Title: THE EFFECTIVENESS OF KNOWLEDGE TRANSFER MECHANISMS IN THE SPANISH UNIVERSITIES: THE CASE OF ACADEMIC SPIN OFF. FASHION OR NEED?

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Abstract
Entrepreneurship at universities involves a number of different means to carry out knowledge transfer towards industry and society. This means require the design and implementation of adequate technology transfer policies and incentives systems. If these policies are to be successful, its design has to take into account local contextual factors. We focus on technology transfer and academic spin-off in the context of Spanish universities. While Spanish university system is rather successful in scientific production, technology transfer to industry manifests room for improvement. For this reason, the Spanish case deserves an in-depth analysis. To this end, we will focus on the following issues:
1. To what extent are public policies and incentives for teaching and research staff favouring the transfer of knowledge from Spanish universities to society?
2. How have the mechanisms of knowledge transfer evolved over the last decade in Spanish universities?
3. As for the creation of spin-off as a transfer mechanism in universities and its evolution over the last decade, is the creation of academic spin-offs being used adequately as a transfer mechanism? And finally, has the creation of spin-offs been consolidated as a mechanism for knowledge transfer?

Introduction
An entrepreneurial economy (Drucker, 1984; Audretsch & Thurik, 2004) requires the existence of scenarios in which different agents are able to explore economic opportunities and knowledge in order to promote new entrepreneurial phenomena. In this context, the entrepreneurial university, through its multiple missions, serves as a vehicle for knowledge transfer to the productive fabric, thus contributing to economic growth (Guerrero et al, 2015). This scenario requires, however, the existence of appropriate public policies and incentives to achieve the proposed objectives in the medium and long term in terms of
economic development of the territory. A basic question to guarantee the success of these policies is that their design and development must be coherent with the territorial context in which they are to be implemented (Autio et al, 2014).

This article focuses on the Spanish case, and more specifically on technology transfer activities, and in particular, the creation of spin-offs carried out by Spanish universities.

According to the 2017 Report of the Spanish R&D&I Observatory, in 2015, Spain's scientific production ranked eleventh in the world, with 78,740 documents in SCOPUS and 58,130 in WOS (FECYT, 2017). However, this scientific panorama and Spain's position in the world ranking does not translate into actual transfer of that knowledge and technology to the business world. On the contrary, the report highlights the lack of a Spanish innovation system in this area (CRUE Spanish Universities, 2017).

On the other hand, Spain has made an important effort in the last decade to create and implement public policies in order to develop an ecosystem of innovation and entrepreneurship that promotes economic growth through the transfer of technology to the productive sector. In this respect, the Spanish policies and regulations have been developed following the guidelines set by the objectives of the EU, both in terms of research and innovation and entrepreneurship. However, a number of laws have also been enacted to cover a number of shortcomings in previous Spanish regulations in the areas of research, technology transfer, spin-off creation and entrepreneurship.

Focusing on academic entrepreneurship, it is crucial to study the effectiveness of business creation based on research results (academic spin-offs) seen as a transfer mechanism. To do this, however, it is necessary to understand beforehand the role of public policies in promoting the creation of spin-offs, the motivation of promoters and the development of transfer mechanisms in Spanish universities over the last decade.

To this end, we will focus on the following issues:

1. To what extent are public policies and incentives for teaching and research staff favouring the transfer of knowledge from Spanish universities to society?
2. How have the mechanisms of knowledge transfer evolved over the last decade in Spanish universities?
3. As for the creation of spin-off as a transfer mechanism in universities and its evolution over the last decade, is the creation of academic spin-offs being used adequately as a transfer mechanism? And finally, has the creation of spin-offs been consolidated as a mechanism for knowledge transfer?

**Methodology and analysis**

In order to answer the questions proposed, different methodologies have been used:

- Bibliographic analysis and that of the policies developed in the field of study that have allowed us to respond to the suitability of the policies in the Spanish context.
- Analysis of the data provided by the RedOTRI technology transfer survey carried out by the CRUE. In this case, we have analysed the data on transfer mechanisms, their results and effectiveness. Among others, we have analysed data on patents (concessions, maintenance costs, licence fees); contracts with third parties (number and scope of contracts, sectors in which they have been produced, types of customers) and the creation of spin-offs.
- Analysis of the academic spin-offs created in the last decade in Spanish universities and their evolution.
- Comparison of the evolution of spin-offs with other companies in their sector.

With all this information, we have been able to reach the following results and conclusions:

**Results and conclusions**

In relation to the first question, to what extent public policies and incentives for teaching and research staff are impelling the transfer of knowledge from Spanish universities to society, we can see that, although an effort is being
made to meet this need, there is insufficient evidence to affirm that the policies are being effective.

In terms of facilitating factors and obstacles to the implementation of policies, we find as facilitators, an extensive network of Transfer Offices which, despite the efforts of its members, has been reduced in resources and, therefore, cannot cover the spectrum of activities that are expected to be developed for universities in accordance with their characteristics.

On the other hand, analysing the remuneration and career policies of Spanish public researchers, we find that there is a clear disincentive to technology transfer, due above all to the lack of recognition in their curricula (although this aspect has been improved in recent years), to the detriment of mere publication in prestigious journals. As long as bodies such as the National Agency for the Evaluation of Academic Quality (ANECA) continue to put mere publication as the first quality criterion, without linking it to a real transfer of knowledge, in the case of applied research, there will not be a real entrepreneurial culture in universities that involves actual knowledge transfer.

As far as the evolution of transfer mechanisms is concerned, we see how the traditional mechanisms are maintained over time, while the emergence of new ones, such as the creation of spin-offs, has yet to be consolidated. In this sense, one of the tools that should improve the absorption capacity of our productive fabric is academic spin-offs. However, our study concludes that those researchers who opt for this transfer mechanism do so mainly for academic reasons, i.e. they are allowed to continue their research work, and, in times of crisis, it has allowed them a pathway of continuity for young researchers who might not otherwise have been able to continue their research work. This leads us to the fact that, in reality, the creation of academic spin-offs in Spain is not a real mechanism for technology transfer, but rather an additional mechanism for expanding the research curricula as a scientific production, which continues to be the ultimate goal of most researchers.

As for the creation of spin-offs, in the case of Spain, we cannot say that they are an effective mechanism for transferring knowledge to the productive sector. Its promoting researchers do not pursue an economic development of the company, but an expansion of their activities as researchers. Only rarely can we
detect spin-offs that have really contributed to the economic growth of the territory.

**Bibliography**