Marketing is changing. 
An Econometric Model on Marketing and New Technologies


Abstract
Change management has always been a topic of vital importance in the managerial sector, and it is more, when this change refers to the technological ambience, the effect is even more dramatic. In this article we will see how the technological change that has supposed the irruption of the Internet phenomenon has affected the way of doing marketing of companies, going on from the traditional marketing to what is named e-marketing. Later we show a censored micro-econometric model with sample selection bias that analyses the influence that different variables exercise on the percentage of expense in innovation dedicated to marketing. The final conclusion is that the expense in marketing is higher for the companies that have been catalogued as innovators in technology in relation to those that are not. Also, it increases other variables increase as the employment of the company, the volume of sales, the volume of expense in innovation, or the percentage of the turnover corresponding to introduced or sensitively improved products.

Keywords: technological change, e-marketing, qualitative choice models, sample selection bias.

JEL Codes: M31, O33, C24, C25.

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1. Introduction

In the sixties the new Information - and Communication Technologies appear (known as ICT) in the private sector. The main aim is to save costs and eliminate manual work and paper processes (payrolls, invoices, etc.). Nowadays ICT plays a more important role, becoming a source of competitive advantage for many companies.

Generally, it is interesting to know how company employees use and apply Internet, as well as to know which kind of monitoring has been established for correct Internet use (Fontrodona and García, 2002). In the same sense, in his paper, Riverola (2003) analyses e-Business projects offering mapping of the Internet application in business models in big Spanish companies, of higher management opinions on these issues and of opinions of e-Business projects related head of departments.

González, Rodenes and Álvarez (2005) examine the excellence model, EFQM, and they conclude that ICT are at least as relevant for the excellence model outcome (commercial manager satisfaction, employee satisfaction and customer satisfaction) as the rest of indicators (general manager quality, human resource management, resource planning and strategic planning). Other papers, like Sieber (2004), state that introduction of new technologies at companies have forced the companies to reconsider management - and organizational processes, although this is only “one small step in a long evolution”. Sieber and Valor (2005) define the criteria that companies use to develop ICT strategies, whereas Sieber and Valor (2006) distinguish the impact of the ICT in different areas of the company: technology and infrastructure, customer and suppliers interaction, business results, internal organization, etc. with the goal of studying this impact and the challenges of new information and communication technologies for the Spanish private sector, and compare with the North American companies results. We can find a complete national study in Sieber and Valor (2007), and in Sieber and Valor (2007b) we can find a study focused on the industrial sector. In this paper they analyse how some companies have obtained a sustainable competitive advantage by means of ICT (see also Rodeiro and López –2007–). Sieber’s (2007) detailed study analyses the impact that ICT has had in the organizational structures and
in the way-of-working. This paper shows how ICT has improved competitiveness, contributing to increased efficiency and level of market penetration. Analysis of the Fundación Cotec report (2007) is worthwhile to obtain a general vision of technology related to competitiveness in the Spanish economy.

The empiric literature contains a considerable amount of papers analysing ICT on European level. Gordo (2005) analyses the innovation activity using the Encuesta de Innovación Tecnológica elaborated by the European Commission. This analysis is from several points of view, from study of the R&D-destined resources to the analysis of the economic impact and also comparing Spanish economy with the European average. Álvarez and Molero (2004) stress the specific characteristics that technological invention has in multinational companies, analysing the new trends in the international frame, although focusing on the Spanish economy as an intermediate country in technology.

1.1. From Traditional Marketing to e-Marketing
Change management is perhaps one of the most important entrepreneurial processes that the majority of big companies must face at least once. It is important to be aware of the role to play in the change management process. Also, if this change is a technological change the effect is even faster and abrupter.

In marketing, an evolution can be observed from traditional marketing, or Jurassic Marketing (De la Rica, 2000), towards a new concept: the electronic marketing or e-Marketing. In this new frame, our traditional marketing mix variables are not differential element in the company. The key to obtain a sustainable competitive advantage is in the intangible assets (the company brand, the company image, the guarantees, the customer attention service, the domain, the Web, etc.). And in this technological environment Internet can help us to improve the intangible assets of our company. First, by increasing the customer perception of our products (electronic catalogues, multimedia elements, personalization of the product –color, model, size–, etc.). Secondly interacting with the user (interactive advertising, obtaining user feedback, humanizing the pur-
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Chasing process, etc.). In this context some authors have considered the importance of the 5th P of marketing mix, People; that is, involve the customer in the achievement of marketing objectives. Flavián and Guinalíu (2007) highlight three basic concepts in relations established through Internet: user’s familiarity, server’s reputation and user’s fidelity. The paper concludes that web servers must increment the familiarity with the web site as well as the server’s reputation that users perceive, in order to increase user’s fidelity.

