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The Basque Innovation System:

a policy review

Beñat Bilbao-Osorio

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Executive summary

The Basque Country has enjoyed major economic and social development in recent years. High economic growth rates in the last decade or so enabled the region to achieve a level of economic and social welfare well above the Spanish and EU average. The Basque Country today is one of the most prosperous regions in Europe.

However, this rapid economic growth was brought about by the economy's increasing capacity to utilise available resources, rather than by achieving higher productivity rates. In other words, the region has been working more, but not necessarily more intelligently, which casts doubts on the sustainability of the current process. The situation suggests the Basque economy was relatively well placed to capitalise on industrial policies mobilising the region's available resources. However, the practically full deployment of existing capital and human resources in the economy also points to the exhaustion of this source of economic growth and the need to embark on a new competitive stage to increase the productivity of resources: the innovation phase.

A result of the system's relatively poor innovation performance, the relative stagnation of productivity also reveals important weaknesses that need to be addressed if the innovative capacity of players in the region is to improve and higher degrees of productivity achieved.

The review of innovation policy in the Basque innovation system shows that the Basque Country is, to a large extent, the result of the innovation policy carried out in the last twenty-five years, when the research system had to be created from scratch. In the early 1980s, the innovation system in the Basque Country was non-existent, with R&D investments below 0.1% of the regional GDP. Subsequent R&D and innovation policies helped the region to achieve R&D rates of 1.6% of the GDP in 2006. However, science, technology and innovation policies tended to follow a linear model with investments skewed towards the creation of a previously non-existent research infrastructure. Nevertheless, more systemic policies, establishing links between the different innovation agents, played a secondary role. The results of these policies are clearly reflected in the current Basque innovation system, where systemic links are still deficient. This is particularly true of the relationships between research institutions, either universities or technology centres, and the local entrepreneurial system, composed mainly of small and medium enterprises in medium technology sectors with relatively low levels of R&D investment. Until now, the system has not managed to transform the ideas and knowledge generated into the necessary applications by bridging the gap between new ideas and the markets.

The planners of the new national and regional science, technology and innovation plans have understood the problem, and have adopted more systemic types of policies. In addition to fostering the science and technology infrastructure, capacity and excellence in the region, the new plans include policies aimed at creating and fostering stronger ties between agents, especially between the scientific community and local business. The new Basque Science, Technology and Innovation Scheme 2010 is of special interest, as it addresses the need to increase such cooperation, particu-

larly as new and promising institutions such as the Cooperative Research Centres (CICs) have been created to foster commercially applicable scientific research in a number of key sectors in the Basque economy. One potentially decisive factor in the success of these policies is the capacity of local firms to invest in R&D, raising their innovative profile and absorptive capacity. Close monitoring of the links created between agents and the introduction of new measures to correct deviations from the plans, are key factors for the success of this scheme.

However, despite the clear improvements envisaged in the new plans, a number of concerns should still be addressed to ensure a more efficient system. These concerns include the risks of underinvestment in basic blue-sky research, the need to enhance cooperation between administrations to benefit from greater economies of scale and avoid overlapping, and the requirement of continuous monitoring and evaluation of policy impacts.

The new innovation scheme stresses the need to create and foster links between agents in the system. While the benefits of this type of measure have already been acknowledged, we need to remember that basic non-oriented research has the potential to bring about substantial benefits in the long run. The Basque Country already has one of the lowest rates of basic R&D investment in Western Europe and OECD countries. While the current composition of the manufacturing sector may not have required much basic R&D, the introduction of new and forward-looking science-intensive sectors, such as biotechnology or nanotechnology, may require the knowledge and skills associated with basic research.

Policy cooperation between administrations is crucial to the multi-governance innovation system in the Basque Country. The development and/or strengthening of cooperation institutions between the region and central government should be a major priority in the implementation of Innovation Plans.

Finally, a scheme for evaluating the way plans are implemented and monitored should be an integral part of Innovation policies and, accordingly, be actively promoted.

El sistema vasco de innovación: un análisis de sus políticas

Resumen ejecutivo

El País Vasco ha logrado un importante nivel de desarrollo socioeconómico. Las altas tasas de crecimiento económico registradas en el País Vasco a lo largo de la última década han permitido a la comunidad autónoma conseguir un nivel de bienestar socioeconómico muy por encima de la media de España y de la UE. En la actualidad, esta comunidad autónoma se encuentra entre las regiones más prósperas de Europa.

Este rápido crecimiento económico, sin embargo, es el resultado de la capacidad de la economía de aprovechar mejor los recursos disponibles, en vez de hacerlo mediante tasas de productividad más altas. Es decir, la comunidad autónoma ha trabajado más, pero no necesariamente de forma más inteligente, lo que, en cierta medida, pone en duda la sostenibilidad del proceso actual. De alguna manera, esta situación señala que la economía vasca está bastante bien posicionada para poner en valor aquellas políticas industriales que preveían la utilización de los recursos disponibles en la comunidad autónoma. No obstante, el despliegue ya casi total del capital y los recursos humanos existentes en la economía nos avisa también del agotamiento de esta fuente de crecimiento económico y de la necesidad de implantar una nueva fase competitiva para aumentar la productividad de los recursos: esto es, la fase de la innovación.

El estancamiento de los niveles de productividad se explica por la relativamente escasa actividad innovadora dentro del sistema. También señala la presencia de relevantes debilidades que debemos abordar para mejorar la capacidad de innovación de los agentes de la región y lograr así unas tasas de productividad más altas.

Un recorrido histórico por las políticas de innovación dentro del sistema vasco de innovación revela que el País Vasco es, en gran medida, el resultado de las políticas de innovación implementadas a lo largo de los últimos veinticinco años, cuando había que crear un sistema de innovación desde cero. A comienzos de los ochenta, el sistema de innovación del País Vasco no existía: la inversión en I+D representaba menos del 0,1% del PIB regional. Pero la confección y el desarrollo de políticas de I+D y de innovación a partir de esa década han permitido a la comunidad autónoma lograr tasas de I+D del 1,6% del PIB en el año 2006. Sin embargo, esas políticas de ciencia, tecnología e innovación tendían a seguir un modelo lineal, con gran parte de las inversiones orientadas hacia la creación de una infraestructura investigadora, hasta entonces inexistente. No obstante, unas políticas de tipo más sistémico, que establecían vínculos entre los distintos agentes de la innovación, desempeñaron un papel secundario. Los resultados de estas políticas están claramente reflejados en el actual sistema vasco de innovación, en el que los vínculos sistémicos siguen siendo, a día de hoy, deficientes. Y esto es especialmente cierto con respecto a las relaciones entre las distintas instituciones investigadoras, sean universidades o centros tecnológicos, y el sistema empresarial local, que consiste de forma mayoritaria en pequeñas y medianas empresas que trabajan en sectores de nivel tecnológico medio, con niveles relativamente bajos de gasto en I+D. En consecuencia, hasta ahora, el sistema no ha conseguido transformar las ideas y los cono-

cimientos generados en las aplicaciones necesarias para cerrar la brecha existente entre las ideas nuevas y los mercados.

Los nuevos planes de ciencia, tecnología e innovación, tanto a nivel regional como nacional, han sabido asimilar esta problemática, adoptando un tipo de políticas más sistémicas. Además de promover las infraestructuras científicas y tecnológicas, y las capacidades y niveles de excelencia dentro de la comunidad autónoma, los nuevos planes han desarrollado políticas orientadas hacia la creación y promoción de vínculos más estrechos entre los distintos agentes, y especialmente entre el mundo científico y las empresas autóctonas. En este sentido, el Nuevo Plan de Ciencia, Tecnología e Innovación 2010 del País Vasco resulta de gran interés, ya que señala la necesidad de aumentar esta colaboración y, sobre todo ahí donde se hayan creado nuevas y prometedoras instituciones, como son los Centros de Investigación Cooperativa (CIC), cuya misión consiste en promover investigaciones científicas con resultados comercialmente aplicables dentro de varios sectores clave para la economía vasca. Otro factor determinante para el éxito de estas políticas será, a buen seguro, la capacidad de las empresas locales para invertir en I+D, mejorando su perfil innovador y capacidad de absorción. Una estrecha monitorización de los lazos establecidos entre los distintos agentes y la implantación de nuevas medidas para corregir eventuales desviaciones de los planes previstos constituyen asimismo un factor clave para el éxito del plan global.

Sin embargo, y a pesar de los ambiciosos objetivos de los nuevos planes, quedan todavía diversos asuntos por abordar si se quiere conseguir que el sistema funcione de forma más eficiente. Se trata del riesgo de invertir por debajo del nivel requerido en la investigación básica tipo blue-sky (sin límites), la necesidad de mejorar la colaboración entre las distintas Administraciones para beneficiarse de unas economías de escala más altas y evitar duplicidades, y la necesidad de monitorización y valoración permanentes de los impactos de las políticas desarrolladas.

Como ya hemos observado, el nuevo plan de innovación pone el énfasis en la necesidad de crear y promover vínculos entre los distintos agentes dentro del sistema. Aunque ya se han reconocido los beneficios de este tipo de medidas, es también muy importante tener presente en todo momento que la investigación básica no-orientada es capaz, a largo plazo, de traer beneficios nada desdeñables. El País Vasco de por sí presenta uno de los niveles más bajos de inversión en la I+D básica de la Europa occidental y, también, de entre los países de la OCDE. Puede que la composición actual del sector manufacturero no haya necesitado hasta ahora grandes esfuerzos en la I+D básica, pero la implantación de nuevos sectores, intensivos en actividades científicas y muy de futuro, como, por ejemplo, la biotecnología o la nanotecnología, van a exigir los conocimientos y las competencias habitualmente asociados con la investigación básica.

Resulta absolutamente esencial para el sistema de innovación que funciona en la actualidad en el País Vasco, regido por las distintas Administraciones, la colaboración entre ellas. El desarrollo o la consolidación de organismos para la colaboración entre la comunidad autónoma y el Estado debe priorizarse dentro del proceso de desarrollo de los distintos planes de innovación.

Para concluir, un mecanismo de evaluación para la implantación y monitorización del plan deberá formar parte integral de las políticas de innovación, y promoverse de forma activa.

