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Abstract

The 2015 series of RIO Country Reports analyse and assess the policy and the national research and innovation system developments in relation to national policy priorities and the EU policy agenda with special focus on ERA and Innovation Union. The executive summaries of these reports put forward the main challenges of the research and innovation systems.

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Foreword

The report offers an analysis of the R&I system in Sweden for 2015, including relevant policies and funding, with particular focus on topics critical for EU policies. The report identifies the main challenges of the Swedish research and innovation system and assesses the policy response. It was prepared according to a set of guidelines for collecting and analysing a range of materials, including policy documents, statistics, evaluation reports, websites etc. The quantitative data is, whenever possible, comparable across all EU Member State reports. Unless specifically referenced all data used in this report are based on Eurostat statistics available in February 2016. The report contents are partly based on the RIO country report, 2014 (Jacob, 2015).

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Executive summary

The report offers an analysis of the R&I system in Sweden for 2015, including relevant policies and funding, taking into account the priorities of the European Research Area and the Innovation Union. The report was prepared according to a set of guidelines for collecting and analysing a range of materials, including policy documents, statistics, evaluation reports, websites, etc. The quantitative and qualitative data is, whenever possible, comparable across all EU Member State reports. The report contents are partly based on the RIO country report, 2014 (Jacob, 2015).

Context

Sweden has a highly competitive and successful economy. The 2008-09 economic crisis had a relatively low impact on economic growth (-5.8% of GDP growth in 2009), which completely recovered the year after (+6% GDP growth in 2010). Presently domestic demand is growing at a healthy pace thanks to consumption and construction, which in turn is supported by expansionary fiscal policy, low interest rates, growing disposable incomes and employment growth. Weak external demand had a negative impact on industrial exports, but service exports are growing fast (European Commission, 2015a). The GDP growth rate has been steadily increasing since 2012 (-0,3%) to 2,3% in 2014 and 4.1% in 2015.

Public research budgets were largely left unaffected by the economic crisis. 2011 was the only year with a moderate contraction of GBAORD (both in absolute and relative terms) followed by a distinct increase in allocations again in 2012. Swedish gross domestic expenditure on research and development (GERD), in absolute terms, decreased during the crisis in 2009 but recovered very soon and in 2013 surpassed pre-crisis levels. GERD funded by the government has registered positive growth rates since 2005, including 2011.

The main sources of Swedish science policy are the Research Bill and the Energy Bill. The bills are produced every four years with the current cycle covering 2013-2016. The 2015-2016 period is expected to be dominated by stakeholder consultations and lobbying as the process of priority setting proceeds. An additional policy document, the National Innovation Strategy (2012), provides guidelines for innovation policy up to 2020.

Sweden takes the top spot in the 2012 Research Excellence Composite Indicator ahead of Denmark and the Netherlands and the EU Innovation Union Scoreboard 2015 classifies Sweden as an innovation leader together with Germany, Denmark and Finland. Sweden has since long ago reached the 3% target for total GERD as share of GDP and this level of investment remains constant despite the financial crisis. In 2014, GERD was the second highest in the EU (after Finland) summing up to 3.16% of GDP, compared to an estimated average of 2.03 % for EU-28. However, Swedish expenditure on R&D has been in decline when expressed as share of GDP since the beginning of the millennia, from 3.61% of GDP in 2003 to 3.16% in 2014¹. GERD performed by the higher education sector has traditionally been high and is still on a slight upward trend, amounting to 0.92% of GDP in 2014, the second highest among EU countries after Denmark.

Key developments in the R&I system in 2015 and early 2016 included²:

- A detailed proposition for a reform of the venture capital sector was presented by the government to the parliament in spring 2016 (Regeringens Proposition 2015/16:110) (Government of Sweden, 2016).

¹ Methodological changes in the statistics in 2005 and the evolution of the GDP may explain part of this decline.

² Please note that the OECD Review of Innovation Policy: Sweden 2016 which was published in March 2016 will be the subject of analysis in the 2016 RIO Country Report for Sweden.

- In 2015, the 23 Strategic Research Areas were evaluated by an international expert panel. The panel delivered a positive opinion and identified the long-term focus as one of the main strengths of the investment which enabled the research groups to engage in a higher degree of risk taking than that associated with project funding. It was however argued that the groups could be more focused on societal needs and undergraduate teaching.
- A 2015 evaluation of the autonomy reform in the tertiary education sector, which was introduced in 2011, found that most staff below the leadership level at universities did not feel themselves affected by this reform. At the level of Vice Chancellors it was felt that gains in autonomy through the reform were lost to indirect governance from the government.
- At the request of the Swedish government, the OECD conducted a review of the Swedish school system and published a report in mid-2015. The report suggests that attention should be given to inter alia: improving the quality and attractiveness of the teaching profession; reviewing present levels of funding of education; increasing existing levels of support for disadvantaged students and creating a national school improvement strategy (OECD, 2015).

In late 2014, the Swedish Research Council proposed a new draft research evaluation model for allocating resources to universities and university colleges which has been under scrutiny by stakeholders. The draft model was designed to be a driver of quality, promoting the contribution of high quality research to societal development and facilitating better informed research policy decisions. Sweden is well aligned with most ERA policies. More recent developments include the introduction of a common platform for research applications called PRISMA which is a joint project of The Swedish Research Council in collaboration with research councils Forte and Formas.

All publicly funded research performers in Sweden are legally obliged to engage in knowledge transfer since 1997. This rule has since been revised to emphasise knowledge transfer to support innovation and most Swedish universities have some type of incubator and support infrastructure for university spin-offs.

The identified challenges for Sweden's R&I system are:

- Strengthening early stage private venture capital investment especially in sectors other than ICT and life sciences and reforming public venture capital so it becomes less risk averse and focuses more on early stage investments– the problem has been recognised and 2014 and 2015 saw a promising reversal in trends as well important policy action resulting in the government's proposition (2015/16:110) about a new structure for the public financing of innovation and sustainable growth in March 2016.
- Reduce dependency of business enterprise expenditure on R&D (BERD) on a few multinational companies (MNCs) – globally owned companies relocate their R&D units while R&D activities in Swedish SMEs are developing unfavourably

In addition, declining performance in primary and secondary education as evidenced by the latest PISA results and high youth unemployment are major concerns and reversing these negative trends is among the main priorities of the government. The need to improve basic skills in education was also pointed out by the European Commission's Country Specific Recommendations for 2014 (Council of the European Union, 2014).

R&I Challenges

Challenge 1: **Strengthening early stage private venture capital and reforming public venture capital**

Description

Compared to other EU countries, Sweden is performing reasonably well when it comes to the overall level of venture capital investment relative to GDP. In 2013, Sweden ranked behind Denmark (0.1%) and the UK (0.12%), on par with Finland (0.08%), above the EU-28 average (0.06%) and well before Germany (0.04%) (European Commission, 2015b). Latest data show promising signs for 2014 with private venture capital investments increasing by 57% compared to 2013. Public investment declined at the same time. Overall, total venture capital investments rose by 27% between 2013 and 2014. In global comparison, overall venture capital investment as a share of GDP is at the top of the OECD middle range (OECD, 2014).

However, total investments are still well below 2008 levels and the World Bank's Doing Business indicator 2015 ranked Sweden only 61st for "getting credit" (overall rank: 11th) with the ease of getting credit worsening over time (rank 42nd in 2013). The market for private venture capital reveals gaps in early-stage investment and available support is still skewed towards public venture capital. A 2014 report by the Swedish National Audit Office pointed to risks of crowding out of private capital as a relatively large share of the public venture capital was invested in the parts of the venture capital market where private actors are most active. Over 40% of the government capital was invested in companies in expansion phases and mature companies whereas companies in the seed stage only received 0.2% of public venture capital. In addition, most state owned actors were found not to have any cost efficiency targets (Swedish National Audit Office, 2014).

Current Swedish programs to support SME access to finance are managed primarily by large public agencies, e.g. ALMI, Norrlandsfonden, The Swedish Industrial Development Fund, Fouriertransform, Inlandsinnovation and the Energy Agency. Additionally, the Swedish pension funds continue to be a source of venture capital but not generally for early stage investment. It should also be mentioned that 2014 saw a drastic reduction in the level of tax deduction for private savings towards pension.

Policy response

Early 2015 saw the formation of a new Innovation Council at highest political level chaired by the Prime Minister. One of its first tasks was to consider how to best promote collaboration between the private and public venture capital initiatives.

Following the government inquiry on "a fund structure for innovation and growth" in 2015 (Government of Sweden, 2015) the Swedish government announced reforms of public financial support to SMEs in the budget bill for 2016. The reforms announced include the ambition to establish a new public state-owned company incorporating the two existing public venture capital companies Inlandsinnovation AB and Fouriertransform Aktiebolag forming a new public company with a larger financial base and without predefined sectoral and regional limitations in investment focus. The investment technique of the new company will be fund-of-funds, i.e. it will co-invest with private capital in venture capital funds. The main objective of the new company will be to co-finance early stage venture capital investments in innovative Swedish enterprises with high-growth potential. Another objective is to contribute to the strengthening of the overall financial ecosystem in Sweden. A more detailed propositions of the reforms was presented to the parliament in spring 2016 (Government of Sweden, 2016). If accepted by parliament the changes will take force from January 1, 2017.

Other developments include the introduction in 2013 of a tax deduction for investment in companies that are not stock market indexed and have less than 50 employees. Another new instrument is the investment savings account which is in effect a reduction of capitals tax for investors. This instrument allows individuals to maintain a personal

account for shares, bonds, etc. which is taxed at a much lower rate than capital tax and there is no tax per transaction (Jacob, 2015).

Assessment

The challenge has been recognised and prioritised at the highest political level. It is yet too early to assess the effectiveness of the recently introduced measures. The tax deduction for investment in not stock market indexed companies is very limited since only companies with 50 or fewer employees are eligible and the deduction must be repaid on sale of the shares. The new investment savings account could become an effective stimulus for the private venture capital market. It is possible that the potential reduction in personal savings due to the de-facto abolishment of tax deduction for private savings towards pension might be compensated by the introduction of this new savings account. However, it is not likely that these accounts will play a larger role for the private venture capital market than the private pension funds did. Currently, personal savings are low and mostly tied up in pension funds and real estate (Jacob, 2015). The marked increase in private investments in 2014 is a very promising sign.

Challenge 2: Reduce dependency of BERD on multinational companies (MNCs)

Description

Private R&D is concentrated in large multinational firms, both foreign and Swedish owned, which dominate the Swedish economy. Foreign-owned firms now employ almost 25% of the workforce in business and industrial sectors, mostly in services and manufacturing. Over the last decade large multinationals have increasingly outsourced their research and innovation facilities, often placing them close to growth markets or in new headquarters, as a result of gradually adopting advanced global strategies as well as foreign ownership. Primarily two reasons have been put forward as explanations to why Swedish owned multinationals locate some parts of their R&D abroad. The first is to adjust their products and processes to specific preferences and needs on the market in another country. The second is to benefit from knowledge and technologies developed in another country by placing some of its own R&D there. Other factors that appear to influence where Swedish MNEs decide to place their R&D are how strong the protection of intellectual property rights is in a country, the country's relative endowment with skilled labour, and how far from Sweden the country is located (Tillväxtanalys, 2014a).

About 80% of Swedish business R&D is performed by a few large multinational companies with more than 200 employees with most of it concentrated in firms with >1000 employees. In 2013, 89 firms with >1000 employees accounted for 63% of Swedish BERD. In the same year, 49% of BERD was spent by Swedish owned multinational companies, 39% by foreign owned companies and 12% by local Swedish companies (Tillväxtanalys, 2015a). BERD is very high in European comparison, with 2.12% of GDP in 2014, but has been on a slight downward trend as share of GDP over the last ten years (2.69% in 2003) due to the relocation of some of the R&D units of MNEs. This illustrates the economic dependence on a few large firms, which creates vulnerabilities and unforeseeable risks. In addition, R&D investments in SMEs fell by 30% between 2005 and 2009 (European Commission, 2014a). Analysis by the Swedish Agency for Growth Policy Analysis (Growth Analysis) shows the same trend for years 2007 – 2011 (Tillväxtanalys, 2015b).

For many years Sweden had a national agency for stimulating foreign direct investment: Invest Sweden. In 2013 the government decided to merge Invest Sweden and the export council (Exportrådet) into the new organization Business Sweden which is no longer following any specific policies aimed at attracting R&D intensive FDI.

Policy response

Over the past two decades there have been substantial efforts focused on an incremental industrial restructuring to reduce economic dependence on a few large actors by supporting growth in high-tech firms and improving framework conditions for

SMEs. With a view of increasing BERD, the previous government introduced a tax incentive scheme for business investment in R&D in 2014. This deduction is very limited in scope and only applies to personnel costs as it is not on total R&D expenditure but on the social insurance per employee. According to DG TAXUD's Study on R&D Tax Incentives, the foregone social security revenues are estimated at about €45m net (SEK 420m) (European Commission, 2014b). Within the current budget suggestions, the government has also proposed to support funding to SMEs covering part of the costs associated with coverage of salary for staff that is ill. About €32m will be devoted to this effort (Jacob, 2015).

Many SMEs receive support from actors such as ALMI, a publicly funded actor charged specifically with promoting business development. VINNOVA offers specific funding to SMEs via its SME umbrella programme, Innovation Projects in Enterprises (created out of already existing programmes in 2015). In 2015, VINNOVA also launched a new scheme for innovation vouchers targeting SMEs. SMEs can also participate in the FFI programmes, the internationalisation programme, the Institute Excellence Centre programme and most other VINNOVA-programmes such as the Challenge Driven Innovation programme or the Strategic Innovation programmes. The Knowledge Foundation, a public research foundation, also funds collaborative projects between university colleges and firms in a large range of programmes including the most recent Researcher Profiles scheme. The Swedish Energy Agency offers support and loans to SMEs in emerging energy technology areas.

Assessment

The tax incentive scheme introduced in 2014 was very limited in scope and it is yet too early to assess its effects. A broader tax credit scheme may be part of a solution but Swedish governments have so far preferred to avoid this particular policy measure. Overall, there is no shortage of initiatives aimed at SMEs; on the contrary, there may be a problem with respect to the proliferation and complexity of some of these measures. Further, these measures do not seem to generate the desired effects at macroeconomic level. There may also be some yet untapped potential in attracting new foreign investments.

1. Overview of the R&I system

1.1 Introduction

The Swedish population accounts for 1.93% of the total population of EU28. In absolute figures, this is 9,804,082 (these figures were reported by the Statistics Sweden for July 2015)³, a change of approximately +1% from the figures reported in 2014 country report. According to Statistics Sweden, 75% of population growth in Sweden may be attributed to migration and 25% to births. Statistics Sweden has not indicated whether the current migrant crisis will affect the annual prognosis. Although unemployment continues to be an important political concern in Sweden, a review of the figures shows that the rate of unemployment remained at 8% for both 2012 and 2013 but declined to 7.4% towards the end of 2014⁴. This compares to a figure well below the EU-28 average for the same period (10.5%). These figures must however be considered against the general growth in population over the same period which is about 1% per annum for the period 2012-2014. Unemployment particularly among young people was a key issue in the 2014 elections and according to Statistics Sweden among those in the 15-24 age group, the level of unemployment was 7.5% in 2013 which is well below the EU28 average of 13%.

Statistics Sweden reported for the first quarter of 2015 that GDP growth for 2014 was 2.1% which was the highest since 2011. This trend is showing signs of cooling as the report for the second quarter shows a slower rate of growth (0.4%). This is however in line with the EU 28 average for the same period. The strong showing in growth in GNP is mainly attributable to a very strong export performance in 2014. The GDP growth rate has been steadily increasing since 2012 (-0.3%) to 2,3% in 2014 (see table 1). GDP per capita increased slightly from €44,500 in 2012 to €45,400 in 2013 but dropped to €44,400 in 2014. The national debt as a percentage of GDP was 37.2% in 2012, and increased to 39.8% of GDP in 2013. In 2014 the level of debt as a percentage of GDP reported was 44.9% which is well below the EU28 average for 2014 (86.8%).

Export growth has been relatively weak in 2012 and 2013 but the level of growth reported for the first quarter of 2015 was 1.7% which is the strongest showing since 2012. Export of services is growing faster than export of manufactured goods. This continues a trend that was already emerging as reported in 2014 Country Report.

The Swedish economy has been relatively stable during the period of the financial crisis however there have been signs of flagging growth and investment levels particularly in Business Expenditure in R&D (BERD). Inflation is still rather low (-0,3%, 2014) and household indebtedness is rather high. The Central Bank of Sweden's annual report for 2014 noted that Sweden was showing signs of sluggish growth as a result of the slow growth in the euro area as a whole (Central Bank of Sweden, 2014). Europe is still Sweden's largest trading partner with Germany and Norway figuring as the two strongest trading partners. Outside of Europe, the USA has traditionally been a strong trading partner for Sweden and recently there are signs of increasing trade with China.

Domestic fiscal policy is currently the source of much concern in Sweden. The Central Bank of Sweden has been experimenting with a more expansionary monetary policy in order to increase inflation levels but this has had minimal effect so far. The impact of low inflation on the real estate market is one of the key drivers of the growing concern about fiscal policy.

³ Statistics Sweden, Population Statistics, Accessed September 21, 2015
<http://www.scb.se/sv/Hitta-statistik/Statistik-efter-amne/Befolkning/Befolkningens-sammansattning/Befolkningsstatistik/#c li BE0101A>

⁴www.scb.se, accessed January 2015

Sweden has traditionally been one of the countries in the world with a high level of R&D investment in percentage of GDP. In 2013, gross domestic expenditure on research and development (GERD) amounted to €144,924m and €136,091m in 2014. These figures are relatively high when compared to the EU28 average. The business sector accounts for almost 2/3 of GERD and this increases vulnerability in times of market volatility e.g. the financial crisis. Public investment in R&D is more stable in part because public R&D budgets follow the suggestions outlined in the Research Bill which comes every four years. Currently, the most significant developments for R&I is the preparation of the Energy and Research Bills, which are expected to go into effect in 2017. The 2015-2016 period is expected to be dominated by stakeholder consultations and lobbying as the process of priority setting proceeds.

The 2012 Research Bill outlined the targets for public R&D investment up to 2016 and although data are yet to be released for 2015, the targets have so far been met. There are no set targets for BERD. The level of investment in R&D has been fairly stable even throughout the financial crisis. The government investment in research in the university sector has increased somewhat in line with the proposals in the 2012 Research Bill. Private sector investment has been slightly affected by the downturn in the global economy with BERD decreasing to 2.12% of GDP in 2014 as compared to 2.22% in 2012 and 2.28% in 2013.

2012-present represents two mandate periods in the political cycle. 2012-2014 represented the tail end of the conservative coalition government's mandate period. Economically, this also coincided with the financial crisis. While Sweden managed relatively well through the crisis, a number of R&I significant issues dominated the election in 2014. Of these, performance in schools and household indebtedness are key. By the end of 2014, Sweden had a new left coalition government, a low inflation rate, high household indebtedness and a government which was keen on signalling a change in some of the fiscal policies that dominated for the previous eight years. Chief among these was the individual tax deductions for pension savings and for household services. The new government also indicated a strong interest in innovation and appointed an Innovation Council with representation from the business and research communities. It is difficult to foresee what would be the effect of the new policies on R&I since most policies with budgetary effect have not been implemented because of the 2014 budget crisis. The budget for the 2015-2016 fiscal year was approved.

Table 1: Main R&I indicators 2012-2014

Indicator	2012	2013	2014	EU28 average (2014)
GDP per capita	44,500	45,400	44,400	27,400
GDP growth rate	-0.3	1.2	2.3	1.4
Budget deficit as % of public budget	-0.9	-1.4	-1.7	-3.0
Government debt as % of GDP	37.2	39.8	44.9	86.8
Unemployment rate as percentage of the labour force	8	8	7.9	10.2
GERD in €m	13,891.27	14,406.17	13,611.92	283,009.388m (total for EU-28)
GERD as % of the GDP	3.28	3.3	3.16	2.03
GERD (EUR per capita)	1,464.9	1,507.6	1,411.3	558.4
Employment in high- and medium-high-technology manufacturing	4.5	4.4	4.3	5.7

Indicator	2012	2013	2014	EU28 average (2014)
sectors as share of total employment				
Employment in knowledge-intensive service sectors as share of total employment	51.5	51.7	52.2	39.8
Turnover from innovation as % of total turnover	6.1			11.9 (2012)
Value added of manufacturing as share of total value added	25.2			26.2 (2012)
Value added of high tech manufacturing as share of total value added	4.2	4.4		

1.2 Structure of the national research and innovation system and its governance

1.2.1 Main features of the R&I system

The Swedish R&I system is characterised by high diversity in its funding arrangements and low diversity in terms of the categories of research performing organisations in the system. Firms account for at least two thirds of the research funded. The public sector research effort is divided among three main types of research performers: universities and university colleges, research institutes and public authorities that perform in house research. The university and university college system is the largest part of the public research performing sector. Almost two thirds of publicly financed research in Sweden is done at 36 universities and university colleges⁵. Industrial research institutes are not part of the higher education sector but are classified as knowledge intensive firms and are organised under one umbrella organisation (RISE) which is a publicly owned company. There are a number of small public research institutes that are special purpose organisations such as the Swedish Institute of Advanced Studies but these are not of direct relevance to R&I policy. Large scale research infrastructure in Sweden is incorporated in universities so there is no national lab system. University hospitals are excluded from the category "research infrastructure". These units are financed through a shared financing system between the universities and the municipality in which the university is located. There is a special research fund for clinical research and this is administered at the county council level.

A new system for funding and prioritising research infrastructure is now in place⁶. Research infrastructure that is specific to a particular research group or a university but is not developed for national purposes has to be maintained from funding raised by the research group that uses the infrastructure. This would suggest that the proportions of institutional to project funding may vary not only among types of research performers

⁵ University colleges differ from universities in that they were originally not intended to do doctoral education. Since 2000 this distinction was removed and some university colleges were granted the right to do doctoral education in some subjects. In 2010, the government discontinued this practice but university colleges may still apply to educate doctoral students in a particular subject. Generally, university colleges have lower research intensity than universities. www.uka.se

⁶ <http://www.vr.se/forskningsinfrastruktur/vetenskapsradetsquidetillinfrastrukturen.4.61663a161121008575380002821.html> The first calls for this had a budget of €36.3m.

(universities versus research institutes) but also between performers in the same category depending on the amount of research infrastructure they manage⁷.

1.2.2 Governance

The national R&I system is governed through the Research Bill⁸ and a National Innovation Strategy which is intended to provide guidelines for innovation policy up to 2020⁹. The Research Bill suggests the budget and agenda for research for four years. Both of these documents are created in a process of consultation with the main stakeholders in the sector. They also represent two instances of more centrally driven priority setting for the national R&I system. Generally, the system is governed in a bottom up fashion that has given rise to charges of fragmentation because of the degree of stakeholders' influence.

The Swedish approach to R&I governance is predominantly decentralised. For this reason, it makes little sense to attempt to point to a particular actor as the main policy making body. A more useful approach would be to focus on where the main policy directives emanate from. This point is the Research Bill and the Innovation Strategy. The expert public agencies such as VINNOVA, the Swedish Energy Agency and the Swedish Research Council are key actors in the policy system. VINNOVA is the central coordinating actor for innovation issues while the Swedish Research Council is the principal actor for providing advice on the research system to the government. These actors have key policy implementation roles and are also main sources of advice and expertise to the Ministries. For this reason, it would also be remiss to maintain that policies are made at the Ministry level and then implemented at the Agency level. Instead, there is a complex backward and forward interaction between the Ministries and the Agencies which they govern on the one hand, and the Ministries and Parliament on the other. For R&I policy as in other policy areas, this process of upward and downward consultation is iterative and includes input from stakeholders either filtered through the Agencies or directly. In 2014, the new government added another actor to this constellation, and this is the Innovation Council. The status of this entity is advisory and the Prime Minister and the Minister of Finance are members as well as the Minister of Enterprise and Innovation and the Minister of Research and Higher Education.

As mentioned earlier, there is more diversity at the level of research funders in Sweden than there is among research performers. Table 2 contains a list of the key funders and the ministries to which they report to. Table 3 is a list of the most important autonomous public funders (i.e. not governed by any Ministries) but the source of the funding that they disburse is public. Evaluations are performed regularly within the Swedish R&I system but there are no evaluation agencies as such. The closest equivalent of this would be the Swedish National Audit Office¹⁰. The Audit Office does both Financial and Performance Audits and reports directly to Parliament. It is however an independent body. Despite the central role of the National Audit Office, a great deal of evaluation of public programmes is distributed throughout the Swedish research system. Expert agencies like VINNOVA and the Swedish Research Council conduct analyses and evaluations regularly, not only of their own programmes and initiatives but of other types of publicly funded programmes. It is also not uncommon that individual researchers are charged with performing evaluations on behalf of government bodies. Last but not least, the research institute and consultancy sector are also important players in this market.

⁷ Given that research groups are often responsible for maintaining infrastructure, there may be local solutions to how both institutional and project funding is used to support infrastructure of this type. This would need to be taken into account when one compares the amount of funding available to universities vis a vis each other and similarly for research institutes.

⁸ <http://www.regeringen.se/sb/d/15650/a/201368>

⁹ <http://www.vinnova.se/upload/EPIStorePDF/DenNationellaInnovationsstrategin.pdf>

¹⁰ www.riksrevisionen.se/en

Science policy advice is channelled through a bottom up arrangement. The main sources of science policy are the Research Bill and the Energy Bill, each of which is produced every four years. During the year that the Research Bill is to be prepared, the Ministry of Education usually appoints a Committee to oversee the preparation of this Bill. The Bills are produced simultaneously and great effort is taken to coordinate inputs. The Energy Agency is charged with producing the Energy Bill and in providing input on energy R&I policy to the Research Bill. The Research Bill is the responsibility of the Ministry of Education and Research. It is customary that an ad hoc committee of representatives from the research, public and industry sectors is appointed by the Ministry to coordinate stakeholder inputs and help with outlining the direction of the Bill. Additionally, the expert agencies provide regular science policy advice to the government through the annual reports on their own activities that they produce. The Swedish Research Council and VINNOVA are the two most important actors in this regard. Last but not least, Sweden has traditionally been keen on integrating science policy advice from international sources such as the OECD and the European Union.

1.2.3 Research performers

The bulk of public research (approx. 2/3) in Sweden is performed by the universities and university colleges. All higher education organisations engage in all three tasks, research, teaching and knowledge transfer. In addition some public agencies perform inhouse research.

Research in the private sector is performed primarily by a few large multinational companies with more than 200 employees. Research institutes and independent consultancies constitute a second category of research performers in the private sector and last but not least there is a small but growing group of small and medium sized firms that are also engaging in research.

Table 2: List of most important public research funders, area of responsibility and Coordinating Agencies

Research funders	Area of Funding	Responsible Ministry
Swedish Energy Agency www.energimyndigheten.se	Funds research on creating the prerequisites for an ecologically and economically sustainable energy system Main tasks in research funding are: funding, business development, network building, statistics, evaluation and governance of energy R&D	Ministry of Enterprise and Innovation, Ministry of Energy and Environment
Swedish Research Council for Health, Working life and Welfare, FORTE www.forte.se	Basic and applied research on health and health care, working life and work organisation, welfare including social policy and social work. Main tasks: research funding, research communication and evaluation	Ministry of Health and Social Affairs
Swedish Research Council, Formas www.formas.se	Basic and applied research to promote sustainable development Main tasks: research funding and communication of research results	Ministry of Environment and Energy, Ministry of Enterprise and Innovation
Swedish Environmental Protection Agency www.naturvardsverket.se	Funds interdisciplinary research on the environment and nature protection Main tasks: funding, statistics, evaluation and control of R&D on environmental protection	Ministry of Environment and Energy

Research funders	Area of Funding	Responsible Ministry
Swedish national space board www.rymdstyrelsen.se	Research, development and other work connected to Swedish space and remote sensing Main tasks: Research funding	Ministry of Education and Research
Swedish International Development Cooperation Agency www.sida.se	International research support for development work and support to Swedish R&D on development cooperation Main tasks: Research funding and development cooperation	Ministry of Foreign Affairs
Swedish Radiation Safety Authority http://www.stralsakerhetsmyndigheten.se/	Research on radiation protection and nuclear safety Main tasks: funding, statistics, evaluation and governance of R&D on radiation protection	Ministry of Environment and Energy
Swedish Research Council www.vr.se	Develops and funds basic research in all scientific areas Main tasks: funding, statistics and analysis, evaluation and research policy advice, research communication	Ministry of Education and Research
Swedish Innovation Agency (VINNOVA) www.vinnova.se	Development of Sweden's innovation system in order to promote sustainable economic growth Main tasks: Research and innovation funding and network building	Ministry of Enterprise and Innovation

Table 3: Autonomous Public Research Foundations and type of research funded

Foundation	Area of research funded	Annual budget for research (approx.)
Swedish Foundation for the Humanities and Social Sciences www.rj.se	Humanities, Social Sciences Main tasks: Research funding and network building	€0.4m
Knowledge Foundation www.kks.se	Knowledge and competence exchange between universities, research institutes, firms and university colleges Main tasks: Information technology Research at university colleges	€20m
MISTRA, Foundation for strategic environmental research www.mistra.org	Research on a good living environment and sustainable development Main tasks: Research funding and network building	€20m
Foundation for Strategic Research www.sfs.se	Funds natural science, technical and medical research Main tasks: Research funding	€50.8m
Swedish Foundation for International Cooperation in Research and Higher education (STINT) www.stint.se	Funds mobility of researchers & teachers to promote internationalisation of higher education Main tasks: Research funding	€6.5m

2. Recent Developments in Research and Innovation Policy and systems

2.1 National R&I strategy

The National Innovation Strategy and the Research Bill produced in 2012 remain the point of departure for research and innovation strategies and policies. Although Innovation Strategies are fairly new, both the Research Bill and the Innovation Strategy are done in broad consultation with stakeholders in keeping with Swedish political tradition. The Research Bill proposed to increase the public budget for research by approx. €127m every year over the period 2013-2016. This would have meant an absolute increase in the public R&D budget by approx. €421m in 2016. This budget increase is divided over a four-year period starting in 2013. For 2013, the bill projected an increase in funding by €180m., in 2014, it was estimated that the level of spending would increase by yet another €101m., in 2015 by €38.5m, and in 2016 by €100m. In 2013, the sector spent a total of €3,614m and in 2014 €3,833M¹¹.

