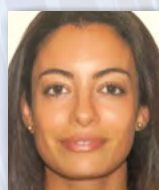


The importance of technological innovation in Spain: evidence before, during and after the global economic crisis



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This paper examines the importance of Technological Innovation (hereafter TI) in Spain by analyzing the volume of financial resources that Spanish businesses invest in the development and promotion of innovations activities and projects. Based on the data available from the Cotec foundation¹ and the Spanish National Statistics Institute², our research shows that Spanish businesses do not conceive innovation as an instrument to improve their competitiveness. However, this trend is now changing.

* Socio de AECA nº 633.

1 The Cotec foundation is a private non-profit organization whose mission is to promote innovation as a driving force of economic and social development.

2 Instituto Nacional de Estadística (INE).

Introduction

Spain is a country that traditionally has not dedicated many resources to support innovation activities, neither in the public nor in the private sectors. The lack of activities promoting innovation on the part of the Spanish Government has been revealed as one of the major problems that has slowed down the firms' economic advancement. Therefore, Spanish businesses lag behind firms from other countries such as the United States, United Kingdom, among others, which are facing better the continuous changes that are taking place in technology and thus, are well placed.

There is a Spanish public institution known as Centre for Industrial Technological Development, whose aim is to provide financial support for the introduction of new technologies in the industrial sector. Nevertheless, to date, the efforts performed by this public institution are not enough to promote firms' technological development. This is mainly due to the still existing gap between universities and private industry in R&D, and the lack of higher public investment by the government.

It is also necessary to highlight the important involvement of the Spanish private sector in financing R&D activities. In the last five years, the private sector has presented a participation share quite similar to the public sector. However, if we compare the contributions made to R&D investments by the Spanish private sector with those made by the private sectors in other developed countries, the contribution made to R&D activities in Spain is significantly lower.

The absence of the necessary investments in TI to promote the economic and technological development of Spanish businesses is constantly reflected in their obtained results. Therefore, the main objective of this paper is to examine how TI investments have evolved in the Spanish Business landscape in last years in order to highlight how these firms have managed innovation activities before, during and after the global economic crisis.

Analysis of the TI executed in Spain

The vast majority of firms have funded most of their R&D investments with their own resources in recent years. Nevertheless, in 2015

there was an important turnaround in this trend due to the fact that R&D investments were principally financed from external sources.

Total internal R&D expenditures in 2016 were 13,259,769 thousands of euros (see table 1), 0.66 % more than in 2015 (13,171,807 thousands of euros). However, the first significant rise since the beginning of the 2008 crisis was in 2015 by 2.74 %. Despite the increase of R&D investments over the last two years, these figures remain significantly distant from R&D expenditures in 2008 of 14,701,392 thousands of euros, with a difference of around 10 %.

In 2016, only the business sector increased R&D expenditures by 2.98 % (see graph 1), while public administration and higher education have reduced it by 2.68 % and 1.49 %, respectively. It is essential to emphasize that in last years, the business sector has accounted for more than 50 % of the total distribution of R&D investments made in Spain. Moreover, almost half of these R&D expenditures have been incurred by SMEs. In 2015, the situation was completely different when all sectors increased their R&D spending, fact that hasn't happened since 2008.

To continue with the main purpose of this study, in the next paragraphs we will focus on the business sector. The R&D expenditures executed by firms in 2016 were 11.74 % lower than in 2008. This decrease in R&D spending in the business sector is higher than that experienced in other sectors such as public administration (8.21 %) and higher education (7.21 %) for the same period. It is also necessary mentioning that the business sector was the most af-

ected at the beginning of the crisis, moving from R&D expenditures of 8,073,521 thousands of euros in 2008 to 7,567,595 thousands of euros in 2009.

