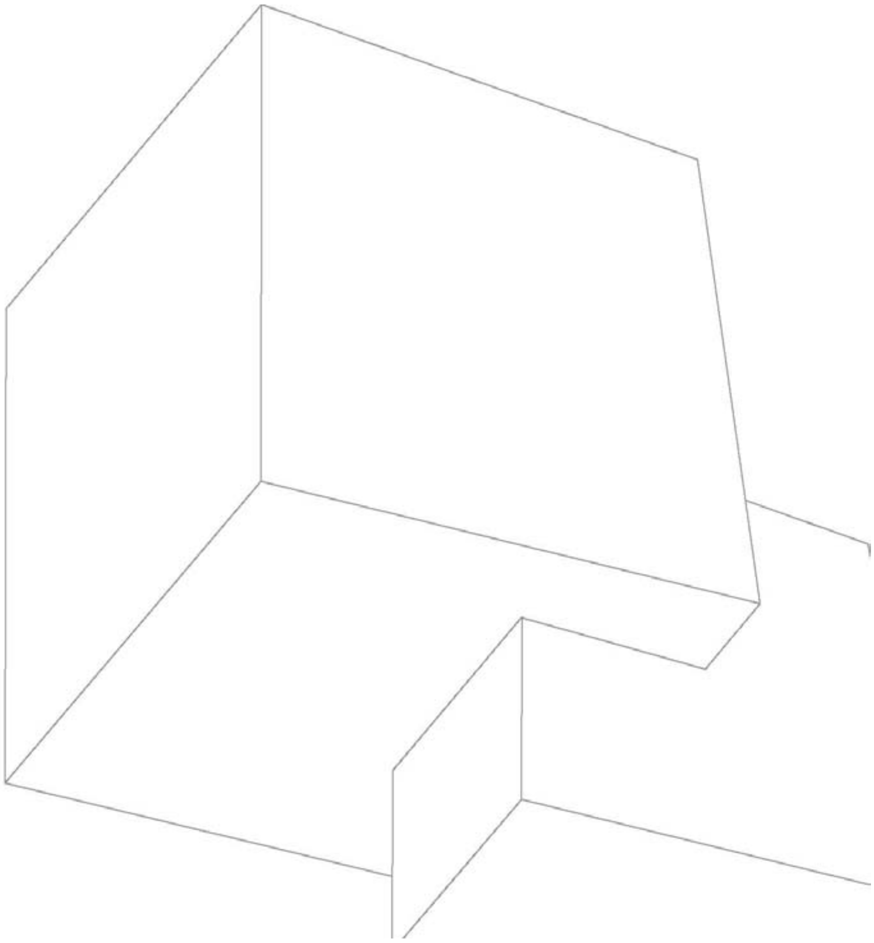
APTE

A STUDY OF THE SOCIAL AND ECONOMIC IMPACT OF SPANISH SCIENCE AND TECHNOLOGY PARKS



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Asociación de Parques Científicos y Tecnológicos de España

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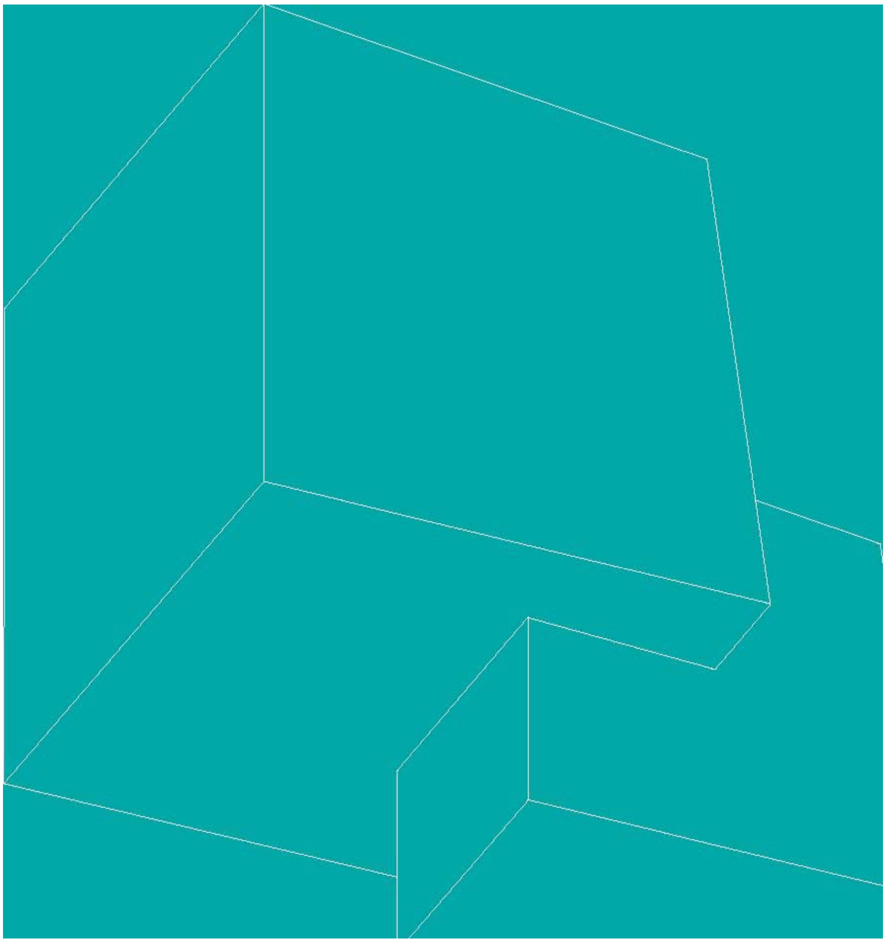

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FOREWORD

In summer 2005, within the El Escorial summer courses, a joint seminar was held by the Spanish Ministry of Education and Science and the Association of Science and Technology Parks of Spain (APTE), entitled “Science and Technology Parks: Our Silicon Valleys”.

We had the opportunity to discuss a project which might allow us to gauge the social and economic development of Spanish parks, and also to analyze their future from the point of view of their economic impact on their environment, and their ability to transform the Spanish innovation system. As a result of those discussions, APTE and eleven science and technology parks submitted this project to the parks department of the Ministry of Education and Science.

This book is a summary of the work carried out. After hundreds of pages written, a new methodology has been created for assessing the impact of parks at a provincial, regional and national level, and most importantly, it has been proved how the Spanish innovation system may improve with the development of the new parks that are currently in the project stage.

I feel sure that the persuasive data contained in this study will be an excellent instrument in order to plan new policies helping us to reach European levels concerning research and development (R&D).

Our thanks to the Ministry of Education and Science for their financial support to this project, to all the technical staff from the eleven participating parks for their devotion and effort to find the most relevant data constituting the basis for this study, to the coordination and enthusiasm by the technicians at APTE and Infyde, who have been able to develop the methodology for this complex project, and more specifically the director of the Project, Jaime del Castillo (University of the Basque Country), Regina Sauto (Infyde S.L.), José Moreno (University of the Basque Country), Jonatan Paton (Infyde S.L.), and Carlos Rivera (Infyde S.L.).

And especially, to David Gastearena. In memoriam.

Felipe Romera
Chairman of APTE

FOREWORD

Over relatively few years, science and technology parks, which were seen as a a promising instrument for the modernization of the Spanish innovation system, have become a well-established reality.

Their expansion has been a spectacular one: according to the data provided by APTE, from about 1,000 firms and research centres located in parks in 2000, we have moved to 2,600 in 2006; from 25,000 to over 79,000 workers; from 3,000 to 9,000 millions in turnover. In other words, over the last six years technology parks have more than doubled their main indicators.

In addition to this, parks offer now structures which are well-connected at a national and international level, able to provide all kinds of services supporting innovation, including firm creation and international transfer of technology. Thus, they are responsible for a sizeable part of the innovation support services in Spain. Also, in many cases they provide the ideal space for the meeting of university research groups, technology centres, new technology-based firms and well-established firms. For all these reasons, they have become a key component of our innovation system.

This has led the Ministry of Education and Science to give strong backing to these infrastructures. Indeed, over the last years a complete scheme has been developed supporting the scientific and technological activity developed in these parks, trying to adapt to their specific circumstances and to the needs of the organizations that are located therein.

As new entrants to our science and technology system, parks require profound analysis. It is essential to closely study their impact upon the economy and upon their environment, in order to allow both the promoters and managers of the parks, but also the government bodies supporting them, to take suitable decisions when designing support mechanisms.

In this respect, this study is an interesting approach to the social and economic impact of parks in terms of their contribution to GDP and employment creation. Even with all methodological caveats (which have rightly been pointed out by the authors), it seems that the parks have had an important influence upon the creation of wealth and employment in the provinces in which they are located; this influence indeed matches the perception by the government institutions that have promoted their development. Obviously, parks must also be assessed regarding their specific impact upon the Spanish science and technology system —national and international R&D projects, publications and patents, technology transfer agreements, creation of technology-based firms—, an area which could be covered in a separate analysis.

Finally, this study proves the hard work carried out by the Association of Science and Technology Parks of Spain towards the establishment of these parks in our country. An increased awareness of their role in technological and economic development is not only of interest for government institutions, but is also one of the challenges of the Association itself. Indeed, and now more than ever, it is a common objective to show the relevance of science and technology parks in Spain, and to progress towards their maturity by stressing their role as promoters of technology and corporate innovation.

For all these reasons, we must express our satisfaction at this work carried out by APTE, which is an interesting contribution towards a better knowledge of our science and technology system. We hope that this is only the first step in an increasingly necessary area of research.

Miguel Ángel Quintanilla Fisac
Secretary of State for Universities and Research

1›

ECONOMY, INNOVATION AND THE SPATIAL DIMENSION OF CORPORATE STRUCTURE

The growing competition at a global scale between major countries and other powerfully emerging nations, such as China and India, is leading towards the search for, and development of, new instruments helping countries to become more competitive.

In this context, there is a crisis in the traditional approach to competitiveness as a phenomenon linked to the provision of services (comparative advantage); this has been replaced by a focus on knowledge and innovation as a source of economic growth and development of competition (competitive advantage).

Given this new framework, Europe is at present in a worse position compared to the United States and Japan, regarding R&D intensity and innovation. Attempts have been made to improve this situation by promoting new innovation policies within the EU (Lisbon Strategy, framework programmes, etc.).

Also, R&D&I promotion is not only done at a European or national scale; rather, increasing emphasis is made on measures at a regional and local level.

At this regional and local level, the development of innovation and R&D processes is closely related to the general environment of all players, but also to the most immediate context. Thus, the mutual relationships between industry, the Government and the research players (universities and other bodies with technology centres) are part of this environment, and have an influence upon these processes.

These players, and the way they relate to one another within the processes leading to innovations, form the so-called (national or regional) innovation systems.

This is where science and technology parks have a role in the promotion of R&D&I as a key component in the whole process, within an innovation system. Thus, a park tries to facilitate the transfer of knowledge from research players to firms, so that this knowledge eventually becomes innovation and reaches the market.

Concerning the various strategies the Government has used in the promotion of R&D&I, the former linear innovation model, where it was assumed that any investment in R&D automatically led to innovation and market results, has been replaced by another, whereby the process is seen as a set of interactions and feedback between various players and areas.

1.1

TRENDS IN INTERNATIONAL ECONOMY

Over the last years, and more specifically during the last two decades, great changes have taken place in the global scene. These economic and technological changes have been accompanied by the globalization of economic activity and an increase in international competition, including the rise of India and China, Free Trade Agreements (FTAs) in America, or the enlargement of the European Union.

In addition to globalization, present economy is characterized by new technologies, new products, the new division of labour and the global dimension of markets. These new production forms cross all borders, not only in the political, but also in the historical, geographic and cultural sense[1].

Globalization has led to a worldwide economic integration process, in which trade, capital and technology are interrelated. The situation can be analyzed from a economic, a social or a cultural dimension, each of them with its own nature and contradictions, which sometimes lead to a refusal of globalization, and in other cases to viewing it as an opportunity for greater development for countries.

As a consequence, there is a crisis in the view of competitiveness as a purely macronomic and sectorial phenomenon, determined by comparative advantage (due to the natural availability of factors). The present theories point out that these advantages can be created by the interaction between the global and the local scale.

In this context, a firm's social, economic and institutional environment becomes more and more important. This is why there is renewed attention towards the regional/local factor in development matters, especially as regards innovation.

This new role of the regional and local level has not resulted in one single interpretation: there are two prevailing ways of understanding the role of each theory, with an emphasis on the "tension" between the national, regional and local scale in a global scene[2]:

- A first approach points out the need to strategically position each specific territory within the global scene. Therefore, local government should try to expand its scope of action, and its traditional roles should be supplemented by designing and implementing local development strategies leading to the generation of territorial competitive advantages.

- A second approach attempts to maximize the endogenous potential of each territory, and to express the suitability of, and need for, coordination between different territorial scales. This approach feels the need to interpret the development process as a system, promoting a type of economic growth that recognizes competitive challenges, tries to boost local resources and better profit from external resources, in order to create employment and improve the lifestyle of the local population.

However, the relationship between the global and the regional/local component, and its influence upon firms, is due to a number of factors that account for the differences between local systems, namely[3]:

(i) The characteristics of the pre-existing environment, which determine the strengths and/or weaknesses of the local systems.

(ii) If there is a regional/local system that actually works and generates positive externalities, the players require a lesser individual effort in order to obtain competitive advantages and profits in the market. However, not all firms are capable of profiting from a beneficial institutional atmosphere, deriving from a properly functioning regional/local system.

(iii) Institutional development is an important factor regarding the innovative capability reached by the players.
(iv) The degree of development of the regional/local system (the strength of its institutional bodies, the relationships between players, the existence of multiple interfaces between players) is a key factor for firms' competitiveness.
(vi) The possibility to develop learning and knowledge processes in a territory becomes a key factor which promotes a framework for the interpretation of the growing economic uncertainty and complexity.

An understanding of the mutual relationship between the global and the regional/local sphere, and the importance of the latter for the attainment of increased competitiveness levels, are reflected mainly in the evolution theories and the studies on the innovation systems. Such studies focus on the interactions, rather than on what happens within firms; in other words, emphasis is made on the importance of the systems –and not only of individual technology centres and firms– in the innovation processes.

