2008 – country report

CREST

expert group report

on the design and implementation of national policy mixes

Policy Mix Peer Reviews: Country Report

AUSTRIA

A Report of the CREST Policy Mix Expert Group

Fourth Cycle of the Open Method of Coordination in favour of the 3% Objective

CREST

European Union Scientific and Technical Research Committee

Policy Mix Review Team

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September 2008

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1 Introduction

As part of the Policy Mix Peer Review Process instigated by CREST,[1] a Policy Mix Peer Review Team visited Austria during the period May 20-23, 2008. The team was led by an independent consultant and comprised representatives of Member States of the European Union (EU) and an observer from the European Commission (EC). During the review, Christian Seiser, the Austrian CREST representative and a member of the Austrian Ministry for Science and Research (BMWF), arranged interviews with a variety of stakeholders in the Austrian R&D and innovation policy system.[2]

This report is based on the views formulated during the review visit, supplemented where necessary by information gathered by the Review Team leader during a preliminary visit to Vienna in April 2008,[3] and by material contained within a Country Report prepared by the ERAWATCH network for the EC's Institute for Prospective Technological Studies (IPTS).[4] The report represents the collective view of the Review Team but does not represent the official view of any of their host organisations. It was discussed with Austrian policymakers during the course of a feedback mission to Austria in August 2008 and, after suitable amendment, presented as a final report to CREST in September 2008 in parallel with a similar report on the results of a peer review of the R&D and innovation policy mix in Bulgaria. The report also fed into a Research Dialogue process initiated within Austria to discuss research and development (R&D) policy options for the future.

As in previous CREST OMC cycles, a simple analytical framework or model depicting and linking the different domains of an R&D and innovation system was used to structure issues and discussions during the peer review exercise.

In this model, policy mixes are conceived as the aggregate of policies affecting four major domains: Human Resources; the Science Base; Business R&D and Innovation; and Economic and Market Development. The governance system linking policies in all these domains is also of central interest, as are the linkages between national and regional, and national and international R&D and innovation systems. **Exhibit 1** depicts all these domains and some of the more important links and flows between them.

Although R&D and innovation systems are typically much more complex than depicted here, this simple model provides a convenient way of visualising some of the more important domains within an R&D and innovation system and the relationships between them. It also provides a useful framework within which questions were asked during the peer review exercise relating to:

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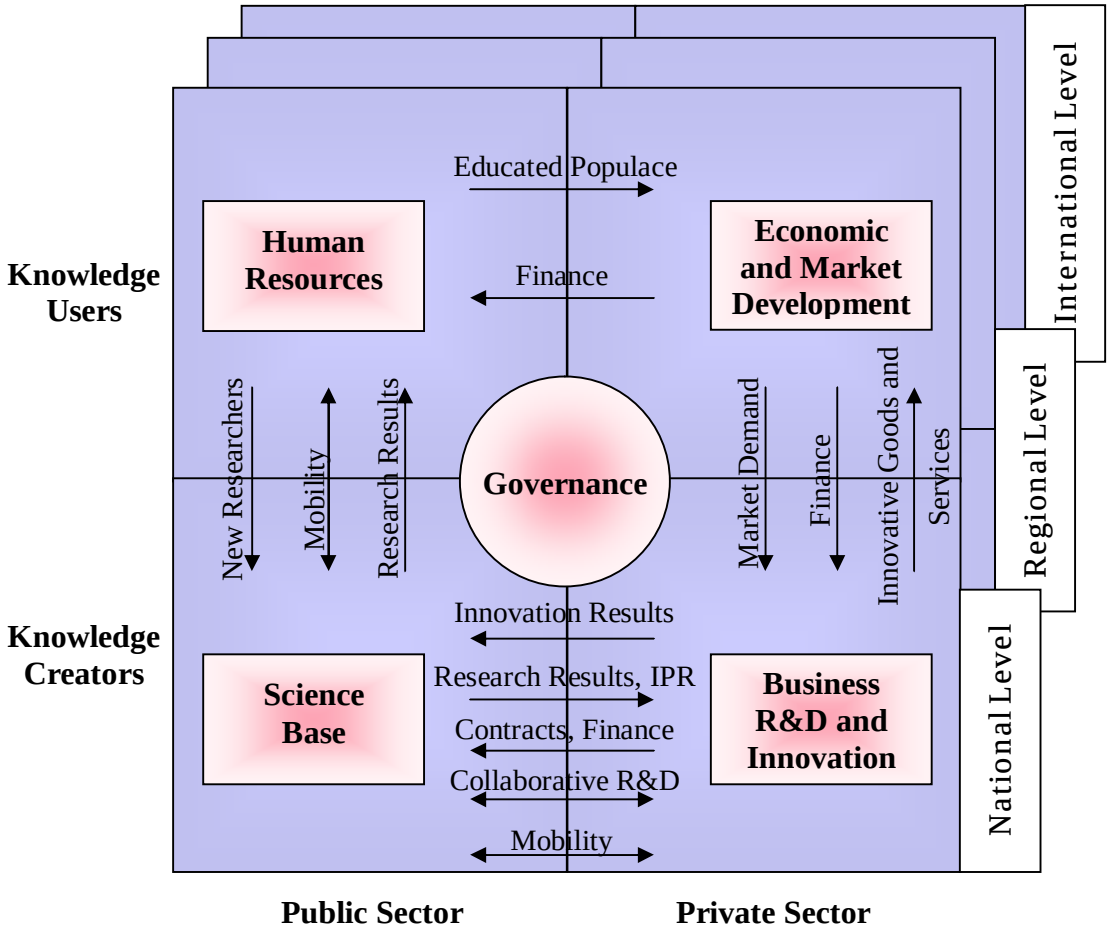
[1] CREST is the European Union's Scientific and Technical Research Committee. As part of the Open Method of Coordination – cyclical activities in support of the effort by the EU to raise R&D expenditures across the EU to 3% of GDP – CREST launched a series of Policy Mix Peer Reviews during the second cycle of activity and continued them in the third and fourth cycles.

[2] Full details of the peer review interview schedule are presented in Appendix 1.

[3] Full details of the schedule for the preliminary visit are presented in Appendix 2.

[4] ERAWATCH Network/IPTS, Country Report: Austria, March 2008 – see Appendix 3.

Exhibit 1 A Simple Model of an R&D and Innovation System



- The relative scale of the challenges Austria confronted both within each of the four R&D and innovation system domains and across them;
- The range of policy responses to these challenges and their 'location' within the R&D and innovation system, e.g. 'reinforcement' policies to strengthen particular domains such as the science base or business R&D and innovation, or 'bridging' policies designed to improve the links or flows between domains, e.g. policies to enhance university-industry interactions or to improve the flow of capital from capital markets to innovative high-tech firms and start-ups;
- The match between problems and policy responses within and across domains;
- The conflicts and synergies between policies within and across domains;
- The governance of policies within and across domains;
- The links between national and regional R&D and innovation systems, and between national and international systems.

The remainder of the report is structured in three sections. **Section 2** provides a thumbnail sketch of the Austrian R&D and innovation system and its associated policy mix. In **Section 3**, some of the most important impressions gained by the Review Team are recounted, together with suggestions for future policy that might be considered appropriate in an Austrian setting. In **Section 4**, the Austrian policy mix is summarised in terms of policy mix issues such as policy gaps, overlaps and interactions, while the final **Section 5** revisits the most important recommendations of the Policy Mix Peer Review Team.

2 The Austrian R&D and Innovation System and Policy Mix[5]

Austria has a small population, an above average Gross Domestic Product (GDP) and a rich and impressive political and cultural history. It is also the birthplace of scientific greats such as Adler, Boltzmann, Doppler, Freud, Gödel, Lorenz, Mach, Mendel, Perutz, Pauli, Reich and Schrödinger, not to mention economists (Hayek, Schumpeter), engineers (Porsche) and philosophers (Popper, Wittgenstein).

Currently, however, Austria ranks as an 'innovation follower' rather than an 'innovation leader' in the terminology of the European Innovation Scoreboard (EIS). **Exhibit 2** shows the position of Austria relative to other countries, while **Exhibit 3** provides more detail on the set of indicators used to describe the performance of Austria's R&D and innovation system.[6] Key determinants or drivers of innovation such as the percentage of the population with tertiary education and the number of scientific and engineering graduates are lower than the EU25 average, though other indicators of the structural conditions required to stimulate innovation, e.g. broadband penetration, youth education attainment levels and participation in life-long learning are close to or above EU25 averages.

In terms of investments in R&D and 'knowledge creation', however, Austria has increased its spend considerably, with both public and private R&D expenditures well above the EU25 norm and expectations that the Barcelona 3% target will be met on schedule in 2010. The manufacturing base constitutes a higher share of the economy than it does in many other advanced Western countries and is largely medium-tech rather than high-tech, with the medium-tech/high-tech proportion of all manufacturing around the EU average. The share of enterprises receiving public funding for innovation, however, was almost double the EU25 average in 2004.

Considering 'innovation inputs', the shares of SMEs innovating in-house and introducing 'soft' organisational innovations are high, and Austria does extremely well compared to EU25 averages in terms of 'upstream' innovation outputs falling under the heading of intellectual property rights (patents, trademarks and designs), but these high performance levels are not reflected in output indicators measuring other 'downstream' aspects of innovation performance and added value. Exports of high technology products, sales of new-to-market products and sales of new-to-firm products, for example, are markedly lower than the EU25 averages.

