ERAWATCH Country Reports 2012: Switzerland

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This analytical country report is one of a series of annual ERAWATCH reports produced for EU Member States and Countries Associated to the Seventh Framework Programme for Research of the European Union (FP7). ERAWATCH is a joint initiative of the European Commission's Directorate General for Research and Innovation and Joint Research Centre.

The Country Report 2012 builds on and updates the 2011 edition. The report identifies the structural challenges of the national research and innovation system and assesses the match between the national priorities and the structural challenges, highlighting the latest developments, their dynamics and impact in the overall national context.

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The report is currently only published in electronic format and is available on the ERAWATCH website. Comments on this report are welcome and should be addressed to jrc-ipts-erawatch-helpdesk@ec.europa.eu.

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EXECUTIVE SUMMARY

Research intensity measured by gross domestic expenditures on R&D (GERD) was 3% in 2009 in Switzerland, which is substantially higher than the average in the EU-27 of about 2%. This high level of expenditures is largely due to the private sector. The Swiss research system is of very good quality and shows a distinct organisation, based on a clear-cut separation between the public sector, centred on very research-intensive universities, and the private sector, centred on the large research units of multinational companies. The Swiss higher education system consists of ten cantonal universities, two Federal Institutes of Technology and nine Universities of Applied Sciences (UAS) (7 public and 2 private). Public research institutes have relatively less prominent role. Private research is strongly concentrated in the chemical and pharmaceutical sector and in the (electro) mechanical industry (including precisions instruments).

Political responsibilities for research and higher education are divided between the central state (Confederation) and the regional authorities (the Cantons). Until the end of 2012, responsibilities at the federal level with respect to research and higher education will be divided between the Federal Department of Internal Affairs (EDI) and the Federal Department of Economic Affairs (EVD). The EDI is responsible for universities and support to basic research, whereas the EVD is responsible for the UAS and the support to applied research. The Swiss National Science Foundation (SNSF) and the Swiss Innovation Promotion Agency (CTI) are the institutions that are responsible for support of basic research and innovation and are headed by the EDI and the EVD, respectively. As of January 1st 2013, all these responsibilities will be regrouped under the umbrella of the EVD that will become the Federal Department of Economic Affairs, Education and Research (EAER).

Swiss research policy is characterised by continuity and stability, including for the level of R&D spending. Important characteristics of R&D funding in Switzerland are the high priority of competition in selecting targets for funding, the bottom-up principle in defining the content, and the absence of instruments to directly support private R&D. Between 2008 and 2012 expenditures grew by 6.3% per year; the strategic plan for 2013-16 foresees an annual increase of 3.7%.

The main structural challenges of the Swiss RDI system can be summarised as follows:

- The dependency on private-sector research. Should the economic prospects faced by companies worsen, Switzerland could see its very good position in the level of R&D intensity and innovation output challenged. The state has little scope to influence the R&D strategies of large companies directly.

- The lack of a systematic mechanism to identify knowledge demands. As a consequence, there are few policy instruments focusing on thematic priorities. While this model has proven to be very effective, the fragmentation of research policy and a largely incremental practice in setting priorities and allocating financial resources might represent a weakness.

- The fragmentation of the higher education system, the slow pace of reforms in this domain, and little influence of policies on knowledge production in the private sector. A challenge is also the lack of skilled workers.

- A lack of systematic policy for knowledge circulation and coordination between research and innovation policy as well as between federal and cantonal tasks.
The main priority of Swiss national research and innovation policies is to provide good framework conditions by fostering basic as well as applied research and technology transfer. Further goals are to sustain the ability to compete internationally in all domains and to promote better coordination between research and innovation policy. Therefore, the Federal Council considers a stronger use of basic research for the promotion of innovation and a stronger coordination between SNSF, CTI and the private sector as well as support of cooperation between different research groups as important. There are regular attempts to reduce fragmentation both at the federal level and between the federal and cantonal levels. For instance, the responsibilities for research, innovation and education have been combined in one ministry. Also, strengthening coordination between research and innovation policy may lead to an even better satisfaction of knowledge demand. Although incremental changes have been sufficient in a well-functioning RDI system, there are concerns on whether and how Switzerland can sustain its very good position with the current strategy.

The policy mix is in line with the major needs of the RDI system. Innovation is fostered by knowledge transfer and public-private cooperation although direct funding mechanisms for firms are mostly absent. The Swiss political system ensures that all relevant stakeholders are included in decision-making. Universities enjoy a relatively high degree of autonomy. Employment conditions for researchers are very good in terms of salaries and provide incentives to attract international talent. Partnerships between higher education institutes, research centres and businesses are actively promoted. Finally, Swiss research policy complies with ERA objectives.
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1 INTRODUCTION

In 2010, Switzerland had a population of about 7.9m people corresponding to about 1.6% of the population in the EU-27. Its gross domestic product (GDP) amounted to about €480bn in 2011, yielding a GDP per capita of about €61,000. Research intensity measured by gross domestic expenditures on R&D (GERD) was 3% of GDP in 2008 and 2009, higher than the average of about 2% in the EU-27. The high level of expenditures is largely due to the private sector, which exceeds 2% of GDP. On the other hand, GERD financed by the State amounted to 0.68% of GDP in 2009, above the EU-27 average. GERD financed by abroad amounts to 0.18% of GDP. The higher education sector accounts for nearly all of the public R&D expenditures, which in turn correspond to about 25% of GERD. In contrast, the private sector accounts for almost 75% of GERD. The higher education system consists of ten cantonal universities, two Federal Institutes of Technology (FIT) and nine Universities of Applied Sciences (7 public and 2 private). Public research institutes are relatively unimportant. The most important are the four research institutes of the FIT domain.

High private R&D expenditures are an outcome of the specific structure of the Swiss economy. The manufacturing sector is dominated by the pharmaceutical and machine industries, where about two thirds of BERD are concentrated. Both are characterised by the presence of large multinational companies with headquarters in Switzerland. Given the size of these companies and their global strategies, the Swiss State has little direct influence on private research, except for providing good framework conditions. Hence, research policy focuses on maintaining the quality of the public research sector and the training of skilled researchers.

The Swiss research system is of very good quality both concerning scientific and technological outputs, as shown by international indicators on scientific production (publications and impact factors) and technological production (patents). It is based on a clear-cut separation between the public sector, centred on very research-intensive universities, and the private sector, centred on the large research units of multinational companies. The cooperation between the public and the private sector on common innovation projects is based on bilateral contacts at the level of research units and its promotion represents a central goal of the Swiss Innovation Promotion Agency (CTI). Moreover, universities train large numbers of PhD students, which then to a large extent continue their career in private companies, thus providing them with a large reservoir of skilled researchers.

With regard to innovation output, Switzerland is ranked among the group of European innovation leaders together with Denmark, Finland, Germany, and Sweden. Switzerland’s main strengths are the open and excellent research system, intellectual assets, innovators and outputs. Relative weaknesses can be found in finance and support, linkages and entrepreneurship (European Commission, 2011a).

Main actors and institutions in research governance

Figure 1 shows a map of the most important organisations for research policy (for a more complete overview of the Swiss system, see Braun & Leresche, 2007; Arvanitis et al., 2010; Lepori, 2007b).

