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The relevance of marketing in the success of innovations

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Abstract

This paper focuses on marketing expenditures and their relation with R&D investments and innovative sales. A higher investment in R&D is associated with the production of a higher quality or faster innovation, with a positive impact on sales and in a macro sense, an increase of GDP. This paper raises the issue that good innovation need a strong marketing effort in order for this innovation to have an impact on sales, it needs to be desired by consumers. This paper finds empirical evidence that marketing expenditures explain a lot of the success of the innovation 0.5 to 0.7% (measured in terms of the elasticity of this effort to innovative sales), even more than the flow of investment in R&D(which counts for 0.3 %). In fact, the size of the coefficient for marketing doubles those found for R&D, a quite surprising result taking into consideration the little importance that marketing has in innovation studies. The paper uses Community Innovation Survey data, the third wave (CIS 3) and set up a system of simultaneous equations like in Crepon et al. (1998).

1 Introduction

Innovation is at the core of European policy as a mean to generate jobs and boost economic growth in the EU area. To boost growth it is important not just to create new knowledge but also to transform this knowledge into productive services and products that are profitable in the market. Only if the innovation is successful, accepted by consumers it will generate profits, jobs and economic growth.

Researchers dealing with innovation and economics have long highlighted the influence of inputs on the success of inventions: investments in R&D (Griliches 1998), in Human Capital (Romer 1990), etc. It is also well known that links between different agents of the society (Edquist 1997) are a critical point in the success of innovation, especially in connection with final users and lead users (von Hippel 2009). This strand of literature however pays very little attention to expenditures in marketing, as a way to diffuse inventions among final users. Marketing seems to be a residual activity that does not generate any physical output, and therefore it is given only scant attention.

From the consumer perspective, the consumption of old goods can be explained by the formation of habits (Duesenberry 1949; Pollak 1970; Ryder and Heal 1973); the consumption of new goods needs a different explanation. Lancaster (1966) finds the explanation for the consumption of new goods on new combination of old characteristics of existing goods. But that puts innovation in a position where only recombination can be explained. The consumption of a new characteristic offered by a new good could never be explained (Swann 2002). A different branch of economists with a less orthodox approach is stating that consumption of new goods could be partially explained by the consumers' needs for novelty (Berlyne 1974; Scitosvky 1977; Bianchi 1998; Bianchi 2002; Garcia Torres 2009). Now, if what consumers are looking for is not an old utility but for a new sensation or utility, then the combination of R&D that generates the good with marketing that let consumers know about the products determines the success of the transformation of the innovation in a profitable invention. A very successful innovation can turn into a failure just because they are not known to consumers, i.e. it fails in the marketing phase (Garcia Torres 2009).

Business literature, closer to firms' mechanisms and with a more micro perspective on the innovation has long understood the relevance of marketing (Urban and Hauser 1993). Good integration of the marketing and the R&D departments inside the firms is one of the biggest indicator for market success of the innovation (Gupta, Raj et al. 1986; Ayers, Gordon et al. 2001;

Becker and Lillemark 2006). Some empirical studies have been carried out to try to assess the elasticity of marketing expenditures on innovative sales (see for example Sethuraman, Tellis et al. 2011). The difficulty of measuring this issue for innovation is that the higher the level of innovation the more difficult it will be to relate the marketing elasticity to the innovative sales. For example it is easy to compare new movies and see if those more advertised are being bought more, but it is difficult to compare the introduction of a more radical innovation with marketing if there is no other control group to relate to.

In this paper I concentrate on a sample of European innovative firms, based on the European CIS(Community Innovation Survey) data. And I will be focusing on innovative firms, and among them see if those firms that have a coordinate policy for R&D and marketing have a more efficient way to benefit from their innovative investment comparing them with those that merely focus on the R&D. The intention of the paper is to empirically estimate the elasticity of marketing and compare it with the elasticity of R&D.

The paper is structured as follows; section 2 will review main issues related to previous work, section 3 will discuss the data used, section 4 will present the econometric model and will discuss the results, and section 5 presents conclusions and policy implications.

2 Review of Literature

New products are a substantial part of technological change. They are like new processes, but the knowledge that we have about the effect of process innovation is much wider than about product innovation. The contribution of new products is harder to understand, harder to grasp. New machines (a new process) reduce productions costs, or increase the quality of final products with the same resources. But what is the effect of new products? If new products are an important part of technical change, a successful marketing phase can explain much of the success of the invention, even more than the previous investments in Research and Development. And this is exactly what this paper is about, an empirical determination of the importance of marketing in highly innovative products.

I will try to demonstrate that in order to understand the importance of marketing, we first have to understand the importance of new products and identify the difficulties that economists experience to explain the success of them from three perspectives: the consumer, the firm, and the economy.