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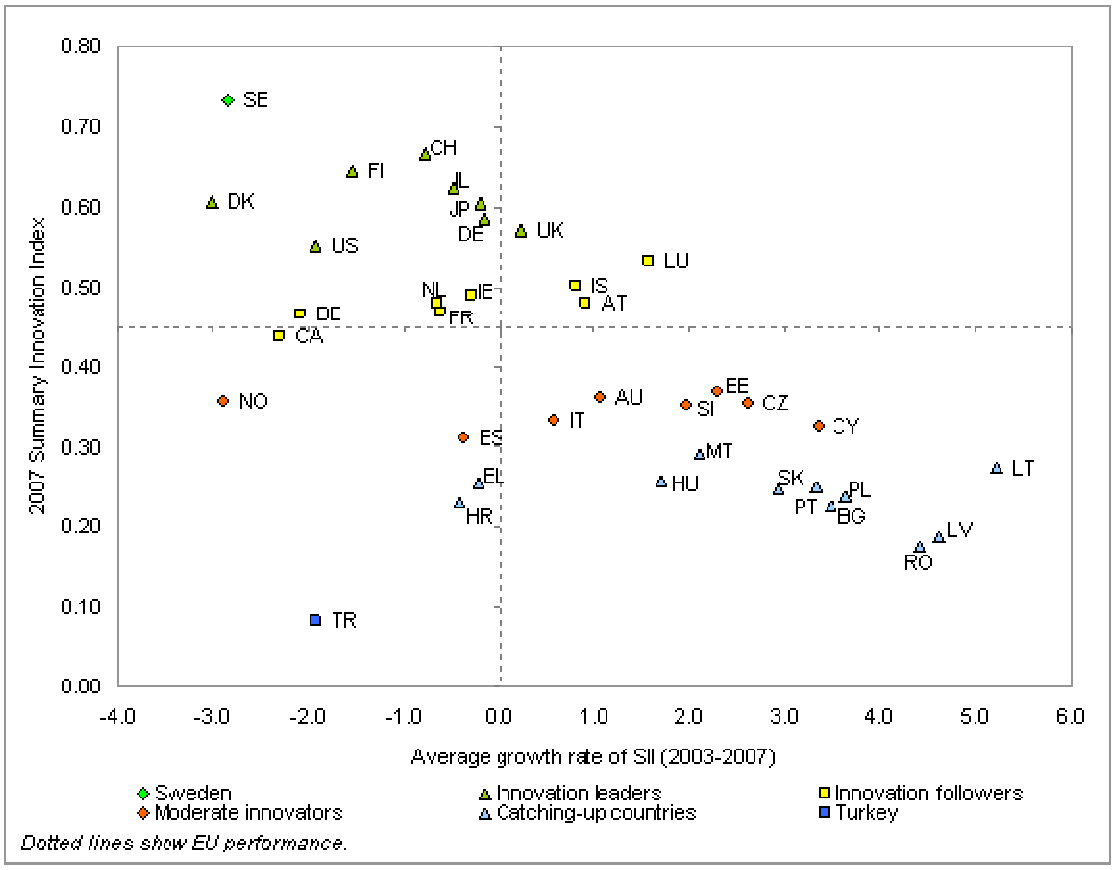
[5] The material in this section draws heavily on the ERAWATCH/IPTS report in Appendix 3 and material contained in the country overviews of R&D policies and innovation policies on the ERAWATCH and PRO INNO TrendChart websites respectively. The relevant links are as follows:
http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.content&countryCode=AT&topicID=4
http://www.proinno-europe.eu/index.cfm?fuseaction=country.showCountry&topicID=263&parentID=52&ID=1

[6] There is a constant debate in science, technology and innovation policy circles about the adequacy and validity of the sets of indicators used to describe innovation performance, and constant criticism by some countries that their performance is better if other indicator sets are used. In Austria's case, there is little doubt that indicators reflecting its particular industrial structure (e.g. the existence of many high quality medium-tech sectors) would paint a more favourable picture than that provided by the set of indicators used by the EIS (which includes an indicator based on high-tech exports, which are low in Austria). However, for the purposes of international comparison it was more appropriate to use the set of indicators currently accepted as the norm for comparisons across the EU25, even though a significant revision of the EIS set of indicators is in hand.

Exhibit 2 Innovation Leaders, Followers, Moderate Innovators and Catching-up Countries, 2007



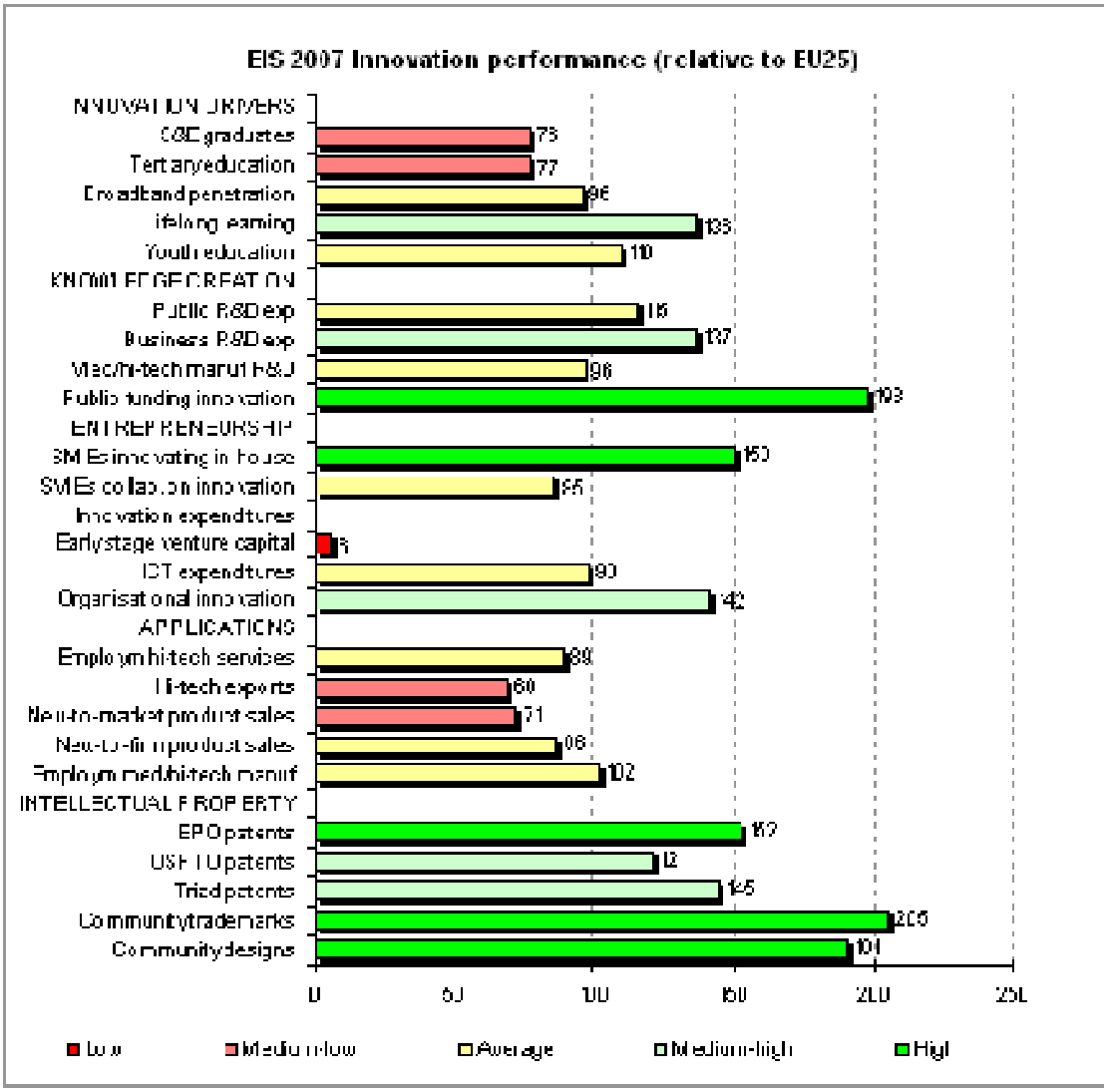
Source: http://www.proinno-europe.eu/index.cfm?fuseaction=page.display&topicID=275&parentID=51#

Overall, therefore, the main characteristics of the Austrian R&D and innovation system that can be discerned from the EIS data are high R&D expenditure levels, high public subsidy dependence, low downstream innovation performance levels and potential human resource problems.

Low innovation output levels have naturally been of concern to Austrian policymakers and many recent policy initiatives have focused on efforts to improve both the overall performance of the R&D and innovation system and its governance structure. Indeed, the Austrian governance system has recently experienced a significant degree of restructuring, with the number of agencies responsible for R&D and innovation policy implementation cut from nine to three. Nowadays, in terms of responsibilities for policy formulation and implementation, it has four primary ministries with a significant interest in R&D and innovation activities and three primary agencies responsible for policy delivery:[7]

Exhibit 3 Austria's Innovation Performance, 2007

[7] These ministries also support some R&D activities directly via a number of other routes, and 'sectoral' ministries in areas such as health, energy and environment also fund a modest amount of R&D. See Figure 2 in Appendix 3: the Austrian Country Report for 2008.



Source: http://www.proinno-europe.eu/index.cfm?fuseaction=page.display&topicID=306&parentID=51

- The Ministry of Finance (BMF) is responsible for indirect R&D tax measures;
- The Ministry for Science and Research (BMWF) supports basic research via the Austrian Science Fund (FWF) and directly via institutional funding to the universities and non-university institutions (especially the Austrian Academy of Science). The ministry also supports EU-measures via the Austrian Research Promotion Agency (FFG);
- The Ministry for Transport, Innovation and Technology (BMVIT) supports applied R&D via the Austrian Research Promotion Agency (FFG), but also some basic research via the Austrian Science Fund (FWF) and innovation-related activities via the Austrian Economic Service (AWS);
- The Ministry for Economics and Labour supports innovation-related activities via the AWS, but also applied R&D activities through FFG.