Political responsibilities for research and higher education are divided between the central state (Confederation) and the regional authorities (the Cantons). The Confederation is responsible for the direct funding of research and for the coordination of research activities. The responsibility for higher education is shared between Confederation and Cantons. The Confederation is responsible for the two Federal Institutes of Technology (FITs) in Zurich (ETHZ) and in Lausanne (EPFL). The Cantons are responsible for their universities, while a national act regulates federal support to these institutions. The Universities of Applied Sciences (UAS) are
governed by the Cantons, but under the framework of national law, which includes financial support by the Confederation.

At the federal level, responsibilities for research and higher education are divided between the Federal Department of Internal Affairs (EDI) and the Federal Department of Economic Affairs (EVD). From the 1st January 2013, all the responsibilities will be concentrated in the EVD that will become the Federal Department of Economic Affairs, Education and Research (EAER). Other departments play a very limited role, mainly through departmental research. An exception is research in the energy field, carried out by the Swiss Federal Office of Energy.

Inside the EDI, the most important organisational unit is the State Secretariat for Education and Research (SER) that coordinates the whole domain together with the Federal Office for Professional Education and Technology (OPET). Responsibilities include: the preparation of the four-year strategic plans sent to the Parliament (Federal Council, 2007), support to cantonal universities, funding of basic research through the Swiss National Science Foundation (SNSF) and international activities. In the same department, the Board of the Swiss Federal Institutes of Technology steers the FIT domain, which includes the two FITs and four annex institutes, namely the Paul Scherrer Institute (PSI), the Swiss Federal Institute of Aquatic Science and Technology (EAWAG), the Swiss Federal Laboratories for Materials Science (EMPA), and the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL).

Within the EVD, the OPET is responsible for vocational education and the coordination and funding of the UAS. The Swiss University Conference (SUC) is a common body of Cantons and Confederation in charge of the coordination of universities (FITs and cantonal universities). The Conference of Rectors of Swiss Universities (CRUS) is a private association composed by the rectors of the cantonal universities and the presidents of the two FITs. The CRUS is in charge of university planning on behalf of the SUC and manages a number of coordination programmes and activities. A similar body exists for UASs, the Swiss Conference of Rectors of Universities of Applied Sciences (UAS-Council).

At the intermediary level, the main actors are the two project funding agencies and an advisory body. The SNSF is a private foundation, headed by the SER and funded by the Confederation, responsible for the support to basic research. Moreover, it manages the national research programmes (NRP), as well as a programme aiming to create “National Centres of Competence in Research” (NCCR) at the national level. The Swiss Innovation Promotion Agency (CTI) is the federal agency for innovation, which supports joint projects between universities and private companies as well as innovation activities. Until 2011 it was situated within the OPET; now, the CTI is an independent decision-making body within the Federal Administration and reports directly to the EVD. The Swiss Science and Technology Council (SSTC) is the advisory body of the national government for science and technology policy.

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1 As of 1.1.2013, the OPET will be attributed to the SER that in turn will become the State Secretariat for Education and Research and Innovation (SERI).
The institutional role of regions in research governance

Due to the federal structure of the country, Cantons are very important actors in Swiss research and higher education policy. Cantons have full sovereignty over their own universities, while the Confederation has the right to manage the two FTIs, as well as to support cantonal universities. Competences for UASs are shared between the Cantons and the Confederation. Cantons are also relevant actors in the debate on research and higher education policy. Finally, Cantons are in charge of economic promotion, though in general they do not pursue an explicit innovation-oriented policy (TrendChart, 2009).
National economic and political context

In 2012, real GDP grew by 1% (provisional figure) on the previous year, although forecasts have been revised downwards during the year reflecting a less optimistic stance. Internal consumption and the construction sector are important drivers of growth, both spurred by relatively good labour market conditions and low interest rates. The economy has been helped also by the solidity of public finances (at the federal, cantonal and local level), which implies that fiscal policy has not become restrictive as in many other OECD countries. The export-oriented sector suffers because of the strong appreciation of the Swiss Franc rate vis-à-vis the euro. The intervention of the Swiss central bank (BNS) that introduced a floor at 1.20 Swiss Francs per Euro since September 2011 helped stabilise the situation and reduce uncertainty. The export sector, however, is still contracting, with the notable exceptions of the pharmaceutical and watchmaking industries. The adverse economic and regulatory environment continue to handicap the financial sector, another mainstay of the Swiss economy.

The external competitiveness problems generated by the "Euro crisis" have spurred a debate on the levers available to stimulate competitiveness. There is a consensus that the only sustainable response is to climb the quality ladder through an even greater use of innovation and skilled labour. This has further strengthened the position of research, innovation and education policies, which already benefit from wide, non-partisan political support. Solid growth in budget allocations in these areas has been maintained, even though increasingly binding financial constraints and mixed economic perspectives imposed greater discipline and a reinforced push towards prioritisation.

Funding trends

Swiss research policy is characterised by continuity and stability of its main orientation, as well as of budgetary planning. The Federal Council aims for a growth rate of expenditures for education, research and innovation of 3.7% per year. Between 2008 and 2012 expenditures grew by 6.3% annually. GERD as a share of GDP increased from 2.9% in 2004 to 3% in 2009. The lack of instruments to directly support private R&D is a relevant characteristic of Swiss research funding. With about 1% of BERD funded by the State, Switzerland ranks at the bottom among OECD countries.

An important trend in public R&D expenditures is the increasing R&D expenditures for universities. Private R&D expenditures also have increased tremendously, but do not account for a higher proportion of GERD than in 2000. In contrast to other countries, Switzerland has very low expenditures for R&D at the federal level other than support to universities. Higher Education Expenditure on R&D (HERD) amounted to €3,152m in 2008 (compared with €2,400m in 2004), BERD to €9,584m in 2008 (€7,728m in 2004), and GBOARD to €96m in 2008 (€112m in 2004). Whereas in Switzerland only 0.75% of GERD is carried out by the State directly, this proportion amounts to about 13% in EU-27 in 2008. Although BERD as percentage of GERD is much higher in Switzerland (73.5%) compared to EU-27 (62.5%), HERD as a percentage of GDP is approximately on the same level (CH: 24.2%, EU-27: 23.4% in 2008) (FSO, 2012a).
Public spending for the FIT domain will be €7,901m over the period 2013-16, following €1,812m in 2012, equivalent to an annual increase of 3.9%. This is lower than the amount requested by the FITs council that asked for an increase of at least 6% (Federal Council, 2012a: 2785). In recent years, there have been always increases in the FITs’ budget. The Federal Council plans to grant €2,514m to Cantonal universities over 2013-16, representing an annual increase of 3.7%, a lower level than in the FIT domain and below the 10% increase sought by the SUC (Federal Council, 2012a: 2790-2). At the same time, the share of third-party funding of universities increased from 20% in 2000 to 23% in 2010 and 24% in 2011 (FSO, 2012b), thus reflecting the limited financial scope of federal budgets. The amount going to Universities of Applied Science will be equal to €1,755m to over 2013-16, representing an annual increase of 4.8%.

Grants to the SNSF will be increased by 3.7% per annum, a rate considerably lower than the 13.3% for 2008-12. Grants to the CTI have increased slightly from €400m in 2008-11 to €110m in 2012 and the estimated €455m for 2013-16. Growth is planned to slow down slightly because of prospected lower economic growth.

