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**Monitoring and analysis of policies
and public financing instruments
conducive to higher levels of R&D investments
The “POLICY MIX” Project**

Country Review Sweden

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Introduction and Policy mix concept

The policy mix project

This report is one of the 31 country reviews produced as internal working papers for the research project “Monitoring and analysis of policies and public financing instruments conducive to higher levels of R&D investments” (Contract DG-RTD-2005-M-01-02, signed on 23 December 2005). This project is a research project conducted for DG Research, to serve as support for policy developments in Europe, notably in the framework of CREST activities. It does not form part of the ERAWATCH project, but the working documents are made available on ERAWATCH webpages for the purpose of steering a debate on the policy mix concept.

The “Policy Mix” project is run by a consortium of 7 partners:

- UNU-MERIT (The Netherlands), consortium leader
- Technopolis (The Netherlands)
- PREST – University of Manchester (United Kingdom)
- ZEW (Germany)
- Joanneum Research (Austria)
- Wiseguys Ltd. (United Kingdom)
- INTRASOFT International (Luxembourg).

Each country review is produced by an individual author, and provides expert’s view on the policy mix in the country. This report is not approved by the Commission or national authorities, and is produced under the responsibility of its author.

The role of country reviews is to provide an exploratory analysis of the current policy mixes in place in all countries and detect the most important areas of interactions between instruments as well as new modes of policy governance that are particularly adapted (or detrimental) for the building of policy mixes. They provide analytical material for the analysis of the policy mix concept and its implementation in Europe. This material will be used as background for further reports of the project and for the construction of a tool for policy-makers (to be made available in late 2007 and 2008).

The policy mix concept

The country reviews are based on the methodological framework produced by the consortium to frame the “policy mix” concept. They have been implemented on the basis of expert assessments derived from the analysis of National Innovation Systems characteristics and policy mix settings, using key information sources such as Trend-chart and ERAWATCH reports, OECD reviews, and national sources, among which the National Reform Programmes.

In this work, the “policy mix for R&D” is defined by the consortium as: **“the combination of policy instruments, which interact to influence the quantity and quality of R&D investments in public and private sectors.”**

In this definition, policy instruments are: “all programmes, organisations, rules and regulations with an active involvement of the public sector, which intentionally or unintentionally affect R&D investments”. This usually involves some public funding, but not always, as e.g. regulatory changes affect R&D investments without the intervention of public funds.

Interactions refer to: “the fact that the influence of one policy instrument is modified by the co-existence of other policy instruments in the policy mix”.

Influences on R&D investments are: “influences on R&D investments are either direct (in this case we consider instruments from the field of R&D policy) or indirect (in that case we consider all policy instruments from any policy field which indirectly impact on R&D investments)”.

Structure of the report

The report is structured along the following questions.

First, in section 1, and in order to place the policy mix in context, the general challenges faced by the National Innovation System (NIS) are analysed by the expert. The view is here not restricted to the challenges with regard to raising R&D investments, but rather encompasses all the conditions that directly or indirectly affect the functioning of the NIS and R&D expenditures. These context conditions are very important for the discussion of the relevance of the policy mix later on.

Second, the stated main objectives and priorities of R&D policy in the country are spelled out in section 2, as well as their evolution over the last ca. five years. This discussion is based on White Papers and official documents, i.e. on published policy statements. The reality of these objectives compared to actual working of policy instruments will appear in section 5.

The third section provides an expert assessment and critical analysis of a possible gap or convergence between the NIS challenges and the main policy objectives and priorities stated before.

Section 4 presents the policy mix in place, following the above definition, i.e. policy instruments affecting R&D activities in the private and in the public sector, either directly for instruments from the R&D policy domain, but also indirectly for instruments outside the R&D domain which are of particular relevance to R&D activities. A typology of instruments is used, to categorise the R&D-specific and non-R&D specific instruments. A short description of each instrument is provided: aim, nature, target group, budget.

Then, section 5 discusses whether there is a gap between the main policy objectives and priorities stated in section 2, and the instruments in place. This is done by com-

paring the set of objectives with the set of instruments at work. When individual evaluations of programmes or policy instruments are available, their results are used if they shed light on contribution of these instruments towards the policy objectives.

Section 6 discusses the orientation of the policy mix, indicating priorities amongst various possible routes to increase R&D investments. Policy instruments are categorised under 6 different routes according to their relevance, and this categorisation is followed by a discussion on the range of instruments affecting each route, missing instruments, routes that are not addressed by instruments, possible redundancies or overlaps, etc.

Section 7 provides another view on the policy mix, focusing on the relative importance of each types of instruments. The aim is to get a picture of the policy mix, the balance between (sets of) instruments, and the relative weight between them.

From section 8 onwards, the review turns to the crucial question of policy governance. That section discusses the emergence of the policy mix through examination of the following question: how did the set of R&D policy instruments arrive ? What is the rationale behind them, what were the driving force behind their establishment, and how is this evolving recently. A crucial question relates to the existence of some consideration of possible interactions when establishing new or suppressing existing instruments. The section tries to establish whether the policy design process is incremental or radical, analytical or non-analytical. From this, that section discusses if the policy mix is a “construct” or an “ex post” reality.

The next section, section 9, focuses on the governance of the system of R&D policy instruments take place. It examines the key question of interactions, i.e. whether there is a form of co-ordination between R&D policy and policy instruments from outside the R&D domain, and the existing mechanisms that favour or hinder such interactions.