Euskal berrikuntza sistema: bere politiken analisia

Laburpen exekutiboa

Euskadik garapen sozioekonomikoko maila garrantzitsua lortu du. Azken hamarkadan Euskadin izandako hazkunde ekonomikoko tasa altuei esker, autonomia erkidegoak lortu duen ongizate maila Espainiako eta EBko batez bestekoaren oso goitik dago. Gaur egun, autonomia erkidego hau Europako eskualderik oparoenetakoa da.

Hazkunde ekonomiko azkar horren jatorria, baina, ekonomiak baliabideak hobeto aprobetxatzean oinarritu da, produktibitate tasa altuagoak erabili beharrean. Hau da: autonomia erkidegoak gehiago egin du lan, baina ez derrigorrez modu inteligenteagoan. Eta horrek, nola edo hala, zalantzan jartzen du egungo prozesuaren iraunkortasuna. Zelanbait esateko, egoera honek argi uzten du euskal ekonomia nahiko ondo kokatuta dagoela, autonomia erkidegoko baliabideak erabiltzea aurreikusten zuten politika industrialei balioa emateko orduan. Alabaina, ekonomiako kapitalak eta giza baliabideak ia oso-osorik hedatzeak adierazten digu hazkunde ekonomikoko iturri hori agortzear dagoela eta lehiakortasun-fase berri bati ekin behar zaiola, baliabideen produktibitatea handitzeko: berrikuntzaren faseaz ari gara.

Produktibitate mailen geldialdiaren arrazoia da sistema barruan oso jarduera berritzaile gutxi egon direla. Gainera, ahuldade handien presentzia ere suma daiteke, eta horiei aurre egin behar zaie, eskualdeko agenteen berrikuntza-gaitasuna hobetzeko eta produktibitate tasa altuagoak lortzeko.

Berrikuntzaren euskal sistemaren barruko berrikuntza-politiketatik egindako ibilbide historikoak argi uzten du Euskadi, neurri handi batean, azken hogeita bost urteotan ezarritako berrikuntza-politiken emaitza dela. Izan ere, sasoi hartan, zerotik abiatuta sortu behar izan zen berrikuntza sistema. 80ko hamarkadaren hasieran, Euskadiko berrikuntza sistema ez zen existitzen: I+Gko inbertsioa eskualdeko BPGren %0,1 baino txikiagoa zen. Baina, hamarkada horretatik aurrera, I+G eta berrikuntza arloetako politikak egin eta garatzearen ondorioz, autonomia erkidegoak BPGren %1,6ko I+G tasak lortu ditu 2006an. Hala ere, zientzia, teknologia eta berrikuntzako politika horiek eredu lineala zuten, eta inbertsioetako asko ikerketarako azpiegitura sortzera zeuden bideratuta (ordura arte ez zen halakorik existitzen). Edozelan ere, berrikuntzako agenteen arteko loturak sortzen zituzten politika sistemikoagoek bigarren mailako zeregina zuten. Politika horien emaitzak argi islatuta daude berrikuntzako gaur egungo euskal sisteman, non lotura sistemikoek urriak izaten jarraitzen baitute oraindik ere. Eta, bereziki, hori horrela gertatzen da erakunde ikertzaileen (unibertsitateak edo teknologia zentroak) eta tokiko enpresa-sistemaren (batez ere, maila teknologiko ertaineko sektoreetan lan egiten duten eta I+Gko gastu baxu samarrak dituzten enpresa txiki eta ertainak) arteko harremanekin. Ondorioz, orain arte, sistemak ez ditu beharrezko aplikazioetan sortutako ezagutzak eta ideiak eraldatu, ideia berrien eta merkatuen arteko etenak ixteko.

Zientzia, teknologia eta berrikuntza arloko plan berriek (eskualde zein Estatu mailan) ondo asimilatu dute arazo hori, politika sistemikoagoak hartuz. Autonomia erkidegoaren barruan azpiegitura zientifiko eta teknologikoak zein gaitasunak eta bikaintasun mailak sustatzeaz gain, plan berriek agenteen arteko lotura estuagoak sortu eta sustatzeko politikak garatu dituzte; bereziki, mundu

zientifikoari eta bertako enpresei dagokienez. Hori horrela, Euskadiko Zientzia, Teknologia eta Berrikuntzako 2010eko Plan Berria oso interesgarria da, lankidetza handitzeko beharrizana erakusten du eta. Hain zuzen ere, hortxe sortu dira instituzio berriak eta etorkizun handikoak; esate baterako, Ikerketa Kooperatiboko Zentroak (CIC), zeintzuen lana ikerketa zientifikoak sustatzea baita. Horren haritik, emaitzak euskal ekonomiarako funtsezkoak diren zenbait sektoretan aplikatu daitezke, modu komertzialean. Politika horien arrakastarako garrantzitsua izango den beste faktoreetako bat, seguruenik, bertako enpresek I+Gn inbertitzeko duten gaitasuna izango da, euren izaera berritzailea eta absortziorako gaitasuna hobetuz. Era berean, plan globalak arrakasta izan dezan, agenteen artean sortutako harremanak estu monitorizatu behar dira eta aurreikusitako planen aldi baterako desbideratzeak zuzentzeko neurri berriak ezarri behar dira.

Hala ere, eta plan berrien helburuak handiak badira ere, oraindik ere gai asko daude lantzeko, sistemak modu eraginkorrean funtzionatuko badu. Blue-sky (mugarik gabe) erako oinarrizko ikerketan eskatutako mailatik behera inbertitzearen arriskuaz, administrazioen arteko kolaborazioa hobetzeko beharraz (eskalako ekonomia altuagoak eskuratzeko eta bikoiztasunak saihesteko), eta garatutako politiken inpaktuen etengabeko balorazioaz eta monitorizazioaz ari gara, zehazki.

Ikusi dugun bezala, berrikuntzako plan berriak sistemako agenteen arteko loturak sortu eta sustatzearen beharra azpimarratzen du. Neurri mota honen onurak argiak badira ere, oso garrantzitsua da jakitea orientatu gabeko oinarrizko ikerketa gai dela, epe luzean, oso etekin interesgarriak sorrarazteko. Euskadik, berez, mendebaldeko Europako eta ELGAko herrialdeetako I+Gko inbertsio mailarik baxuenetakoa dauka. Beharbada, manufaktura sektorearen gaur egungo osaerak ez du orain arte ahalegin handirik eskatu oinarrizko I+Gri dagokionez, baina jarduera zientifikoan oso intentsiboak eta etorkizunekoak diren sektore berriek (besteak beste, bioteknologia edo nanoteknologia) oinarrizko ikerketarekin lotu ohi diren ezagutzak eta gaitasunak eskatuko dituzte.

Gaur egun Euskadin funtzionatzen duen eta administrazioek arautzen duten berrikuntza sistemarako, guztiz beharrezkoa da administrazioen arteko lankidetza. Autonomia erkidegoaren eta Estatuaren arteko lankidetzarako organismoak garatzeak edo sendotzeak lehentasuna izan behar du, berrikuntza planen garapen prozesuaren barruan.

Amaitzeko, plana finkatu eta monitorizatzeko ebaluazio-mekanismoek berrikuntza politikoen parte izan behar dute, eta modu aktiboan sustatu beharko dira.

1. The role of science, technology and innovation policies in the construction and development of regional innovation systems

Innovation as an engine for growth

Today, innovation and innovation capacity are increasingly recognised as one of the key sources of competitiveness and economic development (Romer 1990, Lundvall 1992, Grossman and Helpman 1994) at both national and regional levels. In the international arena, the European Union has also embraced this belief, and in 2000 it set the strategic objective of "becoming the most competitive and dynamic economy through a knowledge-oriented strategy" (European Commission, 2000) The Lisbon strategy made this objective operative by setting intermediate targets for each Member State to achieve by 2010.

Innovation and its impacts on the economy have been widely researched in the academic literature since the pioneering work of Schumpeter (1909). Authors such as Dosi (1982), Cooke and Morgan (1992) or Aghion and Howitt (1992) have already proved the positive impacts of innovation and have argued that "technology (as a specific mode of innovation) is the real force behind perpetual rising standards of living" (Grossman and Helpman 1994:24)

The increasing interest in innovation has led many authors to investigate the processes leading to innovation, as well as the geographical location where innovations appear. Traditionally, innovation and innovation policy had been regarded as a linear process in which technological investment resulted in an increased level of technological development and innovation output that would subsequently impact positively on the economic development of a territory. In this framework, public policies would focus on stimulating science and basic R&D investment that would then be transformed into applied research readily available for firms to develop new and more efficient production processes and generate new products to launch in the market.

However, in the last thirty years a new conception of innovation has emerged and provided the theoretical basis for evolutionary models of economic growth, where innovation is the result of a series of systemic relations between actors (Nelson and Winter 1982, Dosi 1988), which rather than being linear innovation is more a "chain-link process", with constant feedback between the different stages of innovation and across actors. In this new paradigm, the links and institutions brokering relationships between actors are also regarded as an important source of innovation, as actors can seldom act in isolation to develop innovations.

In geographical terms, the recognition of geographical proximity in the development, transmission and absorption of knowledge has led many authors (Braczyck et al 1998, Maskell and Malmberg 1999) to emphasise the importance of the region both as an arena and as an actor in the analysis and promotion of innovation processes (Hassink 1999). In this con-

text, the theoretical corpus increasingly considers the regional scale as the primal locus of innovation (Cooke et al 1997).

As a result of these two core aspects of innovation, i.e. a systemic process geographically localised in a region, Regional Innovation Systems[1] (RIS) have acquired a prominent position as the basic analytical concept in studying innovation processes.

Regional Innovation Systems as an analytical concept

The concept of Innovation Systems appeared in the academic literature during the late 1980s (Freeman, 1987) as an analytical framework to overcome the shortcomings the linear model imposed on the generation and diffusion of innovation, and to emphasise the complexity of the processes where innovations took place. In contrast with the linear model, the RIS literature suggests that innovations do not necessarily occur as a natural process where public research institutes and universities conduct basic research that is then transformed into technological developments and new products and better processes by firms. RIS highlighted the role of "Institutions" and their accumulation over time (Maskell and Mamberg 1999:173); and the interrelations between agents, as a mechanism to generate and diffuse knowledge that is incorporated in innovations.