Overall, promotion of research and innovative activities is of high political priority and resource provision seems to be relatively good. Although the planned increases in budget are rather incremental in scope, there has not been any remarkable impact of the financial crisis on R&D expenditures. Generally, a high priority is attributed to competitive and collaborative funding of research: almost all funds targeted at individual persons or private firms are distributed competitively. In the area of promotion of innovation, almost all instruments are focused on collaborative funding. The overall balance of the share of the main funding mechanisms with respect to competitive vs. institutional funding has not changed in recent years. Although the increase in competitive funding has been steady, it has been counterbalanced by a parallel increase in institutional funding since 2000 (Lepori 2011: 13). Also, there has not been a change in the share provided by different funding sources except for an increased emphasis on third stream funds, especially for FITs.
Table 1 – R&I funding indicators

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012 (estimate, if such data are available)</th>
<th>2020 national target</th>
<th>EU average 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP growth rate</td>
<td>-1.9</td>
<td>3.0</td>
<td>1.9</td>
<td>1.0</td>
<td>N/A</td>
<td>1.5</td>
</tr>
<tr>
<td>GERD as % of GDP</td>
<td>3.0</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>2.0</td>
</tr>
<tr>
<td>GBAORD (£ million)</td>
<td>N/A</td>
<td>3,361.6</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>92,308.3</td>
</tr>
<tr>
<td>GBAORD as % of GDP</td>
<td>N/A</td>
<td>0.81</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>0.73</td>
</tr>
<tr>
<td>BERD (£ million)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>159,975.9</td>
</tr>
<tr>
<td>BERD as % of GDP</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1.26</td>
</tr>
<tr>
<td>R&amp;D performed by HEIs (% of GERD)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>24.1</td>
</tr>
<tr>
<td>R&amp;D performed by PROs (% of GERD)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>12.8</td>
</tr>
<tr>
<td>R&amp;D performed by BES (% of GERD)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>62.1</td>
</tr>
</tbody>
</table>

Note: The Swiss Federal Statistical Office implements a survey on R&D in the business sector every 4 years. The last survey took place in 2008; the 2012 wave is under collection and data at the national level will not be available before mid-2014.

Reflecting the bottom-up principle adopted in Swiss research and innovation policy, there is generally no thematic focus of the R&D budgets. An exception is cooperation in aerospace in Europe. In addition, the State supports departmental research as a way to buttress departments at the federal level. As already mentioned, research at the federal level, accounts for a very small share of total R&D spending.

A considerable part of funding is dedicated to public-private partnerships and knowledge transfer. For example, National Research Programmes (NRPs) and National Centres of Competence in Research (NCCRs) account for 11% of the SNSF’s budget. The CTI’s budget is almost exclusively focused on these purposes although its overall budget is still small compared to the SNSF’s budget.

Bilateral and multilateral cooperation will continue to benefit from strong budget increases also in 2013-16, reflecting their importance for Switzerland. The annual growth rate, albeit lower than in the previous programming periods, ranges from 5.5% to 7.4% according to the line considered.

Swiss participation in the European Framework Program yields about €200m for research per year. Swiss research received funds of €636m during the 6th FP, whereas the Swiss contribution amounted to €620m. The 2012 message budgets contributions to FP of about €370m in 2012, increasing year after year to €450m in 2016.

New policy measures

For the first time, the Federal Council devoted one of its guidelines to the Education, Research and Innovation (ERI) system in its Legislative Plan for 2011-2015, clearly stating that

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2 7,546.9 in 2008.
3 2.11 in 2008.
4 In 2008, 24.1 by HEIs, 12.8 by PROs and 62.1 by BES.
Switzerland considers education, research and innovation to be a top priority and formulating the following ERI policy guidelines (Federal Council 2012b):

- To satisfy the demand for skilled workers through general or vocational education and training;
- To consolidate the high level of grant funding awarded on a competitive basis;
- To further strengthen Switzerland’s internationally competitive position;
- To establish Switzerland as a location where research and economic activities are based on the principles of equal opportunity, sustainability and competitiveness.

In accordance with the Legislative Plan, the Federal Council has submitted the ERI message for 2013-2016.

Recent policy documents

The most relevant policy documents have been regrouped and presented within the ERI message for 2013-2016. This includes eleven financial decrees covering all national measures to be taken in the following areas: upper-secondary level vocational education and training (VET); tertiary-level B professional education and training (PET); tertiary-level A higher education, including the two federal institutes of technology and affiliated research institutes (FIT Domain), cantonal universities and universities of applied sciences (UAS); research and innovation. The ERI message also proposes a new federal law to support umbrella organisations involved in continuing education and training (CET). In addition, the ERI message proposes legislative amendments to five federal laws.

Research and innovation system changes

Although the Swiss system is usually stable and thus major reorganisations seldom occur, an important decision on the political responsibilities at the highest level (i.e. Federal departments) was taken in 2012: all the entities dealing with research, innovation and vocational education and training have been brought under one roof as of 2013. Until the end of 2012, responsibilities for research and higher education were divided between the Federal Department of Internal Affairs (EDI) and the Federal Department of Economic Affairs (EVD). Since the 1st January 2013 all the responsibilities have been concentrated in the EVD. This has become the Federal Department of Economic Affairs, Education and Research (EAER). The State Secretariat for Education and Research (SER), previously within the EDI, now belongs to the EVD and has become the State Secretariat for Education and Research and Innovation (SERI). The Federal Office for Professional Education and Technology (OPET) has been attributed to the SER.

Regional and/or National Research and Innovation Strategies on Smart Specialisation (RIS3)

Although Switzerland does not have a proper RIS3, the current regional economic policy (2008-15) features many aspects that characterise RIS3s, though it mainly targets lagging regions. Among the aspects more closely related to RIS3s are:

- The promotion of innovation and excellence also in traditional industries (such as agriculture, tourism and energy) based upon the relative advantage and opportunities of the region.
- The role of the Confederation as facilitator of efforts initiated and developed by regions, rather than a top-down definition of priorities.
• The construction and leverage of links between regions and value added networks on a supra-regional and supra-national scale.

Evaluations, consultations

The new policy developments, and in particular those promoted by the "ERI message" for 2013-16, discuss the outcomes of consultations and (intermediate) evaluations and take them into account (Federal Council, 2012a). The "ERI message" is prepared by the Federal Council after a broad consultation process of all potential stakeholders and passed by the Parliament. All relevant institutions are addressed and hence all priorities that are relevant for these institutions are considered. Generally, all expertise that is available to assess strengths and weaknesses is used as an input. In addition, the consultation process and the bottom-up principle of not providing thematic steering guarantees that the opinion of different stakeholder at the national and regional level and all relevant business sectors are included. Some evaluations are not carried out specifically for the "ERI message", so the Federal Council relies upon the latest version available. For instance, for the FIT domain it considers the intermediate evaluation for the 2008-2012 period, drafted by a group of international experts, and the associated opinion of the FIT Council. There have not been any systematic evaluations of research and innovation policy in recent years besides internal reports (also including external expertise) conducted by OPET, SER, and the ETH board. There are also a number of evaluations in specialised sub-areas of support activities that are summarised in the ERI messages.

With respect to ongoing developments concerning evaluations, over the next few years the SNSF will develop a systematic monitoring of the output of all projects supported. This implies that the applicants will have to provide, while the project is ongoing and after its conclusion, quantitative data on publications, patents, scientific events, doctorates and so on. The SNSF will also coordinate an external evaluation of the instrument used by the CTI to finance indirect expenses. The results will be used to define the future mechanism to finance overheads by both the CTI and the SNSF.