The Life sciences have been specially prioritised since 2012. This was in part an emergency measure in order to compensate for Astra Zeneca's decision to reduce the size of its R&D investment portfolio in Sweden. In keeping with this, there was also a shift in the pattern of investment of public and private capital towards life science. Other areas of priority were energy, mining minerals, steel and sustainable building and planning. Research on space, forestry products and evidence based pre and primary school education were specifically mentioned priorities. The Bill confirmed government's commitment to using strategic research areas as an instrument for capacity building in the aforementioned prioritised areas. Apart from the research priorities, the bill made provisions for the Swedish Research Council to make a special programme call aimed at younger scholars and recruitment of well renowned senior international scholars. Both programmes are now operational although the one for senior scholars has not been released in 2015.

The National Innovation Strategy aims to promote an innovation friendly climate through: (i) the creation of framework conditions for promoting innovation; (ii) access to competent capital to promote business interests and (iii) a sustainable physical and digital communication infrastructure. The Swedish Agency for Growth Policy Analysis (Tillväxtanalys) has been tasked with monitoring and evaluating progress towards the goals outlined in the Innovation Strategy. The 2014 report used six composite indicators corresponding to the six goals outlined in the strategy: innovative regions and environments; innovative public sector; innovative firms and organisations; framework conditions for infrastructure and innovation; high quality research and higher education for innovation and innovative people. Each of these composite indicators is made up of a number of sub indicators. The report concluded that framework conditions in Sweden for enterprises are good and that Swedish firms have a high degree of innovation in their new products and services (see chapter 5 for more detail).

Both the Research Bill and the Innovation Strategy are predominantly national in their focus and orientation. There is however a considerable degree of complementarity with EU priorities but these are not explicitly framed as such. For instance, the Research Bill contained a strong focus on internationalisation, improving careers for younger scholars, and open access among other issues. The Bill does not address details such as what instruments should be used to implement the priorities it outlines. However, joint programming and cross border cooperation initiatives are integrated into the instruments and calls outlined at the level of Research Funding Agencies such as VINNOVA and the Swedish Research Council.

¹¹ Figures taken from Statistics Sweden <http://www.scb.se/sv/Hitta-statistik/Statistik-efter-amne/Utbildning-och-forskning/Forskning/Forskning-och-utveckling-i-Sverige---oversikt-internationella-jamforelser-mm/8719/8726/FoU-i-Sverige-2014/392527/>

2.2 R&I policy initiatives

The fact that the bulk of the R&I policy initiatives are outlined in the National Innovation Strategy and the Research Bill and that the first is valid until 2020 while the latter runs to 2016 implies that the broad policy focus and direction has not changed significantly from that outlined in the ERWATCH Country Report 2013 and the RIO Country Report 2014. This is despite the fact that there has been a change in government over this period. According to the monitoring report by the Swedish Agency for Growth Policy Analysis, Sweden is still ranked highest among EU28 on the Innovation Union Scoreboard; however, the distance between Sweden and the other EU nations has reduced. Among the issues that were identified as problematic were the following

- Compared to similar countries, quality in publicly financed research had reduced as measured in share of highly cited publications;
- The number of patents in areas connected to societal challenges has decreased as compared to comparator nations within the EU. The tendency to patent as a whole has reduced in Sweden;
- The availability of early phase risk capital has reduced;
- The intensity of research in SMEs has diminished;
- Export levels of high-tech and medium-tech industrial goods are developing slower than comparator countries, particularly Germany.

In summary the Swedish Agency for Growth Policy Analysis maintains that Sweden's most important R&I challenge is to create a better match between the institutional structure for promoting innovation and the changes which have occurred in the character of Swedish industry (Tillväxtanalys, 2015b). This message was also echoed in the Swedish Research Council's Report on the future of Swedish research (Swedish Research Council, 2015) where the Council among other things pointed to the fact that bibliometric measures showed that Sweden was being outpaced by comparator countries such as Denmark, the Netherlands and Switzerland.

Additionally, the focus since the last General Election has been on unemployment, school performance, household indebtedness connected to the real estate market and the low rate of inflation. There has been less attention to R&I issues although a new Innovation Council has been introduced and it has been charged with coming up with suggestions to improve the efficiency of public venture capital. The new Research and Energy Bills are currently under preparation.

In summary, the Swedish R&I context is reasonably well governed, there is a high degree of predictability of government action as the priorities and indicative budgets are laid out well in advance. Priority setting follows a combination of bottom up, top down coordinated processes in which stakeholders groups are consulted. There is an iterative process of monitoring, evaluation and adjustment that continues in between the macro priority setting exercises such as the Research Bill and the Innovation Strategy. The policy initiatives currently in place are not perfect but major shifts in the nature and content of the current set of policies would require radical change at the level of policy culture. Additionally, the number of intervening variables between R&I policies and the contexts that they seek to affect, make it difficult to state with any certainty that a given policy fosters innovation or strengthens the knowledge base and fundamental research.

Evaluations, consultations, foresight exercises

In addition to those evaluations described in the CR 2014, a number of new studies have been completed in 2015. The most significant of these are the Swedish Research Council's Future of Research report; the evaluation of the strategic research areas, VINNOVA's report on the effect of various initiatives to fund knowledge transfer from universities (Åstrom, Melin et al. 2015) ; the evaluation of the effects of the quality and autonomy reforms in the tertiary education sector (Sørensen, Haase, et. al. 2015; VINNOVA's Future Smart Industry report, the so called Långtidsutredning (Government

of Sweden, 2015:104) and the report on the organisation of state support for SMEs (see chapter 5 for details) (Government of Sweden, 2015:64). In order to deal with these in a manner that would prohibit repetition, the results of the studies will be summarised in the chapters relevant to the issue treated in the study. This chapter will focus on summarising the Future of Research Report Future Smart Industry and the Långtidsutredning. The Långtidsutredning is a forecast of the conditions for the Swedish economy that is prepared every four years by the Ministry of Finance. The report is a mix of an analysis of dominant global trends of significance to Sweden and an estimation of what measures will be likely to meet these challenges. The only result of significance to this report that was reported in the Långtidsutredning is its much contested interpretation of the OECD's Programme for the International Assessment of Adult Competencies (PIAAC). The results according to this investigation show that there is no difference in terms of labour market participation of foreign born nationals vis a vis ethnic Swedes when one compares those persons with the same level of education. This was in the view of this investigation a clear sign that there was no labour market discrimination in Sweden. This reading of the results differs substantially from common opinion in Sweden and has been contested by other parts of the Swedish civil service such as the Swedish Higher Education Authority¹².

'The Future of Research' (Forsknings Framtid) is a series of reports produced as input to the the process of preparing for the next Research Bill. The Future of Research is prepared by the Swedish Research Council and contains the overviews and analyses on which the Council bases its recommendations on research policy choices to promote Swedish research in the coming five to ten years. Eight areas are covered in this series of reports: natural and engineering sciences; research infrastructure, development research; artistic research; medicine and health, education research and humanities and social sciences. In addition, The Future of Research also includes analyses and overviews of the following thematic areas: Equality at universities and the Swedish Research Council's Research Funding¹³; Career Structures and Paths in the University¹⁴; Swedish scientific production and publication patterns in International Perspective¹⁵; Researcher mobility in Sweden¹⁶ and Research Policy Reforms in Sweden 1990-2014¹⁷. The full account of the report's recommendations are contained in a separate document.¹⁸ Briefly, the report focuses its recommendations on three key themes: research infrastructure; funding and the research system.

Future Smart Industry summaries the results from a project which was set up to provide an overview of the Information Technology and Automation trends and industrial developments relevant for the commodity sector. The report focuses on technology and market drivers and their implications for Swedish industry. The reports points to the risk of job loss in Sweden as a result of increasing automation, the need for improved efficiency in resource use and to invest in the development of new business models.

2.3 European Semester 2014 and 2015

There were no R&I recommendations for Sweden in 2014 or 2015. In 2015, there was only one recommendation that focused on the problem of household indebtedness and the under supply of housing. The newly proposed budget contains some measures to address these two issues.

¹² <http://uka.se/nyheter/2016-04-27-yttrande-om-langtidsutredningen.html>

¹³ <https://publikationer.vr.se/produkt/en-jamstalld-process/>

¹⁴ <https://publikationer.vr.se/produkt/forsknings-framtid-karriarstruktur-och-karriarvagar-i-hogskolan/>

¹⁵ <https://publikationer.vr.se/produkt/forsknings-framtid-svensk-vetenskaplig-produktion-och-publiceringsmonster-i-ett-internationellt-perspektiv/>

¹⁶ <https://publikationer.vr.se/produkt/forsknings-framtid-svenska-forskare-mobilitet/>

¹⁷ <https://publikationer.vr.se/produkt/forsknings-framtid-reformer-inom-forskning-och-forskarutbildning-1990-2014/>

¹⁸ <https://publikationer.vr.se/produkt-kategori/forsknings-framtid/>

2.4 National and Regional R&I Strategies on Smart Specialisation

After the reorganisation of the regions described in Country Report 2013, it is now somewhat clearer how the regional innovation strategies and smart specialisation initiatives will take form. The focus on smart specialisation will be deepened considerably in the near future. One concrete manifestation of this is the Strategic Innovation Areas programme, which is a joint effort between VINNOVA, the Swedish Energy Agency and the Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS). The programme invites private and public sector actors to develop a common agenda on tackling innovation in a specific area.

Additionally the national innovation systems agency VINNOVA has been promoting growth and innovation at the regional level since 2005 primarily but not exclusively through a funding programme called VINNVÄXT¹⁹. VINNVÄXT, which was initiated in 2002, is now considered to be an instance of smart specialisation. From its inception, VINNVÄXT was directed at regions. Projects are funded for up to ten years and funding can be as high as €1m per year. The eligibility requirements include: active collaboration among business, public sector and research performing organisations; a focus effort on an area in which the applicant region has a strong comparative advantage; and demonstrate how the programme will contribute to sustainable development and renewal. The latest call was in 2013 and three projects were funded: Smart Housing Småland; Paper Province, Karlstad and Geo-Life Region, VPX²⁰. Each project has a budget of about €4m, half of which comes from the region and the other half from VINNOVA. VINNVÄXT regions are also required to participate to a number of supporting activities such as seminars, training, sharing of experiences and best practices, etc. There is a new VINNVÄXT call currently open.

This call is divided into two phases, the first of which closed in June 2015, the second phase closed in December 2015 and the winners are to be appointed in the beginning of 2016. The total budget is approximately €20m and the projects that receive funding can get up to €200,000-400,000 per year for ten years. Some research and innovation components are included in the VINNVÄXT projects and the current call, like its predecessors, is directed at coalitions which include private firms and universities or regional university colleges.

Several regional actors in Sweden are participating in an INTERREG which focuses on transnational regions. In total Sweden is participating in 13 of these projects²¹. These projects are in part financed with EU structural funds and the total EU contribution is €985,483m. This funding will have to be matched by the different actors in the participating regions. Currently, the focus is on allowing the regions themselves to develop their projects based on their different profiles and possibilities. The Swedish Agency for Regional and Economic Growth provides support and is coordinator for the EU structural fund support²².

The Swedish Agency for Regional and Economic Growth (Tillväxtverket) has been charged with the responsibility to provide support to other actors involved in regional development to elaborate on how they will work with smart specialisation strategies and to disseminate knowledge and best practice from this work²³.

19 <http://www.vinnova.se/sv/Recycle-Bin/Insatsomraden/Starka-forsknings--och-innovationsmiljoer/VINNVAXT>
20 <http://www.vinnova.se/sv/Aktuellt--publicerat/Pressmeddelanden/2013/130626-Tre-nya-satsningar-far-VINNVAXT-finansiering/>

21 <http://eu.tillvaxtverket.se/programmen/interregterritoriellasamarbetsprogram.4.703a861f1468c02714177fe7.html>

22 <http://www.tillvaxtverket.se/huvudmeny/insatserfortillvaxt/regionalutveckling/strukturfonderna.4.31c2dc0f149b90a6601dd34f.html>

23 <http://www.esv.se/statsliggaren/regleringsbrev/?RBID=17006>

To the extent that universities are included in Smart Specialisation Initiatives, research infrastructure may be said to be a part of Smart Specialisation but this is not an explicit strategy. Research infrastructure is largely integrated into the university and research institute system, there is no separate research infrastructure system in Sweden.

2.5 Main policy changes in the last five years

Main Changes in 2011

Introduction of autonomy reform for universities and university colleges

Pilot project on support for the development of science parks (VINNOVA, responsible funder)

Decision to initiate a programme for innovation in the construction industry

Main changes in 2012

Publication of new Research Bill outlining priorities until 2016 and the National Innovation Strategy outlining priorities until 2020

Introduction of a fast track recruitment procedure for recruitment of professors from outside of Sweden

Introduction of call for identification of strategic innovation areas

Main changes in 2013

Decision to introduce funding initiatives to strengthen research in the humanities and social sciences

Decision to increase the share of institutional funding that is performance based

Main Changes in 2014

Introduction of a new model for prioritisation and funding of research infrastructure

Finalisation of funding for ESS

Completion of proposed models for research funding and impact

Main Changes in 2015

Initiation of preparation of national energy and research bills

Evaluation of the strategic research initiative

Evaluation of autonomy and quality reforms in the tertiary sector

3. Public and private funding of R&I and expenditure

3.1 Introduction

According to Statistics Sweden, the total R&D expenditure for 2014 was €13.4b, (2014 prices) which represents a net decrease in expenditure since 2013, this decrease is mainly attributed to a reduction in BERD. Statistics Sweden reported that total expenditure on R&D for 2013 was 3.3% of GDP, the highest recorded since 2003. This puts Sweden among the top five in the OECD and second after Finland among the EU28. Corporate expenditure on R&D still accounts for the majority of this investment (69%, 2013), while public expenditure accounts for 31% of the R&D funding from Sweden. 7% of R&D funding came from non-Swedish sources and this is a drop of about 4% in relation to 2011. This is probably the most significant shift in the pattern of R&D spending and is possibly explained by the financial crisis. Public expenditure on R&D is determined by the guidelines outlined in the Research Bill 2012 and the budgetary allocations made on the basis of these suggestions. This implies that for the period covered in table 4 below there are two Research Bills which are relevant. The R&D budget allocations for 2011 and 2012 would have been guided by the suggestions outlined in the 2008 Research Bill. Expenditure up to and including 2016 is governed by the 2012 Bill.

Table 4: Basic indicators for R&D investments

Indicator	2011	2012	2013	2014	2015*	EU average (2014)
GERD (as % of GDP)	3.25	3.28 ^(e)	3.3	3.16	NA	2.03
GERD (Euro per capita)	1,397.4	1,464.9 ^(e)	1,507.6	1,411.3	NA	558.4
GBAORD (€m)	3,208.82	3,581.65	3,639.72	3,612.79	3,606.01	92,828.15 (Total EU-28)
GERD funded by BES (% of GDP)	1.87	NA	2.01	NA	NA	1.12 (2013)
GERD funded by PNP (% of GDP)	0.1	NA	0.1	NA	NA	0.03 (2013)
GERD funded from abroad	0.36	NA	0.22	NA	NA	0.02 (2013)
GERD performed by HEIs (% of GDP)	0.85	0.89	0.90	0.92	NA	0.47
GERD performed by government sector (% of GDP)	0.14	0.16	0.12	0.12	NA	0.25
GERD performed by business sector (% of GDP)	2.24	2.22	2.28	2.12	NA	1.3

3.2 Smart fiscal consolidation

3.2.1 Economic growth, fiscal context²⁴ and public R&D

Sweden has a highly competitive and successful economy²⁵. The 2008-09 economic crisis had a relatively low impact on the Swedish economic growth (-5.8% of GDP growth in 2009), that has completely recovered the year after (through 6% GDP growth in 2010). Presently real GDP is growing at a healthy pace (2014: 2.3%, 2015: 3.6%) thanks to household and government consumption as well as strong investment growth supported

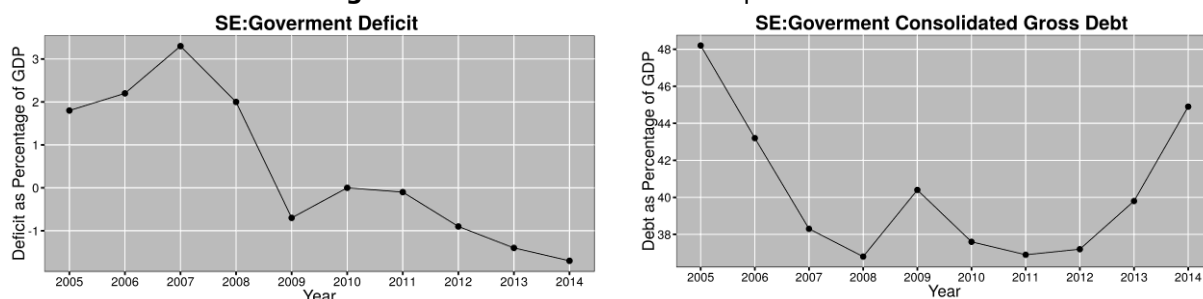
²⁴Sources: DG ECFIN, http://ec.europa.eu/europe2020/pdf/csr2016/cr2016_sweden_en.pdf

²⁵ The World Economic Forum ranks Sweden the sixth most competitive country in the world: http://www3.weforum.org/docs/GCR2013-14/GCR_Rankings_2013-14.pdf

by expansionary monetary policy, low interest rates, growing disposable incomes and employment growth. Although economic growth remains rather robust in the coming years, a slight slowdown is expected (2016: 3.2%, 2017: 2.9%) due to some structural inefficiencies on the housing market that may impact negatively investment growth and labour market mobility (through an increase in housing prices).

With a stable banking system, moderate levels of inflation, healthy public finances characterized by budgetary surpluses since 2004 and a low level of public debt the Swedish public finances proved to be very resilient during the 2008-09 crisis (Figure 1). Using its available fiscal space, the country has pursued an expansionary fiscal policy up to the present and the budget deficit increased to 1.7% in 2014. The deficit is expected to shrink and to stay at around 1-1.2% throughout 2015-17 due to a strong rise in tax revenues supported by private consumption and tax increases. Public debt stands at a relatively low level of around 44-45% of GDP in 2014-15. Thanks to the expected decreases of the government budget deficit along positive GDP growth, it is set to gradually decline by ca. 1-1.5% in the next two years (2016: 43.1%, 2017: 42.3%). Medium term sustainability risks appear due to the impact of age related public spending (health and long term care). Pension expenditure may have some mitigating effect thanks to the pension reforms implemented in the past.

Figure 1: Government deficit and public debt



Data source: Eurostat

Total GERD in Sweden was €14,406m in 2013. There are three main sources of R&D funding: the business sector (€8,782m), the government (€4,073m), and foreign funding (€967m). Direct funding from the government goes to business enterprises (€609m), the public sector (€469m) and the higher education sector (€2,982m).

Table 5: Key Swedish Public R&D Indicators

	2007	2009	2013
GBAORD, % of gov. exp.	1.47	1.57	1.59
GERD, % of GDP	3.26	3.45	3.30
out of which GERD to public, % of GDP	0.87	1.00	1.02
Funding from GOV to, % of GDP			
Business	0.11	0.14	0.14
Public (GOV+HES)	0.69	0.79	0.79
Total	0.80	0.93	0.93
EU funding, % of GDP	0.05	0.05	0.06

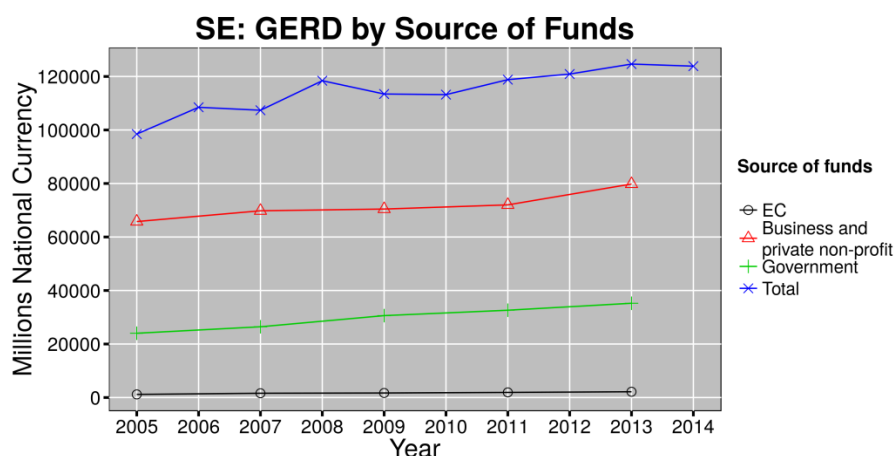
Source: Eurostat

3.2.2 Direct funding of R&D activities²⁶

Sweden has one of the highest annual R&D investments in percentage of GDP in the world. In 2014, gross domestic expenditure on research and development (GERD) was the second highest in the EU (after Finland) summing up to 3.16% of GDP, compared to an estimated average of 2.03 % for EU-28. However, GERD as a share of GDP has been dropping about half a percentage point since 2003 (3.61%), mainly due to a relative decline in business expenditure on R&D (BERD) which fell from 2.69% of GDP in 2003 to 2.12% in 2014. In addition, methodological changes in the statistics in 2005 and the evolution of the GDP may explain part of this decline.

Figure 2, below shows the historical evolution of GERD financing in current prices in Sweden. It illustrates that the total Swedish R&D expenditure, decreased in absolute terms, during the crisis in 2009 but recovered and reached pre-crisis levels in 2011. In 2013, the level of R&D spending increased. The share of business funding of Sweden's research volume in 2007 was 63% before it fell to 60% in 2009 and 58% in 2011 while the government funded ratio over the same three years was 25%, 27% and 27% respectively. In other words, it was the decrease in funding from industry that caused the overall decrease in GERD during the crisis years.

Figure 2: Funding of the total GERD



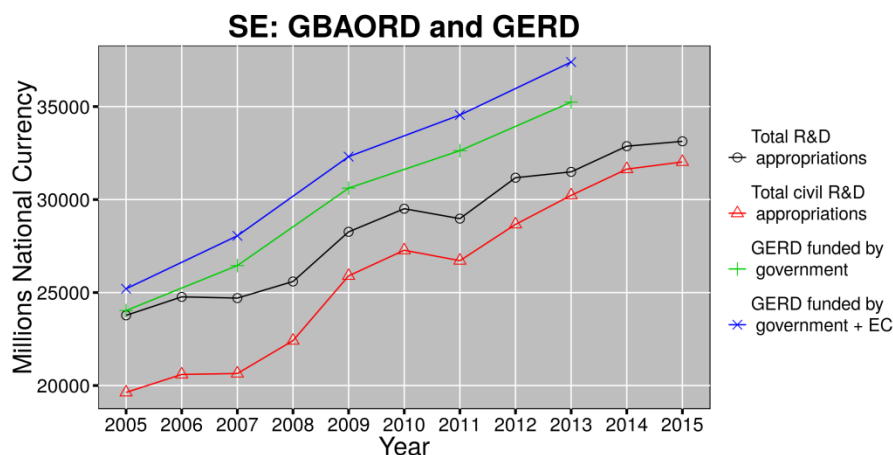
Data source: Eurostat

In 2011, financing from the private sector which is the main source of funds for the Swedish R&D activities showed an increase which continued up to 2013 (in absolute numbers, last data available). Over the same period, public funding kept increasing at a low rate too, even during the crisis. However, GERD decreased slightly in absolute and relative terms in 2014 mainly as a result of reduction in BERD. The increase in public expenditure on R&I was in line with the proposals in the 2012 Research Bill, this has not been framed as an effort at smart fiscal consolidation.

²⁶ The sources of R&D funding according to the Frascati manual are: Government sector (GOV), Higher education sector (HES), Private non-profit sector (PNP) and Abroad (including EC). In this analysis the public sector as source of funds is given by the Government sector (GOV), whereas the public sector as a sector of performance is the aggregation of GOV and Higher education sector (HES). Please note that Statistics Sweden introduced important methodological changes in 2005. Thus, data from before and after 2005 are not directly comparable which is why the qualitative analysis starts with 2005.

3.2.2.1 Direct public funding from the government

Figure 3: R&D appropriations and government funded GERD in millions of national currency



Data source: Eurostat

Figure 3 shows that total R&D appropriations and total civil R&D appropriations have been largely following the same trend since 2005 when expressed in millions of national currency. It can also be observed that expenditures lie above appropriations but why this is the case is not totally clear.

The gap between total R&D appropriations and total civil R&D appropriations has been narrowing over time, especially after 2012 due to cuts in the defence budget for R&D activities. In 2005 defence related R&D represented 17.4% of the total GBAORD whereas in 2015 only 3.3%. In absolute terms the amount dedicated to defence related R&D activities was reduced from €446.3m to 120.6m (again between 2005 and 2015). The financial crisis did not spare Sweden but left public research budgets largely unaffected. 2011 was the only year with a moderate contraction of GBAORD (both in absolute and relative terms) followed by a distinct increase in allocations again in 2012.

GERD funded by the government has registered positive growth rates since 2005, including 2011.

3.2.2.2 Direct public funding from abroad

Table 6: Public Funding from Abroad to the Swedish R&D (in millions of national currency)

Source from abroad	2005	2007	2009	2011	2013
Total	7989.0	10289.0	11671.0	13067.0	8364.0
BES	5695.0	7895.0	8846.0	9947.0	
EC	1171.0	1600.0	1693.0	1917.0	2155.0
GOV	552.0	265.0	495.0	574.0	
International Organizations	154.0	155.0	179.0	97.0	141.0
Total as % GERD	8.1	9.6	10.3	11.0	6.7
EC as % GOVERD	4.9	6.1	5.5	5.9	6.1

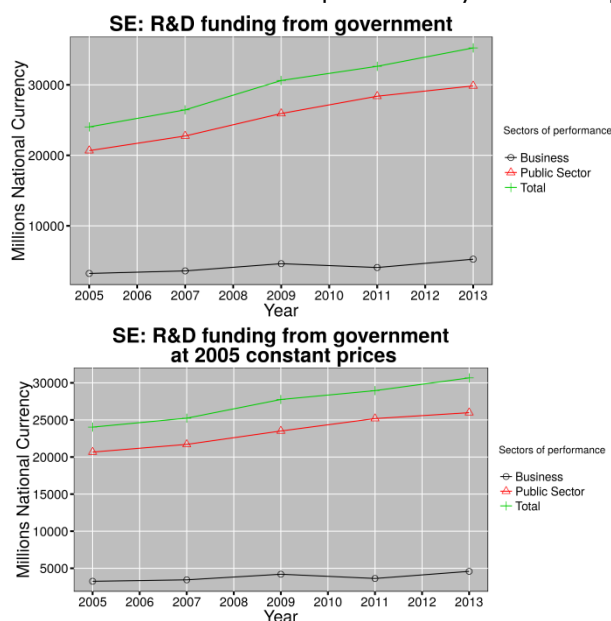
Funding from abroad increased significantly from 2005 to 2011 when it accounted for just above 11% of the total R&D investments. The figure for 2013 is significantly lower but since Sweden reports more detailed data every two years no conclusions can be drawn for 2013 yet. Most of the funding comes from the business sector but the contribution from the European Commission also increased over the years (in absolute values). In relative terms it has always been equivalent to 5%-6% of the GERD funded by the government (public direct support).

Based on data from DG REGIO, the Structural Funds (SF) allocated for Core RTDI rose from 6.2 % of total SF in the period 2000-2006 to 14.4 % in the period 2007-2013 i.e. an increase in the share of Core RTDI of total SF by 132%. Total Core RTDI in absolute terms increased by 74%.

Distribution of public funding

Figure 4, below shows how the distribution of public funding to sectors of performance evolved over time:

Figure 4: Government intramural expenditure by sectors of performance



Data source: Eurostat

As expected, the public sector is by far the main recipient of government funded GERD. A particularity of the Swedish system is the dominance of the Higher Education Sector; Swedish HERD stood at 0.92% of GDP in 2012, the second highest value among OECD countries (OECD, 2014). The universities consume over 90% of total governmental appropriations for R&D. As can be seen from Figure 4, public R&D funding has monotonically been increasing since 2005, although not always at the same rate. Most of the additional funds were used in the public sector but starting in 2011 direct public support to business R&D increases.

3.2.3 Indirect funding – tax incentives and foregone tax revenues

Until very recently, Sweden's R&I funding system did not include any form of tax credits, similar to countries like Germany and Finland and the use of fiscal instruments such as tax deductions to promote increased R&D expenditure in the business sector is still very rare in Sweden today.

It was only in January 2014 that Sweden introduced a scheme for reduction of social security contributions for commercial R&D activity²⁷. The scheme had passed parliament in November 2013. Certain conditions have to apply. Only limited companies in the private sector are eligible. According to DG TAXUD's Study on R&D Tax Incentives (European Commission, 2014c), the foregone social security revenues are estimated at ca. €58m (540m SEK) per year or about €45m net (SEK 420 million) as the deduction expands the company's income tax base and leads to higher tax revenue taxation. The

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<https://www.skatteverket.se/foretagorganisationer/arbetsgivare/socialavgifter/forskningsavdrag.4.8dcbbe4142d38302d7cb4.html>

The measure is laid down in the Social Security Contributions Law, chapter 2, paragraphs 29 and 31.

same study comes to the conclusion that the Swedish scheme is quite unique and different from measures implemented in other EU member states. It has to be noted that this scheme is very limited in scope and should be regarded as a pilot initiative intended to see what effects, if any, this type of fiscal instrument will have.