Now is time to highlight the work of Cristóbal (2006). In this paper Cristóbal analyses the differences between the real and virtual stores, stressing how Web design (graphic design, usability and accessibility) have influenced the development of commercial management. Final conclusions are, first, that design has a significant importance in the visual environment and Internet is a visual environment, and second, that virtual store management should not be a copy of traditional management. If we transfer traditional store management to virtual store, the business will probably fail. In addition, Ruiz and Sanz (2007) propose to use direct selling methods as complementary to traditional establishments sale. The aim is to know them, and they emphasize the TV sale, where comfort and purchase convenience are priority. The final conclusion is that users who buy in traditional stores consider it a leisure activity. In addition, the lack of product touch means a restriction. Finally, the user is not sure of the whole purchase process, or believes that problems may occur in the logistic process. However, there are advantages: normally in 24 hours one can enjoy the product at home.

Pérez-Cabañero (2007) analyses the information search process, previous to purchase, comparing this process between goods and services. In this article they state two maintainable hypothesis: first, the consumer looks for more information when buying goods than when buying services; and second, the consumer searches more information sources for goods than for services. Furthermore, Martín and Quero (2004) show how the companies with Web pages tend towards the relational marketing approach, and thus include some kind of relational marketing tool in the design of the Web pages. On the other hand we can find some papers as
Vallet and Frasquet (2005) proposing a thorough revision of the marketing mix variables. They consider several solutions for the current situation: stand still, complete or partial remake, change direction, turn back or choose the least transited road.

The paper of Lozano and Fuentes (2005) treats the difficulties for trying to value intangibles of the company such as brand image and the importance of correct evaluation. In fact, this value varies enormously: from a 10% for industrial companies, to a 70-90% in the luxury products sector. This value can be even higher in the case of virtual companies.

Other studies deal with the marketing communication and how new technologies provide new means of management and information diffusion (Armelini and Villanueva, 2007 and Villanueva, 2007). This papers shows the WOM (Word Of Mouth) like a new way of communication between the companies, and analyses why the WOM has become a powerful marketing tool. Very interesting also the work of Álvarez, Santos and Vázquez (2005), where the authors make a compilation of the main scale used to determine the market oriented degree. The companies make a test to establish the degree of marketing achieved. In this test, there are a lot of questions about the customers of the enterprise. Romeiro and Garmendia (2007) take a step forward in the analysis of market oriented ICT. Also, they discuss the use of Marketing Information Systems, not only as information managers, but as marketing information managers. This MIS should be a management model, and should spread out like the viral marketing, to all the members of the company for its diffusion.

Finally, we see that technology has influenced the company marketing, and, in fact, it has altered the statu quo of a lot of organizations. The present article studies the technological investment and innovation with an econometric model. This analysis use different methodologies, for example discrete choice models, using data of the Encuesta Sobre Innovación Tecnológica en las Empresas 2000, of the INE. On the following pages we will develop a model to observe the technological innovation in the Spanish companies during the year 2000.
1.2. Econometric Model

Many papers about economic theory of labour market, theoreticians and empiricists analyse the wage equations. These studies are the most widely used in literature when discussing micro-econometrics and discrete choice models. They analyse the participation in a market of specific population groups (generally, men and women in the labour market). During the last few years, the improvement of the information-technology processes has popularized the use of applied econometrics in this field.

One of the classical works about labour market is Fallon and Verry (1988), where the authors describe in a detailed way the micro-econometric model of the labour market supply. In this, the consumer faces a utility function that should maximize subject to a budgetary restriction, and the decision about participating or not in the labour market will be determined by the preferences of the consumer about consumption, leisure, and work. In a corner solution\(^1\), the consumer will prefer not to work unless wage is higher than the offered one. Thus, there is a minimum wage to start to work. That limit wage, is known as reservation wage. For wages equal or inferior to the reservation wage, the consumer chooses not to work, but for wages higher than the reservation wage the consumer prefers to participate in the labour market. As conclusion we can say that the decision to participate or not in the labour market is determined by the existing divergence between the market wage \(-\omega_M\)\(^\ast\), and the reservation wage \(-\omega_R\). So, if \(\omega_R > \omega_M\) the individual does not participate, if \(\omega_R < \omega_M\) he participates and if \(\omega_R = \omega_M\) the decision between participating or not is indifferent.

