Factors Affecting the Adoption of B2C by Manufacturing Companies

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Abstract— **The adoption of e-commerce by Spanish companies has grown considerably in recent years. Nevertheless, it is still far from reaching the levels of other European countries, hence the interest in knowing the main features of the Spanish companies that have adopted e-commerce. We used the data from the Spanish Survey on Business Strategies, and we considered 13 variables from the Technology-Organization-Environment (TOE) model. The temporal scope of the study covers the period 2001-2013 and includes 1,770 Spanish manufacturing firms and 14,029 firm-year observations. The results show that the introduction of e-commerce is conditioned by the technological, organizational and environmental contexts. The oldest and largest companies are more prone to the implementation of e-commerce. These firms have more experience, which allows them to cope with the uncertainty implied in an innovation process. Consequently, policy measures should be aimed at reducing such uncertainty.**

Keywords—B2C; technology adoption; e-commerce; manufacturing firm.

I. INTRODUCTION

Information and communications technology (ICT) has strongly changed the relationship between companies and their customers. The enormous progress of technology together with the rapid growth of the Internet are key drivers to the exponential increase of e-commerce. In Spain, e-commerce sales exceeded 20,000 million Euros in 2015, with annual growth rates above 25% [1]. In 2006, only 8.02% of Spanish companies made online sales, ten years later this figure has grown to 20.14% [2]. Nevertheless, these figures are still far from those of other European countries, where e-commerce is much more popular.

The unequal diffusion of e-commerce has traditionally been explained by environmental, demographic, economic, technological, cultural and legal factors [3]. Previous literature confirms the impact of culture and other social determinants in the implementation of e-commerce [4][5]. Therefore, it is necessary for each country to identify the factors that help organizations to implement this kind of transactions.

In this paper, we analyze the factors that affect the introduction of Business-to-Consumer (B2C) by Spanish manufacturing companies. The identification of these factors is very useful as a preliminary step to be able to face the difficulties inherent in its adoption.

The following section contains a review of the previous literature on the implementation of e-commerce, which serves as a support for the formulation of the research hypotheses. The third section develops the empirical study with the purpose of contrasting the previous hypotheses. The sample used is taken from the Business Strategies Survey (ESEE) and covers a 13-year period. Section 4 shows the results obtained. Finally, Section 5 lays out the main conclusions of this study.

II. THEORETICAL FRAMEWORK

There are many theoretical frameworks in the literature about the diffusion and adoption of innovations. In this paper, we focus on the factors that influence the implementation of e-commerce by Spanish manufacturing companies and we opted for the Technology-Organization-Environment (TOE) framework, since it pinpoints the perspective of the firm.

Tornatzky and Fleischer [6] developed the TOE framework to explain the factors that influence the behavior of organizations in the process of adoption and subsequent propagation of an innovation [7]. The TOE framework assumes that the adoption process within firms is effectively established through the right match between firm's internal and external factors [8]. However, the TOE framework does not offer a concrete set of factors that affect technology adoption, as it provides taxonomies of factors within their respective context where the adoption process takes place [9][10]. It contemplates three aspects of a firm's context that influence the application of technological innovations: the technological context, the organizational context and the environmental context.

The TOE framework has been used by several authors to identify factors with incidence in e-business implementation [11]-[14]. Once the three contexts are reviewed, the corresponding hypotheses are formulated.

A. Technological context

The technological context focuses on how structure and technological practices can influence the e-commerce adoption process. It includes relevant technology for the company, both external and internal. The external technological context is different between countries, but very similar within each country. For example, from the technological point of view and dealing with e-commerce,

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the support of the law, data security and privacy, the ways to address cybercrime concern and online business integrating capabilities contribute to the expansion of e-commerce [15] and they are the same for a geographical environment. This is why the present paper is more focused in internal technology. In particular, the following factors are considered to be relevant: website availability, investment in computer equipment, R&D intensity and the existence of previous experience in online purchase.

The availability of a website in the enterprise interested in offering e-commerce to the customers constitutes an essential issue. In the case of ICT, the development of well-structured websites leads to an improvement in the visibility of the company and in the attraction of new customers. Some authors [16] evidence the importance of website quality for the success of e-commerce. Hence, the first hypothesis is proposed in the following terms:

H_{1a}: Firms with their own website are more prone to the implementation of B2C e-commerce.

