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The Socioeconomic Impact of Spanish Science and Technology Parks

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Executive Summary

This article is based on an Infyde report commissioned by Spain's Ministry of Education & Science and the Spanish Association of Science and Technology Parks (APTE) to find a methodology to explain the quantitative impact of Parks on the Spanish R&D (+I) system.

The report focused on the specific impact of the Parks on GDP, employment, R&D and tax variables. Despite the model's limitations, the report shows how 7 Spanish parks generate nearly 0.65% of the national GDP and 5.8% of employment in R&D. At local level, their impact is even greater, with 3.9% of GDP and 66.15% of employment in R&D. Tax revenue levels demonstrate how the Parks offset the cost of their actual development.

In short, the report quantifies the impact of Spanish parks in economic and social terms and as regards their role as leaders in their respective R&D (+I) systems.

Key Words: Spanish Science and Technology Parks, socio-economic impact, R&D (+I) systems

CONTENTS

I. INTRODUCTION 3
II. PURPOSE 4
III. METHODOLOGY 5
IV. RESULTS 8
V. SCIENCE AND TECHNOLOGY PARKS IN SPAIN: THE FUTURE CALLS 12
VI. CONCLUSIONS 14

I. INTRODUCTION

Growing competition on international markets, plus the appearance of new world competitors, is stimulating the search in countries all over the world for tools to foster competitiveness.

Competitiveness as a phenomenon linked to better positions in respect of resources and costs has given way to a conception focused on the advantages of more knowledge and innovation. Schumpeter[1] was the first to include innovation and technological change as part of the issues involved in economic analysis. Later authors like Romer[2] and Lucas[3] conducted in-depth discussions of the decisive effects of technological development as a source of growth in economies.

Measures focusing on the new models of competitiveness are increasingly better understood from the regional and local viewpoint, as opposed to entailing nationwide action. From stressing the importance of national systems (Freeman[4], Lundvall[5]), innovation theory has shifted to a regional outlook (Cooke[6]).

Science and technology parks in many countries have developed into a key tool in fostering, promoting and basing regional and national competitiveness on the intensity with which knowledge is applied to production. Furthermore, such parks have provided regions with genuine opportunities for knowledge-based competition in a framework of increasing globalization.

The Parks were and are pioneer milieus where the creation and transfer of technology is a fact, where technology-based businesses appear and prosper and finally where the concept of innovation has managed to materialize in a culture of progress that has spread beyond the apparent limits of the parks themselves.

In Spain in the last few years, science and technology parks have developed from being promising tools in R&D (+I) policy into key players in the system as a whole. Today they are infrastructures with solid national and international connections, providing key innovation support services such as business creation and technology transfer and enabling university research groups, businesses and technology centres to work from the same site. The Spanish authorities, in particular the Ministry of Education & Science and the Ministry of Industry, are aware of this fact and have clearly favoured them through specific aid programmes to the Parks themselves and to the companies based there.

Growth at Spanish parks has been intense and, perhaps most notably, very fast. Figures from the Spanish Association of Science and Technology Parks show that, between 2000 and 2006, the number of businesses and research centres at such Parks increased from 1,000 to more than 2,600, employees increased from 25,000 to 79,000, and turnover tripled to more than 9,000 million euros.

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[1] Schumpeter, J.A. (1942). "Capitalism, Socialism and Democracy". McGraw-Hill. New York

[2] Romer, P. (1986) "Increasing returns and long-run growth". Journal Political Economy, vol. 94, no.5
Romer, P. (1990). "Endogenous technical change". Journal of Political Economy, no. 98

[3] Lucas, R.E. (2000) "Some Macroeconomics for the 21st series". Journal of Economic Perspective, vol.14, nº1

[4] Freeman, C (1987) "Technology Policy and economic performance – Lessons from Japan". Pinter Publishers. London

[5] Lundvall, B. (1988) "Innovation as an interactive process: from user-producer interaction to the national system of innovation" in Dosi, G. et al. (1988) "Technical change and economic theory". Pinter Publishers. London

[6] Cooke, P. et al. (1997) "Regional innovation systems: Institutional and organizational dimensions". Research policy, 26

With public opinion fully aware of the advantages of the parks in the socioeconomic and R&D (+I) systems, and clear support from the authorities, it is only fitting to provide a more detailed explanation of the foundations of the phenomenon. If possible, a quantification of its effects would also be useful.

