 10 persons or more and operating on a limited number of sectors in order to compare different countries. The sectors present are as follows: industry, construct, trade, tourism, transport and communications, real estate and business services and social and personal services. The sectors of agro-food industry, finance and insurance are excluded (data available on Eurostat's website).

[4] The reference population is representative of all Internet users aged between 16 and 74 years in countries. According to Eurostat, the most purchased products by European Internet users are books and magazines as well as travel (tickets transport, accommodation...). This is BtoC (Business to Consumer) and it concerns the trade of goods and services made between a firm and individuals through the Internet. In contrast, BtoB (Business to Business) concerns the online trade between firms. Information concerning the nature of BtoB purchases is not available at a European level.

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[5] This rate is about 15% in the countries of southern Europe and 60% in northern Europe.

[6] This rate is about 10% in the south and around 30% in the north.

[7] Luxembourg is at the bottom of the scale with southern countries like Italy (7%).

business transaction time. In this perspective, the setting up of a website is the tool central to the development of the e-business strategy. It makes the management of relationships with customers more effective and permits to develop new business opportunities. We attempt to understand the reasons why e-business strategies are implemented at different rate by firms? What are the differences between adopters and non adopters of a website that can support their whole e-business strategy? Why do firms decide to pursue a simple e-business strategy implemented to canvass new customers and to keep existing customers? Why do they choose to implement a most advanced strategy with the creation of a new distribution channel with an e-commerce website?

To answer these questions, we make use of theoretical economic studies (*e.g.* Geroski, 2000 or Stoneman, 2002) and recent empirical works (*e.g.* Sadowski, Maitland and Van Dogen, 2002; Dholakia and Kshetri, 2004; Lucchetti and Sterlacchini, 2004; Martin and Pénard, 2005; Santarelli and D'Altri, 2003 or Zhu and Kraemer, 2005) that attempt to model the adoption of Internet technologies and the strategic aspects related to these technologies in terms of value creation and efficiency gains for the firm.

After describing the factors likely to influence the implementation of an e-business strategy, we empirically test our main predictions using recent data from the survey "ICT usage by Enterprises" conducted in 2005 in Luxembourg. Thanks to this rich database we apprehend the implementation of an e-business strategy as a complex process that can not be restricted to a simple analysis of adoption *versus* non-adoption as is the case in a number of studies on ICT adoption (Fichman, 2000). Moreover, we not only integrate into the analysis factors highlighted in the literature (*e.g.* resources, ICT experience) but also factors more difficult to measure and therefore little

considered like the economic environment. As the survey was collected midway in the agenda of the Lisbon strategy, we will also try to measure the impact of public policies set up in Luxembourg to facilitate ICT diffusion in this framework.

The remainder of this paper is organized as follows. The second section provides an overview of the literature concerning the adoption and investment in ICT by firms. The third section details the database. In a fourth section, we present the econometric methodology used to analyse the factors that can affect the decision to adopt an e-business strategy and the type of strategy chosen. We use a binary Probit model to study the determinants of the implementation of an e-business strategy and we develop an original econometric model based on count data estimators to analyse the choices made by the firm in the conduct of its e-business strategy. The fifth section presents the empirical results of regressions computed. Finally, the sixth section concludes.

II. Drivers of adoption and use of Internet technologies: A review of the theoretical and empirical literature

Built on the theoretical literature, the empirical literature on ICT diffusion in firms has grown in recent years. As we focus on websites because they supports e-business strategies oriented to customers and permit to identify the type of strategy chosen, we review empirical works related to website adoption. As pointed out in the introduction, most of the existing research on website adoption focused on measures such as "adoption versus non-adoption" (Sadowski *et al.*, 2002; Dholakia and Kshetri, 2004). Since there is a need for a better understanding of post-adoption usage, we also review the empirical literature related to the intensity of investment in the site, *i.e.* the richness of available functions (Lucchetti and Sterlacchini, 2004; Martin and Pénard,

2005)[8], and on the investment in an online business channel (Chappell and Feindt, 2000; Dholakia and Kshetri, 2004 or Zhu and Kraemer, 2005). In each of these works, we can identify two aspects of a firm's context that influence the process by which it adopts and invest: internal factors and external ones.

Internal factors

- Firm resources

From a theoretical point of view, and notably according to "rank models" in the words of Karshenas and Stoneman (1993) and developed by David (1969), we can conjecture that firms with large resources have the characteristics of "more able" firms (Geroski, 2000). They are consequently less risk adverse and in a better position to adopt at an early stage in the diffusion process. Firm size is usually referred in empirical studies to measure the effect of resources, but resources can also be captured by other proxies like a group membership, the age of the firm, the human resources and the communication requirements (*i.e.* in a multi-unit organization).

There are two contrast positions for the role played by resources in the process of website and e-commerce implementations, due to the tension between resource availability and the lack of flexibility. On the one hand, large availability of resources favours adoption and use as they remove financial constraints and risks in the implementation decision (Dholakia and Kshetri, 2004)[9]. By contrast, small firms

with fewer resources should adopt a "wait and see" attitude to see if investments made by primo adopters are profitable before adopting (Farell and Saloner, 1986; Choi, 1997). On the other hand, large firms, old ones and those affiliated to a group are less flexible than small and independent ones which can decide more quickly to adopt a new technology. That's why the effect of the resources may be negative (Lucchetti and Sterlacchini, 2004), notably for the use of e-commerce (Zhu and Kraemer, 2005).

There is a consensus on the effects of the proxies related to human qualifications and communication requirements the existing empirical works. Human qualifications can be associated with faster adoption of ICT because of an easier adaptation of qualified employees to technological progress (Bugamelli and Pagano, 2004; Lucchetti and Sterlacchini, 2004). As multi-unit organizations have a huge potential to networking, they consequently have a higher probability of Internet technologies adoption (Galliano and Roux, 2003; Sadowski *et al.*, 2002).

Hypothesis 1. Firms with large resources availability have less financial constraints and more high skilled workers, consequently they are less risk adverse in the adoption decision. Consequently, resources should have a positive influence on the e-business implementation.

- Business characteristics

The characteristics of the business constitute another factor that can affect the creation and use of the website. According to Sadowski *et al.* (2002) as well as Chappell and Feindt (2000), some sectors like services and technology-intensive sectors (notably computing) are more prone to adopting and using Internet technologies compared to traditional sectors such as industry or retailing.

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[8] The focus is made on the understanding of the richness of the site in terms of contents. This richness can be grasped in different ways. On the one hand, as in Lucchetti and Sterlacchini (2004), a composite indicator can be constructed from the functions provided by the site like catalogue of products, detailed product description, online ordering facility.... On the other hand, as in Martin and Pénard (2005), a distinction can be made between basic websites and elaborate ones according to the type of provided functions.

[9] The lack of resources owned by small

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businesses is often advanced to explain the low interest in ICT by these firms (La Rovere, 1998; Sadowski *et al.*, 2002).

Moreover, the characteristics of the products can have an impact on e-commerce diffusion. As the OECD highlights, *"[t]he products of services like tourism, which are intangible in nature and have a high information content, are well-suited for purchase over the Internet"* (OECD, 2004, p.34). For Santarelli and D'Altri (2003), digitised or delivered online products facilitate e-commerce. According to Chappell and Feindt (2000), fashionable products have, at least for Business to Consumer (B2C) commerce, a higher probability to be purchased[10]. For Dinlersoz and Pereira (2007), goods which do not require a detailed inspection before being purchased are more easily purchased online[11]. As the characteristics of the product have an influence on the creation of a new business channel, it also influences upstream the creation of a website.

The business of the firm can also be characterised by the presence of the firm on foreign markets (the international scope of the firm) and the dependence with customers through subcontracting. When firms evolve on heterogeneous market segments, they need to develop their ICT capabilities to deal with heterogeneity as well as or better than rivals (Lucchetti and Sterlacchini, 2004; Zhu and Kraemer, 2005). In order to know whether or not preferential partnership with a customer is a brake on website and e-commerce deployment, some studies test the influence of this dependence, but no significant results appear[12].