The importance of the "system" concept is emphasised by the role that institutions and their interactions play in the innovation process. Nelson (1993:7) argues that innovation systems are "a way of describing and analysing the set of institutions that generate and mould economic growth, to the extent that one has a theory of economic growth in which technological innovation is the key driver." Freeman (1987:5) defines innovation systems in a similar manner as "a network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies." Both authors emphasise the role of institutions and technology as key drivers of economic growth. A third major author of innovation systems literature, Lundvall (1992:2), provides a slightly broader definition, describing innovation systems as "all parts and aspects of the economic structure and the institutional set-up affecting learning as well as searching and exploring."

The basic idea behind these systems is that the globalisation process and new technological advances have exposed firms to increasing competition. Fierce competition puts pressure on firms to innovate either in their products, processes or organisational arrangements. Rather than being conducted in isolation, innovations are usually carried out in cooperation with other organisations, such as firms, educational institutions and/or governments. Each of these organisations generates knowledge when interacting with the others and it is the role of the institutions to facilitate the generation and assimilation of this knowledge among the different agents. It should be emphasized that the concept of institutions needs to be broadly defined, and includes both hard, e.g. government agencies, chambers of commerce, etc; and soft, e.g. social norms, habits, etc, institutions (Morgan 1997)

Innovation systems therefore consist of a whole range of elements. In their attempt to define them, Cooke and Morgan (1998) pointed to the following as key components of any given system: (1) R&D, (2) education and training institutions, (3) financial systems, (4) network of user-producer relationship, (5) intermediate institutions and (6) social capital: networks, norms and trust.

[1] Regional Innovation Systems have sometimes been criticised in the literature for a lack of clarity and precision in their concepts (Doloreux 2004) and the fuzziness of their components.

Relationships—the links between elements—play a key role in these systems, as they activate and invigorate the innovation process. Lundvall (1992) argues that an innovation system comprises both the elements (institutions) and their mutual relationships. Innovation is an interactive process where the relationships involve users and producers of new knowledge for practical purposes. It is a "social process that involves feedback at different points in the innovation process and it involves knowledge development, diffusion and deployment" (Cooke and Morgan 1998:478)

To conclude, innovation originates in systems in which different players participate and interact.

Despite ongoing controversy about the level at which such systems operate, the proven importance of geographical proximity in the development, transmission and absorption of knowledge has led many authors (Braczyck et al 1998, Maskell and Malmberg 1999) to emphasise the importance of the region as the key level of analysis. It has also instigated a major branch of the literature emphasising and describing the role of Regional Innovation Systems (Cooke et al 1997) as the loci for innovation generation. Iammarino (2005:497) also defends the importance of the regions and after investigating empirically the existence of regional innovation systems, she concludes that there are "actors, relationships and attributes operating at the sub-national scale in the system of innovation."

Regional Innovation Systems as a policy concept

Regional Innovation Systems have equally become a policy concept where the complexity in developing and implementing public innovation policies is acknowledged. If in the past, basic R&D investment policies sufficed to foster innovation, in this new paradigm, public policies need to take into account the main analytical components of the system, i.e. innovation actors, their links and the institutions facilitating the links. They need to incorporate them into the policy agenda set out by a number of policy makers (de Bruijn and Lagendijk, 2005). In other words, RIS are presented as a concept providing support for regional development by stimulating innovation. Moreover, they fit the new policy paradigm of regional development oriented towards self-sustained measures aimed at improving the regional competitiveness (Batchler et al 2003)

However, the transformation of the RIS from an "analytical concept" into a "policy concept" is not always simple. Many policy instruments and measures have been identified: research-business collaborations, business start-ups, clustering and the drafting of regional innovation strategies. However, there are still doubts about its application and the identification of what can be regarded as key success factors (Doloreaux and Parto 2004). There seem to be as many "ideal models" for RIS as there are policy applications (Bruijn and Langendijk 2005) and models distinguishing types of Regional Innovation Systems (Cooke and Morgan 1998) have placed greater emphasis on the principles of governance underpinning RIS applications than on the actual policy types.

Moreover, RIS theory for policy formulation can only be properly applied if the local conditions embedded in the specific RIS (such as economic structure or educational attainment levels) are taken into account in the right way (Rodríguez-Pose 1999, Bilbao-Osorio and Rodríguez-Pose 2004). As a result, the RIS analytical concept of promoting systemic relationships cannot be directly adapted from a general model to a particular context. The wide variations in the use of the RIS analytical concept for policy formulation responds to the need to adapt to local conditions, and highlights the measures counteracting the weaknesses identified in any particular system. In a nutshell, there is no "one size fits all" solution in providing recommendations for policy formulation.

Despite these challenges, the combination of the theoretical framework provided by the analytical concept of RIS, and the identification of a region's specific characteristics provides a good basis for policy formulation and thus for the review of equally specific science, technology and innovation policies aimed at strengthening a particular RIS.

In the European context, innovation related policies are the result of a multilevel governance system (Marks et al 1996, and Sanz-Menéndez and Cruz-Castro, 2005), where regional, national and supranational governments play a key role in adopting legislations and developing innovation policies and instruments. Understanding these policies and how they integrate (or not), in order to address regional innovation system weaknesses is a key factor in assessing the benefits of public policies and providing policy recommendations.

The objective of this paper is to review the science, technology and innovation policy mixes affecting the Basque RIS. Previous policy reviews (Moso 2000, Moso and Olazaran 2002, Olazaran et al 2005 or Sanz-Menéndez and Cruz Castro 2005) focused on highlighting the decisive socio-political and economic factors influencing regional innovation policy. They analysed the economic and political context in the region as well as the incentives of the main agents in the regional system to explain the policies and instruments adopted by the Basque regional government, an objective that falls outside the scope of this paper. The present review identifies the policy measures adopted or foreseen by the regional government and by all other policy makers, namely central Spanish government and the European Union, from a RIS perspective. In other words, it analyses policies and instruments implemented to strengthen the Basque RIS and identifies a list of policy suggestions to set off weaknesses in the regional innovation capacity.

To this end, the following section of this review presents a conceptual model identifying the main theoretical elements of RIS. Section 3 briefly introduces the socio-economic characteristics of the Basque Innovation System and its current innovative profile. More precisely, this section highlights some of the main characteristics of the current Basque Innovation System and identifies some of the principal weaknesses the system needs to address, from a systemic perspective, to enhance innovation in the region. Section 4 provides an overview of the main innovation-related policies implemented to date that help explain the current state of the Basque Innovation System. Section 5 describes recent action taken by policy makers that are currently influencing the performance of the Basque innovation system. Section 6 presents some policy recommendations, grouped in areas of activities that may favour the system's innovation performance. Finally, Section 7 concludes this review.

2. The Basque Country: a prosperous region with a poor innovation performance

Economic characteristics of the Basque Country: a prosperous industrial region

Industry has traditionally played a major role in the Basque economy. Today it still accounts for about 39% of the total value added. For more than a hundred years, the Basque economy developed thanks to traditional coal and steel-based industries. However, during the 1970s and 1980s the Basque economy underwent a process of thorough restructuring. Like many old industrial regions, heavy industries that were the backbone of the Basque industrial structure went into near-terminal decline that seriously affected the region's economic performance. However, unlike other traditional industrial regions in Spain (e.g. Asturias) and elsewhere in Europe, from the early 1990s, the Basque economy began to effect a remarkable turnaround.

As a result of this economic transformation, the region forged a new industrial profile, based on medium and medium-high technology sectors like aerospace, machine-tools, electronic household appliances, electronics and energy. These sectors have been organised around a large population of small and medium enterprises that, in conjunction with a very small proportion of large companies, have transformed the Basque industrial sector. At the same time, the services sector, which accounts for around 60% of the regional GDP, has been substantially transformed: in addition to traditional strengths in the financial sector, advanced business services, trading and tourism, following the opening of the Guggenheim museum, have all developed rapidly.

This economic transformation was possible thanks to major business investments in the Basque Country, (25.7 compared to an average of 18.2 for EU-27[2]) which enabled the region to achieve a high level of economic prosperity. In 2006, per capita GDP in the Basque Country was above 130% the EU-27 average[3]. In 1990, this the figure was just 90%. Furthermore, in the last two decades, the unemployment rate fell to 3.3% in 2007 from the record 25% during the 1980s.

Sources of economic growth: working more but not necessarily more intelligently

Rapid economic growth since the 1990s has permitted the Basque Country to become one of the most prosperous regions in Europe. Although high investment rates in the busi-

[2] Source: Basque Government (2008).
[3] Source: Eurostat (2008).

ness sector may provide a plausible explanation for the growth experience in the region, we also need to understand how this investment has been used, not only its results.

An analysis of some basic macroeconomic variables related to variations in the employment rate and labour and total factor productivity reveals that the Basque economy has grown because of its ability to employ more people in the system, although not necessarily in more productive activities.

Table 1 shows how the employment rate in the Basque economy evolved in comparison to some benchmark economies.

Table 1: Employment rate

Employment rate	1995	2000	2005
Basque Country	48.4	57.6	64.2
EU 15	60.1	63.4	64.7
Spain	46.9	56.2	61.1
USA	72.5	74.1	71.2
Japan	69.2	68.9	68.7

Base: EU25= 100. Source: Aguirre, A (2007)

Table 1 shows how employment rate in the Basque Country finally matched the European Union average. The sharp decrease in unemployment rates that followed the industrial restructuration process has enabled the economy to produce more and accounts for most of the growth. Table 2 shows that productivity in the Basque economy remained stable during that period or even decreased, while increasing in the United States or Japan during the same period.

Table 2: Productivity

Productivity rate	1995	2000	2005
Basque Country	120.5	117.7	118.1
EU 15	110.1	108.4	106.4
Spain	104.4	100.7	102.5
USA	132.9	134.6	143.8
Japan	96.6	95.5	101.1

Base: EU25= 100. Source: Aguirre, A (2007)

Theses findings are in line with a recent study by Erauskin (2007) which argues that both labour and total factor productivity in the Basque Country have remained close to zero or have even been negative in some periods over the last two decades. This figure contrast with labour productivity growth of around 2% for the OECD economies and 1%-plus for EU15.