Although the number of primary agencies responsible for the delivery of R&D and innovation policy has been reduced from nine to three in the very recent past, it is

obvious that the governance system is still quite complex, with each agency serving multiple policy masters and multiple sets of research actors. This is clear from **Exhibit 4**.[8]

Exhibit 4 also shows some of the other bodies influencing policy formulation:

- The Austrian Council for Research and Technology is one of two main advisory bodies and reports directly to the Austrian Government. It formerly made recommendations on the disbursement of funds but now offers advice on all matters pertaining to research, technology and innovation – including research in universities;

- The Austrian Science Council reports to Parliament and its regional counterparts, to the Austrian Ministry of Science and Research (BMWF) and to Austrian universities. It advises on all university-related matters – again including research in universities;

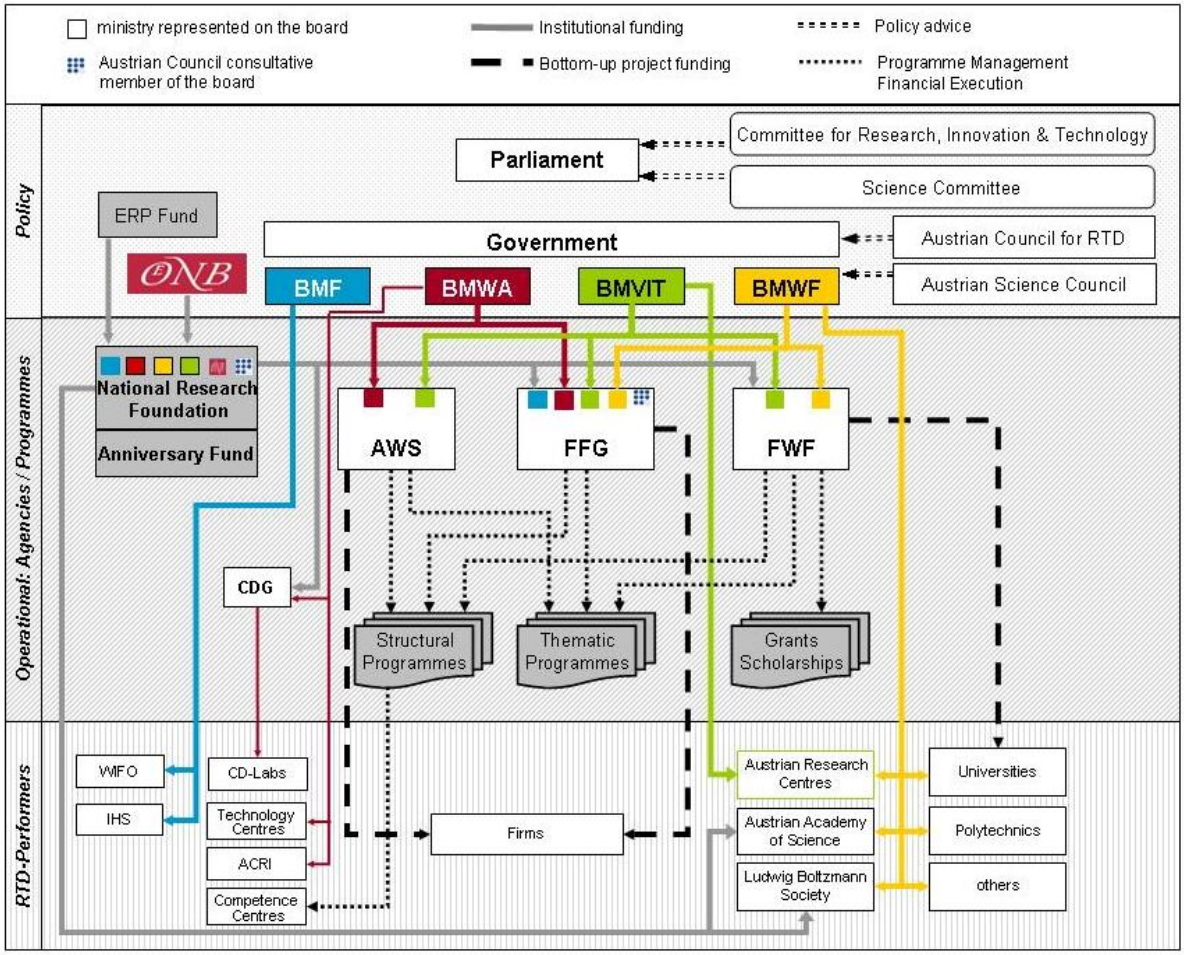
- Two parliamentary committees, the Committee on Science and the Committee on Research, Innovation and Technology, constitute fora for parliamentary debate on research-related matters.

- R&D and innovation policy is also increasingly formulated and implemented at a regional level, largely triggered by the availability of Structural Funds and money generated by the privatisation of energy utilities and banks. Today, seven out of the nine federal states engage explicitly in R&D policy and account for 5.5% of total Austrian R&D expenditures, though the main emphasis is on support for innovation. This includes support for cluster developments, incubators and the co-financing of national initiatives.

- At the R&D and innovation performer level, two thirds of the total R&D in Austria is performed by the corporate sector, mainly by companies in-house. A significant share of this is performed by foreign-owned companies such as Siemens Austria. For the remainder, universities perform most of the 27% for which the Higher Education Sector is responsible, while the public sector itself accounts for only 5% of the total volume of R&D performed.

Exhibit 4 The Austrian R&D and Innovation Governance System

[8] It should also be noted that ministries tend to have ministers from different political parties within the context of a coalition government.



Source: ERAWATCH Research Inventory 2007, Structure of the Research System

Acronyms used in the figure:

Policy Level

BMF: Federal Ministry of Finance

BMWA: Federal Ministry of Economics and Labour

BMVIT: Federal Ministry of Transport, Innovation and Technology

BMWF: Federal Ministry of Science and Research

ÖNB: Austrian National Bank

ERP-Fond: European Recovery Programme Fund

Austrian Council for Research and Technology Development

Operational Level

AWS: Austria Economic Service

FFG: Austrian Research Promotion Agency

FWF: Austrian Science Fund

CDG: Christian Doppler Society

Performers

WIFO: Austrian Institute of Economic Research

IHS: Institute of Advanced Studies

ACRI: Austrian Cooperative Research Institutes

CD-Labs: Christian-Doppler-Laboratories

The policy instruments used to deliver support to R&D and innovation performers constitute a rich mix. Typically, support is available for both public and private sector bodies across a broad spectrum, with no overt national focus on specific scientific, technological or sectoral niches. R&D support instruments are both direct and indirect. R&D tax incentives for firms were initiated in 1996 and expanded recently, while direct measures include support for single firms and, more recently, support for collaborative R&D. In the science base, universities allocate a proportion of their

institutional funding from the state to research. This is the primary source of funding for research in Austria's universities, but they also compete for research funding from bodies such as the Austrian Science Fund (FWF) and the Austrian Research Promotion Agency (FFG) nationally and the EU Framework Programmes internationally. Smaller amounts of research income derive from contract research. On the innovation side, instruments span a broad range and resemble many of those increasingly found in all modern R&D and innovation systems. These include support for incubators, competence centres, cluster developments, pre-seed capital, seed capital, innovation credits etc. Tracking all R&D and innovation programmes, of which there are many, and the budgets involved is exceedingly difficult, however, as the system is renowned not only for the sheer number of programmes implemented but also for its lack of 'transparency'.9 This situation may change, however, given the strong growth of an 'evaluation culture' in Austria over the last decade.

Recent policy developments of importance vis-à-vis the improved performance of the R&D and innovation system are as follows:

- The roll-out of the university sector reforms initiated in 2002, essentially granting much more autonomy to universities but committing them to the attainment of performance targets specified within the context of individually negotiated Performance Contracts;

- The enthusiastic embrace of the Barcelona target for R&D of 3% of GDP by 2010, which looks likely to be met as a result of increased expenditure by the public sector and, more impressively, the private sector;

- Significant involvement in ERANETs and joint programming activities with EU partners;

- The announcement by the Ministry for Science and Research (BMWF) of a target of 1% of GDP for 'basic' research by the year 2020, compared to the current level 0.39%;

- Government policy intentions to:

    - Focus on quality and excellence, particularly in terms of research carried out in the science base;

    - Shift from an emphasis on medium-tech manufacturing industry to an emphasis on high-tech;

    - Move from being an 'innovation follower' to an 'innovation leader';

- The launch of a national 'Research Dialogue' by the Ministry for Science and Research (BMWF), which invited a broad spectrum of R&D and innovation stakeholders to discuss future R&D policies during 2007-8;

- The parallel launch of a 'System Evaluation', commissioned by the Ministry for Transport, Innovation and Technology (BMVIT) to assess the strengths

[9] INNO-Policy TrendChart – Policy Trends and Appraisal Report: Austria, 2007

and weaknesses of the national R&D and innovation system and the Austrian policy mix.

3 Commentary by the Review Team

3.1 Overall Policy Orientation

3.1.1 A Shared Vision

The rise in R&D investment levels in Austria over recent years has been marked and commitment to the realisation of the Barcelona 3% target by 2010 appears stronger and more widely accepted than in many other EU countries. There is also every likelihood that the target will be attained. The Review Team also noted the existence of a number of other targets and aspirations in the current policy milieu. These include the ambitious long-term aim of raising the proportion of public spending on 'basic' research from its current level of 0.39% of GDP to 1% of Gross Domestic Product (GDP) by 2020[10]; the need to place greater emphasis on the quality and excellence of the research performed in Austria, not only by the public science base but also by industry; the desire to shift away from a focus on 'medium-tech' industries and towards a greater focus on 'high-tech' industries; and the ambition to become an 'innovation leader rather than an 'innovation follower'.