Policy developments related to Council Country Specific Recommendations

Not applicable.
3 STRUCTURAL CHALLENGES FACING THE NATIONAL SYSTEM

Following other ERAWATCH country reports from previous years, the main structural challenges can be defined according to needs that have to be fulfilled by the research and innovation system and its policies, namely resource mobilisation, meeting knowledge demand, knowledge production, and knowledge circulation.

Resource mobilisation

Private R&D is strongly concentrated in a few core sectors – chemicals, pharmaceutical, machine industry – which corresponds very well to the technological specialisation of the Swiss export industry – as well as in a few Swiss multinationals in these sectors. The State has little direct influence on private R&D. Public expenditures are strongly concentrated on supporting basic as well as applied research in universities and are relatively small compared to private R&D expenditures.

In 2009, total higher education spending on R&D (HERD) accounted for 0.4% of GDP in the OECD area. Sweden had the highest research intensity in the higher education sector at 0.9% of GDP. Switzerland ranked on the sixth position in 2009 with HERD intensity well above the EU and OECD average (OECD, 2011: 78).

With regard to resource mobilisation, Switzerland’s main strengths are high levels of private research funding, a strong orientation of public funding towards basic and applied research, a very good provision of trained researchers with PhDs, and a highly efficient project funding system especially for basic research (through SNSF). However, the dependency on private-sector research and the relatively low level of public-sector expenditures can be considered a challenge. Public expenditures are strongly focused on supporting basic and applied research in universities and the state possesses few levers to influence the R&D strategies of large companies.

Knowledge demand

An important structural change of all economies in the EU is that they are becoming more and more knowledge-intensive. Switzerland had an above-average proportion of employees in knowledge-intensive activities (42%) in 2009 (EU: 35%) which is one of the highest proportions of all European countries. 20% of all employees in the business sector are engaged in knowledge intensive activities compared to 13% in the EU. In addition, compared to other European countries Switzerland also displays higher annual growth rates of the proportion of employees in knowledge intensive activities (European Commission, 2011b: 383).

Switzerland still has a relatively large manufacturing sector in terms of the number of employees. As in all industrialised countries the growth rate of employment in manufacturing is lower than the growth rate of employment in services, indicating a structural trend towards a services economy. However, there has been a comparably low decline in the share of employment in the manufacturing sector (comparable to Germany) and, correspondingly, a low increase in the share of employment in the services sector (European Commission 2011b: 377-379). This fits well with the relatively high growth of GERD between 2000 and 2009 (4.1% per year on average) because services are generally less research-intensive. In contrast, GERD has been growing by about 2.5% over the last decade in the EU and the US (European Commission 2011b: 51). However, since the beginning of 2011, and especially since the Euro crisis induced a surge in the
value of the Swiss Franc, the risk of a creeping deindustrialisation has been increasingly mentioned in public debate.

More in detail, in 2009, 43% of all employees worked in knowledge intensive services in Switzerland compared to 38% in the EU. In addition, 2.8% of all employees worked in high-tech manufacturing firms, which is one of the highest rates in Europe, compared to 1.1% in the EU. Most interestingly, Switzerland’s economy displays a trend towards more employment in high-tech industries (with a growth rate of 2.6% between 2008 and 2009), whereas other European countries have experienced strong declines (the EU growth rate is -3.5% over the same period). (European Commission, 2011b: 386).

Knowledge demand is characterised by a strong bottom-up approach and an extensive involvement of social and economic stakeholders in the design of research policy, where decision on research direction and content is left to researchers and private companies. As a consequence, there are relatively few policy instruments focusing on thematic priorities.

While this model continues to prove very effective, it implies a fragmentation of research policy, a largely incremental definition of priorities and allocation of financial means. The system does not feature a systematic mechanism to identify knowledge demands and to try to anticipate future challenges requiring new policy action. Stakeholders’ consultation is mainly related to the next planning phase.

**Knowledge production**

The Swiss public scores well in terms of quality and impact of its scientific production. A relatively high number of Swiss universities are in the top spots of international rankings of higher education institutions (Leiden University, 2012; Shanghai Jiao Tong University, 2012; Thomson Reuters, 2012). Switzerland holds the second rank in the relative publication and citation index (State Secretariat for Education and Research, 2011a) and has the highest rate of high-quality publications among OECD countries. Publications from researchers located in Switzerland show the highest impact of international scientific collaboration on research output (OECD, 2011: 94-95). Also, Switzerland had the largest graduation rate at doctoral level of all OECD countries, reaching 3.4% in 2009. The percentage of graduates in science and engineering is about 40% which is only slightly above the OECD average (OECD, 2011: 68-89). In 2010, about 35% of the population between 25 and 64 years had a higher education degree (EU21: 28%) (OECD, 2012: 40).

Given these facts, the knowledge production by higher education institutions can be considered to be very good. Challenges might be the fragmentation of the higher educational system, the slow pace of reforms in this domain, and little influence of policies on knowledge production in the private sector. The lack of skilled workers in spite of relatively high graduation rates has been partly compensated in recent years through a massive inflows of workers, especially from neighbouring EU countries.

**Knowledge circulation**

The promotion of cooperation and technology transfer is a central element of Swiss research and innovation policy. The Swiss National Science Foundation (SNSF) fosters cooperation among researchers by using it as an evaluation criterion and provides instruments explicitly requiring cooperation, notably the interdisciplinary instruments “National Research Programme (NRP)” and “National Centre of Competence in Research (NCCR)”. In addition, most of the Commission for Technology and Innovation (CTI) budget is devoted to projects promoting
cooperative research between higher education institutions and private companies. The SNSF also encourages cross-border knowledge circulation by facilitating mobility of researchers (ERAWATCH Network, 2010).

Traditionally, cooperation between public and private R&D performers and the transfer of research results have been left to bilateral contacts between universities and companies with little intervention from the State. Policy intervention in this area has been mainly indirect and focused on small and medium enterprises (SMEs) through the role of universities of applied science (UAS) as partners of SMEs and through joint public-private project funding by the CTI (ERAWATCH Network, 2009).

Interestingly, although actions to foster innovation mainly focus on enhancing cooperation and knowledge transfer between universities and firms, only about 40% of large firms are engaged in collaborations on innovation activities with other firms compared to 70-80% in other countries as Denmark, Finland, Belgium or Austria. Also, relatively few firms are engaged in international collaborations (OECD, 2011:104 and 106).

The main strengths and weaknesses of the Swiss research system in terms of knowledge circulation can thus be summarized as follows. There is a long tradition of direct collaboration between research institutes in universities and private companies favoured by informal contacts and transfer of people. However, a systematic policy for knowledge circulation and support to absorptive capacity is lacking (ERAWATCH Network, 2009: 52-70). Policies have a minimal impact on the bulk of Swiss private research and innovation budgets managed by multinational companies. In this area, there is a lack of coordination between research policy (focusing on the quality of academic research and provision of skilled researchers) and economic promotion policy (focusing on market and localisation conditions) because of fragmentation of responsibilities both at the federal level and between the Confederation and the Cantons.