Hypothesis 2. Selling digitised or fashionable products should positively influence the probability of implementing an e-business strategy and developing this strategy in a commercial way.

- Brand reputation

With Internet, firms have opportunities to reach a higher number of potential customers, but the website investment remains risky because the returns are not guaranteed. The risks associated with this investment are, *a priori*, less important for well-known firms. According to OECD (2004) *"on-line customers view recognition of a brand or company name as an indicator of a firm's credibility just as they do off-line"* (OECD, 2004, p.26). The brand image permits to avoid price competition or to maintain a value-for-money image when the firm chooses to sell online (Brynjolfsson and Smith, 2000). As many customers still don't choose the lowest price and stick with a particular brand[13], well-known firms don't support much risk. Studies on price competition on the web, such as Shankar, Rangaswamy and Pusateri (1998), show that the brand decreases consumer price sensitivity, which confirms the incitement for well-known firms to invest in e-commerce and thus to pursue a developed e-business strategy. To our knowledge, no empirical study has introduced a measure of the brand and renown of the firm to analyse their impact on the Internet technologies adoption and on the investment in e-business.

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[10] In Luxembourg and in the European Union, tourism products are products that are the most exchanged on the Internet (Eurostat). Hence, the Internet offers large opportunities for firms in this sector.

[11] The theoretical analysis conducted by the authors on the dissemination of electronic commerce shows that *"[f]or 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."* (Dinlersoz and Pereira, 2007, p. 542).

[12] The study conducted by Giunta and Trivieri (2007), shows a negative influence of subcontracting on information technologies adoption.

[13] *"Contrary to the common view that the Web is populated with volatile customers, the Web is actually a very 'sticky' space"* (Feindt, Jeffcoate and Chappell, 2002, p.58).

Hypothesis 3. The ownership of a well-known brand should have a positive influence on the implementation of an e-business strategy and particularly a developed one.

- Attitudes and past experiences with ICT

Adoption costs of an e-business strategy include those associated with the adoption of ICT necessary to its implementation and with the development of new competencies needed to correctly use and properly exploit ICT. These costs are of course reduced if the firm already has some ICT competencies. The skills and experiences accumulated by the firm with prior ICT adoption permit to build an ICT culture and also a better perception of technology's benefits. Consequently, the firm is less risk adverse to new investment in ICT and it permits the development of an in-house expertise[14]. The costs of adopting a new technology are therefore, *a priori*, smaller for firms that use ICT. Empirical studies conducted by Dholakia and Kshetri (2004), Zhu and Kraemer (2005), Martin and Pénard (2005) show a positive effect of prior technology adoption on the adoption and the investment in Internet technologies like a website[15].

In addition, empirical work shows that the adoption of standard ICT such as Electronic Data Interchange (EDI) and/or Enterprise Resource Planning (ERP) positively influence the setting up of a website and the investment in e-commerce. These standard ICT can support the

reorganization of production and distribution processes firms' need to strengthen its flexibility and reactivity to customer demand and to cope with the increased sales that Internet can generate.

Hypothesis 4. Firms with greater prior technology use are more likely to adopt e-business.

External factors

Despite the wide literature on ICT diffusion and the fact that many authors acknowledge the important role played by external environment (Robertson and Gatignon, 1986), its role is still little explored because of the difficulty to find explicit measure of the environment characteristics (Forman, 2005).

- Competition

From a theoretical point of view two effects of the competitive pressure may appear. On the one hand, as suggested by the *density dependence models* (Geroski, 2000; Bocquet and Brossard, 2003) the threat of entry encourages the investment in ICT, permitting to obtain a competitive advantage (Porter, 2001) and to erect an artificial entry barrier (Fudenberd and Tirole, 1985). On the other hand, as shown by Geroski (2000), too intense competition slows down the diffusion of ICT since it limits the possibility of extracting profits and high returns.

This ambiguous effect appears in empirical investigations. Zhu and Kraemer (2005) highlight a positive impact of competitive pressure. However, Chappell and Feindt (2000) show that firms evolving on a niche market in which the competitive pressure is low (and so are the risks of being excluded from the market) have a higher probability of adopting and using new technologies. The works of Anderson (2007), Brynjolfsson, Hu and Smith (2006) or Brynjolfsson, Hu and Simester (2007) on "The Long Tail" highlight the fact that Internet transforms

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[14] For the setting up of a website, the ICT in-house expertise avoids the firm to hand over responsibility for website creation, maintenance and updates to another firm. If the firm chooses to externalise, it resigns control over its website notably for updates, and it can be a failure factor which contributes to website closes (Chappell and Feindt, 2000).

[15] Prior ICT adoption is introduced in different ways in these studies, either as a composite indicator of the use of ICT or the separate introduction of various ICT.

mass markets into a mass of niches. The attraction of Internet users for niche products can allow firms to position themselves on these specific products. Thus, Internet permits the aggregation of the demand of many consumers and provides them with specific products they can't easily find in the real economy. Indeed, storage problems and the issue of too few consumers at one location reduce incentives for firms to provide this type of product. Firms operating in niche markets have therefore a particular interest to take advantage of Internet opportunities. In addition, literature on the barriers to ICT diffusion and notably the work of Baldwin and Lin (2002) highlights the fact that barriers to ICT adoption in particular those related to the costs of adoption[16] are more important when there are many competitors.

Hypothesis 5. Threat of entry should positively influence the implementation of an e-business strategy, but too much competition should have a negative impact.

- Local incentives

The effects of local incentives can be explained from the perspective of epidemic models (Bass, 1969) and information cascade models (Bikchandani, Hirshleifer and Welch, 1992, 1998). When a lot of information about the technology spread around the firm, it is more inclined to quickly adopt the technology. The effects of local incentives are apprehended in the empirical literature by the characteristics of the territory where the firm is located, by competitors' behaviours in terms of ICT adoption and by the support provided by suppliers.

First, the characteristics of the territory of location can measure the intensity of communication between firms and the existing information externalities. The effect of an urban area location is not introduced into specific analysis of the adoption of e-business, relatively to the empirical literature on the adoption of Internet technologies. Thus, the works of Forman, Goldfarb and Greenstein (2005, 2008) show the superiority of the implantation in urban areas compared to rural settlement in the decision to invest in technology. In addition to the provision of better quality ICT services, a densely populated area increases the flow of information on successes and failures associated with the adoption of ICT by firms.

Second, the actions of competitors in terms of ICT adoption can modify the speed of ICT adoption by changing the perception of a firm concerning ICT. Some empirical research, like Dholakia and Kshetri (2004) highlight a positive effect[17]. Galliano and Roux (2008) show that the level of ICT adoption around the firm positively influences Internet technology's adoption.

Third, favoured partners (like suppliers) can advise on their own experience of adoption and can also give technical support. Among the studies identified, only the study of Sadowski *et al.* (2002) analyses the impact of support given by partners on the decision to create a website but does not reveal a significant effect.

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[16] The costs of adoption include acquisition costs of technology, costs of acquiring the equipment necessary for its use (software...), maintenance costs and training costs for employees.

[17] They analyse the actions of competitors as a pressure on firms' adoption motivations. They consider the perceptions of the firm about the uses of the Internet by competitors and they distinguish three uses concerning customer service, environmental monitoring and market research. The results display that the uses of Internet by rivals to improve customer services have a positive influence on the website creation and on e-commerce setting up. The use of Internet for the supervision of the environment has also a positive effect on the website implementation.

Hypothesis 6. Local incentives should be positively associated with the firm's implementation of an e-business strategy.

- Public policies

The national and supranational policies can encourage the diffusion of Internet technologies and e-business by creating a *"favourable business environment with fair and predictable rules"* (OECD, 2004, p.35). These actions undertaken by authorities can stand for the "central source" described in epidemic models. This central source transmits information to potential adopters on notably good practices. It consequently reduces the search costs of the firm and, as a result, can induce a faster adoption of Internet technologies.