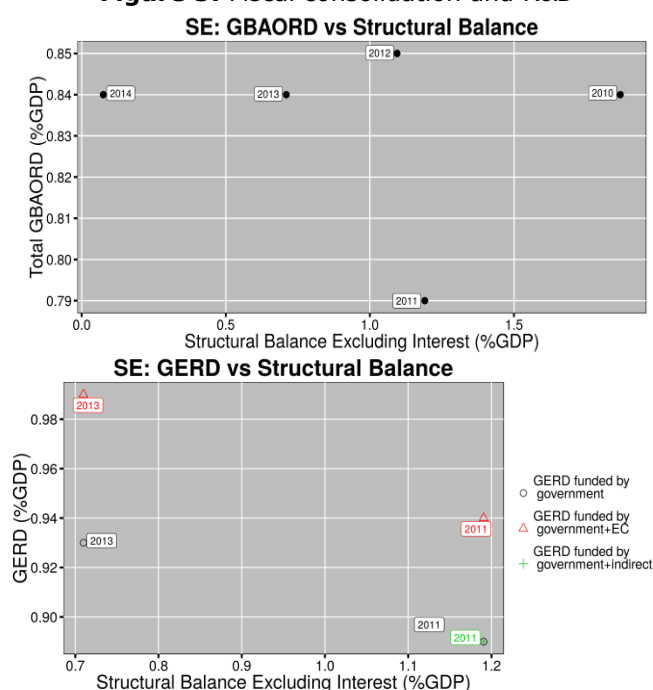
It has also been suggested that a governmental evaluation should be put in place to assess the prospects of extending the so called expert tax²⁸ ("expertskaft") to broader layers of the R&D sectors (Hallonsten, 2014). Under the expert tax measure 25% of the salary is exempt from income tax for temporary foreign employees in knowledge-intensive sectors who have been granted expatriate taxation classification. The measure has been effective since 2011.

Based on OECD the total government support to business R&D in 2011 in Sweden, is 0.11 % of GDP.

3.2.4 Fiscal consolidation and R&D

Figure 5 below displays the scatterplot of the structural balance and GBAORD as % GDP, first panel, as well as GERD as % GDP, second panel²⁹. Based on the available evidence the conclusion can be drawn that in Sweden there was no need for post-crisis fiscal consolidation, and hence one cannot speak of smart fiscal consolidation in the Swedish case. Figure 5 shows that R&D appropriations (GBAORD) remain more or less stable (with one exception in 2011) regardless of the fluctuations of the always positive structural balance. Both R&D appropriations (GBAORD) and government funded GERD grew steadily throughout 2005-2013/15, the former with a small decrease in 2011, which was more than fully recovered the next year. The decreases in GBAORD in 2011 (-0.05%) and 2013 (-0.02%) as a share of GDP, were not the results of budgetary consolidation steps³⁰.

Figure 5: Fiscal consolidation and R&D



Data source: AMECO, Eurostat

²⁸ The measure is laid down in the Swedish Income Tax Act, chapter 11, paragraph 22-23 a.

²⁹ Structural balance data comes from the AMECO database the other indicators were taken from Eurostat.

³⁰ In 2011 it is due to a mild drop of the GBAORD, in 2013 due to the 2012 drop of the GDP, creating a higher base for the calculation.

3.3 Funding flows

3.3.1 Research funders

Tables 7 and 8 provide a list of the main public bodies responsible for allocating research funds (project funding). In addition to the research funding agencies most public agencies also possess R&D budgets which they use to support own research or to commission research. Among these the Energy Agency and the Swedish Transport Administration have significant R&D budgets. All project funding is allocated in competition and open calls. Swedish universities and university colleges receive a separate budget for education and this is allocated on the basis of the numbers of students that they have produced for that particular year. Funding for education is disbursed by the Ministry of Education and Research and may not be used to finance research. 45% of the funding that Swedish HEIs receive is institutional funding for research. Although there is currently an ongoing debate about the mechanisms for allocating institutional funding and the balance between project and institutional funding, there is a fairly complex set of mechanisms in place for deciding on institutional funding to HEIs. Briefly about 20% of the total institutional funding for research is allocated on the basis of the HEI's performance in attracting project funding and in publications. There are some compensatory measures introduced in this calculation to avoid penalizing the humanities and the social sciences where project funding and publication traditions differ. Moreover, additional funding for research is allocated to each HEI to ensure that teaching is research based and this is calculated on the basis of number of full time students. Research institutes and businesses receive mainly project funding (Swedish Higher Education Authority, 2015). More than 50% of state research funding to HEI's is allocated via project funding. According to the Swedish Higher Education Authority, the total amount of funding for research and research education that came from external funding, i.e. allocated in competitive funding was 21,000m in local currency, this amounts to 55% of the total resources available to the universities and university colleges for research in 2014 (Swedish Higher Education Authority, 2015a: 122).

There is a plethora of private non for profit research foundations, the majority of which are rather small. According to the annual report on higher education in Sweden, the Wallenberg Foundation is the most significant private non profit funder (Swedish Higher Education Authority, 2015a). Since 2012, the Wallenberg Foundation's funding to Swedish universities has risen from €57m to €103,6m, over the period 2013-2014 there was an increase of 33% at 2014 exchange rate. The total amount of research funding to HEIS by private non profits for 2014 was €437m. The figures for 2013 were €399m and for 2012, €372,4m (Swedish Higher Education Authority, 2015a: pp.123). This is an increase of 9% over the period 2013-2014 and represents 10% of the total research budget for Swedish HEIs (Swedish Higher Education Authority, 2015a).

3.3.2 Funding sources and funding flows

The disaggregated data available on EU funding to research at HEIs for 2014 shows a total intake of €200m; of this €133m is framework programme funding excluding the ERC. According to the Swedish Higher Education Authority framework programme funding accounted for 7% of the research budget for HEIs in Sweden and EU funding taken as a whole represents 10% of the total funding for 2014.³¹ Other foreign sources were cited as the source of €93.8m in research funding to HEIs for 2014.

Table 7: Swedish HEIs income for research and doctoral education 2012-2014 according to financial year in 2014 Euro exchange rate³²

Funder	2012 €m	2013 €m	2014 €m	Change 2013- 2014 €m
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³¹ All figures here taken from the Swedish Higher Education Authority Annual Report 2015

³² Table adapted from Swedish Higher Education Authority (2015) Universities and University Colleges: Annual Report, Swedish Higher Education Authority, Stockholm, Sweden., pp. 120

Government	2,825	2,865	2,988	122.5
Institutional funding	1,804	1,799	1,874	75
Research Councils	565.3	605	641	36
VINNOVA and Swedish Energy Agency	149	162	170.5	8.5
Other governmental sources incl. universities and university colleges	306.7	299	302	3
Municipalities and Regions	162.5	149	156	6.7
Public Research Foundations	115	120	113.7	-6
Corporate	155.6	150	151	1.2
Private non profit	372.4	399	437	37.6
EU	169.5	181.8	199.6	17.8
Other foreign sources	96.5	92.3	93.8	1.5
Miscellaneous	52.6	42.8	41.4	-1.43
TOTAL	3,949	4,000	4,180	180

Table 7 above provides an overview of the sources of research and research education funding to Swedish HEIs over the period 2012-2014. There is no special regional budget as the only funding data reported at a regional level is that going to medical research. This is the funding source which is described in table 7 as municipalities and regions. Transnational funding that is not EU accounts for a smaller share (2%) of the HEI research budget. The research funding to HEIs over the period 2012-2014 has been steadily increasing as a whole and 2013-2014 saw an increase by €180m. This is no doubt due to the efforts in the wake of the Research Bill 2012. Corporate funding to HEI research increased only slightly. The biggest shifts were the reduction in the share of funding coming from public non profits which was -6% over the 2013-2014 period. This may be a result of the financial crisis as this funding is subject to market fluctuations because the foundations use interest from investments. The private non profit share of research funding was the other area of change and there was a marked increase in funding over the 2012-2014 period. Generally, Sweden does not receive large levels of structural funding, the highest level of funding from this source is concentrated to support for SMEs and issues related to SME support such as technology transfer, voucher schemes and similar type measures aimed at SMEs. In these areas, the support level is less than 20% which higher than comparator countries such as Finland and the Netherlands but slightly lower than EU28 when taken as a whole.

Table 8: Structural Funds RDI allocation 2014-2020

Categories of Intervention	%R&D&I
002. Research and innovation processes in large enterprises	0.0
056. Investment in infrastructure, capacities and equipment in SMEs directly linked to research and innovation activities	5.3
057. Investment in infrastructure, capacities and equipment in large	1.1

companies directly linked to research and innovation activities	
058. Research and innovation infrastructure (public)	16.3
059. Research and innovation infrastructure (private, including science parks)	1.9
060. Research and innovation activities in public research centres and centres of competence including networking	7.8
061 Research and innovation activities in private research centres including networking	1.2
062. Technology transfer and university-enterprise cooperation primarily benefiting SMEs	14.4
063. Cluster support and business networks primarily benefiting SMEs	19.9
064. Research and innovation processes in SMEs (including voucher schemes, process, design, service and social innovation)	8.1
065. Research and innovation infrastructure, processes, technology transfer and cooperation in enterprises focusing on the low carbon economy and on resilience to climate change	23.9

The Nordic countries in general and Sweden in particular are not large attractors of FDI, neither is there much specific policy attention given to this issue except perhaps for Denmark. Traditionally, Swedish companies have been the major investors of R&D in Sweden. This is still the dominant trend.

3.4 Public funding for public R&I

3.4.1 Project vs. institutional allocation of public funding

There have been no significant recent changes in the legislative framework for research funding³³. The budget stalemate taken together with the fact that a new Research Bill is currently under preparation suggest that changes on this front are unlikely for this reporting period. The share of institutional funding to Swedish universities was 45% for 2014. This figure can vary greatly across universities and university colleges. In 2012 the balance between institutional and project funding was 47% institutional funding and 53% project funding as compared to 45% and 55% respectively in 2014³⁴. When taken on average there is little change for the system as a whole but seen from the individual HEI perspective, the situation can be quite different. The majority of the research resources both in terms of institutional and project based funding is concentrated to a few HEIs. These are in order of share of the total budget: Karolinska Institute, Lund, Uppsala, Göteborgs University. Given that Karolinska is focused on biomedicine exclusively and given that the other top earners are also organisations with significant biomedical research effort, one could contend that biomedical research is clearly the revealed priority of the Swedish research funding system.

³³ See RIO Country Report Sweden 2014 for more information on current framework

³⁴ Figures taken from the Swedish Higher Education Authority Annual Report 2015

3.4.2 Institutional funding³⁵

Since the 1990s Sweden has had a research funding system in which the larger share of funding to public research institutions and particularly universities is allocated through competitive means (comprising project funding and organisational level funding linked to organisational assessment). A new system for the allocation and redistribution of the appropriations for research and postgraduate education to the university sector was introduced in Sweden in 2009 (Jacob, 2015 as cited in Jonkers & Zacharewicz, 2016).

The proportion of public funding that was annually redistributed along the new model was initially 10%, and increased to 20% from 2014 onwards. The aim of the model is to reward quality in research and give higher education institution managements the incentives to take measures to increase quality and relevance of the research undertaken at their institutions. This is done by allocating parts of the research appropriations on the basis of quality, based on two indicators: publications/citations, and external funding of research (Jacob, 2015). The assessment of research output is based on a field normalised bibliometric assessment (Kalpazidou Schmidt, 2010; Hicks, 2012 as cited in Jonkers & Zacharewicz, 2016).

This system also gives incentive to the universities to cooperate with the private sector since the more external R&D funds they receive from i.e. Swedish firms, the more they receive from the state through the redistribution of appropriations. The impacts are visible: as a result of the introduction of the new system, external funding from foreign firms to Swedish universities, which has been more or less constant up to 2008, starts to grow steadily. Other indicators considered include e.g. gender balance among academic staff (Jacob, 2015 as cited in Jonkers & Zacharewicz, 2016).

In 2013 the Swedish Research Council was given the task to propose a new performance based model on research funding that should include peer review instead of only indicators. As a preparation a report was produced (Quist et al. 2013) which presented an overview of some existing national evaluation systems (UK, all the Nordic countries except for Iceland, New Zealand, Belgium (Flanders), Netherlands). In December 2014 the Swedish Research Council delivered the full proposal to the government named Research Quality Evaluation in Sweden (Forskningskvalitetsutvärdering I Sverige - FOKUS). VINNOVA has also been charged with developing a system for evaluating outreach and impact from universities. VINNOVA intends to present the final proposal in 2016. The Swedish Research Council and VINNOVA have discussed the need for closer coordination between the two proposals. No additional progress has been made on this front.

3.4.3 Project funding

Given the large share of research funding that is allocated through project funding, it is difficult to give priority to one programme. Project funding is not used as a priority setting mechanism as such since the priorities are set through the Research Bill. In between Research Bills, there is a system of annual monitoring and adjusting via the letters that government agencies are required to submit to their Ministries. Instead project funding's overriding function is to ensure that research funding reaches those who are active in research. It is also important to note that unlike other EU countries where there is a large research institute sector, Swedish universities perform a great deal of applied and commissioned research. The bulk of this work is contracted out in the form of project funding. Project funding is allocated on the basis of peer review and the review panels are usually a mix of international, national and Nordic peers. Success rates differ across calls and across organisations but on average the rate of success is between 8 and 12%. For calls such as the 'Council Professor' call, the success rate is

³⁵ This section is based on Jonkers & Zacharewicz (2016)

about 3%³⁶ while the international postdoctoral call has a success rate of 18.8% which is among the highest for the Swedish Research Council. Project funding is applied to all types of research. What differs is the modality rather than the funding instrument. Thus, basic science project funding would be implemented through open calls while other types of research would be subject to more structured calls. The modalities are however not mutually exclusive.

Two of the most comprehensive programmes illustrating these trends are the Strategic Research Areas and the Berzelii Centres. The first was intended to be a general capacity building and addressing societal challenges programme while the other was intended to promote innovation.

The Strategic Research Areas were selected on the basis of three criteria: (i) international quality; (ii) contribution to fulfilling major needs and solving important problems in society and (iii) relevance to the Swedish business sector. The 23 areas that were selected were evaluated by an international expert panel. The panel found that the investment in Strategic Research Areas have been an excellent and original initiative from the Swedish Government. According to them, one of the main strengths of the strategic research investment has been its long-term focus, which has enabled the research groups to engage in a higher degree of risk taking than that associated with project funding. It was however argued that the groups could be more focused on societal needs and undergraduate teaching. The latter shortcoming can be linked to the fact that Swedish universities are not allowed to use research funding in teaching. For this reason, the links between undergraduate teaching and research programmes of this type are not always obvious.

The Berzelii Centres were the second generation of VINNOVA's competence centres programme and were selected on among other things scientific excellence and large innovation potential. The emphasis was on research at the absolute international frontline and as such there was a much stronger element of this funding compensating for market failure than in the classic research policy argument. Additionally, these centres became integrated in the larger centre of excellence programme run by the Swedish Research Council, known as the Linnaeus centres³⁷. Four centres were funded in the first round and were evaluated in 2013. The results were mixed with one centre emerging as a clear leader on all indicators but all the centres performed well in scientific quality while innovation potential was quite mixed (Reese et al 2013). This may in part be due to the fact that the focus was on frontier research and firms may not be ready to invest at the point in time that the invention emerges. Although there has been little attention to this aspect, the results from both these funding modalities point to an inevitable tension between relevance and scientific excellence. It may be useful to dig deeper into this issue in order to improve the efficiency of the funding system.

Since the 2008 Research Bill, focus has intensified on younger researchers and enabling their career paths. This has led to a combination of modalities in that a portion of traditional project funding is earmarked for person bound grants. These are mainly aimed at younger researchers and the focus is on the postdoc and mid-career levels. Very little project funding is specifically earmarked for individual researchers at the senior level in the way that it has now become common to do so for junior researchers. Apart from the Council Professorship and the Grant for Recruiting Well merited Foreign Professors, there is only one other noteworthy project type modality aimed at individual senior researchers and this is the sabbatical programmes. There are two of these, one run by the basic science research council and the other by the Swedish Foundation for Social Science Research. It has become rather trendy to focus project support to

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<http://www.vr.se/forskningsfinansiering/bidragsbeslut/bidraginomradsprofessorprogrammet.4.7e727b6e141e9ed702b11007.html>

³⁷ For more information on the Linnaeus programme see RIO Country Report Sweden 2014 and ERAWATCH Country Report Sweden 2013

individual younger researchers and there are more calls in this category. There are of course several regular calls to which all researchers are eligible.

3.4.4 Other allocation mechanisms

There are no other noteworthy allocation mechanisms for public funding of publicly performed R&I.

3.5 Public funding for private R&I

3.5.1 Direct funding for private R&I

There are several programmes which provide some element of private R&I support but the majority of these are collaborative programmes which include some involvement of public sector and/or university actors. Technically, programmes which support research at research institutes may be classified as direct funding for private R&I because Swedish research institutes are not formally part of the public sector. Three programmes that involve funding for private R&I are: VINNVÄXT³⁸, Strategic Vehicle Research and Innovation (FFI) and the Institute Excellence Programme. Of these three, only two are still running. The VINNVÄXT programme is described in Chapter 2 as part of the section on smart specialisation. The Strategic Vehicle Research and Innovation (FFI) programme has been running since 2009 and has R&D activities worth approx. €100 million per year, of which half is government funding. The focus areas in FFI are: Energy & Environment; Vehicle and Traffic Safety; Electronics, Software & Communication; Sustainable Production Technology and Transport Efficiency. This programme is directly connected to the priority societal challenges. The Knowledge Foundation also has a number of programmes which fund collaborative R&I projects with new universities or university colleges and firms. Among these the Synergi programme is worth mentioning. This programme has a budget of €8m distributed over six projects, each project has several collaborating companies and in one instance some of the firms are Swedish multinationals³⁹. All of these programmes are peer reviewed, calls are well structured and require matching investments from the private sector. Additionally, collaborative programmes are always in some respect responsive to societal challenges. Sweden is notoriously short on early stage venture capital so this part of the R&DI process is not as well covered as the other stages. It is also not uncommon that a particular project may not cover all the phases of R&DI for a specific innovation. The largest category of direct public support for innovation would be the public venture capital programmes administered by actors such as FourierTransform Ltd., ALMI Invest and the Energy Agency. The Energy Agency's funding is co funding and loans.

Sweden has a plethora of programmes for financing innovation, both those targeting SMEs and others that are simply oriented towards promoting firm collaboration with research performers. The administrative burden of these programmes is often fairly low and in most cases the burden of administration falls on the academic partners rather than on the firm. Nevertheless, SMEs can in many cases feel hard pressed to meet the demands of collaborative programmes. One common reason is that requirements such as in kind contributions like staff time are equally onerous because SMEs are typically short on precisely this resource.

There are also a number of programmes specifically aimed at start ups such as the Business Development Unit at the Energy Agency and the infrastructure support for universities. Chapter 5 focuses on this issue in more detail. See also annex 2 for a list. One of the requirements of public sector funding in Sweden is that programmes are regularly evaluated. Evaluations are typically publicly available and in many cases are even translated into English.

³⁸ <http://www.vinnova.se/sv/Recycle-Bin/Insatsomraden/Starka-forsknings--och-innovationsmiljoer/VINNVAXT/>

³⁹ <http://kks.se/om/Nyhetsarkiv/160%20miljoner%20till%20forskning%20i%20samverkan%20med%20industrin.aspx>

3.5.2 Public Procurement of Innovative solutions

Public procurement in Sweden involves tens of thousands of contracting authorities and entities and the value of public procurement is estimated to be between SEK 450-535 billion (ca.€55bn) per year.

Legal Public Procurement Framework

Public procurement is governed by the Swedish Public Procurement Act (2007:1091 – Lagen om offentlig upphandling, LOU) which is largely based on the EU Directive 2004/18/EC concerning public procurement and which mainly covers government authorities, municipalities, county councils and certain public companies. Article 16(f) of Directive 2004/18/CE and Article 24(e) of Directive 2004/17/CE including exemptions for R&D services were also transposed into national law and the corresponding provisions can be found in chapter 4, section 7 of the Swedish Public Procurement Act (2007:1091 – LOU) and chapter 4, section 2 of the Utilities Procurement Act which covers certain entities operating in the utilities sectors (2007:1092 – Lagen om upphandling inom områdena vatten, energi, transporter och posttjänster, LUF).

Recent public procurement Directives 2014/24/EU (replacing Directive 2004/18/EC), 2014/25/EU (replacing 2004/17/EC) and 2014/23/EU have to be transposed into Swedish law by April 2016 and the Swedish government is currently working on their implementation.

The PCP/PPI⁴⁰ landscape

The Swedish innovation agency VINNOVA's report "Public Procurement as a Driver for Innovation and Change" (2007) can be considered the first Swedish strategic policy document on Pre-Commercial Procurement (PCP)⁴¹. The report found that the Swedish public sector had a longstanding experience in so-called technology procurement (teknikupphandling) gathering a critical mass of buyers committing to first deployment of near-to-the market innovative solutions. Since the 90s Sweden has successfully been applying this technology procurement approach in the energy/sustainability domain. One Swedish authority using technology procurement in step-by-step competitive phases based on R&D is the Swedish Energy Agency. The report also found that Sweden still faced the challenge to deploy the use of pre-commercial procurement for encouraging more mid-to-long term innovations that could help address public sector challenges.

As a response to that challenge, the Swedish government commissioned the innovation agency VINNOVA to support the build-up and interchange of expertise, methods and experiences in innovation procurement. Several PCP/PPI initiatives were launched (see next section). In October 2013, VINNOVA also published a handbook "Pre-commercial Procurement" with guidelines on how to carry out R&D procurement⁴².

The public sector's role as a driver for innovation is also being promoted through the "Swedish Innovation Strategy" (2012), albeit without defining concrete national targets for innovation procurement. According to the Innovation Strategy, innovation procurement is to be understood as:

"Procurement for development and implementation of new solutions, i.e. innovations. Innovation procurement includes both procurement made in such a way that it does not rule out new solutions, so-called innovation-friendly procurement and procurement of innovations, i.e. procurement of the development of new solutions not yet available on the market."

⁴⁰ PCP: Pre-Commercial Procurement; PPI: Public Procurement of Innovations

⁴¹ <http://www.vinnova.se/upload/EPIStorePDF/vp-07-03.pdf>

⁴² http://www.vinnova.se/upload/EPIStorePDF/vr_13_09.pdf

Since July 2014, the Swedish Competition Authority (KKV) has been providing methodology support and guidelines for innovation procurement, while VINNOVA continues to financially support Swedish procurers to undertake innovation procurements via its Innovation Capacity in the Public Sector programme⁴³. VINNOVA and the Swedish Competition Authority have a joint programme which is aimed at increasing familiarity with the new rules for procurement as well as finding ways to use public procurement more proactively in support of innovation. An important focus in this regard is the attempt to use procurement to promote SME driven innovation which is the area where most of the support of the Swedish Competition Authority is targeted.

The National Agency for Public Procurement is the public agency charged with developing and disseminating knowledge about methods and data for purchasing analysis and contract management. This agency provides information on procurement and sustainable procurement to the general public and to other public agencies. While the Swedish Competition Authority's information assumes companies particularly SMEs as the target audience, the National Agency for Public Procurement targets other public agencies. The Agency also works closely together with VINNOVA via a joint agreement and an action plan.

Moreover, procurement of innovation is among the priorities of the prime minister's Innovation Council that was established in early 2015 and that acts an advisory body to the government.

PCP/PPI initiatives

Under the "Innovation Capacity in the Public Sector" umbrella, VINNOVA launched its "Innovation Procurement" programme in 2011. VINNOVA acts as catalyst supporting public procurers during an innovation procurement process (e.g. technology procurement or pre-commercial procurement). First calls were launched in May 2011 and remained open until the end of 2013. Most of the projects financed through the calls relate to the transport, environment and health sector⁴⁴. Within the area of health services, a separate programme, "Innovation Centres and Test Areas within the Health Service", was set up in 2009. The idea behind the programme was to support the development of ideas into needs-driven innovations from the health service within county councils and municipalities. Calls for proposals under this programme were launched in 2009 and 2013. In mid-2013, an intermediate evaluation of the programme was presented⁴⁵. Other VINNOVA programmes within the strategic area "Innovation Capacity in the Public Sector" are FRÖN, a programme for increased innovation in public administration, and SKL-VINNOVA, cooperation agreements between Swedish municipalities and VINNOVA on welfare innovations⁴⁶.

Budget allocations to Swedish PCP calls and related VINNOVA support functions for innovation procurement summed up to ca. €1m in 2011, ca. €3m in 2012 and an additional €3.5m during 2012-2014 for work on a government mandate to VINNOVA, the Swedish Transport Administration and the Swedish Energy Agency on innovation procurement and initiating new PCP projects.

One concrete example of procurement of innovations includes the project "Green Ambulance Procurement" in Stockholm which created a benchmark for similar actions in the region. Another example is the Stockholm County Council's introduction of stringent new environmental requirements for purchasing computers which the County Council

⁴³ <http://cordis.europa.eu/fp7/ict/pcp/sweden-pcp-case-v2.pdf>

⁴⁴ <http://www.vinnova.se/sv/ansoka-och-rapportera/utlysningar/effekta/forkommersiell-upphandling/>

⁴⁵ <http://www.vinnova.se/sv/Aktuellt--publicerat/Publikationer/Produkter/Innovationslussar-inom-halso--och-sjukvarden/>

⁴⁶ <http://www.vinnova.se/sv/Var-verksamhet/Innovationsformaga-hos-specifika-malgrupper/Innovationskraft-i-offentlig-verksamhet1/>

expects to lessen the climate impact of its computers – including during their use phase – by 40%⁴⁷.

It can also be noted that the Stockholm County Council (Karolinska University Hospital) was among the five finalists for the 2015 EU Innovation Procurement Award for the project 'Medical imaging for optimization of care flows.' The award represents the most innovative and impressive public procurement activities carried out in Europe and aims to recognise successful public procurement procedures that have been used to purchase innovative, more effective and efficient products or services⁴⁸.

Transnational Cooperation

Nordic Innovation and the Nordic Council of Ministers ran a Nordic Lighthouse Project on innovation procurement in the health sector that kicked-off in 2012. The call "The Nordic region as frontrunner in innovation procurement in the health sector" focused on a model to support the design and procurement of innovative solutions in which outcome and values were central. Projects started in early 2013 and finished by the end of 2014. A final report was published in February 2015⁴⁹.

The IMAILE project is an example of an EU co-funded project (FP7) under Swedish lead. The Swedish city of Halmstad is coordinating this project where public procurers of ICT in Education from four countries use PCP to stimulate innovative user driven research in cooperation with European ICT industry, research and SMEs⁵⁰.

Other EU co-funded projects with Swedish participation are PROBIS⁵¹ which promotes bidding through innovative solutions aimed at increasing energy efficiency and sustainability of European public buildings, and GrowSmarter⁵² which explores innovative solutions geared towards increasing sustainability in the fields of energy, infrastructure, and transport.

3.5.3 Indirect financial support for private R&I

In 2014, Sweden introduced a R&D tax incentive of a similar type to that used in the Netherlands. The effect of this reform is still unclear. As already noted above, one should keep in mind that this scheme is very limited in scope and should mostly be regarded as a pilot initiative intended to see what effects, if any, this type of fiscal instrument can have. The great bulk of public support to R&I funding to business is channelled via collaboration with universities or research institutes.

Since 2012 Sweden has been consistently ranked among the top three in the EU28 with respect to GERD and innovation performance. Various reports and other details about the functioning of the sector suggest that a closer look at details would show a slightly different picture from that revealed in these figures. In this part of the report, our assessment will focus only on the R&I funding system. Since 2012, the resources to research have outstripped that to higher education and although higher education and research are correlated, regulations do not permit the use of research funding to subsidise teaching and vice versa. Apart from the budgetary restrictions, the Swedish figures may appear much higher than comparator EU28 countries because of the high personnel costs that are common in Sweden. According to Eriksson and Heyman (2014) in a report commissioned by the Association of Higher Education, since 1990 Sweden's investments in higher education have been less than that of other OECD countries.

⁴⁷ http://ec.europa.eu/environment/gpp/pdf/news_alert/Issue15_Case_Study34_Stockholm_ambulance.pdf
http://ec.europa.eu/environment/gpp/pdf/news_alert/Issue10_Case_Study25_Stockholm_IT.pdf

⁴⁸ <http://www.innovation-procurement.org/award/>

⁴⁹ <http://www.nhg.fi/vabpro/>

<http://nordicinnovation.org/Documents/Programmes/2015%2003%2009%20P%2012077%20VABPRO%20Final%20Report.pdf>

⁵⁰ <http://www.imaile.eu/>

⁵¹ <http://www.probisproject.eu/project/project-description/>

⁵² <http://www.grow-smarter.eu/home/>

The balance between project and institutional funding for 2014 was 55%/45% with many HEIs having 60% of research funding coming from project funding (Swedish Higher Education Authority, 2015). It should come as no surprise therefore that there is an ongoing debate about the balance between benefits and disbenefits to the science system of such a high level of dependence on project funding. A brief overview of the two most common opposing arguments will at once exemplify the problem and illustrate its complexity. On one side of the debate, universities are increasingly arguing that project funding is less efficient than it appears as the cost to the system of administering project funding are so high that they may in the long run undermine the science system (SUHF, 2015). Here, it is important to understand that there are no actual cost calculations, although in principle, these can be done. The government argument is that project funding compensates for persistent inefficiencies at the level of HEI management. These longstanding problems create a situation in which HEIs are unable to effectively channel research resources to those who are able to use them and both arguments are grounded in some measure of fact. The Swedish Research Council's report on the future of Swedish Research provides an overview of the resource allocation problem within HEIs when it pointed to the fact that the four most recent research bills have provided additional resources to the University system for research. These increases in funding for research have paradoxically led to fewer resources for research per researcher because the bulk of this money was used to hire new young researchers (Swedish Research Council, 2015: p. 10).