Starting with the consumer, very little is known about how preferences evolve. The consumption

of old goods can be explained by a learned utility, from past consumptions. The choice of goods can be explained out of a rational utility maximization in which budget is proportionally distributed according to marginal utility. These are theories that have looked at the formation of habits (Duesenberry 1949; Pollak 1970; Ryder and Heal 1973) in consumers. However the consumption of new products needs to be explained with a different set of arguments. As already commented, economic theory gives very little explanation for the consumption of new goods. The only relevant attempt was made by Lancaster (1966) that argued that goods are consumed because of their characteristics and new goods are a recombination of old characteristics. When the combination of characteristics that the new good offers is closer to consumer's preferences than those of the old good, hence new goods are bought. The main problem of this approach, which is mentioned by Swann (2002) is that the reason why we consume new goods is simply reworded as why we consume new characteristics of goods. A different alternative was used by Stigler and Becker (1977) suggesting to compare a consumer to a firm. In this approach, the consumer is treated as if he were producing utility in a firm whose inputs are characteristics. However the question of why we consume new characteristics remains without answer. More successful although less formal is the explanation given by Scitovsky (1977) the consumer needs variety in what she consumes simply because she needs novelty to experience well being and comfort. Following his ideas, and merging them with the previous ones, we find useful the work done by Bianchi (1998; 2002). She argues that novelty is a relevant factor in the inputs that the consumer is using to maximize utility. Both Scitovsky and Bianchi acknowledge in their work the research on novelty completed by Berlyne (1974). Deepening in these ideas, some of my previous work try to prove that a minimum level of novelty is needed to make an innovation successful (Garcia Torres 2009). They also state that a very good innovation (with a high potential to generate experienced utility) might fail simply because it is unknown to the consumers; it lacks novelty. Although novelty is addressed by Garcia Torres (2009) as an inner search of the consumer, marketing can be deeply related to increases in the consumer's perception of novelty.

From the firms' perspective, business literature has widely studied the issue. Their interest starts with looking at how the department of R&D and marketing are integrated. People working in the R&D department have very different objectives from people working in marketing; their backgrounds and their interests are of different nature. A higher integration of both departments positively affects the performance of firms (Gupta, Raj et al. 1986; Ayers, Gordon et al. 2001; Griffin and Hauser 2003; Becker and Lillemark 2006; Caraballo 2009). Although integration between R&D and marketing is generally seen as positive, Hashai and Almor (2008) find that integration is good up to a threshold of R&D intensity, after which such integration negatively

affects performance. Focusing on the pharmaceutical sector and the study of patents, Brekke and Straume (2009) built a simulation model. They concluded that in this sector the expenses on marketing can negatively affect expenses on R&D. Their model provides evidence that marketing expenses can be used to detract an entrant to invest in R&D. Ofek and Sarvary (2003), with a similar model, reach a different conclusion; the leader tends to invest more in marketing to maintain its leading position while the follower concentrates more on R&D. Miltersen and Schwartz (2004) based on game theory concluded that strong competence favours the speed at which the results from the R&D are visible. It also positively affects on a more aggressive marketing strategy. Ramrattan (1998) focusing on the largest automobiles companies in the US, say that primarily in this sector firms compete on R&D and only secondary in marketing.

The complication stems from the fact that the higher the levels of novelty for the product, the more difficult is to understand the economics effects of marketing. And a higher level of R&D investments it is normally related to a more differentiated and therefore unknown product to the market. Empirical studies have been launched to try to empirically find marketing elasticities in sales. Luan and Sudhir (2010) for example, find an elasticity of 0.20 -0.14 in the DVD market. But they compare the sales and rents of DVDs, the amount of expenditures in sales in marketing versus sales. But every consumer knows what it is a DVD they only don't know how is the movie. Here, however, if the innovation in the product is higher, for example expenditures in marketing on Blue Ray versus DVDs, it is more difficult to find elasticity because we are not comparing the same goods. A similar exercise is carried out by Cakir and Balgatas (2010) in the dairy market, with elasticities going from 0.20 to 0.02, but with the same problem, as the product studied contains a very low degree of novelty for the consumer: milk, cheese, butter and other frozen products. Sethuraman, Tellis et al. (2011) make a very interesting meta analysis of 56 brand advertising studies and they find that elasticities goes from 0.12-0.24. But in all the studies the level of novelty of the product is substantially low. They are always referring to products known to the public.

The last point is the effect of marketing and its relationship with the economy and ultimately with economic growth. Many are the sources that Economics have identified as positive related to growth (Temple 1999): labour, physical capital, investments in R&D, exports, innovations, etc. However when it comes to marketing it is hardly addressed by the literature, and most economist will agree that it is an unimportant concept for macroeconomics. At the same time new theories of growth are making an effort to connect microeconomics effects with the macroeconomics (Aghion and Howitt 1992). The effect of marketing on creating new habits through the introduction of new inventions in the market is hardly at the center of the economic discussion. Although it has been addressed from a theoretical point of view by some authors (among others

see Benhabib and Bisin 2000; Grossmann 2008). And in a way, this is also a point that wants to be raised by this paper, successful innovation might be successful because of the right combination of innovation and marketing expenses. If products are successful, if they are bought by the consumers, they will then affect growth with the positive impact on the entire economy, on the generation of employment and of on wealth.