The importance of public actions aimed at encouraging the adoption of new technologies has been demonstrated early in the literature on ICT diffusion in firms. The work of Dong and Saha (1998) show that the actions trying to disseminate information on technologies, on training programs for their use, on the existing financial aids, take an important role in the early years of the diffusion process. Zhu and Kraemer (2005) highlight a positive impact of the legal protection of online transactions (in terms of security and privacy).

Hypothesis 7. Public actions should favour the implementation of an e-business strategy.

III. Data

Our data come from the "ICT usage and e-commerce in enterprises" survey conducted by Eurostat since 2001 in the framework of *e*Europe action plans. They relate to enterprises located in the Grand Duchy of Luxembourg employing 10 persons and more and exercising their activities in all the sectors of the economy except the financial one[18]. They were collected by CEPS/INSTEAD in collaboration with STATEC in the first half of 2005. Our statistically representative sample consists of 1132 firms. The rate of website ownership was about 62% (698 firms). Finally, 445 firms have a website with e-commerce functions.

The questionnaire takes over the Community one and inserts new items to analyse particularly the contents of firms' websites and the impact of public initiatives to promote ICT adoption and e-commerce. The data give some information about the characteristics of the firm surveyed and covers: computers and communication technologies use; Internet access and use; e-security and sales; purchases via the Internet or other computer networks.

The main functionalities of the website

Figure 1 presents and list the main functionalities provided by sampled firms on their websites.

As Figure 1 shows, the presentation of the firm is the most provided function. The website may not only offer the possibility of setting up a new retailing channel but also be a way to canvass at low cost new customers for the physical retailing channel. The second most represented function is online sales. The availability of the product catalogue is also one of the most provided functions, but it appears more as a function to inform customers than a commercial one. Thus, a tiny percentage of firms with access to the catalogue of products on the website have already received at least one order online. Finally, online payments, after-sale support and a process of following-up orders are not well-developed, even if they are important for the success of e-commerce.

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[18] Financial firms were excluded from our study since they received a different questionnaire from other economic sectors.

Fig. 1. Websites functionalities
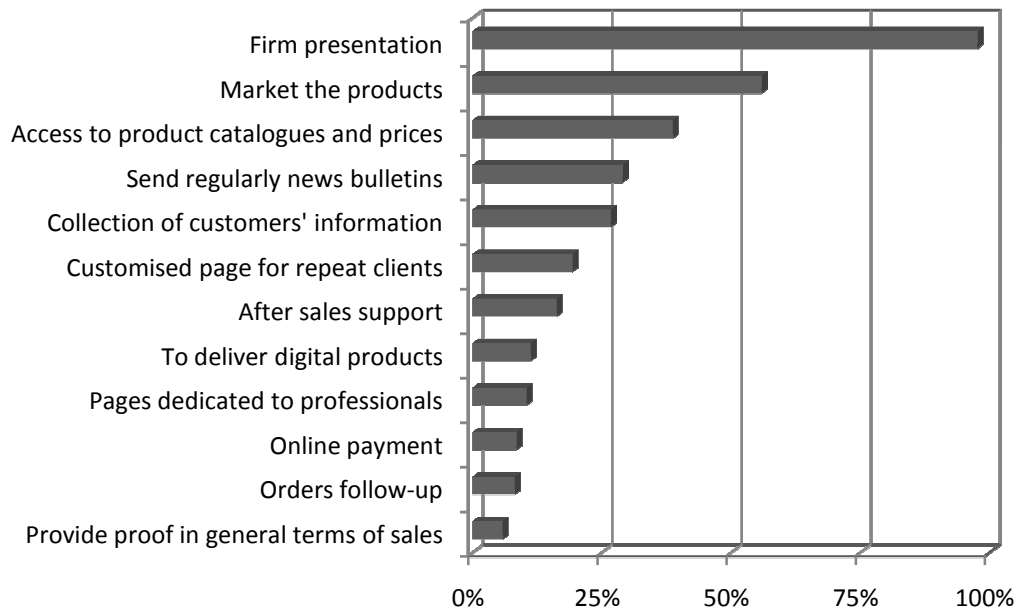
The two e-business strategies

We distinguish two major objectives a website can fulfil so as to define the orientations of the e-business strategy implemented. Thus, the website can, on the one hand, be a tool for an e-business strategy designed to inform potential customers and, on the other hand, a tool to serve a transactional e-business strategy with the setting up of an online distribution channel. From the functionalities of a website, we create three variables capturing the degree of involvement of the firm in an informational e-business strategy, in a transactional strategy or in global strategy including the last two.

The first variable (information score) covers the functions which allow to inform customers: a presentation of the firm, an access to product catalogues, customised pages for regular customers, pages dedicated to professionals, the possibility of sending regular bulletins on the current affairs of the firm and finally the capacity to collect information on visitors to improve services. We sum these functions and we integrate the frequency of the update. The firm gets one point each time

its website provides one function, and we add no points if the update is made less than once a month, 1 if the update is made at least once a month and 2 if the update is made at least once a week.

The second variable (e-commerce score) groups together the functions linked to the creation of an online distribution channel. It encompasses six functions: the marketing of the products, the delivering of digital products, the possibility of paying online, the diffusion of proof rules in general terms of sales, the access to the after sales support service department and the possibility of following-up orders. We also introduce the frequency of the update.

The last variable (total score) is created for a comparison with the others scores and makes no distinction between the needs met by the different functions provided in the site. So this variable makes the addition of the twelve functions a firm can provide on its website and introduces the frequency of the update.

Fig. 2. Description of the scores
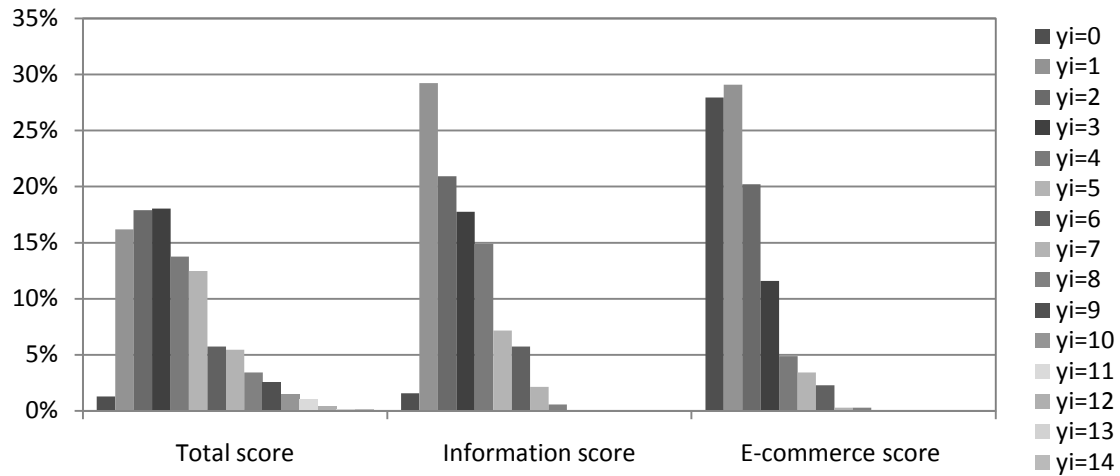
In conclusion, the variables are constructed like this:

- $y_i=0$ if no function is available on the site and the update is made less than once a month;
- $y_i=1$ if only one function is provided on the site and the update is made less than once a month;
- $y_i=2$ if the site provides two functions and an update is made less than once a month or one function and an update made at least once a month;
- $y_i=...$;
- $y_i=c$ if all the functions are provided and the update is made more than once a week, with $c=8$ for the variables information score and e-commerce score, and $c=14$ for the variable total score.

Figure 2 displays the distribution of these scores in the sample.

It appears that there are few firms with $y_i=0$ in the information score and the total score compared with the e-commerce score, where more than 25% of firms owning a website do not propose at least one e-commerce function.

Explanatory variables

The vector of explanatory variable (x_i) includes internal factors and external ones[19].