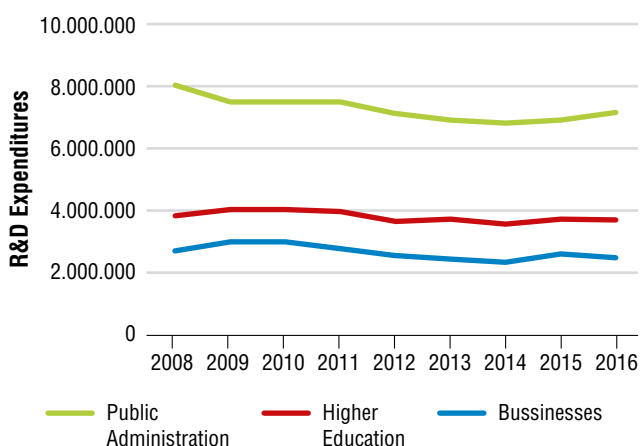
Despite the rise in R&D investments in 2015 and 2016, R&D expenditures as a percentage of GDP have fallen sharply since 2010. This percentage declined from 1.24 % in 2014 to 1.22 % in 2015, and has also decreased in 2016, from 1.22 % to 1.19 %. Therefore, in recent years the growth rate of R&D expenditures is slower than the development of the Spanish economy. However, during the first years of the crisis, R&D expenditures as a percentage of GDP grew to 1.40 % in 2010.

With regard to the business sector, the trend is quite similar to the general case. It only experienced an increase in 2009, while in the rest of the years it declined. Its highest value was 0.74 %, presented in 2008.

In 2016, a total of 205,873 people (in full time equivalent) were engaged in R&D activities, of which 90,129 were in the business sector. In 2010, the quantity of people employed in R&D activities reached its peak in 222,022 and since then, its number has been reduced year by year to its minimum in 2014 with a total of 200,233. Moreover, the business sector holds around 40 % of the total personnel dedicated to research and development in Spain.

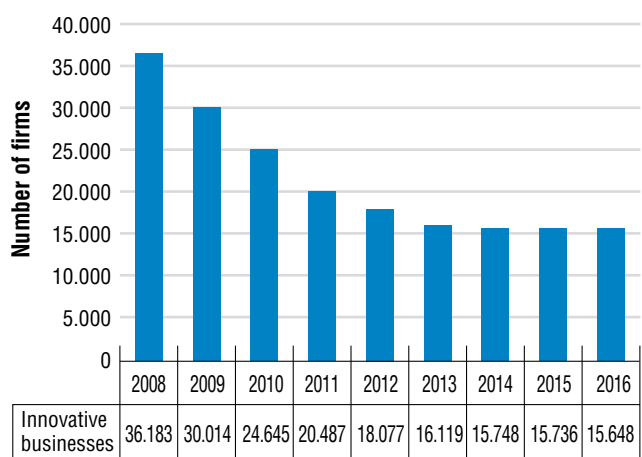
So far, R&D expenditures have been individually analysed because these expenses are the most significant component of the TI process in Spain. However, from now on, emphasis will be placed on the study of TI as a whole. In this vein, TI includes several activities such as the acquisi-

Graph 1. Total internal expenditures in R&D activities by sector (thousands of euros)



Own elaboration from INE.

Graph 2. Total number of firms that declare to perform technological innovation



Own elaboration from INE.

Table 1. Total internal expenditures in R&D activities by years (thousands of euros)

	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total R&D expenditures	14,701,392	14,581,675	14,588,455	14,184,294	13,391,606	13,011,798	12,820,756	13,171,807	13,259,769

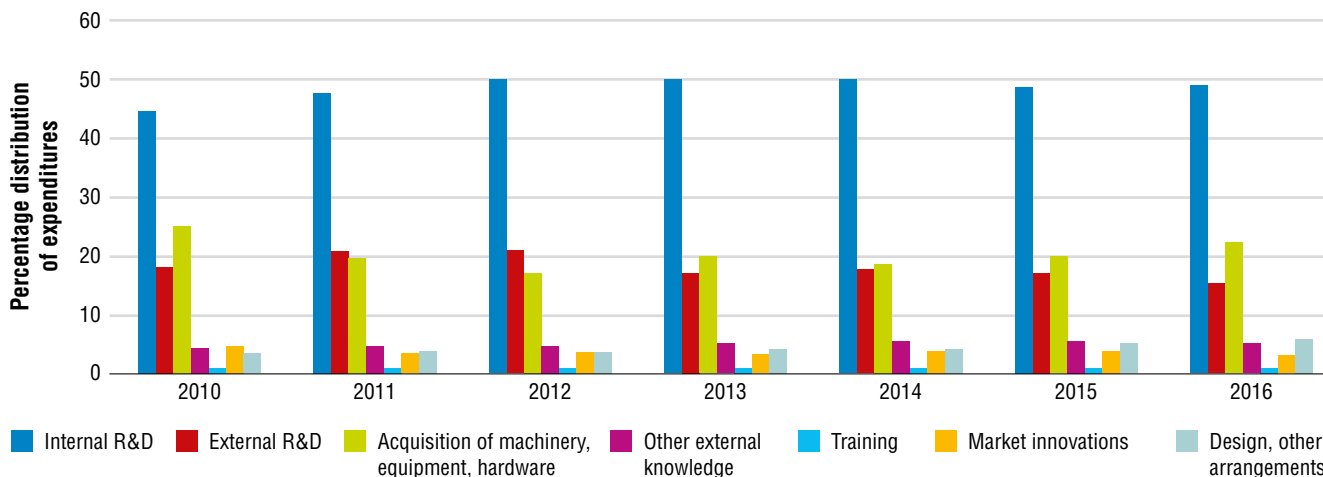
Own elaboration from INE.