E-commerce implementation requires computer and technological resources. For example, bar code systems, automatic inventory replenishment systems, electronic funds transfer systems, electronic internet sales interfaces or integrated back office storage. This is why the availability of these resources facilitates the e-commerce implementation [17]. Therefore, we formulate the following hypothesis:

H_{1b}: Firms with greater investment in computer equipment are more prone to the implementation of B2C e-commerce.

There is a circular relationship between R&D investments and profitability. Investment in knowledge and in R&D may expand the technological opportunities; the increased knowledge endowment in turn enhances the profitability of entrepreneurial activity by facilitating recognition and exploitation of new business opportunities [18] as, for example, e-commerce. Therefore, innovative companies have more chances of success in online business. Hence, we hypothesize that:

H_{1c}: Firms with a greater effort in R&D activities are more prone to the implementation of B2C e-commerce.

Trust is a key pillar in e-commerce. Uncertainty is both one of the most important inhibitory factors when deciding its implementation, and a source of difficulties for companies with their e-commerce initiatives [19]. So, it is necessary for firms to reduce the uncertainty associated with the introduction of e-business. Therefore, previous experience in e-commerce activities as a buyer can be a positive factor for the B2C implementation. Hence, the following hypothesis is formulated:

H_{1d}: Firms with previous experience in purchasing through the internet are more prone to the implementation of B2C e-commerce.

B. Organizational context

The organizational context includes attributes of the firm that can facilitate or limit the adoption of innovations. After reviewing the literature, the most relevant factors of the organizational context were considered: size, previous experience, separation between ownership and control, product diversification, internationalization, operating margin and foreign capital.

The size of the enterprise is an explanatory variable widely used for several motives. First, the risk of failure is greater in small and medium-sized enterprises than in large enterprises [20]. Secondly, larger companies are able to allocate more resources and capital to face the expenses involved in the adoption [21]. Thirdly, larger firms are able to reduce the adoption costs through economies of scale [22]. Therefore, a number of prior papers evidenced the positive relationship between firm size and the adoption of e-commerce [23][24]. However, other studies do not observe such a relationship [25][26]. The reason may be that, unlike other ICT applications, e-commerce could not require large investments, making it accessible even for small and medium-sized enterprises. In the present paper, the arguments in favor of the first relationship are considered more important, so the following hypothesis is formulated:

H_{2a}: Big firms are more prone to the implementation of B2C e-commerce.

As time goes by, firms are able to accumulate resources, managerial knowledge and the ability to handle uncertainty [27]. In addition, mature firms enhance their reputation and position in the market [28]. Finally, there is evidence about the positive effect of firm age on innovative outcomes [29]. Hence, we hypothesize that:

H_{2b}: Oldest firms are more prone to the implementation of B2C e-commerce.

Another key factor in the e-commerce adoption is the top management support. The managers' commitment has positive effects throughout the organization, since it allows acquiring greater awareness of the advantages of technology, reinforces the links with the infrastructure required for its implementation and facilitates the training necessary for the use of the technology [30]. Therefore, to the extent that management is professionalized, the commitment with the implementation of e-commerce could be strengthened. Hence, the following hypothesis is formulated:

H_{2c}: Firms with separation of ownership and control are more prone to the implementation of B2C e-commerce.

Companies that make less diversified products rely on economies of scale to minimize their costs. Therefore, they seek to sell large volumes of products to a small number of customers. On the other hand, firms with a greater diversification of products try to reach a large number of customers, so e-commerce is considered a very suitable strategy for them. Hence, the following hypothesis is formulated:

H_{2d}: Firms with greater product diversification are more prone to the implementation of B2C e-commerce.

Another variable that may influence the e-commerce implementation is whether the firm develops its activity in international markets or not. The empirical literature on technological innovations shows a positive relationship between exports and innovation [31], because internationalization implies growth in competitiveness and market size. ICT reduce the impact of geographical locations and distances [32]. E-commerce offers companies a new way of reaching consumers without physical establishments, so it

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has been recognized as an important facilitator of international expansion [33]. Hence, we hypothesize that:

H_{2e}: The most internationalized firms are more prone to the implementation of B2C e-commerce.