Whilst welcoming the interest in these issues and the level and intensity of debate concerning them, the Review Team also had two major reservations. The first concerns the evidence base for some of the proposed policy orientations. The overall benefits of raising public spending on 'basic' research to 1% of GDP by 2020 were not immediately obvious to the team, and the view was expressed that **a cogent narrative explaining why a 1% target made sense for Austria was needed prior to the wholesale adoption of the 1% target for 'basic' research within the broader context of the development of the Austrian R&D and innovation system as a whole**. Moreover, the target needs to be accompanied by an adequate plan for capacity-building in order to ensure the efficient roll-out of the budget.

Similarly, the Review Team felt that **the evidence for the proposed increase in emphasis on 'high-tech' industries should be carefully compared with the likely costs and benefits of competing options** such as the up-grading of existing medium-tech industries; the development of niche opportunities for high-tech producers within medium-tech industries; or the exploitation of new opportunities in natural resource-based industries and the service sector. In particular, although it was recognised that production industries comprise a higher share of the economy in Austria than in many other Western economies, the historical global growth of the service sector and the increasingly acknowledged potential for technological, non-technological innovation and mixed-mode innovation in all sectors merit further exploration of their relevance to the future development of the Austrian economy.

[10] The ambitiousness of this target can perhaps be judged by considering that the current level in the USA is only 0.49% of GDP.

The other major reservation felt by most of the Review Team concerned **the limited presence of a shared vision and accompanying strategy for the development of the overall R&D and innovation system**. Although many parties had contributed to the development of strategic visions and individual policy thrusts (e.g. the publication of the Strategy 2010 report by the Austrian Council for Research and Technological Development, and the promotion of the 1% basic research target by BMWF, the Ministry for Science and Research), it was not clear that all key actors (e.g. ministries, agencies, research performers and innovation agents) had established common 'ownership' of both a desirable, holistic vision for the future of the Austrian R&D and innovation system and the strategies needed to achieve it.

Ideally, such 'holistic' visions comprise an agreed set of high-level objectives spanning multiple R&D and innovation system domains that are consistent, coherent and shared by all major stakeholders, as are the strategies that accompany them. The intention behind their development is not to impose rigid monolithic policy frameworks along the lines of GOSPLAN[11], but to ensure that government policy *per se* comprises policy strands that are consistent and coherent rather than being at odds with each other, whilst still allowing separate policy actors to be pragmatic and flexible within the overall envelope.

To date, few countries have established 'holistic visions' and accompanying strategies that are shared by all major stakeholders, though some countries have gone further than others. The Danish Globalisation Strategy, for example, attempts to view policy formulation as a coherent process wherein coordination and interactions between different policy fields and between different policy instruments are given a high priority. R&D policy is a key element in this approach, viewed not in isolation but rather as an element closely interwoven with other policy areas. All relevant ministries and most key stakeholders joined forces to formulate a long-term strategy for the development of the Danish society – with R&D, innovation and education policy as the pivotal points.

To some extent the on-going 'Research Dialogue' and 'System Evaluation' being conducted in Austria may strengthen the evidence base for desirable options and help promote a consensus concerning the legitimacy and desirability of particular policy options. The prospect of this occurring risks being compromised by the fact that each initiative is being led by a different ministry, **but it is in the interests of all stakeholder groups to consider the outcomes of both processes objectively and agree common ground if progress is to be made towards the development of a more holistic vision and accompanying strategy**.

3.1.2 Niche Strategies

One characteristic of the current policy orientation is the breadth of support for different scientific and technological areas and industry sectors and the relative absence of any marked niche strategies or concentrations of effort on key technologies, socio-economic issues or sectors. R&D policy initiatives in particular are numerous in number and cover a broad span of technology areas rather than being concentrated in a smaller number of key thematic areas of significant social or economic relevance to Austria. The generic arguments for maintaining a broad

[11] GOSPLAN was the Soviet State Planning Committee established in the 19020s.

research base and supporting innovation across a large number of industry sectors are well known and extremely laudable, and there are strong lobby groups in many countries in favour of maintaining such breadth, especially within the academic research community, but many countries with larger economies than Austria have recognised the danger of spreading resources too thinly and have opted instead for policies aimed at establishing critical research masses in key areas and ensuring that these efforts are effectively linked with innovation activities. The Netherlands is one such country.

In the opinion of the Peer Review team, **the wisdom of maintaining support levels across an extremely broad spectrum should be re-examined**, especially in the light of the drive to improve the quality and excellence of both research and innovation activities. **It may make more sense from a national perspective to divert more resources to areas of strategic relevance to Austria, to major societal issues such as sustainability, and to increased efforts to link research and development in these areas to the innovation activities of firms**.[12]

3.1.3 International Links

Policymakers in all countries nowadays have to develop a stance concerning international cooperation in R&D and innovation activities and the development of technology-related trade activities. In particular, strategies have to be in place firstly to encourage and facilitate cooperation between indigenous researchers and researchers in other countries, and secondly to prioritise international links with particular partner countries. Policy instruments facilitating international linkages allow researchers to seek complementary expertise on a broad basis and generally help ensure that national excellence levels are at least on a par with international levels. They also pave the way for stronger links in terms of technology-related trade activities.

In policy terms, Austria has long been attuned to the need to create links between national programmes and international programmes such as the EU Framework Programmes and those of the European Space Agency (ESA). Contrary to policies in many other countries, Austria – and particularly the Ministry of Transport, Innovation and Technology (BMVIT) – has clearly seen the potential of a win-win situation for both EU and national programmes, with many of BMVIT's programmes initiated in order to facilitate the participation of Austrian researchers in the EU Framework Programmes.

Consequently, many Austrian researchers are active participants in the EU's RTD Framework Programmes, though some of the stakeholders seen by the Review Team suggested that industrial participation was perhaps waning as a consequence of the administrative burden involved. It was also suggested that the relatively higher proposal success rates for submissions to national programmes could also affect the balance between participation levels in national and EU programmes, since success in national competitions might lessen the desire to compete in international competitions. **Future strategy, therefore, should continue to emphasise the interplay between national programmes and EU Framework Programmes in**

[12] It should be noted that focusing attention on specific areas does not imply withdrawing support for excellent research across a broad front. It simply means increasing budgets in priority areas in the hope that the research community pays greater attention to these areas.

order to ensure that the opportunities for Austrian researchers to work international partners are maximised.

Cooperation with variable groupings of EU partner countries via Joint Programming activities should also be factored into the equation. These could provide feasible and attractive ways of overcoming problems of fragmentation and lack of critical mass. Austrian programme owners and managers have participated actively in ERANETs and are well placed to exploit the lessons learned in future joint activities, though **planning for these preferably needs to be done within the context of an overall strategy for Austrian participation in Joint Programming activities**.

The scope for increased international cooperation with other Non-EU countries also needs to be re-examined. Some of the Review Team suggested broadening horizons to include increased cooperation with the US and Japan (in line with the desire to increase levels of excellence via collaboration with leading edge R&D and innovation actors), and with India and China and the other BRIC countries (in line with the desire to establish close links with future R&D and innovation leaders in these emerging markets). The recent report of the EU Expert Group on 'Opening to the World: International Cooperation in Science and Technology'[13] also sets out many of the arguments why it would be beneficial for Austria (and other countries) to explore the extension of international links with both developing countries and near-neighbour countries. Austria undoubtedly benefited from the accession of countries like Hungary and the Czech Republic to the EU in terms of enhanced markets and increased impetus to differentiate itself by moving up the value chain, but this impulse may be on the wane. There may thus be an argument for building on the work of initiatives such as CIR-CE[14] by paying even greater attention to links with other near neighbours, especially those serving a gateway or hub function with the Balkans and former USSR countries, and for learning from the experiences of other countries in terms of benefiting from bi- and multi-lateral cooperations. Both the Dutch and Danish members of the Review Team suggested that there were valuable lessons to be learnt from their own countries' experiences.

3.2 Policy Formulation Structures and Processes

Policy formulation in modern R&D and innovation systems takes place within complex governance systems and is characterised by complex interplays between 'top-down' and 'bottom-up' processes and variable degrees of 'stakeholder inclusivity'. Typically, key roles are played by the ministries and agencies responsible for R&D and innovation activities; by independent advisory bodies set up to articulate visions and recommend strategies; and by parliamentary bodies operating at the nexus of political and bureaucratic spheres of influence over policy formulation. Similarly, key processes involve mechanisms to ensure inclusivity, promote communication and establish consensus.

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[13] 'Opening to the World: International Cooperation in Science and Technology', eg6-international-cooperation_en.pdf, http://ec.europa.eu/research/iscp/index.cfm?pg=allpublications,

[14] The Cooperation in Innovation and Research with Central and Eastern Europe programme (CIR-CE) (see http://www.cir-ce.at/) offers a framework for trans-national networks organised by intermediary organisations (such as competence centres, technology centres, clusters) to encourage trans-national projects covering R&D, technology transfer, benchmarking, quality assurance etc. Potential partner countries include Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Poland, Romania, Serbia, Montenegro, Slovakia and Slovenia.

3.2.1 Role of Advisory Bodies

Austria has two main advisory bodies with slightly overlapping interests in R&D and innovation. The Austrian Council for Research and Technology Development advises the Austrian Government on all aspects of R&D and innovation, whereas the Austrian Science Board advises Parliament (at national and regional levels), the Austrian Ministry of Science and Research (BMWF) and Austrian universities on all aspects of university affairs, including research. The extent of this overlap, however, did not unduly concern the Peer Review team given the overall degree of differentiation between the tasks and remits of the two bodies and their different target audiences. This is despite the fact that some countries (e.g. The Netherlands) have recognised that too many advisory bodies can overcomplicate policy formulation. **In future, one possible way of avoiding overlap and minimising duplication would be to constitute more overt links between the two bodies, perhaps via limited cross-membership**. This would help ensure that each was fully briefed of the activities of the other.