Table 2. Total expenditures on innovative activities (thousands of euros)

	2010	2011	2012	2013	2014	2015	2016
Total expenditures	16,171,218	14,755,807	13,410,348	13,233,291	12,959,842	13,674,177	13,857,481

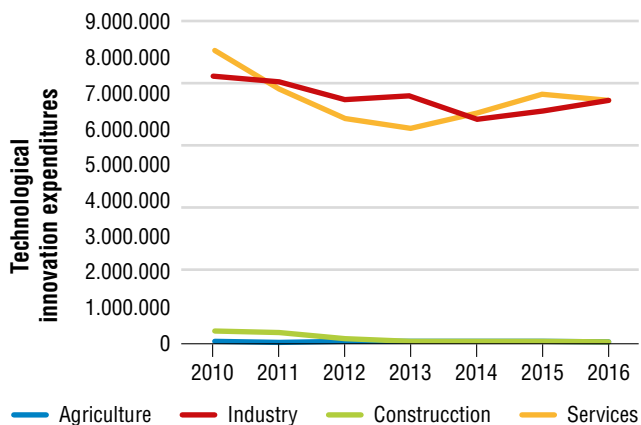
Own elaboration from INE.

Graph 3. Evolution of the technological innovation activities distribution over the total



Own elaboration from INE.

Graph 4. Evolution of technological innovation expenditures by sector (thousands of euros)



Own elaboration from INE.

tion of R&D, machinery, equipment, hardware and training for innovation activities, among others.

The latest survey conducted by the Spanish National Statistics Institute has revealed that in 2016 a total of 15,648 firms have developed innovative activities. This figure has slightly decreased compared to 2015, when there were a total of 15,736 businesses. In graph 2, it can be observed that the downward trend that has been established since 2008 is gradually being diluted. In 2016, the number of firms that have declared to be innovative represents 10.80 % over the total businesses.

With respect to TI expenditures, they reached the figure of 13,857,481 thousands of euros in 2016, representing an increase of 1.34 % over 2015 (see table 2). This amount represented the 1.9 % of the turnover of firms with 10 or

more employees. Moreover, there are two main decreases in TI expenditures, from 2010 to 2011 (8.75 %) and from 2011 to 2012 (9.12 %). Today, the spending level sustained in these two years (2010 and 2011) has not been recovered.

After examining the total TI expenditures in the 2010-2016 period, an in-depth analysis of the different activities that have contributed to such annual disbursements has been developed (see graph 3). In 2016, the following activities should be highlighted: internal R&D (48.8 % of total TI expenditures), external R&D (15.16 % of the total), acquisition of advanced machinery, equipment, hardware or software (21.83 % of the total), acquisition of other external knowledge for innovation (5.15 % of the total) and others (9.06 % of the total).

Graph 3 shows how the proportion of total TI expenditures for each of these activities has fluctuated. The operations that increased their participation in 2016 compared to 2010 are: internal R&D, other external knowledge, and design, other arrangements. The rest of the activities, despite suffering ups and downs during these six years, have ended up declining severely. Thus, we confirm that the business sector spends more on internal R&D activities.