In summary, very little it is known about the evolution of preferences, particularly why new products are picked out by consumer. One possible answer is that consumers need novelty (Scitosvky 1977), the level of novelty in the product can be advertised by marketing and by doing this, the level of expected utility is raised (Garcia Torres 2009). Integration of the R&D and marketing departments in a firm is a high indication for the success of an innovation. Very little is empirically known about the effects of marketing in combination with innovation investments. This is partially due to the fact that the higher the amount of innovation the more difficult is to access the effect marketing expenses on the product in comparison with other similar goods that are not new and not advertised. This paper tries to contribute by estimating an elasticity of marketing only on innovations, in a sample of innovative firms. We will compare this elasticity with the elasticity of marketing in less innovative products, and with the elasticity of R&D investments to innovative sales. The paper will provide empirical evidence that marketing might be at the root of successful transformation of innovation into profitable inventions. An effect at the macro level it is also expected by proving that empirical evidence at the micro level. Although the paper will focus on the relationship between marketing and innovative sales, a positive relationship between the two areas could be seen a positive translation into higher levels of production. In other words, since marketing positively affects the preferences of the consumers, it raises innovative sales which mean higher levels of GDP.

3 Data

The analysis is based on the microdata from the third wave of the Community Innovation Survey (CIS 3) covering 18 European countries: Belgium, Bulgaria, Czech Republic, Germany, Estonia, Spain, Finland, Greece, Hungary, Iceland, Italy, Latvia, Lithuania, Norway, Portugal, Romania, Slovenia and Slovakia. The period covered by this survey is 1998-2000. The research was carried out in the SAFE center at Eurostat in Luxembourg. Although we had access to more recent waves of the survey (CIS 4 and CIS 5), the structured of the questions from CIS 3 provides more detailed information on marketing expenditures.

After a few questions for identification purposes, respondents had to answer the following four

central questions: (1) During the period 1998-2000, has your enterprise introduced on the market any new or substantially improved products? (2) During the period 1998-2000, has your enterprise introduced any new or substantially improved production processes? (3) By the end of 2000, did your enterprise have any ongoing innovation activities? (4) During the period 1998-2000, did your enterprise have any innovation activities that were abandoned?

A first way of characterising innovators is to consider as innovators to be those that have responded "yes" to one of those four questions. This is in the spirit of the CIS survey, where those who have responded "no" to all four questions are considered non-innovators and do not have to answer most of the other questions in the survey. There is therefore only scant information about non-innovators. However for the goal of the paper we can easily focus on innovators, since we are primarily interested in the interrelation between R&D and marketing, and any firm engaging in R&D is an innovator.

After some basic cleaning of the dataset[1] we ended up with 61 540 observations, 20 920 are from innovators (under the CIS definition of an innovator), and 6 400 observations reporting some marketing expenditures. Of especial interest for this research is the question about marketing expenditures, therefore a detailed description of this question will be offered. Those firms reporting innovation activity are asked to give an estimation of their distribution of innovative expenditures: how much the firm invested in intramural and extramural R&D, acquisition of machinery, acquisition of external knowledge and other innovative expenditures. The sum of all of these subsections is the total innovation expenditure of the firm in 2000.

Of particular interest to us is the last section, "other innovation expenditures" which is subdivided into three parts:

- Training expenditures for the personnel directly aimed at the development of innovations.
- Internal or external marketing activities directly aimed at the market introduction of your enterprise's new or significantly improved products.
- Designs and other preparations for deliveries.

Each of the three questions has a yes/no answer and if the firm answered yes to any of the three yes, then it is asked to make an estimation of the expenditure for these activities. So, that other innovative expenditure is a combination of these three activities. For the purpose of the

[1] The original dataset has been cleaned by eliminating the firms that reported zero turnover or zero employees

paper it will be very useful to have a separated estimation of marketing expenditures isolated from training expenditures and preparations for deliveries.

Table 1. Distribution of innovators with marketing activities

	Number of observations	Percentages with respect to all firms	Percentages with respect to innovative firms
Total	61540	100.0%	
Innovators	20920	34.0%	100.0%
Product innovators	15653	25.4%	74.8%
Other expenditures	8370	13.6%	40.0%
Marketing	6400	10.4%	30.6%
Marketing only	1203	2.0%	5.8%

Table 1 shows a representation of the spectrum of innovators that we find in the sample, out of a total of 61 540 observations, 34% of them are considered innovators under the more relaxed CIS definition of innovator. A quarter of the firms in the sample reported having introduced a new product. The analysis will focus on innovators, since very scant information is offered for non innovator. It is also not the goal of the paper understand what is the effect of marketing on sales, but marketing on innovative sales. Therefore there is no selection bias, since the interest of the paper is not marketing in general (also related to old products) but marketing in the specific case of new products. Therefore reducing the sample to innovators implies no problem of selectivity.

8370 firms, 40% of the innovators, reports having some devoted part of investment to training, marketing or designs. 6 400 firms representing 30.6 % of the innovators answered that they have some investments in marketing, and 1 203 firms representing 6% of the sample having invested only in marketing with no contribution to training neither to designs. In this case the amount devoted to other innovations expenditures will be equal to total expenditures in marketing. Making use of the large sample size, the abovementioned 6% percent will be used to extract firm characteristics of firms which determine their level of marketing expenditures. This will be further explained in the section 4 when discuss the model and the construction of the latent variables.

4 Methodology

The question remains whether or not marketing activities affect the success of innovation. In other words, are firms that invest money in marketing more successful than those firms that do not advertise their new products? Do they reach better the needs of demand? And in what way do R&D expenditures relate to marketing? This section is devoted to illustrating the adopted microeconometric modelling strategy, while the following section discusses the results in detail. We start with some methodological notes.