In short, the recent literature stresses the importance of local systems through production specialization processes leading to clusters, participation in productive networks increasing the local weight of the supply chain, the development of an institutional atmosphere supplementing the industrial one, and the key role of the learning processes developed by the various players.

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1.2

THE IMPORTANCE OF THE ENVIRONMENT FOR INNOVATION PROCESSES

All the developments we have discussed so far have led to an important notion, that of the National Innovation System (NIS), which was first described in Freeman's seminal study on innovation in Japan (1987).

The scientific literature describes an innovation system as "a set of both corporate and institutional bodies, which within a certain sphere, interact with one another with the purpose of allocating resources to activities attempting to generate and disseminate the knowledge that supports innovations"[4], or also as "the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify, and diffuse new technologies."[5]

This conceptual framework was not restricted to national innovation systems; shortly after its appearance, a number of scholars started to apply it to the regional sphere.

There are five elements which make it possible to point out specific factors for national innovation systems in a given country[6]:

a. The specific organizational structure existing within corporations, because it is very important for the generation of innovations.
b. The relationships between firms, which are essential for the transfer of knowledge and technology.
c. The role of the public sector, which to a great extent influences the quantity, quality and interests of research, and also the way innovations are developed.
d. The institutional structure, given its role within innovation systems.
e. The organization and intensity of R&D, because it is closely related to innovation processes.

A few common statements can be made summarizing the conceptual framework for innovation systems:

1. Firstly, innovation is central to the analysis, and it is connected to learning processes in specific contexts.
2. An approach is taken trying to encompass all the factors in innovation; such approach is an interdisciplinary one, since it considers both economic and institutional, organizational, social and political factors.
3. There is an implicit recognition of the differences existing between innovation systems, and of the lack of an ideal innovation system.
4. There is an emphasis upon mutual dependence (inherent to the idea of a system) and upon a non-linear view of the innovation process.

Thus, the innovative power of a system (be it national or regional) does not only depend on its quantitative effort regarding R&D (expenditure and staff) and its technological infrastructure, but also on the generation of externalities through the interaction between the various players in the system, such as firms or public government institutions.

At this stage, it must be pointed out that there is no linear relationship between technological efforts (financial and human resources) and the level of the scientific and technological results of the process, and neither with successful market comercialization. A minimum critical mass is required regarding resources (expenditure on R&D, human resources and accumulated experience) so as to obtain a minimum result (indivisibility of innovative activities). The need for a critical mass, the existence of increasing yields from the use of certain facilities and equipment, the long maturity process and the need for highly specialized staff, all lead to a concentration of innovative activities.

This framework implicitly requires a broad definition of innovation, because the system includes not only the players and factors directly linked to research and development activities, but also other players or factors with an indirect influence upon innovative activities. These are, amongst others, the financial system and venture capital, the educational system, or market demand. Also, the limits between these elements are sometimes fuzzy, and there is an amount of overlapping between the various spheres.

Finally, we shall comment on the development of regional innovation systems (RIS).

The notion of regional innovation systems may be seen as an extension and adaptation of the idea of national innovation systems. The purpose is to increase a region's innovative ability through relations and cooperations between firms, encouraging the development and productive usage of specific local capabilities and the synergies between the various regional bodies and institutions.

Largely as a result of regional science and economic geography studies, and also by the development of industrial cluster analysis (notably the work carried out by Porter), the analysis of innovation systems at a regional scale has become a reference, even to a greater extent than other studies at a national level.

Thus, regional innovation systems are a new theoretical approach in the area of regional development, analyzing and detecting the existence of regional clusters and competencies. RIS require coordination between the various players, including local government, chambers of commerce, venture capital societies and employers' associations. These organizations are involved in the various stages of the process, with the aim of facilitating cooperation and decision-making, and also supporting the regional innovation system.

In the definition of a regional innovation system[7] four main components can be distinguished:

1. knowledge and collective learning processes;
2. social capital;
3. externalities and spatial location; and
4, modes of organization of the regional innovation process.

1. KNOWLEDGE AND COLLECTIVE LEARNING PROCESSES

In a scenario defined by fast and continuous technological changes, the power for adaptation and collective learning are key factors to increase the competitiveness of a region.

The new theories on growth emphasize the importance of knowledge within a wider framework, where R&D activities are the result of the optimizing action of the various economic players, which through interaction generate mutual learning processes. In this situation, R&D activities must be seen as an integral part of a complex system, which cannot be separated from all other activities carried out by a firm.

2. SOCIAL CAPITAL

The availability of social capital is a major component of a region's innovative ability. Social capital is associated to those characteristics of a firm, such as trust, development of rules and networks for mutual help and cooperation, which increase its efficiency through the implementation of coordinated actions.

Social capital results from a complex interaction between players and communities, organized in more or less informal institutional networks, which reflect the players' preferences and lead to collective action. Over time, this collective behaviour is codified by means of the creation of formal bodies.

3. EXTERNALITIES AND SPATIAL LOCATION

The existence of externalities is one of the reasons given to justify the role of regional policies. Firms obtain increasing yields due to the externalities created by the geographic proximity between them.

This concentration arises from the firms feeling the need to resort to external sources of scientific and technical knowledge and to a shared culture.

Knowledge externalities result from a collective learning process by the various economic players. This is fuelled by a number of types of local interactions, including informal discussions between workers within the firms, the mobility of qualified staff and the informal exchange of ideas through associations.

4. MODES OF ORGANIZATION IN A REGIONAL INNOVATION PROCESS[8]

There are various modes of organization of the innovation process at a regional level, such as the industrial district, the innovative environment, or clusters. Technology and science parks are one of the instruments available to organize innovation processes and flows both in a specific area and in its hinterland.

1.3

FORMS OF PUBLIC INTERVENTION FOR THE PROMOTION OF R&D&I

In the field of scientific and technical knowledge, there are uncertainties and imperfections that prevent the market mechanisms from adequately allowing an ideal allocation of resources. This is why developed countries have adopted a proactive stance in this area, by designing and implementing policies concerning science, technology and innovation.

Until the mid 70s, technology was considered an exogenous factor, according to the then prevailing neoclassical theoretical framework. This corresponded to what has been called the Linear Model of Innovation.

In this model, the inputs or resources (in this case, R&D) were transformed into results (products) by means of a production function. This process started with the development of basic research, and finished when the innovation reached the markets. Innovation, therefore, was the result of a linear process, with isolated stages which were not influenced by either institutions or the market.

This view provided the foundation for the first generation of innovation policies, which were no more than research support policies.

It was only when the process was seen as an interactive one that a new alternative developed, more in agreement with the real scenario. On the one hand, technology is dealt with as knowledge, accepting the costs this entails, and on the other, there is a great emphasis on innovative activities; these are viewed as a continuous interaction between various elements and players, from invention to the final link in the chain (eventual commercialization of the results).

Unlike the linear model, which focused only on the technological activity of the R&D department, the interactive model underlines the importance of a firm's technological capabilities as a whole. Innovation is considered as a corporate strategic process affecting all levels, with a dynamic evolution and constant feedback effects between all the stages.

The eighties witnessed the confirmation of the evolutionist theory, which laid the foundation for a shift towards a new type of second-generation innovation policies.

However, recent documents and research point out the appearance of a third generation of innovation policies, aiming to integrate innovation within the set of policies implemented by a Government in a specific country. Innovation is today seen as a horizontal policy, but must be integrated within a broad range of vertical policies.

The key for third-generation innovation policies lies in interaction. This requires the development of interfaces making it possible to share knowledge, learn from experience and establish coordination initiatives.

In short, there is a need for integrators, such as science and technology parks, in order to give access to intelligent networks and to appropriate local innovation by means of various forms of protection.

This policy must consider a number of important issues. Firstly, it is necessary to start from the cultural components identifying the regional/local system, that is, to recognize the diverse behaviours and evolution modes; this precludes the possibility of automatically reproducing policies which have been implemented in other local systems, both in the same and in other countries.

Secondly, it is necessary to start from what is already in place; there are not only previous conditions (of a domestic and/or international nature), but often also policies (programmes, projects, laws, activities) and/or private actions being implemented. This means that, as a rule, there are public and private organizations involved in this topic which must also be taken into account.

Thirdly, it is necessary to prioritize efforts. Therefore, there must be a tension between the initial diagnosis and the need to generate visible, short-term results which are compatible with the results expected in the middle and the long term.

Finally, it is also a must to have a clear idea of the real dimensions of the problems and the policies. Firstly, the relationship must be considered between the geographic area of the regional/local systems and the government jurisdictions with an influence upon such territory, since there is almost always a need for coordination between the institutional levels. Secondly, the real scope of effective working processes must be taken into account, both in the productive and commercial sphere, because although production may occur at a local level, the market and the competitive environment are global ones.

It is on the basis of all three analyses that a better study can be made of both the role of technology and science parks in the economy of knowledge in general, and in the Spanish economy in particular. However, in order to gain a better insight into the Spanish economy, a previous analysis is required of the situation of the Spanish innovation system.

2 › THE SPANISH ECONOMY AND INNOVATION SYSTEM

This chapter analyses the Spanish innovation system in order to expand the above information on the context in which science and technology parks operate.

For this purpose, this section will start by presenting the most relevant domestic economic data, with a reference to both the structure and the present situation. The analysis reflects the economic evolution of the whole of Spain and the specific features of the various regions, called in Spain “autonomous communities”. This information gives an idea of the relative position of the country within the European Union and in the international sphere. However, a specific focus is required on the context of each autonomous region, for there are considerable differences among them. Thus, some autonomous communities, such as Madrid, the Basque Country and Catalonia, have R&D indicators in line with the rest of Europe, whereas the less developed ones lie at a great distance from both the aforementioned regions and the average for the whole of Spain.

After an analysis of the most relevant national social and economic variables, a more detailed study is made of the Spanish indicators and innovation system.

In this section a thorough description is also offered of the contribution and role of the various players integrating the innovation system. In the case of the corporate structure, the study focuses on the innovation processes implemented by firms, and also on the importance of R&D for their activities.

Regarding the government sector, a distinction is made between actions concerning R&D&I at a regional, at a national and at a European level, listing the policies for each case, and the strategic approaches used.

2.1 THE SPANISH ECONOMY

2.1.1 BASIC FIGURES

Spain has a total area of 505,988 square kilometres, which amounts to about 12.78% of the total area of the present European Union (EU-25). The population is 44.11 million inhabitants (National Institute for Statistics, INE, 2005), equivalent to approximately 9.4% of the total for Europe. The recent demographic growth is mainly due to the increased registration of foreign citizens (76.45% of the demographic growth). The population growth rate is mainly due to immigrant mothers.

Concerning the most important economic variables, Spanish GDP at market prices in 2005 amounted to 904,000 million euros, which implied a 3.4% increase compared to the previous year (INE 2005).

Per capita GDP at current prices was 20,838 euros in 2005, i.e. 6.2% more than in 2004. Also, that year average per capita GDP, measured in PPP (Purchasing Power Parity) reached 97.6% of the EU average (Eurostat 2004, calculated upon EU-25).

As for the regional communities, seven exceeded the average Spanish GDP (Madrid, Basque Country, Navarre, Catalonia, the Balearic Islands, Rioja and Aragon), whereas only 4 were above the European average (Madrid, Basque Country, Navarre and Catalonia).

As for foreign trade, it accounts for 42.58% of GDP (exports + imports). On the other hand, the trade balance shows a deficit, with imports accounting for 60.1% of international transactions. Thus, the weight of imports compared to GDP is 25.59%, whereas exports only account for 16.98% (INE 2005).

Regarding the sectors in the Spanish economy, the services sector appears as the most important one, with a percentage of 67.02% of GDP. Industry (including the building sector) accounts for 26.4%, and agriculture for 3%. Finally, net taxes on the economy account for 10.4% of GDP (INE 2005).

As for the Spanish labour market, the active population amounts to 20.9 million people (Active Population Survey, EPA, 2005) and the Spanish activity rate is 57.4%. The number of unemployed people in 2005 was 1.9 million, with an unemployment rate of 9.2% of the active population.

2.1.2 PRODUCTIVE STRUCTURE

The services sector

In 2005 services accounted for 67.2% of GDP (INE 2005). Within this figure, 75% corresponded to market services. Also, from the point of view of employment, services employed 65% of the active working population (EPA 2005).

Services firms represent 78.4% of the total number, with a predominance of SMEs. 99% of firms have less than 50 employees, have a turnover of 57% of the total, and provide jobs for over 66% of people working (INE 2005).

Concerning the various regions, the highest percentage in the business figures for the market services sector is held by Madrid with 25.4%, Catalonia with 19.6%, Andalusia with 12%, and Valencia with 9.7%. If we consider also the services addressed at firms, 58.4% of the total turnover corresponds to the Madrid region and Catalonia (INE 2005).

Out of the total expenditure on innovation in Spain, this sector accounts for 38.9%. Also, 27.3% of the service firms in Spain are innovative ones. The greater proportion of this type of firms is found in R&D services, with 75.6%, and computer activities, with 49.9% (INE 2005).

The industry sector
The industry sector comprises three large areas: manufacturing, extraction and power production. This economic sector accounts for 16.5% of GDP, which increases to 27% if the building sector is included.

Spanish industry has a fairly diversified productive structure, with a majority presence of small firms. In fact, more than 80% of the firms existing in the industry sector are microfirms (less than 10 employees), which increases to 95% if we include firms with 10 to 49 employees (Central Businesses Directory, DIRCE, 2002).

Regarding the various regions, more than half of the total figure for industrial turnover is accounted for by Catalonia, with 25%, Madrid, with 11.4%, the Valencian Community, with 10.8%, and the Basque Country, with 9.4%; this increases to almost 70% if Andalusia is also included (INE 2005).

The industry sector employs 3.3 million people, equivalent to 17.3% of the employment provided in Spain (EPA 2005).

The autonomous regions with a greater percentage of people employed in this sector are La Rioja (28.2%), Navarre (25.7%), and the Basque Country (25.6%), whereas in the Canary and Balearic Islands less than 10% of jobs are related to the industry sector.

As for industry R&D&I, 34% of firms are innovative ones. The greatest proportion of them are in the railway equipment and other transport equipment manufacturing sector (67.7%), coal, oil and nuclear fuel (64.3%) and the pharmaceutical industry (59.8%) (Survey on Technological Innovation in Spanish Firms, 2004).