In-depth information on the development, operation and results of the parks will be useful to park managers, "policy makers" and the society in which they function, as well as furnishing elements for a greater understanding of the scope of such initiatives.

Based on a report produced for the Ministry of Education & Science and the Spanish Association of Science and Technology Parks (APTE), the following report seeks to meet the need for further information on the role played and the impact produced by the parks in Spain. The specific objects of the work done here are given in the following section.

In the preparation of the report, a specific methodology was designed and applied to the APTE parks. Dealt with in the third section, the methodology is based on the use of information in the Input-Output tables for the regional economies in which each Park is embedded and on obtaining what are called "multipliers".

According to the results obtained by applying the model to the Spanish case, the parks have had a major nationwide and local impact (particularly at the latter level) reaching 0.65% and 3.49% of the GDP respectively. Results are analyzed in detail in section four.

Finally, the fifth chapter puts these results into context and proposes a set of conclusions designed to give a better understanding of the role played by Technology and Science Parks in the national and regional innovation system.

II. PURPOSE

This report was designed to measure the socioeconomic impact generated while the Science and Technology Parks in the Spanish Association of Science and Technology Parks (APTE) were being developed. The report specifically focuses on calculating the quantifiable effects of the changes caused by the activities undertaken at the Parks in the economic provincial and regional milieu, and where possible, on establishing a relationship between such changes and the way that milieu has evolved.

Indeed, this purpose provided an easy means of observing the joint influence of the parks at national and local level.

The report's more detailed specific objectives were to:

- Put forward a methodology for calculating the impact and effects of the parks on the major variables of regional and local economy and, following a levelling down criterion, extending the calculation to other places
- Identify the scope of the socioeconomic impact of each park and gauge the importance of the parks' local dimension.
- Apply the methodology proposed to the specific case of the APTE Science and Technology Parks and look at the results.
- Draw up a set of conclusions concerning the results.

III. METHODOLOGY

The information contained in the Input-Output tables for each region provided the basis for calculations of Park impacts and for obtaining their respective multipliers. After originally publishing the design for such tables[7] (1941), economist Wassily Leontief subsequently developed them further[8] (1951, 1966). Later authors like Chenery and Watanabe[9] (1958), Rasmussen[10] (1958, 1963) and Ghosh[11] (1958) used the information in the tables to design different impact calculation methods.

A number of studies have used these economic impact analysis methodologies for a wide range of cases. A direct, and particularly relevant, example for the present report was the study produced by consultants KPMG[12] in 2001 on the impact of science and technology parks in the Basque region of Spain. Our own report used all this theoretical and practical background in the design of the methodology proposed herein.

We used this methodology to distinguish two types of impacts, which we labelled direct and indirect.

Direct economic impacts are collected up by the increments in final demand as a consequence of the existence of the productive activity at a specific Technology Park. By aggregating all the direct sectoral impacts we obtain the total direct impact on production in the park's host region.

Indirect economic impacts are the effects that activity conducted at the Park generates in the milieu as a consequence of the multiplier effect on the economy of the direct impacts.

The general idea on which this methodology is based is that each component of the direct impacts creates beneficial multiplier effects on income and employment in the economy. In other words, any company that needs to increase production must, in general, buy goods, assets and services from others, which induces increases in production in the relevant sectors. The new acquisitions in turn generate additional impacts and so on successively, until the induced marginal effects within the economic zone under consideration become negligible. The total economic impact handled in this paper will be the sum of both direct and indirect impacts.

We took the following steps in applying the model to Spanish Science and Technology Parks:

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[7] Leontief, W. (1941) "The Structure of the American Economy, 1919-1939: An Empirical Application of Equilibrium Analysis" Econometrica

[8] Leontief, W. (1951) ""Input-Output Economics". Scientific American
Leontief, W. (1966) "El análisis económico input-output". Spanish version Ed. G. Gili, Barcelona, 1970

[9] Chenery, H. & Watanabe, T. (1958) "International Comparisons of the Structure of Production" Econometrica, Vol.26, No. 4

[10] Rasmussen, P.N. (1958). "Studies in Inter-sectorial Relations". North- Holland P. C. Amsterdam,
Rasmussen, P.N. (1963) "Estudios de las relaciones intersectoriales". Madrid: Aguilar.