The link between profitability and adoption of new technologies has been studied in the literature. Higher-performing firms are more likely to adopt ICT because of their greater availability of resources. For example, some authors [34] conclude that high-performing banks adopt product and process innovations more regularly than low-performing banks. For this reason, in the case of e-commerce, the following hypothesis is formulated:

H_{2f}: Firms with high profitability are more prone to the implementation of B2C e-commerce.

Most of the reasons cited in the literature support a positive relationship between multinational ownership and ICT adoption. This is because firms forming part of a group are able to reduce the risk involved in the adoption of new technologies [35]. The existence of an external network plays a substantial role in the adoption process, since networking heightens the awareness of the innovation and increases the likelihood of its adoption [36]. The literature has found empirical evidence to support this positive relationship [32]. Therefore, the hypothesis formulated is:

H_{2g}: Firms with greater presence of foreign capital are more prone to the implementation of B2C e-commerce.

C. Environmental context

The environmental context is based on the fact that the company is surrounded by multiple stakeholders (customers, suppliers, competitors, government, financial institutions, society and many more), that have decisive influence, among other aspects, on the need to innovate, the ability to obtain resources for innovation and the ability to make the most of them [6]. Regarding ICT implementation, the environment within which the firm performs its activities and the pressure of the stakeholders play an important role [11][37]. The environmental factor has also been called the institutional factor [14] or external pressure [38]. The Institutional Theory [39] points out the influence of environmental variables in companies' decisions, one of them being whether to implement e-commerce.

In the present paper, one variable regarding the environment of the firm is considered; it is customer concentration.

The greater the number of customers, the greater the advantages of implementing e-commerce, since the fixed costs caused by its implementation could be distributed among more users. In addition, online business allows to reach a greater number of potential customers. Hence, we hypothesize that:

H_{3a}: Firms with greater number of customers are more prone to the implementation of B2C e-commerce.

Finally, industry in which the firm operates may have an important influence on the e-commerce adoption. This variable reflects business environment factors, such as heterogeneity and uncertainty. Firms in different industries have to deal with different types of business environment dynamics, which may affect e-commerce adoption [40]. The strategic value of e-commerce seems to be different depending on the sector. That is to say, it becomes a competitive necessity in those industries where competition is very aggressive and competitors are making intensive use of it [41]. Therefore, in this paper the industry ascription was used as a control variable.

The proposed model is shown graphically in Figure 1.

III. EMPIRICAL STUDY

To contrast the formulated hypotheses, an empirical analysis is carried out on a sample of Spanish manufacturing companies. This section exposes the formation of the database, the variables used, the main descriptive statistics of the sample and the methodology used for hypotheses testing.

A. Database

To carry out the empirical study we used the Survey on Business Strategies (Encuesta sobre Estrategias Empresariales - ESEE), elaborated by the Spanish Ministry of Science and Technology. This survey is one of the most representative databases of Spanish companies, since ESEE is a reliable source for information on the strategies of Spanish companies. The reference population of the ESEE is constituted by the Spanish manufacturing companies with 10 or more employees.

In the present study, the period between 2001 and 2013 was taken as temporal scope. After eliminating the companies for which information was not available, we formed a database comprising 1,770 companies.

B. Variables in the analysis

Taking into account the theoretical development and the hypotheses formulation, we considered a number of variables for our analysis. These variables are displayed in Table I. Moreover, twenty dummy variables were considered for the industry in which firm operates.

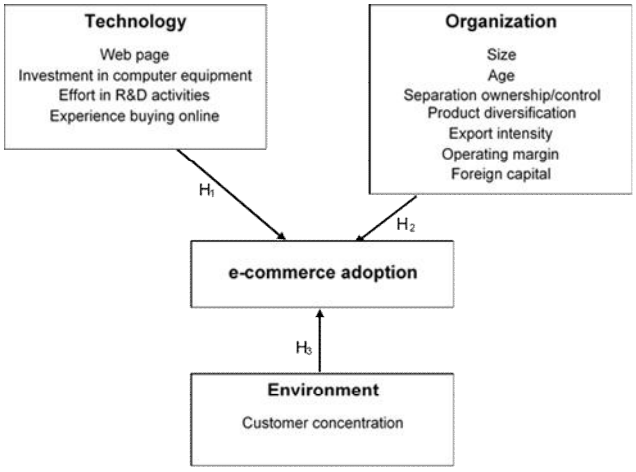

Figure 1. Proposed model for the B2C implementation by the Spanish manufacturing companies