The primary sector
Agriculture, farming and fishing account for only 3% of Spanish GDP, and rank last concerning their contribution to Spanish economy.

The agrarian sector is dominated by small farms, with an average surface area of 22.07 hectares. 54.25% of these have an area of less than 5 hectares, and only 8.9% have more than 50 hectares (INE 2005).

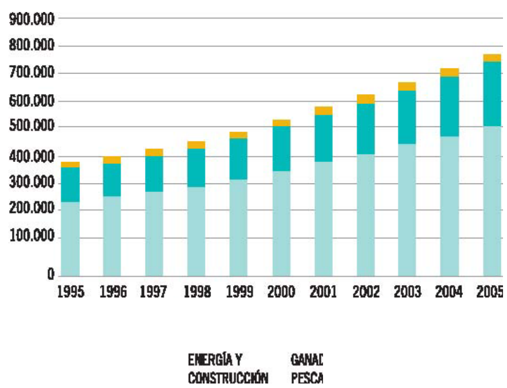
The communities with the largest average surface are Castile and Leon (51.19 Ha), Aragon (42.63 Ha) and Extremadura (39.18 Ha). On the other extreme, the Canary Islands and Valencia have the lowest average values (3.81 Ha and 4.59 Ha, respectively).

In European terms, Spain, with over 25 million hectares of surface area devoted to agriculture, is the second member state regarding surface area, agricultural population and number of farms.

2.1.3 HISTORICAL EVOLUTION OF MACROECONOMIC FIGURES

Over the last years, the absolute figures for Spanish GDP (at market prices) show a more or less constant positive evolution.

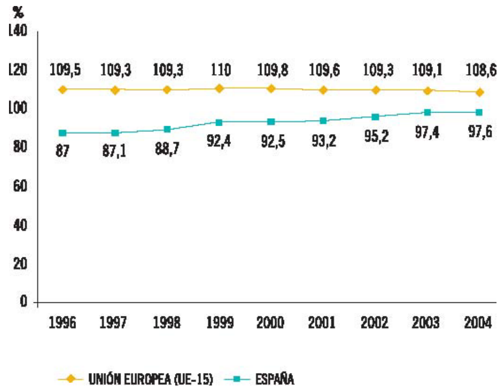
In general terms, the variation suffered by Spanish GDP at market prices between 1995 and 2005 (+102.46%) has entailed an increase from 447,205 to 905,4555 million euros.



The primary sector has lost weight compared to total GDP, and has gone down from 4.5% in 1995 to 3.2% in 2005. The secondary sector includes the power production, industry and building sectors. In spite of the differences between such subsectors, during the period studied (1995-2005) the total for this secondary sector grew by +95.9%. The services sector increased its relative weight within GDP, with a rise from 66.1% in 1995 to 67.4% in 2005.

By analyzing per capita GDP, it can be clearly seen that the variable in Spain tends to converge with EU-25. Thus, there has been an increase from 87% of the European average in 1996 to 97.6% for 2005.

Regarding foreign trade, an increasing trend can be observed both for imports and exports.



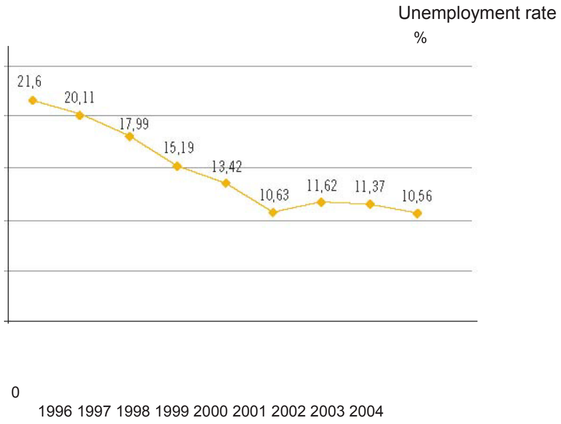
In spite of this, imports have been historically higher, and the difference increases with time, especially after 1999.

Concerning the labour market, the total number of people working in Spain has grown more or less steadily during the whole of the period analyzed, from 13 million in 1993 to 18.28 million in 2004 (+39.9%).

Looking at the different employment sectors, it can be observed that the services sector has a greater percentage of the total figure (over 60%), compared to the secondary (30%) and the primary sector (less than 5%).

Finally, the unemployment rate shows two clearly different stages. The first one corresponds to the period between 1996 and 2001, with a sizeable reduction in the number of unemployed people. Thus, while in 1996 the unemployment rate was 21.6% (a remnant of the economic crisis of the eighties), by 2001 the rate had decreased to 10.63%. After 2001, the unemployment rate stabilized in the 10-11% range. In short, between

1996 and 2004 the unemployment rate decreased by 11 percentage points.



Source: INE 2006

2.2

A DESCRIPTION OF THE SPANISH INNOVATION SYSTEM

2.2.1 FIRMS

Firms are the key element in the innovation process, for they are the ones producing and offering the services, and therefore firms are the ones that do innovate. Nevertheless, they are the weakest link in the Spanish innovation system, probably because there is no innovative tradition in Spanish society.

Innovation in firms

In 2002-2004, the number of firms which saw themselves as innovative, either regarding products or processes, was 51,316[9], that is, 29.74% of the total number of Spanish firms. This figure is still lower than the 41% of firms which saw themselves as innovative in EU-15 in the 1998-2000 period.[10]

The total spent on innovation by firms was 12,490.8 million euros in 2004, i.e., 1.8% of the turnover of firms with innovation activities. Most of them, 56.54%, were allocated to R&D (37.94% to in-house R&D and 18.60% to the purchase of external R&D), 33.06% to equipment, machinery and software purchases, and 3.71% to acquisition of other external knowledge. Only 0.83% was allocated to training.[11]

On the other hand, Spanish firms do not cooperate much in innovation activities, and do not profit enough from the knowledge generated by the various players in the system. Only 10% of innovative firms declared that they had cooperated in innovation activities in the 1998-2000 period, compared to an average of 19% in EU-15[12].

R&D investment

R&D expenditure in Spain amounted to 1.13% of GDP in 2005, quite below the 1.82% average for EU-25, and even further than the GDP 3% agreed in the Lisbon Strategy as the goal for 2010[13]. In addition to this, Spanish firms have a lower share of the total R&D expenditure than those in other EU countries. In 2005 their contribution to the total internal expenditure on R&D was 53.8%, compared to slightly more than 60% for the EU-25 average. [14]

Regarding autonomous communities, Madrid, Catalonia and the Basque Country accounted for 69.8% of corporate expenditure on R&D in 2004, a share which was much greater than the weight of their production power (43% ot the total added value in Spain).[15]

Human capital

Over the last decades, there has been a significant improvement in the educational level of the Spanish population, resulting in 32% of workers in 2005 having further education qualifications, a percentage above the European average, which was 25.5%.

However, Spanish firms only employ 31.9% of the total number of researchers, most of whom work in higher education[16]. The figure is below the average for EU-25, where 48.4% of researchers are working for companies, and much lower than the 81.5% of researchers working for firms in the United States.

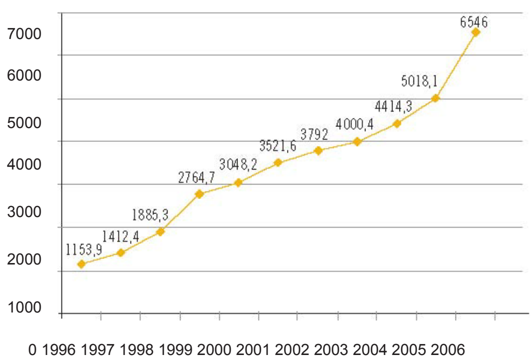
Use of ICTs
The number of firms connected to the Internet is satisfactory: 89.95% of all firms in 2005. However, few of them use new technologies in order to gain greater commercial capability and visibility in markets: only 3.49% made e-commerce sales in 2004. The percentage of firms making e-purchases was also low: 10.59% of the total.

2.2.2 GOVERNMENT BODIES

2.2.2.1 CENTRAL GOVERNMENT

R&D&I Policy
The two forms in which Spanish central government provides funding for R&D&I are the part of the General Budget allocated to research, development and innovation, known as Function 46 (formerly Function 54) and the Structural Funds from the European Union.

Spanish General Budget allocation for R&D (in millions of euros)



Source: Cotec 2006

In 2006, the budget allocated to Function 46 was 6,546 million euros, 30.4% more than 2005.

As for European structural funds, the financial allocation for these activities in the Spanish regions considered under Objectives 1 and 2 for the 2000-2006 period was 3,026 million euros, to which another 779 million should be added as co-financing by the Spanish government.

Concerning the public policies implemented, in an initial stage they focused mainly on improving the potential for scientific research, while technology transfer to firms played a secondary role. At present, scientific activity in Spain can be compared to other countries in its environment, but there is a great lack of corporate innovation.

Finally, regarding the policies already in place, the National R&D Scheme (2004-2007) set the goal of an expenditure on R&D of 1.22% of GDP in 2005, and 1.4% in 2007. Also, under the National Scheme, the innovation expenditure was to exceed 2.1% of GDP in 2005 and 2.5% in 2007. In June 2005 the Government submitted a new initiative, the Ingenio 2010 Programme, to improve the relative position of Spain regarding research, development and innovation. Such programme attempts to involve not only the government, but also firms, universities and other public research institutions. In order to implement this Programme, the Government intends to increase the general budget R&D&I allocation by at least 25% anually during this term in office (2004-2008).

Tax incentives

Under the Spanish tax system, there are deductions for research and development and for other technological innovation activities. According to OECD data[18], Spain was the country with the most tax incentives towards R&D expenditure for large firms and for SMEs in 2004. However, 85% of firms did not profit from these tax benefits, according to the Survey on Technological Innovation in Spanish Firms.

2.2.2.2 REGIONAL GOVERNMENT

All autonomous communities (some earlier than others) have developed plans for the promotion of research, technological development and innovation. Altogether, Spanish regional governments allocated about 2,400 million euros of their budgets to the promotion and development of R&D&I in 2002[19].

One of the characteristics of the Spanish innovation system is the scarce coordination between central and regional government policies. The main body responsible for communication regarding this area between central government and autonomous communities is the General Council for Science and Technology; however, in practice it has proved insufficient for such coordination.

In general terms, and unlike central government policies, it may be said that the measures implemented by regional governments have been more oriented towards the corporate component of innovation than towards the scientific one. There are great differences regarding the expenditure on R&D&I between the various regions, with a great concentration of expenditure in the communities of Madrid and Catalonia. In 2004, the average R&D expenditure per autonomous community was 1.12% of total regional GDP. Only Madrid, the Basque Country, Navarre and Catalonia were above this average; special mention must be made of Navarre, with an expenditure on R&D equivalent to 1.9% of regional GDP, above the European average.[20]

2.2.2.3 EUROPEAN INSTITUTIONS

The main instrument of European R&D policies are the Research Framework Programmes, which set the budget and the priority lines of research for multi-year periods.

The EU 6th Research Framework Programme covered the 2002-2006 period, with a budget of 17,833 million euros. During the 2003-2005 period, Spain obtained 655 million euros through this programme. These funds amounted to 5.7% of the total funds allocated during this period, whereas the Spanish contribution to R&D expenditure in EU-25 was 4.3%[21]. On the other hand, 84% of the firms participating in the 6th Framework Programme were SMEs. As from 2007, the 7th Research Framework Programme (2007-2013) has been in operation, with a budget of 50,521 million euros. In addition to this, there is also the new Competitiveness and Innovation Framework Programme (2007-2013) which, with a projected budget of 3,600 million euros, will support measures contributing towards competitiveness and innovative ability, especially for SMEs.

However, the greatest influence by EU institutions upon the development of public R&D&I measures in Spain, has been through regional policy. During the 2000-2006 period, Spain has received an allocation of 3,026 million euros from the Structural Funds for R&D&I activities in regions considered under Objectives 1 and 2. The importance of these actions has been not only quantitative, but also qualitative, as they have encouraged regional governments to develop measures for the promotion of innovation which are closer to the needs of their regional productive sectors.[22]

2.2.3 R&D PUBLIC SYSTEM

We shall use this term to designate all public institutions and bodies generating knowledge through technological development and research. The most significant bodies are universities and the Public Research Institutions (PRIs), which account for most of the knowledge-generating power and are those mainly responsible for training research staff.

In Spain the public sector has a greater relative weight in the R&D system than in other developed countries. For example, in 2002, 45.4% of the domestic R&D expenditure corresponded to the public sector, compared to an average of about 32% for OECD countries[23].

Most of this R&D expenditure corresponds to higher education institutions, whose relative importance is on the increase. Higher education accounted for 29% of the total Spanish R&D expenditure in the year 2005. According to data from December 2006 from the universities coordination council at the Ministry of Education and Science[24], in Spain there are a total of 50 public and 23 private universities.

Source: INE 2006

Concerning their research tasks, as we had said before, higher education institutions were responsible for 29.5% of the total domestic expenditure on R&D in año 2004. Most of the researchers working in Spain belong to higher education institutions, 51.1% of the total, according to data from 2004[25].

The good results obtained by Spanish universities as knowledge-producing centres are not, however, suitably transferred and used by the productive sector. Compared to other EU countries, in Spain a smaller percentage of firms cooperate in innovation projects with universities from their own country, 5% of innovative firms in the 1998-2000 period, compared to the EU average of 9%[26].

Another mechanism for the transfer of knowledge from universities to industry is the creation of university spin-offs. At present, the spin-off creation rates in Spain are similar to those in more developed countries: in Spain the average number of spin-offs created per university was 2.22, whereas in the USA, universities created 2.11, in Canada 1.53 and in the United Kingdom 3.02.

