



# **OECD Reviews of Regional Innovation: Catalonia, Spain**

**ASSESSMENT AND RECOMMENDATIONS**





## Review context

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*The crisis has highlighted that the prior growth model for Catalonia requires adjustment to focus on innovation for long-term sustainability*

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*Catalonia is seeking a broad-based approach to adapt to the crisis and the changing nature of innovation*

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Similar to Spain, Catalonia's strong period of economic growth since the early 1990s has now ended. In terms of gross domestic product (GDP), Catalonia (3.2%) grew at almost the same average annual growth rate as Spain overall (3.3%) from 1995-2005, and higher than OECD regions (2.9%). For Spain generally, this slowdown is attributed in part to the reduction of the housing construction sector and the adjustment of the financial markets. Catalonia has experienced important increases in unemployment, particularly with its large population of lesser-skilled workers, many being immigrants. Between first quarter 2008 and first quarter 2009, Catalonia's unemployment jumped by 8.6 percentage points to 16.3% – above the national increase of 7.8 percentage points and the increases of other advanced Spanish regions. Recognising its need for sustainable competitiveness, Catalonia has increasingly made science, technology and innovation a focus for regional action in support of economic development.

The OECD is currently developing an Innovation Strategy that emphasises a broad, collaborative and inclusive approach to innovation. The Innovation Strategy underlines that with a mobilising vision – and the ambition to achieve it through effective policy co-ordination – governments can help consolidate or develop new comparative advantages in an environment conducive to innovation. This Strategy is equally relevant for regional as well as national policy communities. It also seeks to promote an integrated approach that combines both attention to framework conditions that support innovation and risk-taking with structural policies to strengthen education, training and entrepreneurship. Moreover, the Strategy emphasises that innovation should be a central component of policy, with strong leadership at the highest political levels. It also affirms that national policy should enable regional actors to foster innovation in their own context, building on local strengths and established frameworks, while ensuring co-ordination across regions and with national efforts. The recent Catalan Agreement on Research and Innovation (CARI) promotes such a broad-based approach to innovation addressing a number of OECD policy principles.

## Diagnosing the innovation system

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*Catalonia: a region with a strong identity and a scale similar to several European countries*

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With over 7 million inhabitants and a GDP of around EUR 204 billion, Catalonia is an important region within Spain and the OECD. Located on the Mediterranean coast and bordering France, this region has a strong identity with its own language and distinct cultural heritage. Catalonia's surface area is similar to that of the Netherlands and Belgium. Its population is similar to that of Switzerland and Denmark. Finally, its economy is at the scale of Portugal and Norway. Catalonia makes a significant contribution to the Spanish economy. While Catalonia accounts for only 6% of Spain's territory, it contains 16% of its population (the second most populated region in Spain) and contributes 19% of its GDP (more than any Spanish region).

While Catalonia is not always the top-performing region in Spain on several innovation-related indicators, given its size it accounts for a large share of Spain's innovation activity and resources. Catalonia is responsible for 21% of Spanish research and development (R&D) investment and 33.7% of its patents. Catalonia contains 22.5% of Spain's innovative firms, a far greater share than other regions, the next highest shares being Madrid (15.6%) and Andalusia (15%). Given its scale and performance, Catalonia is often the largest or second largest recipient region of R&D and innovation-related programme funds from the Spanish government and the European Union (EU) Framework Programme.

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*Over two-thirds of Catalonia's population and economic activity is located in the Barcelona metropolitan area, with areas of dynamism in other provinces*

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*Massive population increases with immigration has helped fuel GDP growth in recent years*

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*But labour productivity has declined in absolute and relative terms over the last 15 years, in part related to the changing composition of the labour force*

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*Diversified but declining medium-technology industrial base, large construction sector and increasing tertiary sector with below average share in knowledge-intensive services*

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Within Catalonia, the province of Barcelona (approximately the footprint of the Barcelona metropolitan area) accounts for 73% of the Catalan population and 74% of the economy. Catalonia has three other provinces (Tarragona, Girona, and Lleida) that contain regional cities and rural areas, with Lleida being the most rural province. All four provinces within Catalonia have a GDP per capita well above the Spanish average, supported by higher than average labour force participation rates. In terms of productivity (GDP per worker), the results are more mixed. The provinces of Lleida and Girona, with more agricultural and lower-technology industries than the other Catalan provinces, are slightly below the Spanish average. Barcelona and Tarragona are above by 4% and 13%, respectively.

A rapid population increase combined with a higher employment rate, related to massive immigration flows, has contributed to GDP growth. Catalonia now accounts for 21% of Spain's foreign-born population, which in 2008 totalled over 1.1 million (15% of Catalonia's population), representing a nine-fold absolute increase in ten years. Catalonia's foreign-born working population has a higher than average share of workers with little or no education, and only a slightly above average share with tertiary education (24%) relative to Spain. When looking at GDP per capita growth, the results are not as strong. Annual average growth from 1995-2005 was around 2.0%, slightly lower than the OECD regional average.

Catalonia's labour productivity (GDP per worker) has declined in absolute and relative terms since 1995, showing weaker productivity growth than in other European regions. The extensive growth model with increases in lower-skilled labour explains in part this decline in productivity (exact rates vary by data source). The region's GDP per worker dipped in the beginning of the present decade, when the productivity of the Catalan and Spanish economies suffered a stronger shock than other European countries. It has yet to reach prior absolute levels. In relative terms, Catalonia was at 115% of the OECD average in 1995, but dropped to only 91% by 2005. GDP per worker and per hour worked remain above the Spanish average but below some other Spanish regions (such as the Basque Country and Madrid). The average annual growth rate of GDP per worker over the ten-year period is therefore negative for Catalonia (-0.6%), like several other regions in Spain.

Catalonia's economy is based on a long-standing industrial tradition, with Barcelona formerly known as the "Manchester of Southern Europe". The crisis of 1984, the entry of Spain in the EU (European Union), and the 1992 Olympic games, among other factors, facilitated a progressive transition of the Catalan economy to a new economic development model. Catalonia has been characterised by a large manufacturing base (26% of the regional gross value added (GVA) in 2000, 20% of regional GVA and 20.8% of employment in 2006). This is higher than Spain (15%) and the EU15 (17.9%). Note that different data sources report either a stable or declining absolute number of manufacturing jobs. If you add both manufacturing and market-related "production services", these sectors account for 53.7% of employment and 59.4% of GVA. Catalonia's manufacturing is more technology intensive than the rest of Spain, but about average for OECD regions generally.