[11] Ghosh, A. (1958): "Input-output approach to an allocation system". Economica, 25

[12] KPMG (2001) "Estudio de Evaluación del Impacto Económico de las Actividades Relacionadas con los Parques Tecnológicos del País Vasco". KPMG Consulting. Bilbao

1. Calculation of the impact multipliers for each year based on input-output models

To begin with, the input-output methodology was used to obtain the impact multipliers that would permit us to measure the drag effect on the rest of the economy of a unitary increment in production. For our specific case, the multipliers to be calculated referred to GDP and employment.

Gross Added Value Multiplier

The added value multiplier measures the increases in the global GAV of an economy owing to the unit increase in final demand in each branch of activity. The idea is that a variation in regional production generates in turn an alteration in the regional GAV. The calculation for the GAV multipliers starts from the expression:

$$\text{GAV Multiplier} = GAV_i^*(I-A)^{-1} = GAV_i^*BR$$

where GAV_i is the vector of coefficients for the GAV at basic prices per unit of production, I is the identity matrix, A is the matrix of internal coefficients and BR is, therefore, the inverse interior matrix.

Employment multiplier

Designing a multiplier on employment entails establishing a hypothesis about the existence of a linear relation between employment in each sector and the value of its production. Bearing in mind such a relation, one establishes the existence of a multiplier that measures the direct effects on employment in a particular economic sector arising from variation in its production:

$$E_j = L_j/X_j$$

where L_j is the number of employees per sector, and X_j is the effective production of the sector under consideration, meaning that E_j would be the direct employment multiplier:

$$\text{Multiplier of total employment effect} = Ej^*BR$$

and BR is, again, the inverse interior matrix.

2. Obtaining total economic impacts on production, Added Value and employment

By applying the above impact multipliers to the value of production at the parks we obtain the total impact on the GDP and employment variables. Furthermore, from these calculations one may also estimate the impact this activity has on taxation by applying the coefficients defined under the tax regime involved. In our case, the coefficients were:

Table 1. Description of coefficients used for impact.

EFFECT	PROCEDURE
MULTIPLIERS OF ECONOMIC MACRO-MAGNITUDES	
GROSS DOMESTIC PRODUCT	Total GDP generated by activity at parks (direct + indirect impacts). Applied on value of production
EMPLOYMENT	Total employment generated by activity at parks (direct + indirect effects). Applied on value of production
MULTIPLIERS FOR PUBLIC AUTHORITY REVENUES	
NET TAXATION ON PRODUCTS	Net taxes on Production as a component of GDP at market prices. Applied to estimated GDP
CORPORATION TAX	Corporation tax as percentage of GDPmp. Applied to estimated GDP
NATIONAL INSURANCE CONTRIBUTIONS	Effective total social contributions divided into employment level. Applied to Total estimated Employment
Personal Income Tax	Personal Income Tax as percentage of total Remuneration of Wage-earners. Applied to an estimate of the average salary of Total estimated Employment
TOTAL	Sum of all these previously calculated effects

Source: Report on socioeconomic impact of Spanish Science and Technology Parks. (APTE 2007)

Having presented the methodology, we need to mention two of its aspects:

- For the sake of intellectual prudence, we preferred to keep the analysis within the quantitative relations confirmed by the Input-Output Tables. In other words, we avoided working on the basis of a hypothesis (true but not quantitatively confirmable) about the greater impact induced by activities at Science and Technology Parks as a consequence of the greater added value achieved through higher technological content (see average productivity of companies housed at Parks compared with the Spanish average), more highly skilled and qualified employees and therefore higher salaries, and the greater pace with which innovations are introduced and the consequently greater drag capacity on other production activities.

- We preferred to use strictly homogeneous data and methodologies for all Parks to obtain comparable and accumulable data so we could make projections for Spain as a whole. This led us to discard, in some cases, the data available in individual, more detailed studies, which in general give higher impact results than our report owing to the fact that they work with detailed information that enables them to take account of the differential aspects mentioned in the foregoing paragraph.

The figures offered below were obtained with a proven methodology based on prudent suppositions, and that the results obtained are most likely infra-estimated, but in any case it is not probable that they are overestimated with regard to reality.