2.2.4 ORGANIZATIONS FOR THE SUPPORT OF INNOVATION

These organizations have been appearing in Spain mainly since the late eighties, at a regional level. Amongst those which might be classified as “organizations for innovation support” are:

INFRASTRUCTURES FOR INNOVATION SUPPORT	NUMBER OF ORGANIZATIONS OR INFRASTRUCTURES
Technology Centres, FEDIT (i)	64
Innovation and Techology Centres (ii)	89
Science and technology parks (iii)	20
OTRI (iv)	210

Fundación Universidad-Empresa (v)	31
European Business Innovation Centres (vi)	23
Test laboratories with ENAC certification (vii)	534

(i) http://www.fedit.es (Spanish Federation of Innovation and Technology Organisations), August 2006
(ii) http://www.mec.es/ciencia/centros/files/directoriocIT-Jun2005.pdf, February 2006
(iii) www.apte.org, 2005 Directory
(iv) http://www.mec.es/ciencia/otri/files/listadoOtri28122005.pdf, December 2005
(v) www.redfue.es/portada.asp, August 2006
(vi) www.ances.com
(vii) www.enac.es, August 2006

Technology Centres (TCs) are institutions aimed at supporting innovation and technological development as a way to improve corporate competitiveness, especially regarding SMEs. In general, Technology Centres have a reduced size and a local or regional scope, which leads to frequent unnecessary duplicity and lack of effectiveness. Over the last years, some of them are trying to overcome these problems by joining centres and creating networks.

Although further analysis will be offered later on, it must be pointed out at this stage that also science and technology parks may be considered as an infrastructure supporting innovation, as they provide the physical environment which may promote such innovation.

The Offices of Transfer of Research Results (OTRIs in Spanish) are responsible for identifying research results which may be transferred to corporations, disseminating the technology available, helping in the negotiation of contracts and protecting the technology generated thereby, and to a lesser extent, identifying the R&D needs in their environment.

The Business Innovation Centres are institutions aimed at helping towards the creation of innovative firms or reinforcing those already in operation. In their initial stages they were promoted and funded by the European Commission, through the Directorate General for Regional Policy.

2.2.5 THE ENVIRONMENT

A firm's environment has an influence upon its ability and tendency to innovate. Traditionally, such environment has not been a favourable one for Spanish firms. On the one hand, internal demand has not been very strict concerning the technological content of goods and services, probably due to a low educational level. Besides, government bodies have not used public demand for goods and services as a tool for the promotion of innovation. On the other hand, the institutions in the financial system have not provided the capital required to tackle the risks and uncertainty that innovation entails.

Internal demand

Over the last year there has been an increased consumption of technology products. This, however, has not been cashed upon by Spanish firms, and has mostly been catered for through imports.

Information society

In comparison with other industrialized countries, Spain has not fully implemented the information society. While in the European Union (EU-25) 48% of homes had an Internet connection in 2005, in Spain the figure was only 36%.

According to the data from the eEurope2002 action plan, Spain is at a clear disadvantage compared to the European average regarding e-business, teleworking, firms selling through the Internet, teachers using the Internet, Internet users, people buying through the Internet, and secure servers.

Venture capital

The venture capital sector, which by the mid-nineties was very little developed in Spain, has gone through an expansion stage. Most of the investment (60.3%) goes to expanding firms, whereas only 3.5% of the total invested in 2004 was spent on firms at an embrionary or start-off stage.

Human capital

The present situation, with 24% of the population possessing higher education qualifications in 2002, can be compared to that of other industrialized countries (an average of 23% in OECD). However, in Spain there is a much lower percentage of inhabitants possessing secondary education, and still a high percentage of people, 58%, with a level lower than secondary education, compared to the 33% OECD average.

However, there are also positive developments, such as the fact that the percentage of science and technology graduates in Spain is already above the European average (28.1% of all graduates, compared to a European average of 24.2%)[27].

As for research and R&D staff, in Spain there is still a lower percentage of the active population involved in R&D activities, 8.5 per thousand in 2003, compared to 10.2 per thousand of the active population in EU-25. On the other hand, 62.1% of the R&D staff in Spain in 2002 were researchers, which is above the 56.7% average for EU-25.

Whatever the case, the improvement in human capital does not seem to have resulted in an improvement in the productive sector. Thus, the unbalance between the training possessed by the population and the needs of the productive sector was greater for younger people[28], with a much greater mismatch than the EU-15 average.

2.3 :

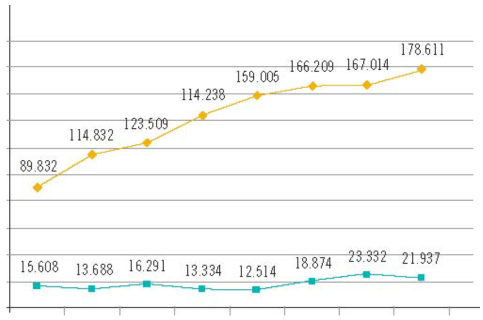
RESULTS OF THE SPANISH INNOVATION SYSTEM

One of the indicators of science and technology production is the number of papers published. In spite of the improvement in scientific output, the number of papers published in scientific journals per million inhabitants (588 in 2003) is still somewhat lower than the European average (639 in EU-25)[29]. However, the weight of Spain in the total number of papers in scientific journals (3.2%) is greater than its demographic (0.6%) and economic importance (2%) in the world.

Patents

200,000
180,000
160,000
140,000
120,000
100,000
80,000 60,000 40,000 20,000

0 1997 1998 1999 2000 2001 2002 2003 2004



Patent applications applicable to Spain

Patents granted applicable to Spain

Source: data from the Spanish Patent and Trademark Office (2006)

However, the Spanish potential for research, which is more than acceptable, does not lead to a productive application of knowledge by means of corporate innovation. According to the European table of innovation indicators, Spain is quite at a disadvantage compared to the rest of EU countries regarding innovation results. We are far below the European average regarding patents applied for and granted, high technology products exports, the percentage of SMEs participating in innovation, or the sale of new products for firms, amongst other indicators.

Also, Spain had only 0.3% of the world total number of triadic patents granted in 2000[30], that is, those granted jointly by European, United States and Japanese offices.

The balance of payments for technological transactions also shows a deficit. This indicator compares the payments and income corresponding to licence transfers, patents obtained, technological services hired or technological knowledge acquired. The technology transactions balance of payments shows a deficit for the whole of the EU, whose income is 7.4 per thousand of its GDP, and whose payments are 7.8 per thousand; however, the deficit is even greater in Spain, with payments amounting to 1.7 per thousand of GDP and income equivalent to 0.3 per thousand[31].

2.4 :

AN ASSESSMENT OF THE SPANISH INNOVATION SYSTEM

According to the report on innovation in Spain in the years 2004-2005, published by the European Commission[32], one of the main weaknesses of the Spanish economy was the low level of development of its innovation system.

The Spanish situation is a good one concerning knowledge creation, mainly due to the activity carried out by the public sector. The difference lies basically in the results of innovation: fewer patents applied for and granted, lower percentage of SMEs cooperating in innovation with other firms, and lower number of exports of high technology products.

Source: INE 2006

The weaknesses originate from the low level of expenditure on R&D of Spanish firms as compared to GDP, the lower expense in innovation, and the lack of venture and seed capital for the creation of firms.

A more positive assessment is that contained in the Cotec report (2004)[33], according to which the size, and more significantly, the diversity of the Spanish innovation system have increased, although it is still too small in comparison with other advanced countries.

In spite of the increase in expenditure on R&D in Spain over the last years, the figure is still too low considered the wealth indicators. While GDP per inhabitant in Spain was equivalent to over 92% of average GDP per inhabitant of EU-25 in 2002, R&D expenditure per inhabitant was only 52% of the European average expenditure in the same year[34].

3.

SCIENCE AND TECHNOLOGY PARKS: THE CASE OF SPAIN

This chapter goes deeper into the notion of technology and science parks. An initial section offers a theoretical analysis of the role of parks within the innovation systems; the description covers from the characteristics, depending on the type of park, to the objectives, location and services offered.

As part of the R&D&I system, a science and technology park has very defined goals: as part of the system, a park strives to promote and strengthen research and development, and also to foster innovation. More specifically, parks are agents seeking the transfer of technology and knowledge between the other players in the system, namely, firms and research institutions (technology centres, universities, research centres, amongst others).

There are various types of parks, from the purely technological to the purely scientific ones, and also those which combine the two models. The results offered are completely different in each case, although in both types the purpose is the same: promoting R&D&I and sustainable, durable economic growth for their geographic environment.

At present, technology and science parks are an increasingly important component of the Spanish R&D&I system, whose growth will be even greater in the future, and with a highly significant influence both regarding research and the purely economic sphere.

3.1 ›

SCIENCE AND TECHNOLOGY PARKS AND NATIONAL INNOVATION SYSTEMS

For some decades now, science and technology parks have been present in all developed countries, and have become public policy tools aiming to promote local economic development and technological progress in their respective areas.

Science and technology parks should be able to integrate the scientific, technical and social capabilities facilitating the creation, transfer, dissemination, measurement and management of knowledge, and its application to production activities.

Also, they attempt to strengthen the connections between the firms located in the parks and their environment, in order to promote the productive use of knowledge and to disseminate the innovation generated by those firms.

More specifically, a technology park is “a project with a physical space, with formal and operational dealings with universities, research centres and higher education institutions, which has been designed to encourage the creation or establishment of technology-based innovative industries, or service sector firms with a high value added. All this with a management system in the park itself actively participating in the technology transfer and value added growth processes of the firms using the park” (IASP definition, which has been also adopted by APTE).

The goals that define a technology park as such, according to the IASP, can be summarized as follows:[35]

• To establish strong functional links with universities, research centres and, in general, higher education institutions.
• To promote the growth and creation of knowledge-based industries, and also of specialized service firms capable of generating a high added value.
• To encourage the transfer of technology to the firms leasing the space in the park.

However, the real added value offered by technology parks lies in articulating and strengthening the relationships between the key players in the science-technology-business system in a region, including:

- the public sector,
- universities,
- laboratories,
- technology research and technology transfer centres,
- firms,
- financial institutions,
- building developers, and
- firms leasing the facilities.

Science and technology parks allow for the interaction between the players in the science and technology systems, and also between such players, industry sectors and firms. Therefore, the influence of a park will greatly depend on its ability to generate efficient networks both within the park and among the production agents, but also with its environment and the local and regional productive sector.

The various activities carried out by a technology park are related to the technology generation and transfer functions, the activities supporting corporate production, and those providing support and logistic help to the goods and services commercialization process.

Recently, IASP has given a new definition of science and technology park, which emphasizes knowledge management through the park management team:

A Science Park is an organisation managed by specialised professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions.

To enable these goals to be met, a Science Park stimulates and manages the flow of knowledge and technology amongst universities, R&D institutions, companies and markets; it facilitates the creation and growth of innovation-based companies through incubation and spin-off processes; and provides other value-added services together with high quality space and facilities. (IASP International Board, February 6, 2002).

The expression “Science Park” can be replaced in this definition by “Technology Park” or “Technopolis”.

3.2

TYPES OF PARKS AND MAIN PLAYERS

The SPRINT project[36] distinguished and defined three types of parks, based on an original classification by the European Commission:

- A science park that tries to promote the development and growth of technology-based firms. In this respect, technology is transferred from the academic and research institutions located in the park to the firms and organizations in the park or its area of influence.
- A science park that focuses on basic research, rather than on development. The emphasis is on links with academic research regarding state-of-the-art science and technology.
- A technology park as a facility hosting firms involved in high-technology commercial application, with activities including R&D, production, sales and services. The difference between this and the other parks lies in the fact that a technology park comprises production activities, and not only R&D.

3.3 :

SERVICES OFFERED BY THE PARKS

Technology Parks should be able to offer firms all types of services giving an added value to the activities such firms are usually involved in. Image and prestige, quality infrastructures, connections with universities and common services at very competitive prices are the features most valued by the firms located in the parks[37], according to an IASP survey.

TYPE OF SERVICE		DESCRIPTION
General infrastructure services	Basic services	Logistics and infrastructure (canteens, security, training and conference rooms, financial institutions, post office, leisure and sports services, etc.)
	Advanced Basic services	Telecommunication infrastructures (connection to information and telephone networks, Internet…)
Specialized services	Advisory services	Advisory Services on subsidies and programmes, advice for the creation of firms, etc.
	Training	Direct or indirect promotion of training courses dealing with topics of interest for firms
	Information and innovation support services	Providing information to firms depending on their area of business, on aids, programmes, etc. and help towards innovation regarding search for funding, partners for innovation projects (identifying potential demand for innovation and technology, technology transfer, etc.)
	Promoting cooperation and dynamization networks	Supporting business cooperation, both between firms and with other bodies (universities, etc.) both in the park and in the local, national and international environment.

Source: LOS PARQUES CIENTÍFICOS Y TECNOLÓGICOS: Una contribución fundamental al sistema de Ciencia y Tecnología en España, APTE 2003.

Also, technology parks participate in projects, both at a local and international level, as part of cooperation networks with other similar parks both in Spain and abroad, and with other players in the innovation system: universities, technology centres, research centres, etc.

3.4

LOCATION OF THE PARKS

The characteristics of the location of a science or technology park are an essential factor in its consolidation and development.

Science and technology parks try to create spaces providing a pleasant working environment. In that respect, the locations offer green spaces, garden areas, etc., which are supplemented by a wide range of services for the workers in the park, both of a technological and a specific nature.

Hence the importance of a location in an environment meeting the following requirements:

- Near universities, research centres, or other training centres capable of providing qualified, specialized labour.
- Advanced telecommunications services.
- Good transport connections.
- An environment rich in services (especially for businesses)
- Tools for the development of creative synergies aimed at SMEs.
- An adequate supply of land, buildings and internal services.
- Green areas, quality in building design, etc.

3.5

AN INTERNATIONAL COMPARISON OF TECHNOLOGY PARKS

The initiative for the construction of parks greatly varies from one country to another. While in the United States there is a usual occurrence of university initiatives, supported by state or local governments, and little intervention by federal government, in France or Spain the role of central government has been an essential one, and in Spain this role has corresponded to regional governments.

Three models can be usually found in the development of science and technology parks:[38]

- The "dirigist" model, exemplified by a number of urban or metropolitan experiences planned in Mediterranean countries, where the effort has focused on concentrating activities with some degree of science or technology content.
- The "spontaneous" model, exemplified by experiences where the spatial concentration of innovative activities results from the spontaneous initiative by the existing private players, with or without the support of local bodies or innovation centres.
- The "network" model, in a geographic sphere containing a number of basic and applied research institutions, and industrial firms operating with a functional division of innovative tasks.