As internal factors and in order to measure firms' resources, x_i includes, first, two dummies (small, medium) for the size of the firm (the base group includes large firms), two dummies for its organisational structure (multi-establishment and subsidiary of a group). Because we do not have information on the skills of the workforce, we introduce a proxy for human capabilities to use ICT which measures the possibility for employees to attend ICT training (ICT training for employees). Second, to characterise the business in which the firm operates: we introduce four dummies (construction, trade, tourism, transport, computing and services) for sectors (industry is the benchmark group), a dummy to characterize the nature of customers[20], a variable to analyse the influence of being

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[19] For a complete description of the variables used, see Table 3 in the Appendix. Table 4 details the characteristics of surveyed firms in the whole sample, in the sub-sample of firms with a website and in the sub-sample of firms doing e-commerce.
[20] This dummy variable for the nature of customers is only included in a second specification.

an exporter and a dummy capturing potential subcontracting[21]. Third, in order to grasp the impact of the reputation of the firm, x_i includes two binary variables (national and international), in accordance with the perception of the firm (the base group is represented by local renown). Fourth, for the prior ICT use, we consider two composite indicators concerning common communicant ICT and management ICT deployed in the firm[22], two binary variables (low DSL connection and high DSL connection) to capture the quality of the Internet access (the reference variable is low connection), and in our second analysis a variable that characterises the age of the website[23].

External factors are related to the external environment in which firms operate. First, we insert variables related to the competition on the market with two dummies (limited competition and very intense competition) to capture the perception of the firm concerning the intensity of competition on its market (intense competition is the reference variable). Moreover, as we have no measure of the threat of entry, we insert three dichotomous variables (leader, challenger and niche) that capture the position of the firm on the market[24] (the

benchmark group is composed of followers). We can reasonably suppose that firms owning a leading position on the market or evolving on a niche market are less affected than others by potential entries. Second, as we want to measure the local incentives[25], x_i includes a dummy (behavioural imitation) to capture the setting up of an e-commerce website by main competitors and a dummy (privileged partnership with a supplier) to grasp the influence of a privileged supplier who can provide support for the adoption of ICT if it is itself a user or highlight a certain stability of contractual relationships of the firm. Third, we include a variable (Governmental initiatives score) for the external support the firm can have when it has to choose to invest or not in ICT. This variable measures the intensity of knowledge concerning the European and Luxembourg initiatives designed to encourage firms to adopt and use ICT and e-commerce within the scope of *e*Europe action plans[26].

IV. Econometric methodologies

Estimation of the implementation of an e-business strategy from a binary Probit model

To empirically identify the main determinants of the existence of an e-business strategy captured by the ownership of a website we estimate the following binary Probit model:

$$Y_i^* = \beta x'_i + \varepsilon_i$$

where Y_i^* is an unobserved variable, x_i the vector containing the exogenous variables, β the vector of parameters that captures the

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[21] To measure potential subcontracting we use information on the dependence with a customer if the firm concludes over a third of its sales with a single customer.

[22] Management ICT are systems adopted to manage placement and reception of orders. With the introduction of these technologies in our analysis we will seek to see if they slow down the development of e-business (EDI can be a substitute of a website to do e-commerce), or, conversely, if they promote e-business. The investment in ICT may, indeed, be a sign of a willingness to reorganize the firms in order to take advantage of the possibilities offered by ICT and support, therefore, the implementation of an e-business strategy.

[23] Table 4 in the Appendix shows that the mean of this variable is around 4 *i.e.* a creation in 2001 on average.

[24] This measure is a perception of firms but does not show disproportionate rates. Indeed, referring to Table 4, we can see that only 20% of firms in the

whole sample consider themselves as leader, 29% as challenger, 32% as follower and 19% think they develop a niche market.

[25] As we don't have information on the location we don't introduce a variable to capture this characteristic.

[26] The various public initiatives studied have two main goals: help the diffusion of information about ICT and build a legal protection of online transactions to stimulate consumer trust and ensure the security of transactions.

influence of the exogenous variables and ε_i the random error term ($\varepsilon_i \sim N(0,1)$).

The variable Y_i^* indicates whether the firm ($i=1,...,n$) has or not an interest to have a website and thus to develop an e-business strategy depending on the trade-off between expected costs and benefits. The result of the arbitration is unobservable and thus is latent. We observe, however, the variable Y_i that takes the value 1 if the firm has a website and 0 otherwise.

Estimation of the choice of the e-business strategy from count data models

In order to analyse the drivers of firms' choice of their e-business strategy we will use a methodology derived from count data models[27]. These models (Poisson and Negative Binomial models) are generally used to model discrete random and positive variables[28].

We mobilize this type of model to investigate the scores calculated previously. The dependent variable Y_i is a count data which can take on the values: 0, 1, 2,...,c[29]. The three variables show the characteristic of being right-truncated, therefore, we adapt count data models in order to reflect this truncation. As the e-commerce score includes a large number of zeros, to take into account this characteristic, we use a particular model, *i.e.* a right-truncated Zero-Inflated Poisson.

Building on Clifford Cohen (1961), Grogger and Carson, (1991) and Gurmu and Trivedi, 1992, the right-truncated probability distribution of observing $Y_i = y_i$ can be written as follows:

$$f(y_i, \lambda_i | y_i \leq c) = \frac{\exp(-\lambda_i)\lambda_i^{y_i}}{y_i!} \times \frac{1}{\sum_{j=0}^{c} \frac{\exp(-\lambda_i)\lambda_i^{j}}{j!}}$$

$$= \frac{\lambda_i^{y_i}}{y_i! \sum_{j=0}^{c} \frac{\lambda_i^{j}}{j!}}$$

The most common formulation for λ_i is the log-linear model: $\ln \lambda_i = \beta x'_i$ with x_i the vector of explanatory variables and β the vector of parameters[30].

The Log-likelihood function can be written as:

$$\ln L = \sum_{i=1}^{n} \left[y_i \beta x'_i - \ln(y_i!) - \ln\left(\sum_{j=0}^{c} \frac{\lambda_i^{j}}{j!}\right) \right]$$

With c=8 for the information score, and c=14 for the total score. The truncated Poisson models for these scores are then estimated by maximum likelihood through a procedure *ml model lf* written with STATA 9.0 SE[31].

As the e-commerce score includes a large number of zeros and is also right-truncated (*c.f.* Figure 2), to take account of a possible bias related to zero, a right-truncated Zero-Inflated Poisson (ZIP) model is estimated[32].

For firms whose score is nil, zero can come from two regimes. In one of the regimes the result is always 0 (regime 1). This zero can be due to the fact that firms have no willingness to develop a transactional e-business strategy. The score will therefore always be zero. In the other regime (regime 2), the zero is being generated by a Poisson distribution. This process generates both 0 values and j=1,2,...,c values for firms that develop a transactional e-business strategy. The

[27] For a general description of these models see Greene (2003), Chapter 21 or Scott Long (1997), Chapter 8.

[28] They are widely used in the empirical literature on the analysis of the determinants of the productivity of researchers or the number of patents application filed each year (Hausman, Hall and Griliches, 1984; Hall, Mairesse and Turner, 2007).

[29] Recall that c=8 for the information score and the e-commerce score, c=14 for the total score.

[30] Finally, we can note that the assumption of equality between the mean and variance of Yi (with λi) needed in non-truncated Poisson models and that induce sometimes problems is, by construction, removed for truncated models. Indeed, E(Yi=yi|yi $\leq$ c, xi) $\neq$ λi .

[31] The created routine is available on request.

[32] For a general description of these models see Lambert (1992) and Greene (2003).

zeros, in the regime 2, may be due to the fact that the firm, even if it has the characteristics to develop an e-commerce website, has not made this choice at the time of observation. The probability that the value of Y_i is created by the regime 1 is noted p_i and the probability that the value of Y_i is created by the regime 2 is noted $1 - p_i$. The probability p_i can be modelled as $p_i = F(\gamma z_i')$

With F the distribution function of the Logistic Law and z_i a set of variables distinguishing firms with a score that is always be 0 from others with a score that takes positive values or zero. The probability of observing Y_i with j=0,1,...,c (Prob(Y_i= j|x_i, regime 2)) is generated by a right truncated Poisson distribution.