4.1 Econometric Model

It is not sufficient to compare means of the respective variables for firms engaging and not engaging in marketing. A control for other variables is needed since another variable might be explaining the changes in those means. Moreover the investments in marketing and R&D might be endogenous, that is, there might be a correlation between the expenditures and the size of the firm, the fact that they belong to a group, and many other variables. A matching estimator will shed little light to the questions of the paper. Instead a structural model is set to specifically deal with the endogeneity related to the decision of investing in marketing, in R&D and its impact on innovative sales. Some similar exercises (Dutta, Narasimhan et al. 1999; Bhargava, Chatterjee et al. 2011) have been completed without addressing the issue of simultaneity (marketing is probably decided upon at the same time as R&D) or the externalities of marketing expenditures (the fact that the R&D carried out for one specific product will affect all similar products).

The main source of endogeneity comes from the fact that firms determine their investments in R&D and their expenditures in marketing at the same time, so the same factors affecting one decision might at the same time affect the other decision. For example, a large firm will present a higher investment in R&D and higher expenditures in marketing. A system of simultaneous equations is established where marketing expenditures, R&D investments and innovative sales are all three endogenous. More precisely, the model is composed of three equations. The first equation determines the expenditures of marketing, the second investment in R&D and how both affect innovative sales. A latent variable will be defined for each equation. The definition of the latent has two reasons, one methodological, which is the only way a system can be defined using non linear estimations (tobit), and a theoretical reason; the existence of externalities beyond the limits of the firms. To explain this last point, consider the expenditures on marketing of one firm in one sector, it might indirectly affect the sales of their competitors in a similar substitutive product. A similar idea is used when defining a latent for R&D; the effort made in one specific area

positively affects competing firms close to this one, through spillovers, spin off and all other possible sorts of positive R&D externalities.

The sample was restricted to innovative firms, but within these innovative firms a very big proportion of them report zero expenditure in marketing, in R&D or zero innovative sales. Therefore the system of equations is formed by three tobits, one for expenditures in marketing, one for investments in R&D and one for innovative sales. The latent variables of the two first ones enter as explanatory variables in the latent for innovative sales.

Formally the model is as follows:

$$
\begin{aligned}
MKT &= MKT^* && if \quad MKT^* = \beta_{MKT} z_1 + \varepsilon_{MKT} > 0 \\
&= 0 && if \quad MKT^* = \beta_{MKT} z_1 + \varepsilon_{MKT} \le 0 \\
R\&D &= R\&D^* && if \quad R\&D^* = \beta_{RD} z_2 + \varepsilon_{RD} > 0 \\
&= 0 && if \quad R\&D^* = \beta_{RD} z_2 + \varepsilon_{RD} \le 0 \\
INNO &= INNO^* && if \quad INNO^* = \beta_{INNO} MKT^* + \beta_{INNO} R\&D^* + \beta_{INNO} z_3 + \varepsilon_{INNO} > 0 \\
&= 0 && if \quad INNO^* = \beta_{INNO} MKT^* + \beta_{INNO} R\&D^* + \beta_{INNO} z_3 + \varepsilon_{INNO} \le 0
\end{aligned}
$$

Where ε_{MKT}, ε_{RD}, and ε_{INNO} are normally distributed error terms with zero mean and resp. σ_{mkt}, σ_{rd} and σ_{inno} standard deviations, z_1, z_2, z_3 are vectors of controls variables, and MKT(Marketing) is the log of total expenditures in marketing carried out by the firms. R&D (Research & Development) is log of total investments in research and development, both intramural and extramural. And INNO(Innovative sales the log of total innovative sales, total turn due to innovative sales multiply by the share of innovative sales).

We are in the presence of a system of simultaneous equations with limited dependent variables as in the study by Crepon, Duguet et al. (1998). The three dependent variables are censored variables. The econometric model is estimated by using the method of ALS (Asymptotic Least Squares), also known as a minimum distance estimator. This estimation process is statistically more efficient than an OLS approach and still gives an unbiased estimator. In an initial stage, the reduced form equations of the model are estimated. To estimate the first reduced equation, a tobit is run on marketing expenditures, using firms that have only information on other expenditures on innovation is purely marketing expenditures, and firms that report zero on other innovation expenditures(This corresponds to 1203 firms reported in section 3 and all those firms reporting no expenditures in the section other R&D expenditures) The latent variable for marketing is created for all innovative firms, it is a linear projection of firms charasteristics. A simple tobit is also estimated for R&D and for Innovative sales, using as explanatory variables the previous two latent variables from the previous two tobits. In the second stage (if there are

overidentifying restrictions) the parameters of the structural form are estimated by minimising the distances between the estimated reduced-form parameters and those predicted by the model form the identifying constrains, weighted by the estimated variance-covariance matrix of the reduce form parameters (Gourieroux, Monfort et al. 1985). Identification is generally ensured by means of exclusion restrictions. Asymptotic least squares yield convergent and asymptotically normal estimates. Endogeneity and selectivity are explicitly taken into account in the estimation of the model. As opposed to Heckman's selection models there is no allowance for correlation between the error terms of the selection and the outcome equations, but a latent variable is estimated for marketing and R&D for every firm in the working sample. (for examples of sample selection models in this context, see Busom 2000; Hussinger 2008).