The final section, section 10, deals with the core question of the policy mix concept: it endeavours to discuss interactions between policy instruments to affect R&D expenditure. The section discusses possible positive, neutral and negative effects of R&D policy instruments; both within the R&D policy domain, but also with instruments from other policy domains. In most cases, this takes the form of hypotheses rather than hard evidence.

Feedback welcome

Feedback on this report is gladly received. Individual country reports will not be updated but discussion on policy mixes is welcome during the timeframe of the study (2006-2008). Please send your comments to:

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On September 17, 2006, general elections in Sweden led to a change in government (from social democratic to conservative). The questions of this review have been answered assuming there will be no major changes in research and innovation policies.

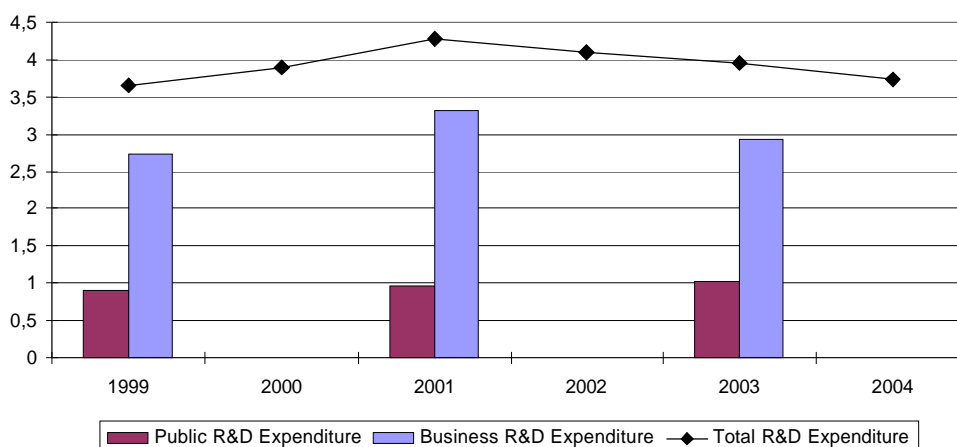
1. National Innovation Systems Challenges

Inadequate return on public investments in R&D. Sweden's high investments in R&D are not seen as paying off sufficiently in terms of economic growth, which has been termed a "Swedish paradox". This challenge, which likely has no short-term effect on R&D intensity, has been widely recognised for a number of years.

Inefficient collaboration between R&D providers and industry. For over 50 years, the unique Swedish research doctrine has prescribed that the universities should be the main providers of both curiosity-driven and mission-oriented research services. However, the universities have proven incapable of fulfilling the intended function of intermediary between academic research and industrial exploitation (the "third task") in a satisfactory way and do not live up to the needs of industry in terms of contract R&D. Moreover, public support of R&D favours curiosity-driven over mission-oriented research. Funding priorities in favour of universities and curiosity-driven research have resulted in an institute sector that by international standards is weak, fragmented, small and under-funded. Despite their relatively modest collective size, the research institutes are nevertheless largely successful intermediaries between research and industrial application, particularly for SMEs. This challenge has detrimental effects on NIS efficiency, but likely no effect on R&D intensity. This challenge has been widely recognised for several years, but the causes of the inefficient collaboration have been hotly debated. However, at present most stakeholders recognise that the universities cannot be expected to fulfil all R&D needs and that the institute sector plays a vital role.

Declining R&D intensity. Swedish R&D intensity is clearly world-class and highest in EU25. However, while public R&D investments remain close to the government target of 1% of GDP, business R&D investments are decreasing following a peak in 2001, see *Exhibit 1*.

Exhibit 1 Expenditure on R&D [% of GDP]



Sources: Statistics Sweden, "2005 European Innovation Scoreboard - Sweden", European Commission, 2005

Inadequate national coordination. There is limited horizontal coordination between ministries, little or no formal horizontal coordination between implementing authorities (research councils, sector agencies etc.) and weak vertical coordination between ministries and implementing authorities, meaning that in the end there is little coordination of RTDI measures. There is consequently a large number of seemingly uncoordinated public initiatives and organisations involved, particularly in support of innovators and entrepreneurs. The overall picture is fragmented and not designed for efficiency; many of the initiatives and organisations devised to support for example innovators and entrepreneurs cannot achieve critical mass. Corollary consequences of the Swedish model with small ministries and relatively independent implementing authorities are that policy implementation is slow and that policymakers have limited influence over how policies are implemented. This challenge does not affect R&D intensity, but certainly has detrimental effects on NIS efficiency. Most stakeholders accept the challenges associated with inadequate coordination.

In summary, the main challenges of the Swedish NIS are:

1. Inadequate return on public investments in R&D
2. Inefficient collaboration between R&D providers and industry
3. Declining R&D intensity
4. Inadequate national coordination

2. Objectives and priorities of R&D policy

It is often quite difficult to distinguish between Sweden's research policy and its innovation policy, since the former effectively is a partial implementation of the latter. Sweden's first **innovation policy** was presented in 2004 in the White Paper *Innovative Sweden*¹, which outlines four prioritised areas:

- **Knowledge base for innovation:**
 - Ensuring that Swedish education and research are of world class
 - Concentrating efforts in Swedish profile areas
 - Seizing the opportunities presented by globalisation
- **Innovative trade and industry:**
 - Strengthening the innovative capacity of existing SMEs
 - Increasing the commercialisation of research results and ideas
- **Innovative public investment:**
 - Using the public sector as an engine for sustainable growth
 - Promoting renewal and efficiency in the public sector
 - Developing infrastructure that promotes renewal and sustainable growth
- **Innovative people:**
 - Stimulating entrepreneurship and enterprise
 - Making the most of people's skills