In conclusion, high investment rates in the Basque economy have succeeded in mobilising the region's available resources and increasing its production capacity. However, the economy has somehow "failed" to deploy these resources in more productive activities. This casts some doubt on the sustainability of the growth process, especially in view of the expansion of the Central and Eastern European economies that benefit from more competitive pro-

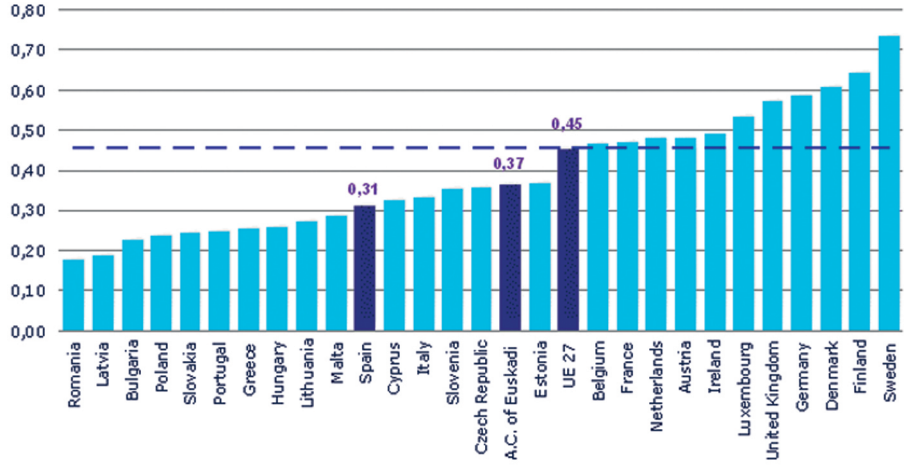
duction costs. In other words, from a "Porterian" perspective, the Basque Country seems to have exhausted its capacity to compete through costs and to increase efficiency by more investments. Further economic growth may need to come from higher productivity rates and for that more innovation may be needed.

Poor innovation performance

The relatively disappointing growth in productivity in the Basque economy originates from the system's poor innovation performance.

The European Innovation Scoreboard[4] (EIS) is a benchmarking exercise in which a number of indicators summarise the main elements of innovation performance. Graph 1 shows the EIS value for the Basque Country in comparison to other European economies. The Basque Innovation System is clearly underperforming, scoring below the EU27 average, which is particularly worrying if we take into account the level of economic development of this region, well above the EU average.

Graph 1: European Innovation Scoreboard



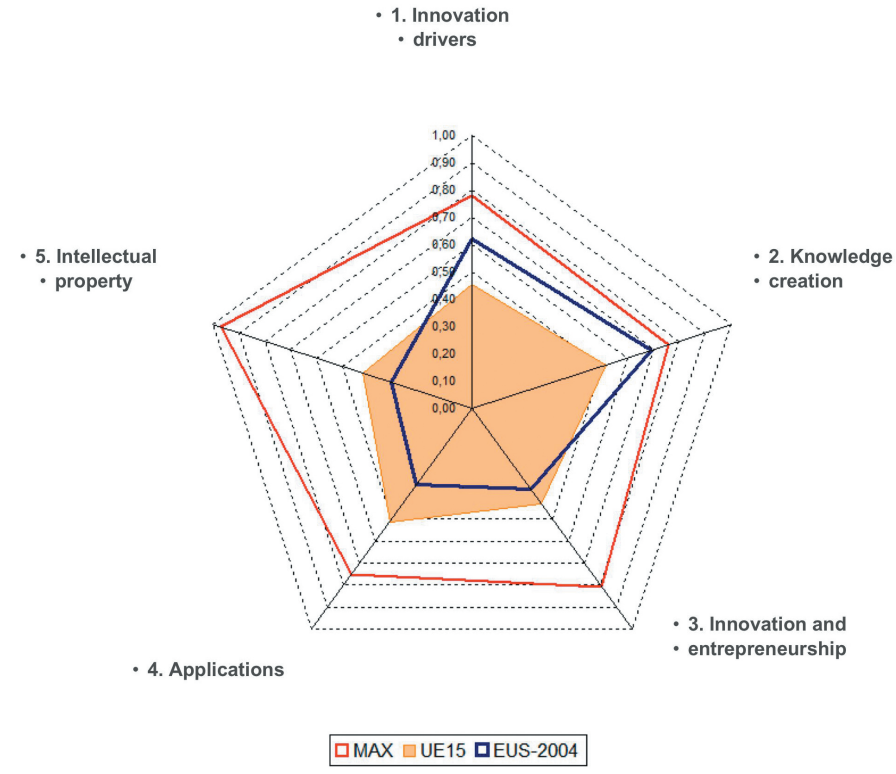
Source: Eustat, 2008

In addition to this overall index, the EIS helps identify the sources that feed the innovation performance index, providing clearer pictures on the causes that lead different countries to perform differently.

Graph 2 shows the European Innovation Scoreboard's five main axes for the Basque Country, the European Union (EU15) and the leader in each dimension.

[4] For a full description of the European Inniovation Scoreboard methodology and composition, please visit: http://www.proinno-europe.eu/doc/EIS2006_final.pdf

Graph 2: European Innovation Scoreboard: Basque Country, EU15 and leader



Source: Eustat, 2008

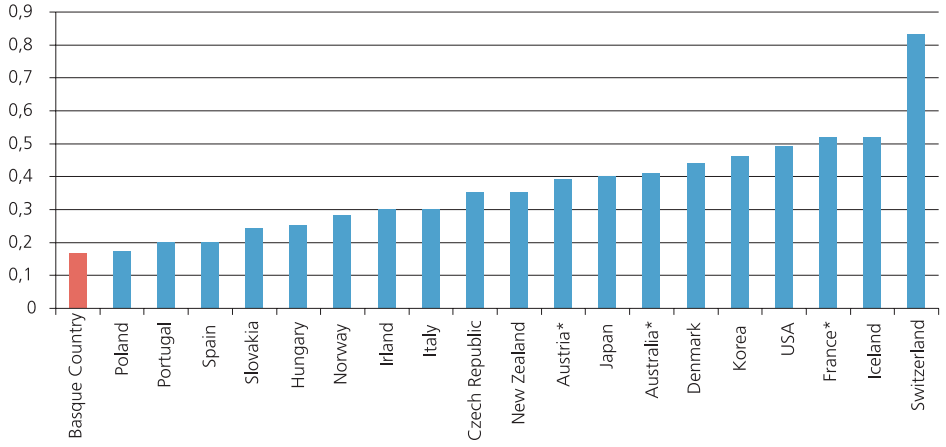
As the graph shows, innovation drivers, comprising a well-educated population and the availability of infrastructures, and knowledge creation, composed of R&D investment values, are relatively healthy. These two dimensions represent the innovation inputs.

However, an analysis of the innovation outputs paints a rather less rosy picture, which raises questions about the ability of the system to transform innovation investments into outputs, and/or suggests that the system needs more time to mature and capitalise on innovation inputs. In any case, at present, the Basque Country underscores both in terms of innovative applications (measured by the economic benefits of the sales of new products or the exports of high technology products, among other variables) and intellectual property, measured mainly by new patents.

More specifically, if one considers two main innovation output indicators, i.e. scientific articles and patents, the results are discouraging. In terms of scientific publications, the Basque Country clearly underscores in its production of scientific articles. According to COTEC (2007) the Basque Country was the 12th region in the production of scientific articles in international journals between 2001-2005, with an average of 555 articles per year per million inhabitants (in contrast to 1444 in Madrid or 1070 in Catalonia) In an international context, the situation is even worse, as Spain already scores low (lower than the OECD or EU averages) in this respect (OECD 2008)

One of the reasons for this poor scientific performance is the longstanding preference in Basque government innovation policies for a "business approach"(or "R&D approach") as opposed to the "academic approach". This preference has resulted in a system with a relatively high level of private R&D investment, mainly thanks to the Technology Centres, and a low level of public or university research. Consequently, the relative importance of basic research in the system is very low, the lowest in the OECD economy (See graph 2)

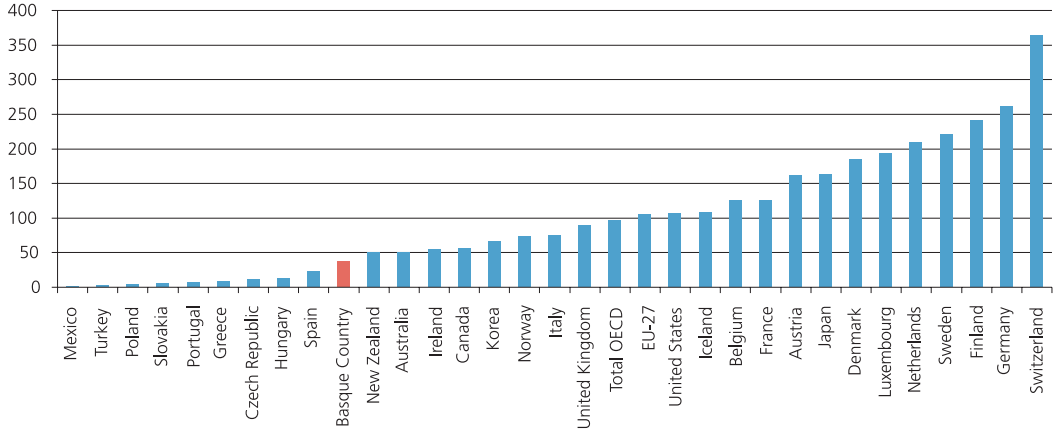
Graph 3: Basic R&D as percentage of GDP (2005)



Source: MSTI, OECD (2007), Eustat

In technological terms, patent production in the Basque Country has also remained below the standards of other advanced economies.

Graph 4: Patents (EPO) per million inhabitants (2003)



Source: MSTI (OECD) and OrKestra

Although above the Spanish average, patent production in the Basque Country is still a long way from the OECD average. Although private R&D values have grown significantly, there is still room for a net improvement in the technological output produced by the system.