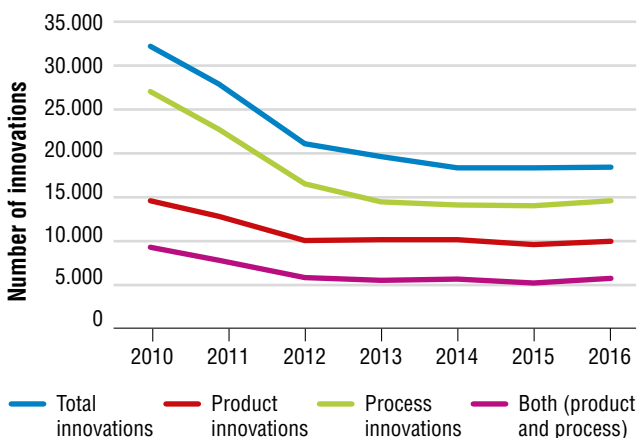
As regards TI expenditures by activity fields, there are two sectors that outperform the rest: industry and services. In other sectors, such as agriculture and construction, spending on TI is very low. This fact could explain to some extent the stagnation experienced by these two activity areas after the beginning of the 2008 crisis. Graph 4 reveals how

Table 3. **Product and process innovations by activity sector (2016)**

	Total innovations	Product innovations	Process innovations	Both
Agriculture	458	103	423	68
Industry	7,105	4,332	5,515	2,742
Construction	1,020	301	839	120
Services	9,892	4,947	7,553	2,608

Own elaboration from INE.

Graph 5. **Evolution of product innovations, processes, both and total businesses**



Own elaboration from INE.

the construction sector was seriously affected, moving from an expense of 370,702 thousands of euros in 2010 to 126,630 thousands of euros in 2016, representing a decrease of 65.84 % in just six years. The agricultural sector, although having ups and downs throughout the 2010-2016 period, has been able to maintain the figure of TI expenditures in a constant line. The service sector has also been another major victim of the crisis, moving from an expense of 8,191,899 thousands of euros in 2010 to 6,809,329 thousands of euros in 2016, representing a decrease of 16.87 % in six years. In relation to industry, it has also suffered a decrease in its TI spending due to the crisis, but in a smaller proportion than sectors such as construction or services.

To conclude this section, we have to analyze the number of Spanish firms that develop product and process innovations or both. We also study the type of innovation that is most frequently implemented in the different above-mentioned sectors in 2016.

The total number of innovations that businesses have developed in recent years has been alarmingly reduced. The 2008 crisis led firms to focus their attention on meeting other needs and thus, firms began to put innovative activities aside. Graph 5 shows how businesses went from 32,041 innovations in 2010 to 20,815 in 2012, representing a decrease of 35 %.

From 2013 onwards, the total number of innovations continued to decline, but at a slower rate. In 2016, an increase occurred for the first time after the major reduction in the 2010-2012 period.

In terms of product and process innovations, the trend is quite similar to the total set of innovations. Both product and process innovations have been decreasing since 2010, but with an important difference, due to the fact that process innovations have experienced a greater fall (38.76 %) in the 2010-2012 period than product innovations (13.97 %). However, both typologies of innovation have experienced growth in 2016, and are expected to keep growing in the next years.

Regarding the activity sectors, in 2016 all of them have implemented more process innovations than product innovations (see table 3). As for the total number of innovations made by sector, these are in line with the total expenditures on TI executed by firms in each sector, as shown in graph 4.

Conclusions

After conducting a profound analysis of the importance of TI in Spain, we can conclude that our country has never been prone to promote TI among businesses. In the years before the 2008 crisis, great efforts were made to overcome the lack of technology in Spain, but once the economic and financial crisis began, several steps were taken backwards³⁻⁴.

The event that Spanish firms' reaction to the crisis was to reduce their innovation expenditures, reflects the poor perception among Spanish businesses of the innovation possibilities as tools that increase their competitiveness. However, the country economic situation has improved considerably in the last two or three years. In this vein, data from 2016 regarding TI seems to predict better results for the following years.

Finally, it is important to highlight that firms and universities should develop more binding innovation ties⁵. This fact is extremely important for the businesses survival and the maintenance of the Spanish economy, in case another period similar to the 2008 crisis arises. In this line, Spain could approach countries such as Sweden, United Kingdom and USA that are world leaders in innovation. ▽

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