So, we can focus our econometric model as a discrete dependent variable model, or as a limited dependent variable model. First, we can define a binary discrete choice model (1 = participate, 0 = not participate), where the goal is to estimate the probability of participating and not participating in the process (either in an innovation process or in a labour market participation process). The next step is to choose between different distribution functions, which provide us with different estimations of the parameters. That way, for example, the linear probability model consists in the OLS estimation of the binary model. If we use a logistic distribution function we obtain the Logit model (or logistic model). And, finally, using

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\(1\) In *Modelling individual choice. The econometrics of corners, kinks and holes* (S. Pudney), we can find a complete description about the econometric specification problems of use discrete variables.
a normal distribution function we obtain the Probit model (or probabilistic model). A second kind of model are the censored dependent variable models, in which we observe the independent variables for the whole sample, and where the dependent variable is observed only for the range of censored values. And as last, we have the truncate dependent variable model, that is similar to the censored model, but in which we observe the independent and the dependent variables only for the not truncated range.

The possibility also exists –as is our case– to consider that the censored model has sample selection bias. So, we must use a bietapic estimation method, like the estimator proposed by Heckman (1979) whose detailed explanation we can find in Amemiya (1988), where the solution is to make an estimation in two stages: in the first, the individual makes a decision about participating or not, and in the second, once the individual has chosen to participate, he must decide the grade of participation (in the labour market, the individual decides how many hours to work; in the innovation process, the company decides how much to spend on marketing). Kalb and Scutella (2003), use the Heckman bietapic model to estimate a wage equation. Similar studies we can find in García (1991), Stern (1986), or Killingsworth (1983).

In the present paper we estimate a censored model with sample selection bias, in a technological innovation process, where the decision is to take part in the innovation process investing a part of the budget in marketing. Other models in the literature relate econometrics and marketing, for example in Allenby and Rossi (2003), where the authors use the bayesian approach to solve marketing problems. A similar paper, using also Bayesian methods is Chiu, Gilbride, Kao and Otter (2005). Also, we can find interesting econometric models about innovation in Baumert, Buesa, Heijs and Martínez (2002), in Acosta (1995), in EU Research on Social Sciences and Humanities (2005), or in Benavente (2005). This paper uses an econometric analysis to evaluate the impact of R&D activities on innovation and productivity.

In summary, this paper analyses a marketing expense equation with sample selection bias, and estimates the model according to the traditional two-stage method proposed by Heckman (1979). The second chapter explains the theoretical frame essential to understand this investigation,
exposing the theoretical foundations which justify the use of the econometric model. In the third chapter we define the equations to be estimated, as well of the selection model (Probit model), as of the behavioural model (or equation of innovation expense dedicated to marketing). Also in this chapter we describe the variables used in each model. In the same part we analyse the sample to be used in the estimation process. The fourth chapter shows the results obtained with the selection model and behavioural model estimations as well as the diagnosis of the model. The work finalizes with the chapter of conclusions and with the one of bibliography.

2. Theoretical frame
As we have just seen, the first decision that the company has to take is whether or not to participate in the technological process. As we can see in figure 1, such decision is determined for the difference between the benefit obtained by innovating (or market benefit \( b_M \)) and the minimal benefit that any company considers necessary to invest in technology (or reservation benefit \( b_R \)). So, if \( b_R > b_M \) the company does not innovate, and if \( b_R < b_M \) the company innovates, and if \( b_R = b_M \) the company is indifferent between innovating or not.

Figure 1. Participation Decision Process

![Figure 1. Participation Decision Process](image-url)
In any case, the companies first decide to participate or not. If so, they decide which percentage of innovation budget will be dedicated to marketing. So, we are censoring the sample, since for the dependent variable we did not observe the whole sample (for the individuals that not take part in the process the value is 0, that is, the sample is observed only for the range \(Y_t^* > 0\)), while we observe the whole sample for the independent variables. This model is also known as censored Tobit model.