The other 79.2% of employment is in the tertiary sector (66.8%), construction (10.2%) and agriculture (2.2%). While construction and services grew in absolute and relative terms through 2006, the construction sector has been subject to current crisis shocks. In terms of knowledge-intensive services (KIS), Catalonia and Spain are both below EU averages. As knowledge-intensive services firms have positive R&D investment spillovers for manufacturing firms, those sectors and their linkages are important to promote.

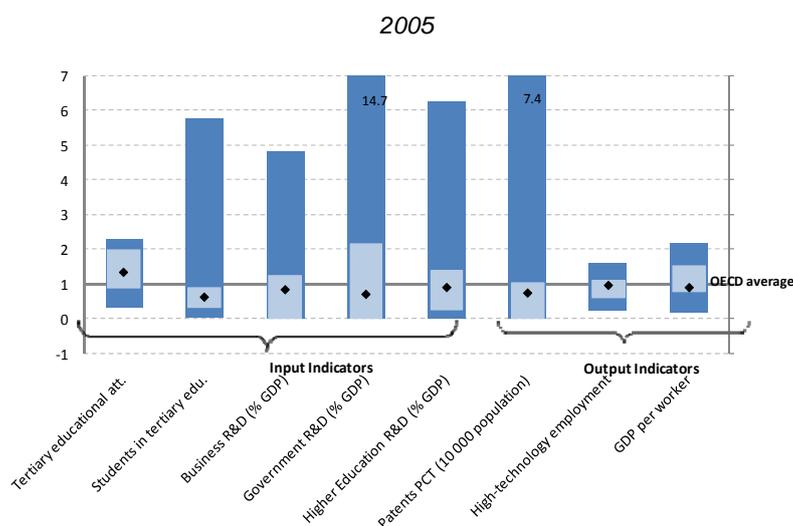
*The dominance of SMEs in most sectors of the economy is a challenge given their lower productivity, but the region's industrial districts, specialisations and international linkages are positive factors*

*In terms of traditional innovation indicators, Catalonia is a leading region in a lagging OECD country...*

There is evidence that not only the leading metropolitan centres in Spain account for a lot of innovation activity, but also industrial districts of the kind found in Catalonia. The predominance of small and medium-sized enterprises (SMEs) in different areas of specialisation has contributed to the development of a number of such local production systems. Forty-two have been identified across the metropolitan area of Barcelona and the rest of Catalonia. SMEs represent 93.2% of GVA in the primary sector, 91.8% in construction, 66.2% in services and 56.2% in industry. Large firms continue to register a significantly higher average GVA per worker than SMEs, which are at 75% that of large firms. Yet it is small firm productivity per worker that has grown more over the last few years while that of medium and large-sized firms has decreased. Catalonia has many international linkages, being one of the main Spanish regions for foreign direct investment (FDI) inflows and outflows, along with growing exports and the presence of many foreign firms. The region's trade to GDP ratio grew from 24.7% to 32.5% between 1995 and 2005. Those levels are higher than Spain overall (from 16.7% to 25.2%) and the OECD average (from 13.3% to 19.4%) over the same period.

The range of values for Spanish regions on traditional economic and innovation performance indicators is lower than that of top OECD regions, albeit within Spain, Catalonia is generally near the top (see Figure 1). This explains in part why Catalonia's GDP per worker is only 91.4% of the average for OECD regions. For example, Catalonia is below OECD averages for R&D intensity by all actors: business (0.86% versus 0.93%); government (including both Spanish and Catalan Research Centres [0.16% versus 0.21%]); and higher education (0.33% versus 0.37%). There is a possibility that some business R&D conducted in Barcelona is not reflected in this figure due to a headquarters bias in the statistics. International patents are also below average at 54.7 per million inhabitants, versus 72.3 for OECD regions, although patenting is not the only way that firms protect intellectual property. Catalonia does perform well above OECD averages on skill levels in terms of the share of the workforce with a tertiary education (32.4% versus 23.9%), despite the recent influx of lower-skilled immigrants.

**Figure 1. Catalonia's innovation performance summary**



Notes: The outer band in dark blue represents the range of values for OECD regions. The inner band in light blue represents the range for TL2 regions in Spain. The diamond represents the value for Catalonia. The values of each variable were normalised to the OECD regional average for available regions. Information on all OECD regions is not available for each indicator.

Source: OECD Regional Database.

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*...but Catalonia has shown very strong increases on a number of innovation indicators*

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*Innovation variables associated with higher productivity among Catalan firms, however innovation investment remains concentrated and linkages across actors insufficient*

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*While "hidden" innovation does not appear to explain these often below-average results, there is innovation activity missed by traditional indicators*

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*Catalonia has a strong and continually improving knowledge generation system...*

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While Catalonia is not in the top-ranked OECD regions, the remarkable increases in innovation-related indicators should be recognised. Over the period 1996-2008, Catalonia increased R&D intensity from 0.9% to 1.61% of GDP, two-thirds of which is performed by the private sector. In absolute amounts, the expenditure by all actors on R&D increased four-fold over that period to EUR 3.3 billion, or an average annual growth rate of over 13%. From 1996 to 2006, the region's share of publications in Spain grew from 21.2% to 25.5%, in the EU15 from 1.5% to 2.5%, and in world production from 0.5% to 0.9%. In absolute terms, that is a 70% increase over the period.

The type of innovation and propensity to innovate among Catalan firms depends on several factors. The bulk of R&D in Catalonia is conducted by a small group of firms in only a few sectors. The majority of research staff are found in two sectors: pharmaceutical (high-tech manufacturing), and research and development (knowledge-intensive services – KIS). Firms that innovate show much higher levels of spending on innovation and R&D, by several multiples, as compared to firms that did not report an innovation (high-tech innovators 3.5 times more, low-tech innovators 5.4 times more, and KIS 11.3 times more). The probability of a Catalan firm to innovate generally has been found to increase with: i) firm size (but there are many examples of innovation-intensive small firms in KIS); ii) access to public funds (results more sensitive for KIS firms); and iii) firms with a higher intensity of R&D expenditure per employee. Firm perception of cost barriers (spillover failures) and knowledge barriers (co-ordination failures) appear to effect the innovation process most, over market barriers (information failures). Knowledge linkages among firms and between firms and public research institutions/universities are also relatively low in Catalonia – a problem in Spain generally – contributing to these co-ordination failures. For Catalan firms, labour productivity is positively affected by R&D intensity, the share of new products and services in sales, belonging to a group, investment in physical capital, and firm market share. In terms of firm size, the positive effect is noted for manufacturing but not services.