IV. RESULTS

Initial consideration

The methodology described above was applied for the Spanish case to 11 APTE member parks

- Parque Tecnológico de Andalucía (Málaga, Andalusia)
- Parque Científico-Tecnológico Cartuja 93 (Seville, Andalusia)
- Parque Tecnológico de Ciencias de la Salud de Granada (Andalusia)
- Parque Tecnológico de Boecillo (Castilla y León)
- Parque Tecnológico de Galicia (Ourense, Galicia)
- Parque Científico Tecnológico de la Universidad de Alcalá (Community of Madrid)
- Parque Científico de Madrid
- Parque Tecnológico de San Sebastián (Basque Country)
- Parque Tecnológico de Álava (Basque Country)
- Parque Tecnológico de Vizcaya (Basque Country)
- Parc Científic de Barcelona (Catalonia)

The impact of the parks considered in the report was analyzed on the basis of two territorial dimensions, national and local levels. The analysis for Spain as a whole was based on the aggregate data provided by the APTE. Local[13] analysis estimates exclusively the impact of the 11 Parks in question, and is based on the figures provided by each one.

Further, the impact results were completed in a second phase by other quantitative indicators (employment in R&D and expenditure on R&D) that give an idea of the significance of the Parks in the Spanish Innovation System and Regional Innovation Systems.

Finally, an estimate was made of the activity generated by the Parks for the public sector in tax and other revenues.

National impact results

As they stand, the results highlight the importance of the national impact of the APTE technology parks. In 2005, the total share of park activities and the traction effect generated on the economy came to 0.65% of the Spanish GDP.

Further, the percentage of the GDP generated by the parks increased in the 2001-2005 period, accounting for 0.44% of Spain's GDP in 2001 to 0.65% in 2005.

Total employment generated as a consequence of the APTE parks' activities accounted in that same year for 0.60% of total employment in Spain. The share in State tax revenues originating in the activity generated by the APTE shows similar percentages.

The percentage of jobs generated by the Parks in relation to total employment in Spain increased from 0.34% in 2001 to 0.60% in 2005.

[13] The administrative reference for local analysis was the province, an intermediate dimension in Spain between the Region and the Municipality.

Graph 1. Impact of APTE parks on national GDP and employment

Source: *Report on socioeconomic impact of Spanish Science and Technology Parks. (APTE 2007)*

Average APTE productivity was noticeably higher than the Spanish level and similar to the figure for leading countries worldwide such as the United States or Finland. The actual figure was 62.54% higher than the Spanish figure for 2004.

Table 2. Comparison of values in productivity

2004	PRODUCTION (Million €)	JOBS	PRODUCTIVITY (€ per job)
APTE	6,115	45,492	134,419
Spain	1,584,683	19,162,800	82,696
USA	17,794,715	145,789,000	122,058
UK	3,169,121	29,495,000	107,446
Finland	275,798	2,367,000	116,518

Source: *Report on socioeconomic impact of Spanish Science and Technology Parks. (APTE 2007)*

The report also highlights the high share percentages in R&D variables. Research staff working at the Parks accounted in 2005 for 5.8% of all Spanish researchers, this variable having improved from 5.03% in 2001.

Table 3. Employment in R&D at Parks as percentage of Spanish total

TOTAL APTE EFFECTS ON COUNTRY					
	2001	2002	2003	2004	2005
Employment R&D APTE	6,330	7,108	8,115	9,330	10,140
% of Spanish total	**5.03**	**5.29**	**5.35**	**5.76**	**5.8**

Source: *Report on socioeconomic impact of Spanish Science and Technology Parks. (APTE 2007)*

With regard to the tax revenues generated by global park activity, the effects were divided according to the tax headings affecting the economic activities of firms located at APTE member parks.