Of more concern were the current role, status, legitimacy and credibility of the Austrian Council for Research and Technology Development. During the peer review, some observers offered the view that the influence of the Austrian Council had waned in recent years in line with a shift towards the provision of more high-level advice rather than advice focused on the disbursement of specific research budgets. Others raised questions about the constitution of the Council and its representativeness, arguing that the breadth of its constituency was not adequately represented by its current membership. The view was also expressed that the role of the Austrian Council had to some extent been marginalised by the existence of the Research Dialogue and the absence of any formal mechanisms for the Austrian Government to respond to the advice given to it by the Austrian Council. Bodies with advisory responsibilities are increasingly commonplace within modern R&D and innovation governance systems, and as such governments are not formally obliged to act in accordance with the advice offered by them, but weak or no responses to advice that is offered can ultimately undermine the credibility and utility of the advisory system itself.

An independent advisory body such as the Austrian Council can play an important role in the formulation of policies in a modern governance system, but only if both the body itself and the advice it offers are regarded as credible, authoritative, non-partisan and, ultimately, seen to be having some effect. **In the opinion of the Peer Review team, the role, constitution and *modus operandi* of the Austrian Council should be thus be reviewed with a view to enhancing the significant contribution such a body can have on R&D and innovation policymaking in Austria**. Important ingredients of a successful recipe are likely to include:

- Representatives from a broad spectrum of R&D and innovation stakeholders, not just some of the more powerful interests;

- Adequate funding and resources for a secretariat to conduct research and analyse data relevant to the formulation of policy advice, with guaranteed access to official sources of policy-relevant information;[15]

- Procedures in place for government to acknowledge receipt of any advice offered and to comment on its implications for future policymaking.

3.2.2 Role of Ministries and Agencies

Two governance issues concerning the role of ministries and agencies in policy formulation attracted the interest of the Peer Review team. The first relates to the relative apportionment of responsibility for policy formulation between individual ministries and the agencies that serve them. The second concerns communication and coordination between different ministries and agencies in the formulation of R&D and innovation system-wide policies, i.e. in the development of coherent R&D and innovation policy mixes.

In some countries, there is a one-to-one correspondence between a single ministry and the single agency that serves it, with a correspondingly simple division of responsibility for policy formulation (seen as the task of the ministry) and policy implementation (seen as the role of the agency). In Austria this simple system does not prevail. In the first instance, all the relevant agencies (AWS, FFG and FWF) have multiple ministerial masters (BMWA, BMVIT, BMWF and, indirectly, BMF). Secondly, there is no clear division of responsibility in terms of the initiation and evolution of the action lines implemented by the agencies, with different ministries responsible for the origin of specific action lines within agencies, and the agencies themselves responsible for the initiation and evolution of others.

This situation has advantages and disadvantages. On the positive side, the system is responsive to the needs of multiple stakeholders and socio-economic issues; and flexible enough to allow the development of action lines customised to the satisfaction of these needs. On a negative note, however, it can also give rise to the evolution of an inefficient 'programme jungle', with a multitude of small programmes, high administration costs, and different ministries supporting similar, duplicative activities within individual agencies. In Austria, even though the responsiveness of the system to stakeholder needs was emphasised, signs of an overgrown 'programme jungle' were also evident.

In terms of governance structures, there is often a trade-off between, on the one hand, simple structures that are efficient but inflexible and, on the other hand, complex structures that are more flexible but often also more inefficient. Complexity need not always go hand in hand with inefficiency, however, especially if all parties involved in complex governance structures are 'singing from the same hymn sheet', i.e. if the action lines formulated by different ministries and agencies are all informed and

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[15] One member of the Review Team suggested the possibility of locating the secretariat within a ministry or agency in order to increase cost-effectiveness and optimise policy linkages. Another, however, felt this might compromise the independence of the Council or alienate other ministries and agencies. One country where this model is used successfully is the UK. The UK's Advisory Council on Science and Technology is composed of senior independent figures appointed by the Prime Minister. Its brief is to advise on strategic issues that cut across the responsibilities of individual government departments, but it has a secretariat located within one of these departments (see http://www2.cst.gov.uk/).

shaped by a common vision or high-level objectives, a joint strategy and highly effective communication and coordination channels between the interested parties.

The Peer Review team was not convinced, however, that this situation prevailed in Austria. Although it was evident that individual ministries and ministers felt that policy formulation processes relevant to their own primary interests (e.g. basic research, applied R&D and innovation) were adequate, and that formal and informal communication and coordination mechanisms between ministries were sufficient, there was – as noted earlier – little evidence to suggest the existence of adequate mechanisms to develop coherent sets of objectives and strategies for the global development of the Austrian R&D and innovation system, and more to suggest the threat of incrementalism, overlap, funding gaps and lack of adequate priority setting.

Other countries have responded to similar problems via the adoption of structures or processes designed to improve coordination and cohesion in the development of overarching national visions and strategies. These include the establishment of bodies such as the Finnish Innovation Council, chaired by the Finnish Head of State; the Danish Globalisation Council, again chaired by the Danish Prime Minister; or the Dutch Innovation Platform. The latter involves the Dutch Prime Minister, ministers from the main ministries concerned with R&D and innovation, and key stakeholders. It is also supported by an inter-ministerial directorate working on long-term strategy geared towards the fulfilment of societal objectives.

In other national settings, cohesion is stimulated via the regularisation of policy formulation processes (e.g. the four-year cycle for Research Bills in Sweden) and the demand that all relevant ministries and agencies contribute to the policy debate during this cycle. In Austria, the current Research Dialogue is led by the Austrian Ministry for Science and Research and does involve consultation with other ministries, but it is of a one-off nature rather than part of a regular cycle of activities, and its focus is determinedly on the generation of a strategy for research rather than on the formulation of a strategy covering the development of R&D and innovation more generally.

In the considered opinion of the Review Team, therefore, Austria would benefit from a re-evaluation of the structures and processes in place to formulate coherent R&D and innovation policies.

3.2.3 Role of Parliamentary Bodies

In some national contexts, independent Parliamentary Committees concerned with science, technology, research and innovation both scrutinise existing government policies and provide important inputs into policy formulation discussions. In the UK, for example, a Select Committee on Science and Technology composed of members from the House of Commons is charged with monitoring the work and activities of the ministries with responsibility for science and innovation, while the Science and Technology Committee of the House of Lords has a broader mandate to consider 'science and technology' more generally. Supported by small secretariats, the activities of these Committees primarily take the form of consultative inquiries into issues they consider to be important and topical, with the choice of topics reflecting the particular interests of Committee members, the impact that the Committees believe they can make and the timeliness of inquiries. Once inquiries are completed, reports are published containing conclusions and recommendations. The Government

is then obliged to respond to each of the conclusions and recommendations made within a period of two months. The Government may choose to accept or reject the views of the Committees, but even when a recommendation is rejected it may play a role in influencing subsequent discussions, or be used to inform policy development at a later date.

Austria has two Parliamentary Committees dealing with science and technology and research and innovation-related matters: the Science Committee and the Committee for Research, Innovation and Technology. Their role is to act as discussion fora for strategy related to these topics. In comparison to the situation in the UK, however, the influence of these Committees on policy development appears relatively weak, with relationships between the Committee members and ministry representatives based on an informal rather than a formal footing (unlike the case, for example, in either the UK or the Netherlands) and no formal mechanisms in place requiring government to respond to any of their reports, conclusions or recommendations. **Given the valuable contribution that consultative inquiries and obligatory governmental responses can have on the quality of policy formulation, the Austrian government may like to consider how the role played by its two Parliamentary Committees and Parliament in general could be strengthened**. Options include either allowing these Committees to undertake broad-ranging consultative inquiries, as in the UK, or empowering them to ask Austria's advisory bodies undertake them on their behalf.

3.2.4 Evaluation

Starting from a low base in the early 1990s, Austria now has one of the most well-developed and embedded R&D and innovation evaluation cultures in Europe, with a strong cadre of experienced and independent professional evaluators, regular programme evaluations and, currently, an ambitious attempt to move towards 'portfolio' and/or 'system' evaluations. Nevertheless, whilst praising these achievements and ambition levels, the Review Team had some cautionary words concerning evaluation theory and its practice in Austria. Concerning the current 'System Evaluation' being undertaken in parallel with the Research Dialogue, members of the team most familiar with evaluation theory commented that any results to emerge from the study should be regarded as tentative and suggestive rather than definitive and authoritative, given that current theories of how innovation systems operate are not sufficiently well developed to allow fully-fledged system evaluations. It was still felt, however, that the study was likely to yield valuable insights of great use to Austrian policymakers and to advance the state-of-the art of evaluation practice. The need for 'portfolio' and/or 'system' evaluations is growing apace as policymakers and policy analysts recognise the importance of thinking in systems terms, and the Austrian policymaking community is to be congratulated for commissioning a study of this nature.

A more critical reservation concerns the use of evaluation results in general. Although the practice of evaluation is widespread, some observers doubted whether the results of these evaluations fed adequately into future policy formulation. The existence of a 'programme jungle' and the consequent plethora of programme evaluations also raised the spectre of information overload and consequent 'paralysis via analysis'. **Evaluations are of little utility if their results fail to inform future policy and practice. More thought should therefore be given to the mechanisms**

needed to ensure that the results of evaluations do feed back into policy formulation and implementation.

3.3 Policy Implementation

3.3.1 Structural Change and Programme Rationalisation

The extent of structural change in the Austrian governance system has been considerable in recent years, the major change being the reduction in the number of agencies implementing R&D and innovation support schemes. The current structure, however, is still quite complex. Three main agencies serve the needs of three main ministries (four if the Ministry of Finance (BMF) is included), and each agency has multiple ministerial masters. The question of the need for further structural change thus arises.