Table 2 – Innovation Union indicators

<table>
<thead>
<tr>
<th>HUMAN RESOURCES</th>
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<tbody>
<tr>
<td>New doctorate graduates (ISCED 6) per 1000 population aged 25-34</td>
<td>3.6</td>
</tr>
<tr>
<td>Percentage population aged 25-64 having completed tertiary education</td>
<td>44.2</td>
</tr>
<tr>
<td>Open, excellent and attractive research systems</td>
<td></td>
</tr>
<tr>
<td>International scientific co-publications per million population</td>
<td>2,300</td>
</tr>
<tr>
<td>Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country</td>
<td>15.5</td>
</tr>
</tbody>
</table>

Finance and support

| R&D expenditure in the public sector as % of GDP                                 | 0.68  |

FIRM ACTIVITIES

| R&D expenditure in the business sector as % of GDP                              | 2.1   |

Linkages & entrepreneurship

| Public-private co-publications per million population                           | 200   |

Intellectual assets

| PCT patents applications per billion GDP (in PPS€)                              | 8.1   |
| PCT patents applications in societal challenges per billion GDP (in PPS€) (climate change mitigation; health) | 2.6   |

OUTPUTS

<table>
<thead>
<tr>
<th>Economic effects</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Medium and high-tech product exports as % total product exports</td>
<td>63</td>
</tr>
<tr>
<td>Knowledge-intensive services exports as % total service exports</td>
<td>31</td>
</tr>
<tr>
<td>License and patent revenues from abroad as % of GDP</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Note: Latest year available; see European Commission (2012: 10-11) for more detail.
4 ASSESSMENT OF THE NATIONAL INNOVATION STRATEGY

National research and innovation priorities

The most important policy document is the "Message" on the Promotion of Education, Research and Innovation by the Federal Council (Federal Council, 2007; 2010; 2012a). With this message, the Federal Council presents federal goals and measures in the field of ERI and asks Parliament to grant the necessary funds. Although the ERI message tries to set priorities, these are not limited, since all relevant institutions are consulted and all priorities that are relevant for these institutions are considered. The consultation process and the bottom-up principle of not providing thematic steering guarantees that the opinion of different stakeholder at the national and regional level and all relevant business sectors are included.

Generally, the Federal Council sets up such messages for four years. For 2012, there was an exception with a one-year message, mainly continuing goals and measures from the 2008-2011 "message". The reason is a change in the Federal Council’s schedule in sending messages to the Parliament, in order to reach a better coordination between the financial messages and the planning of the legislation. After the transitional message for 2012, there has been again a four-year message for 2013-2016. Research and innovation policy is characterised by a high degree of continuity: there have not been any major changes in the orientation or in the priorities set by the federal government. Swiss research and innovation policy with respect to private firms is almost exclusively focused on SMEs and their cooperation with HEIs. The most important priority is to create favourable conditions for firms. This includes a strong focus on knowledge transfer, but almost no direct policy support measures. Emerging topics arising from societal challenges and enabling technologies are addressed in the ERI message, but they must be mainly dealt with within existing policy measures. Therefore, there is no selection of specific topics.

In 2012, the Federal Council defined the following priorities in order to put its vision into force: Satisfy the demand for workers with general education or vocational / professional education and training (VET/PET) qualifications; Consolidate the high level of grant funding awarded on a competitive basis and further strengthen Switzerland’s internationally competitive position; Establish Switzerland as a location where research and economic activities are based on the principles of equal opportunity, sustainability and competitiveness.

Given the Swiss tradition of no direct intervention of the State in private R&D activities, only a few promotion instruments exist and the strategic routes of stimulating greater R&D investment in R&D performing firms, stimulating firms that do not perform R&D yet and attracting R&D performing firms from abroad has a limited importance for Swiss research and innovation policy. On the contrary, promoting the establishment of new R&D performing firms and cooperation between HEIs and private companies are very important in the Swiss context.

The CTI has been recently re-organised and, as of January 1, 2011, it has become an independent agency within the Federal Administration headed by an executive committee. Moreover, the CTI's mandate and tasks are now defined in the Federal Law on the Promotion of Research and Innovation (FIFG) rather than in the employment legislation as before. An explicit goal of the CTI is to open up to new potential applicants, especially firms that have not cooperated with universities yet. It is intended to support R&D projects from non-technological subjects, for
instance from services, health, or social work and arts, as well as risky R&D projects. The CTI also strives to enable their clients to get access to international R&D and innovation networks. The Federal Council wants the CTI to become more customer-friendly, for example by working on demands for funds more efficiently and constructively. CTI shall support all steps of innovation projects in order to improve their overall quality. The CTI has experienced an enormous growth in applications from 444 in 2008 to 780 in 2010; the promotion of start-ups has also grown strongly. With the extra-ordinary measures adopted to counter the excessive strength of the Swiss franc, in 2011 it was allocated additional funding for its projects.

In a country where almost all public research is performed in HEIs, it is obvious that higher education policies are highly relevant for public research. With respect to the FIT domain, the 2013-2016 message defines ten goals, among which the most relevant are: first-class teaching, top position in international research, cooperation with the industry, bilateral international cooperation, attractive and family-friendly working conditions and gender equality, cooperation with other universities, performance-oriented allocation of funds, recognition in society and enforcement of dialogue with society. Regarding the ten cantonal universities, it is planned to improve the number of students relative to the number of scientific staff and the education on doctoral level.

The SNSF fulfils an important role with respect to ensuring the top position of Swiss basic research in cooperation with HEIs. The main goal for the SNSF is to increase support by funds that are distributed competitively and strengthen the training of the new generation of scientists. A relevant change in the recent past has been that SNSF grants entail an overhead to cover general costs of the hosting institution paid to the institution directly. This measure has a high political relevance, since it is a first step towards the direct financing of general costs of research, separated from the universities’ core budget.

The Federal Council considers a stronger use of basic research for the promotion of innovation and a stronger coordination between SNSF, CTI and the private sector as well as support of cooperation between different research groups as important. Applied research to solve problems in society and the economy is of growing importance to the SNSF. For this purpose it established the NFP, where researchers work together with research groups from the business sector. The NFP aims to apply knowledge and contribute to the acceptance and understanding of scientific results.

As of 2013, education and research have been brought together under the umbrella of the Federal Department of Economic Affairs, Education and Research. The goal is to minimise frictions and to simplify coordination between both activities, promotion of basic and applied research.

In the past, major policy changes have been infrequent and activities mainly focused on creating framework conditions and enhancing cooperation between HEIs and private firms. The guiding principle, with few exceptions, has been that of refraining from direct funding and fostering competition.

**Evolution and analysis of the policy mixes**

A well performing national and regional research and innovation system should be able to enhance competitiveness and job creation and to address major societal challenges such as resource efficiency, climate change, and health and ageing. It should be designed in a strategic, coherent and integrated framework geared towards fostering innovation and strengthening the knowledge base and fundamental research.
The Swiss research and innovation policy is focused towards strengthening the knowledge base and fundamental research. Innovation is fostered by knowledge transfer and public-private cooperation although direct funding mechanisms for firms are mostly non-existent. The federal authorities are aware of all major societal challenges: these are addressed in the main policy documents and there are a lot of external evaluations highlighting them. However, as outlined above, strategic intelligence to tackle these challenges with concrete measures is lacking. In addition, the policy mix is oriented towards generic support rather than development of specific research topics, including main social challenges. A notable exception is the planned “Action Plan for Integrated Energy Research in Switzerland” (SER, 2011b).

The design and implementation of Swiss research and innovation policies is steered at the highest political level and based on multi-annual strategies. Although Switzerland is not a member of the EU, Swiss politicians are well aware of the opportunities and strengths of R&D cooperation within an EU context. The political system ensures that all relevant stakeholders are included in decision-making. Although policy documents reflect emerging opportunities, they tend to emphasise strengths of Swiss research and innovation policy and its outcomes without analysing weaknesses in depth. A comprehensive monitoring and review system is not in place.