While pointing to general needs and areas that need to be addressed, the White Paper stops short of proposing concrete measures. In contrast, the 2005 research policy bill *Research for a Better Life*² states that the overall goal of the government's **research policy** is for Sweden to be a leading research nation and then goes on to make a range of priorities:

- Additional funding will be allocated to three **high-priority research fields**:
 - Medicine
 - Technology
 - Environment and sustainable development
- Funding will be provided for up to ten-year periods to internationally competitive **centres of excellence** in all scientific fields
- Additional funding will be provided to **graduate more researchers** and to provide them with **improved career prospects**
- **Transfer of knowledge between academia and industry** will be boosted through:
 - Improved efficiency of university holding companies, including capitalising them
 - Cooperative state-industry R&D programmes
 - Long-term funding for research institutes
 - Measures to facilitate SME access to research

¹ Ds 2004:36.

² Government bill 2004/05:80.

Both the White Paper and the research policy bill consolidate policy developments that have been underway for several years. Neither the ambition for Sweden to be a world-class research nation nor the concentration of public funds to a few select research fields represents new developments. However, the realisation that the universities have not managed to live up to their third task and that technology transfer in general – and to SMEs in particular – need to be strengthened are developments that have grown since the turn of the century. The focus on innovative public investment and innovative people are areas that in earnest entered the policy debate with the aforementioned White Paper.

According to the White Paper and research policy bill, Sweden's top priorities may be summarised as follows:

1. *Maintain world-class quality in education and research:*
This is clearly top priority and has been so for many years
2. *Focus public R&D investments to a limited number of areas:*
Concentration of public investments to a limited number of areas where Swedish preconditions are the best represents a continuation of previous policy bills
3. *Eliminate the Swedish paradox:*
This generally, albeit reluctantly, accepted deficiency of the Swedish NIS is a key challenge that urgently needs to be resolved
4. *Ensure a smooth generation shift among researchers:*
Some 45% of teaching and research staff at Swedish universities retire within the next 15 years

3. Coherence between NIS challenges and R&D objectives and priorities

Inadequate return on public investments in R&D. Among other things, the White Paper *Innovative Sweden* attempts to address this issue and pinpoints many of the needs, which nevertheless still remain to be satisfied. It has also been suggested that an important reason for the Swedish paradox is that significant parts of the R&D investments made by Swedish MNCs are exploited by the Swedish-based company, but outside of the country and thus do not show up in national statistics. Arguably, a significant reason for the paradox lies in the emphasis of public funding on curiosity-driven research without any view of how it could lead to economic growth (the “linear model”). Another very important reason is that the NIS has several weaknesses, as further discussed under “Inefficient collaboration between R&D providers and industry” below. Both these reasons are addressed in policy, but not to a sufficient extent; indeed, most of the good intentions in the White Paper have yet to be implemented or implemented with sufficient fervour.

Inefficient collaboration between R&D providers and industry. While maintaining the standpoint that the universities are to remain the primary source of publicly funded research, the government recognises that they need support in fulfilling the third task. A 2001 government bill³ awarded all universities the right to establish holding companies to facilitate exploitation of their research results. The 2005 research policy bill offered funding to improve efficiency of university holding companies, including capitalising them.

Previously there was no national strategy for the research institutes; indeed, their *raison d’existence* was questioned altogether. A change came about in a 2001 government bill, which stated that the research institutes are important in supporting competence development in industry and as intermediaries between academic research and industrial application³. The bill stated that the research institute system was to be consolidated into fewer and larger institutes with improved international competitiveness and that industry was expected to take on a greater responsibility for the institutes. The 2005 research policy bill reinstated some of the previously cut funding to the research institutes. The 2005 research policy bill also specified cooperative state-industry R&D programmes and a new initiative to facilitate SME access to research services.

While all these measures are welcome and represent steps in the right direction, they are insufficient to remedy the weak collaboration between R&D providers and industry. While support to universities in exploitation of their research results is appropriate and probably could be further enhanced, their role as Sweden’s dominating source of publicly funded research should be re-evaluated, possibly in favour of the institute sector.

Declining R&D intensity. While Swedish R&D intensity is second only to Israel’s, public R&D investments remain at the government target of 1% of GDP, which, although high by international standards, is equalled or surpassed by several countries.

³ FoU och samverkan i innovationssystemet, Government bill 2001/02:2.

It is consequently the R&D investments of Swedish industry that brings Sweden to such an impressive overall level and this contribution has been steadily decreasing from a peak in 2001, cf. *Exhibit 1*. Clearly, one important reason for the decline in industry R&D is the “IT crash” in the beginning of the century, which led to a dramatic contraction of the IT sector. A distinctive feature of Swedish R&D is the dependence on a handful of MNCs, mainly within pharmaceuticals, automotive products as well as electronic and telecom products. The 20 most R&D intensive companies contribute 68% of total industry and business R&D⁴. Due to globalisation, these MNCs are relocating an increasing part of their R&D closer to markets, coupled with a general downsizing of in-house R&D. High labour costs and an inflexible labour legislation exacerbate these trends. Further, Sweden has the highest share of R&D intensity in affiliates under foreign control leading to further vulnerability and among the lowest shares of SMEs performing R&D (13.1% compared to 22.4% for EU25)⁵. During 2006, rapidly increasing electricity prices have made companies in energy-intensive industries, such as paper and pulp, cancel or postpone major investments and close down plants, which clearly also negatively influences corollary R&D investments.