Unlike many other EU28 countries, Sweden's science system has for many years been outward oriented. By this we refer to the fact that international publications and project funding are not new to the system. What is new is the balance of project to institutional funding. There was no one rationale for this shift but two arguments dominated the list of rationale initially and are still the most significant. One is that mentioned earlier of re-allocating research resources and the other is that of steering the system to increase relevance and contribute to innovation⁵³. A third and more recent argument is that of excellence. For a variety of reasons, assessing the efficiency of the current approach is not simple but suffice it to say that the structure of the public R&D system with a small research institute sector implies that Sweden's universities do more applied and commissioned work than their EU28 counterparts. This suggests that the notions of relevance and needs-driven research may be better read as research policy doctrines rather than instruments intended to incentivise a particular type of behaviour as such. There is increasing evidence that it is the basic science effort that has been most negatively affected by the over reliance on project funding. This is evidenced by the decline in the number of highly cited publications and in the reduction in the amount of ERC funding that Swedish researchers are able to attract⁵⁴.

Business expenditure on R&D in Sweden has always been rather high in comparison to the EU28 average. Support for business R&D is currently done through measures other than fiscal supports such as tax incentives and increasingly this is being redirected to SMEs. It is difficult to assess to what extent public measures of the type currently employed in Sweden are effective in promoting business R&D expenditure. Large firms of the type that exist in Sweden are rather R&D intensive. Indirect measures have been aimed mainly at increasing collaboration with university and research institute actors rather than on increasing R&D expenditure per se.

⁵³ Last four research bills have consistently argued for using measures of relevance and excellence as steering mechanisms for research quality in Sweden.

⁵⁴ According to the Swedish Research Council, Sweden's share of grants from the ERC has been decreasing since the last FP when it went from 5,3% to 3,6% (2013) and in Horizon 2020, Sweden's share of ERC funding for 2015 is 2% and for MSCA it is 2,9%. <http://www.tidningencurie.se/22/nyheter/nyheter/2015-09-22-sveriges-andel-av-erc-medlen-minskar.html>

3.6 Business R&D

3.6.1 The development in business R&D intensity

As one can see from Figure 6, the intensity of the Swedish BERD is well above 2%, one of the highest in Europe. In 2013, BERD intensity stood at 2.28%, corresponding to 69% of total R&D investments in Sweden. One can also observe that BERD intensity has been on a slight downward trend for the past ten years which, after a phase of consolidation between 2010 – 2013, seems to be continuing in 2014. Preliminary figures estimate BERD intensity at 2.12% for 2014 and also point to a fall in BERD in nominal values. This downward trend is often ascribed to the relocation of some of the R&D units of big Swedish and foreign owned enterprises.

About 80% of Swedish business R&D is performed by a few large export-oriented, internationalised companies with more than 200 employees with most of it concentrated in firms with >1000 employees. In 2013, 89 firms with >1000 employees accounted for 63% of Swedish BERD. In the same year, 49% of BERD was spent by Swedish owned multinational companies, 39% by foreign owned companies and 12% by local Swedish companies. In addition, R&D investments in SMEs fell by 30% between 2005 and 2009 (European Commission, 2014a). Analysis by the Swedish Agency for Growth Policy Analysis shows the same trend for years 2007 – 2011.

The vast majority of corporate R&D is funded by the business sector itself, with a small contribution from the government which has been very stable and a contribution from abroad that used to be above 10% but reduced to 7% in 2013 (see Figure 7). In 2013, contributions from abroad were on about the same level as contributions from public sources in 2013.

Over the past two decades there have been substantial efforts focused on an incremental industrial restructuring to reduce economic dependence on a few large actors by supporting growth in high-tech firms and improving framework conditions for SMEs. With a view of increasing BERD, the previous government introduced a tax incentive scheme for business investment in R&D in 2014 which is however very limited in scope and serves mostly as a pilot initiative intended to see what effects, if any, this type of fiscal instrument will have. Swedish governments have so far preferred to avoid the introduction of a broader tax credit scheme.

In recent years the Swedish economy has been shifting toward smaller, more service-oriented and diversified firms, which employ a significant share of the creative labour force in Sweden. Exports of services have also been growing faster than export of manufactured goods. Although large firms dominate R&D in manufacturing industries, smaller firms make a larger contribution in the services sector.

The service sector accounted for 30% of Swedish BERD in 2013 (see Figure 6). The OECD's country report for Sweden 2012 and the Swedish Agency for Growth Policy Analysis evaluation of progress towards the 2012 Innovation Strategy converge on the finding that an increasing share of Sweden's manufacturing firms are moving into services. This is also supported by recent estimates for BERD. The estimated decrease in BERD for 2014 (see above) is due to spending decreases in the goods producing enterprises. At the same time R&D expenditures for the service producing enterprises were increasing⁵⁵.

⁵⁵ Statistics Sweden, Statistical news, accessed May 2016, http://www.scb.se/en/_/Finding-statistics/Statistics-by-subject-area/Education-and-research/Research/Research-and-development-in-Sweden---an-overview-international-comparisons-etc/Aktuell-Pong/8726/Behallare-for-Press/392528/

Figure 6: BERD intensity broken down by most important macro sectors (C= manufacture, G_N=services).

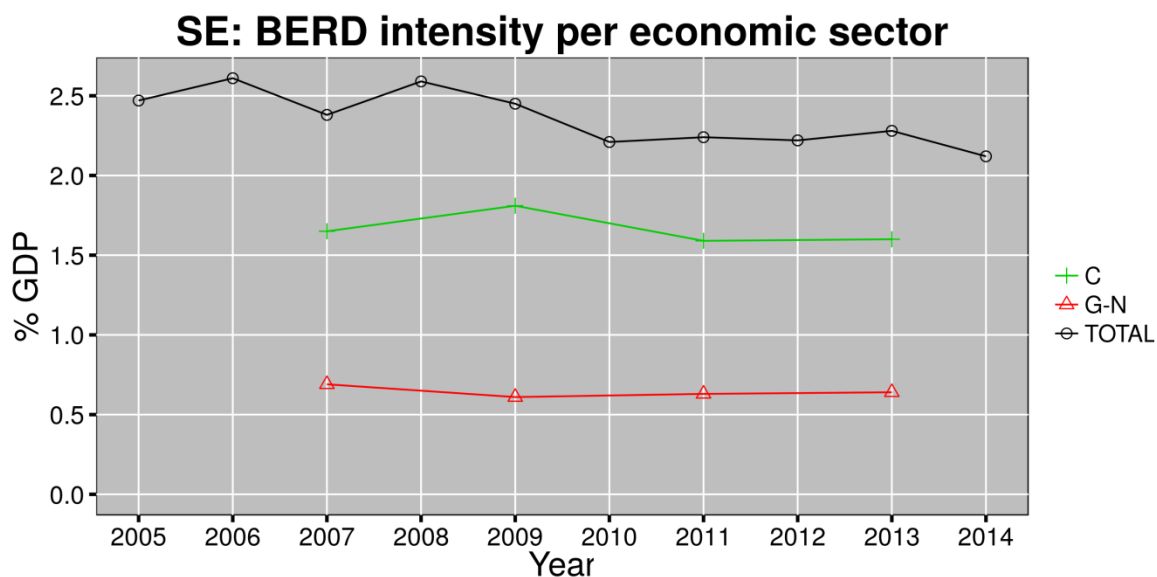
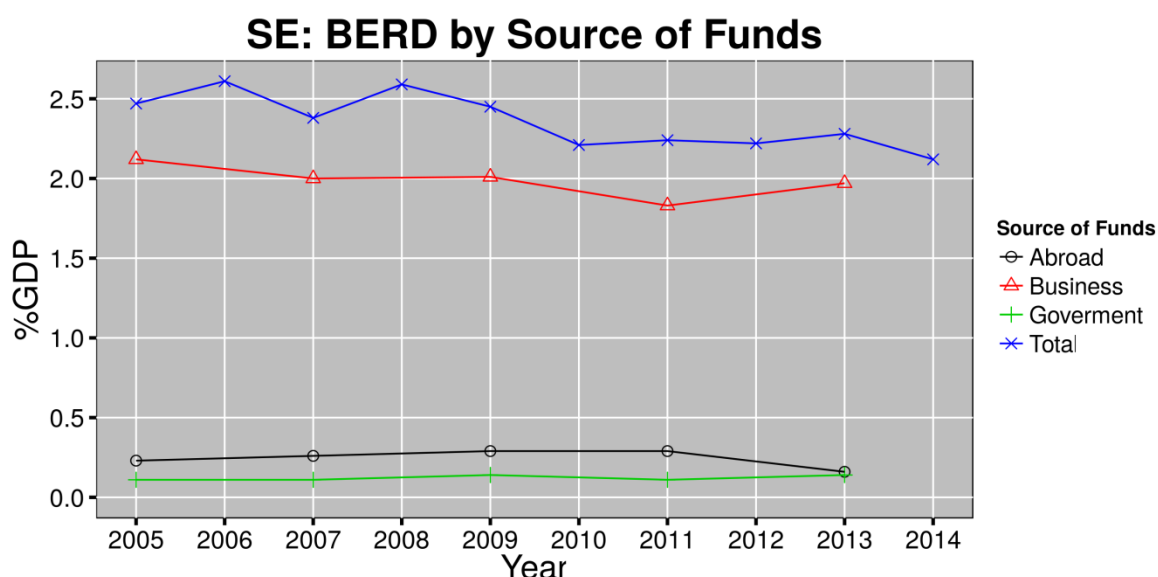


Figure 7: BERD by source of funds



3.6.2 The development in business R&D intensity by sector

The manufacturing of computers, electronic and optical products, the pharmaceutical industry and manufacturing of other machinery and equipment together accounted for 36% of Swedish business R&D expenditures in 2013. Out of these three, the manufacturing of computer, electronic and optical products is by far the most important sector (see Figure 8). Another important sector is the vehicle manufacturing industry which, when looking at expenditures for intramural R&D in relation to net sales, is actually more important than the manufacture of other machinery and equipment⁵⁶. While R&D in manufacturing of computers, electronic and optical products and the pharmaceutical industry reduced between 2011 and 2013, the dynamics in

⁵⁶ Statistics Sweden, 2015, Statistical news, accessed May 2016, <http://www.scb.se/en/Finding-statistics/Statistics-by-subject-area/Education-and-research/Research/Research-and-development-in-the-business-enterprise-sector/Aktuell-Pong/8753/Behallare-for-Press/391739/>

manufacturing of other machinery and equipment have been following a positive trend since 2007.

The number of person-years in R&D amounted to roughly 56,400 in 2013. Roughly two-thirds of the person-years of enterprises were conducted within the goods-producing enterprises, and roughly one third within the service-producing enterprises⁵⁷.

In terms of individual companies, Ericsson (9) and Volvo (19) are the top performers of R&D, both ranking among the top20 in the R&D Industrial Scoreboard for 2015.

Figure 8: top sectors in manufacturing (C26=manufacture of computer, electronic and optical products; C21=Manufacture of basic pharmaceutical products and pharmaceutical preparations; C28=Manufacture of machinery and equipment n.e.c.).

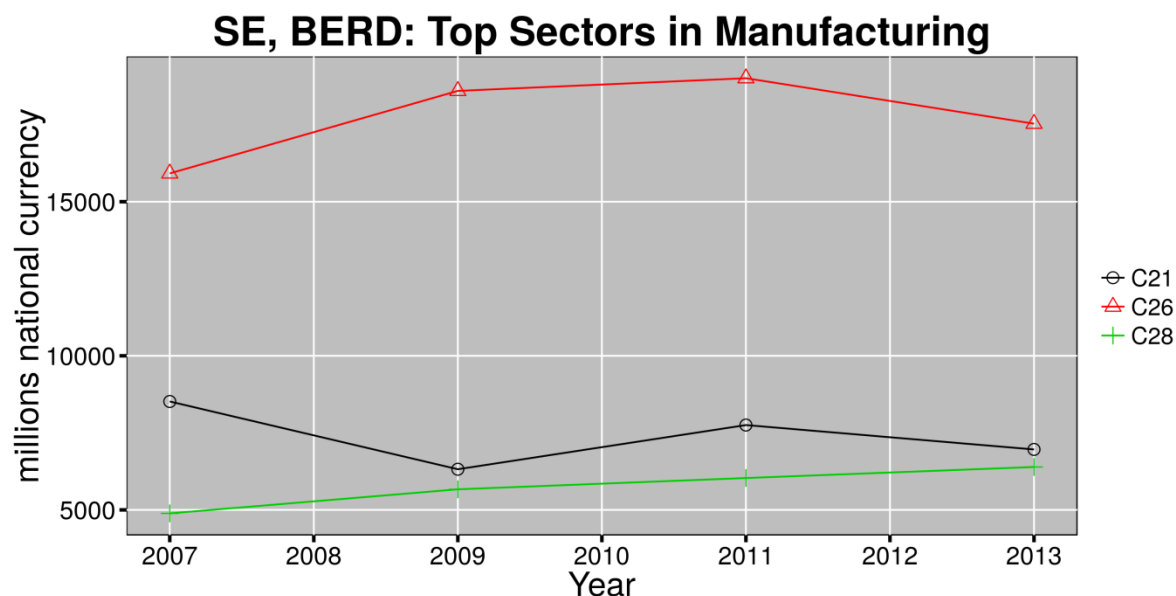
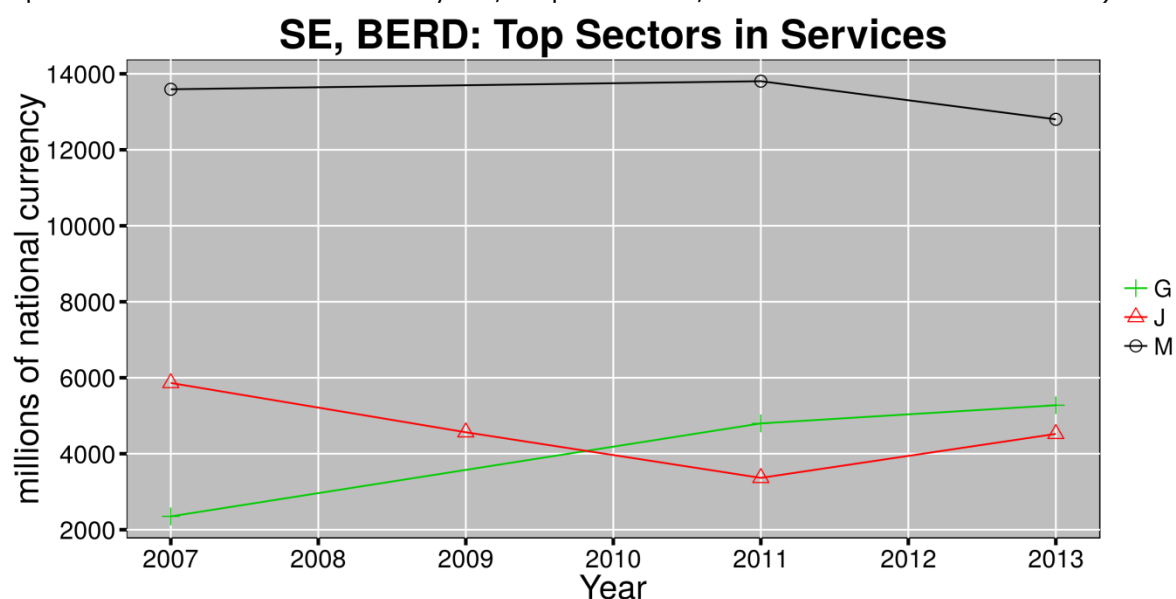


Figure 9: top service sectors (J=information and communication, G=wholesale and retail trade; repair of motor vehicles and motorcycles, M=professional, scientific and technical activities).



⁵⁷ Statistics Sweden, 2014, Statistical news, accessed May 2016, <http://www.scb.se/en/Finding-statistics/Statistics-by-subject-area/Education-and-research/Research/Research-and-development-in-the-business-enterprise-sector/Aktuell-Pong/8753/Behallare-for-Press/379887/>

As far as the services are concerned (see Figure 9), the general predominance of the scientific/technical services can be noticed. R&D in wholesale and retail; repair of motor vehicles and motorcycles has been following a very dynamic development, more than doubling in value between 2007 and 2013 and outranking ICT services in value. R&D expenditure in ICT services were strongly decreasing between 2007 and 2011 but have been catching up since.

Goods-producing enterprises accounted for 70% and service-producing enterprises accounted for 30% of the expenditure for research and development in 2013.

Unfortunately the data about the economic sectors in manufacture and services is available only with a biannual frequency (for services quadrennial frequency in some cases), which partially limits the conclusions one can draw from its analysis.

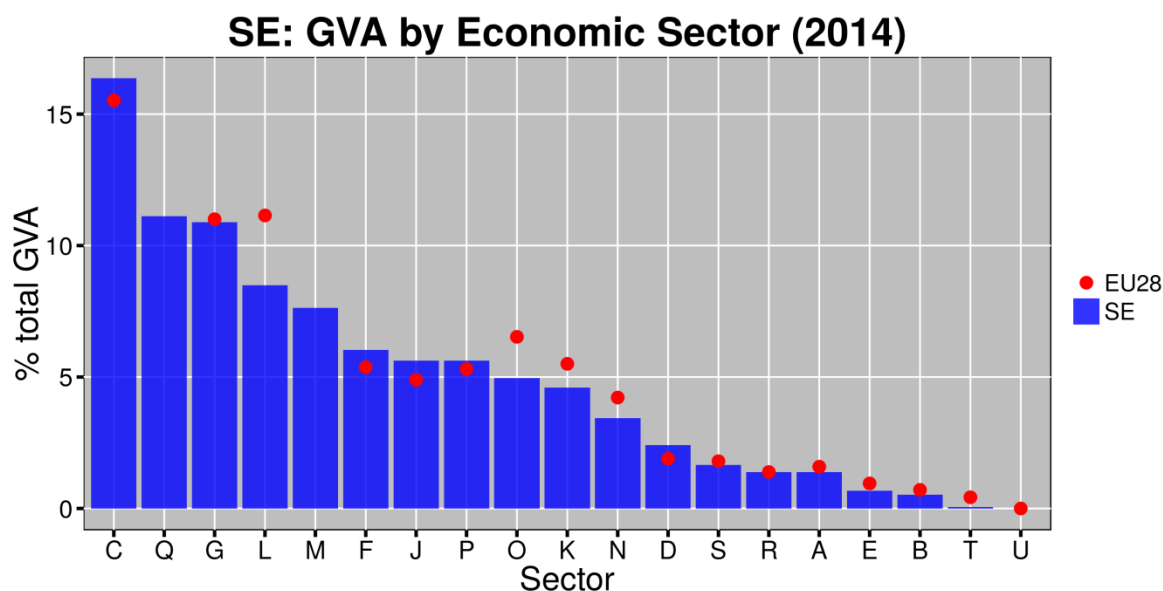
3.6.3 The development in business R&D intensity and value added

Unsurprisingly, due to their importance in the Swedish BERD, manufacturing, wholesale and retail trade including repair of vehicles and motorcycles and professional, scientific and technical activities are among the top five leading economic macrosectors also in terms of gross value added (GVA). On top of that, human health and real estate generate a substantial GVA despite not being among the leading sectors in terms of BERD expenditure (see Figure 10).

In relation to total value added the Swedish corporate R&D spending is 3.7%, a top position in an international comparison. Only companies in Israel, Finland, South Korea and Japan have higher R&D intensity relative to value added in the industry⁵⁸.

Figure 10: economic sectors as percentage of the total GVA.

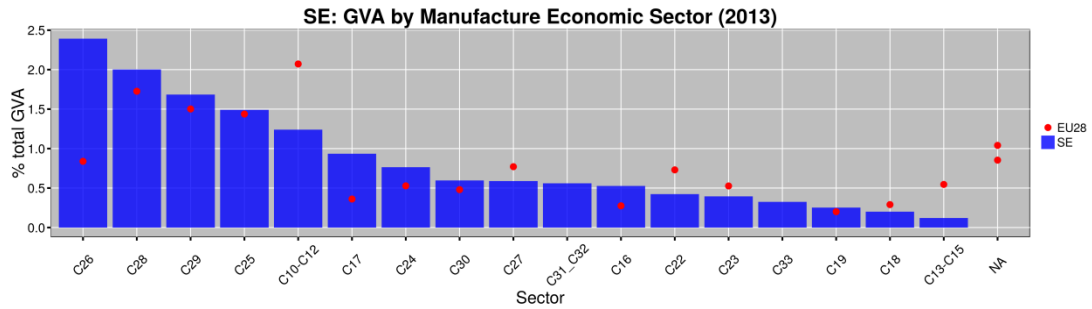
Top 6 sectors in decreasing order: 1) manufacture, 2) Human health and social work activities; 3) wholesale and retail trade; repair of vehicles and motorcycles; 4) Real estate activities; 5) Professional, scientific and technical activities; 6) Transportation and storage.



⁵⁸ Statistics Sweden, 2015, Statistical news, accessed May 2016, <http://www.scb.se/en/Finding-statistics/Statistics-by-subject-area/Education-and-research/Research/Research-and-development-in-the-business-enterprise-sector/Aktuell-Pong/8753/Behallare-for-Press/391739/>

Figure 11: GVA in manufacturing.

Top 6 manufacturing sectors: 1) Manufacture of computer, electronic and optical products; 2) Manufacture of machinery and equipment; 3) Manufacture of motor vehicles; 4) Manufacture of fabricated metal products; 5) Manufacture of food products; beverages and tobacco products; 6) Manufacture of paper and paper products.



When looking at the GVA in the manufacture sector (see Figure 11), we notice the presence of computer, electronics and optical products and machinery; among the leading contributors to the total GVA in Sweden (ranked 1st and 2nd respectively). The R&D intensive pharmaceutical industry does not contribute to any significant degree to GVA in manufacturing.

Figure 12: Value added for the leading manufacture and service sectors in Figures 8 and 9.

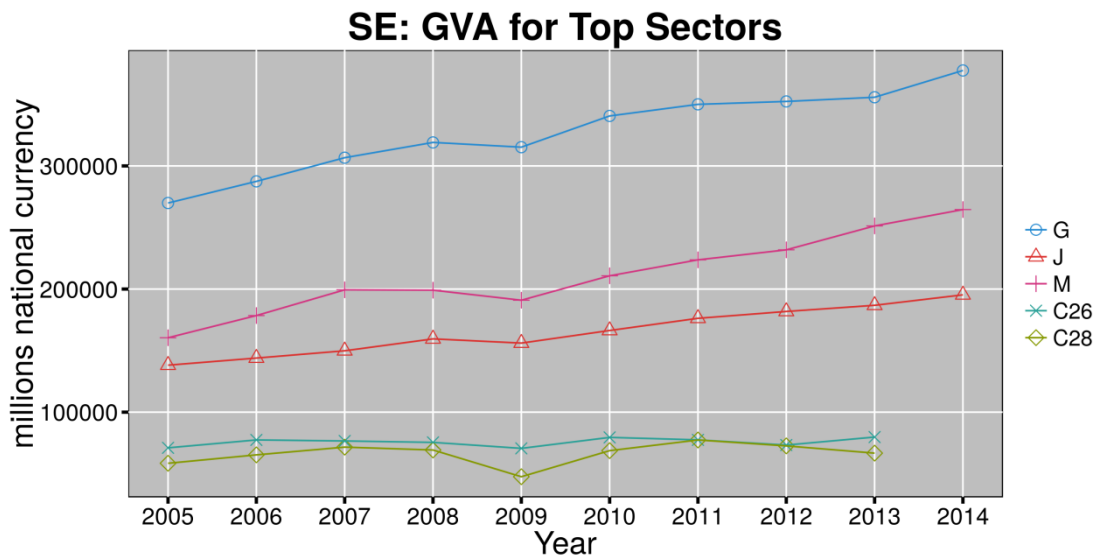


Figure 12 shows the GVA in millions of national currency for the top manufacture and service sectors identified in Figures 8 and 9. One notices that sector G (wholesale and retail trade; repair of motor vehicles and motorcycles) gravitating around the automotive industry is by far the dominant sector in terms of its value added at factor cost. The other two R&D intensive service sectors, i.e. ICT and professional, scientific and technical activities are also both considerably more important in terms of GVA than the strongest manufacturing sectors. One also notes that GVA in all three service sectors has been increasing since 2009 while GVA in manufacturing sectors has remained at relatively constant levels.

4. Quality of science base and priorities of the European Research Area

4.1 Quality of the science base

According to the latest Country Report on Sweden prepared by the OECD (2015), Sweden's performance in higher education and research is declining particularly in terms of share of highly cited publications and in share of European Research Council Grants. This is not immediately noticeable if one compares Sweden's performance to EU28 as a whole. As the table below shows, the number of publications per thousand of population was 3.32- a figure which is more than twice the EU28 average. Eurostat data also shows Sweden as being above comparator countries such as the Netherlands and the UK. A perusal of the Research Council of Sweden's reports prepared for the next Research Bill (expected Autumn 2016) will reveal that the Council finds that while Sweden is doing well on publications and citations, it has only been able to demonstrate excellence in a small number of areas (Swedish Research Council, 2015).

Since the 1990s, Sweden has been transforming its model for resource allocation to higher education and research to one in which both higher education and research are subject to performance based allocation. The budgets for these two activities are separate and higher education institutions may not transfer resources from one budget area to another. Education is resourced via an allocation model which is based on productivity in terms of numbers of students who successfully completed degrees. Resource allocation to research from public funding is done via two types of funding instruments, institutional and project funding. A minor share of the institutional is performance based. The share of project to institutional funding is 55%/45% on average for the whole system, including external funding from the EU, private and international sources.

The Swedish system is characterised by a high number of international and public-private co-publications. The number of co-authored publications with firms per million inhabitants is 147, equal to 3.35% of total production. These figures outstrip the EU28 average (52.8) and are surpassed only by the Netherlands and Denmark. With regard to internationalisation, the latest available figures (2013) show that 56.7% of publications produced by Swedish researchers were co-authored with international authors as compared to the EU averages which is 36.4%.

Table 9: Scientific publications – Swedish performance compared to EU performance

Indicator	Year 2013	EU average
Number of publications per thousand of population	3.32	1.43
Share of international co-publications	56.7%	36.4%
Number of international publications per thousand of population	1.88	0.52
Percentage of publications in the top 10% most cited publications	16.41(2010)	12.25
Share of public-private co-publications	3.3%	1.8%

4.2 Optimal transnational co-operation and competition

In the last three years, Sweden has intensified its efforts at internationalization of the higher education and research sectors. The most significant developments in this regard are the international fellowships aimed at promoting mobility of young scholars. This effort is aimed at both attracting young scholars to Sweden as well as encouraging Swedish scholars to travel abroad. In 2014 nearly all Swedish public research funders had at least one call which was directed at promoting mobility among young researchers. Since 2011, Sweden introduced a fee for students from non-EU/EEA countries. Despite the fact that there were a number of exceptions to this new rule and a number of stipends were made available for such students, the effect of the new arrangement was that the number of international students reduced by 80% (2011), (Swedish Higher Education Authority, 2015c). Since then, the figures have been getting better, for instance in 2012, the number of non-EU/EEA students increased by 19% and by 25% by Fall 2014. According to the Swedish Higher Education Authority, this upward trend is unlikely to hold true for 2015 because the 2015 budget (prop. 2014/15:1) did not provide any increase in Swedish Institute stipends. Since the introduction of a fee, non EU/EES students have tended to be more common on the Masters' rather than on the undergraduate level.

The reduction in numbers of non-EU/EES students has been compensated by a marked increase in the number of students coming from other EU countries (60%). The net effect of the introduction of the fee system may be regarded as a setback for internationalization in higher education but a marked improvement in terms of aspirations for more mobility in the higher education sector within the EU (Swedish Higher Education Authority 2015c).

4.2.1 Joint programming, research agendas and calls

Joint Programming is one instrument through which Sweden pursues transnational cooperation⁵⁹. It is not clear how visible Sweden's participation in Joint Programming is from within the country except for among those actors who are directly involved. Nevertheless, several Swedish public research councils participate in Joint Programming and coordinate actions with other European Funders.

The Swedish public research system has generally been more open when compared to most of the EU28 with the exception of the UK. Since the 1990s, there has been a renewed focus on transnational collaboration and there are several initiatives of a bilateral and multilateral character to support transnational collaboration. Although transnational collaboration is generally perceived as a means through which quality improvements may be achieved, this has not been the official rationale used to motivate Swedish initiatives. Instead, collaboration is treated as a necessary measure in order to compensate for the relatively small size of the Swedish research system. Additionally, for historical reasons, Sweden has also been involved in research collaboration with other Nordic countries.