The Review Team concurred that the current degree of complexity of the system is not sufficient in itself to warrant further major structural reform, though the election of a new government in September 2008 may provide a political opportunity to further rationalise governance structures. Some of the consequences of the existing complexity, however, are a cause for concern and do strengthen the case for less severe reforms. The most important problem, as noted earlier, is the proliferation of programmes across the system as a whole and the concomitant dangers of duplication, incoherence, sub-criticality and low value for money. If anything, the current structure is perhaps over-sensitive to the needs of different stakeholder groups, and – again as noted earlier – changes are needed in strategy formulation processes and procedures to ensure that the future generation of action lines is informed by a coherent vision. **There may also be a need to reconsider the relative autonomy of the agencies (especially FFG and AWS)**. At present there is no clear separation between policy formulation (typically a ministerial function) and policy implementation (typically an agency function), with the agencies having less control over some aspects of implementation and ministries having a greater hand in aspects of implementation than is probably desirable.

There is also an urgent need, however, to ascertain the extent of the problems created by the current preponderance of programmes and to rectify them if they are severe. Hopefully the current 'System Evaluation' will throw some light on this issue, especially concerning innovation-related initiatives, but the likelihood is that some form of programme rationalisation will be needed, as has happened in many other countries in recent years (e.g. the UK).

3.4 Science Base

There have been extensive changes affecting the Austrian science base in recent years. Prime amongst these have been the structural reform of the Austrian university system, granting universities an unprecedented degree of autonomy; the implementation of Performance Contracts for universities as part of this reform; the drive to promote excellence in both teaching and research; and substantial increases in the amounts of public funding for research, available to universities via both 'block' or 'institutional' funding and via 'competitive' funding sources.

3.4.1 University Performance Contracts

In principle, Performance Contracts are the price universities pay for greater autonomy, with future 'block' or 'institutional' funding for both teaching and research linked to the achievement of targets specified within contracts individually negotiated with the Ministry for Science and Research (BMWF).[16] During its discussions, the Review Team was told that the initial implementation of Performance Contracts went smoothly, in part because the ministry deliberately did not specify ambitious targets in order to ease the initial burden of reform for universities. **In future, however, it will be important for targets to become more ambitious if excellence is to be engendered in the system, with rewards (and penalties) in the shape of future funding levels keenly tied to target attainment**.

It will be also be important, however, to ensure that the targets set for individual universities are both customised to the individual needs and capabilities of each university and strongly influenced by strategic priorities set for the evolution of the university system as a whole. Greater autonomy presents a wonderful opportunity for the development of individual universities, but also poses a potential threat to the attainment of a nationally desirable profile of research and teaching capabilities if universities alter their own profiles in a totally independent and *ad hoc* fashion. Research in some disciplinary areas, for example, could be threatened as universities concentrate resources in particular areas of strength and drop activities in areas of weakness. An important first step, therefore, is to articulate a national vision for the university sector in Austria. The next step is to develop a core set of indicators reflecting these goals and ensure that this common set is built in to individual Performance Contracts, with university-specific indicators then complementing but not supplanting this core set.

3.4.2 University Research Funding

The relative amounts of funding universities receive for research via 'block' or 'institutional' funding compared to funding received from 'competitive' sources (e.g. from successful proposals to the Austrian Science Fund) varies from one country to another, and there are few 'best practice' benchmarks to guide national policymakers intent on optimising R&D and innovation system performance via the establishment of prescribed levels of institutional and competitive funding.[17] There does appear, however, to be general trend towards higher levels of funding from competitive sources as excellence and research quality become national leitmotifs. In The Netherlands, for example, the proportion of funding from competitive sources rose significantly over the period from 1990 to 2006 as greater emphasis was placed on the attainment of research excellence, and in the UK the proportion is approximately 60%.

In Austria, as in many other countries, institutional funding is used to fund both research and teaching. The exact proportions spent on each, however, are difficult to calculate on a national basis since the figures for individual universities are not generally available. National figures for the relative amounts spent on teaching and

[16] Each university has its own contact point within the ministry, with whom these contracts are negotiated.

[17] An OECD project (Developing and Collecting Indicators on Direct Public Funding) that touches on this issue, however, is currently in preparation.

research are thus based on an approximation (the Review Team was variously told this lay somewhere between 60:40 and 50:50 for research:teaching). In comparison, the figures received by universities for research from competitive sources are well known, but the opaqueness surrounding the research:teaching ratio in institutional funding make it difficult to calculate the institutional:competitive ratio with any precision.

If Austria is serious about raising research excellence levels in the university sector, key elements include introducing performance-related elements into the provision of institutional funding (which is being done via performance contracts) and increasing levels of competitive funding (which is likely to occur given the BMWF 1% target for 'basic' research by 2020). **But a good starting point would be to clarify exactly what the baseline is in terms of the actual amounts currently spent on research via the aggregation of data on the research expenditure of individual universities**. In the past this was not possible because the accounting systems of universities rarely allowed research:teaching ratios to be calculated with any accuracy. Since the university reforms of 2002, however, this situation has changed, and it is now in the interests of all universities to understand this ratio, if only to calculate the true costs of research and negotiate realistic overhead rates with funding bodies. It is also very much in the national interest, since the current opaqueness of the system makes it hard to estimate the true amounts of money being spent on research. This could undermine political demands to establish the 'productivity' associated with the recent large increases in public research expenditure – which in turn could have a backlash effect on research policy and future funding levels.

3.4.3 Other Issues

During the course of its discussions, the Review Team touched upon a large number of other issues concerning the science base that it was not possible to cover in any depth. Some of these are mentioned here in passing:

- The recent introduction of a 20% overhead rate by the Austrian Science Fund (FWF) was welcomed as a move in the right direction, though the general hope was that improved accounting practices in the university sector would provide the evidence needed for funding bodies to introduce overhead rates based on accurate assessments of true costs;

- The high success rate for proposals received by the Austrian Science Fund (FWF) in comparison to success rates in other countries was noted with interest. This could of course be simply related to the high quality of Austrian science and its research community. Conversely, it could also signify lower acceptance standards than elsewhere. The situation thus warrants further investigation;

- The decision by the Austrian Science Fund (FWF) not to provide subsequent support for Austrian silver medallists in European Research Council (ERC) competitions was a surprise, especially given that the international peer review process used by the ERC had considered all such applications to be of an extremely high quality. Awarding support in future might stimulate even more Austrian submissions to the ERC;

- University involvement in K-Centres and Doppler Labs[18] was welcomed, though some concern was expressed that involvement in such centres was neither recognised nor rewarded by the indicators currently used in Performance Contracts. One member of the Review Team also doubted that such centres would be viable without some degree of public funding, going on to argue that this consideration should be embedded in the development of any long-term strategy for the evolution of both these centres and the science base as a whole;

- Some concerns were also expressed about the public research institute sector in Austria. Although the Review Team did not have an opportunity to meet with representatives of the Austrian Research Centre (ARC), a number of other discussants expressed the view that further efforts were needed to revitalise this crucial sector, perhaps via the greater involvement of industry in the setting of research agendas and the funding of projects;[19]

- The Review Team recognised the value of the Austrian Academy of Science within the fabric of the Austrian R&D and innovation system and noted the importance of establishing a Performance Contract with the Academy that recognised its specificity.

3.5 Industrial R&D and Innovation

Four main issues concerning the Austrian industrial R&D and innovation base captured the attention of the Review Team. First was the overall performance of the sector in the light of public support dependence, while the second issue of interest was the attraction and retention of inward investment. The formulation and implementation of support measures by the relevant ministries and the Austrian Research promotion Agency (FFG) and the Austrian Economic Service (AWS) constituted the third main issue, and the relative emphasis given to single firm support and collaborative R&D was the fourth.

3.5.1 The Performance of the Industrial R&D and Innovation Base

Contrary to the situation in many other countries, where industrial R&D intensity is stagnating, increases in industrial expenditure on R&D have contributed significantly to the recent overall rise in R&D funding levels in Austria, though public support for industrial R&D has also risen to a lesser extent. One explanation is that public support policies may have leveraged this additional R&D spend by industry, with some observers noting that the expansion of R&D tax schemes in 2004 could have played a part in this. The Review Team was also told that almost all eligible firms took advantage of both direct and indirect funding support schemes for R&D. Similarly, according to the European Innovation Scoreboard, public support for innovation in Austria is endemic, with the share of enterprises receiving public funding for innovation double the average for the EU25 countries. Unfortunately, however, innovation performance in terms of output indicators such as sales of high-

[18] The K-Centres are competence centres set up to encourage collaboration between firms and universities. The Christian Doppler Laboratories at universities were set up in 1989 to perform application-oriented basic research funded by both the public and private sectors.

[19] The Review Team was told that less than 20% of the budget of ARC stemmed from industry while around 80% came from the Austrian public purse.

tech exports, new-to-market products, and sales of new-to-firm but not new-to-market products are lower than the EU25 averages, and innovation intensity (the share of innovative products in overall business sales) is low compared to innovation propensity (the proportion of businesses recording new-to-firm or new-to-market product innovations).

The combination of relatively high and extensive public sector inputs to both R&D and innovation and low industrial innovation output levels is disturbing. It may just be a matter of time before increases in public sector input levels work their way through the system and EIS innovation output levels start to rise,[20] but there is also the fear that high public investment levels could induce or continue to nurture a 'subsidy culture' antithetical to entrepreneurial and innovative behaviour, with ever diminishing subsequent returns to higher public investment levels. **This did not appear to be an issue of major concern to Austrian policymakers during the course of the review, but perhaps it deserves to be one in the future.**

Austria is attempting to shift from being an 'innovation follower' to an 'innovation leader', with public support policies expected to play a major role in this transformation. Before this can happen, however, **the effectiveness and value for money of current R&D and innovation-related policies need to be thoroughly examined and discussed**. The current 'Research Dialogue' should bring the spotlight to bear on the R&D-related policies of the Ministry for Science and Research (BMWF), and the 'System Evaluation' is casting its net more broadly to include coverage of the innovation-related policies of the Ministry for Transport, Innovation and Technology (BMVIT) and the Ministry for Economics and Labour (BMWA). **It is be hoped, therefore, that the 'Research Dialogue' and publication of the 'System Evaluation' lead to an open public debate about future directions and an overall strategy for the development of the national R&D and innovation system as a whole**.