3.5.1 DIFFERENT MODELS FOR PARKS

Parks in the United States

In the United States, parks (science or research parks) originate in universities, and in some cases receive state or local government support, but with very little federal intervention.

The American model for parks follows the pioneering example of Stanford, better known as Silicon Valley. Alongside this one, other parks have appeared, such as Boston's Route 128, the Seattle excellence area, the semiconductor industry in Minneapolis-St. Paul, Philadelphia and Tucson; the science parks of Triangle Park, North Carolina and Duke University; the Massachusetts-128/MIT Harvard U.-Brandeis U-Boston U. area; and other parks, such as Torrey Pines-San Diego I or -SDST-Scripps Institute-Salk Institute.

The most salient features of these parks are:

- Many of them are known as Research Parks, because most of them were created directly by universities.
- The parks have an open-doors policy towards society and firms in particular.
- The parks are linked to emerging technological sectors, i.e. ICTs, biotechnology, aerospatial industry, domotics, new materials, etc.
- There is strong interaction between universities and research centres and the parks.
- The parks attempt to be self-funded.
- The approach is a typically business-minded one, which prevents them from eventually relying on public funding.
- In American parks two of the most important factors are the creation of start-ups (or newly created firms) and spin-offs (new firms created for the commercialization of the results of technological research).
- The parks have staff specializing in technology transfer.

Parks in the United Kingdom

In Great Britain, the forerunners of these facilities in Europe, the parks are created by universities with abundant real estate and experience in technology transfer.

The pioneering parks were the Cambridge Science Park, and the Heriot-Watt University Research Park in Edinburgh, both created in the early seventies.

Many of these parks, which appeared as semi-spontaneous initiatives by universities, went through an initially slow stage concerning the establishment of firms. Later, due to the scarce participation by the private sector, the few jobs created and the weak results, a second wave of parks appeared prioritizing the creation of firms in incubators, attracting venture capital.

Unlike their American counterparts, British parks tend to host small firms, with a much lower number of employees. Their main promoters are universities and local and regional authorities, some regional development agencies and banks.

As has been said above, universities play a major role in British parks, as promoters in almost all cases. This is why they are usually located in the vicinity of, or even within, university campuses.

The dirigist model: parks in France

In the French model, based on public initiative, the purpose is to reduce the disadvantages of medium-sized cities compared to the main centres of scientific research located in l'Ile de France (the Paris region). Using their own resources, in order to maximize their value, it is cities and city councils that play a major role in order to create "poles of excellence".

Sophia Antipolis is the technopolitan model most widely known both in France and in other countries, and has provided inspiration for many other initiatives. The Park was promoted by the authorities at the Côte d´Azur, in order to modify the economic structure of the region, which so far had been based on tourism.

For their part, the Technopoles attempted to integrate all the science and innovation activities by the universities, researches and industry of the host city or department. The main promoters were local governments, who were greatly interested in contributing towards local and regional development.

Although there are great differences between the various French projects, the literature has considered two prevailing models[39]:

- The "pole-model" Technopoles, pioneered by Sophia Antipolis, concentrate within the same location a set of activities which previously did not exist in the region.
- The "agglomeration-model" Technopoles are mainly aimed at promoting the global development of the area of influence of their location. This model is illustrated by Montpellier and Lyon.

The French Technopoles created in the eighties arose from a single pole (or park). However, some have progressively evolved and developed a wider or multi-pole strategy, in order to reach the category of Technopole in the broadest sense. Such is the case of Montpellier Europole, which integrates five specialized poles: Euromédicine, linked to healthcare; Agropolis specializing in food and farming; Antenna, in multimedia; Communicatique, in computers and robotics; and Heliopolis, specializing in tourism and leisure activities.

The network model

The network model for technology parks is mostly found in Germany, where the technology transfer centres play a major role. The Baden-Württemberg land, with over one-hundred centres, is the most important technology transfer pole in Germany.

With the exception of Spain, where the parks have greatly developed, the rest of European countries lie at a great distance regarding the number of parks.

3.5.2 FACTORS IN THE SUCCESS OF PARKS

After an analysis of the experiences in various countries, it might be possible to list two types or sets of factors determining the potential success of science and technology parks. Firstly, there would be a set of "hard" factors, which would determine the initial conditions of the location of the park. Amongst these "hard" factors we might point out:

• Communication infrastructures.
• Flexibility of the real estate market in the surroundings of the park.
• An initial agglomeration of firms specializing in a dynamic productive sphere.
• A set of basic services for the firms in the parks to carry out their activity, such as production services, consultancies, specialized services, etc.

In addition to these, a number of “soft" factors can be identified, accounting for the qualitative transformation and the sustainability of the experience:

• Creation of an alliance with both economic and social key players.
• Existence of a regional development and/or technological innovation scheme, providing the framework for the park’s activities.
• Existence of broad local and regional consensus for the ecologic sustainability of the area;
• Existence of various mechanisms providing funding for business activities.

3.6

THE CONTRIBUTION OF PARKS TO NATIONAL INNOVATION SYSTEMS

Parks offer undeniable advantages for regional development. They are the symbols of the innovation process, as they provide a link between basic and experimental research, universities and firms, and integrate supply of, and demand for, technology.

A glance at the experience obtained in other countries shows that technology parks are effective tools in order to:

- Establish links between universities and the industry;
- Develop innovation at a regional scale;
- Incubate new firms;
- Generate added value and jobs;
- Train and serve entrepreneurs;
- Transfer technology;
- Create short-, middle- and long-term strategic alliances; and
- Implement government policies.

Due to their multiple connections with the various social and economic players, science and technology parks become the instruments of choice for the promotion of innovation at a local scale.

Therefore, it can be said that the role of a science and technology park consists in:

- Boosting and managing the knowledge and technology flowing between universities, research institutions, firms and markets.
- Promoting the creation and growth of innovative firms through incubation and generation mechanisms (spin-offs)
- Providing value-added services, and also quality spaces and facilities.
- Helping towards innovative and technology-based entrepreneurial development.
- Contributing towards the international integration of innovative firms.

3.7

A HISTORY OF SCIENCE AND TECHNOLOGY PARKS IN SPAIN

The first technology parks appeared in Spain in the mid-80s, promoted by autonomous communities, which had just been created at that time. The general situation was that of a serious economic crisis, with a technologically backward industry structure, whose ability to compete in world markets was based on its low-cost workforce. In this context, some of the most industrialized autonomous communities saw in technology parks a tool for the modernization of the traditional industrial structure and for diversification towards new sectors, which could contribute towards regional economic development.

According to Romera (2003)[40], there have been three stages in the evolution of Spanish science and technology parks:

1) Initial stage (1985-1992)

In this period the first eight Spanish technology parks were created, in the Basque Country, Madrid, Catalonia, Valencia, Andalusia, Castile and Leon, Galicia and Asturias.

The first technology park was the one in Zamudio, a town in Biscay close to Bilbao, created in 1985, after an initiative by the Basque Development Agency (SPRI).

In the same year, the Madrid Technology Park was created in the town of Tres Cantos, north of Madrid. The creation of this park was promoted by the Madrid Institute for Development (IMADE). Before it disappeared, due to the loss of its legal personality (once all the land was sold, it was transformed into a community of owners), the Tres Cantos Technology Park took the initiative of starting a cooperation process, leading to the creation in 1988 of the Association of Science and Techonology Parks of Spain (APTE).

In this initial stage, the aim was mainly to attract advanced technology firms, often multinationals, which could act as innovative engines at a regional level.

2) Development stage (1993-1998)

After 1993, new initiatives appeared by other promoters, beyond the strictly regional level; this led to a new type of park, the Science Park, whose main feature is the major role played by the commercialization of R&D public and private activities.

During this period universities started to become interested in the business application of knowledge, and to become involved in science and technology park projects, such as the one in Alcalá de Henares, presented in 1993, or the Parc Científic in Barcelona, created in 1993, which since then has been the reference for most of the science parks created later in Spain.

For the first time, central government became one of the shareholders of a park, with its stake in the Cartuja 93 Science and Technology Park. New agents appeared in the promotion of parks, such as the Gijón city council, which created the Gijón Technology Park.

Besides, another two technology parks were created in the Basque Country, one in Álava and one in Guipúzcoa, which to date (2006) makes the Basque Country the autonomous community with the largest surface area of operational parks.

3) Expansion stage (since 1999)

After 1998, a great economic growth took place, and parks became filled with firms. Also, there was a great development of science parks, mainly promoted by universities.

In this period central government, through the Ministry of Education and Science, gave for the first time explicit support to this type of initiative, and opened the first programme for aids to science and technology parks (which eventually became known as the “Parquetazo”) in December 2000. Since then, every year the Ministry has had a scheme for aids to parks.

All this has led to a spectacular growth of science and technology parks. By late 2005, there were 22 operational parks in 11 autonomous communities, and almost another 50 projected parks, which would add another 4 autonomous communities.

3.8

THE ASSOCIATION OF SCIENCE AND TECHNOLOGY PARKS OF SPAIN (APTE)

The first Technology Parks created in the 80s were surrounded by a certain degree of secrecy. Each autonomous community, then in its initial stages, independently planned its projected park, and believed that this would be the key to ensure the technological development of the region, mainly based on attracting foreign companies.

In that context, the Tres Cantos Technology Park organized a meeting, where all the then existing technology parks were invited to participate in a round table on parks. This was the beginning of a process eventually leading to the creation of the Association of Science and Technology Parks of Spain (APTE) in 1988, by the managers of the first six technology parks existing in Spain.

In its initial stages, APTE had a rotating presidency, and its meetings were itinerant ones. This allowed its managers to visit and become acquainted with the situation of the other parks, and helped to strengthen the Association. Little by little, and as new parks were projected and created, the number of members of APTE progressively increased. Also there were new types of parks, with a new model, the science park; as a result, mainly due to the role of the Barcelona Science Park, the participation of universities in APTE started to increase after 1996/97.

While in the early years the main concern amond park managers was the introduction and development of a new model for industrial urbanization, as years passed the focus shifted gradually towards intangible aspects. Today, the main challenge faced by science and technology parks is promoting the creation and transfer of knowledge, innovation and cooperation between various players.

APTE has two types of members: full members and associate members[41]. The full members are operational science and technology parks, whereas associate members may be organizations whose objectives are in line with those of the Association, even though they are in the project or planning stage.

By late 2005, APTE had 65 members, of which 22 were full members, i.e. operational parks, whereas 43 were associate members, many of them parks in their creation stage.

3.9

PARKS IN SPAIN: GENERAL DATA AND FIGURES

After the developments occurred in the recent years, the following table can give an idea of the importance of parks in Spain (22 members by late 2005).

GENERAL DATA ON APTE MEMBERS (22)				
NAME OF THE PARK	SIZE IN SQ. M.	AVAILABLE SPACE FOR BUILDING IN SQ.M	GREEN AREAS, STREETS AND SERVICES, IN SQ M.	YEAR OF CREATION
Bizkaia Technology Park	2,060,320	723,009		1985
San Sebastián Technology Park	1,300,000	290,000	650,000	1994
Álava Technology Park	1,171,864	607,482	487,507	1992
Andalusia Technology Park	1,864,953	518,887	1,093,000	1992
Cartuja 93: Seville Science and Technology Park	822,564	447,427	490,550	1991
Granada Health Sciences Technology Park	626,614	372,083		2003
Vallés Technology Park	585,000	183,150	401,850	1987
Barcelona Science Park	23,000			1997
La Salle Innovation Park Foundation	24,000	24,000		2001
València Technology Park	1,038,290	682,367	355,923	1990
Alicante Technology Park	567,000	170,000		1998
Polytechnic City of Innovation (Valencia)	140,000	100,000		2002
Boecillo Tecnology Park	1,180,000			1992
Galicia Technology Park	514,438	236,524	246,330	1992
Vigo Technology and Logistics Park	874,436	395,762 (business) 11,211 (R&D)	467,463	-
Asturias Technology Park	440,000	290,000	150,000	1991
Science and Technology Park of Gijón	217,000	50,000	167,000	2000
Tecno-Alcalá, Alcalá de Henares Technology Park	375,000	187,000	73,000	2003
Madrid Science Park	100,000			2001
Balearic Park of Technological Innovation	1,400,000	91,500 (phase A)	307,000 (phase A)	1997

Walqa Technology Park	534,655		114,067	2002
Centro de Desarrollo Tecnológico Universidad de Cantabria	6,000	6,000		1999

Source: APTE 2006 Firms and Institutions Directory / Asturias and San Sebastián data supplied by the parks

GENERAL INFORMATION ON THESCIENCE AND TECHNOLOGY PARKS IN THIS STUDY (11)					
NAME OF PARK	LOCATION	NUMBER OF FIRMS AND INSTITUTIONS (2005)	TURNOVER IN EURO (2005)	JOBS (2005)	BUSINESS ACTIVITIES
Bizkaia Technology Park	Bizkaia, Basque Country	166 (2006)	1,580	6,100	ICTs, consultancies, design and advanced services, industrial engineering,biotechnology, R&D, aeronautics, electronics, power production
San Sebastián Technology Park	Gipúzcoa, Basque Country	46	306	2,512	Microelectronics, ICTs, services and consultancy, power production
Álava Technology Park	Álava, Basque Country	86	467	2,612	Aeronautics, power production, ICTs, engineering, environment
Andalusia Technology Park	Malaga, Andalusia	375	1,022	8,539	ICTs, biotechnology, R&D services, power production, engineering, electronics
Cartuja 93: Science and Technology Park	Seville Andalusia	311	1,676	11,455	ICTs, services and consultancy, engineering
Health Sciences Technology Park	Granada, Andalusia		10.57	471	Biotechnology, services and engineering, ICTs
Science Park	Barcelona, Catalonia	25 (2004)		1,376 (2004)	Biotechnology, services and consultancy, laboratory services
Boecillo Technology Park	Boecillo, Castile and Leon	113	384.34	5,037	ICTs, electronics, engineering and advanced services, R&D
Galicia Technology Park	Ourense, Galicia	62	82.69	763	ICTs, engineering services, general services, biotechnology
Tecno-Alcalá. Alcalá de Henares Technology Park	Madrid	11 (2006)	56.1	598	Electronics, ICTs, R&D, services and consultancy
Madrid Science Park	Madrid	39 (2006)	13.64	104	Biosciences, nanotechnology and materials science, R&D, services and consultancy
APTE (Full Members and Asóciate Members)		2,010	7,494	51,488	ICTs, consultancy, advanced services and design, industrial engineering, biotechnology, R&D, aeronautics, electronics, power production

Source: Own elaboration, based on data supplied by the parks.