Reflecting the orientation of the Swiss economy, the scope of innovation policy mainly comprises technological innovations and not so much innovation in services and improvements in processes. Switzerland tries to help spur innovation nearly exclusively through supply-side instruments. Scientists define projects with industry participation while the concept of valorisation of knowledge leads to the creation of transfer centres and networks of transfer institutions. There is generally no support for mobilising demand for R&D and related services, specifically in small firms.

Public investment in research and innovation can be considered predictable and stable although there are only incremental increases in related budgets. The public budget is also established in the four-year ERI messages to ensure predictability and long-term impact. It is ensured that public sector firms receiving public funds have to increase their own R&D expenditures, therefore leveraging greater private sector investments.

Excellence, high quality and competition are important criteria for the allocation of funds. Projects are generally selected according to the quality of proposals which is in line with the bottom-up principle. Universities enjoy a relatively high degree of autonomy. Employment conditions for researchers are very good in terms of salaries and provide incentives to attract international talent which is reflected in a high proportion of foreign PhD students, Post-Docs, and professors. The Swiss research and innovation system can be considered very open.

Partnerships between higher education institutes, research centres and businesses are actively promoted. Policies and instruments such as knowledge transfer platforms, and voucher systems are in place to encourage cooperation and knowledge sharing and to create a more favourable business environment for SMEs.

Legal framework conditions can be generally considered as being supportive in promoting business investment in R&D and innovation. Switzerland offers a reliable legal framework including an appropriate system for the protection of intellectual property, favourable taxation, and a highly developed financial system.

Public support to research and innovation in businesses is simple, easy to access, and of high quality. There are output-oriented funding instruments available which are especially focused on the needs of SMEs. Access to funding instruments is generally non-bureaucratic. Funding schemes are regularly evaluated although not always in international comparisons.

The Swiss public sector does not provide explicit incentives to stimulate innovation within its organisations and in the delivery of public services, although some public offices perform various sorts of internal research. Efforts in the field of e-government also represent an
opportunity to innovate. In general, however, the public sector cannot be considered to be a driver of innovation itself.

A major threat may be the insufficient supply with graduates in science, technology, engineering and mathematics. In addition, education and training curricula show deficits with respect to entrepreneurial education. Barriers to entrepreneurship, such as the limited availability of early-stage venture capital and regulatory burdens, are still a weakness of the Swiss innovation system (OECD, 2006, p. 101). Public support for entrepreneurship is however provided through CTI’s start-up funding programme plus a mobilisation initiative called Venturelab. A number of recent reforms, such as the limitation of the double taxation of dividends and regulatory simplifications for SMEs, reveal an increased awareness of policymakers.

In sum, there have not been any major changes in the policy mix as Swiss policies can be generally described by a high level of stability and continuity. The message on the promotion of education, research and innovation for 2013-16 adopted by the Federal Council does not set new priorities compared with former messages. The only relatively recent important trend is an increased emphasis on internationalisation, e.g. by taking part in Europe-wide R&D collaborations. It can be expected that this trend will continue further. The general direction of the Swiss research and innovation policy is to provide favourable framework conditions. Hence, priorities are to foster basic research and technology transfer. Furthermore, the government fosters start-ups by providing advisory and network services. Most policies are implemented in a bottom-up approach, i.e. have no predefined priority area.

**Assessment of the policy mix**

The implementation of the four-year plans generally follows a bottom-up strategy, that is, governmental funding is granted as either block grants or distributed in a peer-reviewed evaluation process. Hence, Swiss policy provides little thematic steering, but focuses on providing favourable framework conditions for research and innovation.

Although Switzerland has a very good position with respect to the number of publications per 1,000 inhabitants, the total number of publications is small and the growth is limited. Switzerland is dependent on foreign countries in a number of ways, such as the large number of researchers in Switzerland that come from abroad. Therefore, policy actions in order to improve international cooperation are essential for Switzerland.

Promoting the establishment of new R&D performing firms, especially of university start-ups, has been a clear focus in the most recent years. Most initiatives have been promoted by regional actors together with the universities themselves: among the most active have been the EPFL, which hosts a science park, as well as the university of applied science (UAS). Science and technology parks have been created in about 20 Swiss cities, mostly in cooperation with higher education institutions (http://www.swissparks.ch). They offer favourable locations, coaching and support to start-ups. At national level, the CTI supports the creation of innovative start-ups through its CTI start-up programme, while training in entrepreneurship is provided through the national Venturelab programme. These initiatives have some relevance to promote the creation of innovative start-ups, but in the aggregate the impact on private R&D activities is likely to be very limited (TrendChart, 2009).

Promotion of cooperative research between higher education institutions and private companies is the main route of direct support from the State to technological innovation, especially in companies without their own research capacity. Most of the budget of the CTI is devoted to these projects and measures target essentially SMEs.
The volume and the efficiency of R&D activities in the public sector is a priority of Swiss research policy. As usual in the Swiss context, this does not take the form of new investment plans, but of a gradual increase of resources and shifts in priorities. This route is meant to have an indirect impact on private R&D activities: namely, given the sector composition of these activities, it is assumed that multinational companies tend to locate their laboratories near to very good research centres and are influenced by the availability of well-trained researchers having obtained a PhD.

While the support of R&D in private firms remains limited and focused on the facilitation of cooperation between public and private sector, it is organised with SMEs in mind. Hence, the organisation of support measures displays a simple structure, provides guidance and uses relatively few resources. However, no institutionalised evaluation programmes exist. Since 2009, the federal procurement process explicitly names fostering SMEs and promoting innovativeness as a goal.

Cantons attempt to create favourable framework conditions to new companies and multinational companies. This might include for example simplification of administrative procedures and investment in infrastructure. In their economic promotion policy, most Cantons provide this type of measure and there is a clear trend to favour innovative companies against more traditional activities. The function of promoting research in specific technological domains has been largely delegated to European Framework Programmes, whose importance has strongly increased in the Swiss context. Framework programmes are the second most important project funding instrument in Switzerland after SNSF grants. Furthermore, the weight of other European agencies, like the European Space Agency and Euratom have increased as well (SER, 2008).

Support to private companies has been explicitly targeted only towards small and medium enterprises (SME) and focuses on the promotion of technology transfer. The CTI funds the costs of public research partners in innovation projects that entail both private and public partners. Private partners are not directly funded by the CTI and originally had to cover at least half of the project costs, even though this threshold has now become less binding. The mechanism has proven to be very effective in answering private companies’ needs and evaluation studies have shown that CTI funded firms show a significantly better innovation performance than comparable firms without CTI support (Arvanitis et al., 2005). While the CTI budget has been strongly increased since the end of 1990 in parallel with the creation of the UAS, its magnitude remains relatively small. Regarding private R&D investments, barriers are essentially related to the structural organisation of the Swiss economy and the dominance of large multinational companies in the high tech sectors. In the context of an extremely open economy with traditionally low levels of State intervention in private economy, public research policy has limited leeway to trigger changes.