Given the region's poor productivity growth record, it is difficult to document the benefits of "hidden" innovation. However, there are signs of innovative activity not captured by traditional measures such as R&D investment and patents. Catalonia appears to be active in utility models (less stringent than a patent and more adapted to SME incremental innovation), and Catalonia accounts for 30% of those granted in Spain in 2007. Barcelona, the driver of Catalonia's economy, has a reputation for a growing "creative class" and strengths in design. These creative elements are likely to increasingly contribute to the innovation system in the future. Catalonia has both a higher share and a higher number of workers in the creative and culture industries than any other Spanish region. It is also a leading region in Spain for brands and trademarks.

The knowledge generation sub-system includes almost 25 000 researchers. Private firms account for over 40% of Catalan researchers. The approximately 14 000 public researchers may be working in several different types of research centres. The Catalan Research Centres network, created to develop strong research centres outside of universities, accounts for over 2 500 or 18% of public researchers. There are now 37 centres in the network and six others in the process. The Spanish Research Council (CSIC) has 1 300 researchers located within Catalonia for around 9% of total public researchers. These institutions, while part of a national network, have become in several cases joint centres with a Catalan university or research entity (including six centres in the Catalan Research Centres network). Public researchers are also found in other research facilities, including those in health care (11 hospital research institutes) and other large scientific infrastructures.

Most public researchers in Catalonia are found in universities. Higher education in Spain was devolved to the regional level in 1986; therefore regions fund and administer universities but are subject to certain Spanish



government regulations. Catalonia, like other Spanish regions, took the devolution opportunity to create additional universities for greater balance across its territory and to increase enrolment. Of the now 12 universities in Catalonia, most have been created since the 1990s, albeit many of these “newer” universities are based on the branch campus infrastructure of previously existing institutions. The increased number of universities has improved higher education attainment in the region as well as attracted many students (12.2% net balance of students, accounting for student inflows and outflows). Universities have also created affiliated non-profit foundations as vehicles to support more professional degrees and lifelong learning. The concept of a “third mission” of universities to support the economic development of the region has now taken root but is still new. Catalan universities are often in the top of different rankings in Spain regarding research strength and “third mission” activities.

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*... an insufficient technology transfer system...*

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Improvements in the Catalan knowledge exploitation and technology transfer sub-system have proven more difficult to achieve than in its knowledge generation sub-system. While firms are responsible for around two-thirds of R&D, Catalonia’s technology transfer system can be characterised as public-driven since the “infrastructure” for technology transfer is mainly publicly funded and relatively recent. A number of institutions have developed with public support, including those with the labels of Technology Centres and Technology Dissemination Centres (launched in 2004). While centres were deemed to be part of a network, in fact they were individual centres with a shared label based on the associated public programme – like the Centres for Technological Innovation Support (XIT) created in 1999. There are also 25 science and technology parks existing or underway in Catalonia. Most are university-linked (17), while others are more broadly the initiative of a city-region (8) but may still involve universities. Given the proliferation of technology centres with successive policy instruments, and their resulting different sizes and quality of services, the Catalan government is now seeking to map and rationalise the existing offer. TECNIO (Catalan Technological Network) is the brand for this new network that will include five advanced centres, 15 technology centres and 80 innovation centres.

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*...and a changing regional governance system*

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The Catalan Ministry of Innovation, Universities and Enterprise (DIUE) accounted for over 68% of R&D and innovation-related spending by the Catalan government in 2007. Other sectoral ministries finance research and innovation, health being the largest at 19.5% of that regional spending, followed by agriculture. The inter-ministerial committee named CIRIT, created in the early 1980s with some changes over time, has been responsible for promoting and co-ordinating R&D and innovation support across the Catalan government.

Under the ministry level, there are several public agencies and publicly funded foundations that play an implementation role in R&D and innovation. They include: ACC1Ó (business development and external promotion, formerly CIDEM and COPCA); the Agency for Management of University and Research Grants (AGAUR) which manages a large portfolio of grant programmes for research and scholarships; the Agency for Quality Assurance in the University System of Catalonia (AQU) and the Catalan Agency for Health Technology Assessment (AARTM) to promote the introduction, adoption and utilisation of medical technologies as well as to co-ordinate and assess health research in conjunction with the Catalan health service. AGUAR has developed evaluation capacities (notably for *ex ante* analysis of research projects) as well as AQU (for professor performance). Foundations include ICREA, which focuses exclusively on talent (researcher) attraction, and FCRI, for science and technology, innovation and advisory services.

The organisation of Catalan public entities for research and innovation is undergoing change as a result of the CARI analysis and commitments. These changes include the creation, merger and restructuring of several agencies at the policy implementation level. They include the ACC1Ó merger, already near completion, and the creation of Talència, the Catalan Agency for Research that merges parts of AGAUR, ICREA and

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*The Catalan system has a number of opportunities to overcome existing weaknesses and build on its strengths*

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## Catalonia's innovation policy

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*A long history of regional S&T and innovation policy subject to several internal and external influences*

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*Despite initial efforts for a balanced approach in the early 1980s, the region took a more narrow academic focus, with a dual-track system for S&T and innovation*

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FCRI. New structures to manage the research centres (CERCA) and technology centres (TECNIO, serving in a first phase as a consortium) are also in progress. Another governance change is the creation of a new Catalan Research and Innovation Council for high-level policy guidance and the reattribution of the other roles of the former CIRIT to this Council, the Inter-ministerial Research and Innovation Commission (CIRI) and a technical secretariat named the Research and Innovation Coordination Office (OCRI).

Among the region's main strengths are its strong research infrastructure and regional attractiveness, Catalonia being one of the top regions in Spain (see Table 1). The main weaknesses concern regulatory issues and rigidities with respect to universities and long-term researcher mobility, the fragmentation of public action (within Catalonia and in co-ordination with programmes from other levels of government), and the lack of innovation culture, as manifested in the lower patenting rates and R&D intensity relative to other leading OECD regions. While there are threats to the system, including increased competition from emerging economies and a lack of productivity growth in the region, there are also opportunities. Catalonia may seize on its attractiveness and broad-based innovation approach to address emerging market opportunities raised by social challenges in the region and the world. The public sector itself can be an important driver of innovation, particularly for social challenges, through services for health, education and the aging population. The region can also better engage its SMEs in innovation strategies and global value chains.