Firms that have not introduced a product or a process, and have no unfinished or abandoned innovation activities are asked to respond to only a few questions for identification purposes. Information relevant to what determines a certain level of marketing expenditures, or R&D investments is only available for 20 920 firms in the sample that are considered innovative in some way. For this reason, and based on the idea that we are mostly interested in marketing for new products, the analysis was performed on this subsample of innovating firms.

4.2 Control Variables

In each equation, there is a control for a number of determinants other than marketing and R&D. The idea of introducing other control variables is to isolate the effect of these two investments from other factors affecting innovative performance. The choice of control variable is not a trivial one: it is done based on the literature (similar studies) and partially on the availability of data in the CIS survey. To reduce the effects of the choice of control variable, a different set of them are used in each equation, generating three different estimations: Model one, Model two and Model three (a combination of the two previous ones). This is done as a robust check for the estimates. To identify the parameters of the model exclusion restrictions are imposed, i.e. some explanatory variables are excluded in some of the equations in order to identify the other ones. The choice of exclusion restrictions is based in part on theoretical grounds (for example marketing expenditures might be more important for a firm that has introduced some aesthetic changes, these aesthetic changes might be less related with R&D investments), and partially based on the significance of the estimated coefficients. Non- significant coefficients might characterise as bad instruments to identify other key parameters of the model when moving from the reduced form to the structural equations.

Table 2 offers a brief discussion of the variables that we are using in the model.

- There are a few variables that are part of all equations in the systems, it means that they enter in all 3 equation:
    - Size of the firm: the size effect is controlled using the log of the number of employees.
    - Competiveness. A fear competition can explain a lot of the firm behaviour. It is measured by the importance given by the firm to the international market.
    - Belonging to a group.
    - Dummy variables for industry and country dummies
- Specific variables used as explanatory variables in the marketing equation are as follows:
    - Using clients as a source of innovation, since it is expected that if a firm bases its innovation on the information that it gets from its clients, it also makes more effort on marketing expenditures, i.e. in letting its clients know about the innovation.
    - Changes in marking strategy. If the strategy has been change, it points to some internal recognition by the firm to the relevance of advertising.
    - Aesthetic changes to products/designs. Probably a firm that changes the appearances of its product is keener on spending on marketing.
- For the R&D equation, these are the specific control variables:
    - Skilled labour. A positive relationship is expected between a higher education and a higher effort in the R&D investments.
    - Funding. If the firms receive any kind of aid, it is expected that they do raise their investments in innovation.
    - Patent. If a firm is applying for a patent, it is because it has previously done some investment that needs to be protected.
    - Cooperation. If a firm is cooperating carrying out innovation might be well make a bigger investment in R&D.
- In the innovation sales, we have as exclusion restriction:
    - Information from the Universities. It is used as a proxy for how close the firm is from basic research.

As mentioned before, another reason for the selection of some of the variable in one equation and not in other is exclusion restrictions. We need at least one variable, whose estimation coefficient is statistically significant (different from zero) in each of the equations in order to identify the coefficients from the reduced form to the structural form parameters (which is the

interest of the paper).

Table 2. Description of the covariates used in the regression

Variable	Explanation	mean	Stand. Dev.
Size	logarithm of the number of employees (ln emp)	3.79	1.26
Competitiveness	The firm declares that has some activities in the international market (sigmar=4)	0.22	0.42
Group	Reports belonging to a group (ho)	0.21	0.41
Information from Clients	Reports using clients as a source of information for innovation (scli)	0.67	0.46
Marketing Strategy	Change to the firm's marketing strategy (actmar)	0.21	0.41
Aesthetic Changes	Significant changes in aesthetic appearance or design of one of the products. (actaes)	0.25	0.43
Skilled labour	Logarithm of the number of employees with higher education. (ln emphi)	1.61	1.52
Funding	Access to any funding (funloc, fungmt, funeu or funrtd)	0.28	0.50
Patent	Application for at least one patent (paap)	0.06	0.25
Cooperation	Any cooperative efforts for innovation (co)	0.26	0.43
Information from University	Reports using clients as a source of information for innovation (suni)	0.32	0.47
Industry dummies	Based on NACE (2 digits)		
Manufacture			
High-tech	30+32+33	0.03	0.17
Medium high-tech	24+29+31+34+35	0.13	0.33
Medium low-tech	23+25+26+27+28	0.14	0.34
Low-tech	15+16+17+18+19+20+21+22+36+37	0.33	0.47
Electricity	40+41	0.02	0.14
Services			

Market service low	51+60+63	0.41	0.20
Financial services	65+66+67	0.03	0.17
High-tech services	64+72+73	0.05	0.21
Low-tech services	50+60+63	0.20	0.40
Country dummies (dummy mean)	Based on nuts_2.		
Belgium(0.019), Bulgaria(0.201), Czech Republic(0.053), Germany(0.045), Estonia(0.037), Spain(0.128), Finland(0.023), Greece(0.024), Hungary(0.015), Iceland(0.011), Italy(0.20), Latvia(0.03), Lithuania(0.03), Norway(0.05), Portugal(0.02), Romania(0.026), Slovenia(0.040) and Slovakia(0.027).			

As stated before, a robust check is carried out by playing a bit with the set of covariates introduced in each of the equations. Table 3 is a map of the variable entered in each of the models. It is used to make the reader understand the results of the next section.