Since public R&D expenditures are solely provided for basic and applied research, Switzerland runs the risk of neglecting the breeding ground for following activities of R&D and innovation. A general problem is that policy is well aware of challenges but policy actions are rather indefinite. The reason may lie in dispersed political responsibilities so that it is not easy for political authorities on federal level to put concrete measures into force.
Table 3 – Assessment of policies addressing structural challenges

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Policy measures/actions addressing the challenge</th>
<th>Assessment in terms of appropriateness, efficiency and effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependency on private-sector research, relatively low level of public-sector expenditures and little direct influence on private knowledge production</td>
<td>NRPCs, NCCRs</td>
<td>The focus of policy actions on basic research reflects the general tradition of Swiss research policy. The division of tasks between the private and public sector has been proved efficient and effective. Future outcomes will however continue to depend on the performance of large multinational companies. Programmes such as NRP and NCCR are only of minor significance, given the rather low budgets. However, they are well-functioning and suited to improve cooperation between research in universities and in the private sector.</td>
</tr>
<tr>
<td>No mechanism to identify knowledge demands and fragmentation of R&amp;I policy</td>
<td>The ERI message routinely considers improved monitoring of the education, research and innovation domain as a key priority in order to improve steering capabilities. The monitoring is important in order to avoid excessive and unnecessary spending but knowledge demand is still defined in a bottom-up approach. This has proved an effective approach although it might take rather long to define priorities in this way.</td>
<td></td>
</tr>
<tr>
<td>Lack of skilled workers</td>
<td>Support of applied R&amp;D in UAS; improved cooperation between SNSF and HEIs in promoting young researchers; improved cooperation between SNSF, CTI and private sector businesses; the initiative for a skilled workforce launched in 2011 and objectives for 2020. There are limited concrete actions beyond statements of intentions, probably because Switzerland still can satisfy its demand with the immigration of skilled workers.</td>
<td></td>
</tr>
<tr>
<td>Strong increase in the number of students; quality of education at risk</td>
<td>The Swiss Centre of Accreditation and Quality Assurance in Higher Education (OAQ) prepared guidelines for quality management Problems are acknowledged and goals are formulated, e.g., increasing the number of professors; however, increases in budgets are incremental and concrete measures are lagging behind.</td>
<td></td>
</tr>
<tr>
<td>Little coordination between R&amp;I policy and economic promotion</td>
<td>Cooperation between SNSF, CTI and private sector businesses further promoted; NRPs; NCCRs Because SNSF and CTI follow similar principles in selecting targets for funding, cooperation might be fruitful. There are already joint meetings but no concrete actions such as joint evaluations of applications going beyond basic forms of cooperation and statements of intention.</td>
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</table>

5 Changes in the legislation and other initiatives not necessarily related with funding are also included.
5 NATIONAL POLICY AND THE EUROPEAN PERSPECTIVE

The ERA pillars comprise the following objectives:

- Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers
- Facilitate cross-border cooperation, enhance merit-based competition and increase European coordination and integration of research funding
- Develop world-class research infrastructures and ensure access to them
- Strengthen research institutions
- Facilitate partnerships and productive interactions between research institutions and the private sector
- Enhance knowledge circulation across Europe and beyond
- Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world.

The European Commission (2012) has recently singled out the following priorities:

- More effective national research systems;
- Optimal transnational co-operation and competition;
- An open labour market for researchers;
- Gender equality and gender mainstreaming in research;
- Optimal circulation, access to and transfer of scientific knowledge including via digital ERA.

These aspects are obviously intertwined. With respect to the labour market, Switzerland still experiences a lack of skilled workers, especially in sciences and engineering. As a consequence, inward flows of researchers are important for Switzerland and the Swiss labour market for researchers is very open offering attractive employment conditions. Generally, international cooperation is very important for researchers and is actively promoted by Swiss research institutions. Swiss immigration policy already ensures that demand for human resources for research is more or less satisfied although there are temporary scarcities and demand can by no means be satisfied solely with domestic employees. An important challenge remains the qualification of domestic employees.

The SNSF tries to enhance international cooperation by signing own multilateral contracts with other research councils abroad. There are already some world class research infrastructures within the ETH domain and they have become a focus of further activities in this field. Partnerships between HEIs and private firms are the major goal of Swiss innovation promotion and almost all measures are addressed towards enabling cooperation and knowledge transfer. Knowledge circulation across borders is also emphasised by various SNSF activities. Switzerland participates in European research programmes and has tried to intensify cooperation with upcoming key countries in worldwide research.

Switzerland has a rather good tradition of participating in international programmes at the European level. It participates in the Cooperation in Science and Technology in Europe (COST), where the State Secretariat for Education and Research provides additional funding for research in COST actions with Swiss participation. It further participates in the European technology initiative EUREKA, where Swiss participations are funded through the CTI. Switzerland also supports a number of inter-governmental research infrastructures, namely ESA, CERN, ESRF,
EMB, ESO, ILL, CIESM and HFSP. Switzerland also participates in the European framework programmes, where Swiss researches have been quite successful in obtaining funds, and in a number of projects of the European Science Foundation (ESF) besides contributing to the general budget.

In general, Swiss participation in international programmes and opening of national programmes reflects the decentralised nature of Swiss research policy and less focus on grand challenges. This implies that there is no overall planning of such initiatives and of the domains where joint programming should be promoted. Since both the SNSF and the CTI are based on a bottom-up approach to project selection, they do not devote a large share of their resources to joint programmes. This is can be an obstacle to the participation to large structural initiatives like Joint Technology Initiatives. On the other hand, research funding organisations are generally willing and financially capable to participate and the funding situation of Swiss partners in ESF initiatives, COST and Eureka is generally more favourable than in the other European countries. (Lepori 2011: 27)

Switzerland reached an agreement with Germany (DFG) and Austria (FWF) concerning joint financing of bilateral or trilateral projects, where submission and evaluation takes place in one of the three countries, while funding is on national basis (lead agency procedures) or from the country where most of the research is performed (money follows cooperation line procedure).

Furthermore, for researchers moving abroad, there are also possibilities to transfer SNSF funding to finalise the project. A specific agreement has been signed with Austria and Germany (D-CH-AT cooperation).

As a general rule, nationality is not a criterion for participation in Swiss research programmes. What is generally required instead, is to have a stable long-term appointment in a Swiss institution (this applies also to professors living in transborder regions and working in Swiss universities). SNSF funding for stays abroad is not restricted to the European Union, hence allows outward mobility to third countries as well.

Cooperation with third countries generally differs little from cooperation with partners from the EU. Hence, the general international orientation of Swiss research and innovation policy applies for third countries as well. Similarly, those programmes that allow foreign institutions to acquire funding are generally open to both Europe and third countries.

When looking to the relevance of the ERA for Swiss research policy, one needs to consider that Switzerland is not a member of the EU and thus, unsurprisingly, very few references to ERA policies can be found in Swiss official documents. However, by and large Swiss research policy complies with the spirit of ERA objectives and the related priorities.

This is the case for example for researcher’s mobility, where the Swiss researchers market is one of the most open internationally (about half of the PhD students and of the university professors are of foreign nationality). The impact of the EU in this context has to be sought rather in the liberalisation of the labour market and of people mobility in general, against a traditionally restrictive Swiss policy in these domains.

In the domains of research infrastructures and opening of research programmes, Switzerland is following the decentralised and bottom-up approach which broadly characterises its research policy. Thus, participation in European infrastructural initiatives and international programmes, as well as opening of national programmes, is decided case by case when the research community shows an interest for them. This approach entails however some risks in case the EU launches large-scale joint schemes, where participation has to be decided at the political level (as the non-participation of Switzerland to Joint Technology Initiatives might show). The federal roadmap for research infrastructures drafted by the State Secretariat for Education and Research (SER) in August 2010 details projects for the creation and development of international research
infrastructures to which Switzerland can participate. Many of these projects appeared in the 2008 roadmap of the European Strategic Forum on Research Infrastructures (ESFRI).