The government aims to boost knowledge and skills in the business sector in order to stimulate innovation, growth and modernisation. This is done in cooperation and in consensus with trade unions and industry; together they have decided to focus on six key industry sectors representing around 80% of all business R&D. The government recently (August 2006) commissioned VINNOVA to develop research programmes targeted at these strategically important industry sectors (aerospace, metallurgy, automotive, forestry, pharmaceuticals and IT/telecom). These programmes are to be developed in collaboration with industry and will require industry to match public grants. On the same note, several centre of excellence initiatives will require financial involvement from industry and a new initiative to provide SME access to research is expected to lead to additional industry investments in R&D. The government is currently (autumn 2006) in the process of developing a strategy for public procurement of innovations, which in the long term may boost business R&D.

It is questionable whether these initiatives will manage to reverse the trend of business R&D since 2001, since it is to a significant degree caused by globalisation, an industry base in mature industries, high labour costs, inflexible labour legislation and a tax system that creates negative incentives for R&D investments in Sweden. The latter three issues are of course possible for government to tackle, but not within the scope of research and innovation policies.

Inadequate national coordination. The White Paper *Innovative Sweden* aims to synchronise the activities of the Ministry of Education, Research and Culture (responsible for research policy) and the Ministry of Industry, Employment and Communications (responsible for innovation policy) in terms of research and innovation policies and is consequently an important step towards addressing intra-ministerial coordination and thus also provides a foundation for coordination of the entire NIS. This is a welcome and commendable development. However, the second most important ministry in terms of public R&D funding, the Ministry of Defence (as well as several

⁴ “Forskning och utveckling i Sverige 2003”, Statistics Sweden, 2003.

⁵ “Key Figures 2005, Towards a European Research Area – Science, Technology and Innovation”, European Commission, 2005.

other in this respect less important ministries) is not part of the exercise and the fact remains that the responsibilities for research and innovation policies rest with two different ministries.

Moreover, what little coordination there is between the relatively independent implementing authorities usually takes place informally and by personal initiative, rather than through a strategic approach. Such horizontal coordination thus remains a significant and essentially unaddressed challenge.

Vertical coordination between ministries and implementing authorities represents another significant challenge, since the authority's independence from its ministry means that the ministry has limited influence over policy implementation.

In essence, all four of the main NIS challenges are to some extent addressed in research policy, but none of them forcefully enough. Research quality and quantity are the top priorities of policy. Quality and quantity certainly ought to remain *among* the key priorities, but the unrelenting belief in the linear model is counterproductive, meaning that the payback in terms of growth and other societal benefits is lagging behind. There is consequently a major gap between the NIS challenges and the priorities of research policy.

4. Composition of the policy mix for R&D

The main policy instruments are summarised in *Exhibit 2*.

Exhibit 2 Policy mix for R&D in Sweden

Policy categories	Policy instruments: short description and target group
R&D Domain	
R&D policy generic	<p>Annual block grants for universities and university colleges Target group: Universities and university colleges</p> <p>Annual block grants for research institutes Target group: Research institutes</p> <p>Programmes for curiosity-driven research projects Project funding for curiosity-driven research carried out by internationally competitive research groups in all scientific fields Target group: Universities</p> <p>Programmes for collaborative mission-oriented R&D projects Project funding for mission-oriented R&D projects carried out in collaboration between R&D providers and industry. Industry is to match public funds Target group(s): R&D providers, indirectly industry</p> <p>Programmes for centres of excellence Long-term public funding commitments for internationally competitive research groups in all scientific fields. Mainly for curiosity-driven research and only to a lesser extent for mission-oriented research Target group(s): R&D providers, indirectly industry</p> <p>Programme for regionally based research and innovation environments Support for development of strong research and innovation environments between universities, companies, research organisations and public bodies that, on the basis of a regional perspective, see opportunities for the development of internationally competitive innovation systems Target group(s): R&D providers, indirectly industry</p> <p>SME support programme New programme to facilitate SME access to R&D services, representing a shift in policy since SMEs (regardless of sector) receive cash grants Target group: SMEs</p>
R&D policy sectoral	<p>Industry sector strategies/Industry sector research programmes Together with industry, the government has developed national strategy documents for six strategically important industry sectors (aerospace, metallurgy, automotive, forestry, pharmaceuticals and IT/telecom). The government has commissioned VINNOVA to develop research programmes for these areas in collaboration with industry. Industry is to match public funds Target group(s): R&D providers, indirectly industry</p>
R&D/Innovation policy – Linkage	The linkage between R&D and innovation policies is provided by the White Paper <i>Innovative Sweden</i> as further described under question 2
R&D/Innovation policy – IPR	
R&D specific financial and fiscal policy	