Since the first autonomous elections of 1980, Catalonia's government has recognised the importance of investing in R&D and innovation for the economic growth, industrial diversification and social welfare of the region. Yet the development of a comprehensive innovation system has been slow to emerge. Catalan approaches to S&T and innovation policies have evolved under the influence of several factors, including: the constitutional/devolution issues in Spain on S&T policy and resources; the importance of EU Framework Programme and Structural Funds since 1986; the relative balance of power between the academic and business communities; and the region's own political situation – which has transitioned from a period of long-term continuity (1980-2003) to one of political turnover. The Catalan Agreement for Research and Innovation (CARI) signed at the end of 2008 represents a major effort to take stock of these evolutions to foster a socio-political consensus on the diagnosis of the Catalan innovation system.

The initial phases after the first autonomous elections (1980-1988) could have led to a balanced approach to R&D and innovation but shifted to an academic focus that was reinforced through the early 1990s. The inter-ministerial committee (CIRIT) was not in a position to prove its expected effectiveness due to a budget crunch. It was not able to maintain a balanced institutional approach, with a shift in the balance of S&T and innovation policy away from inter-departmental co-ordination towards the academic side, which led to a de facto bias in the governance of the system. During the transitory period of 1988-1992, the lack of articulation between the research and innovation pillars of S&T policy (a dual-track approach) deepened even though the President of the Catalan government presided over CIRIT in those years. Upon resolution in 1992 of the region's case in Constitutional Court requesting the full decentralisation of R&D resources, which did not occur, CIRIT obtained a ten-fold increase in the Catalan budget appropriations for R&D. But in absolute terms this budget remained quite small for an economy the size of Catalonia. Therefore, to obtain funds from EU and Spanish sources, the region instituted a strategy of financing S&T infrastructure in universities and research centres, supporting the creation of research groups, and increasing the number of doctoral programmes and scholarships.

**Table 1. Overview of the Catalan innovation system**

<b>Strengths</b>	<b>Weaknesses</b>
<ul style="list-style-type: none"> <li>• High political commitment to S&amp;T and innovation (CARI)</li> <li>• A number of top quality universities and public research centres (Spanish and Catalan centres)</li> <li>• A sizeable pool of qualified scientists</li> <li>• International excellence in some sectors</li> <li>• High level of creativity</li> <li>• Regional and local dynamism (including Higher Education Institutions)</li> <li>• Good infrastructure, including in S&amp;T</li> <li>• Significant increases in R&amp;D investment</li> <li>• Attractiveness (FDI, top international scientists, students, entrepreneurs)</li> <li>• A leading region in Spain</li> <li>• Strength of the regional health care system</li> <li>• Capacity for <i>ex ante</i> research project evaluation</li> </ul>	<ul style="list-style-type: none"> <li>• Rigidities in the HEI sector (e.g., that pose problems for long-term researcher mobility, competitive salaries, accreditations, contractual arrangements for co-operation)</li> <li>• Relative scarcity of middle level HRST (technicians)</li> <li>• Low technological absorptive capacity of the vast majority of SMEs (dual industrial structure)</li> <li>• Spin-offs that do not grow</li> <li>• Weak intellectual property rights culture and low patenting level</li> <li>• R&amp;D intensity across manufacturing lower than most EU counterparts</li> <li>• Too many public research centres and technology centres (problems of critical mass and performance)</li> <li>• Complex governance</li> <li>• Policy fragmentation; low “behavioural additionality” of support instruments; windfall benefits</li> <li>• Fuzzy policy mix and lack of priority focus (strategic priorities)</li> <li>• Financial markets ill-adapted to innovation-related investment</li> <li>• Low level of public-private co-operation</li> <li>• Bureaucratic management of support programs, and lack of <i>ex post</i> evaluation of programme effectiveness</li> </ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"> <li>• Growing demand for knowledge-intensive social goods, many driven by the public sector (e.g., health, environment and aging)</li> <li>• Insertion in global knowledge networks and technological platforms (EU and beyond)</li> <li>• Better co-ordination and complementarity with external S&amp;T and innovation financing sources (State and EU) to devote larger share of Catalan resources to regional priorities</li> <li>• European and Mediterranean markets</li> <li>• Diversification of production and trade towards goods and services with higher knowledge content</li> <li>• Engaging SMEs in more innovation-driven strategies and clusters</li> <li>• Technology diffusion around multinational enterprises in line with the development of innovation-based global value chains</li> <li>• Knowledge-intensive services</li> </ul>	<ul style="list-style-type: none"> <li>• Recent economic growth fuelled by immigration but not productivity</li> <li>• Growing competition from emerging economies</li> <li>• Growing competition to attract EU research and innovation funds</li> <li>• Concerns related to alleviation of effects of current crisis (e.g., priority support to labour intensive traditional sectors)</li> <li>• Accelerated pace of expansion of the scientific and technological frontier</li> <li>• Intensifying global competition to attract talent</li> </ul>

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*The first two Research Plans (1993-2000): from the primacy of the academic approach to the recognition of complementarities*

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*The Third R&D plan: institutionalisation of separate and complementary research and innovation plans, leading to greater innovation spending but a multiplicity of technology transfer initiatives*

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*The 2005-2008 Research and Innovation Plan (PRI): towards an integrated approach*

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*Monitoring and evaluation of the PRI are not adapted to Catalonia's needs, and this should be addressed for future plans*

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While the Catalan government desired to strike a better balance between supply and demand factors in their policy tools, this did not begin to occur until the second Research Plan. New institutional bodies were put in place to achieve this balance. Nevertheless, in the first Research Plan 1993-1996, the bulk of resources were devoted to consolidation of research groups through support to the physical, human and organisational S&T infrastructure in universities and public research centres. Therefore the de facto policy mix was heavily tilted towards the scientific base without much concern with either the demand side or the articulation between latent demand and the orientations of supply.

The second Research Plan (1997-2000) evolved towards an improved balance. AGAUR, the region's Agency for Management of University and Research Grants, was created around this time (2001). While the main emphasis of the second Plan remained on research infrastructure and human capital, there were significant new initiatives to support private R&D and innovation activities, linkages and interface mechanisms. During that time period, albeit not through the research plan, Catalonia created the Centres for Technological Innovation Support (XIT). In terms of resources, innovation instruments remained rather poorly endowed *vis-à-vis* those focusing on the strengthening of the research infrastructure.