The bottom-up approach and the focus on funding of basic research coupled with competitive funds for joint public-private research projects has to be judged positively given the Swiss tradition of delegating as much as possible responsibilities to researchers in defining their priorities. However, the coordination between research and innovation policy does not rest upon a formal basis.

An important challenge for Swiss research policy is to further strengthen its universities and to allow them to position themselves in the European and international context. While this is already the case for some of them – especially for the two Federal Institutes of Technology – cantonal universities need a stronger effort in this direction. At the political level, initiatives have been undertaken to grant universities wider autonomy and strategic capability but conflicts emerged in this respect between some universities and cantonal authorities. A new higher education act was adopted by the parliament in 2011 that provides a common regulatory framework for the whole system and establishes a joint governance body between the Confederation and Cantons.
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Lepori, B. (2011): Joint and Open REsearch Programs - National report on joint and open programmes – Switzerland


## List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>BERD</td>
<td>Business Expenditures for Research and Development</td>
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<td>CERN</td>
<td>European Organisation for Nuclear Research</td>
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<td>CIESM</td>
<td>The Mediterranean Science Commission</td>
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<td>COST</td>
<td>European Cooperation in Science and Technology</td>
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<td>CRUS</td>
<td>Conference of Rectors of Swiss Universities</td>
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<td>CSCS</td>
<td>Swiss National Supercomputing Centre</td>
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<tr>
<td>CTI</td>
<td>Commission for Technology and Innovation</td>
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<tr>
<td>DFG</td>
<td>Deutsche Forschungsgemeinschaft</td>
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<tr>
<td>EAER</td>
<td>Federal Department of Economic Affairs, Education and Research</td>
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<td>EAWAG</td>
<td>Swiss Federal Institute of Aquatic Science and Technology</td>
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<td>EDI</td>
<td>Federal Department of Home Affairs</td>
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<td>EMB</td>
<td>European Marine Board</td>
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<td>EMPA</td>
<td>Swiss Federal Laboratories for Materials Science</td>
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<td>EPFL</td>
<td>Federal Institute of Technology Lausanne</td>
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<td>ERA</td>
<td>European Research Area</td>
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<td>ERA-NET</td>
<td>European Research Area Network</td>
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<td>ERI</td>
<td>Education, Research and Innovation</td>
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<td>ERIC</td>
<td>European Research Infrastructure Consortium</td>
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<td>ERP</td>
<td>Fund European Recovery Programme Fund</td>
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<tr>
<td>ESA</td>
<td>European Space Agency</td>
</tr>
<tr>
<td>ESF</td>
<td>European Science Foundation</td>
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<tr>
<td>ESFRI</td>
<td>European Strategy Forum on Research Infrastructures</td>
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<tr>
<td>ESO</td>
<td>European Southern Observatory</td>
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<tr>
<td>ESRF</td>
<td>European Synchrotron Radiation Facility</td>
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<tr>
<td>ETH</td>
<td>Federal Institute of Technology</td>
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<td>ETHZ</td>
<td>Federal Institute of Technology Zurich</td>
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<tr>
<td>EU</td>
<td>European Union</td>
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<tr>
<td>EU-27</td>
<td>European Union including 27 Member States</td>
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<tr>
<td>EUREKA</td>
<td>Europe-wide Network for Market-Oriented Industrial Research</td>
</tr>
<tr>
<td>EVD</td>
<td>Federal Department of Economic Affairs</td>
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<tr>
<td>FDFA</td>
<td>Federal Department of Foreign Affairs</td>
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<tr>
<td>FDI</td>
<td>Foreign Direct Investments</td>
</tr>
<tr>
<td>FIFG</td>
<td>Federal Law on the Promotion of Research and Innovation</td>
</tr>
<tr>
<td>FIT</td>
<td>Federal Institute of Technology</td>
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<tr>
<td>FORS</td>
<td>Swiss Center of Expertise in the Social Sciences</td>
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<tr>
<td>FP</td>
<td>Framework Programme</td>
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<tr>
<td>FP7</td>
<td>7th Framework Programme</td>
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<tr>
<td>FSO</td>
<td>Federal Statistical Office</td>
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<tr>
<td>FWF</td>
<td>Fonds zur Förderung der wissenschaftlichen Forschung</td>
</tr>
<tr>
<td>GBAORD</td>
<td>Government Budget Appropriations or Outlays on R&amp;D</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>GERD</td>
<td>Gross Domestic Expenditure on R&amp;D</td>
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<tr>
<td>GOVERD</td>
<td>Government Intramural Expenditure on R&amp;D</td>
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<tr>
<td>GUF</td>
<td>General University Funds</td>
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<tr>
<td>HEI</td>
<td>Higher education institutions</td>
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<tr>
<td>HERD</td>
<td>Higher Education Expenditure on R&amp;D</td>
</tr>
<tr>
<td>HES</td>
<td>Higher education sector</td>
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<tr>
<td>HFSP</td>
<td>Human Frontier Science Program</td>
</tr>
<tr>
<td>ILL</td>
<td>Institut Laue-Langevin</td>
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</table>
IP  Intellectual Property
JTI  Joint Technology Initiatives
NCCR  National Centre of Competence in Research
NRP  National Research Programme

OAQ  Swiss Centre of Accreditation and Quality Assurance in Higher Education
OECD  Organisation for Economic Co-operation and Development
OPET  Federal Office for Professional Education and Technology
PRO  Public Research Organisations
PSI  Paul Scherrer Institute
R&D  Research and Development
RDI  Research Development and Innovation
RI  Research Infrastructures
RTDI  Research, Technological Development and Innovation
S&T  Science and technology
SER  State Secretariat for Education and Research
SERI  State Secretariat for Education, Research and Innovation
SF  Structural Funds
SIB  Swiss Institute for Bioinformatics
SME  Small and Medium Sized Enterprise
SNSF  Swiss National Science Foundation
SRRI  Swiss Roadmap for Research Infrastructures
SSTC  Swiss Science and Technology Council
SUC  Swiss University Conference
THE  Times Higher Education
UAS  University of Applied Sciences
Abstract
This analytical country report is one of a series of annual ERAWATCH reports produced for EU Member States and Countries Associated to the Seventh Framework Programme for Research of the European Union (FP7). The main objective of the ERAWATCH Annual Country Reports is to characterise and assess the performance of national research systems and related policies in a structured manner that is comparable across countries.

The Country Report 2012 builds on and updates the 2011 edition. The report identifies the structural challenges of the national research and innovation system and assesses the match between the national priorities and the structural challenges, highlighting the latest developments, their dynamics and impact in the overall national context. They further analyse and assess the ability of the policy mix in place to consistently and efficiently tackle these challenges. These reports were originally produced in December 2012, focusing on policy developments over the previous twelve months.

The reports were produced by independent experts under direct contract with IPTS. The analytical framework and the structure of the reports have been developed by the Institute for Prospective Technological Studies of the Joint Research Centre (JRC-IPTS) and Directorate General for Research and Innovation with contributions from external experts.
As the Commission’s in-house science service, the Joint Research Centre’s mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new standards, methods and tools, and sharing and transferring its know-how to the Member States and international community.

Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security including nuclear; all supported through a cross-cutting and multi-disciplinary approach.

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