This is a very important decision since, as we are only going to estimate expense equations for companies that innovate and dedicate part of the budget to marketing, there is a sample selection bias which has to be corrected. In order to solve this problem, as we can observe in Amemiya (1985, p.384), two equations are defined. The first is the BEHAVIOURAL EQUATION (censored Tobit model):

\[
Y_n^* = X_n\beta + \varepsilon_n \quad [2]
\]

and where we did not observe \(Y_n^*\) directly, but: \(Y_n = 0 \iff Y_n^* \leq 0\), and \(Y_n = X_n\beta + \varepsilon_n \iff Y_n^* > 0\). And where the sample selection is determined for the binomial model of the second equation, SELECTION EQUATION, defined as: \(E_n^* = Z_n\alpha + \eta_n\) \([3]\)

and where we did not observe \(E_n^*\) directly, but: \(E_n = 0 \iff E_n^* \leq 0\), and \(E_n = 1 \iff E_n^* > 0\).

Then the solution is:

1\(^{\circ}\) Estimate \(\alpha\) using MLE, like a binomial model, using any of the techniques previously described: Logit, Probit or extreme value, although generally the normal distribution function is used (binomial Probit model).

2\(^{\circ}\) Estimate by OLS: \(Y_n = X_n\beta + \sigma\hat{\lambda}(Z_n\hat{\alpha}) + \varepsilon_n\) \([4]\)

using only the positive observations, where \(\hat{\lambda}(Z_n\hat{\alpha})\) is known as inverse Mills ratio, otherwise called Heckman’s correction, and is defined as: 
\(\hat{\lambda}(Z_n\hat{\alpha}) = \phi(Z_n\hat{\alpha})/\Phi(Z_n\hat{\alpha})\) \([5]\)
and where \( \phi(Z_n \hat{\alpha}) \) is the density function of the binomial model, \( \Phi(Z_n \hat{\alpha}) \) is the distribution function and \( \hat{\alpha} \) the parameter obtained in the first stage. As well, \( \sigma \) is the covariance between the behavioural equation error term and the participation equation error term and Heckman proves that \( \lambda \) approaches the probability to innovate, the probability to take part in the innovation process. Putting \( \lambda \) in the marketing expense equation we take into account the sample selection bias deriving from not observing the marketing expenses of those companies which do not participate and can therefore not be used in the sample. The significance of the inverse Mills ratio \( \lambda \) shows us the importance of the sample selection and allows us to estimate consistently the rest of the equation coefficients (Cameron and Trivedi, 2005, pp. 546-551).

So, we can define our participation econometric model (participation in the innovation process) as a discrete choice model (binary model). Where the dependent variable takes value 1 if the company participates in the innovation process, and 0, if it does not participate\(^3\). This model is similar to the previously defined model, where the goal is to estimate the participation (\( P(E_n = 1) = F(Z_n \hat{\alpha}) \)) and not participation probabilities (\( P(E_n = 0) = 1 - F(Z_n \hat{\alpha}) \)), and where \( F(Z_n \hat{\alpha}) \) is a distribution function. With this function we guarantee that probabilities lies in the range [0,1]. For example:

1\(^o\) A linear probability model, consisting of the simple OLS estimation of [1]. This function has one problem: there is no guarantee that the estimated probabilities stay within the admissible range for all probability, [0,1]:

\[
F(Z_n \alpha) = Z_n \alpha \quad [6]
\]

2\(^o\) A logistic distribution function, or Logit model:

\[
F(Z_n \alpha) = \Lambda(Z_n \alpha) = \frac{1}{1 + e^{-Z_n \alpha}} = \frac{e^{Z_n \alpha}}{1 + e^{Z_n \alpha}} \quad [7]
\]

3\(^o\) Or a normal function, or Probit Model:

---

\(3\) In our model, “participate” is innovate and invest a part of the Budget in marketing
We can apply Heckman’s estimation method in a simple way to our innovation and marketing expense model. In the behavioural equation the dependent variable is the marketing expense logarithm, and the explanatory variables are those of company characteristics, \( g_n = X_n \beta + \varepsilon_n \). And where the sample selection equation is a binomial participation model: 
\[
I_n^* = \tilde{X}_n \tilde{\beta} + u_n
\]
being \( I_n \) a binary variable that takes the value 1 if the company takes part in the innovation process and 0 if not.

3. Equations to estimate

To estimate the equations defined in the following chapter, we will use the data of ENCUESTA SOBRE INNOVACION TECNOLÓGICA DE LAS EMPRESAS of the Instituto Nacional de Estadística for the year 2000. This opinion poll informs us about the innovation process structure, showing the relations between this process and the technology strategies of the companies. In addition, we can get also information about other aspects of the innovation process, like the degree of technology utilization, the payments and revenues in technology, patents, innovation expenses dedicated to marketing, etc.