Table 4a. Tax revenues generated by companies at Parks in Spanish total

REVENUES FOR PUBLIC AUTHORITIES, APTE (Million €)					
(M€)	2001	2002	2003	2004	2005
Net Taxation on Products	299.41	372.56	437.27	483.09	592.03
Corporation Tax	93.12	115.87	135.99	150.24	184.12
National Insurance Contributions	337.52	419.99	492.92	562.62	667.39
Personal Income Tax	127.52	158.68	186.24	212.57	252.08
TOTAL	**857.57**	**1,067.10**	**1,252.42**	**1,408.52**	**1,695.62**

Source: Report on socioeconomic impact of Spanish Science and Technology Parks. (APTE 2007)

Table 4b. Share of tax revenues generated by Parks in national total

REVENUES FOR PUBLIC AUTHORITIES, APTE (%)					
% Spanish Total	2001	2002	2003	2004	2005
Net taxation on Products	0.43	0.52	0.56	0.57	0.64
Corporation Tax	0.45	0.49	0.53	0.51	0.51
Nat. Insurance Contributions	0.51	0.59	0.65	0.69	0.8
Personal Income Tax	0.26	0.3	0.33	0.37	0.39

Source: Report on socioeconomic impact of Spanish Science and Technology Parks. (APTE 2007)

Growth in each tax revenue heading has been constant, in absolute terms and in relation to the total collected. This aspect is important. For any discussion on the interest of public investments needed to create the Parks, one has to know that, besides improving the respective innovation systems, the Parks have generated significant financial return for the public sector.

Even so, a specific study is required to determine the real rate of return on such public investments. Such a study would also need to differentiate between the territorial levels at which the investments are made and revenues plus a more sophisticated analysis of the yield in terms of the individual taxes.

Regional (provincial) impact results

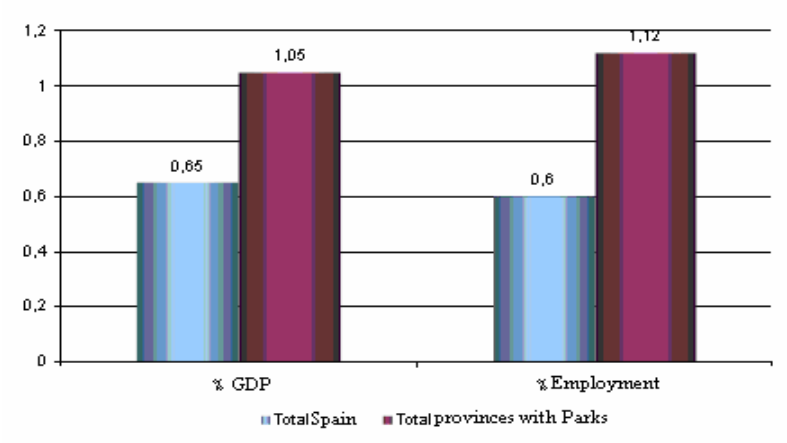
Although the values presented above are significant in themselves, the impact obtained in smaller geographical environments is substantially greater. This aspect acquires greater relevance if we are looking to analyze the effect each park has on its immediate surroundings.

Until now we have presented the results of economic activity at the Parks in respect of the total for the Spanish economy. However, as not all Spanish provinces have a Park working at full capacity, it is necessary, and more representative, to calculate exclusively the Parks' contribution to the economy of the provinces that have had Parks up and running for a sufficient length of time to be considered mature. Most of the literature considers at least 10 years are necessary from the moment a Technology Park is created to the time it can be evaluated, as before that there is not enough time to lay out the park's streets and services, attract companies and generate synergies

between them. Even so, several Parks included here have not been running 10 years, so once again we used a prudent, conservative methodology to measure impacts.

The percentages calculated show a contribution to the aggregate GDP of the provinces with Parks running actually of 1.05% in 2005 (compared to 0.65% for all Spain), and employment of 1.12% (compared to 0.6% for all Spain).

Graph 2. Share of GDP and employment at Parks at national level and in provinces



***Source**: Report on socioeconomic impact of Spanish Science and Technology Parks. (APTE 2007)*

After, the territorial limited analysis was decided for the seven most consolidated parks as being the ones reflecting better the real impact of a "standard" park to the greatest extent in the long term. The parks considered were Álava, Vizcaya, Guipúzcoa, Ourense, Boecillo, Málaga and Seville.

Total GDP generated by these 7 parks has a very high share in their respective provinces. Furthermore, the tendency has been for them to increase their influence, as they went from 3.13% of the GDP of their provinces in 2002 to 3.49% in 2005. This figure indicates that business dynamics are clearly superior in the Park environment to the economy's average. Employment began at a percentage of 2.76% of the provincial total in 2002, rising to 3.43% in 2005.