C. Sample characteristics

The sample used comprises 14,029 firm-year observations obtained from 1,770 companies over the period 2001-2013. Tables II and III display some descriptive statistics for the dichotomous and continuous variables, respectively. For the former, frequencies and percentages are shown and for the latter, mean, standard deviation, minimum and maximum were computed.

TABLE I. VARIABLES IN THE ANALYSIS

Variable	Meaning
web-b2c	Business-to-consumer e-commerce. Dummy variable that equals 1 if the company makes B2C and 0 otherwise. This is the dependent variable of the model.
age	Number of years since the company was founded.
owner_control	Dummy variable indicating whether there is identity between ownership and control of the company. Equals one if the owners or their family are in management positions.
sales	Net sales of the company.
margin	Margin over operating income. Margin is defined as the sum of sales, changes in inventories and other current operating income less purchases, external services and personnel costs. Operating income is total sales plus the change in stocks and other current operating income.
con_conc	Consumers' concentration. Percent of the sales made to the three main customers over the total company sales.
diversif	Diversification of products. Equals 0 if the company manufactures only one product (at 3-digits classification level) and 1 otherwise.
for_cap	Percent of direct or indirect participation of foreign capital over the share capital of the company.
invcom	Investments in computer equipment. Percent of computer equipment purchases over investments in property, plant and equipment.
ownserver	Dummy variable indicating whether the Web page of the company is hosted on its own servers (1) or not (0).
intpurchases	Dummy variable indicating whether the company makes purchases through the Internet (1) or not (0).
rd_sales	Percent of R&D expenditure over total sales.
export_sales	Percent of exports over total sales.

TABLE II. FREQUENCIES OF THE DICHOTOMOUS VARIABLES

Variable	0	1	Total
web-b2c	13,258 (94.50%)	771 (5.50%)	14,029 (100%)
owner_control	8,224 (58.62%)	5,805 (41.38%)	14,029 (100%)
diversif	12,211 (87.04%)	1,818 (12.96%)	14,029 (100%)
ownserver	9,610 (68.50%)	4,419 (31.50%)	14,029 (100%)
intpurchases	10,567 (75.32%)	3,462 (24.68%)	14,029 (100%)

TABLE III. DESCRIPTIVE STATISTICS FOR THE CONTINUOUS VARIABLES

Variable	No. obs.	Mean	St. dev.	Min	Max
age	14,029	37.71787	21.639	10	179
sales	14,029	9.19×10^{7}	3.99×10^{8}	11.805	7.62×10^{9}
margin	14,029	7.027664	33.32573	-913.9	3.150.4
con_conc	14,029	44.21705	28.42819	1	100
for_cap	14,029	19.08675	38.22149	0	100
invcom	14,029	6.495524	17.40614	0	100
rd_sales	14,029	0.0085402	0.1076871	0	12.41273
export_sales	14,029	0.2163531	0.2776703	0	1

D. Empirical Methods

Random effects Logit panel-data estimations were used. The STATA 13.1 software package was used. The dependent variable is web-b2c, a dichotomous one, which equals 1 if the company makes sales to individual customers through the Internet and 0 otherwise. The independent variables are age, owner_control, sales, margin, con_conc, diversif, for_cap, invcom, ownserver, intpurchases, rd_sales, export_sales, and the dummy variables indicating the sector ascription (In order to avoid perfect collinearity we dropped the largest sector).

IV. RESULTS

Table IV contains the results of the panel logit regression estimation. We display the coefficients and their standard errors, as well as the z statistics and the corresponding p-values. We also include some additional statistics (Log likelihood and the corresponding test, and the ρ test on the significance of the panel variance).