4. METHODOLOGY FOR ASSESSING THE IMPACT OF SCIENCE AND TECHNOLOGY PARKS

The fourth chapter of this study concerns the theoretical model used for the assessment of the impact of science and technology parks on their environment.

After a presentation of the issues concerning the priorities and objectives that the methodology chosen must deal with, and also its assessability regarding the design and structure of the whole model, the various types of impact upon the environment will be studied. These impacts may be classified into two basic types: direct and induced impact.

Direct impact results from the activities carried out specifically by the science and technology parks, whereas induced impact is that originating from the various spillover effects that such activities have upon the economy.

The model for the study is based on an input-output analysis methodology, which through the use of multipliers makes it possible to quantify the impact of each park upon its environment. In this case, the impact is shown in the following economic variables: gross value added generated, job creation, and taxes, for the period chosen.

4.1

AN ANALYSIS OF THE SOCIAL AND ECONOMIC IMPACT OF PARKS IN SPAIN

The study focuses on the analysis of the social and economic impact resulting from the creation and development of the Spanish science and technology parks members of APTE, and more specifically, on the following 11 parks:

- Andalusia Technology Park
- Cartuja 93 Science and Technology Park
- Granada Health Sciences Technology Park
- Boecillo Technology Park
- Galicia Technology Park
- University of Alcalá Science and Technology Park
- Madrid Science Park
- San Sebastián Technology Park
- Álava Technology Park
- Bizkaia Technology Park
- Barcelona Science Park

The first issue that arises when analyzing the impact of these parks is the need to differentiate between two types of parks: technology and science parks. These two types differ in their origin, characteristics and objectives, and therefore a differentiated analysis of the two options has been made here. The group of science parks is integrated by the Parc Científic in Barcelona and the Parque Científico in Madrid. The Health Sciences Technology Park in Granada lies half-way between the two categories, because at this stage the land availability for firms is still being developed, although for the purposes of this study it has been considered a science park. The remaining parks may be considered as technology parks.

Another of the issues to be considered is how long the park has been in operation. Most of the social and economic effects that can be expected from the creation of science and technology parks are middle and long-term ones. However, some of the parks studied have been created very recently, and therefore it is too early for these effects to become noticeable and for the park to make its full contribution to economic growth and the development of an innovation system.

The study on which this summary is based, was carried out at three levels:

- regarding the whole of Spain, for all the science and technology parks who are members of APTE.
- for each province and autonomous community, in all the provinces and autonomous communities to which any of the 11 parks studied belongs.
- regarding each park. For the purposes of this analysis, a difference has been made between technology and science parks.

Regarding the whole of the Spanish territory and each province and autonomous community, the analysis is mainly based on the assessment of the economic impact of the activities deployed by science and technology parks, by means of an input-output methodology, as is explained in the following chapter. The analysis for the whole of Spain is based on the consolidated data provided by APTE. The analysis for each autonomous community (and for each province, if there are available data) only assesses the impact of the 11 parks studied, and is based on the data supplied by each park. The results of the economic impact analysis have been supplemented by the use of other quantitative indicators (R&D jobs and R&D expenditure), which give an idea of the weight of the parks within both the Spanish and the regional innovation systems.

For each park, the study makes a difference between technology and science parks. For each park, there is an assessment of the economic impact of each park, calculated by means of the same input-output methodology applied to assess the consolidated effects at a regional level. Also, there is a description of all science and technology parks, in which more qualitative elements are offered for assessment, together with indicators of the role of each park within the regional innovation system.

This summary will focus on the analysis of the impact of parks upon the whole of the Spanish economy. For this purpose, we have already offered a description of the situation of both the Spanish economy and the R&D&I system, and also of the innovation system accompanying the impact results shown here. This is essential not only to provide a context for the results, but also to understand the origins, the present situation, and the potential evolution of the data and players analyzed.

The following section deals more specifically with the methodology used in order to assess the economic impact of technology parks.

4.2

METHODOLOGY FOR THE ECONOMIC IMPACT ANALYSIS

Classification of impacts

The impact analysis has focused on the study of quantitative variables. The qualitative impact upon national and regional innovation systems has not been dealt with here, due to the difficulties for the obtention of the data required for scientific analysis.

Concerning our study, it must be said that an analysis of quantitative impacts should make an initial distinction between two types of impact: direct and induced ones.

Direct economic impacts are shown by the increase in final demand resulting from the existence of a production activity in a certain technology park. By adding all the direct impacts in each sector, the total direct impact upon production in an area can be obtained.

The induced economic impacts are those effects generated in the environment or in the area as a result of the multiplying effect that direct impacts have upon the economy.

Each component of the direct impacts (in our case, turnover in a specific sector) creates beneficial multiplier effects upon income (in our case, added value) and employment in the economy of the region. It must be borne in mind that any impact on production has, in turn, induced impacts upon the economic system, because any firm with an increased production will, in general, have to purchase goods and services from other firms (and, at the same time, increase its primary input, such as wages, social security contributions, etc.), which leads to increased production in the relevant sectors. The new purchases, in turn, generate additional impacts, and the process continues until the marginal induced effects in the area under study become negligible. The total of all the increases in production demand, added value and employment which derive from each item in the direct impacts, represents the corresponding induced impacts.

Therefore, the induced impacts are due to the "spillover effect" that each euro invested in an economic sector has upon the whole of the regional economy.

Thus, the total economic impact results from adding the direct and the induced impacts.

Structure of the impact analysis

The analysis of the total economic impact generated by the production activity of the various parks is structured as follows:

1. ***Calculating the impact multipliers for each year, based on the input-output models.***

   There are various forms of calculating the induced economic impacts. In our case, the input-output methodology has been used in order to obtain the impact multipliers, allowing us to measure the spillover effect of each increase in production upon the rest of the economy. More specifically, in our case the availability of input-output tables (IOTs) prepared by most autonomous communities, confirms this as the ideal method, as it makes it possible to use the information from the inter-sector economic relations contained in such tables.

2. ***Obtaining the induced economic impacts upon production, value added and employment.***

   By applying the impact multipliers to the direct production impacts, and adding the corresponding income and employment coefficients, the induced impacts are obtained upon income (GVA in our case) and upon employment, respectively.

VALUE ADDED MULTIPLIERS

The value added multiplier measures the increase in global GVA in an economy for each unit increase in final demand in each area (turnover, in our case). The idea is that every change in regional production results in a modification in regional GVA. This multiplier can be defined for both market price GVA and for cost GVA.

The GVA multipliers are calculated as follows:

$$GVA\ multiplier = GVAi*(I-A)-1 = GVAi*BR$$

Where GVAi is the GVA coefficients vector at basic prices per production unit, I is the identity matrix, A is the internal coefficient matrix and BR is, therefore, the internal reverse matrix.

EMPLOYMENT MULTIPLIERS

Designing an employment multiplier involves formulating a hypothesis on a linear relationship between employment in a specific sector and the value of its production[42]. Considering such relationship, a multiplier is formulated measuring the direct effects upon employment in a specific sector resulting from changes in production:

$$Ej = Lj/Xj$$

where Lj is the number of workers per sector, and Xj is the effective production of the sector under study, and therefore Ej would be the direct employment multiplier. However, the variations in final demand generate more added employment requirements than those that can be analyzed by means of direct multipliers, and therefore a total employment multiplier can be established, showing the direct and indirect effects upon employment generated by each unit increase in final demand.

$$Total\ employment\ effect\ multiplier = Ej*BR$$

and BR is, again, the reverse internal matrix.

These are, therefore, the methodological foundations for the impact analysis which is presented here, always following the most careful scientific standards. In this respect, it must be said that:

1. In order to avoid mistakes, we have preferred to restrict our analysis to the quantitative relationships shown in the input-output tables, without formulating hypotheses (which may be true, but cannot be validated quantitatively) on the greater induced impact that the activities of science and technology parks might have, as a result of the greater value added generated (see, for example, the average productivity of the firms in the parks compared to the Spanish average), the higher staff qualification and therefore higher wages, together with innovations introduced, and therefore a greater spillover ability upon other production activities.

2. We have preferred to use strictly homogeneous data and methodology for all the parks, in order to obtain comparable data which could be accumulated for projection upon the whole of Spain. This has led us, in some case, to ignore data from other, more detailed individual studies. Such is the case with parks in the Basque Country, for which a study is available with more detailed data, making it possible to infer that the impact generated is greater than is shown in this study.

This is why it may be said that the data which are offered below have been obtained by means of a well-established methodology, that the starting hypotheses have been prudent ones, and therefore the results obtained are probably underestimated; however, it is very unlikely that they might be overestimated compared to the real situation.

5. TOTAL EFFECT OF THE IMPACT OF APTE PARKS

This section presents the aggregated results of the impact of the parks which are members of APTE, from three different points of view. On the one hand, the present impact of APTE parks. On the other, the present economic impact of the so-called “well-established” parks[43], among the 11 parks studied, in their respective provinces. Finally, a number of estimates are presented giving an idea of the possible economic impact of parks in the whole of Spain, once the various initiatives existing at present have developed a significant part of their potential.

The economic impact of the parks has been calculated for the following variables: production, GDP mp, employment and public government income; except for the first indicator (external to the model), the rest has been calculated by means of the input-output multipliers method, showing the total values (both induced and direct) of the impact generated upon the economy of the environment of the park.

5.1
PRESENT TOTAL EFFECT

At an economic level, the main conclusions for each variable have been as follows:

PRODUCTION
The turnover of firms in the APTE parks has steadily increased during the 2001-2005 period. The turnover of Spanish parks in 2005 was equivalent to 0.44% of Spanish total production that year, which is significant in itself, considering the relatively reduced surface area occupied by parks compared to the whole of Spain.

Total effect current APTE %
Production / Turnover

%

0.50
0.45
0.40

0.44

0.35

0.37

0.39

0.30

0.34

0.29

0.25
0.20
0.15
0.10
0.02

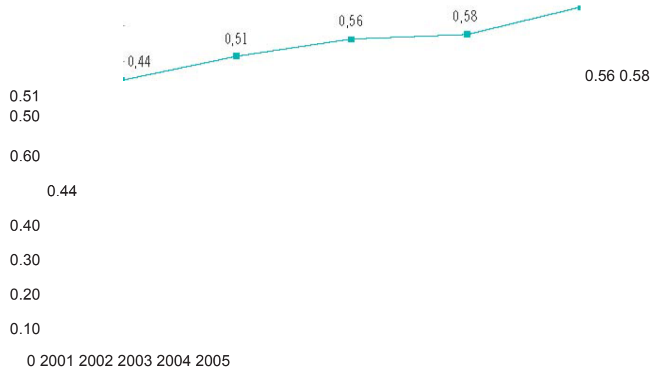
0 2001 2002 2003 2004 2005

GDP AT MARKET PRICES
Total GDP mp generated by the Parks was equivalent to 0.65% of Spanish GDP mp in 2005. The percentage of APTE in Spanish GDP is higher than the percentage of total production, which means that the production sectors in the parks generate more added value than the average Spanish production.

Total effects present APTE %

%
0.70

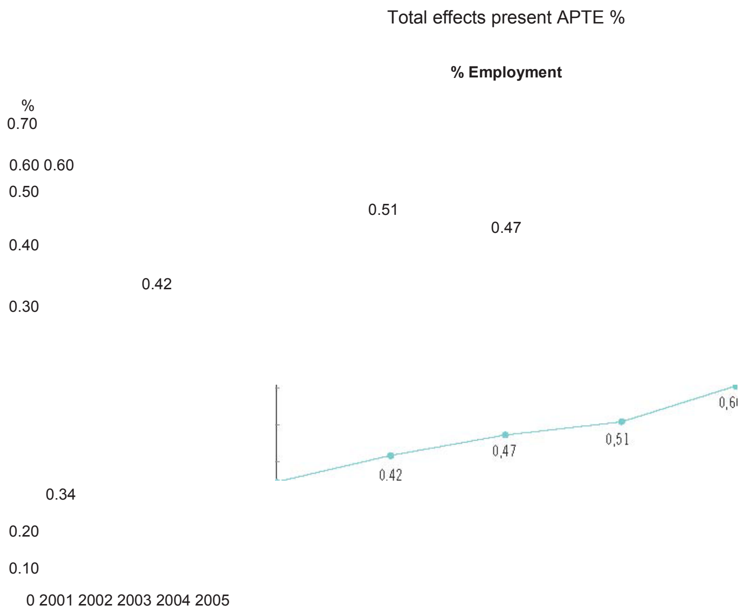
GDP mp 0.65



Also, the percentage of GDP generated by the parks has steadily increased in the 2001-2005 period, from 0.44% of Spanish GDP mp in 2001 (compared to 0.29% of the production) to 0.65% in 2005 (compared to 0.44% of the production).

EMPLOYMENT

The absolute values of total employment generated have been increasing during the whole period under study, from a total of 60,640 jobs in 2001 to 119,904 in 2005. This figure means that the number of jobs created has doubled in five years. In relative terms, compared to total employment in Spain, the percentage of jobs generated by the parks has risen from 0.34% in 2001 to 0.60% in 2005.



So far, the results of the economic activity carried out by parks have been compared to the total figures for the whole of Spain. However, as not all Spanish provinces have a park which is a member of APTE, it might be interesting to calculate the contribution by parks only to the economy of the provinces that do possess one of them. Such percentages show a contribution of parks to aggregated GDP mp of provinces with parks of 1.05% in 2005 (compared to 0.65% for the whole of Spain), and a contribution towards employment of 1.12% (compared to 0.6% for the whole of Spain). The following table shows the results for 2002-2005.

IMPACT OF APTE IN PROVINCES WITH PARKS				
	2002	2003	2004	2005
Estimated GDP mp (in millions of euros)	3,725.64	4,372.65	4,830.85	5,920.26
% of GDP mp for APTE provinces	0.87	0.95	0.92	1.05
Estimated jobs	75,456	88,560	97,840	119,904
% of jobs for APTE provinces	0.81	0.93	0.94	1.12

TAX REVENUE

This item calculates the tax revenue obtained as a result of the activities of all the firms in APTE parks. The total tax effects have been divided according to the origin of revenue, i.e. to the various types of tax categories applied to the economic activity of the firms in APTE parks.