4.2.2 RI roadmaps and ESFRI

The most recently published Roadmap for Research Infrastructure in Sweden date from 2014. In 2014, the Swedish Research Council developed a new model for funding and prioritising national research infrastructure, which will be gradually implemented over the period 2015-2020. In 2015, the Council initiated a national inventory of needs for new research infrastructures the results of which will be published as an Appendix to the National Roadmap in fall 2016. Only the infrastructures of highest priority will be included in the appendix, and to be included will be a prerequisite to be eligible to apply in future calls. The key provisions of the existing Roadmap for Research Infrastructures are that over the period 2015-2020, the Swedish Research Council will review and revise

⁵⁹ Also see RIO Country Report Sweden 2014 and ERAWATCH Country Report Sweden 2013

the Swedish participation in international research infrastructures with a view to creating coherence between national and international participation. The Roadmap also recommends that research infrastructure priorities should issue from identified research needs. Further, it is argued if RI investments are to be utilised to the fullest, they will have to be matched by similar investments in research competence and personnel. For this reason, the Roadmap for RI recommends that all RI investments are accompanied by investments in education and research in the area. RI investments need to be complemented with e-infrastructure and previous investments in experimental infrastructures need to be monitored and upgraded with significant investments in computing resources, etc⁶⁰.

Sweden hosts two important new international research infrastructure projects: the European Spallation Source (ESS) and the EISCAT radar⁶¹. The national RI Roadmap also includes plans to expand a number of currently national projects to international level such as the MAX IV Synchrotron Light Facility. The national RI is coordinated with ESFRI and includes detailed information on which international RI projects Sweden is participant.

4.3 International cooperation with third countries

Transnational co-operation has been mainstreamed in the public research funding system. Sweden has ongoing bilateral agreements with among others South Africa, China, India, Japan and the USA⁶².

In 2015, the Swedish Research Council funded joint calls with China and India, and another recent effort in this regard is VINNOVA's Sweden-India programme on Embedded Systems which is a joint call between Sweden and India and involves private, public and research sector actors⁶³. The budget for this call is €2m which will be divided among 3-4 projects.

The Swedish Foundation for International Cooperation in Research and Higher Education, (STINT) was set up by the Swedish Government in 1994 with the mission to internationalise Swedish higher education and research. STINT promotes knowledge and competence development within internationalisation and invests in internationalisation projects proposed by researchers, educators and leaderships at Swedish universities. STINT currently runs bilateral programmes with China, Japan, South Korea and South Africa.

A more longstanding transnational collaboration is the Nordic Minister's Council agreements on collaboration in research and education. Sweden, Denmark, Iceland, Finland, and Norway are members of this council and while Sweden, Denmark and Finland are EU member states, the other two Nordic countries are not. Collaboration on this level is divided among a plethora of initiatives and it is not within the scope of this report to provide an exhaustive list. In this chapter, a few examples from research cooperation will be highlighted. NordForsk is a funding agency under the Nordic Council of Ministers which takes care of research funding for Nordic projects. Currently, there are no open calls but there are ongoing programmes in a number of significant areas. These include the Nordic eScience Globalisation Initiative (NeGI) which has a total budget of about €14.8m of which €3.9m is distributed by NordForsk. NeGI focuses on e science on global challenges and consists of three Nordic Centers of Excellence, two within eScience in Climate and Environmental Research, and one within eScience in Health and Social

⁶⁰ <https://publikationer.vr.se/produkt/the-swedish-research-councils-guide-to-research-infrastructures-2014/>

⁶¹ MAX IV has been run as a national project with partners from neighboring countries but is expected to be opened up to more countries in a later phase.

⁶² See

<http://vr.se/internationellt-samarbete/bilateralaavtalomforsknings-samarbeten.4.aad30e310abcb9735780003907.html> for a comprehensive overview of bilateral agreements on research collaboration

⁶³ <http://www.vinnova.se/sv/EU-internationell-samverkan/Internationellt-samarbete/Asien/Samarbete-Sverige-Indien-Tema-Inbyggda-System/>

Preconditions to Health⁶⁴. These started in January 2014 and will be funded for five years. A second significant Nordic collaborative effort is the Top-level Research Initiative (TRI)⁶⁵ which is the largest joint Nordic research and innovation initiative to date. TRI started in 2008 by a declaration of the Nordic Prime Ministers and was scheduled to run until 2014. It was divided into six sub programmes⁶⁶ and the total budget was €53.5m. There are at present no new national initiatives to ensure further uptake of EU or bilateral initiatives.

4.4 An open labour market for researchers

4.4.1 Introduction

Sweden is a country characterised by high institutional autonomy in the higher education and research system. By this we mean that universities and university colleges, despite being part of the public sector, have a great deal of freedom with respect to internal organisational matters⁶⁷. The higher education and research sector occupies the largest share of the Swedish public sector and had a total budget of approximately €7,003m in 2014 according to the Swedish Higher Education Authority (2015). All public universities and university colleges are subject to the authority of the Ministry of Education. The only exception to this rule is the Swedish Agricultural University which is supervised by the Ministry of Enterprise and Innovation since 2014. The Swedish higher education and research landscape includes another category of HEIs which are the public foundations such as Chalmers and Jönköping. Given that the market for higher education is a monopsonic one, even these public foundations are run along similar lines as their counterparts that are supervised by the Ministry of Education. All HEIs have a high degree of institutional autonomy with regard to recruitment decisions and nature of positions but not over budgetary matters. There are 28,345 scientific staff employed at Swedish Universities and University Colleges⁶⁸. The balance between temporary and permanently employed staff is improving in favour of the latter. The Swedish Higher Education Authority recently published a study (2016) which contends that one third of scientific staff at Swedish universities are on fixed-term contracts. These figures may however vary radically across universities, the Swedish University Teacher's Association for instance published figures which showed that for Karolinska Institute 49% of the staff are non-tenured, at Uppsala university, it was 37%, while Lund and the Royal Technical University were slightly better with only 34% of scientific staff on fixed term contracts, these figures are for 2013 (SULF, 2014). The financial crisis has had little or no impact on the Swedish higher education and research system. Since 2012, there has been a steady increase in public research funding (see chapter 2 for specific budgets). The relative importance of teaching vis-a-vis research has changed to the advantage of the latter according to the Swedish Higher Education Authority (2015a). The conservatism with respect to hiring permanent staff is a well acknowledged problem in the Swedish higher education and research system. This is expressed not as a lack of preference for hiring permanent staff per se but as a preference for recruiting internally. The two

⁶⁴ <http://www.nordforsk.org/en/programmes/projects/nordic-information-for-action-escience-center-niasc>
<http://www.nordforsk.org/en/programmes/programmer/escience/esticc-tools-for-investigating-climate-change-at-high-northern-latitudes>

⁶⁵ <http://www.toppforskningsinitiativet.org/en/om-toppforskningsinitiativet>

⁶⁶ The six sub-programmes are: Effect studies and adaptation to climate change; Interaction between climate change and the cryosphere; Energy efficiency with nanotechnology; Integration of large-scale wind power; Sustainable bio-fuels; CO₂ - capture and storage

⁶⁷ The autonomy of universities and university colleges is outlined in the main ordinance which is the steering document for the sector which is called Högskoleförordningen. A number of reforms aimed at increasing autonomy have subsequently been introduced to the sector, the most recent of which was outlined in the 2009 Research Bill "En akademi i tiden – Ökad frihet för universitet och högskolor" (prop. 2009/10:149), implemented in 2011 and evaluated in 2015. See material on evaluation in this chapter.

⁶⁸ This figure is taken from the appendices of Swedish Higher Education Authority's report (2015a), it does not include doctoral students or staff from the small colleges and other types of tertiary institutions of low relevance to RI. <http://uka.se/download/18.68b9da0d14d8a7e2f5aa836/1434629098622/UKA-arsrapport2015-tabellbilaga.pdf>

primary ways of doing this is to allow staff contracts that are temporary to be automatically transformed into permanent contracts as a result of labour rules or to internally promote staff who was educated at the university. A recent investigation by the Swedish Research Council showed that at least 50% of the Phd educated staff at universities were educated at the same university (Barriere, Baard and Nordstrand, 2016). Barriere et al. (2016) is among the first systematic investigation that provides evidence of the preference for recruitment of one's own at Swedish universities and their study shows that the problem is greater at the larger universities and varies across scientific fields with the humanities and the social sciences representing the fields with the highest level of internal recruitment and the natural sciences with the lowest. The agricultural sciences represent an outlier which is explained by the fact that there is only one Agricultural university in Sweden.

4.4.2 Open, transparent and merit-based recruitment of researchers

Sweden has a long history of an official policy of open, transparent, merit-based recruitment. Over recent years, this system has been criticised for not functioning in the way intended for a number of reasons. Of these three are persistent and are recognised at all levels. The first is the system's inability to recruit female candidates to senior researcher positions, the second is the long delays that are almost endemic to the recruitment process and the third is the perception that Sweden is not attractive for foreign researchers primarily because of its reputation for being a high tax economy. The problem of low levels of female recruitment otherwise known as gender equality is well recognised by the Swedish government and most universities have policies in place for addressing this issue. The delays in the recruitment process have also been acknowledged and one attempt to deal with this is the introduction of a measure which allows universities to introduce a type of fast track for some professorships (Government of Sweden, 2007) The issue of taxation is also well acknowledged and the measure introduced to provide some relief is documented below. Taken together, these three system flaws are said to hamper the public research system from accessing the best people. Universities have now been given the possibility of radically shortening the recruitment process at least on the professorship level and only for candidates who are already professors. The 2012 Research and Innovation Bill explicitly addressed the problem of internationalisation in relation to attracting excellent talent to Swedish universities and a number of measures have been introduced to promote this. One is the introduction of a fixed term reduction in taxes for incoming researchers⁶⁹. Interest in transparency and meritocracy has been, for a variety of reasons, almost entirely focused on gender despite the fact that the transparency and meritocracy issues include a range of other issues such as the representation of minorities. These drawbacks notwithstanding, there is a relatively high degree of transparency and commitment to merit based recruitment in Sweden particularly when compared to most of the EU28.

The system is decentralised and universities make recruitment decisions in a bottom up fashion, i.e. at the departmental level. Sweden has traditionally been very attractive to junior foreign researchers, particularly those studying for the doctoral degree. For instance, the Swedish Higher Education Authority reported that 40% of new PhD students in Sweden (2014) were foreign born (Swedish Higher Education Authority 2015a). This also explains why it is at the postdoc level that the largest cluster of foreign born academics may be found. The scientific labour market has been improving and all reports from both Academic Unions and the Swedish Agency for Higher Education demonstrates that the number of permanent contracts now outweigh temporary ones. It should be noted however that for the university sector as a whole the two largest costs are personnel and rent for facilities. According to the latest annual report from the Swedish Higher Education Authority personnel costs increased by €60.5m over the period 2013-2014 and costs of facilities by €43.2m (Swedish Higher Education Authority

⁶⁹ <http://forskarskattenamnden.se/forskarskattenamnden/summaryinenglish/taxreliefforforeignkeypersonnel.4.383cc9f31134f01c98a800018147.html>

(2015a). The increase in personnel costs is one of the factors which the university and university college sector uses to explain among other things the variations in overhead costs on research and the discrepancy between the increasing resources allocated to research and the lack of any appreciable increase in research time allotted to scientific staff. According to the sector, institutional allocations do not cover salary increases (Association of Swedish Higher Education, 2015).

Most of the new recruitment opportunities are concentrated on early entrants, i.e. junior researchers (post docs and doctoral students) and some efforts are being made to address tenure track issues. The latter is however hampered by an unfortunate conflict between the labour laws and the academic practice of privileging merit and open recruitment for every step in career development. Generally, after two years of employment, a researcher would be automatically given tenure as a result of the law. Doctoral and postdoctoral positions are excluded from this rule. The tricky bit for universities is how to leverage 'tenure track' and still maintain the right to terminate the contract if they are not happy with the researcher's performance. This issue is one of long contention and there are two schools of thought that dominate the debate, one which states that universities, and particularly academic leaders, are not sufficiently motivated to pursue this issue and the other which states that the problem lies in the law.

Universities and research councils are currently very focused on making career paths for junior researchers as clear as possible. This involves a number of support services and networks at the local level as well as funding calls directed exclusively to junior researchers. There are currently a number of grants available for reintegrating postdocs who have been abroad. There are no specific measures at the university level for reintegrating postdocs.

4.4.3 Access to and portability of grants

There has been little discussion of grant portability or access. In the case of the latter, there may be several explanations but the most obvious is that there is no shortage of grants that Swedish researchers may apply for. The funding landscape is quite diverse in that, there are several funding agencies and many are fairly niched e.g. focused on a specific area of research⁷⁰, such as environmental research or health and social welfare. This diversity does not however translate into ease in getting grants since the funding landscape is quite competitive and the average rate of funding is somewhere between 10-22% (Swedish Research Council, 2015)⁷¹. Although the situation is changing, it appears that Swedish researchers still prefer to apply for national funding because the costs of research labour and overheads in Sweden makes most EU funding rather unattractive. This is borne out by two types of data: number of Swedish researchers applying for EU grants and percentage of universities' funding originating from EU⁷². In principle, non-Swedish researchers may apply for almost any grants in Sweden as long as they partner with a Swedish organisation. This organisation would be the main grant recipient but can sub contract non-Swedish researchers who are not working in Sweden to perform work in the project.

Grant portability is available but it is unclear how widespread is the level of awareness of this feature in the research community. Apart from the relatively low mobility of Swedish researchers even within Sweden, the issue may be complicated by the fact that a large

⁷⁰ See tables which provide a list of the major funders in Sweden at the end of chapter 1

⁷¹ Vetenskapsrådets årsredovisning 2015

<http://www.vr.se/nyheterpress/vrkommenterar/vrkommenterar/25miljardertillfriprojektbidrag.5.26f56f72149ba1151e676446.html>

FORTE's annual report for 2014 showed that the success rate was somewhat higher than 15% if one grouped all the calls together (17%) <http://forte.se/wp-content/uploads/2015/10/fortes-arsredovisning-2014.pdf>

⁷² See annual reports on universities Swedish Higher Education Authority, Universities and University Colleges, Annual Report 2014. The report shows a 7% increase in the percentage of research funding coming from the EU to Sweden from 2012 to 2013. The total figure reported was 5%

portion of individual and research group grants are negotiated with some inputs from the organisational budget. This is often because overhead costs in Swedish universities differ widely even within the same faculty, thus moving a grant between universities may require significant amount of re-negotiation. Despite the difficulties, it is both practically and theoretically possible to move grants between institutions as most grants are given to individuals although universities are formally expected to take responsibility for ensuring that the grant is managed properly.

4.4.4 Doctoral training

There are no policy efforts at the national level that are tailored to directly address the Innovative Doctoral Training Principles. However, doctoral training in Sweden is not easy to adapt to European models for a number of reasons. The most important is that doctoral students are regarded as junior researchers in Sweden. This means that they are salaried university employees. The Swedish government introduced in the 1990s a reform which made it impossible to admit students to the doctoral programme unless they were funded for the entire period of their doctoral work, which is four years (chapter 2 provides detail on the funding situation for doctoral students). This taken together with the reduction in institutional funding has meant that a vast majority of Swedish doctoral students are project workers, i.e. they are funded from grants for which their supervisors are responsible. Although working conditions, rights, etc. are regulated through university and union rules, the employment situation varies for doctoral students within universities and between universities.

Doctoral work is an integral part of the Swedish public R&D effort and consumes a significant share of the governmental R&D appropriations to the academic sector (Jacobsson and Rickne, 2004; Swedish Higher Education Authority, 2015 a). This is directly related to the fact that doctoral work is not classified as training but as research and that doctoral students are employed. Remuneration for doctoral students is fairly competitive, explaining why doctoral work accounts for so much of the public R&D budget as well as the relative lack of interest in Swedish doctoral students to migrate to other parts of the EU to do their doctoral work. It has also meant that traditionally, Swedish doctoral programmes are rather attractive to both EU and non-EU students⁷³.

Content and quality in doctoral programmes are the responsibility of the faculty and department but there are national evaluations which are performed by the Swedish Higher Education Authority. The next evaluation is scheduled for fall 2016⁷⁴ and a pilot study is currently being performed⁷⁵. The evaluation will focus on the quality of the education, working environment for the doctoral students and will be comprised of interviews and a self-evaluation to be submitted by the universities.

4.4.5 Gender equality and gender mainstreaming in research

Sweden has a long history of working with gender equality and mainstreaming in research and teaching. Since the 1990s, successive Swedish governments have introduced different measures to facilitate, persuade and, in some instances, mandate that universities adopt hiring practices that would be attractive to female researchers. All university committees are subject to the equal gender representation. Gender equality is also one of the indicators that is integrated in all reporting on university performance. The 2014 annual report on Swedish Higher Education showed that about 30% of scientific employees at Swedish universities have temporary positions and that there is a slight majority of women in this category. Generally, the situation varies across fields within the same university but on average the ratio of male to female scientific employees was on average 60-40. However, the gender distribution among professors is changing only very slowly.

⁷³ According to the Swedish Higher Education Authority 40% of new doctoral students for 2014 were foreign students

⁷⁴ <http://uka.se/utbildningskvalitet/utvardering-av-forskarutbildningar.html>

⁷⁵ <http://www.uka.se/nyheter/testavnyutvarderingsmodellforforskarutbildning.5.3673205e14acd5ce45931fb5.html>

4.5 Optimal circulation and Open Access to scientific knowledge

4.5.1 e-Infrastructures and researchers electronic identity

The EU level initiatives to build research infrastructures for facilitating the dissemination of data and results (e.g. European Social Survey, CESSDA, SHARE) are supported by the Swedish government who takes active part as member of these initiatives and thus secures the access for Swedish researchers to them. In 2015, the Swedish Research Council in collaboration with Forte and Formas have introduced a common e- platform for research applications called PRISMA. This platform is connected to ORCID and SWAMID. PRISMA was introduced in spring 2015. The platform allows researchers to access and cross reference data they upload such as CV information. This is of course limited to the councils that are part of this scheme. Private partners are not involved in this as drivers of the initiative but will certainly use this infrastructure when they apply for funding separately or in collaboration with the research community.

There is as yet no discussion about creating a common platform across universities which would allow staff to access digital research services in other organisations. There is however an infrastructure that could facilitate this. Likewise, the Swedish population has access to digital IDs in order to perform services such as tax declarations and bank transactions and this infrastructure or a version thereof could presumably be adapted to university use to allow for identity validation and tracking; however, this is not yet under discussion. Most universities and research organisations have implemented organisation wide solutions of this kind. The focus is however on allowing staff to work on remote and access research and administrative systems.

4.5.2 Open Access to publications and data

In order to promote open access to publications, many public research councils are now automatically including funding for making publications open access in grants. This is a follow up to the introduction of mandatory requirement to make research results open access which many Swedish public research councils have introduced. The 2012 Research Bill initiated a process of institutionalising the principle of open access in the Swedish public R&D system by giving the Swedish Research Council and the National Library the task of developing structures and "national guidelines" for access to research results and research data. The draft of this policy was circulated for comment by public authorities and the research community between the 10th October and 2nd November, 2014⁷⁶. In January 2015 the Swedish Research Council presented their report to the government. The basic principles in the proposed national guidelines are that by 2025 all research funded by public money should be published immediately in open access (gold access)⁷⁷ and have a creative commons license. This includes books, papers and artistic works. Research data forming the basis for scientific publications is suggested to be made publicly available as soon as possible, by the use of targeted pilots for different areas. The proposed national guidelines will be implemented, in whole or in parts, in the upcoming bill for research and innovation.

Since 2010, the Swedish Research Council, the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (Formas), the Swedish Council for Working Life and Social Research (FAS)⁷⁸, the Swedish Foundation for the Humanities and Social Sciences Foundation (RJ), the Knut and Alice Wallenberg Foundation (KAW) require that scholars funded by them publish their results open access. Almost all Swedish universities and higher education institutions have open, searchable databases

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<http://www.vr.se/omvetenskapsradet/regeringsuppdrag/regeringsuppdrag/nationellariktlinjerforoppentillgangtillvetenskapliginformation/kommenterarvetenskapsradetsutkasttillnationellariktlinjer.4.70a7940b146b8f93794b3d6c.htm>

⁷⁷ There is increasing evidence that scientific disciplines differ in terms of their preferences for open access arrangements.

⁷⁸ FAS has since changed its name to Forte

where publications are listed and in many cases online versions of publications are openly accessible. Currently about 10% of all published articles from the Swedish research community are in green open access while about 9% are available in Gold open access, about 57% of all Swedish scientific publications are available in some form of open access arrangement. These figures are slightly above the EU28 average⁷⁹. It is important to note that the open access issue is not simply about making information that is paid for with public money freely available to the public. In the context of R&I policy, other factors such as absorptive capacity of the general population, knowledge intensity of the economic structure play significant roles in determining whether the cost of the additional investment in making scientific articles open access is warranted.

⁷⁹ Open access figures taken from Archambault, É et al (2014) Proportion of Open Access Papers Published in Peer-Reviewed Journals at the European and World Levels—1996–2013 available at http://science-metrix.com/files/science-metrix/publications/d_1.8_sm_ec_dg-rtd_proportion_oa_1996-2013_v11p.pdf

5. Framework conditions for R&I and Science-Business cooperation

5.1 General policy environment for business

Overall, the general policy environment for doing business in Sweden is favourable. The country has performed well on the World Bank's Doing Business indicators throughout the past decade. In the most recent ranking on the ease of doing business, for 2015, Sweden is on place 11th among 189 economies, higher than the average G7 and OECD high-income rankings (World Bank, 2015a,b). This is an improvement since 2013, when Sweden ranked 14th⁸⁰.

Sweden ranks especially high on measures of Trading across borders (4th) and Getting electricity (7th). Also on the indicators of Resolving insolvency (17th), Dealing with construction permits (18th), Registering property (18th), and Enforcing contracts (21st) the ranking is relatively high. When it comes to the ranking of Getting credit (61st), Paying taxes (35th), Protecting minority investments (32nd) and Starting a business (32nd) the ranking is lower. In addition, the ease of getting credit has actually worsened lately (ranking 61st 2015, 56th 2014, and 42nd 2013).

Swedish firms face a total tax level that is one of the highest among OECD high-income economies (World Bank 2015c). The share of social security contributions in the total tax burden borne by businesses is among the largest in the world (35.5%).

Globally, Sweden stands at 32 in the ranking of 189 economies on the ease of starting a business (World Bank 2015a,b). The process of starting a business takes shorter (3 vs 9.2 days) and costs less (0.5 vs 3.4 % of income per capita) in Sweden than in most other OECD high-income economies, with some exceptions like New Zealand, Australia and the UK. The cost of starting a business in Sweden (as % of income per capita) is one of the lowest in the world. This suggests that this constraint on entrepreneurship and job creation has improved.

The essential legislation on insolvency in Sweden consist of: (i) the Bankruptcy Act (1987:672⁸¹), which regulates bankruptcies (insolvent liquidations) for companies and natural persons; (ii) the Business Reorganisation Act (1996:764⁸²), which regulates company reorganisations; (iii) Chapter 25 in the Swedish Companies Act (2005:551⁸³), which regulates solvent liquidations; and (iv) the Priority of Rights Act (1970:979⁸⁴), which regulates in which order a company's debts are paid in a bankruptcy. Regulation (EC) 1346/2000⁸⁵ on insolvency proceedings (Insolvency Regulation) is applicable in Sweden. Other applicable regulations are the Nordic Bankruptcy Convention 1933⁸⁶ (signed with Denmark, Finland, Iceland and Norway) and Regulation (EC) 44/2001⁸⁷ on jurisdiction and the recognition and enforcement of judgments in civil and commercial matters⁸⁸.

Effective insolvency proceedings promote economic activities and access to finance by enabling viable but financially distressed firms to continue their operations and creditors to recover larger shares of their loans from insolvent firms. According to statistics from UC 2015⁸⁹ (a Swedish business and credit reference agency that provides inter alia

⁸⁰ <http://www.doingbusiness.org/~media/GIAWB/Doing%20Business/Documents/Annual-Reports/English/DB15-Full-Report.pdf>

⁸¹ http://siteresources.worldbank.org/GILDSWEDEN/Resources/Sweden_Bankruptcy_Law.pdf

⁸² <https://www.notisum.se/rnp/sls/lag/19960764.htm>

⁸³ <http://www.bolagsverket.se/en/us/about/news/2006/swedish-1.7190>

⁸⁴ https://www.sbab.se/download/18.789dba4212dc43733b8800076/1296118685621/1_Swedish_CovBondAct.pdf

⁸⁵ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2000:160:0001:0018:en:PDF>

⁸⁶ http://www.insol.org/pdf/cross_pdfs/Sweden.pdf

⁸⁷ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32001R0044:en:HTML>

⁸⁸ <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3A133054>

⁸⁹ <https://www.uc.se/uc-in-english/english-start.html>

bankruptcy statistics), bankruptcies in Sweden have continued to decrease, with the largest decreases within the construction, wholesale, law and economic services sectors. According to UC, the reason for the decrease in bankruptcies is partly due to the fact that domestic demand is pushing growth, primarily within the construction and wholesale sectors. Swedish companies generally have good ability to pay their debts and UC estimates that over 90% of Swedish companies have good credit ratings.

However, in Sweden completing the insolvency process takes longer and costs more than in many other high-income economies, including the Nordic economies (World Bank, 2015a,b). In addition, creditors recover smaller shares of their loans than in the Nordic average. Litigation of creditors' claims takes the most time during the proceedings, and attorneys' fees and payment of the administrator account for much of the high cost. Eliminating duplicate or unnecessary steps and setting reasonable deadlines that are adhered to in practice could shorten the duration of insolvency proceedings, help lower the cost and increase the recovery rate (World Bank 2014). Thus, a possible area for policy action is in reducing the costs of experimentation. Entrepreneurial experimentation will be attractive relative to employment only if the cost of experimenting, learning from failure and starting up again is not too high—and if the full resale value of initially invested assets can be rapidly recovered (through efficient insolvency procedures) for redeployment in new ventures. As measured by the World Bank (2015b) the efficiency of Sweden's insolvency regime lags behind those of comparators. Creditors can expect to recover 75% through reorganisation, liquidation or foreclosure in Sweden, compared with almost 89% in the UK and more than 90% in Finland (World Bank, 2014).

The Swedish government initiated an investigation in 2007 regarding the regulations in the Swedish Company Reorganisation Act. The purpose of the investigation was to examine how to improve the execution of company reorganisations and how to better synchronise such reorganisations with bankruptcy procedures. The investigation resulted in a proposal to the Swedish government in January 2010 (SOU 2010:2). However, the report did not cause introduction of new legislation. A new investigation regarding, inter alia, the regulations in the Swedish Reorganisation Act was initiated in 2014. The new committee (Entreprenörskapskommittén – The Entrepreneurship Committee) will submit a report to the Swedish government in August 2016.

5.2 Young innovative companies and start-ups

The Swedish Agency for Innovation Systems, VINNOVA, is the most important government agency for the support of young innovative companies. This support is complemented by a number of other public actors, like ALMI, Universities' Innovation Offices and Holding companies. There is no shortage of initiatives targeting innovative firms.

Several government departments and government agencies provide support to companies in various areas. Agencies like Tillväxtverket (Agency for Growth) and Jordbruksverket (the Board of Agriculture) handles support and programmes co-financed by the EU. The Swedish Energy Agency also provides loans and support to innovative new firms in the energy sector. Organisations like Business Sweden provide assistance to exporting companies. Swedish Patent and Registration Office (PRV) works with the strengthening companies' strategic management of intellectual property assets.

VINNOVA has a special programme for innovation-driven growth in SMEs. It includes various forms of support for a total of €42.6 m per year. The support is often provided in collaboration with other support agencies:

- Innovation vouchers: smaller amounts (€11,000) to invest in an idea. Support is passed through Almi, IUC Sweden AB and Cooppanion Cooperative Development. Total: about €3.2m per year.

- Verification support in early stages: A total of € 6.4m, of which €3.2m allocated by a VINNOVA grant of up to € 0.2m. The remaining €3.2m allocated by VINNOVA through the Innovation offices at universities and colleges.
- Innovation projects in enterprises: support for innovative development projects with international market potential at an early stage. Contributions are in two levels; co-financing of up to € 0.5m. Total: approximately € 19.2m per year.
- EUREKA / Eurostars: support for small and innovative companies to participate in EU programmes for innovation and development. Total: about € 11m.

Since 2015, VINNOVA is once again responsible for the special public support for incubators. The programme started at VINNOVA in 2003, but was transferred to ALMI's Innovationsbron in 2008. Since 2003, the state has provided special support for the national incubator programme, initially with the purpose to increase commercialisation of research. The support offered in the programme is performance-based, and only the best performing incubators (slightly over 20) get financial support. The incubator support is expected to be around € 8.5m per year.

Incubators and science parks have been developed in Sweden since the 1990s and are now at various levels of society. Cooperation through incubators take place regionally or locally and with different principals and agents. Several incubators and science parks are closely linked to universities and other innovation structures like the Innovation offices and the Holding companies.

SISP (the Association of Swedish Incubators & Science Parks) has 65 members. The focus is on knowledge-based, growth-oriented companies⁹⁰. Taken together, the SISP members have about 80 physical meeting places, offering business development support and interaction with clusters and the Triple Helix anchor. Several incubators and science parks also run a business angel network and seed funds for investments in early growth phases. As mentioned above, VINNOVA is responsible for the national incubator programme, which supports the operation of the best performing incubators (based on a number of different criteria).

With University Holding Companies, Innovation Offices and Incubators, Swedish universities play an important role in the innovation system. Since 1994, universities can get government consent to form companies for research, called Holding Companies. Today there are a total of 18 university-affiliated holding companies. The holding companies dispose relatively limited resources for investment. All universities are also linked to an Innovation office. Innovation Offices serve as local nodes for the innovation support system. Innovation offices were originally set up (2009) at seven major universities, as well as one joint office for a number of younger universities, but the ability to start the innovation office has subsequently been extended. In 2015, there were 12 innovation offices.

The reason for the creation of innovation offices was to streamline the utilisation of research and help to create benefits for society and business. The innovation offices' role includes providing expert support on issues concerning the utilisation of research including the commercialisation of patents and licensing, knowledge sharing and principles of contract research. Another task is to inform and stimulate researchers to innovate. Innovation offices are included in the organisation of universities and funded by annual appropriations. Some of the innovation offices have the task to also support other educational institutions in the local environment.