Analysing the poll we obtain some results to highlight. First that 19.77% of the Spanish companies innovated in product or process in the year 2000. Besides, Cataluña, Madrid, País Vasco and Comunidad Valenciana, are the communities with highest innovation budget. The expense in technological innovation in the year 2000 was 10.174 million euros, and in 1998 6.074 million, being an increase of 67.5%. The innovation expense in 2000 was 0.93% of the turn-over of the companies with innovation activities. Between the most innovative activities we can highlight the R&D activities (representing the 41.45% of total innovation expense) and the acquisition of machinery and equipment for innovation (36.73%). The rest of innovation activities involved the 21.83%.

How do companies participate in the innovation process? Of the total polled companies (11.778), 31.98% (3.767 companies) invest in innova-
This group of companies is distributed in a uniform way between the different scales of expense: scale 1, 1,963 enterprises (25,56%), scale 2, 935 enterprises (24,82%), scale 3, 946 enterprises (25,11%) and scale 4, 923 enterprises (24,50%). The rest of companies (8,011 companies representing the 68,02%) do not invest in innovation.

By sectors, the technology companies spend more on innovation, the majority of sectors are in the first positions (nearly all the 20 first positions are companies classified as technology innovators) with percentages that go from 45% for companies investing in “Otras Actividades Informáticas” to 77% of participation in the innovation process for companies in the sector of “Radios, TV y Comunicación”.

The marketing expense by sectors show the same as previous results: the technological companies are the most participative in the marketing innovation process, applying part of their budget to marketing. Again, “Aparatos de Radio, TV y Comunicación” is the sector with the higher percentage of companies taking part in the marketing innovation process (33%), followed by “Instrumentos Médicos y de Precisión” (25%). We must highlight the low percentage obtained by “Construcción Aeronáutica y Espacial”, having a high percentage of companies that take part in the innovation process (45%), but only a 3% dedicate part of their budget to marketing.

But our study deals with the companies that in addition to innovation, invest part of their budget in marketing. Of the 3,767 innovative companies, 72,6% (2,735 companies) do not have a marketing budget at all, whereas 27,4% (1,032 companies) do have a marketing budget. In figure 2 we can see the scheme of the econometric process that we are going to follow in this paper. Once we have the decision process sample (with sample selection bias), see figure 1, we define the participation model as a binary choice model, and we will use the maximum likelihood approach for estimating the model. In this model the dependent variable is a binary variable taking value 1 if the company takes part in the innovation process. The independent variables are the turn-over (measure like the sales volume), if the company belongs to a holding, if the company receives some kind of financing for innovation and, finally, if it has been classified as a
technological company or not. The binary model estimation allows us to obtain the inverse Mills ratio, and this ratio will be used in the behavioural model (expense equation) as other new variable in the model to be estimated by OLS using only the data of the companies that take part in the process, and using as dependent variable the logarithm of the marketing expense, and as independent variables, in addition to Mills’s lambda, the turn-over, the number of employees, if the company receives or not funds (as well financing of national government support as EU support), if it is a technological company, if the company cooperates with others in innovation or R&D, if the company innovates in processes or in products, the volume of expense in innovation, as well as if the company has introduced new products or has improved the existing products.
3.1. Selection Model

To estimate the selection model we have created the binary variable \( \text{PART}_n \), which is the dependent variable of the discrete choice model. This variable takes the value 1 if the company takes part in the innovation process and also assigns a percentage of their expense to marketing, that is if the company has declared some innovation expense in the opinion poll (if the variable \( \text{TRAMOINN}_n \) is 1, 2, 3 or 4) and dedicates part of their budget of invention to marketing (that is if \( \text{GMARKET}_n \) is positive). The dependent variables take the value 0 in opposite cases. That way, the Probit model to estimate is:

\[
\text{PART}_n = \beta_0 + \beta_1 \text{VENTAS}_2 + \beta_2 \text{VENTAS}_3 + \beta_3 \text{VENTAS}_4 + \beta_4 \text{GREMPRDUMMY}_n + \\
\beta_5 \text{FINADUMMY}_n + \beta_6 \text{IDENTDUMMY}_n + u_n
\]  \[9\]

Besides, the sales variables, \( \text{VENTASX}_n \), are four dummy variables showing if the company sales volume is in the scale 1, 2, 3 or 4 (according to \( \text{TRAMOVENTAS}_n \) variable). And also we have the variable \( \text{GREMPRDUMMY}_n \), a dummy variable taking value 1 if the company belongs to any holding, or 0 if not. The last variable, \( \text{IDENTDUMMY}_n \), shows if the company is technological or not, and that way, we have classified the companies between innovators in technology and not.