Table 3. Relationship between the model and the presence of the covariates

	MODEL 1			MODEL 2			MODEL 3		
	MKT	R&D	INNO	MKT	R&D	INNO	MKT	R&D	INNO
Size(ln emp)	x	x	x	x	x	x	x	x	x
Competitiveness	x	x	x	x	x	x	x	x	x
gp	x	x	x	x	x	x	x	x	x
industry dummies	x	x	x	x	x	x	x	x	x
country dummies	x	x	x	x	x	x	x	x	x
Inf. Clients	x			x			x		
Marketing str	x						x		
Aest. Changes				x			x		
Ln Emp hi		x			x			x	
Funding		x			x			x	
Patent		x						x	
Cooperation					x			x	
Inf. University			x			x			x

5 Results

Table 4 contains the magnitude and the direction of the marginal effects of the ALS estimation. Due to space constraints, the same coefficients for the industry and country dummies are reported in Table 5. The only difference between Model 1, Model 2 and Model 3 is the selection of the variables (see Table 3). If we look at the equation for marketing, out of the three common variables only size is significant. If the size is increased by a 1% it will increase on average a 0.04% the expenditures in the marketing expenditures carried out by that firm. Neither the fact

that firms face pressure from international markets (measured by the variable competitiveness) nor the fact that they belong to a group makes any difference in the way they decide for their marketing expenditures.

The variables that have specifically enter in the marketing equation, are always significant, partially because those firms reporting that the information from clients is important for innovation, and firms having introduced changes to the marketing strategy or some kind of aesthetic changes are firms that are closer to final demand. Firms reporting that clients are a source for innovation make between 0.37% to 0.44% more than others not reporting to have used information from clients. It makes sense that if a firms produces an innovation according to the needs of the clients, it must also dedicate extra effort to letting them know that there is a new product in the market that it suits existing needs. If a firm reports a change in its marketing strategy it will be on average expending on marketing between a 0.53 to 0.46% more than a firm which has not changed its marketing strategy.

By examining Table 5 we can see that none of the industry dummies, with the exception of financial services, is significant. This can be explained in part by the fact that the grouping of the sector is based on R&D intensity. It will be interesting to repeat the exercise classifying the sectors according to how close or far they are from final demand, and in such a case the industry dummies will be more significant. However, firms in the financial service sector make around a 0.6% more expenditures than the rest of the firms. Country dummies are in general significant capturing country differences across the European nations.

By looking at the R&D equation we can see that size explains 0.3% of the capacity to benefit from clients, if the firm faces competition it makes 0.7-0.6% more expenditures than another firm that does not face such international pressure. There is not significant distinction on belonging to a group of firms, probably this effect is captured by the other covariates. A 1% increase in the number of employees with secondary degree increases the R&D investment by a 0.8-0.7%. Receiving funding from either the European or from the national government increases the R&D effort by 1.7-2%. If the firm has applied for at least one patent on average, this firm is investing between a1.8-2% in R&D compare to a firm that did not apply for a patent. The same level of impact is found by the variable cooperation.

Table 4. ALS estimation marginal effects.

Variables	Model 1	Model 2	Model 3	Variables	Model 1	Model 2	Model 3	Variables	Model 1	Model 2	Model 3
								marketing*	**0.676 *****	**0.548 *****	**0.708 *****
								randd*	**0.32 *****	**0.325 *****	**0.347 *****
Size(ln emp)	0.046 *	0.042 *	0.042 *	Size(ln emp)	0.322 **	0.307 **	0.3 ***	Size(ln emp)	0.245 *	0.333 **	0.191 *
competiveness	-0.095	-0.072	-0.091	competiveness	0.709 **	0.773 **	0.64 ***	competiveness	0.654 **	0.574 *	0.621 **
gp	0.056	0.033	0.057	gp	0.318	0.168	0.133	gp	0.052	0.144	0.065
Inf. Clients	0.377 ***	0.439 ***	0.359 ***								
Marketing estr	0.541 ***		0.462 ***								
Aest. Changes		0.28 ***	0.286 ***								
				Ln Emp hi	0.81 ***	0.8 ***	0.727 ***				
				Funding	2.133 ***	1.941 ***	1.752 ***				
				Patent	2.06 ***		1.845 ***				
				Cooperation		2.028 ***	1.875 ***				
								Inf. University	0.62 **	0.91 **	0.425 *
Industry dummies and country dummies(table 5)				Industry dummies and country dummies				Industry dummies and country dummies			

	Reference models Innovative Sales.			
Variables	**Model 1**	**Model 2**	**Model 3**	**Model 0**
marketing* randd*	0.366***	0.366***	0.408***	
Size(ln emp)	0.563***	0.567***	0.511***	1.122***
competiveness	0.2*	0.194*	0.149	0.736***
gp	0.254**	0.267**	0.24**	0.578***
Inf. University	1.138***	1.09***	0.976***	1.486***
Industry dummies and country dummies				

(*) Significant at the 10%, (**) significant at the 5%, and (***) significant below the 1%.

Table 5. ALS estimation marginal effects of the country dummies and industry dummies.