There are a number of other support organisations in Sweden, targeting innovative young firms. For example, the Venture Cup competition has been run yearly since 1998. Since the start of the competition around 27 000 entrepreneurs have competed with over 13,000 business ideas. In 2015, Venture Cup awarded € 0.2m to entrepreneurs. In addition, the CONNECT network has six local offices in Sweden. CONNECT was

⁹⁰ <http://www.sisp.se/?language=en>

introduced in Sweden in 1998 and has a large network of partners, including industry and financial partners (around 400 investors). Connect offers support to young firms through, for example, the Springboard, Accelerators, meeting-places and the financing network. IUC Sweden is owned by 12 regional, independent IUC companies, where the main aim is to carry out development-projects together with small and medium-sized companies in particular⁹¹.

To support innovative entrepreneurship and make new ventures more attractive, Sweden could consider policy actions in several areas. One area is facilitating patenting by young firms: only 8% of patents filed in 2009–11 came from young firms in Sweden, less than in comparator economies (World Bank 2014). Another is tilting public research and development (R&D) support toward smaller firms: more than 80% of public R&D support to the business sector goes to large firms, compared with roughly 50% in Denmark and Finland. A third area is reducing the costs of experimentation and failure (discussed above). This is also linked to the challenge of strengthening early stage venture capital for innovative start-ups (see section 5.4).

5.3 Entrepreneurship skills and STEM policy

Sweden's competitive advantage lies in the size and quality of its human capital stock, which depends vitally on the education system and skills development. Sweden faces challenges in both these areas. Sweden has very high enrolment rates in primary and lower secondary education. The main concern in the public debate on education in Sweden is that, despite large investments in education, results in international assessments of student competencies have been declining.

In addition, there are problems of skills matching in the labour market that are linked to worrying outcomes in tertiary education. Compared with the OECD average (World Bank 2015c), Sweden has a larger share of workers who are underskilled or underqualified for their job. At the same time, many tertiary graduates fail to find the right job and are overeducated for their tasks. About a third of Swedish adults aged 25–64 have a tertiary education (a smaller share than in Finland or Norway). Younger adults (ages 25–34) in Sweden are doing better: 43% have attained a tertiary education—a higher share than in Finland (40%) though still lower than in Norway (47%). Moreover, while the gross enrolment ratio for tertiary education is just above 70% in Sweden, it is more than 90% in Finland. Sweden also lags behind other countries in the completion of tertiary education: only 53% of students who enter a tertiary education programme go on to graduate, compared with 68% for all OECD economies, 76% in Finland and 81% in Denmark.

Sweden's low tertiary completion rate, particularly worrisome given its high youth unemployment rate, might be explained at least in part by lack of incentives: the average earnings of workers with a tertiary education are only 25% higher than those of workers with an upper secondary education. On average, they are 57% higher among OECD economies (World Bank 2015c).

At the EU level, the share of STEM university graduates has remained basically stable in relation to the total number of university graduates between 2006 and 2012: from 22.3% to 22.8%⁹². However, there is considerable variation between countries. In the Netherlands and Luxembourg, the share of graduates in 2012 is below 15% whilst it is higher than 27% in Sweden, Finland, Greece and Germany. Sweden is also one of the 15 EU countries where the share of STEM graduates has increased between 2006 and 2012. Even so, Sweden share the general concern about the attractiveness of STEM subjects particularly to the female population but as yet there are no major policy initiatives directed at this issue.

⁹¹ <http://www.iuc.se/>

⁹² http://www.europarl.europa.eu/RegData/etudes/STUD/2015/542199/IPOL_STU%282015%29542199_EN.pdf

Tertiary education is often regarded as the crucial phase in which students develop skills—either managerial or technical— that will foster innovation and productivity once they enter the labor market. Sweden has a very high level of higher education expenditure in R&D (twice the OECD average), according to the OECD Review of Innovation Policy for Sweden (OECD 2013a). In addition, four universities (Karolinska, Lund, Stockholm and Uppsala) regularly appear among the top 100 in global rankings (such as the Times Higher Education Supplement).

Nevertheless, the OECD report also points out that Sweden has lost scientific competitiveness. For example, while Sweden is among the 39 countries with the largest production of scientific publications, it had the third smallest increase in the mean citation rate over the past two decades. Besides, the average annual growth in publications between 2000 and 2008 was only 3.5%, compared with an average of 5.1% in the EU.

OECD (2013a) also point out the very low mobility in the higher education sector as a Swedish problem: 58% of teachers have a PhD from the same institution in which they teach, there is only a limited inflow and outflow of grant recipients, and the introduction of tuition costs for students from outside the-EU/EEA (and Swiss citizens who study there) has reduced the inflow of foreign students. In addition, research conducted in Swedish universities has a low impact as measured by citations, and it is concentrated mostly in a few successful fields (such as biomedicine).

A number of factors contribute to this low mobility rate. Two of the most significant are the fact that many Swedish academics choose to build their families during the PhD study period. Considerations such as schools, proximity to family etc then complicate the post PhD trajectory. Additionally labour laws also play a role in explaining the high number of academics who teach at the same institution from which they graduated. This is particularly so in scientific areas where graduate students do a significant portion of the teaching. Many such students become automatically permanently employed after graduation, thus reducing their incentive to look further afield for jobs.

The PIAAC survey collects information allowing assessment of education and skills mismatch (OECD 2013b). According to the results, in Sweden the share of workers who report that their highest qualifications exceed the qualifications that they deem necessary to get their job today is slightly less than 20%, below the average for participating countries. However, the share of workers reporting that their qualifications are lower than would be required to get their job today exceeds 20%, well above the international average. At the same time, analysis of the skills mismatch on the basis of literacy shows that Sweden has a larger share of underskilled workers and a smaller share of overskilled workers than the international average

About one-quarter of Swedish employers reported difficulties in filling vacancies in 2013, and the 10 most difficult to fill jobs included occupations at all skill levels: accountants, technicians, engineers, and managers, but also sales representatives, skilled trades, supervisors, machine operators, cooks, and drivers. Small firms had most difficulties in hiring, and recruitment times were the longest for information technology (IT) specialists, professionals, and Stockholm-based positions (World Bank 2015c). There are specific measures aiming to support staff training in young SMEs.

Traditionally, the Swedish education system has been very student focused and even more so in the last decade where pedagogic innovation such as 'problem based learning' etc. have been integrated in undergraduate and postgraduate programmes. There is a great deal of focus on independent problem solving, initiative taking and critical thinking. These aspects are integrated already in the primary and secondary school education. In fact, the levels of expectation on this front are so high and taken for granted that it has often been a problem when students from other backgrounds are integrated into the system.

Since the revision of the university Act (1997) to include the third mission, there has been a focus on skills in tertiary education. Teachers are required to ensure that all courses give students the opportunity to put the theoretical aspects of their education in practical context. This is usually dealt with by bringing in lecturers from firms, public sector, etc as relevant. Increasingly, some programmes are moving towards integrating internships.

In the 1990s, entrepreneurship education became a specific area of interest and since then these programmes have proliferated. In addition to the business plan courses normally run by the Innovation Offices at universities, there are specific programmes in entrepreneurship at most universities. In 2009, the Swedish government invited Swedish Universities to apply for extra funding to create world-class educational programmes in entrepreneurship and innovation. In total, 11 applications were submitted (often collaborations between several universities), and the two highest ranked applications received funding of approximately €1.5m⁹³: These were: 1.) Gothenburg Schools of Entrepreneurship (including Chalmers University of Technology and University of Gothenburg), and 2.) Master's Programme in Entrepreneurship, Lund University. Additionally, there are entrepreneurship electives available in all types of tertiary education programmes and in some faculties at some universities, it is compulsory for doctoral students.

Analysing innovation indicators for Sweden, the World Bank (2015c) points to challenges in areas relating to education and skills development where policy actions could improve competitiveness by training people with entrepreneurial talent and increasing the attractiveness of starting new businesses and by supporting further managerial skills upgrading.

5.4 Access to finance

Sweden's overall performance on access to finance outranks that of all the EU countries. There has been little relative progress since 2008 as for many years this has been one of the strong areas in the country's SBA performance. Although the share of rejected loan applications rose from 12 % in 2013 to 17 %, 2015, data show that Swedish SMEs have relatively few problems when raising capital (European Commission, 2015c, SBA Fact Sheet Sweden)⁹⁴. As mentioned in section 5.1 "getting credit" is one of the areas where the Swedish system has some weaknesses. The prominent players in the financial system include commercial banks, mortgage credit institutions, insurance companies, and to a lesser extent mutual fund companies and state-administered pension funds. Apart from investment banks and brokerage firms, financial firms from outside the Nordic region have not yet gained significant market shares in Sweden. The four largest banks—Swedbank, Nordea, SEB, and Handelsbanken—account for 86% of banking sector assets.

One of the first tasks of the newly formed Innovation Council (with the Prime Minister as chairman) was to consider how to best promote collaboration between the private and public venture capital initiatives. A report by the Swedish National Audit Office (Riksrevisionen 2014) had concluded that a relatively large part of the public national capital was invested in the parts of the market where private operators are most active, and in companies who made good progress in their development. According to the audit over 40% of the state risk capital was invested in companies in the expansion and mature phases, 27% of companies in the startup phase and only 0.2% in companies in

⁹³ The evaluation was done by an expert panel commissioned by the Swedish National Agency for Higher Education and resulted in the following ranking: 1. Gothenburg Schools of Entrepreneurship, Chalmers University of Technology and University of Gothenburg, 2. Master's Programme in Entrepreneurship, Lund University, 3. International Master's Programme in Entrepreneurship and Innovation, Jönköping University, Växjö University and University of Kalmar, 4. Master's Programme in Business Innovation and Technology-based Entrepreneurship, Royal Institute of Technology (HSV Beslut 69-5683-08).

⁹⁴ <http://ec.europa.eu/growth/smes/business-friendly-environment/performance-review/#sba-fact-sheets>

the seed phase. They saw a risk that government efforts crowd out private capital and that it is also at present overlapping activities between the state actors. In turn, this report led to a public inquiry: "A fund structure for innovation and growth" reported in SoU 2015:64 (Government of Sweden 2015).

The remit and focus of the inquiry has been to submit proposals for how state financial support to SMEs should be organised and conducted in order to be efficient. The focus has been on high-growth enterprises with a high technological content. The inquiry has analysed and assessed when state financial support, e.g. grants, loans or equity, may be motivated in order to correct or complement private financing in the market. In general, the Swedish financial markets are well developed by international comparison. However, the inquiry identified a need for stronger support in very early stages of the development of new or innovative enterprises. It also identified a lack of capital when financing the interval € 0.5–5.0m. Furthermore, it concluded that measures should be taken to enhance the availability of loans for SMEs in general.

Following the inquiry the Swedish government announced reforms of public financial support to SMEs, in the budget bill for 2016. The reforms announced include the ambition to establish a new public state-owned company incorporating the two existing public venture capital companies Inlandsinnovation AB and Fouriertransform Aktieföretag forming a new public company with a larger financial base and without predefined sectoral and regional limitations in investment focus. The investment technique of the new company will be fund-of-funds, i.e. it will co-invest with private capital in venture capital funds. The main objective of the new company will be to co-finance early stage venture capital investments in innovative Swedish enterprises with high-growth potential. Another objective is to contribute to the strengthening of the overall financial ecosystem in Sweden. A more detailed proposition of the reforms was presented to the parliament in March 2016 (Government of Sweden 2016). If accepted by parliament the changes will take force from January 1, 2017.

Current Swedish programmes to support SMEs access to finance are broadly focused and offer a variety of instruments and investment mandates. These programmes are managed primarily by large public agencies, e.g. ALMI, Norrlandsfonden, The Swedish Industrial Development Fund, Fouriertransform, Inlandsinnovation and the Energy Agency.

The largest, ALMI Företagspartner AB, is owned by the state and is the parent company of a group with 16 regional subsidiaries (40 national offices) that also includes Almi Invest AB and IFS Consulting AB. Almi has a broad mandate and activities include brokering of loans, equity and advisory services to companies. Operations are supposed to complement the private market and be accessible across the country. Almi has no formal limit as concerns the industry or development focus of businesses. Even so, today, the operational focus is on companies with high growth potential.

Almi Invest AB is the Group's venture capital company that was formed in 2009. In 2013, it acquired ALMI Innovationsbron AB (previously among other things responsible for the national Incubator programme, see 5.2 above). Venture capital activities are divided into a national fund for seed financing as well as eight regional venture capital companies. The regional venture capital companies make investments in collaboration with private and public actors, and with funds from the EU structural funds. In 2014, together with private capital, Almi Invest made 193 investments, including 70 new investments, totalling €62m.

The regional subsidiaries in Almi are primarily engaged in lending and advice activities to SMEs. The most common form of loan are the business loans that can be provided in addition to a bank loan. The loan may be adapted to the demand and needs. Companies in the early stages can be offered small loans with softer conditions. Special loans have been developed for innovative projects and companies. Innovation Loan is a small loan, approximately €5,000, with softer conditions intended for innovation projects in early stages. In 2014, €12.5m in loans were granted. There is also a new "growth-loan" aimed

at innovative companies with a need for larger amounts (from €25,000). Growth loans have a total ceiling of €128m by 2020, including funding from the European Investment Fund (EIF).

The total venture capital funds of ALMI amounts to €160m. At the end of 2014, ALMI had holdings in a total of 375 portfolio companies and in addition, holdings in 10 fund companies. In 2014, investments amounted to €23m, of which €11m related to new investments. ALMI's loan fund amounts to €600m. In 2014, loans totalled €260m to 4 000 companies. Almi receives an annual operating budget from the state of €28.5m and €4.4m to cover losses for innovation support. Almi had 481 employees at the end of 2014.

The foundation Norrlandsfonden (the Norrland Fund) was established by the state in 1961 with the mission to promote the development of manufacturing and services production in northern Sweden. The Fund's capital was built up by annual contributions from the mining company LKAB and later directly from the state. The foundation's capital amounted in 2014 to over €130m, of which €99m in loans and other involvement. Credits granted in the same year amounted to €34m (149 companies), of which €21m constituted loans. In February 2016 the European Investment Fund (EIF) and Norrlandsfonden, have signed a guarantee agreement to increase lending to innovative small and medium-sized enterprises (SMEs) and small mid-caps in Sweden. The new agreement will allow Norrlandsfonden to provide ca. EUR 19m of loans to innovative companies in Sweden over the next 2 years (see further below).

The Swedish Industrial Development Fund was established by the state in 1979, with the task to contribute to strong expansion and competitiveness in Swedish industry, by loans and guarantees primarily focused on larger companies. After EU admission in 1995, the Fund received a new focus on SMEs in the context of EU state aid rules. Since its inception, the Investment Fund has invested €1.65bn in Swedish companies. The Fund invests primarily through equity capital but also offers options and convertibles. Investments are made primarily in companies building and expansion in which the Fund will be an active and long-term minority shareholder. In 2013-14, the fund's capital and assets totalled €0.4bn, of which €198m were invested in companies. The same year, new investment and commitment amounted to €46m.

In the government's new proposition (Government of Sweden 2016) it is proposed that two existing public venture capital companies Inlandsinnovation AB and Fouriertransform Aktiebolag will be forming a new public company (Fondinvest) with a larger financial base and without predefined sectoral and regional limitations in investment focus. Fouriertransform is a venture capital company that invests in or finance companies engaged in research, development and investment. The Company's strategy is to be a long-term industrial partner and active owner of the companies. Investments are made on a commercial basis in partnership with private investors and are expected to provide a market return. When it was founded (in 2008 in reaction to the crisis in the automotive sector), Fouriertransform was assigned a capital of €310m. In 2014, it invested a total of €22m in five new companies and €21.6m in existing portfolio companies. Since its inception in fall 2009, Fouriertransform has invested around €150m in 25 companies. Fouriertransform has offices in Stockholm and Gothenburg and had 13 employees at the end of 2014.

Inlandsinnovation AB is a state-owned venture capital firm formed in 2010. Its task is to promote entrepreneurship and development in northern Sweden. Inlandsinnovation has since then invested €220m. Until 2014 the company invested €80m in 45 portfolio companies, of which 34 operating companies and 11 regional venture capital and growth funds. It has also contributed with loans to the Norrland Fund and Kredit Garantiföreningen in the north. Inlandsinnovation has offices in Östersund and at the end of 2014 it had seven employees.

The Energy Agency annually evaluates approximately 120 applications for commercialisation projects from SMEs in the energy sector. Of these, about 10 companies are granted support in form of soft loans, conditional loans and "growth-loans" for an annually amount of about €11m.

In the planning for the new Structural Funds period 2014-2020, the EU has given the Member States increased opportunities to apply for the so-called revolving instruments. The Swedish Government, in its national programme, proposed two new funds: a national fund-of-funds and a national green fund. In February 2016 the European Investment Fund (EIF) and Norrlandsfonden, have signed a guarantee agreement to increase lending to innovative small and medium-sized enterprises (SMEs) and small mid-caps in Sweden. This transaction benefits from the support of the European Fund for Strategic Investments (EFSI), the heart of the Investment Plan for Europe. The new agreement will allow Norrlandsfonden to provide SEK 180m (ca. EUR 19m) of loans to innovative companies in Sweden over the next 2 years. The loans will be enabled by an EIF guarantee under the "EU InnovFin finance for Innovators" initiative with financial backing from the European Commission's Horizon 2020 programme. The agreement will make it possible for Norrlandsfonden to offer innovative companies additional financing at favourable conditions⁹⁵.

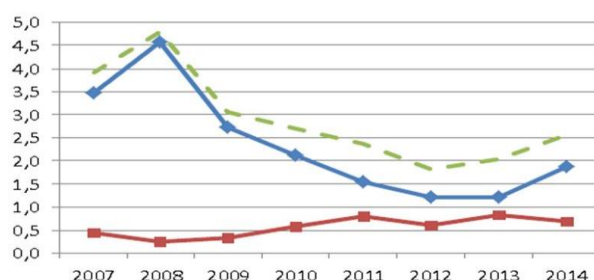
The Green Fund, the carbon fund, should be a direct invest fund for investments related to climate change, renewable energy and energy-efficiency. The Fund's investments will be focused on SMEs in the early phase. Investments are planned in about 50 different companies, initially with an investment per company at up to €0.8m. The preparations for the fund are in progress focusing on the business to start in 2016. National co-financiers to the Green Fund are planned to be the Energy Agency by 25%, €18.5m, and the project owner with the same percentage, 25%. In addition, funding from the EU is expected with €37m. In total, the fund's assets amount to €75m.

The inquiry also concluded (Government of Sweden, 2015) that there is a financial gap when it comes to bank financing for smaller companies with higher risk or without their own collateral. These companies cannot get bank loans but are referred to other forms of financing, mainly different forms of equity financing. The assessment is that some form of government guarantee scheme could facilitate this group of companies. The guarantee would aim to bridge a financing gap for loans to small businesses around €0.2-2m (with probable emphasis of about €0.3-1m). As for medium-sized enterprises (> 50 employees) it is deemed to be no need for government market-supporting measures in debt financing.

The inquiry (Government of Sweden, 2015) also took into account the existence and functioning of private venture capital funds. It was concluded that after several years of decline in the total venture capital investment, the trend has now reversed (Tillväxtanalys 2014b). In 2014, the private venture capital investments increased by €209m, an increase of 57% compared to 2013. Public investment declined at the same time. Overall, this meant that total venture capital investments rose by 27% between 2013 and 2014 (see Figure 13).

⁹⁵ https://ec.europa.eu/commission/2014-2019/katainen/announcements/investment-plan-europe-eu19-million-smes-sweden_en

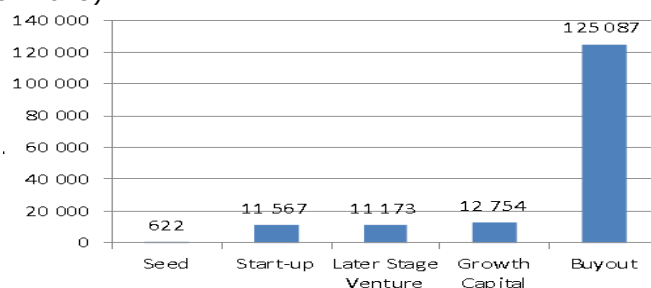
Figure 13: Venture capital 2007–2014, Billion SEK, 1 SEK is approximately €0.104-0.11 (Blue: Private, Red: Public, Green: total. Source SVCA and Government of Sweden 2015)



As shown in the figure, the total venture capital investment peaked in 2008, with a total of €500m but declined sharply after the financial crisis to a level of just over €200m in 2013. In essence, it was the private funds that reduced their investments after 2008, from nearly €470m in 2008 to €125m in 2013. The public venture capital companies increased their investments in the same period, albeit from a relatively low level.

The majority of venture capital investment in recent years has been in later phases of company development, particularly in the buyout stage (see Figure 14). Investments in the early stages were at a considerably lower level. The two largest sectors for venture capital investments in Sweden during this period were the IT sector and the life sciences, as well as energy and environmental technology although both life sciences and the cleantech area are known to lack capital in both early- and growth stage. The profile of the venture capital investments in Sweden largely follows the same trend as in the rest of Europe. In international comparison, Sweden is performing well when it comes to the level of venture capital investment relative to GDP. Among European countries, Sweden is ahead of Finland and Great Britain with investments averaging 0.08% of GDP, compared with a European average of 0.032% for the period 2007-2013.

Figure 14: Stages of VC investment, MSEK. 1 SEK is approximately €0.104-0.11 (Source: SVCA and Government of Sweden 2015)



Taken jointly, growth capital for private companies has generally decreased over the period 2006-2014. As we have seen, the venture capital investment over time demonstrated a changed patterns, the investment has gone more towards investments in the later stages. The explanations may be that venture capital funds with investments in earlier stages did not provide sufficient return, and that they have had difficulty attracting capital for further investment. Investments in later phases generally mean lower risk. Moreover, venture capital investments are concentrated in a few industries, especially the IT sector, which now represents about 65% of investments, and life science. Another change is that the venture capital is mainly invested in companies with global growth potential. The size of investments has also increased. Despite these changes, the risk capital in the form of venture capital investments is important as growth capital for companies.

The state inquiry (Government of Sweden, 2015, SOU 2015:64) recommends that a new public state-owned fund should be set up in order to co-invest with private capital in venture capital funds. The fund will also act as the holding company in a new investment structure. The main objective of the new fund will be to co-finance early stage venture capital investments in innovative Swedish enterprises with high-growth potential. Another objective is to contribute to the strengthening of the overall financial ecosystem in Sweden. The fund will be a limited company called Fondinvest AB, with a total capital of €960m.

Fondinvest AB will be a holding fund in a structure comprising several funds. Up to six new funds will be set up with total capital of €53–107m. Furthermore, two EU-financed funds will be incorporated into the new structure. The inquiry also proposes a demonstrator fund, capitalised with €160m, for investments in production-scale facilities. Fondinvest AB will also administer a loan guarantee system, aimed at securing access of small enterprises to financing. Finally, the inquiry proposes measures to enhance the support for developing innovative enterprises. In total, €36m in increased funding is proposed for several measures to enhance loans and grants for innovation. In accordance with the government's proposition (Regeringens Proposition 2015/16:110) the implementation of the new investment structure should be conducted in 2016 so that the new fund, Fondinvest AB, can be in full operation at the beginning of 2017.

As regards Business Angels, in the case of Sweden, the Government has not prioritised a direct role in the development of the Business Angel market. Certain legislative proposals and programmes had a bearing on Business Angels, but they have not been a priority objective of the Swedish government and the relevant government agency (*Tillväxtverket*) has not assumed the promotion of Business Angels as an explicit objective.

5.5 R&D related FDI

A range of data shows that Sweden is a strong destination for FDI. Foreign ownership in Sweden has increased rapidly in the past decade. Foreign-owned firms now employ almost 25% of the workforce in business and industrial sectors, mostly in services and manufacturing. While it was heavily affected by the global financial crisis, FDI inflows for 2012 indicate that the country is well on its way to making a full recovery in attracting investment (World Bank 2015c). Inward FDI in Sweden's manufacturing sector seems to be dominated by market-seeking FDI—investment attracted by the size of the domestic market and its potential for growth. Technologically advanced industries attract a large share of FDI, while natural resources, such as the country's forestry industry, attract relatively little. Foreign companies invest in Sweden's manufacturing and services sectors in part because of the country's comparative advantage in capital-, human- and energy-intensive products and because of the appeal of industries offering assets in the form of well-known products and strong brand names (World Bank 2015c). In 2012 Sweden ranked among the top 20 host economies for FDI inflows in absolute terms, according to UNCTAD's World Investment Report 2013, ahead of all other Nordic economies. Among OECD high-income economies, on a per capita basis, Sweden was the 6th largest recipient of FDI (UNCTAD 2013).

Sweden's regulations relating to the activities of foreign investors are mostly in line with best practices around the world. Foreign investors setting up a company in Sweden complete the same few procedures as domestic investors do. As part of the country's harmonisation with EU rules, the central bank abolished virtually all exchange controls in 1989 and eliminated the rest in 1994. There are no controls on FDI-related capital flows, and investment-related payments may be made freely. Nor are there any restrictions on making current payments in foreign exchange, other than a need for reporting related to anti-money-laundering or tax requirements.

Foreign direct investments in OECD economies like Sweden have primarily taken the form of acquisitions, in which foreign multinationals expand their network of production, sales, and research and development (R&D) units and locate them as FDI firms across a set of countries. In Sweden about 50% of foreign-owned firms are acquisitions, and 30% new establishments.

In 2013, 39% of R&D-activities in the Swedish business sector were carried out by foreign-owned companies. This corresponds to approximately €3 750m. The major part of this (€3 135m) was carried out in foreign formerly Swedish enterprise groups (Tillväxtanalys 2015a)⁹⁶.

The inflow of foreign firms and owners seems to strengthen Sweden's future prospects rather than erode the basis for the competitiveness and attractiveness of dynamic local sectors. The substantial increase in foreign ownership in Sweden in the 1990s led to greater relative demand for skilled labour in the country. Besides, the larger presence of foreign multinational enterprises in an industry appears to increase the relative demand for skills in Swedish multinationals within the same industry as well as technology transfers.

For many years Sweden had a national inward investment agency: Invest Sweden. In 2013, the government decided to merge Invest Sweden and the export council (Exportrådet) into the new organisation Business Sweden. Business Sweden gets directions from the government each year, but there is no longer any specific policies aimed at attracting R&D intensive FDI. Annually, Business Sweden participates in around 25 high-quality FDIs.

5.6 Knowledge markets

The existence of the professor's privilege (see further section 5.7) means that there is little utility in creating centralised arrangements for dealing with intellectual property. Instead Sweden has chosen a decentralised approach in which the emphasis has been on ensuring that there is widespread knowledge of intellectual property support services. In addition, there is a mixture of public and private providers in this sector. For example, university employees and students have access to legal and other support mechanisms for patent creation, licensing, etc. through the innovation offices, the holding companies at universities, etc. Private citizens and companies have a similar array of services available to them through ALMI, CONNECT and other similar arrangements. There are several events annually spread out all over the country at which these entities present their services to the public and business community. The national patent agency has a search engine which is available both publicly and on a fee basis for patent searches, and similar type services.

5.7 Public-private cooperation and knowledge transfer

In Sweden, many of the standard proxies and indicators for knowledge transfer and open innovation cannot be provided because of the way in which these activities are categorised or as a result of other peculiarities in the Swedish system. Three of the most relevant framing conditions that undermine the possibility of providing standard indicators on knowledge transfer are (i) professor only exists as an academic position in Sweden, it is not a title. Thus, one cannot have professors employed at firms and if they are perhaps on a part time basis, their employment there will be formally not as Professor (ii) Swedish researchers and not universities own intellectual property arising from their research results (the Professor's Privilege), this implies that patent applications and firm formation done by Swedish researchers even within the context of the university are done in their capacity as private individuals and does not feature in the university's reporting on knowledge transfer, and (iii) universities collaborative

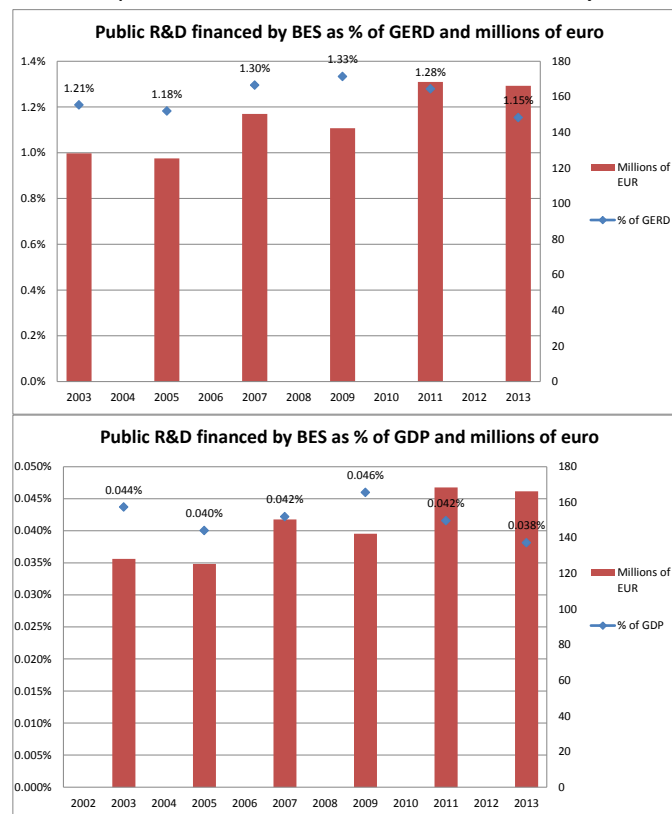
⁹⁶ <http://www.tillvaxtanalys.se/publikationer/statistikserien/statistikserien/2015-05-27-forskning-och-utveckling-i-internationella-foretag-2013.htm>

agreements with firms are not recorded as a separate category from other project funding obtained by the university. Thus, one may obtain an estimation of how much corporate funding went to Swedish universities but not whether it was specifically for a collaborative agreement. This last issue is further complicated by the fact that universities and firms are often co-applicants for project-based funding from research councils and foundations. The firm's own contribution to this agreement in such cases is often embedded in the application and not visible at the level of funding. These facts also make it problematic for the Swedish government itself to track knowledge transfer and the increased promotion of open innovation chains has made it doubly so. A classic manifestation of this is the belief that there is an innovation paradox while much of the empirical evidence suggests otherwise. An important contributing factor to this is the inability of government to ascertain for itself, the extent of university-industry collaboration generally and particularly the level of patenting and firm formation arising from academe.