REVENUE FOR PUBLIC GOVERNMENT, APTE (in millions of euros)					
	2001	2002	2003	2004	2005
Net tax on products	299.41	372.56	437.27	483.09	592.03
% Spanish Total	0.43	0.52	0.56	0.57	0.64
Corporate Tax	93.12	115.87	135.99	150.24	184.12
% Spanish Total	0.45	0.49	0.53	0.51	0.51
Social Security Contributions	337.52	419.99	492.92	562.62	667.39
% Spanish Total	0.51	0.59	0.65	0.69	0.80
Income Tax	127.52	158.68	186.24	212.57	252.08
% Spanish Total	0.26	0.30	0.33	0.37	0.39
TOTAL	857.57	1,067.10	1,252.42	1,408.52	1,695.62

As the table shows, the growth experienced by all tax categories has been a steady one, close to 20% yearly (except for the slowdown in 2003-2004, where there was only a 10% increase). Thus, the total collected by the revenue authorities from the activities carried out by APTE firms and parks can be estimated at 1,695.61 million euros in 2005, which almost doubles the 857.58 million collected in 2001.

It seems important to underline this increase, because it proves that, as a consequence of the public investment made in technology parks, the public sector has received significant returns.

A more specific study would be required to calculate the actual rate of return of this public investment, in which it would also be necessary to distinguish between the various geographic spheres (as a rule, investment is made at a local or regional level, whereas the tax returns are collected at a national level), and it would be necessary to carry out a more refined analysis of the returns. For example, it can be assumed that, due to the type of production existing in parks, with qualified staff and products and services with a high added value, the impact upon VAT and income tax is greater than the average for the whole of the economy.

However, even with the present data, it might not be exaggerated to say that, for the Spanish public sector as a whole, the investment made in parks is amongst the most profitable ever made, and this only in financial terms, i.e. without considering the impact in terms of cultural change, attractiveness of regions for new value added activities, and generation of new firms with higher productivity levels and more qualified jobs.

PRODUCTIVITY

It must be pointed out that Spanish science and technology parks have an average productivity which is much higher than the Spanish average, and even higher than the figure for the economy of the United States or Finland, as shown by the data in the 2004 table.

YEAR 2004	PRODUCTION (IN MILLIONS OF EUROS)	JOBS	PRODUCTIVITY (EUROS PER JOB)
APTE	6,115	45,4925	134,419
Spain	1,584,683	19,162,800	82,696
USA	17,794,715	145,789,000	122,058
United Kingdom	3,169,121	29,495,000	107,446
Finland	275,798	2,367,000	116,518

According to these data, the value of APTE's average productivity amounted to 134,419 euros per job in 2004, compared to the Spanish average of 82,696 euros per job. It must be emphasized that, if all jobs in Spain had been as productive as the jobs in the APTE parks, Spanish production that year would have been 62.54% higher than it actually was.

R&D EMPLOYMENT IN PARKS

The relative importance of R&D jobs in parks compared to the Spanish totals is about 5-6% during the period studied. The participation percentage has experienced an increase, from 5.03% in 2001 to 5.8% in 2005.

	TOTAL EFFECTS PRESENT APTE UPON THE WHOLE OF SPAIN				
	2001	2002	2003	2004	2005
R&D jobs in APTE	6,330	7,108	8,115	9,330	10,140
%	5.03	5.29	5.35	5.76	5.8

As can be seen with GDP and other variables, concerning APTE provinces[44], and as a result of the entrance of new provinces (especially Madrid) as the new parks have started to operate, the total number of R&D jobs in the provinces has also experienced an increase between 2001 and 2005, from 41,725 jobs to 118,133 (that is, +183.24%). In fact, as a result of these new entrances, the increase in R&D jobs in the provinces was higher than that of the parks, which means that their relative weight has decreased, from 15.17% in 2001 to 10.86% in 2002, 9.29% in 2003, and 8.48% in 2004. Finally, in 2005, when the firms in the new parks started to have a positive influence, the impact started evolving again as usual, and it increased up to 8.5% of the total R&D jobs in the provinces where there is a park in operation.

	TOTAL EFFECTS IN THE PROVINCES UNDER STUDY				
	2001	2002	2003	2004	2005
R&D jobs in APTE	6,330	7,108	8,115	9,330	10,140
%	15.17	10.86	9.29	8.48	8.58

5.2

PRESENT TOTAL EFFECTS OF WELL-ESTABLISHED PARKS IN THEIR RESPECTIVE PROVINCES

Although the values seen in the previous sections are significant by themselves, an approach to the impact at a global scale, that is, for the whole of APTE and in the whole of the Spanish territory, may hide the actual impact that can be found if detailed attention is paid to the impact upon a park's more immediate environment.

In short, the purpose here is to analyze the situation of each of the so-called well-established parks[45], in order to show its importance and the real impact it has upon the economy of its environment, i.e. of its province.

TOTAL EFFECTS IN PROVINCES				
7 WELL-ESTABLISHED PARKS (in millions of euros)	2002	2003	2004	2005
PRODUCTION / TURNOVER	4,004.81	4,349.43	4,894.56	5,518.83
GDP mp	3,163.80	3,436.05	3,866.70	4,359.88
%	3.13	3.17	3.34	3.49
JOBS	64,077	69,591	78,313	88,301
%	2.76	2.91	3.18	3.43

PRODUCTION

The total turnover of the 7 parks analyzed amounted to 5,518.83 million euros in 2005. For its part, the tendency during the period under study shows a total increased turnover for the parks in the 10% range. Thus, the total increase occurred between 2001 and 2005 was +37.8%, from 4,008.81 to the already mentioned 5,518.83 million euros.

GDP AT MARKET PRICES

It is important to point out that the total GDP generated at market prices by the 7 parks under study represents a high percentage in their respective provinces, Thus, for 2005 the percentage of induced GDP resulting from the activities in the parks, in the respective provinces, amounts to 3.49%. The tendency shows an increase in relative weight, from 3.13% of GDP of the provinces in 2002, to 3.49% in 2005, in the same conditions (that is, same number of parks, same number of provinces), which clearly indicates that the entrepreneurial spirit in the parks' environment is greater than the average in the economy of their respective provinces.

EMPLOYMENT

As for the jobs generated by the parks' activity, compared to the total figures for the provinces, the initial stage shows percentages below GDP (2.76% compared to 3.13% en 2002), but the increase has been a spectacular one, and in 2005 the figure is almost equivalent (3.43% for jobs and 3.49% for GDP), which shows the spillover effects that the activities of the parks have upon those in their environment.

R&D EMPLOYMENT

Concerning R&D employment, it has only been possible to incluye the data for the Álava province as from 2004, and those for the Cartuja 93 Park are not available.

It can be observed that, throughout the period, the number of jobs has experienced a steady growth.The greatest increase occurred in 2004 (+24.19), and in 2005 (+16.27). Concerning the relative weight in R&D jobs of these parks in their respective provinces[46], in 2005 it reached a percentage of 66.15%% of the total. The increases in percentages are constant ones, which shows that the R&D employment variable in the parks has grown at a faster rate than the whole of their respective provinces.

	TOTAL EFFECTS IN THE PROVINCES				
7 WELL-ESTABLISHED PARKS	2001	2002	2003	2004	2005
R&D employment	n/a	3,707	3,765	4,676	5,437
%		56.61	51.78	60.95	66.15

Data from Álava as from 2004; no data available for Seville.

In our opinion, it would not be exaggerated to underline the importance for the whole of the Spanish innovation system of the clusterization of business research activities around the parks. Such clusterization, in the middle and long term, will transform the innovative situation in the Spanish economy, because for the first time in our history, the objective foundation will be created for the spontaneous occurrence of two essential factors for a creative environment:

1. Cross-fertilization, which is only possible once a minimum density and total number of researchers and entrepreneurs has been reached. This is something that may start to appear in parks, which as a result should increase their social activity and informal meeting centres, in order to reinforce the network effect.

2. Recognition and visibility of innovation and research activities, which will make it possible to replace the traditional Spanish “let others do the inventing” attitude, by a culture of admiration and respect for new things and for those who dare to change. The concentration of technology firms and research activities in such an attractive environment, as that offered by parks, which are also associated to positive messages by the natural leaders of each autonomous community (more particularly, their governments), is a clearly positive reference for the whole of the population. This is why parks should reinforce their open days and their communication policies, and their respective promoters (specifically, governments) should strengthen the positive messages and use that visible reference as one of the basic instruments in their efforts towards a more innovative society.

5.3

ESTIMATED TOTAL EFFECTS AFTER AN EXPANSION OF PARKS TO ALL SPANISH PROVINCES

We shall now present a number of estimates for 2005, which will allow us to gauge, with a view to the future, the potential impact that APTE parks would have if they spread to the whole of the Spanish economy.

The first two estimates concern a not very distant scenario. The estimate in this case is reinforced in two ways; on the one hand, although the starting points are radically different for the two estimates, it may be seen that the values reached do not show excessively large differences, which makes us think that perhaps they might not be too far from a likely situation.

Finally, a projection will be made of the potencial impact of the APTE group if it had members in the whole of the Spanish territory; the purpose is to have a global view for the whole of Spain regarding the situation of the well-established parks that was discussed above.

5.3.1 ESTIMATED IMPACT OF APTE AT FULL DEVELOPMENT (BASED ON PLANNED SURFACE AREA)

The estimate shown here will attempt to calculate a hypothetical turnover for 2005, based on the planned surface area which is currently projected by APTE.

The projection is based on actual data, i.e. the planned APTE expansion for the short term, which perhaps may yield a more realistic, reliable forecast. The data obtained are shown for each variable; in each case the percentage is shown compared to the value for the whole of Spain.

YEAR 2005	APTE AT FULL DEVELOPMENT	PRESENT APTE
TURNOVER (in millions of euros)	14,568.48	7,494.00
%	0.86	0.44
GDP mp (in millions of euros)	11,509.1	5,920.26
%	1.27	0.65
EMPLOYMENT	184,146	119,904
%	0.93	0.60

PRODUCTION

In this estimate, if all the space that APTE plans to offer in an immediate future were already in use, production would increase from 7,494 million to 14,568 million euros, that is, production would double if in 2005 all the space projected by APTE were already active. In terms of relative share of Spanish production, the percentage would increase from 0.44% to 0.86% in 2005.

GDP AT MARKET PRICES

GDP at market prices generated by the whole of APTE would increase from 5,920.26 million euros at present to 11,509.1 million after an estimate based on planned surface area. The share of Spanish GDP would also double, from 0.65% to 1.27% in 2005, if all the projected space were fully operational.

EMPLOYMENT

For its part, employment would experience a lower increase than the previous variables, from the present 119,904 to 184,146 jobs in the estimated scenario. The share of total employment in Spain also would experience a considerable increase, although again below the values of the other two variables. At present, the relative share for the whole of Spain is 0.6%, whereas with a hypothetical usage of all the projected space, the 2005 percentage would be 0.93%.

TAX REVENUE

Concerning taxes collected in the estimated scenario, the figures increase between 150% and 200% in all categories.

YEAR 2005	APTE AT FULL DEVELOPMENT	PRESENT APTE
Net tax on products	1,150.91	592.03
%	1.25	0.64
Corporate Tax	357.93	184.12
%	1.0	0.51
Income Tax	387.13	252.08
%	0.6	0.39
Total tax revenue	2,920.92	1,695.62

R&D EMPLOYMENT

An estimate of R&D jobs for a projected APTE extension to the whole of the Spanish territory, based on projected surface area, would entail an increase from 10,140 to 19,712 R&D jobs for 2005. The percentage compared to the Spanish figure would increase to 11.2% compared to 5.28 at present (2005 data).

YEAR 2005	APTE AT FULL DEVELOPMENT	PRESENT APTE
R&D Jobs	19,712	10,140
%	11.28	5.8

Again, it is important to emphasize the importance in the future of this development for, on the one hand, there will be a significant increase in the total number of researchers and staff involved in R&D in Spain, but on the other, as this activity will concentrate in a reduced area, there will be a significant increase (as has been said above) in the interaction between researchers and innovative firms, and also their visibility and recognition by the general public will improve.

5.3.2 ESTIMATED IMPACT OF AN EXPANSION OF PARKS TO ALL PROVINCES: HIGH- AND MEDIUM-TECHNOLOGY FIRMS METHOD

Unlike the previous one, the estimate in this section will attempt to calculate a hypothetical turnover for 2005 if there were parks in all Spanish provinces, using a specific percentage determined by the weight that APTE firms have compared to the total number of high- and medium-technology firms in their respective provinces.

Compared to the previous section, an extension of parks' activity to each and every Spanish province leads, as could be expected, to slightly higher values concerning impact. In this case, the purpose is to attenuate, to a certain extent, the short-term scenario, in order to be able to see (albeit in a not so near future) the potential effects of a greater expansion of parks' activity to the whole of Spain.

YEAR 2005	APTE IN THE WHOLE OF SPAIN	PRESENT APTE
TURNOVER	20,824.37	7,494.00
%	1.22	0.44
GDP mp	16,617,84	5,920.26
%	1.84	0.65
JOBS	318,004	119,904
%	1.60	0.60

PRODUCTION
In this estimate, production would increase from 7,494 million to 20,824.37 million euros, that is, an extension of APTE according to this criterion would almost treble the figure. In terms of relative share of Spanish turnover, the percentage would increase from 0.44% to 1.22% in 2005.

GDP AT MARKET PRICES
In short, GDP at market prices generated by the whole of APTE would shift from the present 5,920.26 million euros to 16,617.84 million, with an estimate based on high- and medium-technology firm increases. Thus, the percentage of Spanish GDP would almost treble, from 0.65% to 1.84% in 2005 with this extension of APTE to the whole of the Spanish territory.

EMPLOYMENT
As with the surface area estimate, the number of jobs increases somewhat less than the turnover and GDP variables, from the present 119,904 jobs to 318,004 jobs. The percentage of total employment in Spain also increases noticeably, although it also fails to reach the levels of the other two variables. At present, the relative percentage in Spain is 0.60%, whereas with a hypothetical increase in APTE firms resulting from their expansion would raise the percentage to 1.60%.