Weaknesses of the Innovation System

The sector's relatively poor innovation performance points to the existence of a number of persistent weaknesses in the Basque innovation System. Orkestra (2008) identifies some of the main weaknesses affecting the Basque innovation system. These may be grouped into three main categories:

1. Poor scientific capabilities of the local agents:
   * A network of four universities with poor research skills[5] and not open internationally
   * Lack of public research organisation
   * Technology Centres not focused on the generation of new technologies
2. Insufficient technological and scientific demand:
   * Weak technological capacity in the local industry, as shown by the relative lack of high technology manufacturing sectors and knowledge-intensive services, and poor development of innovation support institutions such as business angels or seed capital infrastructures.
   * Low innovation demand from local consumers
   * A poorly organised lifelong learning system, with very low participation
   * Weak innovation promotion through public procurement
3. Weak links between industry and the system's science and technology agents:
   * Poor links between universities and technology centres
   * Poor links between technology centres and enterprises
   * Poor links between universities and technology centres
   * Poor B2B cooperation
   * Technology parks and Business Innovation Centres poorly connected to the rest of the regional agents.
   * No international Technology- or Knowledge-Intensive Business Services

The current features of the Basque innovation system are rather different from the Spanish context, being to a "great extent a consequence of the process of configuration of regional R&D policies" (Moso and Olazaran 2002:68) The next section sheds more light about this provocative statement and presents the main characteristics of science and technology policies implemented in the Basque Country since the 1980s.

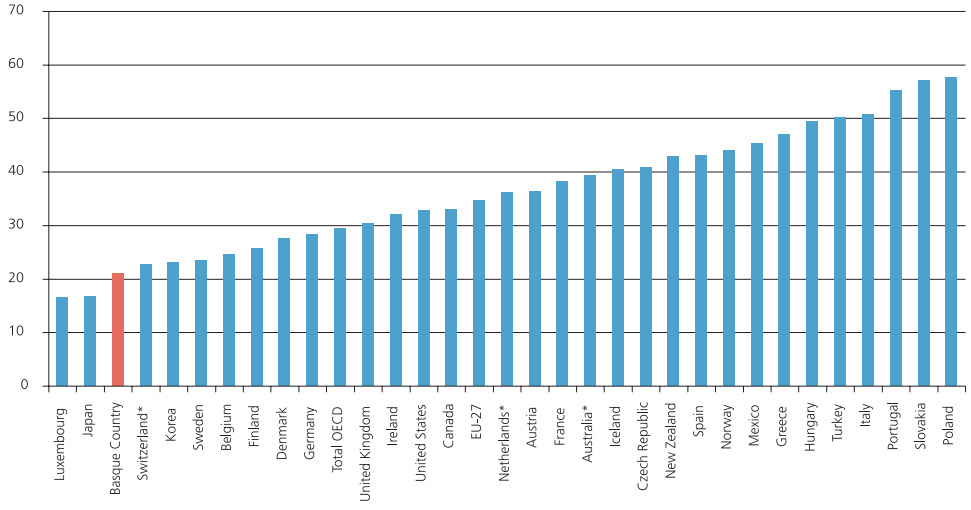
[5] Some research excellence groups do exist at Basque universities

3. Science, technology and innovation policy in the Basque Country (1981 – 2007)

Introduction

Institutional support for science and technology policy in the Basque Country reflects the complex administrative situation of Spain's decentralised political system. Competence attribution between central and regional governments in Spain was established in 1978 with the approval of the Spanish Constitution and the Basque Devolution Act ("Estatuto de Gernika"). In this decentralised model, the Basque Country controls and supervises the public university, as well as the public health system and the research conducted in hospitals. However, the central government did not transfer any funds specifically for R&D policy, although Article 10:16 of the Devolution Act gives the Basque regional government exclusive competence for scientific and technological research, in coordination with the central government. In addition, the European Union has become increasingly active in fostering R&D policies through its R&D Framework Programmes. This multi-level governance arrangement affecting the Basque Innovation System is a major factor in explaining the role and actions of the various Administrations and their impact on the Basque innovation system.

Graph 5: Percentage of GERD financed by government (2006 or last available year)

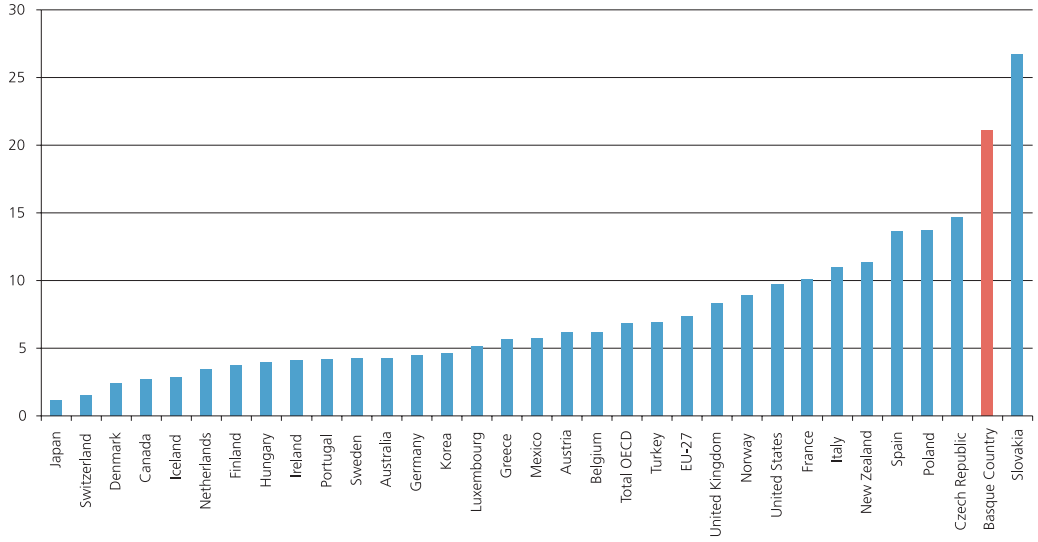


Source: Eurostat (2008), Eustat (2008)

Innovation policies (at least, technology-based policies) have played an increasing role in the Basque Country and have received increasing resources over time. The overall percentage of Gross Expenditure in R&D financed by the public sector is similar to the EU average.

However, the public authorities help to finance a substantial share of global private R&D investment. As Graph 6 shows, the public authorities finance more than 20% of the overall R&D investment made by the business sector, which contrasts with the role the public authorities play in other OECD economies, where the public sector barely finances private R&D. As shown below, this somewhat atypical situation is the reflection of Basque technological policy. The regional authorities have largely financed the constitution and development of the Technology Centres, privately owned but to a large extent publicly funded, to offset the lack of public research institutions in the region.

Graph 6: Percentage of Business R&D financed by government (2005 or last available year)



Source: OECD (2008), Eustat (2008)

In a multilevel system of public support, not all Administrations play an equal role in financing regional R&D and innovation expenditure. In the 1980s and 1990s the Basque regional government was responsible on average for about 75% of all public R&D resources deployed in the Basque Country, while the Spanish central government accounted for about 10%-15%, with the EU supplying the remaining funds (Moso 2002). The Basque Government has continued to play a major role, as Table 1 shows. Today, the Basque Government remains responsible for more than half of all public resources financing R&D investments in enterprises of all sizes, especially SME, which represent the vast majority of the regional business world.

Table 3: Internal expenditure in R&D at current prices according to funding Administration

	2001					2005				
	Micro	10-49	50-249	250-499	500+	Micro	10-49	50-249	250-499	500+
Internal expenditure in R&D at current prices funded by the central public administration	12%	37%	28%	60%	63%	11%	27%	31%	39%	11%
Internal expenditure in R&D at current prices funded by the regional government	71%	45%	60%	40%	37%	65%	60%	56%	58%	85%
Internal expenditure in R&D at current prices funded by the provincial administration	N.A.	N.A.	N.A.	N.A.	N.A.	24%	13%	13%	3%	4%

Source: Eustat

As a result, given the relevance both in terms of legislations and funding supplied, this section concentrates primarily on the Basque regional government' science and technology policy. As Moso and Olazaran (2002:68) mention, "the regional government has been the main public actor in the construction of the R&D structure, reacting to the lack of (initial) R&D structures in the region."

First steps: creating the technological infrastructures

The R&D and innovation systems in the Basque Country during the 1970s were virtually non-existent, and the concept of innovation or R&D was mainly foreign to local firms, still producing in old, mature industries. Gross expenditure in R&D amounted to 0.069% in 1977, 0.063% in 1979 and 0.097% in 1981, well below the Spanish average of 0.42% in 1981 (Moso and Olazaran 2002). Moreover, none of the 92 public Spanish Research Council centres (CSIC) were based in the Basque Country and there were very few university faculties or schools, and what little research was done was disconnected from emerging technologies.

This disastrous situation prompted the Basque regional government to implement a series of science and technology policies designed to create a regional research system to overcome the traditional deficiencies of a historical lack of R&D and innovation investment in the region.

Ever since, the Basque Government's Science policy has continued to enhance basic research capabilities in the region, through increasing human and material resources devoted to R&D activities, mainly within the university system. This policy focused on improving overall research excellence and developing external relationships with researchers outside the Basque Country. It also stimulated the creation of an important scientific community and the constitution of some centres of excellence in research, e.g. "the Etxenike group"

However, research priorities were not then established a priori by the Department of Education, Universities and Research, and university researchers were not actively encouraged, through an appropriate system of incentives, to establish relationships with the local industry or other research agents in the region. In the late 1990s, this situation changed a little with the recognition that universities needed to get increasingly in touch with the local social and economic requirements. However, time and administrative reforms were clearly necessary before this objective could be achieved.

Technology policy also aimed at enhancing the research infrastructure, by developing the competences of the private (but publicly funded) technology centres and improving research capabilities of private firms. The first technology policy had three major targets: (1) to build an initial technology centre model as the main player responsible for carrying out technological research activities in the region, capable of solving local technology needs, (2) to support R&D activities at Basque firms, and (3) to create the Basque regional development agency SPRI, to support the introduction of new technologies. These activities continued throughout the 1980s and early 1990s.

First shift: Stimulating technology demand

In the mid-1990s, the policy orientation shifted. In the first phase, the policy objective was to create a technology supply and transfer infrastructure. The second phase saw an increasing recognition of the need to consolidate the system and stimulate the demand for technology from other agents, mainly from sector and business R&D units, and from sector clusters. An important development of this phase was the consolidation in public funding of the technology centres (see Table 2). These centres were regarded good technology developers, but also they were crticized for being weak in research and at creating links with all types of firms.