5.7.1 Indicators

Funding: BES-funded/publicly-performed R&D

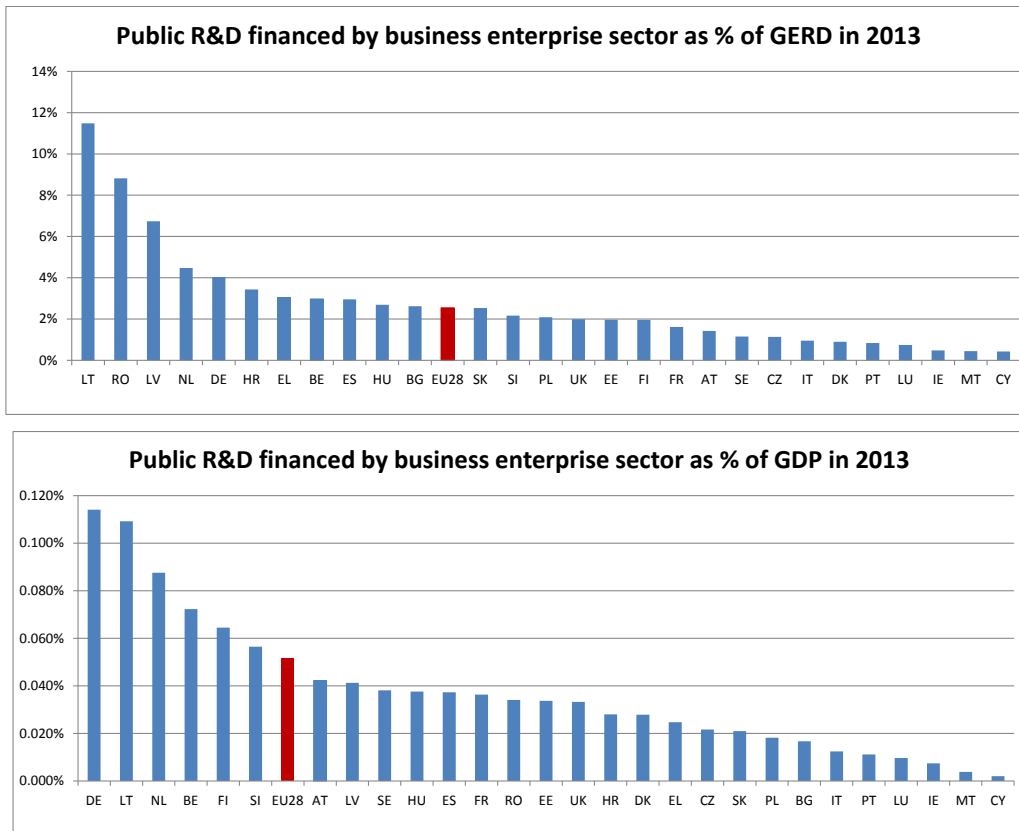
Figure 15: BES-funded public R&D in SWEDEN as % of GERD (in €MLN) and % of GDP



In 2011, the level of public R&D expenditure funded by the business enterprise sector in Sweden stood at 0.04% of GDP which is low compared to similar countries such as Finland (0.08%) and Germany (0.11%). This is mainly due to the fact that the private non-profit (PNP) sector is not included in the above figures which is the sector that stands for the lion share of privately funded public R&D in Sweden. Including the PNP funding would bring the above value up to ca. 0.14% of GDP for 2011 and 0.13% for 2013 which would make Sweden top the list of EU-28 countries. The same observation is true for privately funded publicly performed R&D expressed as share of GERD: when contributions from PNP are included, the share of GERD stood at around 4.2% of GERD in 2011 and 3.8% in 2013.

The two charts in Figure 16 show the values of BES-funded public R&D in all EU-28 as percentages of GERD and GDP respectively. The same caveat applies as for the interpretation of Figure 15, i.e. the PNP sector not being included in the calculation of the shares.

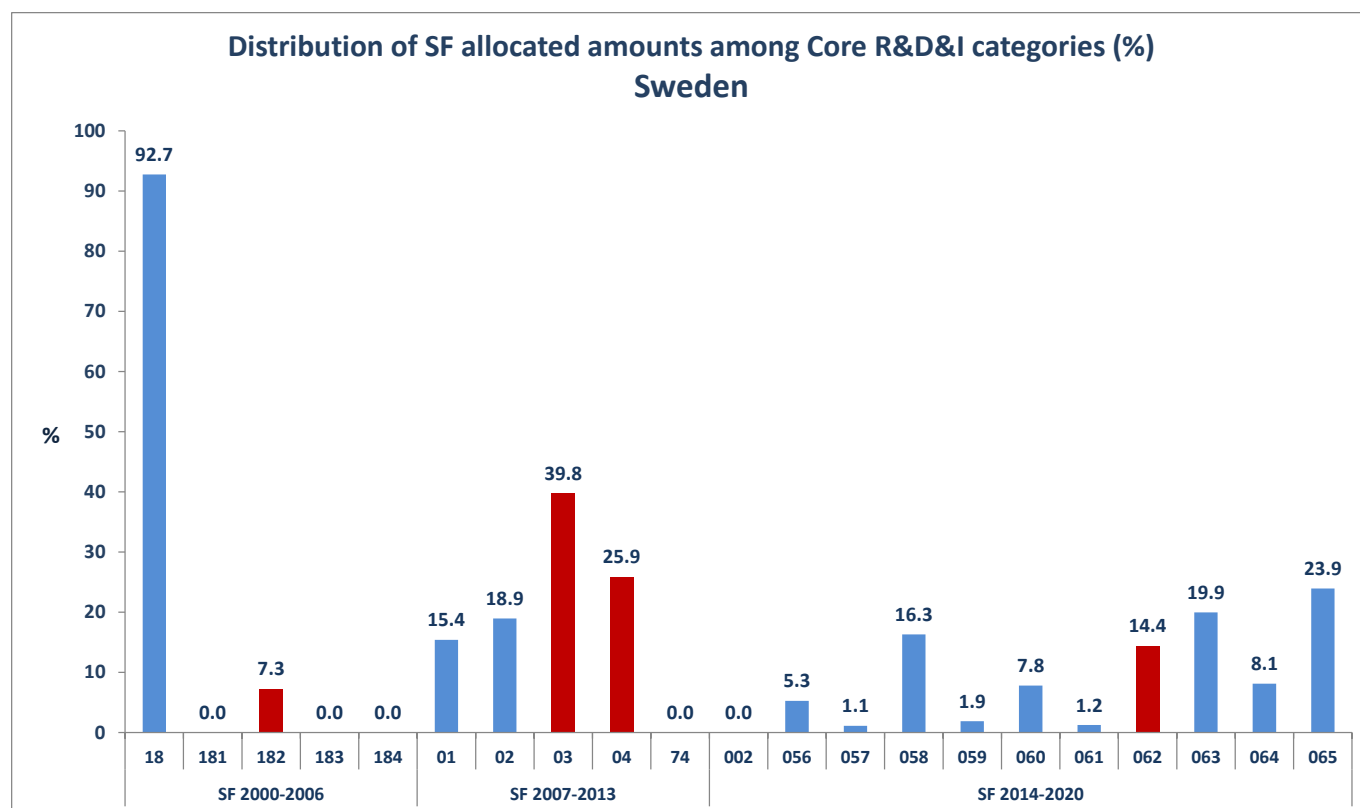
Figure 16: BES-funded public R&D as % of GERD and as % of GDP in 2013 in Member States⁹⁷



⁹⁷ 2013 was chosen as the latest data series providing a full comparison within EU-28.

Funding: Structural funds devoted to knowledge transfer

Figure 17: Structural Funds for core R&D activities 2000-2006, 2007-2013 and 2014-2020⁹⁸. The categories: 182 (2000-2006), 03 and 04 (2007-2013) and 062 (2014-2020) are used as proxies for KT activities.



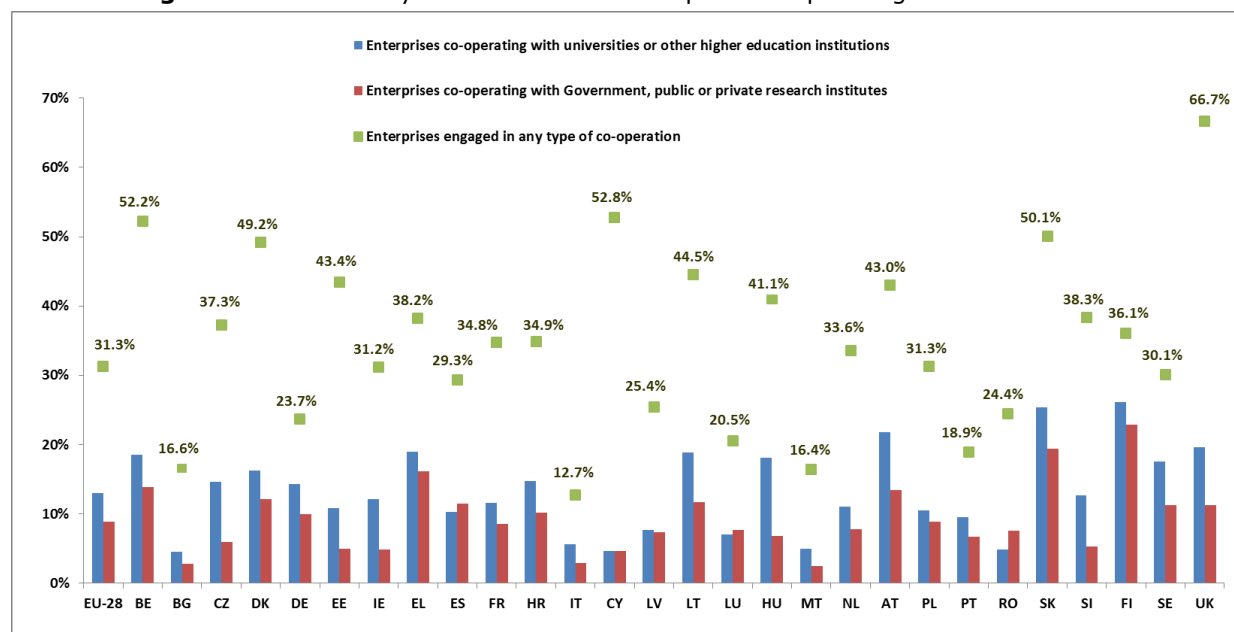
Over the programming period 2007–2013 Sweden allocated 65.7% of its structural funds for core R&D activities to technology transfer and improvement of cooperation networks as well as assistance to R&TD (compared to 7.3 % in the previous programming period). This share was more than double the EU average of 30% for the 2007-2013 period but much lower than the EU average of 26% in the 2000-2006 period. For the current

⁹⁸ Figure 17 provides the Structural Funds allocated to Sweden for each of the above R&D categories. The red bars show the categories used as proxies for KT. Please note that the figures refer to EU funds and they do not include the part funded by the Member State. The categories for 2000-2006 include: 18. Research, technological development and innovation (RTDI); 181. Research projects based in universities and research institutes; 182. Innovation and technology transfers, establishment of networks and partnerships between business and/or research institutes; 183. RTDI infrastructures; 184. Training for researchers. The categories for 2007-2013 include: 01. R&TD activities in research centres; 02. R&TD infrastructure and centres of competence in specific technology; 03. Technology transfer and improvement of cooperation networks; 04. Assistance to R&TD particular in SMEs; 74. Developing human potential in the field of research and innovation. The categories for 2014-2020 include: 002. Research and Innovation processes in large enterprises; 056. Investment in infrastructure, capacities and equipment in SMEs directly linked to Research and Innovation activities; 057. Investment in infrastructure, capacities and equipment in large companies directly linked to Research and Innovation activities; 058. Research and Innovation infrastructure (public); 059. Research and Innovation infrastructure (private, including science parks); 060. Research and Innovation activities in public research centres and centres of competence including networking; 061. Research and Innovation activities in private research centres including networking; 062. Technology transfer and university-enterprise cooperation primarily benefiting SMEs; 063. Cluster support and business networks primarily benefiting SMEs; 064. Research and Innovation processes in SMEs (including voucher schemes, process, design, service and social innovation); 065. Research and Innovation infrastructure, processes, technology transfer and cooperation of enterprises focusing on the low carbon economy and on resilience to climate change. This allocation is not very precise, since the category 'Research and Innovation in SMEs' also comprises SMEs including voucher schemes, which may be used for contract research, whereas the funds allocated to infrastructure are the highest. The latest Innovation Union Scoreboard 2015 ranks the Slovak Republic as moderate innovator..

programming period, 14.4% of Core R&D funds are budgeted for knowledge transfer activities.

Cooperation: Share of innovative companies cooperating with academia

Figure 18: CIS survey 2012 – share of enterprises cooperating with academia



According to data from the CIS survey 2012, 30.1% of innovative Swedish companies were engaged in some type of cooperation with academia, which is very close to the EU average of 31%. A bit more than half of these companies (i.e. 17.6% of total sample of innovative companies) cooperate with universities and higher education institutions. This is slightly more than in Denmark (16.2%) and clearly more than in Germany (14.3%), two countries classified as innovation leaders in the Innovation Union Scoreboard, just as Sweden. A bit less, 11.3% of innovative companies cooperate with government or public or private research institutes. Cooperation with government or public or private research institutes is at similar levels in Denmark (12.1%) and Germany (9.9%). In the fourth country belonging to the group of innovation leaders, in Finland, innovative companies are much more frequently engaged in cooperation with universities and higher education institutions (26%) as well as with government or public or private research institutes (23%).

Cooperation: Technology Transfer Offices (TTOs), incubators and technological parks

Sweden has been focusing on science-based entrepreneurship for over a decade and the first science parks were constructed in the 1980s. This earlier generation of investments in which science parks played a pivotal role focused on improving collaboration between large firms and universities. A recent example is Johnson & Johnson's planned "innovation hub" linked to the creation of one of Europe's largest science parks at the Karolinska Institute in Stockholm⁹⁹. Since 2000, the general focus has shifted away from science parks to put incubators in focus instead (also see section 5.2). This fits with the last two decades of economic growth policies which have been largely focused on an incremental industrial restructuring to decrease Sweden's dependence on the large multinational firms such as Ericsson and ABB.

⁹⁹ <http://www.sciencebusiness.net/news/77328/Building-the-innovation-hub-in-Stockholm>

The Swedish innovation agency VINNOVA re-assumed responsibility over the national support for incubators in early 2015. The Swedish National Association for Business Incubators and Science Parks (SISP)¹⁰⁰ has 65 members that are organised in 43 business incubators and 33 science parks. All members together unite 5 000 companies with more than 70 000 employees.

Although Sweden has not formally changed the property ownership rules to favour universities ownership, Swedish universities are obliged to provide an infrastructure to support dissemination and/or commercialisation of research results created by their employees and students. This would include services such as advice and expertise on patenting, information about how to start a company, etc.. As discussed above (see section 5.2) most Swedish universities have some type of incubator and support infrastructure for university spin-offs. Based on the 2008 research bill and following a government decision in 2009, 12 Innovation Offices have been established at Swedish universities.

Cooperation: Share of public-private co-publications

Figure 19: Co-publications by field 2003-2013 in Sweden. Scopus database¹⁰¹

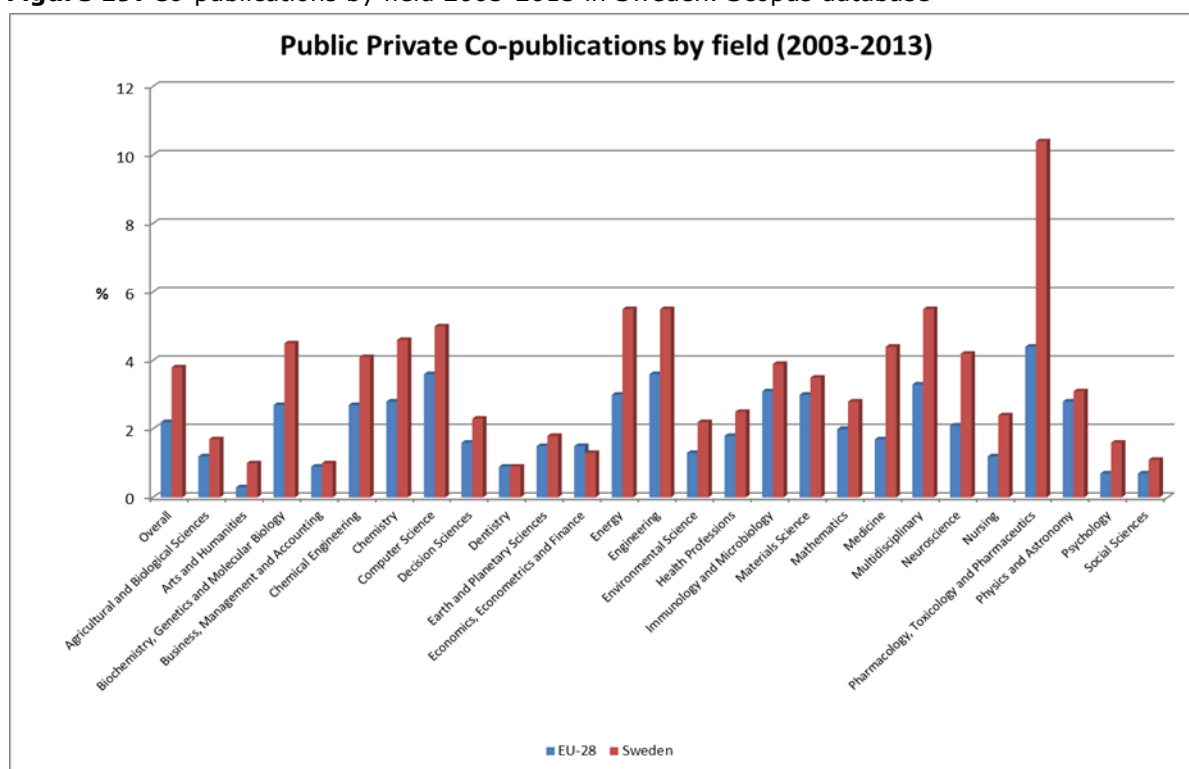


Figure 19 shows the 2003-2013 average percentage of academia-industry co-publications by field in Sweden compared to the European average. The Swedish share of public-private co-publications is considerably higher than the EU average in almost all fields. The domains with highest percentage of co-publications (excluding multidisciplinary publications) are by far pharmacology, toxicology, pharmaceutics followed by energy and engineering. Moreover, in 2013 Sweden had 113.3 public-private

¹⁰⁰ <http://www.sisp.se/>

¹⁰¹ Source: JRC IPTS RIO elaboration on Scopus data collected by Sciencematrix in a study for the European Commission DG RTD (Campbell, 2013). The share of public-private co-publications is derived from the Scival platform and is also based on Scopus data (September 2015). SciVal[®] is a registered trademark of Elsevier Properties S.A., used under license. The data on public-private co-publications is not fully compatible with the data included in the IUS, due to differences in the methodology and the publication database adopted.

co-publications per million of population compared to 29 for the EU-28 (155 for Finland, 182.1 for Denmark and 57.8 for Germany)¹⁰².

Cooperation: Inter-sectoral mobility

Knowledge transfer as measured in exchange of personnel between firms, the public sector and universities may be tracked through the categories of adjunct personnel and industrial doctoral students. This is only a partial indicator since it only tracks inflows to universities from other sectors not outflows. This is in part due to the fact that most of the programmes aimed at promoting inter-sectoral mobility have been focused on firm-university mobility rather than the other way round. The 2015 annual report for the higher education sector showed that number of researchers and teachers at universities in Sweden in 2014 was 34 500 persons and they represented 28 937 FTE. Of these FTE, 5 075 (18%) were professors, 8 378 (29%) were lecturers, 2 892 (10%) were post docs, adjunct (personnel without a PhD) accounted for 18% (5 081) and another 26% were described as simply other research personnel. Industrial doctoral students probably represent the largest and most fluid exchange of personnel between academe and industry. In addition, there were 18 970 doctoral students at Swedish universities (Swedish Higher Education Authority, 2015a).

Recently, there have been attempts to promote flows of personnel from academe to industry but these are not as numerous as the other way round. One such programme is FLEXIT which is a pilot programme to promote exchange; it targets young researchers from the Humanities and Social Sciences. FLEXIT started in 2010 and 20 researchers have been placed since then¹⁰³.

Cooperation: Patenting activity of public research organisations and universities together with licensing income

Sweden is one of the three EU countries (together with Italy and Poland) where university researchers and teachers own the rights to any intellectual property arising from their research. This also means that patent applications from universities are filed by individuals or firms (instead of institutions). This is so despite several national government investigations and repeated arguments by e.g. the OECD that Sweden should change this institutional setting. Jacobsson, Lindholm Dahlstrand and Elg (2013) discussed this "dominant belief" and the commercialisation of academic research in Sweden. They found strong indications that Sweden was performing quite well, both in terms of the number of university spin-offs created and the amounts of patenting originating in Swedish universities.

Researchers' ownership of intellectual property generally makes it difficult to make a systematic evaluation of the public science system's contribution to technology development. This needs to be taken into account when analysing the below data. When discussing patents originating in Swedish universities it is also important to distinguish between the share of university inventors or the share of university ownership (including individual university researchers' ownership) that is discussed. In Sweden it is relatively usual with a university researcher as inventor, but a private company as applicant/owner of the patent. If these patents are included as university patenting, the share of university patenting increases considerably. By checking patents with university inventors, Ejeremo (2012) finds that 6% of all Swedish patents originate in universities, a figure quite similar to the US. This is an important form of knowledge transfer in the Swedish system.

According to the Knowledge Transfer Study 2010 - 2012, 2.9 patents were granted per 1 000 research staff in Sweden for 2011 and 2012 combined, which is clearly below the EU average of 4.5 patents granted and below the numbers for many other EU countries but interestingly still above the number of patents granted for Finland (1.3), Denmark (2.1)

¹⁰² RIO elaboration based on Scopus data.

¹⁰³ <http://www.rj.se/For-forskare/Flexit-univ--naringslivet/>

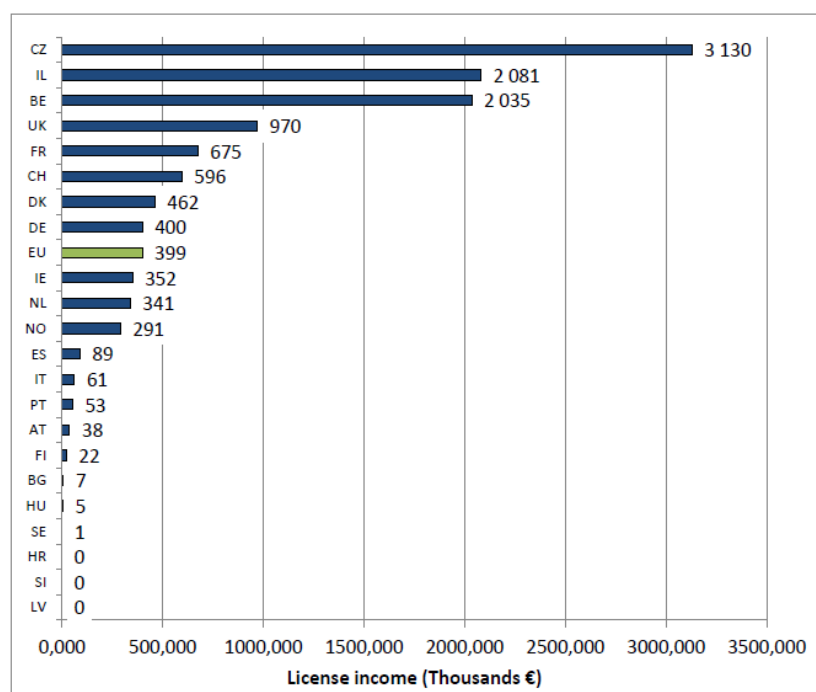
and Germany (2.6). Over the same period, less than one new licence agreement was concluded per 1 000 research staff which is the second lowest value of all countries studied. Consequently, licence income is equally low with only €1,000 received per 1,000 research staff for 2011 and 2012 combined. On average close to €400,000 were received per 1,000 research staff in the EU (Figure 20). Danish institutions received €462,000, German institutions received €400,000 and in Finland – that also ranks low on this indicator – institutions still obtained €22,000. Research agreements concluded show a similar picture with 2.2 agreements concluded by Swedish research staff compared to an EU average of 82.8 (European Commission, 2012).

There is some evidence that Sweden also lags in opportunities to learn from foreign intellectual property. Royalties, license fees and similar payments to non-residents—which reflect learning opportunities from the use of patents, copyrights, trademarks, industrial processes and franchises—account for 3.2% of service imports in Sweden (World Bank, 2015c). This share is larger in all comparator countries except Denmark, and especially so in the United States, where these payments account for more than 8% of its significantly larger service imports. The extent to which domestic patents are sold or licensed is another indicator of the ease and extent of knowledge flows. Here too Sweden lags behind its comparators, with 8% of patents sold and 7% licensed.

Figure 20: License income per 1 000 research staff by country. EKTIS 2011-2012 survey.

Source: KT study 2010-2012

Exhibit 3-35: Thousands Euros of license income per 1,000 research staff by country, EKTIS 2011 and 2012 results combined



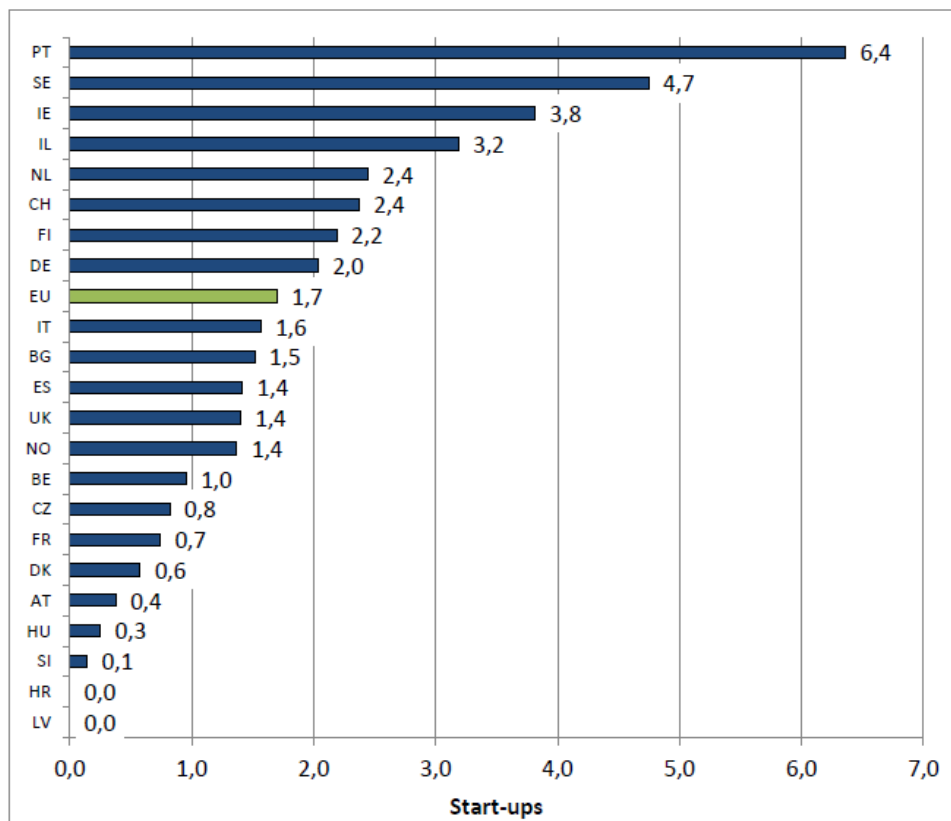
Source: MERIT, European Knowledge Transfer Indicator Survey 2011 and 2012.

Cooperation: Companies

In terms of the number of start-ups from the research sector, Sweden comes in second with 4.7 start-ups per 1 000 research staff. On this indicator, Sweden performs clearly better than Finland (2.2), Germany (2.0) and Denmark (0.6) (European Commission, 2012).

Figure 21: Number of start-ups per 1 000 of research staff per country. EKTIS 2011-2012 survey

Exhibit 3-33: Number of start-ups per 1,000 research staff by country, EKTIS 2011 and 2012 results combined



Source: MERIT, European Knowledge Transfer Indicator Survey 2011 and 2012.

5.7.2 Policy Measures

Although Swedish University researchers and teachers own the intellectual property arising from their research, there are several programmes at the national and university level promoting the commercialisation of research results. Additionally, most Swedish universities have some type of incubator and support infrastructure for science based entrepreneurship. One of the more significant initiatives in this regard is the university and university college strategic outreach programme for the Development of the Knowledge Triangle¹⁰⁴ (Utveckling av Kunskapstriangeln) which was initiated by VINNOVA in 2013. In December 2013, the winning applications were announced uniting 28 higher education and research entities that will receive a total of €9.5m (SEK 82m)¹⁰⁵ over two years. Another call was opened in 2014. This programme is a second generation version of the Key Actors Programme¹⁰⁶ (Nyckelaktörsprogrammet) which was launched in 2006 and had a total budget of approx. €22.6m (Jacob, 2015).