Catalonia grew to recognise the weaknesses in its supply-side driven approach, but the decision to develop a separate Innovation Plan (by CIDEM) apart from the Research Plan (managed by CIRIT) had mixed effects. On the positive side, it may be argued that an initial "autonomisation" of innovation policy under the Ministry of Industry and CIDEM probably facilitated a better identification of the market and systemic failures that impaired the development of innovative capabilities of firms. It also allowed for larger budgetary appropriation for innovation-related programmes. On the negative side, it seems that the Innovation Plan was plagued by a multiplicity of initiatives that tend to reflect a "one problem-one instrument" syndrome with a difficulty to really understand the rationale behind the definition of programmes and the boundary of their scope. This is particularly the case for the numerous networks created to address the chronic technology diffusion weakness of the Catalan S&T and innovation system.

The 2005-2008 Research and Innovation Plan reflects a more balanced approach between the support of supply (academic) and demand (firm) factors. However, the integrated approach that underlies the conception of the Plan at the analytical level is more weakly followed at the level of policy implementation and budgetary allocation. Integration is too often sought through juxtaposition of programmes involving complementarities than through incentive structures that have built-in integration dynamics. Co-ordination is rarely, if at all, implemented through joint management and financing procedures between responsible departments from different ministries or agencies. The increased resources devoted to support firm investment in R&D and innovative activities took the form of competitive grants, and, to a lesser extent, subsidised loans and guarantees. There was increased effort devoted to technology transfer programmes tailored to the needs of diverse categories of enterprises and innovation projects. For the first time there is an explicit recognition of the fact that the financing constraints faced by innovative enterprises deserve attention through policy instruments.

Development of the 2005-2008 PRI and the upcoming 2010-2013 PRI have not been underpinned by robust evidence-based evaluations of the actions undertaken in the context of the preceding Plans. For the Second and Third Plans, that evaluation was more an *ex post* exercise focused on a review of the allocation of resources and Catalonia's position relative to other regions on some common indicators. Evaluations need to encompass assessments of implementation agencies and institutions benefitting from government support.



To monitor and assess its achievements in quantitative terms, the 2005-2008 PRI defined two sets of indicators. The first set of “key indicators” relates to the Plan’s global objectives in bridging the gaps with the EU average in terms of innovation performance. Most of the quantitative targets were not met, namely the R&D intensity of the region. The region did surpass by far one goal, the number of researchers. The second set of “reference indicators” intended to monitor the outcome of policy actions was unrealistically detailed given the cost of such data collection. It would have been more useful to contemplate a less detailed but more realistic set of monitoring indicators along with the development of an appropriate statistical system allowing the production of regular performance documents in the interim years of the Plan, or at a minimum in its last year.

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*The latest plan (2005-2008 PRI) consolidated research strengths but didn't sufficiently resolve structural weaknesses*

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The Plan gave continued priority to strengthening the Catalan public research system, but was more mixed in terms of overcoming the already identified structural weaknesses of the Catalan innovation system. Despite the well-articulated programmes in support of business R&D and innovation activities, the actual set of individual support instruments is quite complex. This resulted in high transaction costs and a lack of a comprehensive view of the market and systemic failures being addressed. A rationalisation of support schemes is needed. Notwithstanding the diversity of support schemes, the PRI has not fully succeeded in broadening the scope of firms that undertake such activities as part of their development strategy. It seems that, with the exception of new technology-based firms, the overwhelming majority of SMEs do not share these characteristics and are therefore excluded from the benefits of these programmes. Lessons for future design include the necessary customisation (while avoiding unnecessary multiplication) of instruments to support the heterogeneous population of SMEs; financial support instruments that are better articulated with other policy actions so as to increase their behavioural additionality effects; and accounting for duplication or complementarity with the State (CDTI) (i.e., concentrate Catalan support either to address specific weaknesses related to the regional industrial structure or funding research and innovation projects in the priority areas of the region). ACCIÓ has been working with CDTI in a bilateral agreement since 2007 for greater complementarity of these programmes.

The complex system of technology transfer networks has had some successes, particularly with the networks known as XIT and XTT created ten years ago. But the benefits of the services have not generated sustained knowledge relationships between the majority of beneficiary firms and knowledge production institutions. The weak intellectual property culture is slow to materialise in terms of changes in firm behaviour, as evidenced by continued low patenting rates. Efforts must be pursued over the long term using a variety of complementary approaches going from dedicated courses in science and engineering departments and business schools to training sessions in technology transfer offices and specialised services provided in the framework of cluster policies. In terms of risk assessment and innovation financing, the Catalan Institute of Finance (IFC) could support to a greater extent its venture capital (VC) activity. A path that could be explored to broaden the investment portfolio and mitigate the risks is the progressive development of a fund of funds associating capital from both the IFC and other local VC funds.

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*Several blind spots exist in the 2005-2008 PRI, such as insufficient prioritisation, that should be addressed in the 2010-2013 PRI. A few of these problems were already recognised in the CARI*

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The most notable blind spot in the last PRI is the lack of prioritisation, especially given that much of the science, technology and innovation (S&T&I) funding is coming from outside the region with different priorities. In the past, there has been some minor prioritisation of a small share of the budget to certain industries, but not overall challenges for Catalonia. A series of other instruments and approaches are also missing. Public-private collaboration is common in OECD member countries (including Spain’s own CENIT programme) to strengthen industry/science relationships and facilitate technology transfers. The incipient support to the development of innovative clusters is also too narrowly conceived.

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*Several imbalances in the policy mix also need adjustment, among which is the lock-in of resources for the ever-growing network of Catalan Research Centres...*

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*... as well as the need for ensuring Catalan priorities such as through thematic research programmes...*

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*... and addressing challenges in human resources, like integrating PhDs and improving the balance between researchers and technicians*

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While the CARI rightly emphasises the importance of a more innovation-related cluster policy, it focuses too much on high-technology sectors or on the somewhat restrictive notion of sectoral/territorial approach to technology transfer. Innovation in services is widespread and very important for aggregate productivity and economic growth. While the 2005-2008 PRI pays practically no attention to the promotion of innovation in services activities, or to the role of knowledge-intensive services in technology diffusion, the CARI does in its broad-based vision of innovation. This concept needs to be operationalised in the next PRI. Public procurement does not seem to have been actively used for innovation in Catalonia and the PRI does not allude to this policy instrument whose importance is, however, highlighted in CARI's recommendations. While this may raise some legal and/or regulatory issues with the State level, it merits concrete actions as well.