R&D specific education policy	<p>Funding to graduate more PhDs and to provide them with improved career prospects The 2005 research policy bill provides additional funding to facilitate graduation of more PhDs and to provide them with improved career prospects in light of the fact that some 45% of teaching and research staff at Swedish universities retire within the next 15 years Target group(s): Graduate students, post-docs and universities</p> <p>Graduate schools Long-term funding for thematic graduate schools in all scientific fields. Some initiatives specifically target graduate students employed by industry Target group(s): Graduate students and universities</p>
R&D specific employment policy	
Finance Domain	
Financial and fiscal policy	<p>The Innovation Bridge The Innovation Bridge (Innovationsbron) was set up in 2005 to commercialise research-related ideas through business development and incubators as well as by providing seed funding Target group: SMEs</p> <p>The Industry Fund The Industry Fund (Industrifonden) promotes innovative Swedish growth companies by investing equity capital or granting loans. The Industry Fund invests in cutting-edge, product-oriented companies with export potential during start-up, development and early expansion and focuses on ICT, life sciences and industrial ventures Target group: Industry</p> <p>Tax incentive for foreign experts Foreign experts, executives, scientists and researchers may only have to pay tax on 75% of income during their first three years in Sweden Target group(s): Foreign experts, indirectly industry</p> <p>Inheritance tax abolition January 1, 2005, the inheritance tax was abolished, which facilitates succession in non-listed companies and likely encourages a longer-term view, possibly including R&D investments Target group(s): SMEs, indirectly their owners</p>
Macroeconomic policy	<p>Monetary policy and financial stability The objective of monetary policy is to “maintain price stability”, which the Riksbank has interpreted as a low, stable rate of inflation of around 2%. In order to achieve this, the Riksbank adjusts its key interest rate, the repo rate. Another key function of the Riksbank is to promote a safe and efficient payment system</p>
Human Capital Domain	
Education policy	<p>Entrepreneurship training schemes Most universities offer entrepreneurship courses and occasionally entire programmes Target group: undergraduate students</p> <p>See also “R&D specific education policy” above, as well as “Innovation policy generic” below</p>
Employment policy	
Innovation Domain	
Innovation policy generic	<p>Entrepreneurship programme Funding for diffusion of best practice methods to influence attitudes towards entrepreneurship in primary and secondary schools. Supplementary activities directed towards universities, including develop-</p>

	<p>ment of entrepreneurship courses, and continuing education of business advisors. Pilot regional programmes Target group(s): students in primary and secondary schools, undergraduate students</p> <p>Funding for development of university holding companies Support for development of efficiency of university holding companies, including capitalising them Target group(s): University holding companies, indirectly universities</p>
Innovation policy sectoral	
Other policies – industry	
Other policies – trade	
Other policies – defence	<p>Defence materiel procurement programmes Procurement of innovative technologies Target group(s) Indirectly industry and to a lesser extent R&D providers</p>
Other policies – consumer protection	
Other policies – health and safety	<p>Prioritisation of health Medicine is one of three research fields prioritised in the 2005 research policy bill</p>
Other policies – environment	<p>Prioritisation of environment and sustainable development Environment and sustainable development is one of three research fields prioritised in the 2005 research policy bill and environmental considerations are present in nearly all R&D instruments</p>
Other policies – regional development	<p>Regional growth programmes Regional policy is formulated in regional growth programmes engaging regional stakeholders. Funding is provided from public and private sources; in some regions, the Structural Funds contribute a substantial portion of overall funding Target group: industry</p>
Other policies – competition	
Other policies – social security	

5. Coherence between main policy objectives and priorities, and policy instruments

Inadequate return on public investments in R&D. This issue is intimately connected to the issue of “Inefficient collaboration between R&D providers and industry” below and some reasons for the inadequate return is discussed under the latter header. However, two possible reasons will be discussed here. The linear model has by most accounts proven inefficient and obsolete, but it remains a basic presumption of Swedish research policy. The subtle shift towards more mission-oriented R&D seen in the 2005 research policy bill is not sufficient to remedy the situation.

Another reason lies in a weak entrepreneurial culture and risk aversion. With some notable exceptions, Sweden is not known for its entrepreneurship culture; people are more likely to identify themselves with employment in an MNC or in some public agency or authority. Transforming a “national mentality” to become more entrepreneurial and daring is certainly an immense challenge, but it nevertheless urgently needs to be addressed. While stimulation of entrepreneurship and enterprise is mentioned in the White Paper *Innovative Sweden*, there are insufficient policy instruments to implement such commendable intentions (although there are ample university courses on entrepreneurship). Moreover, instruments to stimulate the innovative capacity of existing SMEs as well as instruments to increase commercialisation of research results have been introduced, but they are far from sufficient to exploit the latent potentials. There are currently no significant instruments to stimulate innovative public investment, but VINNOVA and NUTEK were in April 2006 jointly assigned to develop the foundation for a national policy for public procurement of innovations for delivery in October 2006.

Inefficient collaboration between R&D providers and industry. In terms of supporting the universities in fulfilling their third task, policy measures may be adequate, but it is naïve to assume that further enhanced collaboration between universities and industry would be able to make any significant contribution to elimination of the Swedish paradox. Possibly the weakest link in the Swedish NIS is the institute sector, which is a vital link and intermediary between universities and industry. The institute sector is by government decree belatedly being strengthened after several years of starvation, but the Swedish institute sector is still marginal by international standards and it receives a significantly lower level of base funding than institutes in comparable countries. Strengthening of the institute sector would make a notable contribution to improved collaboration between R&D providers and industry. Such instruments should include both significantly higher level of base funding and strong, businesslike owners and boards.

However, it should be noted that one important reason for the inefficient collaboration lies in many companies’ attitude towards academia. Many companies, notably but not only SMEs, feel that university research and researchers have nothing to offer them. While this is probably a correct assessment in many cases, it is at other times often a sign of arrogance or ignorance; in the first case the company’s internal R&D personnel may feel that it does not need outside help (“not-invented-here (NIH) syndrome”), in the second case the company may feel it can not communicate with “high-brow”

academics or it may plainly be unaware that help might be available. In the latter case, the ignorance often stems from the low educational level in parts of Swedish industry, particularly in SMEs. VINNOVA's new instrument to support research in SMEs certainly is a step in the right direction, but there is a long way to go. Moreover, there are insufficient policy instruments to implement the praiseworthy intentions of stimulating entrepreneurship and enterprise outlined in the White Paper *Innovative Sweden*.