Then, the distribution model associated with the right-truncated ZIP can be written as:

$$
f(y_i|x_i) = \begin{cases} p_i + \dfrac{1}{\sum_{j=0}^{c} \dfrac{\lambda_i^j}{j!}}(1-p_i) & \text{for } y_i = 0 \\[4ex] \dfrac{\lambda_i^{y_i}}{y_i! \sum_{j=0}^{c} \dfrac{\lambda_i^j}{j!}}(1-p_i) & \text{for } y_i = l \text{ with } l = 1,2,...,c \end{cases}
$$

The Log-likelihood function can be written as follows:

$$
\ln L = \sum_{i/y_i=0} \ln \left[\left(\frac{\exp(\gamma z'_i)}{1+\exp(\gamma z'_i)} \right) + \left(\frac{1}{1+\exp(\gamma z'_i)} \right) \frac{1}{\sum_{j=0}^{c} \dfrac{\lambda_i^j}{j!}} \right]
$$

$$
+ \sum_{i/y_i=1,2,...c} \ln \left(\frac{1}{1+\exp(\gamma z'_i)} \right) + y_i \beta x'_i - \ln(y_i!) - \ln \left(\sum_{j=0}^{c} \frac{\lambda_i^j}{j!} \right)
$$

With c=8 for the e-commerce score. The truncated ZIP model for the e-commerce score is estimated by maximum likelihood through the procedure *ml model d0* with STATA 9.0 SE[33].

A sequential estimation of the presence of an e-business strategy (ownership or not of a website) and the choice of the strategy implemented (informational and/or transactional depending on the functionalities offered on the site) requires that there is independence between the two decisions and no selection bias in the use of a sub-sample for the second decision. As there are no specific tests for the use of a binary Probit model and count data models we check from binary variables created from scores and estimated with Probit models[34]. To test the independence between the two decisions, we conduct LR tests (one for each score). The three tests highlight the independence between the two decisions. To test the absence of selection bias in the use of a sub-sample for the choice of the e-business strategy, we use the two step estimation method of Heckman (1979). The coefficient associated with the inverse Mills ratio in our various regressions is still not significant, which corroborates our choice to separately estimate the decision to set up an e-business strategy and the decision to develop a particular strategy.

V. Econometric Results

The drivers of the implementation of an e-business strategy

The results of our estimations are presented in Table 1. It provides both the estimated coefficients and the marginal effects associated with the different explanatory variables.

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[33] The routine is available on request. To test the presence of two regimes mechanism, we use a statistical test proposed by Vuong (1989). The calculation of the Vuong statistic (available on request) tends to favour the use of the ZIP model in both specifications used for the estimation of the e-commerce score with the introduction or not of the characteristics of customers.

[34] These variables take the value 1 if the site gets a score greater than or equal to the average of the score on the sub-sample of adopters.

Table 1. Understanding the determinants of website ownership

	Model 1		Model 2	
	Coefficients	Marginal effects	Coefficients	Marginal effects
Internal factors				
Firm resources				
Small	-0.624 (0.285)**	-0.214	-0.624 (0,285)**	-0.2142
Medium	-0.463 (0.288)	ns	-0.464 (0,288)	ns
Large	Ref.	…	Ref.	…
Multi-establishment	0.253 (0.141)*	0.09	0.253 (0.141)*	0.0900
Subsidiary of a group	0.092 (0.111)	ns	0.091 (0.111)	ns
ICT training for employees	0.223 (0.096)**	0.0816	0.222 (0.096)**	0.0814
Business characteristics				
Industry	Ref.	…	Ref.	…
Construction	0.188 (0.150)	ns	0.187 (0.150)	ns
Trade	0.213 (0.147)	ns	0.210 (0.150)	ns
Tourism	0.955 (0.236)***	0.2711	0.954 (0.236)***	0.2709
Transports	0.207 (0.182)	ns	0.208 (0.182)	ns
Computer	1.061 (0.315)***	0.287	1,061 (0.315)***	0.2871
Services	0.377 (0.164)**	0.1319	0.378 (0.164)**	0.1321
Business To Consumer	…		0.010 (0.112)	ns
Exports	-0.001 (0.002)	ns	-0.001 (0.002)	ns
Subcontracting	-0.095 (0.110)	ns	-0.093 (0.111)	ns
Brand reputation				
Local renown	Ref.			
National renown	0.308 (0.121)**	0.1138	0.309 (0.122)**	0.1143
International renown	0.088 (0.143)	ns	0.090 (0.145)	ns
Attitudes and past experiences with ICT				
Communicant ICT score (0-8)	0.179 (0.035)***	0.0663	0.179 (0.035)***	0.0663
No or low connection	Ref.	…	Ref.	…
Low DSL connection	0.394 (0.103)***	0.1415	0.394 (0.103)***	0.1417
High DSL connection	0.414 (0.106)***	0.1481	0.414 (0.106)***	0.1483
Management ICT score (0-6)	0.032 (0.032)	ns	0.032 (0.032)	ns
External factors				
Competition				
Limited competition	-0.029 (0.135)	ns	-0.029 (0.135)	
Intense competition	Ref.	…	Ref.	…
Very intense competition	0.072 (0.090)	ns	0.072 (0.090)	ns

14

Leader	0.334	0.1184	0.334	0.1183
	(0.136)**		(0.136)**	
Challenger	0.191	0.0696	0.191	0.0696
	(0.112)*		(0.112)*	
Follower	Ref.	…	Ref.	…
Niche	0.201	0.0728	0.201	0.0727
	(0.120)*		(0.120)*	
Local incentives				
Behavioural imitation	0.305	0.1102	0.305	0.1102
	(0.094)***		(0.094)***	
Privileged partnership with a supplier	-0.079	ns	-0.079	ns
	(0.095)		(0.095)	
Public policies				
Governmental initiatives score (0-8)	0.006	ns	0.006	ns
	(0.025)		(0.025)	
Constant	-0.732	…	-0.735	…
	(0.341)**		(0.342)**	
Correctly classified	72.17%		72.00%	
Pseudo R^2	0.1762		0.1763	
Log likelihood	-620.83		-620.82	
Observations	1132		1132	

Note: *, **, and *** indicate statistical significance at the 10%-level, 5%, and 1% respectively. Standard errors are in brackets; ns: non significant; Ref.: reference group.

Concerning internal factors, the results suggest that financial resources have a positive influence on the decision to implement an e-business strategy through the ownership of a website. Thus, small firms have a lower probability of creation compared to medium and large ones, *ceteris paribus*. As small firms have a higher anticipated cost than the expected gains for the creation of a website, they adopt a "wait-and-see" attitude in order to see if the profitability associated with a website is revealed by other firms (Farrell and Saloner, 1986; Choi, 1997). As expected and shown by empirical analyses (*e.g.* Galliano and Roux, 2003), an organization characterised by a high potential of knowledge sharing (*i.e.* a multi-unit organization) display a positive influence. It is also the case for the proxy for human competencies. The marginal effects suggest that, *ceteris paribus*, being a multi-unit organization increases the probability of possessing a website by more than 9%, and enabling employees to attend ICT training increases the probability by about 8%. Therefore, the results substantiate for the most part Hypothesis 1 formulated above.

Firms in the computing industry, services and tourism sectors have a greater probability of creating a website than firms in the industry, construction, trade and transport sectors. Thus, technology-intensive sectors (computing) and sectors selling products that fit the lifestyle of consumers (tourism)[35] are different from others in terms of their probability of possession. The probability of having a website is thus increased by more than 27% when the firm evolves on the computing or tourism sectors and only by 13% when the firm evolves in services. The fact that a firm exports products, the quality of the customers (*i.e.* household *vs.* firms) and subcontracting are revealed to be insignificant in all models. However, the results concerning the business characteristics support for the most part Hypothesis 2.

A firm that holds a brand or a trade name with a national renown has their probability of website creation increased by more than 11% compared to a firm with

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[35] This is the case of digital products (software, music...) or products with a large demand (tourism products in particular) by Internet users in the European Union and in Luxembourg (Eurostat).

a local or an international renown, *ceteris paribus*. This result does not fully corroborate the Hypothesis 3.