Graph 3. Share of GDP and employment at consolidated parks in their provinces

***Source**: Report on socioeconomic impact of Spanish Science and Technology Parks. (APTE 2007)*

With regard to employment in R&D generated at the Parks over the provincial total, the figures for the Álava Park were included from 2004 onwards and are unavailable for the Cartuja 93 Park. Despite this, the parks with figures available for their respective provinces are clearly pulling their weight, accounting for 66.15% of total provincial R&D employment in 2005.

Table 5. Consolidated R&D employment at Parks in their respective provinces

	2002	2003	2004	2005
Consolidated R&D Employment Parks	3,707	3,765	4,676	5,437
%	56.61	51.78	60.95	66.15

Source: *Report on socioeconomic impact of Spanish Science and Technology Parks. (APTE 2007)*

The figures are an example of how important the "clusterization" of business research activities associated with the Parks is to the Spanish innovation system as a whole. In the mid- to long-term, this associational clusterization will transform the innovative drive of the Spanish economy, creating the objective basis by which two factors essential to facilitating a creative milieu may come spontaneously into being: cross-fertilization and the legitimization and visibility of innovative and research activity.

In Spain the visibility generated by concentrating technological companies and research activities in physically attractive areas like the Parks is a clearly positive reference point for the population as a whole in initiating and stimulating a change towards a culture based on innovation and progress.

V. SCIENCE AND TECHNOLOGY PARKS IN SPAIN: THE FUTURE CALLS

From the methodology proposed and with the figures obtained in the previous chapter, it is possible to produce a set of estimates, based on the data for 2005, that enables us to observe the possible impact of APTE Parks should the projects currently underway have been up and running and Parks had spread to the Spanish economy as a whole in the mid- to long-term.

We looked at three alternatives. The first two estimates are for a point in time not too far distant. It is interesting to note that, despite two radically different starting assumptions, the resulting values do not greatly diverge, which suggests that the results do not deviate to a significant extent from an achievable situation.

In the third hypothesis, we made a projection for APTE to spread to Spain as a whole, i.e. a park in every single province or basic territorial unit. If we extend the "standard" consolidated park to the entire country, it is possible to obtain an impact at national level similar to the one registered for this type of park in their immediate surroundings.

Table 6. Comparison of future projections with the current APTE situation

2005	APTE TODAY	APTE at full development (M2)	APTE throughout Spain on basis of HAMT(High and Medium Tech) firms	APTE throughout Spain (1 park per province)
% GDP	0.65%	1.27%	1.84%	3.48%
% Employment	0.60%	0.93%	1.60%	3.18%
% Net Taxation on Products	0.64%	1.25%	1.81%	3.42%
% Corporation Tax	0.51%	1%	1.44%	2.72%
% Nat. Insurance Contributions	0.80%	1.23%	2.12%	4.22%
% Personal Income Tax	0.39%	0.60%	1.03%	2.04%
% R&D Employment	5.80%	11.28%	16.14%	29.78%

***Source**: Report on socioeconomic impact of Spanish Science and Technology Parks. (APTE 2007)*

The first projection (m2) was based on the consideration that, in square metres, the short-term expansion of APTE would give the same billing/surface area ratio as the projected surface area now up and running. This is perhaps the most realistic and reliable projection of the three, as it refers to projects that will be operating in a fairly short period. With respect to the present situation, the increase in the % share in the total of the Spanish economy advances substantially, increasing in some variables up to 50% of the current value.

Unlike the previous one, the second projection (high and mid-tech businesses – HAMT) estimates hypothetical turnover for 2005 as if there had been a park in every Spanish province. The number of enterprises as a result of the expansion involved was calculated via the application of the average ratio of APTE firms/ total HAMT firms for each province to the national total of HAMT enterprises, and this in turn by the average ratio of turnover per company located at APTE parks.

In this second case, by extending the average level of actual activity of the Parks to all Spanish provinces, the assumption of short-term reality is relaxed to a certain degree to reveal the possible effects of a greater extension of APTE over the country as a whole. As we can see, the result is a higher value for all indicators with regard to the current situation (virtually 3 times more) and also with regard to the previous estimate in hypothesis 1.

Finally, the estimate based on the assumption of a "standard consolidated" park per province (50 in Spain as a whole) shows a situation further removed from reality, in so far as it presupposes the existence of a completely consolidated park in every province in the country. Logically, given the size, activity and specialization proper to each zone, this estimate is unlikely to materialize in the future.