The analysis of the ρ-statistic reveals that the panel-level variance is significant. Therefore, the use of a panel data approach is justified. Furthermore, the likelihood ratio test evidences the joint significance of the set of independent variables. With regard to the results for each one of the proposed indicators, the following results are obtained:

- Our data provide evidence to support H_{1a}, H_{1d}, H_{2a}, and H_{2b}. This implies that older and larger companies are more prone to the implementation of e-commerce. In addition, companies that have their own servers to host their websites and those who had previous experience in making purchases online are also more prone to the implementation of e-commerce.
- The results show that the higher the consumers' concentration, the less the propensity to implement e-commerce, and thus H_{3a} is confirmed. In addition, the companies that invest the most in computer equipment are less likely to implement e-commerce.

TABLE IV. RESULTS OF THE PANEL LOGIT REGRESSION

	Coef.	Std. Err.	z	P>z
age	*0.0123028*	*0.0057153*	*2.15*	*0.031*
owner_control	-0.2349963	0.1889312	-1.24	0.214
sales	*5.51×10^{-10}*	*2.28×10^{-10}*	*2.41*	*0.016*
margin	0.0001943	0.0030858	0.06	0.950
con_conc	*-0.0104101*	*0.003728*	*-2.79*	*0.005*
diversif	-0.0978172	0.2200009	-0.44	0.657
for_cap	0.0017419	0.0027105	0.64	0.520
invcom	*-0.0084241*	*0.0040836*	*-2.06*	*0.039*
ownserver	*1.514425*	*0.1661262*	*9.12*	*0.000*
intpurchases	*2.128654*	*0.1539428*	*13.83*	*0.000*
rd_sales	0.3449393	0.6762351	0.51	0.610
export_sales	-0.3080579	0.4131901	-0.75	0.456
Intercept	*-7.794592*	*0.5501702*	*-14.17*	*0.000*
Log likelihood	-1703.4359			
Likelihood-ratio test:				
χ^2=434.46	p=0.000			
ρ	0.7557506	0.0207241		
Likelihood-ratio test of ρ=0				
χ^2=1517.11	p=0.000			

This is the opposite of what we hypothesized (H_{1b}). As reasons for this, it is possible to point out that the implementation of this innovation requires, rather than an investment in physical equipment, the development of software projects, and companies that are forced to renew/expand their hardware may no longer have available resources to purchase/develop software products. This is because all these investments usually belong to the common chapter of technological investments within the company budget.

- For the other independent variables there seems to be no influence.

The results show the influence of factors belonging to the three contexts identified by the TOE framework in the e-commerce implementation.

V. CONCLUSIONS

Despite the positive effects of the adoption of e-commerce, a considerable number of Spanish companies have not yet implemented it. This situation differs from what happens in other European countries, where rates of use of e-commerce are much higher. This justifies the interest in knowing the characteristic factors of the companies that have adopted e-commerce.

The results obtained reveal the positive influence in the implementation of e-commerce of two relevant factors, which belong to the organizational context of the company: size and age. It seems clear that older and larger companies are perceived by consumers as more trustworthy and less risky, and this leads this kind of firms to implement e-commerce. Indeed, trust is considered a key factor for the success of e-commerce. This perception may move older and larger companies to implement e-commerce.

Two variables from the business technological context (whether the company makes purchases through the Internet, whether it has its own servers to host its website), are also shown as determining factors for the implementation of e-commerce.

Finally, as regards the environmental context, the evidence obtained supports that the dispersion of customers has an influence on the implementation of e-commerce.

It should be noted that the introduction of e-commerce is conditioned by the technological context, the organizational context and the environmental context of the company. This means that in order to increase the implementation rates, it is necessary to act on the three contexts at the same time. The results obtained show that the main measure to be taken is to reduce the uncertainty that any innovation process entails. Because of such uncertainty, the larger and the older (more experienced) companies are in better position for the implementation. However, the contagion effect that these companies exert on the others in any area makes more and more companies betting on it.

Finally, as future lines of research to develop the present paper, we propose to analyze the reasons why many companies still do not use e-commerce, even though the number decreases progressively over time. It should also be interesting to determine why some of the factors that were proven relevant in prior research conducted at the international level (ownership-control separation, margin, diversification, foreign capital, R&D intensity and exports) are not relevant for the Spanish case.

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