Concerning technologies adoption, the results provided by Table 1 show the expected positive sign for the communicant ICT (*e.g.* Dholakia and Kshetri, 2004; Zhu and Kraemer, 2005). The more a firm has adopted ICT, the higher its probability of website creation is. Regarding the adoption of management ICT set up in order to make the organization of the firm more flexible, the results show no significant parameters on website ownership. Having a DSL connection to Internet, whatever the quality, has a positive influence and increases by 15% the probability of ownership, *ceteris paribus*. Therefore, the regression results provide support to Hypothesis 4 only for communicant ICT.

Concerning external factors, the results show that the intensity of competition on the market does not have an influence on the decision to create or not to create a website, but being the leader or a challenger on the market has a positive impact on the setting up. The position of leader increases the probability of having a site by more than 11%, all else equal, and by 7% for the position of challenger. In addition, it emerges that firms developing a niche have their probability of creation raised by 7%, *ceteris paribus*. In other words, having a feeling of protection against the risk of exclusion from the market if the investment fails has a positive effect on adoption (Chappell and Feindt, 2000). As the intensity of competition has no significant coefficient, Hypothesis 5 is not substantiated in our study.

The adoption of e-commerce websites by rivals has a positive influence on the website creation decision for an individual firm. This result shows that behavioural imitation is an important determinant for firms in the implementation of an e-business strategy. Even if the result

concerning the support given by a favoured partner has no effect, the results support, for the most part, Hypothesis 6 formulated above.

Concerning public policies, the knowledge of government initiatives has no significant influence on the creation decision. Therefore, the results don't support Hypothesis 7.

The drivers of the choice of the e-business strategy implemented

The results of regressions using count data models for the study of firms' choice concerning their e-business strategy are displayed in Table 2[36].

• The choice of an informational e-business strategy

Concerning internal factors, the results show that the resources owned by a firm have little impact on the decision to use the website in an informative way. Indeed, only the fact of being a subsidiary of a group that can give financial and human resources has a positive impact on the information score. It seems that a large availability of resources given by the group permits the firm to belong to primo adopters of an informational e-business strategy. The results don't really substantiate Hypothesis 1 formulated above.

Concerning business characteristics, it appears that selling online fashionable products as the sector of tourism does has a positive influence on the implementation of an informative website. Contrary to what we can expect, the computing sector, producer of digital products does not seem to choose to pursue such a strategy.

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[36] We don't dwell specifically on the total score results, given that, they are close to those obtained for the information score. Thus, we focus on the two other scores that distinguish the functionalities offer by the website to potential visitors depending on the aim pursued by the e-business strategy.

Table 2. Understanding the choice of the e-business strategy

	Total score		Information score		E-commerce score	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
	Poisson	Poisson	Poisson	Poisson	ZIP	ZIP
	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Internal factors						
Firm resources						
Small	0.137	0.142	0.107	0.113	0.064	0.072
	(0.091)	(0.091)	(0.110)	(0.110)	(0.149)	(0.149)
Medium	0.109	0.110	0.100	0.102	0.000	0.002
	(0.090)	(0.090)	(0.109)	(0.109)	(0.147)	(0.147)
Large	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Multi-establishment	-0.071	-0.073	-0.049	-0.051	-0.041	-0.043
	(0.060)	(0.060)	(0.072)	(0.072)	(0.102)	(0.102)
Subsidiary	0.085	0.086	0.104	0.104	0.118	0.121
of a group	(0.049)*	(0.049)*	(0.059)*	(0.059)*	(0.077)	(0.077)
ICT training	0.033	0.031	0.035	0.031	0.083	0.078
for employees	(0.043)	(0.043)	(0.053)	(0.053)	(0.073)	(0.073)
Business characteristics						
Industry	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Construction	-0,141	-0.152	-0,1892	-0.205	-0.245	-0.264
	(0.082)*	(0.082)*	(0.098)*	(0.099)**	(0.135)*	(0.135)*
Trade	0.032	0.006	0.044	0.007	0.056	0.013
	(0.074)	(0.076)	(0.089)	(0.091)	(0.119)	(0.121)
Tourism	0.325	0.319	0.351	0.342	0.442	0.428
	(0.097)***	(0.097)***	(0.119)***	(0.120)***	(0.150)***	(0.150)***
Transports	0.009	-0.014	0.074	-0.080	-0.031	-0.043
	(0.092)	(0.093)	(0.112)	(0.112)	(0.150)	(0.150)
Computer	0.027	0.027	0.001	0.002	0.090	0.086
	(0.104)	(0.104)	(0.125)	(0.125)	(0.166)	(0.166)
Services	0.051	-0.047	0.087	-0.081	0.007	0.010
	(0.080)	(0.080)	(0.095)	(0.095)	(0.129)	(0.130)
Business To Consumer	...	0.096	...	0.134	...	0.154
		(0.055)*		(0.068)**		(0.087)*
Exports	0.001	-0.001	0.001	-0.001	-0.004	-0.004
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)***	(0.001)***
Subcontracting	0.135	-0.121	0.104	-0.085	-0.243	-0.221
	(0.056)**	(0.057)**	(0.067)	(0.068)	(0.093)***	(0.094)**
Brand reputation						
Local renown	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
National renown	0.002	0.009	0.023	-0.008	0.080	0.097
	(0.071)	(0.071)	(0.084)	(0.085)	(0.118)	(0.119)
International	0.147	0.163	0.156	0.179	0.234	0.265
renown	(0.077)*	(0.078)**	(0.093)*	(0.094)*	(0.129)*	(0.130)**
Attitudes and past experiences with ICT						
Communicant ICT	0.031	0.031	0.048	0.048	0.031	0.032
score (0-8)	(0.014)**	(0.014)**	(0.018)***	(0.018)***	(0.024)	(0.024)
Low connection	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Low DSL connection	0.012	-0.012	0.002	-0.001	0.031	0.030
	(0.053)	(0.053)	(0.064)	(0.064)	(0.089)	(0.089)
High DSL connection	0.042	0.042	0.040	0.042	0.094	0.088
	(0.053)	(0.053)	(0.064)	(0.064)	(0.088)	(0.088)
Management ICT score	0.063	0.064	0.046	0.048	0.069	0.070
(0-6)	(0.014)***	(0.014)***	(0.017)***	(0.017)***	(0.023)***	(0.023)***
Age of the website	0.022	0.025	0.015	0.018	0.036	0.041
	(0.012)*	(0.012)**	(0.014)	(0.015)	(0.019)*	(0.019)**
External factors						
Competition						
Limited competition	0.003	0.000	0.018	0.023	-0.026	-0.021
	(0.066)	(0.066)	(0.080)	(0.080)	(0.106)	(0.106)

17

Intense competition	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Very intense competition	0.022 (0.043)	-0.019 (0.043)	0.015 (0.052)	0.019 (0.052)	-0.118 (0.068)*	-0.114 (0.068)*
Leader	0.150 (0.063)**	0.147 (0.064)**	0.160 (0.077)**	0.155 (0.077)**	0.170 (0.102)*	0.172 (0.102)*
Challenger	0.082 (0.060)	0.081 (0.059)	0.100 (0.072)	0.099 (0.072)	0.024 (0.100)	0.024 (0.101)
Follower	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Niche	0.038 (0.066)	0.038 (0.066)	0.063 (0.080)	0.062 (0.080)	-0.062 (0.114)	-0.060 (0.113)
Local incentives						
Behavioural imitation	0.205 (0.042)***	0.203 (0.042)***	0.155 (0.051)***	0.152 (0.051)***	0.232 (0.070)***	0.226 (0.070)***
Privileged partnership with a supplier	0.112 (0.046)**	0.110 (0.046)***	0.100 (0.056)*	0.097 (0.056)*	0.158 (0.073)**	0.154 (0.073)**
Public policies						
Governmental initiatives (0-8)	0.041 (0.010)***	0.041 (0.010)***	0.040 (0.013)***	0.040 (0.0123)***	0.050 (0.017)***	0.051 (0.017)***
Constant	0.598 (0.139)***	0.561 (0.141)***	0.302 (0.168)*	0.249 (0.171)	-0.278 (0.226)	-0.338 (0.228)
Log likelihood	-1446.57	-1445.08	-1216.91	-1214.954	-1081.82	-1080.29
R^2_{cw}	0.2845	0.2875	0.2495	0.2546	0.2037	0.2073
Observations	698	698	698	698	698	698

Note: *, **, and *** indicate statistical significance at the 10%-level, 5%, and 1% respectively. Standard errors are in brackets; Ref.: reference group.