¹⁰⁴ <http://www.vinnova.se/sv/Var-verksamhet/Innovationsformaga-hos-specifika-malgrupper/Kunskapstriangeln/Utveckling-av-kunskapstriangeln/>

¹⁰⁵ All currency conversions to EUR are RIO conversions based on the ECB 2013 average exchange rate, http://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=120.EXR.A.SEK.EUR.SPOO.A

¹⁰⁶ <http://www.vinnova.se/sv/Var-verksamhet/Innovationsformaga-hos-specifika-malgrupper/Kunskapstriangeln/Nyckelaktorsprogrammet/>

Closer collaboration between industry and academia is also among the objectives of two of VINNOVA's strategic areas of activity, the Strategic Innovation Areas¹⁰⁷ (Strategiska Innovationsområden) which invite private and public sector actors to develop a common agenda on tackling innovation in a specific area and the Challenge Driven Innovation Programme¹⁰⁸ (Utmaningsdriven Innovation). Funding for the Strategic Innovation Areas was approx. €17m (SEK 145m) in 2013 including around €2.3m (SEK 20m) from the private sector. It is due to increase to €144m (SEK 1.25bn) in 2016 with around 50% from business.

The regional growth programme VINNVÄXT – Regional Growth through Dynamic Innovation Systems¹⁰⁹ - that was launched in 2001 emphasizes the geographical component of knowledge transfer between disciplines as well as R&D and innovation. It follows the principle that colocation can provide conduits for knowledge flows based on social interaction, visibility and networks. The programme is managed by VINNOVA. Triple Helix constellations (actors from the public sector, academia and the business sector) are a prerequisite to receive funding. VINNVÄXT has a total budget of about €62m and has issued five calls for proposals, the latest of which was opened in February 2015. Another platform for knowledge transfer and open innovation are the Competence Centres and Centres of Excellence for Innovation. The second generation competence centres were called Berzelii centres and were a VINNOVA-Swedish Research Council funding collaboration. Selection criteria included scientific excellence and large innovation potential. Four centres were funded in the first round and were evaluated in 2013. An evaluation of the centers focused on scientific performance and innovation potential. The results were mixed with one centre emerging as a clear leader on all indicators and all the centres performing well in scientific quality while innovation potential was quite mixed (Reeve et al 2013). This may in part be due to the fact that the focus was on frontier research and firms may not be ready to invest at the point in time that the invention emerges. It is interesting to note that an evaluation of the strategic research areas came to a similar result, arguing, among other things, that the groups could be more focused on societal needs. Although little attention has been paid to this aspect, the results point to a tension between relevance and scientific excellence which may warrant some further research.

Eventually, the Berzelii centres became integrated in the larger centre of excellence programme run by the Swedish Research Council, known as the Linnaeus centres. In 2015 VINNOVA launched a new call for Competence Centres. The new Competence Centre programme aims to stimulate businesses, the public sector and academia to connect their research and innovation efforts. VINNOVA intends to finance 13 centres, each with annual financing between €0.3 and 1m (for 5 or 10 years). Matching co-funding from both industry and the university is required¹¹⁰. Another scheme, the VINN Excellence Centers¹¹¹ provide a forum for collaboration between the private and public sectors, universities, colleges and research institutes and organisations. The Centres can be funded up to ten years and work to ensure that new knowledge and new technological developments lead to new products, processes and services. VINNOVA is currently funding 17 VINN Excellence Centers with a total budget of €23m. VINNOVA's programme for concept verification, VINN-Verification¹¹² (Verifiering för tillväxt) offers

¹⁰⁷ <http://www.vinnova.se/en/Our-activities/Cross-border-co-operation/Cooperation-Programmes/Strategic-innovation-areas/>

¹⁰⁸ <http://www.vinnova.se/en/Our-activities/Cross-border-co-operation/Challenge-driven-Innovation/>

¹⁰⁹ <http://www.vinnova.se/sv/Var-verksamhet/Innovationsformaga-hos-specifika-malgrupper/Individer-och-innovationsmiljoer/VINNVAXT/>

¹¹⁰ <http://www.vinnova.se/sv/Var-verksamhet/Innovationsformaga-hos-specifika-malgrupper/Individer-och-innovationsmiljoer/Kompetenscentrum--nytt-program-for-langsigtig-forskningssamverkan/>

¹¹¹ <http://www.vinnova.se/en/Our-activities/Innovativeness-of-specific-target-groups/Individuals-and-Innovation-Milieus/VINN-Excellence-Center/>

¹¹² <http://www.vinnova.se/en/Our-activities/Innovativeness-of-specific-target-groups/The-Knowledge-Triangle/VINN-Verification/>

the possibility to conduct a more comprehensive commercial and technical verification and validation of research results with commercial potential. Moreover, a number of programmes have been introduced for promoting intersectoral mobility with emphasis on university-industry mobility, such as Mobility for Growth¹¹³, which is supporting attractive career opportunities for experienced researchers in both public and private sectors and encouraging them to move between countries, sectors and disciplines. Mobility for Growth is implemented by means of partnerships between public and private actors from different countries across Europe and beyond and is further developing the previous VINNMER programme¹¹⁴. Vinnmer ran from 2007-2014 with a total budget of just over €69m (SEK 600m). The programme was co-financed by the FP7 Marie Curie Actions.

Since 2000, the focus has shifted away from science parks to instead put incubators in focus. In 2013, the government also topped up funding for strengthening business incubators in Sweden with an addition of €3.5m in the annual appropriations of the incubator programme run by VINNOVA. In January 2015, VINNOVA re-assumed responsibility for all support to incubators that is now pooled under its roof. Over the course of 2015, VINNOVA ran another call in its incubator scheme.

Furthermore, VINNOVA together with Almi, the public venture capital and business support agency for helping SMEs, manages a programme for Innovation vouchers¹¹⁵ (Innovationscheckar) that provide companies with growth potential the opportunity to obtain externally supplied knowledge and technology which may help the company in commercialising an innovation that in turn leads to increased company growth. Using the innovation vouchers SMEs can purchase the services of universities, institutes or other public or private knowledge providers for up to €9,000. Over 200 SMEs received vouchers in 2013.

The Knowledge Foundation is a public research foundation which was set up specifically to promote collaboration between the new university colleges and firms. It has launched two new programmes focused on knowledge exchange: the Expert Competence for Innovation and the Avans programme. The Expert Competence for Innovation is a funding call directed at university colleges, research institutes and firms and intended to provide funding to create educational offerings that would meet the needs of the company. The intention is that this educational offering would be grounded in an existing critical mass of research in the area. It is expected that successful applications would receive about €420,000 each to prepare, evaluate and conduct a pilot. The Avans programme¹¹⁶ refers to the development of industry relevant training programmes at advanced level. The Foundation is also engaged in the programme Research Profiles¹¹⁷ (Forskningsprofiler) which funds new research environments with up to €3.3m each. Half of the total amount of funding relates to issue of strengthening the links between science and industry and to creating environments conducive to increased private investment in R&D. The foundation also provides funding for Company graduate schools¹¹⁸ (Företagsforskarskolor) for individual doctoral students at small companies as well as for the development of larger industrial research schools. A similar scheme run by the

¹¹³ <http://www.vinnova.se/sv/Var-verksamhet/Innovationsformaga-hos-specifika-malgr http://www.vinnova.se/en/Our-activities/Innovativeness-of-specific-target-groups/The-Knowledge-Triangle/VINNMER/upper/Kunskapstriangeln/Mobility-for-Growth/>

¹¹⁴ <http://www.vinnova.se/en/Our-activities/Innovativeness-of-specific-target-groups/The-Knowledge-Triangle/VINNMER/>

¹¹⁵ <http://www.vinnova.se/sv/Var-verksamhet/Innovationsformaga-hos-specifika-malgrupper/Innovativa-sma-och-medelstora-foretag/For-Foretag/Innovationscheck1/>

¹¹⁶ <http://www.kks.se/verksamhet/SiteAssets/Kompetensutveckla%20p%20avancerad%20niv/Startsida/Programblad%20Avans.pdf> (in Swedish)

¹¹⁷ <http://www.kks.se/verksamhet/Bygga%20forskningsmiljer/Forskningsprofiler.aspx>

¹¹⁸ <http://www.kks.se/verksamhet/Forskarutbildning/F%C3%B6retagsforskarskolor.aspx>

Swedish Research council, the Industrial PhD project (Industridoktorandprojekt – ID-projekt), was discontinued in 2013 due to insufficient interest¹¹⁹.

As from 2015, VINNOVA gathered support for innovation in SMEs in a new programme. This concerns above all the programmes Research&Grow and VINN NU which are now pooled under the new umbrella programme Innovation Projects in Companies¹²⁰.

Research funders Forte, Formas, the Bank of Sweden Tercentenary Foundation and the Swedish Research Council announced joint funding for a research programme entitled Society's Long-Term Supply of Knowledge. The call opened in January 2015¹²¹.

In October 2014, VINNOVA published the study "Patterns of Cooperation of Higher Education Institutions and its Effects" (VINNOVA, 2014) as part of a broader assessment exercise to evaluate HEIs collaboration with industry, the public, government and other organizations in the community. This report mainly presents a literature review of interaction patterns and their effects. Its main findings are that collaboration in technology transfer provides relatively modest effects compared with other interaction patterns such as cooperation in education and research (which include joint research projects, contract research and mobility of personnel) which generate clear competence and learning effects.

5.8 Regulation and innovation

The Ministry of Enterprise and Innovation is the ministry in charge of innovation policy. There are two bodies under its domain that are commissioned to analyse and assess aspects of regulation that may impact innovation:

a) The Swedish Agency for Growth Policy Analysis ("Tillväxtanalys")

This agency is in charge for evaluations and analyses on growth policy. In its legal foundation, it is stated that the Agency has to evaluate, analyse and account for impacts of governmental initiatives for sustainable growth, industry and regional development in the whole country, and provide support and recommendations for reconsideration and increasing efficiency of such initiatives (Förordning (2009:146) med instruktion för Myndigheten för tillväxtpolitiska utvärderingar och analyser). Within this remit, Growth Analysis assesses impacts on innovation.

The Agency focuses on three specific priority areas, all of which are of relevance for innovation¹²²:

- Structural transformation and industry dynamics for sustainable growth
- Knowledge and competence for innovation in global value chains
- Regional attractiveness and power to develop throughout the country

b) The Swedish Better Regulation Council

The Swedish Better Regulation Council was established in 2008 as a public commission of inquiry. The main mission of the council is to assess the design of proposals for new legislation containing regulations that might impact the conditions for business to carry out their activities, the competitiveness of companies or other concerns. The assessment

¹¹⁹ <http://vr.se/franvetenskapsradet/nyheter/nyhetsarkiv/nyheter2013/nyheter2013/ingennyutlysningavindustridoktorandprojekt.5.7e727b6e141e9ed702b15e5.html>

¹²⁰ http://www.vinnova.se/sv/Aktuellt--publicerat/Nyhetsbrev/2014-12-11-Nytt-program-for-smaforetag?utm_source=apsis-anp-3&utm_medium=email&utm_content=unspecified&utm_campaign=unspecified

¹²¹ <http://www.formas.se/sv/finansiering/utlysningar/samhallets-langsigtiga-kunskapsforsorjning>

¹²² See for example Tillväxtanalys Reports 2015:

Research and innovation for transition of the energy system– an analysis of the Swedish Energy Agency's R & I activities Report 2015:08

Do Selective Industrial Policies Cause Growth?– Experiences from Sweden Report 2015:07

Innovation climate in Sweden – an analysis of the Innovation Union Scoreboard Report 2015:06

Sweden's innovation climate 2014 – Indicators for the national innovation strategy Report 2014:06

Effects of publicly funded support for the internationalisation of SMEs Final report Report 2015:03

is based on mandatory impact assessments that should be part of all proposals for new regulation.

As point of departure, the assessments target the administrative (economic) burden of companies (Kommittédirektiv 2008:57¹²³). Innovation is not explicitly targeted. The initial choice of this focus was based upon the assumption that diminished administrative cost creates better preconditions for business to devote more time and resources to running and develop their activities to contribute to increased growth and employment. Thus, the preconditions for innovation may be said to be implicitly addressed by the council.

In January 2015, the Swedish Better Regulation Council published its final report as a public commission of inquiry¹²⁴. Its activities now run on a permanent basis. It is described as a "specific decision-making body organised under the auspices of the Swedish Agency for Economic and Regional Growth."

"The government appoints the members of the Council. The Council is responsible for its own decisions. Its tasks is to review and issue opinions on the quality of impact assessments to proposals with effects to business. The Council shall also on request from regulators review impact assessments on EU-proposals that are assessed to have a great impact to businesses in Sweden¹²⁵.

The importance of effective framework conditions, including regulation for innovation, was acknowledged in the Swedish Innovation Strategy, published in 2012¹²⁶. The sub target "Regulations, market conditions and norms that promote innovation" highlighted a number of areas of work where the government and other relevant players need to pay attention to in order to promote innovation:

- To maintain and develop good framework conditions for innovation and all phases of entrepreneurship: start, growth and liquidation. In particular, the work to simplify the day-to-day life of businesses and identify and rectify rules and regulations that hamper innovation must continue.
- The continued development of framework conditions to give people, businesses and other organisations incentives to invest in innovation and take risks in order to develop new solutions and grow through internationalisation. This includes reviewing the possibility of changing tax regulations in order to promote investments in innovation – including R&D – and attract investments to Sweden.
- To continue to strive for appropriate and effective protection for intellectual property rights on a national scale as well as a functioning, uniform patent protection and a uniform patent court in the EU.
- To promote standardisation as a driving force for innovation, e.g. for increasing green innovation and the development of a greener economy.
- To continue to strengthen the Single Market and open global market through international agreements and cooperation.
- To continue to strive for appropriate formulation and implementation of framework conditions for state subsidies for research, development and innovation within the EU.

In April 2014, the liberal-conservative government appointed a commission of inquiry for Entrepreneurship¹²⁷ with the mission to assess the conditions for starting, running, developing and owning business in Sweden. The remit of the commission was broad, and included i.a. analyses and proposals for tax regulations, some regulations concerning the

¹²³ http://www.regelradet.se/wp-content/uploads/2012/03/Kommittedir-regelradet-2008_57.pdf

¹²⁴ <http://www.regelradet.se/wp-content/uploads/2015/05/The-Final-report.pdf>

¹²⁵ <http://www.regelradet.se/en/>

¹²⁶ <http://www.government.se/information-material/2012/10/the-swedish-innovation-strategy/>

¹²⁷ <http://www.regeringen.se/contentassets/c6dedf42b0d4460e503062af64072e/forbattrat-klimat-for-entreprenorskap-och-innovativt-foretagande-dir-201446>

fees paid by entrepreneurs for social insurance, and regulations for insolvency and company reconstructions.

The social democratic and green coalition government that took office after the general elections in September 2014 terminated the commission, whilst appointing a new commission (under the same chairperson) with a narrower remit¹²⁸. The new commission is not to make any proposals regarding taxes, nor analysing or making proposals regarding social insurance aspects. The commission is to submit its final report to the government (before October 15, 2016).

Within its remit, VINNOVA carries out some projects and studies that include aspects of regulation on innovation. Among those initiatives there is a call, launched in 2014, in which four projects were granted funding for developing remuneration systems that drive innovation. Project owners are four municipalities, one county council and one hospital.

VINNOVA is also working to increase demand-driven innovation in collaboration with the National Agency for Public Procurement and the Swedish Association of Local Authorities and Regions. This is part of the high-attention issue of innovation procurement, where efforts are being made to make greater use of the space within the existing regulations of procurement for processes that drive or open up for innovative solutions to public demand.

5.9 Assessment of the framework conditions for business R&I

Sweden has a highly competitive and successful economy. The 2008-09 economic crisis had a relatively low impact on economic growth and the general policy environment for doing business in Sweden is favourable. The majority of R&D investment in Sweden is undertaken by large private sector firms and higher education institutions. Virtually all corporate R&D is funded by the business sector itself, with a minimal contribution from the government. In addition, private sector R&D is almost entirely financed by firms using their own resources and Sweden is one of the few OECD countries with no major tax incentives for R&D, making R&D investment more expensive and less attractive than in its international competitors.

Sweden has a high-performing business sector with a relatively large number of innovative, export-oriented, internationalised firms. These firms operate in diverse industrial sectors ranging from telecommunications equipment, pulp and paper, chemicals to mining, pharmaceuticals, and electrical goods. Swedish firms also have a large and increasing presence in the services sector which contributes a comparatively large share of GDP. Although large firms dominate R&D in manufacturing industries, smaller firms make a larger contribution in the services sector. In recent years the Swedish economy has been shifting toward smaller, more service-oriented and diversified firms, which employ a significant share of the creative labour force in Sweden.

The OECD's country report for 2012 (OECD, 2013a) and the Swedish Agency for Growth Policy Analysis evaluation of progress towards the 2012 Innovation Strategy (Tillväxtanalys, 2015f) converge on the finding that an increasing share of Sweden's manufacturing firms are moving into services.

Private R&D is concentrated in large multinational firms, both foreign and Swedish owned, which dominate the Swedish economy. Foreign-owned firms now employ almost 25% of the workforce in business and industrial sectors and, in 2013, account for 39% of R&D-activities in the Swedish business sector. Over the last decade large multinational firms have increasingly outsourced parts of their research and innovation

¹²⁸ <http://www.regeringen.se/contentassets/9c444547eddb49d090f628cccc3a23a8/utveckling-av-innovations--och-entreprenorskapsklimatet-dir.-201510>

facilities as a result of gradually adopting advanced global strategies as well as foreign ownership.

About 80% of Swedish business R&D is performed by a few large multinational companies with more than 200 employees with most of it concentrated in firms with >1000 employees. In 2013, 89 firms with >1000 employees accounted for 63% of Swedish BERD. In the same year, 49% of BERD was spent by Swedish owned multinational companies, 39% by foreign owned companies and 12% by local Swedish companies (Tillväxtanalys, 2015a). BERD is very high in European comparison, with 2.12% of GDP in 2014, but has for a decade been on a slight downward trend due to the relocation of some of the R&D units of MNEs. This illustrates the economic dependence on a few large firms, which creates vulnerabilities and unforeseeable risks.

Thus, over the past two decades there have been substantial efforts focused on an incremental industrial restructuring to reduce economic dependence on a few large actors by supporting growth in high-tech firms and improving framework conditions for SMEs. Despite of this, R&D investments in SMEs have not been able to compensate for this decline, these investments actually fell by 30% between 2005 and 2009 (European Commission 2014a).

Other framework conditions affecting private firms are found in the Swedish tax system and the insolvency proceedings (see section 5. 1). Swedish firms face a total tax level that is one of the highest among high-income economies (World Bank 2015c). Especially the share of social security contributions in the total tax burden borne by businesses is among the largest in the world (35.5%). In addition, despite effective insolvency proceedings that promote economic activities and access to finance, completing the insolvency process takes longer and costs more in Sweden than in many other high-income economies (World Bank, 2015a,b). Creditors recover smaller shares of their loans in Sweden than in the Nordic average. It was argued that eliminating duplicate or unnecessary steps and setting reasonable deadlines that are adhered to in practice could shorten the duration of insolvency proceedings, help lower the cost and increase the recovery rate (World Bank 2014). Thus, a possible area for policy action is in reducing the costs of entrepreneurial experimentation.

As in the rest of EU28, Sweden has committed to an economic transformation in which knowledge plays a key role. This transformation requires a re-fitting of extant institutions and competences as well as the introduction of new infrastructure and competence. These investments are of the type that are traditionally public. This being said, more can be done in Sweden to introduce better alignment between the supply and demand aspects of RI policy. Sweden's competitive advantage lies in the size and quality of its human capital stock, which depends vitally on the education system and skills development (see section 5. 4). Sweden faces challenges in both these areas. Sweden has very high enrolment rates in primary and lower secondary education. The main concern in the public debate on education in Sweden is that, despite large investments in education, results in international assessments of student competencies have been declining.

The share of STEM university graduates is, however, relatively high in Sweden. Sweden is also one of the 15 EU countries where the share of STEM graduates has increased between 2006 and 2012. Even so, Sweden share the general concern about the attractiveness of STEM subjects particularly to the female population but as yet there are no major policy initiatives directed at this issue.

It was further argued that Sweden's low tertiary completion rate, particularly worrisome given its high youth unemployment rate, might be explained at least in part by lack of incentives: the average earnings of workers with a tertiary education are only 25% higher than those of workers with an upper secondary education. On average, they are 57% higher among OECD economies (World Bank 2015c).

VINNOVA is the main policy actor for implementing the National Innovation Strategy. VINNOVA reports to the Ministry of Enterprise and Innovation is charged with the responsibility of promoting sustainable growth by improving the conditions for innovation, as well as funding needs-driven research. VINNOVA also coordinates with other actors in the innovation system such as the other funding agencies and is particularly charged with coordinating with the agencies for energy and transport. A recent example of this is the Strategic Innovation Areas programme, which is a joint effort between VINNOVA, the Swedish Energy Agency and the Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS). This relatively large programme invites private and public sector actors to develop a common agenda on tackling innovation in a specific innovation area. Funding of the Strategic Innovation Areas is due to increase to €144m (SEK 1.25bn) in 2016 with around 50% from business.

6. Conclusions

Meeting structural challenges

The policy mix in Sweden related to the two identified structural challenges is discussed in Table 10, which lists relevant policy actions, assesses their appropriateness, efficiency and effectiveness, and provides links to relevant evidence (based on evaluations or empirical analyses).

Other emerging challenges that might deserve more in-depth analysis in future editions of this report are Sweden's limited success in strengthening the university research base as well as inefficiencies that might be induced by systematic shortcomings in governance structures (OECD, 2016). In view of that a Research Bill is expected to be presented in the fall 2016, it would be best to await this. The bulk of the issues that require attention have been presented in the various reports and documentation that the different Ministries and Agencies have prepared as part of the process. The issues that will be prioritised are however not yet known. If one takes a broad view of the research and innovation system, there are a number of issues that will clearly be prioritised at the very least for the rest of the mandate period for the present government. These are reform measures for addressing the declining performance in primary and secondary education as evidenced by the latest PISA results and high youth unemployment. Reversing these negative trends is among the main priorities of the government.

Table 10: Policy measures addressing structural challenges in Sweden.

Structural challenge	Policy actions addressing the challenge	Assessment in terms of appropriateness, efficiency and effectiveness	Evidence on the impact and outcomes of policy actions
(1) Strengthening early stage private venture capital investment and reforming public venture capital - the market for private venture capital reveals gaps in early-stage investment and available support is still skewed towards public venture capital.	<ul style="list-style-type: none"> • Issue taken up by new Innovation Council at highest political level • Government inquiry (SOU 2015:46) on "a fund structure for innovation and growth" in 2015 led to the formulation of several recommendations and a new Government proposition in 2016 • Introduction in 2013 of a tax deduction for investment in companies that are not stock market indexed with less than 50 employees. • Introduction of new investment savings account 	<ul style="list-style-type: none"> • The problem has been recognised and 2015 and early 2016 saw a promising reversal in trends as well important policy action • The new investment savings account could become an effective stimulus for the private venture capital market. • However, tax deduction for investment in not stock market indexed companies is a limited scheme with only very limited potential to create significant impact 	<ul style="list-style-type: none"> • The government inquiry (SOU 2015:46) and Proposition (2015/16:110) on "a fund structure for innovation and growth" in 2015 which identified a need for stronger support in very early stages of the development of new or innovative high risk enterprises as well as a lack of capital when financing the interval € 0.5–5.0m. It also recommends that a new public state-owned fund should be set up in order to co-invest with private capital in venture capital funds.

Structural challenge	Policy actions addressing the challenge	Assessment in terms of appropriateness, efficiency and effectiveness	Evidence on the impact and outcomes of policy actions
<p>(2) Reduce dependency of BERD on a few multinational companies (MNCs) – globally owned companies relocate their R&D units while R&D activities in Swedish SMEs are developing unfavourably</p>	<ul style="list-style-type: none"> • Introduction of a limited tax incentive scheme for business investment in R&D in 2014. • The government proposed to support funding to SMEs covering part of the costs associated with coverage of salary for staff that is ill. • Targeted support to SMEs from a.o. ALMI, VINNOVA, the Knowledge Foundation and the Swedish Energy Agency in the form of e.g. grants and vouchers 	<ul style="list-style-type: none"> • Substantial efforts focused on an incremental industrial restructuring to reduce economic dependence on a few large actors by supporting growth in high-tech firms and improving framework conditions for SMEs. • No shortage anymore of initiatives aimed at SMEs; there may be a problem with respect to the proliferation and complexity of some of these measures. • The introduced measures have not generated the desired effects at macroeconomic level yet • There may be some yet untapped potential in attracting new foreign investments. 	

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Abbreviations

BERD	Business Expenditure on Research and Development
GBAORD	Government Budget Appropriations or Outlays on Research and Development
DG	Directorate General (of the European Commission)
EC	European Commission
ECB	European Central Bank
ERA	European Research Area
ESFRI	European Strategy Forum on Research Infrastructures
EU-28	European Union including 28 Member States
FORMAS	The Swedish Research Council Formas (in the areas of Environment, Agricultural Sciences and Spatial Planning)
FORTE	Swedish Research Council for Health, Working life and Welfare
FP / FP7	European Framework Programme for Research and Technology Development / 7th Framework Programme
GERD	Gross Domestic Expenditure on Research and Development
GDP	Gross Domestic Product
GOVERD	Government Intramural Expenditure on R&D
HES	Higher Education Sector
HEI	Higher Education Institutions
ICT	Information and Communication Technology
IUS	Innovation Union Scoreboard
MISTRA	Foundation for Strategic Environmental Research
MNC	Multinational Company
OECD	Organisation for Economic Co-operation and Development
PCP	Pre-commercial Procurement
PPI	Public Procurement of Innovations
R&D	Research & Development
R&I	Research and Innovation
SME	Small and Medium-sized Companies
STINT education	Swedish Foundation for International Cooperation in Research and Higher education
UNCTAD	United Nations Conference on Trade and Development
VC	Venture Capital
VINNOVA	The Swedish Innovation Agency
VR	Vetenskapsrådet

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Annex 1 – List of the main research performers

Organisation	2001-2004	2005-2008	2009-2012
Lund's University	5162	5620	5818
Karolinska Institute	4527	5061	5628
Uppsala University incl Gotland University College	4802	4939	5433
Göteborg's University	3196	3388	3954
Royal Technical University	2824	3309	3703
Stockholm's University	2511	2853	3422
Chalmers Technical University	2193	2229	2281
Swedish University of Agricultural Science	2107	2023	2349
Umeå University	1875	2258	2675
Linköping University	1954	2108	2590

Source: Adapted from Swedish Research Council (2015) *Forskningens Framtid! Svensk Vetenskaplig Produktion och Publiceringsmönster I ett internationellt perspektiv*, Bilaga 3 pp. 44 Stockholm Sweden

Annex 2 – List of the main funding programmes

Name of the funding programme	Timeline	Budget 2015	Target group
Strategic Research Areas	2009-2014	No new budget ¹²⁹	Universities, research institutes and collaborating partners
Berzelli Centres phase 3	2004-2014	€ 4,78m	Universities, research institutes and collaborating partners
Linnaeus Centres	2006-2016 2008-2018	€ 27,7m	Research groups at universities
Council Professorship	ongoing	€51,4m Covers period 2016-2025	Senior researchers
Recruitment of international professors	2015-2024	€36,4	Senior researchers
International postdocs	2016-2018	€4,6m	Young researchers
MISTRA Innovation	2015-2019	€2,14m	SMEs, universities and research institutes in collaboration
Research School (Neutrodiffusion)	ongoing	€23,6m	Doctoral training
Future Research Leaders (6 th generation)	Ongoing	€25,67m	Young researchers
Industrial Research Centres	Ongoing	€42,7m	University-Industry collaboration
VINNOVA Strategically important knowledge areas	ongoing	Granted in 2015:	Public and private research
Health and Healthcare		€10.9m	
Transportation and Environment		€14.1m	
Services and ICT		€10.8m	
Manufacturing and Working Life		€14.0m	
Innovation systems analysis		€4.8m	
VINNOVA Innovativeness of specific target groups	ongoing	Granted in 2015:	Public and private research
Innovation Capacity in the Public Sector		€8.2m	
Innovative Small and Medium-sized Enterprises		€45.0m	
The Knowledge Triangle		€21.5m	
Individuals and Innovation Milieus		€29.5m	
VINNOVA Cross-border co-operation	ongoing	Granted in 2015:	Public and private research
Challenge-driven Innovation		€24.8m	

¹²⁹ After the 2015 evaluation the research funding agencies who participated in this programme have recommended that the SFOs be continued and that the money be reported as a special category in the institutional funding to the host universities. It was also recommended that two of the host universities be allocated a reduced share of the funding compared to what they previously possessed. It was also argued that the released funds be reallocated to the host universities that have shown excellence in strategic leadership of the strategic research areas they are hosting. <http://yr.se/download/18.5f3cd6ec14d0737bc694553b/1430376205962/Myndigheternas+rekommendationer150429.pdf>

Partnership Programmes		€85.2m	
EU and international co-operation		€12.7m	
KK-Foundation		Granted in 2015:	
HÖG	ongoing	€15.9m	Public research
Competence development	ongoing	€12.4m	Public and private research cooperation
Research School	ongoing	€1.9m	Public research
KK-miljöer	ongoing	€9.9m	Public research
IT in HEI	ongoing	€0.7m	Public research

Annex 3 – Evaluations, consultations, foresight exercises

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