3.2. Behavioural Model

The behavioural model to estimate will be:

\[
\text{LNGM}_n = \beta_0 + \beta_1 \text{EMPLEROED}_n + \beta_2 \text{VENTASRED}_n + \beta_3 \text{FINADUMMY}_n + \\
\beta_4 \text{IDENTDUMMY}_n + \beta_5 \text{INPROCDUMMY}_n + \beta_6 \text{INPRODDUMMY}_n + \\
\beta_7 \text{TRAMOINN}_n + \beta_8 \text{PRONUEVO}_n + \sigma \Phi(\cdot) + \Phi(\cdot) + u_n
\]  \[10\]

To obtain the estimation of the dependent variable of the selection model from the data of the opinion poll we have the problem that we did not observe directly the expense in marketing. That way, we use a proxy variable\(^4\). The variables of employment and sales are calculated in the same way. The variable that measures the financing received by the company, \( \text{FINADUMMY}_n \), is a dummy variable taking value 1 if the company receives some kind of financing (from local or autonomic administrations,
from the state, or from European Community). \( COOPDUMMY_n \) is also a binary variable (takes value 1 if the company cooperates with other companies or institutions on innovation questions, and takes the value of 0 in other cases). Other variables to be used are \( INPROCDUMMY_n \), which takes value 1 if the company innovates in process and 0 if not, \( INPROD-DUMMY_n \) (1, when the company innovates in product; 0, if not), \( TRAMOINN_n \) (between 1 -low-, and 4 -high-, according to value of the innovation expense volume of the company), and last, \( PRONUEVO_n \) is the percentage of the turn-over corresponding to introduced or improved products in the 1998-2000 period.

3.3. Hypothesis of the Model

We will have to validate some hypotheses about the functioning of the variables in our behavioural model. The investment of any company is intimately related to the good functioning of the enterprise. So, the innovation investment (and consequently the percentage of innovation expense dedicated to marketing) will be affected by the company results, and so as the company indicators (sales volume, employees, etc.) increment, the marketing expense should increase (for the increased part of the budget dedicated to innovation). That way we can formulate the

*Hypothesis 1: an increment in the turn-over indicators increase the marketing expense through a higher innovation expense.*

Another of the environment variables affecting the behavioural econometric model will be if the company receives financing (as well of national organisms as of the European Union) or not. If so, the company will not need to dedicate an important part of the budget to innovation, because they will be able to dedicate to innovation the government support funds. Consequently the total sum of innovation expense dedicated to marketing will also be reduced. This allows us to formulate the

*Hypothesis 2: an increase of the financing implies a minor innovation expense, and therefore a minor marketing expense.*
To estimate the behavioural model we have a set of variables measuring the degree of the company’s implication in innovation questions. These variables are the volume of innovation, if it is a technological company, if the company has innovated in product, as well as if the company has introduced new products or has improved the existing products. All this set of variables position to the company as an innovative enterprise and therefore those companies with higher values of these variables will dedicate a higher budget to innovation and therefore also to marketing expense. This allows us to state the

**Hypothesis 3:** A company implicated in innovation questions will dedicate a higher budget to marketing expense increasing the innovation expense.

In other kind of things, there is another set of variables, indicating also the degree of company implication in innovation, but that does not imply increasing innovation expense. This is because these indicators need part of the company budget, and so, it is necessary to decrease part of the amount devoted to innovation expense (another items of the company budget must be also reduced in order to spend more in these variables) to be able to dedicate more budget to activities like cooperation with other companies, R&D or innovation in processes.