Table 4: Technology Centres: internal expenditure in R&D by source of funding (1990 -2005) (%)

	1990	1995	2000	2005
Internal expenditure in R&D at current prices funded by public administration	**47.11**	**27.61**	**30.10**	**34.66**
Internal expenditure in R&D at current prices funded by central public administration	11.54	6.51	20.67	9.09
Internal expenditure in R&D at current prices funded by regional government	32.80	19.06	2.20	22.53
Internal expenditure in R&D at current prices funded by provincial administration	2.77	2.04	1.06	3.04
Internal and external expenditure in R&D at current prices funded by Higher Education sector	NA	0.00	0.00	0.05
Internal expenditure in R&D at current prices funded by firms	**39.41**	**31.45**	**33.00**	**32.06**
Internal and external expenditure in R&D at current prices funded by the Not-For-Profit sector	NA	0.00	0.00	0.03
Internal and external expenditure in R&D at current prices funded by foreign sources	**6.33**	**8.94**	**7.65**	**8.40**
Internal and external expenditure in R&D at current prices funded by EU Programmes	6.33	8.57	7.54	8.22

Source: Eustat

Critics to the Technology Centres focused on their lack of a well defined strategy, scarce specialisation in specific technological areas and on their weak links with local industry. Part of this negative evaluation may have been the result of a lack of absorptive capacity or sustained demand from local industry. Although the technology plans aimed at enhancing the technological demand capability of private firms and cluster associations, the truth is that the technological capacity of most Basque firms (SME mainly) is limited. With the exception of a number of firms carrying out their activities in technologically advanced industries, private R&D, as a proxy to measure the technological and absorptive capacity of local firms, is still very low. Although business expenditure in R&D in the region has progressively increased over time to reach over 1% of the GDP, the R&D carried out by the Technology Centres accounts for a large share of this investment. This relatively weak business technological capacity is one of the most serious weaknesses of the Basque innovation system.

Second shift: Coordination of the science and technology policies:

In recent years, a second shift has attempted to integrate the scientific world, until then completely disconnected from technology policy. Although the 1997-2000 Science and Technology Plan covered the scientific policy, this inclusion was more anecdotal than real (Olazaran et al 2005). It was only with the 2001-2004 Science, Technology and Innovation Plan that technology and science policy started to interact, with the introduction of innovative concepts such as "basic oriented research" and "strategic research" and the creation of the Cooperative Research Centres (CRC). These measures sought to integrate the scientific and technological worlds, by approaching the main institutions traditionally involved in scientific and technological development, i.e. the University and the Technology Centres. This entailed a significant increase in the resources available for academic research from the Department of Industry.

General features of the science and technology policies

The R&D policies described above have facilitated the rapid creation of a regional R&D structure from scratch. Close to zero in the early 1980s, R&D investment in the Basque Country stood at 1.5% in 2005. The increase in R&D expenditure is to a large extent the result of the regional science and, above all, technology policies. In more concrete terms, the system now has a large network of powerful technology centres and a network of technology parks and Business Innovation Centres. Moreover, in scientific terms, a number of research groups with significant research and funding attraction capacity have appeared in the system.

Unfortunately, these policies have also burdened the Basque Innovation System with two distinctive characteristics: (1) a longstanding lack of coordination between the science and the technology policies and (2) the predominance of technology policy over science policy.

It was not until 2002 that the scientific environment was explicitly introduced in the technology plans. Until then, the action taken by the Department of Education, Universities and Research, responsible for science policy, were out of line with both technology policy and the needs of the local industry.

The technology policy predominated because the Basque government decided to back its technology policy as a means to react to the severe economic crisis that affected the region in the early 1980s[6].

[6] For a detailed analysis of the factors behind these two characteristics of science and technology policy in the Basque Country, see Moso and Olazaran (2002), Olazaran et al (2005) and Sanz-Menedez and Cruz-Castro (2005)

Sánz-Menédez and Cruz-Castro (2005) suggest two different approaches to adopting innovation-related policies, depending on the emphasis these policies place on the role of the agents as innovation drivers, and the activities they promote. The first is the "academic approach", where measures are taken to enhance academic research at local universities or, to a lesser extent, public research centres. The second is the "business approach", which attaches more importance to applied research and technological innovation in businesses. Both approaches seek to increase and foster the production of new knowledge and skills, although the first looks to finance academic activities with no connection to short-term results, while the second one aims to encourage private investment, raise technology capacity at local firms and enhance technology transfer from public institutions to the private sector.

These two policy conceptions could also correspond to what Olazaran et al (2005) call "scientific policies" and "R&D—or innovation—policies", the first highlighting the importance of basic research and believing that scientific research will produce technological innovations (linear model of innovation or innovation "mode 1", Gibbons et al., 1974). The second approach gives more importance to the technological uses of science and emphasises the need to create relationships with other agents in the system (innovation "mode 2")

Sanz-Menédez and Cruz-Castro (2005) analyse three key variables to identify the type of regional science and technology policies implemented by the regional governments in Spain: (1) the budget allocated to funding academic research and business research respectively, (2) the nature and targets of the measures included in the plans, programmes, instruments, etc and (3) the creation of regional research centres and infrastructures in accordance with the nature of their ties (university versus industry) and their activity.

An analysis of the Basque regional government budget clearly shows a policy geared towards funding private technology centres and business R&D activities. The "business approach" (or "R&D policy") was clearly favoured over the "academic approach" (or "scientific policy"). Until the mid-90s, science policy represented 0.2% of the region's total budget, while technology policies accounted for 1% (Moso 2000:406) This tendency continued in the 1997-2000 Science and Technology Plan. .

The Basque Government's Science and Technology Plans included programmes primarily designed to support the technology centres, as the institutions capable of meeting business R&D needs. Finally, this "business approach" is also reflected by the fact that innovation policy has been implemented by the Department of Industry

These science and technology policies and the preferences in the definition of strategic activities, priorities and actors clearly have an impact on the composition, organisation and performance of the Basque Innovation Region. Analysis sheds some light on the present balance of the innovation system in the region, and gives some idea of the direction future policies should take and their consequences for the innovation system. The next section presents the new innovation plans for the region designed to offset off current weaknesses.

4. The new R&D and innovation policies affecting the Basque Innovation System

The new Research and Development and Innovation policies from the various Administrations address the existing weaknesses of the system that hinder its ability to produce better scientific and technological results and, consequently, to achieve higher productivity levels.

Introduction

A complex territorial administrative system involves several layers of public authorities developing and carrying out Research and Development and Innovation (R&D&I) policies that affect the regional innovation system in the Basque Country. The Spanish Constitution defines R&D&I policy as a competence shared between regional and central governments, although the central government has the exclusive competence for "co-ordination and general promotion". The Basque regional government, however, is responsible for supervising and funding universities and has played—and continues to play—a significant and growing role in the funding and definition of active policies affecting the regional innovation agents.

In addition to these two major players, the Basque administrative organisation also gives an important role to the region's three provincial councils or *Diputaciones*. The provincial councils play an important role in innovation, especially through their policies and incentives promoting economic and entrepreneurial activities in their territories. Their administrative powers, above all over taxation, are especially relevant in this respect[7]. The Basque Government signed an agreement on the 2000-2003 Inter-Institutional Economic Promotion Plan with the three provincial councils. The Plan co-ordinates and informs all economic promotion activities launched by any Basque institution, including R&D and innovation.

Finally, the Basque Regional Innovation System can only be fully understood in the context of the European Union. Since the year 2000, the EU has been working intensively to create "the most advanced knowledge economy" and has drafted and implemented a series of policies and programmes affecting all innovation agents in Europe.

For an overview of the effects of the R&D&I policies transforming the Basque Innovation System, one needs to understand and analyse the policies and measures of all these agents. These are presented in the following sections.

[7] Although the fiscal policy is an exclusive competence of the *Diputaciones*, any tax incentives should comply with EU legislation on fair competition and be in line with national measures to avoid distortion.

The Basque Government Science, Technology and Innovation Scheme 2010

In October 2007, the Basque regional government presented the new Science, Technology and Innovation Scheme 2010. To date, this plan represents the principal and most ambitious bid by the Basque Government to ensure science and technology in the Basque Country comes in line with the rest of Europe. Its objective is to raise R&D investment from 1.43% in 2005 to 2.25% of the regional GDP by 2010, as a first step towards achieving the Lisbon objective of 3% in 2015. Altogether it is expected to mobilise €6.71 billion, with the private sector contributing €3.6 billion, and the Basque Government with more than €2 billion.

The Scheme revolves around a vision of "the Basque Country as a world benchmark in innovation" and achieving "its second great economic transformation", involving a move into a higher competitive stage featuring innovation as a growth engine. Directly linked to this vision, three ambitious, interrelated goals are defined for the Scheme: enhanced economic competitiveness, environmental equilibrium and social development.

To achieve these goals, the Scheme proposes four broad areas of intervention designed to (1) increase the levels of competitiveness in existing economic sectors, (2) diversify the current economic structure, opening it up to promising sectors, (3) develop the eco-innovation industry as a means to promoting sustainable development and (4) enhance social innovation to promote the social development of people living in the Basque region.

These areas of activity lead to a series of innovation policy instruments that feed the four strategic areas and address the remaining obstacles in the Basque innovation system, as presented in the previous section of this review. It takes a bottom-up approach, and the needs are identified and defined by private firms themselves in a guided strategic process.

Policy instruments are grouped into four target areas for action: (1) Develop and improve the scientific and technological supply, (2) Increase the innovation demand from the private sector, (3) Foster Industry-Science links and (4) Train human resources for Science and Technology.

Table 3 below presents a summary of the main policy instruments envisaged in the new Basque Science, Technology and Innovation Scheme.