R^2_{cw} is calculated with the Cameron and Windmeijer (1996) method (see Greene, 2003).

Thus, the expected number of informative functions for firms evolving on tourism sector is about 35% higher than for firms of other sectors, all else equal. In the Model 2, the variable "Business To Consumer" is associated with a positive coefficient. Thus, firms that deal directly with end-consumers tend to invest more heavily in informative functions than firms dealing with business customers. Therefore, the results substantiate for the most part Hypothesis 2.

Having a brand or a trade name known at an international level influences positively the implementation of an informative e-business strategy. The results substantiate for the most part Hypothesis 3.

For attitudes and past experiences with ICT, both the ICT score and the management ICT score have a positive impact on the choice of informative functions. This result confirms a result widely highlighted in literature about the importance played by an ICT culture on adoption and investment in other more sophisticated ICT (*e.g.* Dholakia and Kshetri, 2004; Zhu and Kraemer, 2005).

The ICT culture promotes the development of a better perception of technologies benefits. In addition, investment in standard technologies (such as EDI) appears complementary to the deployment of an informational e-business strategy. In conclusion, the results provide support to Hypothesis 4 formulated above.

Concerning external factors, the results suggest that the intensity of competition does not have significant effects on the number of functions chosen, while being the leader on the market has a positive influence on the choice of an informational e-business strategy. As the leading position removes the risk of being excluded from the market if the investment fails, it removes the constraint of uncertainty linked to the website investment. However, the regression results don't really support Hypothesis 5.

The impact of behavioural imitation on the decision to invest in an informative site appears to be important (as for the decision of creation). In addition, benefiting from a support given by a favoured partner

increases the expected number of informative functions chosen by 10%. So, the results substantiate Hypothesis 6.

Concerning the impact of the knowledge of public actions implemented in Luxembourg that can favour the diffusion of relevant information on ICT, the results show positive effects on the development of an informative e-business strategy. Thus, the expected number of informative functions is, all else equal, on average 4% more important when the firm has heard about an additional public action. Thus, the results are in line with Hypothesis 7.

- The choice of a transactional e-business strategy

Regarding internal factors, the results suggest that resources owned by a firm have no impact on the decision to develop the e-business strategy in a commercial way. As resources have at least a little impact on the choice of an informational e-business strategy and no impact here, it confirms the ambiguity associated with resources in the literature. Therefore, the results don't support Hypothesis 1.

As in the study of investment in an informative site, firms that sell holiday accommodations, flights and hotels have a greater probability than others to invest in e-commerce. Moreover, this positive effect is even greater in this case than in the one relative to the informational strategy. Indeed, the expected number of commercial functions for firms evolving on tourism sector is about 43% higher than for firms of other sectors, whereas it was 34% in the case of the implementation of informative functions. Subcontracting has a negative influence on the commercial use of the site. This exclusivity reduces incentives for the firm to try to expand its market area catchments through an e-commerce website dedicated to consumers. Thus, the number of commercial functions is reduced by 24% if the firm has a favoured customer. Selling products abroad has a negative but limited impact, thus, the number of commercial

functions is reduced by about 0.4% if the percentage of exports increases by 10%. The results substantiate for the most part Hypothesis 2 formulated above.

Firms which have a reputation at an international level have a bigger probability than others to develop an online commercial channel. The expected number of commercial functions for firms with an international renown is about 27% higher than for firms known locally or nationally. This result is in line with works that highlight the market power available to renowned firms and that allows them to get higher margins on the Internet than others (*e.g.* Brynjolfsson and Smith, 2000, Shankar *et al.*, 1998). They have, thus, stronger incentives to invest in e-commerce. The results support Hypothesis 3.

If we look at the impact of experiences gain thanks to prior ICT adoption, the communicant ICT score is not significant, while the management ICT score is significant and positive. This type of ICT that permits the reorganization of the firms seems, therefore, to support the implementation of a transactional e-business strategy. In addition, these ICT can lead to productivity and market share gains by making the production and distribution processes more flexible. Regarding the age of the site, the results emphasize that the older the site is, the higher the expected number of commercial functions is. Consequently, Hypothesis 4 formulated above is, for the most part, substantiated.

Regarding external factors, as we discussed in the theoretical and empirical literatures, "too much" competition ("Very intensive competition") has a negative impact on the e-commerce investment (*e.g.* Geroski, 2000; Martin and Pénard, 2005). Thus, the expected number of commercial functions is reduced by 11% when the firm perceives the competition that it faces in its market as very intense However, as for the development of an informational

19

strategy, it appears that being in the position of leader in the market positively influences the choice of a transactional strategy. Thus, the regression results go in the direction of Hypothesis 5.

Behavioural imitation is important and bigger than for the investment in informative functions. Thus, the expected number of commercial functions is 23% higher for firms that are aware of the adoption of e-commerce by their competitors, than for others, all else equal. The result for the support provided by a favoured supplier suggests that the expected number of transaction-oriented functions is, *ceteris paribus*, about 15% higher if the firm has a privileged relationship with a supplier. Hypothesis 6 is therefore strengthened.

For public policies, as for the information score analysis, the knowledge of various governmental initiatives has a significant influence on the number of commercial functions provided on Internet. Thus, the results are in line with Hypothesis 7.

VI. Conclusion

Grounded in the theoretical and empirical literature on ICT diffusion, we seek to identify factors that can affect the decision to adopt these technologies. We focus our attention on the development of e-business strategies through the setting up of a website. The nature of the e-business strategy chosen is apprehended through the functions offered by the website. On the one hand, the firm can choose an e-business strategy designed merely to inform potential customers. On the other hand, the firm can choose to implement e-commerce functionalities in order to develop a more advanced strategy aimed at creating a new distribution channel.

The objective of this article was to identify the major determinants of e-business strategy adoption and deployment. Like existing studies on ICT diffusion in businesses, we analyse the influence of factors highlighted in the literature to determine the impact of variables like resources or prior ICT use. In contrast with previous studies, we don't reduce our analysis to the "adoption versus non-adoption" of ICT (Fichman, 2000) and we seek to understand the role of different potential drivers that have never or rarely been tested empirically as the reputation or imitation behaviours. In addition, we seek to capture as finely as possible the impact of the competitive environment on the decisions related to the implementation of an e-business strategy. To do so, we have integrated questions in the survey in order to have specific information on the degree of effective competition felt by the firm and the threats of entries.

Our econometric analysis mobilizes a largely diffused methodology (Probit) but also another one, more original, derived from a methodology used in the works of the economy of innovation to study notably patents (count data models). The results show that there are common determinants to the decision of setting up an e-business strategy (*via* the ownership of a website) and the choice of the strategy pursued (an informational or transactional oriented strategy). In fact, the sale of online fashionable products like tourism, the ownership of a well-known brand and the follow-up of rivals' behaviours play an important role in the adoption and development of an e-business strategy. Other factors, by contrast, are specific to the implementation of the strategy or the choice of strategy pursued.

Regarding the specific determinants of website ownership, our study sheds light on the importance of financial, human and technological resources. For the specific drivers of the choice of the strategy, we find that the use of ICT that make the business process more flexible and the presence of public policies that diffuse best practices concerning ICT adoption have a positive impact.

If we dwell on the intensity of competition, the results highlight interesting lessons. On the one hand, the intensity of competition has no impact on the choice of an informative e-business strategy. However, being well established in the market (*i.e.* being the leader) and having no risk of exclusion from the market if the investment fails has a positive impact on the choice of an e-business strategy oriented to information and to transaction. On the other hand, an intense perceived competition negatively influences the decision to invest heavily in e-commerce. These results are consistent with the theoretical literature, in the sense that "too much" competition increases the risk taken and consequently has a negative impact on a risky investment. Too much competition increases the risk that the firm takes when it invests in assets whose profitability remains uncertain at the time of adoption, which reduces, in return, the incentives to invest.