Catalonia developed its own system of Catalan Research Centres, a unique strategy in Spain, building a strong research infrastructure in the region. However, the continued proliferation of such centres poses critical mass problems, locks in budgets and de facto locks in the region's research priorities. The network was created to circumvent problems with the university system and there are important strengths in many centres of the network. This separate network preserves the research autonomy of universities but does limit research funding available to them since the Catalan government does not typically finance competitive research projects. The centre-based approach is less able to promote interdisciplinary research, which can be more efficiently undertaken in a university context than in dedicated research centres. By international and regional standards, the number of Catalan public research centres is quite large (37 with 6 in process, and not including the already existing network of Spanish CSIC centres). This number raises questions of critical mass and efficiency, even if some centres may be very productive. The contract programmes to which the centres are now subject could be utilised to alleviate this problem, but it is always easier to create a new centre than to suppress an existing one, and new centres continue to be created.

Catalonia has few "flexible" funds available and tools to orient thematic research, as most research funds are locked into institutional funding for research centres. Furthermore, one may argue that the support given to university research groups is probably insufficient. Given the size and the excellence level reached by public research in Catalonia, quasi-exclusive reliance on project funding by the State and the EU may be insufficient to ensure a better contribution of the Catalan research system to the region's socio-economic needs. Thus far, competitive funding on thematic priorities has been through fellowships and other grants but not on a project basis. The Catalan government should consider launching thematic research programmes focusing on regional priorities and open to competitive funding of projects presented by or in association with Catalan institutions – an approach now under discussion for the 2010-2013 PRI. These programmes could encompass public-private partnerships and act as leverage for private investment in R&D activities related to the satisfaction of collective needs.

Catalonia recognised very early the development of human resources or "talent" as an essential pillar of its transition to a knowledge-based economy and society. On the whole, its government has skilfully played within the framework given by the devolution of the education sector. The success and growth of the efficiently managed ICREA programme is an example of a well-designed initiative. Despite these achievements, Catalonia continues to suffer from many of the same shortcomings as Spain generally, some of which relate to regulatory obstacles. The insertion of highly qualified personnel in enterprises, in particular PhDs, is still low. In comparison with the majority of European countries, insufficient resources are allocated to the recruitment of technicians in public research institutions. In this innovation policy area, Catalonia's policy mix is well oriented and the main problems that hinder further improvements are related to resource availability and regulatory obstacles to a great extent under the purview of the Spanish government.

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*While support to business R&D and innovation has increased over time, that support is fragmented, requires greater private sector participation, and could address some of the blind spots of prior plans*

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*The Catalan Agreement on Research and Innovation served to build social consensus, but with 131 commitments does not address the recurring lack of prioritisation*

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*Several potential pitfalls in the implementation of the CARI need to be avoided in the 2010-2013 PRI*

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The relative importance of support to business R&D and innovation (including technology transfer programmes) has increased in the Catalan policy mix over the present decade. Resources devoted to this support amounted to 37% of the PRI budget in 2007. The support programmes developed by CIDEM (now ACCIÓ) suffer from a fragmentation into numerous support measures that may generate inefficiencies due to lack of critical mass and management costs. The financial instruments, essentially grants, may not always be the ones most suited to the needs of the enterprises, especially those SMEs that have the most difficulties to access the Spanish government CDTI support programmes. The organisation of technology transfer programmes in different “networks” is a source of complexity and inefficiencies, with the possible exception of the more experienced XIT and XTT networks. The private sector needs to assume a greater role and support for technology transfer. In general, Catalonia needs to do more to respond to market demands. Insufficient funding has been allocated to support public-private partnership for R&D and innovation that can leverage private R&D investment focused on regional priorities. Finally, Catalan cluster policy could be further integrated with mainstream innovation policy.

The ambition and merits of CARI lie in the fact that it built social consensus and set a long-term framework for the innovation system that will outlast political cycles. And it served as a platform for quickly implementing several regional governance changes to better plan and deliver research and innovation policy. But it also blurs the hierarchy of policy priorities with 131 different commitments. The document reads more like a wish list given that the consensus building process was not subject to resource estimates as CARI was not intended as a planning tool. The resulting recommendations are too often presented without due attention to policy complementarity requirements or resource implications. As a result, policy mix issues are conspicuous in their absence in both the CARI and its background documents. Too often the level of specificity of the object of commitments, coupled with the general character of the actions to comply with commitments, reduces their credibility.

The CARI background document does present a number of very valuable recommendations; however, there are some recommendations that could be challenged or even be counterproductive. Examples of questionable recommendations include: the broadening of the mission assigned to ICREA; an increase in the number of research centres in strategic fields; and an approach to resolving governance problems that does not always address in a satisfactory way weaknesses raised by a prior study, such as the capacity to prioritise resources or to co-ordinate across all implementation agencies.

Having so many commitments and targets in the CARI entails risks. As the main “sponsor” of the CARI, the Catalan government must be exemplary in its compliance with the numerous qualitative and quantitative commitments. It also needs to effectively monitor the commitments of other institutions. The Research and Innovation Coordination Office (former CIRIT) should be responsible for the oversight of the monitoring and assessment function. Consistent and reliable information systems will also be required that rely on decentralised compilation of statistics and indicators by diversified agents according to comparable centrally defined standards. Commitments are numerous and they form a set that seems overly specified for achievement of the CARI objectives in the sense that if a commitment is not complied with, the fulfilment of the objectives is in jeopardy. In monitoring exercises, micro-management or oversight of compliance requirements should be avoided and transaction costs associated with this compliance should be accounted for.

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*Especially in the context of the global economic crisis, there is a need for resource contingency planning along with prioritisation and sequencing of CARI actions*

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The preparation and implementation of the upcoming PRI will be a test case for the compliance with CARI commitments, including ensuring the necessary resources. While no explicit attention is given to policy mix issues in the CARI document, an important merit of the set of Catalan government commitments is that they implicitly lead to an improvement of this mix as well as new governance structures. In the context of the preparation of the 2010-2013 PRI, and in light of the global economic crisis, contingency planning should be undertaken to determine which of the CARI commitments ought to be prioritised and which could be postponed without jeopardising the coherence of the exercise. In this context, a sequencing exercise should be carried out that includes an analysis of the complementarity of objectives. Finally, the compliance of their commitments by other non-governmental stakeholders may give rise to resources claims that the Catalan government should be in a position to assess.