Table 5: Main Policy Instruments by target area in the Basque Science, Technology and Innovation Scheme 2010

Target Area	Policy Instrument
Scientific and technological offer	* Non-reimbursable research grants contingent on research capacity of centres in the Basque Science, Technology and Innovation Network (SAIOTEK programme) * Generation and creation of the knowledge required to provide a response to short- and long-term needs and challenges facing Basque businesses (ETORTEK Programme) * Support with non-competitive funding for technology centres * Funding of basic university research * Development of the Basic and Excellence Research Centres (BERCs)
Innovation demand from the private sector (Business R&D and innovation)	* Needs assessment, definition, prioritisation and execution of innovative projects for clusters and existing economic sectors (Innova cooperación Programme)

	* Support for individual innovative enterprises (Innova empresa Programme) * Support for R&D&i activities by companies developing new products (GAITEK Programme) * Support for R&D&i activities of firms improving existing products or processes (INNOTEK Programme) * Promotion of innovative firms with high growth potential (CONNECT GUNEA Programme), including access to seed capital funding- * Creation of new science and technology start-ups (NETS Programme)
Industry-Science links	* Development of Cooperative Research Centres * Private-Public Research Partnerships (ETORGAI programme)
Development of Human Resources in Science, Technology and innovation	* Attraction and retention of internationally-based researchers in the Basque Network of Science, Technology and Innovation (IKERBASQUE) * Science, Technology and Engineering graduates internships in members of the BNSTI, and secondments of BNSTI personnel into private firms and vice versa * Research grants for researchers (pre-doctoral and post-doctoral grants) Research mobility programmes * "Euskadi" award for research excellence * Research support staff within universities

Spanish R&D&i policy instruments portfolio

The Spanish central government has identified raising R&D investment and promoting innovation as one of the key changes the Spanish economy needs to make to address its persistent lack of productivity and continue with the growth path initiated two decades ago.

To this end, the central government has embarked on a seven-part series of administrative reforms ("The National Reform Programme"), which include (1) a new strategic initiative for R&D&I (INGENIO 2010), (2) a Business Promotion Plan to foster SME innovation and competitiveness[8] and (3) initiatives to increase innovation capacity and knowledge transfer via the promotion of spin-offs from research centres, financial support for technology projects, non-technological innovation support action and the promotion of technology centres.

More resources are available as central government has substantially increased its R&D&I budgets in recent years, indicating an effective commitment to supporting R&D&I activities.

[8] The Business Promotion Plan comprises activities in five action plans: (1) Promote entrepreneurship throughout society, (2) Foster the creation of new business and business growth, (3) Increase innovation capacity and knowledge transfer, (4) Foster internationalisation and (5) Administrative simplification

In particular, the 2006 annual budget allocated €6.5 billion to R&D support, 3% of the overall annual budget and an increase of over 30% with respect to 2005 (Martínez et al 2006:46) The following year saw a similar increase in the annual budget provision, as the central government budget rose to over €8.1 billion, up 30%-plus. These two major increases will continue over time as one of the key objectives of the current government is to raise the overall level of R&D investment in Spain to the threshold of 2% of the GDP in 2010.

Most Spanish R&D&I policies are implemented under the umbrella of the National R&D&I plan, which every four years sets central government priorities, objectives and instruments for the distribution of public funds. Although the ultimate goal of the 2004-2007 National Plan was to contribute to knowledge generation for society and improve social welfare standards, it also included three sets of strategic objectives designed to improve (1) the science, technology and business system, (2) business competitiveness and (3) the coordination of the science, technology and business system.

In addition to the National Plan, in its 2005 communication to the European Commission in the framework of the Lisbon Strategy, the Spanish Government presented the strategic initiative R&D&I INGENIO 2010, which made R&D&I an explicit objective of the economic policy of the Spanish Government, and set the objectives of raising national R&D from 1.05% in 2003 to 2% of the national GDP by 2010, increasing the private sector's share from 48% to 55% and reaching the EU15 average in the percentage of GDP devoted to Information and Communication Technologies, i.e. from 4.8% in 2004 to 7% in 2010. The initiative represents a minimum 25% increase in the national R&D and innovation budget for strategic initiatives grouped in three main programmes with three clear objectives: the CENIT Programme to stimulate R&D and Innovation Collaboration, the CONSOLIDER Programme, to achieve critical mass and research excellence, and the AVANZ@ Plan, to converge with Europe in the main information society indicators.

As a result of the R&D&I Plan and INGENIO 2010, the central government drafted a series of policy instruments addressing the shortcomings of the national Innovation System, and whose activities and programmes also affect, or may affect, the regional Basque Innovation System and its agents. Table 4 presents the main Spanish R&D and Innovation Policy Mix.

Table 6: Spanish R&D and Innovation Policy Mix: Target Areas and Policy Instruments

Target Area	Policy Instrument
Science and technology base	* Thematic R&D&I projects * Science and technology infrastructure projects * Improvement of, and access to, large scientific installations
Business R&D and innovation	* Promotion of technical research under the PROFIT Programme umbrella * R&D&I tax incentives[9] * Support for NEOTEC start-ups * Support for technology centres

[9] Not applicable in the Basque Country, as the region has its own fiscal system.

Industry-Science links	*Support for PETRI research transfer projects * One-off and strategic science-technology projects * Equipment and infrastructure at science and technology parks * Support for OTRI technology transfer offices * Loans to encourage public-private interaction
Development of Human Resources	* Pre- and Post- doctoral research fellowships * Contracts for Research training for recent health specialist trainees Ramón y Cajal Programme, contracts for PhDs at PROs and Universities for maximum of five years * Contracts for National Health System researchers for a maximum of six years Juan de la Cierva Programme, contracts for postdoctoral researchers at PROs Torres de Quevedo Programme, contracts for R&D personnel and engineers at firms and technology centres * Contracts for manpower for research at the NHS shared research infrastructure * I3 Programme for research incentives and the incorporation and intensification of research activity * Support for the mobility of NHS personnel * Contracts for R&D technical personnel * I3P Programme, pre- and post- doctoral contracts at CSIC * Researcher mobility projects Support for international co-operation projects

The European Union R&D and Innovation Programmes

The European Union has become one of the major R&D and innovation actors since the adoption of the "Lisbon Strategy" agreed in March 2005, where the role of technological and non-technological innovation was emphasised as a key supporting sustainable development and economic cohesion between EU regions.

In order to support and make this strategy operative, the EU has adopted two framework programmes mobilizing substantial public resources and in which the Basque research and innovation agents can participate and benefit from: the Competitiveness and Innovation Programme 2007-2013 (CIP) and the Seventh EU Research and Technological Development Framework Programme (FP7)

CIP encourages competitiveness at European firms, focusing particularly on SME. The Programme supports technological and non-technological innovation by providing better access to finance and delivering business support services in regions. It also encourages improved assimilation and use of information and communication technologies, helps to develop the information society and promotes the use of renewable energies and energy efficiency, all areas of interest to the Basque business. To achieve these objectives, the Programme is divided in three sub-programmes:

– The Entrepreneurship and Innovation Programmem, which provides better access to finance for SME through venture capital investment and loan guarantee instruments, business and innovation support services delivered through a network of regional centres; it also promotes entrepreneurship and innovation and supports eco-innovation and policy-making that encourages the above mentioned objectives.
– The Information and Communication Technologies Policy Support Programme, which strengthens the use of ICT and innovations in firms associated with these new technologies.
– Intelligent Energy Europe, which fosters energy efficiency and renewable sources as well as the rational use of these sources.

Sector-based initiatives like Europe Innova, which strategically identifies and analyses leverage and barriers to innovation in specific sectors, including those of interest to Basque industry, combined with innovation policy analysis and development (PRO INNO Europe), all stem from this Programme.

FP7 is the main financial tool through which the European Union supports R&D activities covering virtually all scientific disciplines, and for the 2007-2013 period has an overall budget of €50 billion-plus, a significant increase over previous programmes. Growth in resources opens the door to substantial R&D opportunities for agents in the Basque Research and Innovation System, which can participate in any of the Programme's four basic components: cooperation in transnational and international research activities (Cooperation Programme), research excellence in Europe (Ideas Programme), qualitative and quantitative strengthening of human resources in research and technology (People), and development of research infrastructure and research for the benefit of SME and regions (Capacities Programme)

In addition to these two overarching programmes, the reform of the European structural funds will also affect the available resources that the European Commission allocates to Spanish regions for R&D&I activities. While Spain will lose around €37.3 billion in comparison with the structural funds received for the 2000-2006 programmatic area, a new, €2 billion-a-year European technology fund will be created for Spain to compensate from this overall reduction of the Structural Funds. Moreover, the strategic direction of the structural funds will also shift towards investing in R&D&I activities, and as a result "the share allocated to R&D&I (from the Structural Funds) will grow around 30% for the period 2007-2013, (…) and Spain will have around 10 billion euro from the Structural Funds to invest in R&D&I" (Martinez et al 2006:46)

Conclusions

All the three public administrations are clearly making increasing efforts to bring innovation to the centre of the economic policy arena. All three have decisively opted to increase their resource commitments to support innovation capacity as a way to enhance local competitiveness and to ensure economic progress. New strategic plans, including policy measures and regulatory reforms, have been drafted and are being implemented. All these plans, to a greater or lesser extent depending on proximity to local players, have the potential to influence the production, use and diffusion of innovation in the Basque innovation system.

Besides fostering the science and technology capacity of regional players, the design of policy instruments also strengthens the mutual links needed to achieve innovation. While any system needs a strong science and technology system, capable of supplying the required knowledge, innovation can only appear in a region if there is also a scientific and technological demand for that knowledge. The links between the scientific, technological and entrepreneurial communities are, therefore, essential features of any innovation system. All three admi-

nistrations have developed programmes that promote the scientific and technological capacity and ability of research institutions, entrepreneurial capacity and the links between all these players.

The source of the conceptual framework inspiring these policies and instruments is the "chain-link" model of innovation, or "mode 2", presented in the introduction of this review. The linear model of innovation, where an increase in R&D inputs leads to a substantial increase in outputs that finally impact on innovative production and an area's economic growth, seems incapable of providing an optimal solution. Alternatively, the chain-link model emphasises the need to create forward and backward links between innovation players to generate the desired innovation. The review of the new main science, technology and innovation programmes has gone in this direction, emphasising the need to create links between scientific and technological institutions and industry in particular.

So the new policy instruments, together with additional resources from the three administrations, provide a clear opportunity to correct some of the existing weaknesses in the Basque Innovation System. However, it must be noted that many of these policy instruments are fairly new and time may be needed for specific measures to be defined, initiatives to be implemented and results to accrue. Moreover, the multiplicity of actors and plans may also create some coordination problems between administrations. The next section provides some general recommendations for tackling the system's innovation weaknesses. Although many of these recommendations have already been taken on board in the present Schemes, it includes some new policy instruments that may be worth further consideration. Finally, it stresses the need to enhance coordination between administrations to avoid duplication, overlapping and confusion and the need to perform systematic and profound evaluations of the innovation policies and the agents involved.