Declining R&D intensity. Both the policy instruments already in place and the budgetary increases of the 2005 research policy bill apparently attempt to address this challenge. Although most of the traditionally used instruments as well as the newly introduced ones are well considered, they do not address the key issue that it is expensive to perform R&D in Sweden, partly due to high labour costs and partly due to inflexible labour legislation. Thus, fiscal instruments addressing labour taxes and R&D tax incentives together with a more flexible labour legislation would in the long term likely have far greater effect on industry R&D investments than conventional grant-based instruments.

Globalisation is likely responsible for part of the decrease in industry's R&D investments, so focus ought to be on exploiting the opportunities of globalisation, rather than only considering it as a threat, which is the focus in the public debate. The White Paper *Innovative Sweden* discusses the opportunities of globalisation, but no obvious policy instruments to reflect this priority have been introduced.

Inadequate national coordination. There are few explicit objectives or priorities regarding overall national coordination, and none in terms of horizontal coordination between implementing authorities and vertical coordination between ministries and implementing authorities.

While the White Paper *Innovative Sweden* lays a good foundation for increased national coordination, implementation still appears haphazard. The White Paper may have led to coordination between the Ministry of Education, Research and Culture and the Ministry of Industry, Employment and Communications, but the Ministry of Defence and several other in this respect less important ministries are not part of the exercise and the fact remains that the responsibilities for research and innovation policies rest with two different ministries.

Furthermore, horizontal coordination between implementing authorities and vertical coordination between ministries and implementing authorities is inadequate and would, if achieved, result in significant efficiency gains. There is consequently little apparent consideration as to who is to do what in the NIS and there are too many public and semi-public players (agencies, authorities, councils, foundations, organisations etc.) active. A major strategic coordination effort would be desirable, but appears not to be in the cards.

In summary, when comparing the top policy priorities of question 2 and the present instruments introduced in question 4 the following picture emerges:

1. Maintain world-class quality in education and research:

- The instruments in place are highly commensurate with this priority**
2. *Focus public R&D investments to a limited number of areas:*
The instruments in place are highly commensurate with this priority
 3. *Eliminate the Swedish paradox:*
There is a large gap between the instruments in place and this very challenging priority. While many of the challenges associated with this priority are addressed by a range of instruments, they collectively fall short of making any major difference; much more forceful interventions are required
 4. *Ensure a smooth generation shift among researchers:*
The instruments in place are probably commensurate with this priority

6. Policy mix instruments and target groups

The target groups of the main policy instruments are summarised in *Exhibit 3*.

Exhibit 3 Policy instruments and broad routes to increase R&D investments

Policy categories	Policy instruments	ROUTE 1: promote establishment of new indigenous R&D-performing firms	ROUTE 2: stimulate greater R&D investment in R&D-performing firms	ROUTE 3: stimulate R&D investments in firms non-performing R&D	ROUTE 4: attract R&D-performing firms from abroad	ROUTE 5: increasing extramural R&D carried out in cooperation with public sector	ROUTE 6: increase R&D in public sector
R&D Domain							
R&D policy generic	Annual block grants for universities and university colleges				X	X	XX
	Annual block grants for research institutes	X		X	X	XX	XX
	Programmes for curiosity-driven research projects		X		X	X	XX
	Programmes for collaborative mission-oriented R&D projects		XX	X	X	XX	XX
	Programmes for centres of excellence		X		X	X	XX
	Programme for regionally based research and innovation environments		X	X		X	XX
	SME support programme		XX	XX		X	X
R&D policy sectoral	Industry sector strategies/Industry sector research programmes		XX		XX	XX	XX

R&D / Innovation policy – Linkage							
R&D / Innovation policy – IPR							
R&D specific financial and fiscal policy							
R&D specific education policy	Funding to graduate more PhDs and to provide them with improved career prospects				X	X	XX
	Graduate schools				X	X	XX
R&D specific employment policy							
Finance Domain							
Financial and fiscal policy	The Innovation Bridge	XX	XX	X		XX	X
	The Industry Fund		XX	X	X	X	X
	Tax incentive for foreign experts		X				
	Inheritance tax abolition		X	X			
Macroeconomic policy	Monetary policy and financial stability		X		X		
Human Capital Domain							
Education policy	Entrepreneurship training schemes	XX				X	
Employment policy							
Innovation Domain							
Innovation policy generic	Entrepreneurship programme	XX				X	
	Funding for development of university holding compa-	XX	X		X	X	

	nies						
Innovation policy sectoral							
Other policies – industry							
Other policies – trade							
Other policies – defence	Defence materiel procurement programmes		XX		XX	XX	XX
Other policies – consumer protection							
Other policies – health and safety	Prioritisation of health		XX		XX	XX	XX
Other policies - environment	Prioritisation of environment and sustainable development		XX	X	X	XX	XX
Other policies – regional development							
Other policies – competition							
Other policies – social security							

Route 1 is intimately tied to the Swedish paradox and should receive more forceful attention in policy than it is currently receiving. Route 2 is well covered for the large enterprises that dominate private R&D expenditure, but more attention should be paid to SMEs, e.g. through enlargement of the present SME support programme and through SME R&D tax incentives. Also route 3 would merit from extension of the present SME support programme, R&D tax incentives and/or similar instruments. Route 4 is well covered in terms of raising foreign interest in Swedish R&D (and occasionally acquisition), but few foreign firms establish or expand R&D activities in Sweden, partly due to high costs. Route 5 represents a rather weak link with industry funding comparatively modest R&D activities in the public sector; it is difficult to see how this could be changed in the short term since it is partly based on tradition, except possibly through some targeted R&D tax incentive. Routes 1–5 would all likely benefit from reduced labour taxes, R&D tax incentives and a more flexible labour legislation. Route 6 is by most accounts well covered in Sweden with a public R&D intensity of 1%, but it would probably be beneficial from a national growth point of view to shift the balance somewhat from curiosity-driven to mission-oriented R&D on the one hand and from universities to research institutes on the other hand.