	Marketing expenditures			R&D expenditures			Innovative Sales		
Variables	**Model 1**	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
Industry Dummies									
Manufacture									
High Tech	0.383	0.424	0.333	3.919 ***	4.039 ***	3.693 ***	2.954 **	4.051 **	2.395 **
edium High Tech	0.353	0.386	0.306	3.374 ***	3.579 ***	3.178 ***	3.149 **	4.183 **	2.637 **
edium Low Tech	0.194	0.241	0.154	2.184 **	2.292 **	2.028 **	3.481 **	4.444 ***	3.11 ***
Low Tech	0.303	0.291	0.23	1.166	1.253	1.072	3.099 **	4.206 ***	2.758 **
Electricity	-0.122	-0.053	-0.1	0.433	0.139	0.174	0.008	0.555	-0.132
Services									
Low Tech	0.333	0.361	0.309	-0.324	-0.346	-0.497	3.456 **	4.557 ***	3.106 ***
Finantial	0.612 *	0.587 *	0.574 *	0.821	0.346	0.535	2.714 **	4.184 **	2.256 **
Market services	0.253	0.311	0.224	1.849 *	1.709 *	1.593 **	2.14 *	3.018 **	1.753 *
Hight Tech	0.237	0.288	0.203	3.841 ***	3.754 ***	3.569 ***	2.91 **	3.942 **	2.369 **
Country Dummies									
Belgium	-2.052 ***	-1.797 ***	-2.062 ***	-1.845 *	-1.892 *	-1.621 *	8.314 ***	6.072 ***	9.207 ***
Bulgaria	-2.505 ***	-2.113 ***	-2.47 ***	-7.96 ***	-8.269 ***	-7.874 ***	17.012 ***	13.974 ***	18.135 ***
Check Republic	-1.909 ***	-1.643 ***	-1.943 ***	-7.645 ***	-7.766 ***	-7.319 ***	3.993 **	0.653	5.151 ***
Estonia	-2.401 ***	-2.082 ***	-2.445 ***	-4.41 ***	-4.868 ***	-4.458 ***	14.192 ***	11.255 ***	14.871 ***
Finland	-2.554 ***	-2.124 ***	-2.534 ***	-1.188	-1.518 *	-1.304 *	10.171 ***	6.974 ***	11.014 ***
France	-2.467 ***	-2.01 ***	-2.401 ***	-2.29 **	-2.039 *	-1.916 **	11.654 ***	8.38 ***	12.499 ***
Germany	-2.843 ***	-2.402 ***	-2.826 ***	-3.013 **	-2.808 **	-2.71 ***	12.124 ***	8.62 ***	13.013 ***
Greece	-2.798 ***	-2.545 ***	-2.866 ***	-6.669 ***	-7.058 ***	-6.606 ***	13.88 ***	10.617 ***	14.992 ***
Hungary	-1.737 **	-1.461 **	-1.78 ***	-3.634 **	-4.619 **	-4.058 ***	5.493 **	3.22 *	6.328 ***
Iceland	-1.728 **	-1.56 **	-1.783 ***	0.6	-0.373	0.064	8.754 **	7.445 **	9.534 ***
Italy	-2.883 ***	-2.541 ***	-2.916 ***	-3.99 ***	-3.693 ***	-3.588 ***	13.759 ***	10.394 ***	14.776 ***
Latvia	-1.695 ***	-1.386 ***	-1.678 ***	-4.02 ***	-4.763 ***	-4.304 ***	7.11 ***	4.862 **	7.947 ***
Luxembourg	-3.222 ***	-2.825 ***	-3.221 ***	-3.279 **	-3.628 **	-3.253 **	14.743 ***	11.125 ***	15.755 ***
Netherlands	-3.869 ***	-3.291 ***	-3.802 ***	-1.72 *	-1.741 *	-1.51 *	18.74 ***	14.389 ***	19.896 ***
Norway	-2.852 ***	-2.382 ***	-2.815 ***	-1.722 *	-1.967 **	-1.75 **	13.41 ***	10.028 ***	14.266 ***
Portugal	-2.64 ***	-2.307 ***	-2.66 ***	-2.507 **	-2.795 **	-2.375 **	10.291 ***	7.032 ***	11.213 ***
Romania	-2.283 ***	-1.991 ***	-2.317 ***	-5.922 ***	-6.248 ***	-5.809 ***	11.676 ***	8.926 ***	12.605 ***
Slovakia	0.119	0.239	0.077	-1.007	-1.943	-1.571	-0.433	-0.753	0.206
Slovenia	-1.629 ***	-1.375 **	-1.672 ***	-0.609	-1.314	-0.781	6.652 ***	4.546 **	7.249 ***
Spain	-2.563 ***	-2.25 ***	-2.596 ***	-3.271 **	-3.205 **	-2.918 ***	14.98 ***	11.826 ***	15.803 ***
Sweden	-2.451 ***	-2.006 ***	-2.404 ***	-0.901	-0.909	-0.909	7.927 ***	4.757 **	8.576 ***

(*) Significant at the 10%, (**) significant at the 5%, and (***) significant below the 1%.

Looking again at Table 5, the effect of industry dummies and country dummies can be studied. In this case, we can see that in manufacture for high-tech sectors, medium high-tech, and low high-tech present a significant coefficient: in fact, the higher is the intensity of R&D in the sector, the higher the coefficient. In any case, it is higher for high-tech and lower for medium low-tech. It is not significant for low-tech, electricity or financial services. But it is significant for market services (1.5-1.8%) and for high-tech services (3.5-3.8%). In a way, the coefficients are as would be expected since the grouping of the sector is related to R&D intensities.