5. Recommendations

On the basis of the analysis of the system's weaknesses and the innovation policies currently being implemented, we make a number of recommendations for future policy formulation. Many of these recommendations have already been taken on board in plans drafted by the Administrations with powers in these issues. However, their implementation and future impacts need to be monitored.

Improve the scientific performance of the local research institutions as a means for developing existing and forward-looking industries. Existing Basque scientific agents should improve the quality and quantity of their research outputs. Continued R&D investment is a key to enabling the production and transfer of scientific outputs that generate substantial benefits accruing to the local economy. Another way of enhancing the scientific performance of Basque-based research institutions is to attract new skills for research excellence, improve and promote researchers' careers and create world-class research centres. Policies oriented towards these goals, alongside the creation of Ikerbasque and the Basic Excellence Research Centres (BERCs) under the Basque Science, Technology and Innovation Plan 2007-2010, are therefore particularly welcome. Equally, the introduction of block-grant funding for university research[10], in addition to the existing system of competitive funding, could raise research quality and excellence, helping to counter the fragmentation of research, by elevating the specialisation and critical research mass. Block-grants will only achieve this objective if they are closely linked to the assessment of organisational performance.

Foster policies to enhance private innovation and absorptive capacity of firms. Perhaps the most important challenge to improving innovation performance is the relatively low level of local business investment in innovation, particularly in terms of R&D. This affects a firm's capacity to develop and absorb technological innovations and interact more closely with science agents. Innovation demand policies should be clearly promoted to stimulate the existing and enhanced future system of scientific and technological supply agents. Research grants and the use of tax credits should increasingly focus on priority areas identified as crucial for the strategic achievement of the region's socio-economic objectives, and public procurement should exemplify the shift towards an increasing demand for innovative products

[10] A central government power in the current administrative division of competences.

and processes from the public sector. Simplified and enhanced access to capital schemes for all enterprises in different stages should be promoted in order to raise awareness and transparency between firms. In addition, policies oriented towards increasing the number of PhDs and Science, Technology and Engineering graduates working in firms, as well as the promotion of publicly employed scientists seconded to private firms would increase the available skill base in local businesses and their capacity to absorb extramural technological and non-technological advances alike.

Strengthen the links between industry and science-based institutions in the region. Relatively weak science-industry links in the region are a serious handicap in developing an effective innovation system in the Basque Country. In addition to the policies described in the two paragraphs above, dealing with the improvement of research excellence in Basque scientific institutions and the promotion of greater technological development in Basque business[11], a number of policy responses might accelerate and strengthen existing links. At national level, the CENIT programme seeks to facilitate links between the public and the private sectors. At regional level, the Cooperative Research Centres (CIC) are designed to create private-public platforms to enhance and promote the commercialisation of the scientific and technological research carried out in the Basque Country. Both initiatives are examples of instruments that could perform the task in hand. Likewise, reforms at universities enhancing autonomy and making them more entrepreneurial and reactive to local industrial scientific and technological needs could foster the cultural change needed to embark on closer cooperation with the private sector. Finally, the Basque Innovation System should also build on two of its most distinctive features: a series of consolidated, experienced technology centres and a network of industrial clusters. Both technology centres and cluster associations should play a crucial role in integrating and structuring the system, fostering closer cooperation with scientific players, mainly universities, and an enlarged, technologically-literate business world. To this end, these institutions may require a series of reforms to adapt to the expected changes in the science and technology sub-systems.

Improve the governance system, enhancing coordination between Basque Government departments and with Spanish and international, namely European Union, administrations. The creation of the Basque Council of Science, Technology and Innovation in July 2007, brought together under the leadership of the regional president, the innovation activities undertaken in several areas of the regional government, mainly Education and Research, Industry and Health. At the same time, duplication and overlapping of activities and resources should be avoided between regional and central governments and the EU administration. An improved coordination framework between administrations should allow firms, especially SME, and other stakeholders to exploit the existing synergies between administrations and research programmes. The General Council for Science and Technology, a forum to improve co-ordination between central government and the regions, or the "Conference of Presidents", could serve as platforms to enhance the co-ordination of national and regional initiatives, and to make progress towards the overall objectives. Alternative institutions could also be envisaged to deal with this task. National and regional science, technology and innovation plans must have visible governance bodies to establish clear links between strategic objectives and the measures, instruments and managing units.

[11] Both measures may be regarded as prerequisites for the creation of stronger science-industry links.

Perform continuous monitoring and evaluation of players' and agents' innovative activities and of innovation policies and instruments, to assure objectives of plans are achieved. A coherent evaluation framework is needed to assess progress towards the strategic objectives and to monitor the performances of the innovation actors in the framework of international benchmarks. These activities would then feed policy debate and formulation and enhance public accountability and transparency. The system also needs to assess the impacts of policies and measures implemented, feeding the policy design procedure in order to develop cost-effective mechanisms to assure policy goals are achieved. At national level, a new Integrated Monitoring and Evaluation System (SISE) has been put in place for all R&D and innovation programmes and instruments. A similar system should be established at regional level to monitor and evaluate the implementation of the regional plan, and more resources should be devoted to improving the regional statistical infrastructure, supporting the collection and analysis of the necessary data. The newly created Basque Innovation Agency, working with other players in the system, i.e. Eustat and university research centres like the Basque Institute of Competitiveness, may be a definitive step forward in structuring a coherent evaluation system. In performing its tasks, the Agency should also enhance coordination with national evaluation agencies CDTI and ANEP and international initiatives, e.g. EU Framework Programme, to avoid evaluating "excellence" with different criteria, leading to "forum-shopping" for applicants.

6. Conclusions

The Basque Country has enjoyed major economic and social development in recent years. High economic growth rates in the last decade or so enabled the region to achieve a level of economic and social welfare well above the Spanish and EU average. The Basque Country today is one of the most prosperous regions in Europe.

However, this rapid economic growth was brought about by the economy's increasing capacity to utilise available resources, rather than by achieving higher productivity rates. In other words, the region has been working more, but not necessarily more intelligently, which casts doubts on the sustainability of the current process. The situation suggests the Basque economy was relatively well placed to capitalise on industrial policies mobilising the region's available resources. However, the practically full deployment of existing capital and human resources in the economy also points to the exhaustion of this source of economic growth and the need to embark on a new competitive stage to increase the productivity of resources: the innovation phase.

A result of the system's relatively poor innovation performance, the relative stagnation of productivity also reveals important weaknesses that need to be addressed if the innovative capacity of players in the region is to improve and higher degrees of productivity achieved.

The review of innovation policy in the Basque innovation system shows that the Basque Country is, to a large extent, the result of the innovation policy carried out in the last twenty-five years, when the research system had to be created from scratch. In the early 1980s, the innovation system in the Basque Country was inexistent, with R&D investments below 0.1% of the regional GDP. Subsequent R&D and innovation policies helped the region to achieve R&D rates of 1.6% of GDP in 2006. However, science, technology and innovation policies tended to follow a linear model with investments skewed towards the creation of a previously non-existent research infrastructure. Nevertheless, more systemic policies, establishing links between the different innovation agents, played a secondary role. The results of these policies are clearly reflected in the current Basque innovation system, where systemic links are still deficient. This is particularly true of the relationships between research institutions, either universities or technology centres, and the local entrepreneurial system, composed mainly of small and medium enterprises in medium technology sectors with relatively low levels of R&D investment. Until now, the system has not managed to transform the ideas and knowledge generated into the necessary applications by bridging the gap between new ideas and the markets.

The planners of the new national and regional science, technology and innovation plans have understood the problem, and have adopted more systemic type of policies. In addition to fostering science and technology infrastructure, capacity and excellence in the region, the

new plans include policies aimed at creating and fostering stronger ties between agents, and especially between the scientific world and local business. The new Basque Science, Technology and Innovation Scheme 2010 is of special interest, as it addresses the need to increase such cooperation, particularly as new and promising institutions such as the Cooperative Research Centres (CICs) have been created to foster commercially applicable scientific research in a number of key sectors for the Basque economy. One potentially decisive factor in the success of these policies is the capacity of local firms to invest in R&D, raising their innovative profile and absorptive capacity. Close monitoring of the links created between the agents and the introduction of new measures to correct deviations from the plans, are key factors for the success of this scheme.

However, despite the clear improvements envisaged in the new plans, a number of concerns should still be addressed fto ensure a more efficient system. These concerns include the risks of underinvestment in basic blue-sky research, the need to enhance cooperation between administrations to benefit from greater economies of scale and avoid overlapping, and the requirement of continuous monitoring and evaluations of policy impacts.

The new innovation scheme stresses the need to create and foster links between agents in the system. While the benefits of this type of measure have already been acknowledged, we need to remember that basic non-oriented research has the potential to bring about substantial benefits in the long run. The Basque Country already has one of the lowest rates of basic R&D investment in Western Europe and OECD countries. While the current composition of the manufacturing sector may not have required much basic R&D, the introduction of new and forward-looking science-intensive sectors, such as biotechnology or nanotechnology, may require the knowledge and skills associated with basic research.

Policy cooperation between administrations is crucial to the multi-governance innovation system in the Basque Country. The development and/or strengthening of cooperation institutions between the region and central government should be a major priority in the implementation of Innovation Plans.

Finally, a scheme for evaluating the way plans are implemented and monitored should be an integral part of Innovation policies and, accordingly, be actively promoted.

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Annex 1: List of people interviewed

Name	Organisation
Pello Salaburu	University of the Basque Country
Mikel Gomez	University of the Basque Country
Alberto Fernandez	SPRI- Basque Government
Jon Azua	e-Novating Lab
Igone Ugalde	Labein- Tecnalia
Jose María Mato	CIC Biogune
Eduardo Arechaga	CONFEBASK

Orkestra
BASQUE INSTITUTE OF COMPETITIVENESS

Clusters, Regional Development and Innovation Series

This study applies the Regional Innovation System analytical framework as a tool to review the scientific, technological and innovation policies applied in the Basque innovation system in the last twenty-five years, their results, and the current and future measures envisaged in the ongoing national and regional innovation plans. From this review, the paper identifies five key areas of policy recommendations in order to address the current and persisting weaknesses in the system.

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