### 4. Estimation results

#### 4.1. Selection Model

In order to determine which is the best econometric model, we have estimated different equations. For each, enough statistics have been calculated, and besides, for each model we have calculated the success generated for each model, obtaining for our model a 91,24% of success, which means a threshold of 0.5, and a 76,87% when we regard a threshold equal to the mean of the dependent variable, \( \text{PART}_p \), (that is a threshold of 0.0876). These success percentages are the highest of all the alternative estimated participation models. The statistics of the estimated model are:
The model, which has been selected in the previous analysis, is the one belonging to the equation [9]. It is also the model which provides us with better statistics and where the estimated values are:

Table 2.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient (z - value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VENTAS2ₙ</td>
<td>0.1220 (2.17)</td>
</tr>
<tr>
<td>VENTAS3ₙ</td>
<td>0.2495 (4.57)</td>
</tr>
<tr>
<td>VENTAS4ₙ</td>
<td>0.4069 (7.20)</td>
</tr>
<tr>
<td>GREMPRDUMMYₙ</td>
<td>0.1230 (2.97)</td>
</tr>
<tr>
<td>FINADUMMYₙ</td>
<td>0.8276 (19.87)</td>
</tr>
<tr>
<td>IDENTDUMMYₙ</td>
<td>0.4780 (12.40)</td>
</tr>
<tr>
<td>Constant</td>
<td>-1.9195 (-43.61)</td>
</tr>
</tbody>
</table>
We can now estimate the INVERSE MILLS RATIO, and we can estimate the marketing expense equation.

4.2. Behavioural model
The marketing expense logarithm equation, including Heckman’s correction variable, is the one belonging to the equation [10]. When we estimate the equation for OLS, we obtain the following results:

Table 3.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient (z-value)</th>
<th>Effect %</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMPLEOREDn</td>
<td>0.1151 (1.76)</td>
<td>12.2%</td>
</tr>
<tr>
<td>VENTASREDn</td>
<td>0.0073 (3.49)</td>
<td>0.7%</td>
</tr>
<tr>
<td>FINADUMMYyn</td>
<td>-0.4771 (-1.77)</td>
<td>-37.9%</td>
</tr>
<tr>
<td>IDENTDUMMYyn</td>
<td>0.1360 (0.85)</td>
<td>14.6%</td>
</tr>
<tr>
<td>COOPDUMMYyn</td>
<td>-0.0220 (-0.23)</td>
<td>-2.2%</td>
</tr>
<tr>
<td>INPROCDUMMYyn</td>
<td>-0.1864 (-2.13)</td>
<td>-17.0%</td>
</tr>
<tr>
<td>INPRODDUMMYyn</td>
<td>0.0939 (0.74)</td>
<td>9.8%</td>
</tr>
<tr>
<td>TRAMOINNn</td>
<td>0.5621 (11.74)</td>
<td>75.4%</td>
</tr>
<tr>
<td>PRONUEVOn</td>
<td>0.0038 (2.52)</td>
<td>0.4%</td>
</tr>
<tr>
<td>INVMILLSn</td>
<td>-0.5242 (-1.34)</td>
<td>---</td>
</tr>
<tr>
<td>Constant</td>
<td>13.9400 (15.75)</td>
<td>---</td>
</tr>
</tbody>
</table>

4.3. Validity of the Econometric Model
Once the model has been estimated, we should validate the coefficients using a standard Student’s t test, where we notice that nearly all estimators are significant, as well in the selection model as in the behavioural one. Besides, we have accomplished a significance test on all the parameters of the model. In the Probit model we obtained a Chi² value of 814,58 with 6 degrees of freedom, and in the behavioural model the value for the F with 10 degrees of freedom is 47,11. So, in both models we refused the
null hypothesis that all coefficients are 0, being therefore the models significant.

To check the normality of residuals we calculate the Jarque-Bera statistic. The results of the $\chi^2$ statistic with two degrees of freedom, for the participation and behaviour models, are near to zero in both cases, so, with a 95% of confidence, the null hypothesis of normality of the disturbances is accepted, and that way we can conclude that residuals distribute normally.

It is interesting to analyse the participation probability for a mean company according to the selection model. That way, for the mean values of the independent variables of the Probit model, we calculate $\Pr(\text{Partic}) = [1-F(-X_t^\text{-})] = F(X_t^\text{+}) = 0.0685$, and that way, we can observe how the probability of participation in the innovation process for a mean company is quite low, only a 6.9%, and the probability of no participation in the process is 93.15%: $\Pr(\text{NoPartic}) = 1-\Pr(\text{Partic}) = 1–0.0685 = 0.9315$.