When looking at the third equation, we should understand that marketing* and R&D* are latent variables. It is the latent variable that has been built according to the two previous tobits already discussed. As already introduced in previous section, the idea of a latent, is that the effect of both variables in the economy cannot be purely captured by looking at a firm's single level efforts. It cannot be done for endogeneity problems, but also for the externalities associated to both R&D and marketing investments. The effort made in one sector might affect the visibility of competitive innovation. Therefore the use of a latent captures the general idea of an effort made in a nation with sectoral differences. It has to be said that the elasticity of R&D is due to the flow of the latent variable, the differences in size might be due to the fact that the stock might be what is really affecting innovative sales. As Table 4 shows the latent variable for R&D accounts for an increase in sales close to a 0.32%. However the effect of the latent for marketing 0.54-0.7% is at least twice as much as the previous one. This is at least surprising, since most of the literature bases on the effort needed to be done on R&D, but very little attention is offered to the effect of the commercialisation and marketing of the innovation. The work carried out by Dutta, Narasimhan et al (1999) had result in line with the idea offered in Garcia Torres (2009) which states that very good innovations might be a failure simply because they are not known, they do not have enough novelty or in other words they need higher marketing expenditures.

Size explains about a 1.9-3.3% of the effect on innovative sales, competitiveness 0.57-0.65% depending on the model, and information from universities (a proxy for how close the firms are to basic research) explains 0.9-0.6.2%. The fact that industries dummies are relevant is also quite interesting. They show that low-tech manufacturing and low-tech services have very strong capacity to capture innovative sales. Meaning that although those sectors are not the higher R&D investors, they have a very strong capacity to take advantage of sales and opportunities associated with innovation even more that other more intensive R&D sectors.

For comparison proposes in Table 4, in the right down corner, it shows an estimation done for the last equation if we take out the effect of marketing(model 1 to 3), and later of R&D (model 0).

This is done to show the consistency of the estimation and the robustness of the analysis.

Now it is time to compare our results with other papers. First, from the papers reviewed in the literature (Cakir and Balgatas 2010; Luan and Sudhir 2010; Sethuraman, Tellis et al. 2011) on not highly innovative markets, the elasticity of marketing to sales moves around 0.2-0.02 %. In this paper, that focuses on highly innovative markets since only new products are studied, the elasticity is between 0.70-0.54 %. This comparison points out once more, how important are marketing expenditures for innovative product, perceptually at least three times more important than for exiting products with a higher degree of innovation.

Our results show that marketing is more relevant that R&D for the success of innovation, which seems to be in line with the work carried out by Dutta, Narasimhan et al (1999) in the semiconductor industry, as well as the work about Germany by Bhargava, Chatterjee et al (2011). This paper sample covers 18 European countries and all sectors.

6 Conclusions

The purpose of the paper is to understand the relation between marketing and innovation. In particular, the paper focuses on the combination of R&D investments and marketing expenditures and their relationship with innovative sales. A higher investment in R&D is normally associated with a higher quality innovation or a faster rate of innovation. And therefore with a positive impact on sales and on GDP. The paper raises the idea that successful innovation needs a strong marketing effort in order for this innovation to have an impact in the society, it needs to be known and desired by consumers.

The paper finds empirical evidence that marketing expenditures explains a large part of the success of the innovation (measured in terms of the elasticity of this effort towards innovative sales), even more than the flow of investment in R&D. In fact, the size of the coefficient for marketing doubles that found for R&D, a quite surprise result taking into consideration the little importance that marketing has in innovation studies. The result is in line with similar studies carried out in national or sectoral markets as reported by literature.

Despite this evidence showing that the innovation process is not in isolation from the commercialisation phase of the product, most of the policies designed to help innovation focus

on the R&D phase (grants, funding, co-funding…). It is more difficult to find a governmental program that supports innovation in the commercialisation phase, providing for example support to the marketing effort carried out by the firms for introducing new products or services to the market. Moreover, the results of the analysis consistently show a significant impact of size in the three equations, highlighting that small firms have difficulties for investing both in marketing and R&D and less capacity for recovering these investments in terms of innovative sales. This means that policy should always take into account the size of firms when considering to support their R&D and, if possible, commercialisation investments, giving preference to small ones as they seem to show the bigger difficulties.

Assessing the success of the innovation and the profitability of new ideas at firm level is a big challenge. The results presented in this paper point out that a very good indicator for measuring such success is, rather than the amount of R&D investments, the strength of the marketing activities and, even more importantly, the degree of integration between the R&D and the marketing departments. A good integration will probably be the best sign of a successful innovation. It is not just a problem of generating more knowledge but of letting the demand know about the usefulness of the inventions.

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Abstract

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This paper focuses on the combinations of R&D investments and marketing expenditures and their relationships with innovative sales. A higher investment in R&D is associated with a higher quality innovation or a faster innovation, with a positive impact on sales and in a macro sense, in GDP. This paper raises the issue that good innovation need a strong marketing effort in order for this innovation to have an impact in the society, it needs to be desired by consumers. This paper finds empirical evidence that marketing expenditures explains a lot of the success of the innovation (measured in terms of the elasticity of this effort to innovative sales), even more than the flow of investment in R&D. In fact, the size of the coefficient for marketing doubles those found for R&D, a quite surprising result taking into consideration the little importance that marketing has in innovation studies.

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