## Catalonia's policy in a multi-level governance context

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*EU policy and funding streams have influenced Catalan policies and actors, with EU regional policy funds declining and EU research funds increasing*

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While Catalonia had developed its own regional science policies prior to Spain's integration in the EU in 1986, EU policy has impacted the Catalan innovation system in a number of ways. The different regulations and sectoral policy streams have an impact on the framework conditions for firms in member states. There are over-arching agendas like the Lisbon Agenda and the Bologna Process that influence public policy and actors in the innovation system. Catalonia also participates in a number of networking activities promoted by Europe, including the Four Motors Agreement (trans-national collaboration akin to the EU ERA-NET model).

The two main EU funding sources for Catalonia innovation actors are EU regional policy and EU research policy. The regional policy funds for Catalonia declined by 40.4% between the prior (2000-2006) and current (2007-2013) programme periods. One of the five axes of the current European Regional Development Fund operational programme is "knowledge economy, innovation and firm development" which will receive approximately EUR 51.4 million annually, some of which is R&D and innovation-related spending. The seventh Research Framework Programme (FP) reflects a 65% annual budget increase at EU level relative to the sixth FP. Catalonia's average annual receipt in the sixth FP was EUR 54.4 million, and in the first year of FP7 (2007), that figure jumped to EUR 86.2 million. The new European Research Council (ERC) funding streams, while not large, have been strategic for strengthening the region's research base. Catalonia accounted for more than half of Spain's receipt of the first rounds of the ERC Starting Independent Researcher Grants and ERC Advanced Investigator Grants.

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*Differentiated Spanish policy mix actively used by R&D and innovation performers in Catalonia*

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Spanish S&T and innovation policy – which in its modern form dates back to 1986 – has been evolving, generating a differentiated policy mix. The main frameworks of Spanish policy today are: the sixth National Plan for Scientific Research, Development and Technological Innovation; and the INGENIO 2010 initiative contained in the National Reform Plan developed in 2005 in the context of the re-launch the EU's Lisbon Strategy. In this framework, attempts have been made to better link national policies to both European and regional policies and initiatives. Over time, the Spanish government has substantially increased its funding for R&D and innovation. These funds are allocated through a differentiated set of direct instruments of public support (grants and loans) and via tax incentives. Spain's tax incentives are among the most generous in the OECD. In addition to European funding streams, Spanish programmes and initiatives provide important opportunities for research and innovation actors in Catalonia. In fact, Catalonia – being one of the hubs of R&D and innovation within Spain – has been able to attract considerable shares of these flows of funds. The question that remains is how to better co-ordinate such actions between the Spanish and Catalan governments to ensure the coherence of the overall policy mix across levels of government.

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*Attribution of roles between Spain and Catalonia for S&T, a source of inter-governmental dispute in the past, is now clearer – but attention needs to be paid to certain “gaps”*

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*Central-regional co-ordination mechanisms for S&T and innovation policy, both formal and informal, could be strengthened*

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*Both levels formally recognise a need for greater co-operation, but are struggling with how to improve systemic co-ordination ...*

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Both Spanish and Catalan levels are active in science and technology policy. There were conflicts regarding this policy domain in the late 1980s, as both levels claimed exclusive competency. In 1992, the Constitutional Court ruled that such competencies should be shared and did not respond favourably to the region's request for total decentralisation of R&D. Nevertheless there has been explicit devolution of some areas of research funding, including university funding, the public health system and its associated research, and agricultural research centres. In terms of R&D&I spending in Spain, approximately 20% of the EUR 10 billion spent in 2007 was from the regions versus 80% from the central government.

Multi-level governance of S&T and innovation must address different kinds of “gaps” to better manage duplication and enhance complementarity. In terms of “information gaps”, as both Catalonia and Spain are active in this area of policy making, there are asymmetries of information in the policy development process for both levels. In terms of the “capacity gaps”, Catalonia's resources and infrastructure are best suited to supporting science-based research but less so to the needs of SMEs and service sectors, for example. In terms of a “fiscal gap”, while this policy field in Spain is not characterised by unfunded mandates for the regional government, there are some situations where the Catalan government becomes de facto responsible even if not part of the decision-making process. Some efforts have been made to address the “administrative gap”, resulting from spillovers that transcend administrative borders, as Spain and Catalonia work together for the development of large infrastructure projects. However, the positive spillovers of Catalonia's innovation system for Spain in general may be insufficiently addressed, despite the region's ability to capture a large share of national resources. An incoherence of the policy mix across sectors can create a “policy gap”, although both Spain and Catalonia have been making efforts at their respective levels to improve cross-sectoral collaboration through mergers of ministries and inter-ministerial committees.

Catalonia fits in a context of a relatively high degree of overlap with the central level as compared to peer countries. Co-ordination challenges are further exacerbated by the highly political and sometimes conflictual nature of relations across levels of government. A 1986 law created a General Council for Science and Technology (*Consejo General de la Ciencia y Tecnología*) for the purpose of central-regional and regional-regional co-ordination on R&D. Subsequent working groups of this body have been created. Given the degree of co-ordination needs, additional efforts within and outside of this body are warranted.

The governments of both Spain and Catalonia recognise that more co-ordination is needed to guarantee greater effectiveness in co-design and implementation in this policy field. The current Spanish National Plan (2008-2011) includes a chapter on greater co-ordination between the central level and regions. Catalonia has formally recognised that improved co-ordination with the State for S&T and innovation is required. In the context of the Catalan Agreement on Research and Innovation, developing an agreement with central government is one of its commitments. Nevertheless, Catalonia has missed several opportunities to better involve the central government in its R&D and innovation efforts, such as in the development of the 2005-2008 or 2010-2013 Research and Innovation Plans as well as the 2008 CARI.

Catalonia and Spain may consider a range of mechanisms used in OECD member countries to improve systemic co-ordination. There are OECD examples of both formal and informal co-ordinating bodies for S&T policy across levels of government. Germany is an example of a formal systemic co-ordination mechanism with the GWK or Joint Conference for Science, its mission being to co-ordinate R&D policies across regions and with international policies. In the United Kingdom, an active dialogue has recently been established via an informal arrangement but to meet a central government imperative of aligning a certain share of regional funding (a transfer from central government) with central level programmes.