However, rather as a strict foresighting exercise, unlike, to a greater or lesser extent, the other two estimates, this last projection should be understood as an imaginative hypothesis to show a long-term vision of a Spanish economy fully adapted to the knowledge society. In any case, this latter estimate enables us to appreciate the potential and significance of science and technology parks in the Spanish case, and in general in any economy that seeks to compete in terms of knowledge.

VI. CONCLUSIONS

Although far from being perfect, the input-output methodology is today the most used, and perhaps the most objective, in the calculation of economic impacts. In view of possible faults attributable to the methodology used, the criterion of prudence was applied throughout the study, with the most conservative alternatives or hypotheses being chosen to assure that the impact measured was in no case overvalued, so as not to call into question the validity of the values achieved.

This cautious approach is fully justified if, as we pointed out, we take into account the limitations of the model. In the first place, the availability of the Input-Output tables for a single (or limited number of) year(s) is already a problem, particularly when one is looking to understand the impact from a dynamic perspective of qualitative change in sector-to-sector relations.

Secondly, the tables show average values, something that, although susceptible of partial correction, is also an obstacle to understanding the induced effects of activities that stray from the average, which, once again, is the case of the activities performed at the Parks. The same occurs with employment, which in the case of firms installed at the Parks is of higher than average quality.

Despite all these limitations and precautions, the results remain spectacular. Taking into account only the 7 relatively mature Parks, these already generate 0.65% of the national GDP and 5.8% of the jobs in R&D in all Spain. But—and this is even more significant—these values, when compared with their respective provinces, already increase to 3.49% of GDP and 66.15% of employment in R&D.

It is also important to stress the fact that average productivity of the activities performed at Spanish parks is significantly higher than the average of any economy, including the US economy. In the Spanish case, it is 62.54% higher than the average for the entire Spanish economy. This fact becomes especially relevant with productivity being the decisive factor for long-term economic growth and for the competitiveness of nations. As Krugman[14] (1990) noted, "*productivity is not everything, but in the long term it is practically everything*."

On the basis of the figures presented in this analysis we may conclude that the parks are not only an essential instrument in R&D (+I) policies, but are also decisive players in national, regional and local economic development. For this reason, policy managers cannot afford to ignore the potential these tools give them, not only for maintaining sustained growth in the developed regions, but also as a stimulating factor for R&D (+I) in less developed regions.

As we have highlighted for the Spanish case, a 0.4% increase of the Spanish GDP, and an increase of almost 6% in R&D personnel, will be achieved just by carrying out the development plans for existing land at the new Science and Technology Parks.

But what is even more significant is that if a profound, long-term commitment led to the phenomenon being extended to the whole of the Spanish economy, the GDP would increase by nearly 3% and the number of R&D personnel would go up 25%.

Besides the advantages already noted, the Parks are also extremely profitable tools for the public sector. The study makes clear how Park activity generates a flow of tax revenues for the state and the regions that offset in the short-mid term the funds invested in them. Specifically, tax figures

[14] Krugman, Paul R. (1990). "The Age of Diminished Expectations". Cambridge: MIT Press.

suggest they generate between 0.2 and 0.5% of Spanish tax revenues, although in a very short time the figure could well account for more than 1% and in the long-term more than 3%.

The reason why the Parks are so beneficial to the Spanish socioeconomic and innovation system lies in a synthesis of the aspects that favour and encourage R&D (+I) activities, including suitable space, innovation support activities and player-to-player proximity.

In this sense, in Spain the Science and Technology Parks are helping to increase relations between the academic world, technology centres and business, thereby favouring the creation and consolidation of new technology-based companies and an increase in the intensity of R&D (+I) activities in businesses in general.

In short, besides facilitating cooperation between players within and beyond their own boundaries, the Parks have helped to generate synergies and cross-fertilizations, attract talents, develop new businesses and, above all, to bring about a cultural change in their environment. But perhaps the most important thing, as this report underscores, the Science and Technology Parks have been confirmed as one of the most efficient instruments available to countries and regions for consolidating the modernization of the economy and increasing wellbeing of society. As Benjamin Franklin noted, "*there's no more profitable investment than in knowledge*."