3.5.2 The Attraction and Retention of Inward Investment

A significant proportion of industrial R&D performed in Austria is undertaken by large, foreign-owned firms[21] and Austrian support policies undoubtedly play a part in both attracting and retaining high inward investment levels in R&D. Certainly the Review Team was told that most foreign-owned firms benefited from both direct support schemes and fiscal R&D schemes, with the latter being particularly attractive to them. Many other countries, however, are now improving their 'fiscal attractors', and alternative incentives may be needed to retain potentially footloose R&D capital. One member of the Review Team suggested that an option in line with the national imperative to improve the excellence of research conducted in Austria would be to replace existing tax schemes with a tax credit scheme based on the quality of R&D projects proposed by industry. Given that the R&D conducted by many foreign-owned firms tends to be of a high quality, a scheme such as this could be very attractive to them. One model could be the Norwegian SkatteFUNN tax credit

[20] This is obviously not a simple linear process, but there is a natural and justifiable expectation in policy circles that there should be some return on public investment.

[21] The percentage of GERD financed from abroad in Austria (15.5% in 2007) is one of the highest in the OECD, and nearly a quarter of R&D performed in Austrian companies is financed by other companies abroad (see Appendix 3).

scheme, which covers up to 20% of R&D project expenditure once projects have been checked for quality and approved.

Before introducing any schemes that could potentially increase subsidy levels, however, **a detailed examination of the factors influencing the locational and investment behaviour of foreign-owned firms with R&D capacity in Austria would need to be undertaken**. To some observers, subsidy levels already appear relatively high and increasing them will yield little benefit if they are not a major influence on either the location of R&D capacity or inward investment levels for R&D. There may even be an argument for reducing them in such circumstances, in order to obtain better value for money from public expenditure.

3.5.3 Support Measures for Industrial R&D and Innovation

The Review Team heard three major criticisms of policy measures in support of industrial R&D and innovation. The first, reflecting the phenomenon of a 'programme jungle', was that – across all relevant ministries and agencies – there were too many, sub-critical measures spanning a vast range of different technology areas and industry sectors, with many initiated to appease small groups of influential stakeholders rather than implemented in line with well-defined national interests and strategies. As already argued in Sections 3.1.2, 3.2.2 and 3.3.1, **the resolution of this dilemma involves better strategy formulation processes, the adoption of a strategy focusing on key strategic areas or themes, and measures to rationalise existing programme portfolios**.

In a similar vein, the second criticism was that the R&D programme portfolio of the Ministry for Transport, Innovation and Technology (BMVIT), which is largely implemented by the Austrian Research Promotion Agency (FFG), was not only too densely populated with potentially sub-critical programmes but also that the 'sectoral' elements of the ministry, i.e. the sections of the ministry dealing with transport and telecommunications policy,[22] were only weakly linked with the 'innovation and technology' elements of the ministry.[23] In a similar vein, the Review Team was also told that the R&D activities of BMVIT and FFG were also only weakly connected with sectoral activities overseen by other ministries (e.g. health, environment, agriculture etc.). If this is correct, **it represents a wasted opportunity to connect R&D activities to the broader development of these policy areas via either the construction of thematic 'mission-oriented' programmes or the deployment of R&D and innovation friendly procurement regimes**.

Thirdly, turning to the innovation-related activities of the Ministry for Economics and Labour (BMWA) and the Austrian Economic Service (AWS), the low availability of early-stage venture capital relative to the EU25 average (a mere 6% of the EU25 average in 2006, according to the European Innovation Scoreboard) suggests that **the adequacy of funding for innovative start-ups should be reviewed to establish**

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[22] Historically, BMVIT is the result of an amalgamation of formerly separate ministries.

[23] Some links do exist, e.g. the Transport Telematics initiative, but the view offered to the Review Team was that considerable scope existed for the strengthening of the links between innovation policy and other policies. Earlier studies also suggest the historical existence of weak links, e.g. Whitelegg, K. (2005), "Patchwork Policymaking: Linking Innovation and Transport Policies in Austria", in OECD (2005), 'Governance of Innovation Systems', Volume 3: Case Studies in Cross-Sectoral Policy

whether there is scope for new or expanded initiatives to stimulate the supply of venture capital.[24]

3.5.4 Single Firm Support and Collaborative R&D

The Review Team was surprised to hear that much direct R&D support took the form of subsidies to individual firms to pursue R&D projects on their own rather than in collaborative projects, which typically involve firms working with research institutes, universities or other research performers. Collaborative R&D programmes and schemes certainly exist, but they do not dominate the R&D support landscape as they do in many other countries, where support for single firms has diminished.[25] Collaborative R&D schemes have much to commend them in terms of the prescriptions of current R&D and innovation system theory (which emphasise the crucial role of interactions between R&D and innovation stakeholders in the generation and deployment of knowledge and innovations), while single firm support schemes run a greater risk of encouraging reliance on the state and stifling truly innovative behaviour. **It may repay Austria, therefore, to think again about the balance between these two modes of direct funding support for R&D**.

3.6 Human Resources

3.6.1 The Supply of Trained Personnel

Three main issues tend to dominate discussions about the human resources needed for the healthy evolution of strong R&D and innovation systems: the numbers of skilled personnel both needed and capable of being absorbed and incorporated into the system; the quality of these personnel – both desired and actual; and the mobility of skilled personnel both within the system and between other R&D and innovation systems in different countries and regions.

In Austria, the main concern appears to be with numbers. Some concerns were expressed about quality, and there was some discussion about the barriers to mobility between R&D and innovation-related ministries and agencies (which should ideally be removed if the systemic thinking needed for the formulation and implementation of effective policy mixes is to become widespread in policymaking circles), but **the primary problems concern low input numbers and high attrition rates**. Insufficient numbers are being attracted to study science and technology, with the proportion of science and engineering graduates in the economy considerably lower than the EU25 average; drop-out rates were said to be high, though not dramatically so; and career paths in universities are apparently restricted by a relative glut of middle-aged, tenured personnel not subject to the new contractual regimes associated with the reform of the university sector. The proportion of the population with tertiary education – an important driver of innovation and a surrogate measure for the absorptive capacity of an economy for innovative goods and services – is also lower than the EU25 average.

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[24] Despite the existence of a 'programme jungle' and the need for some form of rationalisation, slimming the programme portfolio via rationalisation does not exclude the creation of new programmes to fill policy gaps.

[25] Support for single firms of any description is exceedingly rare in the UK, for example, though support for single SMEs is still common in many countries.

Considerable efforts are thus needed to rectify this situation, in addition to the initiatives already in place. Promising avenues include a stronger emphasis on efforts designed to increase the public understanding of science and make careers in science and engineering attractive to schoolchildren; greater investment in education generally; more resources for PhD and Post Doctoral places; greater efforts to encourage women and immigrants into science, engineering and research – both sources of largely untapped potential; and more vigorous attempts to persuade highly qualified members of the Austrian diaspora to return to Austria. Another route would be to place greater emphasis on retraining and continuous education, though participation in life-long learning in Austria is already well above the EU25 average and the other routes probably hold more promise.

4 Policy Mix Issues

Looking again at the simple model of an 'R&D and Innovation System' used by the Review Team to guide its discussions (see **Exhibit 1**), some comments can be made about the policy mix in place in Austria to nurture its development.

The most obvious point to make is that most policies are **domain specific** and geared towards the **reinforcement** of existing strengths and the **rectification** of weaknesses.

The second point is that most domain specific policies seem to be formulated in **relative isolation** from each other, with few mechanisms in place to evolve either **holistic visions** or **holistic strategies** capable of realising these visions.

Thirdly, this relative isolation means that there are relatively few initiatives deliberately attempting to encourage **linkages** and **interactions** between the various domains and the R&D and innovation actors within them. The exception concerns efforts to encourage **collaboration and knowledge transfers** between actors in the science base and those involved in business R&D and innovation, though the emphasis on this aspect was less than in many other R&D and innovation leader countries and counterbalanced by a continued emphasis on single firm support initiatives.

Fourth, there was some suggestion of **overlap** and **duplication** in terms of different ministries supporting similar initiatives in the agencies serving them.

Fifth, there is an apparent **gap** in terms of **demand-side policies** designed specifically to nurture an innovation–friendly economic and market environment by increasing the absorptive capacity of the economy for innovative goods and services. There was some indication that innovation-friendly **procurement policies** were being discussed, but little evidence of tangible moves in this direction.

Sixth, **external linkages** with other national R&D and innovation systems and actors were fairly well established within EU circles, but opportunities exist for both strengthening these and expanding links with other R&D and innovation leader countries, neighbouring countries and developing countries.

Seventh, **internal linkages** between R&D and innovation policies and policymaking at the national and regional level seemed relatively unidirectional, with policies at a national level influencing policy developments and R&D and innovation activities at a regional level, but not *vice versa*.

One other point also needs to be noted concerning the evolution of effective policy mixes for the system as a whole. This concerns flows of **money**, **information**, **knowledge** and **innovative goods and services** in the system and the problems of **absorptive capacity** and **transmittive ability**. System development is vitally dependent on both the absorptive capacities and the transmittive abilities of each of the constituent domains. The ability of the science base to absorb large increases in funding for research, for example, is vitally dependent on the number and quality of the researchers in this sector; the ability of the science base to transmit these demands to the human resource domain; the ability of the human resource domain to meet the demands for additional highly qualified personnel; and the ability of the science base to create jobs for them. Similarly, the extent of knowledge transfer from the public

science base to the commercial R&D and innovation sector is dependent on the ability of this sector to absorb these flows and the efficiency and effectiveness of the policy mechanisms in place to encourage interaction and absorption. Critically, the flow of innovative goods and services is also dependent on the absorptive capacity of the economy as whole for these commodities and, to complete the domain linkages, the human resource sector has to be capable of absorbing and responding to signals transmitted by the economy concerning the demand for human resources and be able to absorb investment monies generated in the economy as a whole.