In addition to seeking more co-operation at the political level, a first step is to establish more working groups below the political level. In the United Kingdom, at the practitioner level, there is a group called Regional Innovation, Science and Technology (RIST) that brings together RDAs and devolved governments with central government as a very active forum for information sharing with several meetings annually. Perhaps the CICYT General Council and its Working Group could help to serve such a role in Spain. The development of comparable S&T and innovation indicators across Spain is vital for both central and regional policy makers for greater multi-level governance dialogue, and indicators such as spending calculations are not yet harmonised around the country.

Joint institutions are not easy to build but serve as an opportunity for co-ordination that could increase system efficiency. While a joint evaluation agency is one example (there are at least 12 in Spain), others could be considered with respect to R&D funding or other areas. Catalonia may also take the initiative to promote more systemic co-ordination by inviting central level authorities to participate in different Catalan committees in the strategy development process.

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*...with an increasing use of bilateral agreements*

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In Spain, the use of bilateral agreements (contracts known as *convenios*) has proliferated in recent years, with varying modalities. In the context of Spain's INGENIO 2010 programme, a number of bilateral agreements are used to implement different S&T related programmes, such as Plan Avanza. The bilateral agreement between the State and Catalonia to support the construction of the ALBA Synchrotron facility has been recognised as an example of a highly effective co-ordination tool. The structure of this agreement includes many of the characteristics of a "relational" contract that ensures an ongoing relationship across levels of government to derive the maximum benefit of the project and limit risks. Other bilateral agreements may take a very broad perspective by "agreeing to work together" and then include annual work plans. The Catalan innovation support agency, ACC1Ó, and the Spanish CDTI have such an agreement. In the first work plan, areas covered include data exchange, personnel exchange, accepting the other's evaluation assessment, joint financing of projects, and promotion of Catalan projects in EU programmes.

The lessons of best practice examples (from Spain and beyond) of comprehensive bilateral agreements could be helpful as Catalonia seeks a broad S&T framework agreement. In a light form, this may include a Memorandum of Understanding and concordats, such as in the United Kingdom between central government and Scotland. In a more comprehensive and formal form, there is the French CPER (*contrat de projet Etat-région*). It offers a framework for long-term planning and co-financing for a number of investments related to S&T and innovation between several central level ministries and the region. In the 2000-2006 round of the CPER, areas covered included: i) the development of existing excellence poles; ii) continued deployment of research capacities in regions with strong university potential; and iii) preserving the influence and international competitiveness of large scientific centres. Support of S&T and innovation is also part of Italy's central-regional contracts known as the *Accordi di Programma Quadro*.

There is also an opportunity for greater bilateral and multilateral agreements between Catalonia and other Spanish regions. For example, Catalonia's AGAUR is already used by some other Spanish regions as an evaluation agency for the scientific merit of certain research projects. Catalonia is also seeking bilateral agreements with other regions when there is a common interest or complementarity in assets.

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*Catalonia seeks to create optimal conditions for bottom-up local initiatives...*

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*... but it could perhaps do more ex ante, including an explicit territorial approach in strategic plans, to avoid the strategy of labelling ex post when the landscape becomes too cluttered*

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*If Catalonia seeks pan-regional S&T collaboration around the Mediterranean, OECD examples show that the feasibility will depend on the types of collaboration gains expected*

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Catalonia's various sub-regional levels are taking different initiatives to support innovation in a broad sense, seizing opportunities from Spanish and Catalan policy. The tools most commonly used are incubators and science or technology parks. Higher education institutions are often the leaders in these local initiatives and may take a highly proactive approach, such as Rovira i Virgili in Tarragona or the University of Girona. In several cities around Spain, including in Catalonia, there is also an accent in the city-level innovation plans on the importance of ICT infrastructure and its usage (in households, SMEs and public administrations) as well as developing an innovation culture, including through public service delivery. For example, Manresa has produced two volumes of stories about local innovators and Reus has actively promoted creative public service delivery mechanisms.

Unlike many other OECD regions, Catalonia's formal research and innovation plans thus far do not have a territorial focus, or a sectoral focus that is de facto territorial. While some of the cluster-based approaches with a territorial focus are supported by ACC10, this is one programme in a much broader set of policies. As a result, Catalonia has a need to rationalise physical infrastructure as well as innovation system support entities after they are developed and the landscape becomes cluttered. It is likely that Catalonia played a role in funding many of the initiatives from the beginning. The region has chosen to take the approach of labelling and financing as the primary vehicles for co-ordination with localities to help rationalise *ex post* these local and regional initiatives. Labelling systems are underway for technology centres and science parks, for example. The labelling will help prioritise for investment as well as other support that the region can offer, such as international promotion. There is a balance to be struck between top-down and bottom-up approaches, but perhaps the region could do a bit more to avoid some of the efficiency losses of a purely bottom-up strategy that nevertheless relies on Catalan funding. The upcoming 2010-2013 Research and Innovation Plan is likely to take a more territorial approach that could help better mitigate this problem in the future.

Catalonia is located in the Mediterranean basin whose regions and countries may confront some common or interdependent challenges. The Euro-Mediterranean Partnership, formerly known as the Barcelona Process, was re-launched in 2008 as the Union for the Mediterranean. The possible rationales for S&T collaboration in this area are many, and may include: building critical mass among common strengths, addressing shared or interdependent challenges, increasing specialisation, or better supporting functional linkages. The spatial footprint and the context (strategic versus ad hoc) are other important factors for the appropriate selection of instruments.

Catalonia is already involved in some transnational networks of regions that include an S&T or innovation element. They include the Four Motors Agreement, the Community of Work of the Pyrenees (CTP), the Pyrenees-Mediterranean Euroregion and a network of Creativity Districts. Other international examples of this transnational collaboration could offer additional lessons for Catalonia. They include ELAt (tri-county cross-border arrangement that builds on the S&T strengths of the bordering regions), the US-Mexico Foundation for Science (an effort at national level for both countries to use S&T to address inter-dependency issues) and the Baltic Sea Knowledge Region (experience in transnational collaboration with an ultimate goal of an inter-connected regional innovation support system across metropolitan areas in the different countries).

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### **For more information**

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### **For further reading**

OECD Reviews of Regional Innovation: Catalonia, Spain, [www.sourceoecd.org/9789264082052](http://www.sourceoecd.org/9789264082052)