TAX REVENUE
Concerning the tax revenue estimate based on the high- and medium technology firms ratio method, the figures are trebled in all categories.

YEAR 2005	APTE IN THE WHOLE OF SPAIN	PRESENT APTE
Net Tax on Products	1,661.78	592.03
%	1.81	0.64
Corporate Tax	516.81	184.12
%	1.44	0.51
Social Security Contributions	1,770.01	667.39
%	2.12	0.80
Income Tax	668.75	252.08
%	1.03	0.39
TOTAL	4,618.35	1,695.62

R&D EMPLOYMENT
An estimate of R&D employment for a projected APTE expansion to the whole Spanish territory, based on the high- and medium-technology firms method, would entail an increase from 10,140 R&D jobs to 28,210 in 2005.

The percentage of the Spanish total would rise to 16.14%, compared to 5.8% (data for 2005).

YEAR 2005	APTE IN THE WHOLE OF SPAIN	PRESENT APTE
R&D Jobs	28,210	10,140
%	16.14	5.8

5.3.3 ESTIMATED IMPACT OF AN EXPANSION OF PARKS TO ALL PROVINCES: ONE WELL-ESTABLISHED PARK IN EACH PROVINCE

The estimate in this section attempts to establish a hypothetical turnover for 2005 based on an extension of APTE to all Spanish provinces, through the creation of a "model" well-established park in each of them.

Compared to the previous estimates, the one presented here is the most optimistic one, because in addition to an extension to each and every province, it also requires the existence in each of them of a fully established park similar to those already in operation. However, it must be remembered that such parks are the result of a historical evolution and of a specific geographic, social, cultural and production context. Therefore, this estimate should not be regarded as a strict forecast, unlike the previous ones, to a greater or lesser extent; this is rather an imaginative hypothesis giving a long-term view of a Spanish economy fully adapted to the society of knowledge. Whichever the case, what this projection shows is the great potential of parks towards the improvement of competitiveness and R&D&I activities in the Spanish economy.

	APTE IN THE WHOLE OF SPAIN	PRESENT APTE
TURNOVER	39,420.21	7,494.00
%	2.32	0.44
GDP mp	31,457.33	5,920.26
%	3.48	0.65
Jobs	630,723	119.904
%	3.18	0.60

PRODUCTION

In this estimate, production would increase from 7,494 million to 39,420.21 million euros, that is, the turnover would be multiplied by five if there was one well-established park in each province. In terms of relative percentage of Spanish turnover, the percentage would increase from 0.44% to 2.32% in 2005.

GDP AT MARKET PRICES

The GDP at market prices generated by the whole of APTE would increase from the present 5,920.26 million to 31,457.33 million in the estimate based on one well-established park per province. The percentage of GDP would also be multiplied by five, from 0.65% to 3.48% in 2005 according to this estimate.

EMPLOYMENT

As with the surface area estimate above, the number of jobs would experience a somewhat lower growth than the GDP and turnover variables, and rises from 119,904 jobs at present to 630,723 jobs in the estimated scenario. The percentage of total employment in Spain also increases considerably, but again fails to reach the levels of the other two variables.

At present, the relative weight in Spain amounts to 0.60%, whereas with a hypothetical extension of well-established parks to all provinces, the percentage would rise to 3.18%.

TAX REVENUE

Concerning the estimated tax revenue based on one "model" park per province, the main figures are as follows:

YEAR 2005	APTE IN THE WHOLE OF SPAIN	PRESENT APTE
Net tax on products	3,145.73	592.03
%	3.42	0.64
Corporate Tax	978.32	184.12
%	2.72	0.51
Social Security Contributions	3,510.60	667.39
%	4.22	0.80
Income Tax	1,326.38	252.08
%	2.04	0.39
TOTAL	8,961.03	1,695.62

R&D EMPLOYMENT

An estimate of R&D jobs for the projection of APTE extended to the whole of Spain in this way, would entail an increase from 10,140 R&D jobs to 52,055 for 2005.

The percentage in the Spanish total figure would rise to 29.78% compared to the present 5.8% (data for 2005).

YEAR 2005	APTE IN THE WHOLE OF SPAIN	PRESENT APTE
R&D Jobs	52,055	10,140
%	29.78	5.8

7 :

CONCLUSIONS

In order to draw any conclusions from this study on the impact of technology parks upon the Spanish economy, a number of remarks must be made.

Firstly, the results are still provisional ones, because this methodology is subject to further refinement. Although, as said above, this methodology has been tested before, and it is becoming increasingly widespread in order to gauge the effects of certain policies or events, this does not mean that all the problems resulting from its usage have already been solved. In fact, the availability of tables for only one year, or for a limited number of years, is a problem in itself, especially when trying to understand the impact of factors such as parks, which due to their nature generate dynamic processes of qualitative change in the production structure and, as a result, in the relationships between the various sectors. Besides, the tables show average values, which may be partially corrected, but it is certainly a problem in order to study the induced effect of activities departing from the average, as is again the case of the activities deployed in parks. The same can be said about employment, which in the case of firms in these parks is of greater than average quality; nevertheless, it is also true that there might also be a greater induced demand for personal services, which are less qualified, than for other activities. Whichever the case, the input-output tables are still the most objective tool for the measurement of the macroeconomic impacts of any activity.

The study has always tried to be careful in its statements, always trying, when there were various alternatives or hypotheses, to choose the most conservative one, thus preventing any overestimation of the impacts measured. Even in the case of future projections, constraints have been placed on our imagination in order to prevent it from flying too high, which might undermine the results obtained.

Nevertheless, in spite of all these limitations and precautions, it must be admitted that the results are spectacular. In our opinion, it would be unforgivable if the leaders of the country and its autonomous communities ignored the middle- and long-term potential of science and technology parks as tools for improving the ability of the Spanish economy to reach the objectives of the Spanish Reform Scheme and the Lisbon Strategy, and also to play a competitive role in the global economy and the society of knowledge.

The total results of only 7 parks, which have reached a relative degree of maturity, represent already 0.65% of Spanish GDP, and 5.8% of the R&D jobs in the whole of Spain. What is more significant, when these values are compared with those of their respective provinces, they amount to 3.49% of GDP and 66.15% of R&D jobs.

On the other hand, it also seems important to emphasize that the average productivity of the activities deployed in the parks is 62.54% higher than average Spanish productivity; this comes at a time when there is widespread concern about the long-term problems that may appear in an economy with increasing wealth and employment, but with lower productivity levels, which leads to doubts as to its competitiveness levels in the middle term.

Therefore, at a time when the Spanish government has expressed, in the Spanish Reform Scheme, its intention to progressively reach the Lisbon goals, and to quickly become level with Europe-25 both regarding per capita income and R&D expenditure as a percentage of GDP, the development of technology parks can appear as the best instrument for such purpose. By simply completing the space development projects already in existence, Spanish GDP would increase by 0.4%, and the number of staff involved in R&D activities would increase by almost 6%. However, if in the long term these parks reached the whole of the Spanish territory, GDP would increase by almost 3% and R&D staff by 25%.

In our opinion, the figures are significant by themselves, and they prove an ability for improvement that perhaps cannot be equalled by none of the other available policies promoting R&D&I.

From our point of view, this is because parks are a synthesis of various factors contributing to R&D&I activity: suitable space, activities supporting innovation, and proximity between the players. All this makes it possible to attract talent, generate synergies and cross-fertilization, and above all to foster a cultural change, clearly between the actors present in the park, but also among all the social players in its close (and sometimes not so close) environment.

Besides, the parks generate a process which is basic for a sound modernization of Spanish economy and society: increased contact between firms and researchers, especially university researchers. In this process, whereby university research is trying to reach the needs of its social and economic environment, nothing can be more profitable than fostering a common language with, and physical proximity to, the firms that may understand the results of that research (and which may even themselves generate results that can be of interest to researchers). In this respect, technology parks play an important role, but we may not disregard the importance of science parks, where university researchers find a natural way to approach the world of industry within a familiar, controlled atmosphere.

The joint effect of technology and science parks is helping to change the context of the Spanish R&D&I system, increasing the connections between universities, technology centres and firms, fostering the creation of new technology-based firms, and promoting the increase in, and maintenance of, the R&D&I activity deployed by firms.

In addition to all this, parks are extremely profitable for the public sector because, as has been proven, they generate a tax revenue for central and regional government which, after a very short period, allows them to recover all the public money invested in them. At present, depending on the tax category, they already generate between 0.2 and 0.5% of the revenue, but could even reach slightly over 1% very shortly, and over 3% in the long term.

Therefore, and even if it were only seen from the point of view of aggressive managers, not worried about corporate social responsibility (that is, the qualitative effects mentioned, leading to improved innovation capability), and only concerned with the financial returns of their investment, this analysis seems to clearly recommend that the various members of the Spanish public sector should become more interested, in the future, in further promoting the appearance and suitable development of science and technology parks, and also in providing them with the necessary instruments for them to play their role as promoters of corporate innovation.

LANDMARKS IN THE SPANISH PARKS SYSTEM

Creation IASP
Tres Cantos TP
Bizkaia TP
II Framework Programme 87-90'
Vallés TP
Creation of APTE
Andalusia TP
Galicia TP
Boecillo TP
National Plan for R&D&I 92-95
ATYCA Initiative
Álava TP
Barcelona SP
Granada HSP
San Sebastián TP

Infobusiness Project
VI Framework Programme 02-06
National Plan for R&D&I 04-07

Spanish Accession to EU
General Council for Science and Technology
Creation CICYT
Promotion and General Coordination of Scientific and Technical Research Act
III Framework Programme, 90-94
Valencia TP
Advisory Council for Science and Technology
National Plan for Scientific Research and Technological Development (multi-year plan)
IV Framework Programme, 94-98
IASP headquarters in Málaga (PTA)
National Plan for R&D&I 96-99
Cotec White Paper
V Framework Programme 98-02
National Plan for R&D&I 00-03
Madrid SP
Walqa TP
Alcalá TP*
Ingenio 2010 (R&D&I 2% of GDP)
Technology Transfer Network (22 parks)
DEMANTIC

* Project started in 1993

7 WELL-ESTABLISHED PARKS

BOECILLO TECHNOLOGY PARK

ANDALUSIA TECNOLOGY PARK

CARTUJA 93 SCIENCE AND TECHNOLOGY PARK

GALICIA TECHNOLOGY PARK

BIZKAIA TECHNOLOGY PARK

SAN SEBASTIÁN TECHNOLOGY PARK

ÁLAVA TECHNOLOGY PARK

ECONOMIC INDICATORS

• Data for the 7 well-established parks in induced terms
• Values regarding the provinces with the 7 well-established parks

GDP mp

140,000 120,000 100,000 80,000 60,000 40,000 20,000 0

8

100,967.16 108,232.82 115,711.27 124,897.90 6 7

3.13 3.17 3.34 3.49 4 5 %

3

2

3,163.80 3,436.05 3,866.70 4,359.88 1

0

2000 2003 2004 2005

GDP mp 7 parks
GDP provinces 7 parks
% parks compared to provinces

Employment

8
2,576,400
2,464,000
6 7
2,321,000 2,391,100

5
%
3.18 3.43 3 4
2.76 2.91

2
78,313 88,301 1
64,077 69,591

0

2002 2003 2004 2005

GDP mp 7 parks
GDP provinces 7 parks

% parks compared to provinces

3,000,000 2,500,000 2,000,000 1,500,000 1,000,000 500,000 0

R&D&I SYSTEM

• Values compared to total R&D employment of the seven well-established parks, per province and region.

R&D Employment (provinces)

9,000

8,219

8,000

7,272 7,672 7,000

6,548 6,000 5,437

5,000

4,676 4,000

66.15 3,000

3,707 3,765

60.95 2,000

56.61

1.000

51.78

0

2002 2003 2004 2005

R&D jobs 7 parks R&D provinces 7 parks % Parks with respect to provinces

R&D jobs (per regionl)

90

85

80

75

%

70

65

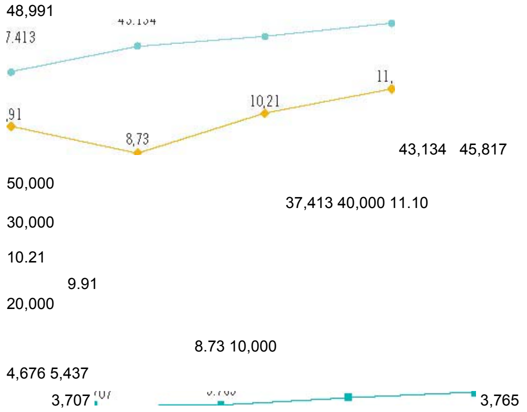
60

55

50

60,000

48,991



43,134 45,817

50,000

37,413 40,000 11.10

30,000

10.21

9.91

20,000

8.73 10,000

4,676 5,437

3,707

3,765

0

2002 2003 2004 2005

R&D jobs 7 parks | R&D jobs provinces 7 parks | % parks with respect to provinces

15

14

13

12

%

11

10

9

8

7

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41.- There is a third category, that of honorary members, which can be persons or organizations, be them individuals or firms, public or private, and either from Spain or abroad, who have been appointed by the General Assembly at the proposal of the Executive Committee, due to their applicable merits and their contribution to the goals of the Association. These members will not have voting rights, and are exempt from membership fees.

42.- It must be said here that no attention has been paid to the changes that innovation and technological change processes may introduce in these relations.

43.- Although the assessment stage differs for each of these parks, the Álava, San Sebastián, Vizcaya, Boecillo, Galicia, Andalusia and Cartuja 93 parks are considered here as "well-established" due to the time they have been in operation. Both the Alcalá and the Granada park have just started their real estate operations, whereas the Barcelona and Madrid science parks do not offer spaces for well-established production firms to set up business; therefore, their impact cannot be assessed in the same way as for Technology Parks.

44.- As there are no statistics avalilable for R&D employment for individual provinces, this has been estimated through regional R&D employment in proportion to the economic weight (GDP) of each province within the region.

45.- As has been said before, these are the ones located in the provinces of Álava, Biscay, Guipúzcoa, Ourense, Boecillo (Valladolid), Málaga and Seville.

46.- As before, the R&D employment figure for each province has been estimated through regional R&D employment in proportion to the economic weight (GDP) of each province within the region.