4.4. Interpretation

The interpretation of the coefficients of the semi-logarithmic model is not so simple like in OLS traditional model. The effect of an unitary change in a characteristic is calculated using the following formula:

$$\text{Effect} = (e^{\text{coefficient}} - 1) \times 100 \ [11]$$

That way, for example, in the case of dummy variables, like financing, we calculate the effect using the last formula and we obtain -37.9%, which indicates for financed companies, the marketing expense is approximately a 38% lower than for the companies that do not receive financing, so the second hypothesis is verified.

For the rest of dummy variables we make the same, obtaining that for companies cooperating in innovation projects with other companies or institutions, the expense falls a 2.2%, and besides, the companies that innovate in processes spend less in marketing (a 17%) than the companies that do not innovate in processes, while the ones that innovate in product spend more (a 9.8% ) than the ones that do not innovate in product. It is
very interesting the result of the dummy variable IDENTDUMMY_n, which has the value of 1 if the company has been classified as innovator in technology and 0 otherwise. This variable is important because it measures the effect in the marketing expense when the company invests in technological innovation. So, we have obtained that the expense be almost a 14.6% bigger for the companies that have been catalogued as innovators in technology in relation to the companies not catalogued as innovators. That way, it is verified what was advanced in the introduction of this paper: the technology is changing the companies’ marketing, and for the companies catalogued as technological the marketing budget is higher than for companies not catalogued as technological. The variables of innovation in product and in process have opposite sign. That way, innovating in process does not imply invest in marketing, and therefore the expense is a 17% lower than for the companies that do not innovate in process. However if a company innovates in product it is necessary to make advertising and spend in marketing to promote this new product that is going to be developed, so the marketing expense is a 9.9% higher in these companies than in the companies that do not innovate in product. Also, if a company is in a higher scale of the volume of innovation expense, it has a positive effect (increasing the marketing expense). Besides, if the percentage of turn-over corresponding to new products or to improved products increase, the marketing expense is higher. So, we verify the hypothesis 3.

In the rest of variables, we see that the marketing expense increases as the volume of employment, and company sales grow, which is sustained by the first Hypotheses presented in the article.

We have to highlight the estimated inverse Mills ratio. As we have seen, if this ratio -λ_n(.)- is significant, then we verify the importance of the sample selection, and this allows us to estimate consistently the rest of coefficients of the marketing expense equation, and, as we see in the Table 3, the coefficient has the right sign. According to Heckman (1979), λ is a monotonic decreasing function of the probability to take part in the process. So, given two companies with different values of λ, the one that has a bigger probability to take part in the technological innovation process will have a lower value of λ, and as λ has negative coefficient in the marketing
5. Conclusions

Marketing is changing, and one of the main sources of this change is technology. This technology has changed the rules of the competition becoming a source of sustainable competitive advantage for companies. In this paper we have defined a limited dependent variable model with a sample selection bias, using the poll *Encuesta Sobre Innovación Tecnológica en las Empresas* of the INE, and using data of the year 2000.

We are interested in 32% of the companies that declare invest in innovation. These 3,767 companies spend on innovation, and a 27% of them, besides dedicate part of its innovation expense to marketing tasks. Precisely, these 1,032 companies constitute the nucleus of the micro-econometric analysis of this paper.

The estimation results of the marketing expense equation offer us some interesting conclusions. This equation has some variables of characteristics and the inverse Mills ratio in order to obtain coherent estimators when, like in our case, there are sample selection bias. Logically, when the company obtains external financing to innovate, the enterprise does not have to assign part of the budget to marketing, since it can use part of the financing. That way, the companies that receive financing, dedicate to marketing a 38% less than the companies that do not. When a company cooperates with others in innovation, the company must dedicate part of the budget to this investigation process, so the company will have to retract funds of all the departures to be able to finance this activity. Not surprisingly, the marketing expense also will be seen reduced, in a 2.2% (according to estimations) regarding the companies that do not collaborate in innovation projects. Besides, if the company does not innovate in process the expense in marketing decreases a 17%, while the innovation in product increases the expense a 10%, because expense in marketing is more beneficial in products than in processes, since the customer appraises more the product than the processes used to create the product.
In addition, the principal indicators of company (number of employees and volume of sales) are positively related with the marketing expense, and so, the companies with higher indicators, generally, invest more in marketing. Another expected result is that when a company spends more in innovation, it also spends more in marketing. And also it is very logical that the companies with higher percentage of introduced or improved products dedicate more budget to marketing than the companies with lower percentages.

6. Bibliography


MARKETING IS CHANGING. AN ECONOMETRIC MODEL ON MARKETING AND NEW TECHNOLOGIES