7. Balance within R&D policy mix

The importance of policy instruments are indicated in *Exhibit 4* according to the following dimensions:

- a) Overall contribution to increase of private R&D expenditures
- b) Impact on specific aspects of the NIS or R&D performers
- c) Public attention/attention by policy makers
- d) Volume of public funding involved
- e) Beneficiary of a shift in public funding

Exhibit 4 Assessment of 'importance' of R&D policy instruments

Instruments	Funding	Criteria				
		a	b	c	d	e
Annual block grants for universities and university colleges			XX	XX	XX	X
Annual block grants for research institutes		XX	XX		X	XX
Programmes for curiosity-driven research projects			XX	XX	XX	X
Programmes for collaborative mission-oriented R&D projects		XX	XX	X	X	
Programmes for centres of excellence		X	XX	XX	XX	X
Programme for regionally based research and innovation environments		X	XX	X		
SME support programme		X	XX	X		XX
Industry sector strategies/Industry sector research programmes		XX	XX	X	X	X
Funding to graduate more PhDs and to provide them with improved career prospects			X	X	X	XX
Graduate schools			X			
The Innovation Bridge		X	XX	X	X	X
The Industry Fund		X	XX	X	XX	
Tax incentive for foreign experts						
Inheritance tax abolition						
Monetary policy and financial stability				XX		
Entrepreneurship training schemes			XX			
Entrepreneurship programme			XX	X		XX
Funding for development of university holding companies			X	X		X
Defence materiel procurement programmes		XX	XX	X	XX	
Prioritisation of health		XX	XX	XX	XX	
Prioritisation of environment and sustainable development		XX	X	XX	X	

8. Emergence of R&D policy mix

Sweden has a long and proud heritage as a strong and successful research nation and in broad terms research policy has remained largely unaltered for many years. Thus, key elements of the policy mix are established since long, e.g. the research policy doctrine that the universities should be the main providers of research is approximately 50 years old. Substantial block grant to universities and university colleges are thus a long-standing tradition, but the fact that 42% of the universities' research funding comes directly from the state is unusually high by international standards⁶. The focus onto a few select research fields is partly the result of a realisation that Sweden is a small country with limited resources and partly caused by international trends. The fields selected reflect areas wherein Sweden already has a competitive advantage and is in part the result of lobbying from both industry and R&D performers. It is also interesting to note that the correlation between prioritised research fields in the government's research policy bills and those of EU's framework programmes is significant. The government's renewed interest in the role of the research institutes in the NIS has partly resulted from intense lobbying by key stakeholders and possibly also from a realisation that the universities cannot be expected to fulfil all industry needs. However, the reinstated funding for the research institutes follows several years of starvation and painful cutbacks.

Programmes for curiosity-driven research projects follow international models and employ peer review. Programmes for collaborative mission-oriented R&D projects have a long tradition in Sweden and they are well received by industry and R&D performers alike. The different centre of excellence programmes are influenced by international trends (particularly the US) and by the successful competence centre programme run 1995-2005 by VINNOVA and the Swedish Energy Agency (STEM) (superseding NUTEK). Also graduate schools are influenced by international trends (once again the US). Regional programmes (as well as the previously established regionally based "new universities") are the result of the ideology that "all of Sweden shall live" and, of course, regional influence. VINNOVA's programme to facilitate SMEs access to R&D is explicitly inspired by international experiences and in particular the US SBIR programme.

The industry sector research programmes, which are the result of industry sector dialogues, are clearly a consequence of both outright industry lobbying and an outcome of the "Swedish model" of consensus discussion among a plethora of stakeholders. It is also likely that the increased international competition brought on by globalisation has spurred a political desire to support vital industry sectors. Sweden has a proud heritage of far-ranging and long-lasting public-private partnerships (e.g. Televerket-Ericsson, Vattenfall-ASEA, Defence Material Administration-SAAB Aircraft) that have produced large and competitive MNCs. Since such intimate PPPs are no longer possible, new routes for public-private collaboration are sought.

The funding to graduate more PhDs and to provide them with improved career prospects stems from the realisation that 45% of teaching and research staff at Swedish universities retire within the next 15 years.

⁶ Ken Guy et al., *Policy Mix Peer Review, Sweden*, CREST Policy Mix Working Group, 2006.

The Innovation Bridge was created in 2005 by the seven Technology Bridge foundations (Teknikbrostiftelser), the Industry Fund (Industrifonden) and the government and thus merged several organisations' scattered activities, particularly those of the Technology Bridge foundations and VINNOVA.

The Industry Fund is a foundation founded by the government in 1979, which promotes innovative Swedish growth companies by investing equity capital or granting loans. It currently receives no government grants.