The actions introduced, for the most part, by *e*Europe action plan seem to have a positive influence on firms owning a website when they choose the number of functions to be provided on their site. These programs allow access to important information when firms choose the strategy to pursue, on notably, good practices and regulations in force in Europe.

As Luxembourg is one of the countries where the rate of ICT use is the most important and as public actions positively affect the deployment of e-business strategies, the Grand Duchy is an example to follow for countries which are behind like France and countries of southern Europe. However, Luxembourg needs to take new actions to promote online sales in the framework of i2010 UE action plans, because of a relatively low rate compared with other European western countries.

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Appendix

Table 3. Description of variables

Internal factors	
Firm resources	
Small	10-49 employees
Medium	50-249
Large firms	250 and more
Multi-establishment	1: the firm has more than one legal unit in its organization, 0 otherwise
Subsidiary of a group	1: the firm belongs to a group, 0 otherwise
ICT training for employees	1: possibility for employees to attend ICT training devoted to a better use of operating systems, software, Internet,…, 0 otherwise
Business characteristics	
Industry	1: the firm belongs to the industry sector, 0 otherwise
Construction	1: the firm belongs to the construction sector, 0 otherwise
Trade	1: the firm belongs to the trade sector, 0 otherwise
Tourism	1: the firm belongs to the tourism sector (hotels, restaurants, travel agencies and passenger transport activities (by train, by car, by boat and plane), 0 otherwise
Transports	1: the firm belongs to the transports of merchandises sector, 0 otherwise
Computer	1: the firm belongs to the computer sector, 0 otherwise
Services	1: the firm belongs to the services sector, 0 otherwise
Business To Consumer	1: the customers are predominantly households, 0 otherwise
Exports	Percentage of the firm's sales realised abroad
Subcontracting	1: 30% or more of sales concluded with one consumer, 0 otherwise
Brand reputation	
Local renown	1: reputation at the town level, 0 otherwise
National renown	1: reputation at the country level, 0 otherwise
International renown	1: reputation beyond the borders, 0 otherwise
Attitudes and past experiences with ICT	
Communicant ICT score (0-8)	Total number of common ICT: local computer network (wireless or not), Intranet, Extranet, electronic mail service, video conference, electronic forum, electronic working group calendar and group project scheduler
Management ICT score (0-6)	Score composed of internal systems for re-ordering replacement supplies, systems of invoices and payment, systems for managing, logistics or services operations, ICT linked with suppliers' business systems or with customers' business systems, and finally Electronic Data Interchange (EDI)
No or low connection	1: low connection to the Internet, 0 otherwise (no connection to the Internet is associated with this category for the analysis of possession of a website)
Low DSL connection	1: connection to the Internet through low speed DSL (< 2Mb/sec)
High DSL connection	1: connection to the Internet through High speed DSL ($\geq$ 2Mb/sec)
Age of the website	The variable takes the following values depending on the year of the site creation: 1) 2004-2005; 2) 2003; 3) 2002; 4) 2001; 5) 2000; 6) 1998-1999; 7) before 1998.
External factors	
Competition	
Limited competition	1: the intensity of competition perceived is limited, 0 otherwise
Intense competition	1: the intensity of competition perceived is intense, 0 otherwise
Very intense competition	1: the intensity of competition perceived is very intense, 0 otherwise
Leader	1: leading position on the market, 0 otherwise
Challenger	1: Position of challenger on the market, 0 otherwise
Follower	1: Position of follower on the market, 0 otherwise
Niche	1: the firm develops a niche, 0 otherwise
Local incentives	
Behavioural imitation	1: the firm knows that rivals have websites, 0 otherwise
Privileged partnership with a supplier	1: if 30% or more of the purchases are transacted with one supplier, 0 otherwise

Public policies

Governmental initiatives score (0-8)	Composite indicator to measures the intensity of knowledge concerning the public initiatives to encourage ICT adoption: two Guild chamber platforms, the Cyberworld Awareness Security Enhancement Structure portal, the law related to electronic signatures, the "electronic commerce" committee, the code of electronic commerce, the "Luxembourg e-commerce certified" and the office that allocates quality labels

Table 4. Descriptive statistics of the data

	Whole sample (1132 firms)		Ownership of a website site Web (698 firms)		E-commerce website (300 firms)	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Internal factors						
Firm resources						
Small	0.7394	0.4392	0.6819	0.4661	0.6467	0.4788
Medium	0.2182	0.4132	0.2564	0.4370	0.2900	0.4545
Large	0.0424	0.2016	0.0616	0.2406	0.0633	0.2440
Multi-establishment	0.1166	0.3211	0.1433	0.3506	0.1467	0.3544
Subsidiary of a group	0.2792	0.4488	0.3324	0.4714	0.4133	0.4933
ICT training for employees	0.3560	0.4790	0.4355	0.4962	0.5300	0.4999
Business characteristics						
Industry	0.1343	0.3411	0.1203	0.3256	0.1133	0.3175
Construction	0.2597	0.4387	0.2264	0.4188	0.1300	0.3369
Trade	0.2668	0.4425	0.2593	0.4386	0.3400	0.4745
Tourism	0.0495	0.2169	0.0616	0.2406	0.0967	0.2960
Transports	0.0892	0.2852	0.0788	0.2696	0.0767	0.2665
Computer	0.0389	0.1934	0.0573	0.2326	0.0667	0.2499
Services	0.1617	0.3683	0.1963	0.3975	0.1767	0.3820
Business To Consumer	0.1996	0.3999	0.1848	0.3884	0.2200	0.4149
Exports	19.76	32.38	19.60	31.73	19.05	30.73
Subcontracting	0.2041	0.4032	0.1891	0.3919	0.1533	0.3609
Brand reputation						
Local renown	0.1661	0.3723	0.1218	0.3273	0.0867	0.2818
National renown	0.4965	0.5002	0.5215	0.4999	0.4833	0.5006
International renown	0.3375	0.4731	0.3567	0.4794	0.4300	0.4959
Attitudes and past experiences with ICT						
Communicant ICT score (0-8)	3.1051	1.6461	3.5387	1.6758	3.7933	1.7873
No or low connection	0.3489	0.4768	0.2493	0.4329	0.2133	0.4103
Low DSL connection	0.3322	0.4712	0.3711	0.4834	0.3700	0.4836
High DSL connection	0.3189	0.4663	0.3797	0.4856	0.4167	0.4938
Management ICT score (0-6)	1.2977	1.5882	1.5043	1.6521	1.8833	1.7588
Age of the website	…	…	4.0544	1.8315	4.4033	1.8723
External factors						
Competition						
Limited competition	0.1325	0.3392	0.1232	0.3289	0.1367	0.3441
Intense competition	0.4337	0.4958	0.4269	0.4950	0.4533	0.4986
Very intense competition	0.4337	0.4958	0.4499	0.4978	0.4100	0.4927
Leader	0.2023	0.4019	0.2521	0.4346	0.3233	0.4685
Challenger	0.2898	0.4530	0.3138	0.4644	0.3200	0.4673
Follower	0.3163	0.4652	0.2464	0.4312	0.2067	0.4056
Niche	0.1917	0.3938	0.1877	0.3907	0.1500	0.3577
Local incentives						
Behavioural imitation	0.3101	0.4627	0.3668	0.4823	0.4567	0.4990
Privileged partnership with a supplier	0.3012	0.4590	0.2751	0.4469	0.3267	0.4698
Public policies						
Governmental initiatives score (0-8)	1.5442	1.8562	1.7335	1.9522	1.9533	2.0942

Note: the whole sample includes 74% of small firms, 22% of mid and 4% of large ones. For firms owning a website, the sample includes 68% of small, 26% of mid and 6% of large firms. And for the firms with at least 2 transactional functions, 65% are small, 29% are mid-sized and 6% are large.