The tax incentives for foreign R&D personnel and executives is a result of industry lobbying and a way to partly circumvent Sweden's oppressive tax burden, which for economical reasons makes it difficult to recruit high-calibre foreigners to Sweden.

The inheritance tax was long criticised by conservative politicians and the public alike. Its abolition can likely only to a lesser degree be accounted to the oft-criticised difficulties in succession of non-listed companies.

At the end of the 1990s, Parliament decided to give the Riksbank an independent status. Parliament's aim in formally delegating the task of maintaining price stability to the Riksbank was that monetary policy would gain a clearer long-term perspective and this would create better conditions for credibility. Over the past ten years the Riksbank has worked on making its operations more transparent and predictable. The transparency contributes to making it easier to assess the Riksbank's activities and to creating confidence in monetary policy.

Many universities offer entrepreneurship courses and occasionally entire programmes; such courses and programmes appear to have developed spontaneously. However, the present entrepreneurship programme run by NUTEK appears to be a result of the White Paper *Innovative Sweden*.

The initiative to strengthen the university holding companies is a result of the reluctant realisation that too few university innovations are commercialised.

The Swedish policy mix has developed incrementally and is clearly an "ex-post" reality, but belatedly things are changing. Sweden now has its first innovation policy, which is the combined result of visionary politicians, an intense policy debate on the Swedish paradox, industry lobbying and the Lisbon strategy. The innovation policy essentially paints the broad picture for future policy development; the 2005 research policy bill, as well as other lesser government initiatives, constitute partial implementations of the innovation policy. However, the change in government from social democratic to conservative resulting from the September 17, 2006, elections makes it difficult to predict how innovation and R&D policies will evolve. The new government's initial policy declaration nevertheless speaks of increased spending on R&D.

9. Governance of the policy mix

In formulating policy, the government is supported by a research policy council, an innovation policy council and the Institute for Growth Policy Studies (ITPS), but neither body has any formal authority meaning that they are reduced to advisory functions. The Ministry of Education, Research and Culture is responsible for research policy and thus for research policy bills. However, in the Swedish governance model, a decision by a ministry needs to be approved by all other ministers to become a government decision. While the ministry defines policy, implementation is carried out by relatively independent implementing authorities, which annually receive their instructions from government (regleringsbrev). This means that the government's influence is limited to general principles and directions on how policy is to be implemented, which translates into a lower level of influence over how policy is implemented than in most other countries.

The White Paper *Innovative Sweden* is intended to be the foundation for coordination between the Ministry of Education, Research and Culture and the Ministry of Industry, Employment and Communications (which is responsible for innovation policy). There is no apparent additional horizontal coordination between R&D policy and policy instruments from outside the R&D domain, except for the overall government budget bills. Moreover, there is no formal overall horizontal coordination between implementing authorities and no overall vertical coordination between ministries and implementing authorities (apart from the annual instructions mentioned in the previous paragraph). What little horizontal coordination there is between implementing authorities usually takes place informally and by personal initiative. It is therefore hardly surprising that the insufficient coordination at all levels of the NIS – from ministerial level and all the way down – is one of the main Swedish policy challenges (cf. question 1).

10. Interactions between policy objectives and instruments

A clear majority of publicly funded research is curiosity-driven and carried out within universities without any view of future exploitation. It is likely that increased emphasis on mission-oriented research and on research carried out at research institutes would have a more positive impact on growth and societal development.

Many of the more recently introduced instruments aiming in part to address the Swedish paradox (e.g. the recent increase in research institute funding, an SME support programme, creation of the Innovation Bridge, the entrepreneurship programme, funding for development of university holding companies etc.) are well-considered but are not far-reaching enough or under-funded, meaning that their impact is likely to be limited.

Arguably the strongest policy interaction is between tax policy and the overall research policy objective for Sweden to have very high R&D intensity (“to be a leading research nation”), since tax policy:

- Discourages industry R&D investments in Sweden due to high labour costs and also makes high-calibre international recruitment difficult (despite the available tax incentive for foreigners), leading to many MNCs relocating R&D activities to other countries, while smaller companies may not invest in R&D at all
- Deprives would-be entrepreneurs sufficient incentives to take risks, both in terms of setting up a company and in pursuing growth

It should be noted that the relatively low corporate tax (28%) is not included in this argument. The high labour costs and lack of personal incentives are mainly to be attributed to high social costs for employers, high income tax for employees and strong tax disincentives for small entrepreneur-led companies.

A desirable but regrettably absent fiscal policy instrument is that of R&D tax incentives for companies (which Sweden had prior to 1982). On the same note, the inflexible labour legislation not only discourages industry R&D investments in Sweden, but particularly discourages “risky” recruitments, such as for R&D projects.

Deregulation of the electricity market did not provide the level of competition foreseen and has thus not lead to decreasing prices as intended, but rather the opposite. The very high electricity prices have recently (autumn 2006) made companies in energy-intensive industries, such as paper and pulp, cancel or postpone major investments or even close plants, which negatively influences corollary R&D investments. A major reason for the increase in electricity prices is inadequate supply (another is supplier oligopoly), which partly has been caused by the closing down of two nuclear reactors and partly due to increased energy taxes, both of which have their origins in environmental policy. On the other hand, the current situation may also inspire R&D in environmentally friendly technologies, which is a key goal of environmental policy.

It is likely that fiscal instruments to reduce labour taxes and R&D tax incentives together with a more flexible labour legislation in the long term would have far greater effect on R&D investments than additional conventional grant-based instruments. Thus, a combination of grant-based instruments and such “new” instruments would appear appropriate.

11. Literature

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