In Austria, the recent increases in funding for R&D raise a number of questions concerning the ability of the system as a whole to respond to these changes. Ideally, for example, the need for more researchers should be transmitted to the human resource domain and policies put in place to meet this demand. Similarly policies are needed in the business R&D and innovation domain to cope with the additional knowledge flows one hopes would result from large increases in R&D expenditure. In reality, however, the lack of an overt holistic overview in Austria and the weak coordination mechanisms of its R&D and innovation governance system do not suggest that sufficient consideration is being given in all relevant policy circles to the recent and projected rises in R&D levels.

Austria certainly has an extremely broad and complex array of different policy mechanisms and initiatives in each of its R&D and innovation system domains, perhaps too rich a mixture if the existence of a 'programme jungle' is acknowledged, but there are legitimate concerns about the coherence of the whole. In such a situation, **the policy prescription is unlikely to be the addition of yet more measures and much more likely to involve an injection of clarity, a good shake up of existing measures and a healthy regime of integrated policy portfolios**.

5 Recommendations

5.1 **Austria currently lacks a shared, holistic vision and a coherent set of public policies to stimulate the development of the entire R&D and innovation system. It also lacks adequate mechanisms to arrive at them. In the considered opinion of the Review Team, Austria would benefit from a re-evaluation of the structures and processes in place to formulate holistic R&D and innovation related strategies and the subsequent articulation of a coherent policy mix.**

5.2 **Within the context of this broader, holistic vision and strategy for the development of the R&D and innovation system as a whole, a cogent narrative explaining why a 1% target for 'basic' research makes sense for Austria is needed prior to its wholesale adoption.**

5.3 **Also within this broader framework, the evidence for an increased emphasis on 'high-tech' industries should be carefully compared with the likely costs and benefits of competing options.**

5.4 **The wisdom of maintaining support levels across an extremely broad spectrum of technology areas and industrial sectors should be re-examined with a view to diverting more resources to areas of key strategic relevance to Austria, with increased efforts to link R&D in these areas to the innovation activities of firms.**

5.5 **The widespread dependence of firms on public support for R&D and innovation and the possibility that this could stifle innovative behaviour and encourage a 'subsidy culture' did not appear to be an issue of major concern to Austrian policymakers, but perhaps it deserves to be one in the future.**

5.6 **Future strategy should continue to emphasise the interplay between national programmes and EU Framework Programmes in order to ensure that the opportunities for Austrian researchers to work with international partners are maximised. Moreover, plans to overcome problems of fragmentation and lack of critical mass via participation in initiatives such as ERANETS and Technology Platforms should be formulated within the context of an overall strategy for Austrian participation in Joint Programming activities.**

5.7 **The scope for increased international cooperation with other Non-EU countries also needs to be re-examined, with the intention of increasing cooperation with R&D and innovation leader countries, emerging markets (BRICs), neighbouring countries and developing countries.**

5.8 **In terms of the structure and operation of those elements of the governance system responsible for the implementation of policies, the Review Team concurred that the current degree of complexity of the system is not sufficient in itself to warrant further major structural reform, though the forthcoming election of a new government in September 2008 may provide an opportunity for further rationalisation.**

5.9 The autonomy of the agencies and the separation of responsibilities between ministries and agencies could also be revisited. One suggestion concerning FFG (and perhaps other agencies) might be to increase its control over programme design and implementation by giving it full responsibility for these tasks after the acceptance by its board of an annual work programme.

5.10 Dealing with the problem of a densely populated 'programme jungle' will require better strategy formulation processes, the adoption of a strategy focusing on key strategic areas or themes, and measures to rationalise existing programme portfolios. Overall, the preferred policy prescription is likely to involve an injection of clarity, a good shake up of existing measures and a healthy regime of integrated policy portfolios.

5.11 In terms of advisory bodies, the role, constitution and *modus operandi* of the Austrian Council for Research and Technology Development should be reviewed with a view to enhancing the significant contribution such a body can have on R&D and innovation policymaking in Austria. Additionally, it will be important to review the procedures in place for government to acknowledge receipt and comment on any advice offered.

5.12 Also in terms of advisory bodies, one way of avoiding overlap and minimising duplication between the Austrian Council for Research and Technology Development and the Austrian Science Board would be to constitute more overt links between the two bodies, perhaps via limited cross-membership.

5.13 Given the valuable contribution that consultative inquiries and obligatory governmental responses can have on the quality of policy formulation, the Austrian Government may like to consider how the role played by its two Parliamentary Committees could be strengthened by enabling them to conduct such inquiries.

5.14 Evaluation is now well embedded in the Austrian R&D and innovation system, but evaluations are of little utility if their results fail to inform future policy and practice. More thought should be given to the mechanisms needed to ensure that the results of evaluations feed back adequately into policy formulation and implementation.

5.15 In terms of the human resources required by the Austrian R&D and innovation system, quantity is the most pressing problem. Greater efforts are needed to make careers in science, engineering and research attractive to schoolchildren and to encourage women and immigrants into the area – both sources of largely untapped potential. Greater investment is also needed in education generally and for the provision PhD and Post Doctoral places in particular.

5.16 Concerning the Performance Contracts that universities are now required to negotiate with the state, it will be important for targets to become more ambitious in future if excellence is to be engendered in the system, with rewards (and penalties) in the shape of future funding levels keenly tied to target attainment.

5.17 It will be also be important, however, to ensure that the targets set for individual universities are both customised to the individual needs and capabilities of each university and strongly influenced by strategic priorities set for the evolution of the university system as a whole.

5.18 Prior to any efforts to raise excellence levels in universities, accurate data on the research activities of individual universities should be aggregated to provide a true picture of the current quantity and quality of research being undertaken.

5.19 Many countries have substituted R&D support for single firms with support for collaborative R&D. It may repay Austria to think again about the balance between these two modes of direct funding support for R&D.

5.20 The support available to foreign-owned firms via direct and indirect measures may help attract and retain footloose R&D capital, but the price may also be higher than the Austrian taxpayer is willing to bear. A detailed examination of the factors influencing the locational and investment behaviour of foreign-owned firms with R&D capacity in Austria needs to be undertaken.

5.21 The R&D programme portfolio of the Ministry for Transport, Innovation and Technology (BMVIT) is weakly linked to the 'sectoral' elements of the ministry, i.e. to the sections of the ministry dealing with transport and telecommunications policy, and to 'sectoral' policies covered by other ministries. Options designed to connect R&D activities to the broader development of these policy areas via the construction of thematic 'mission-oriented' programmes and the deployment of R&D and innovation friendly procurement regimes should be explored.

5.22 The detailed appraisal of the R&D and innovation-related policies being conducted within the context of the current 'System Evaluation' merits an open public discussion of policy options if progress is to be made towards the evolution of coherent and broadly accepted strategies for the development of the R&D and innovation system.

5.23 Concerning the innovation-related activities of the Ministry for Economics and Labour (BMWA) and the Austrian Economic Service (AWS), the low availability of early-stage venture capital relative to the EU25 average suggests that there is scope for a review of the supply of venture capital and, if necessary, the implementation of policies designed to stimulate this supply.

5.24 More broadly, there is an apparent gap in terms of demand-side policies designed specifically to nurture an innovation–friendly economic and market environment by increasing the absorptive capacity of the economy for innovative goods and services. Again there is scope for innovation-friendly procurement policies that could help fill this gap, though experience elsewhere suggests that implementing these is by no means straightforward.

Appendix 1

Timetable for CREST Policy Mix Peer Review, 19-23/5/2008

Timing	Discussants	Discussion Topics
Monday, 19 May		
20:00 – 22:00	Review Team and Austrian innovation policy experts	Welcome dinner; Reflections on National Innovation System
Tuesday, 20 May		
09:00 – 10:00	Review Team only	Internal briefing
10:00 – 11:00	Review Team and Austrian Science Board	Interview
11:00 – 12:00	Review Team and Universities Austria	Interview
12:30 – 14:30	Review Team and Austrian Council for Research and Technology Development	Lunch discussion
14:30 – 15:30	Review Team and Ministry for Transport, Innovation and Technology	Interview
15:30 – 16:30	Review Team and Ministry for Economics and Labour	Interview
16:30 – 17:30	Review Team and Ministry of Finance	Interview
20:00 – 22:00	Review Team and Christian Seiser	Background talks over dinner
Wednesday, 21 May		
08:30 – 09:00	Review Team only	Internal briefing
09:00 – 10:00	Review Team and representatives from private sector	Working breakfast
10:00 – 11:00	Review Team and Austrian Science Fund	Interview
11:30 – 12:30	Review Team and Ministry of Science and Research	Interview
12:30 – 14:30	Review Team and Austrian Parliament	Lunch discussion
14:30 – 15:30	Review Team and Austrian Research Promotion Agency	Interview
15:30 – 16:30	Review Team and Austria Wirtschaftsservice	Interview
16:30 – 17:30	Review Team and Academy of Science	Interview
Thursday, 22 May		

Timing	Discussants	Discussion Topics
11:00	Review Team and Christian Seiser	Departure by bus for a debate with regional policy makers in Styria scheduled for Friday, 23 May
Friday, 23 May		
09:00 – 10:00	Review Team	Internal briefing
10:00 – 12:00	Review Team and representatives from regional government office, Technical University Graz, Industry, regional clusters, Joanneum Research	Group discussion on regional research policy
12:00 – 14:00	Review Team and representatives from regional government office, Technical University Graz, Industry, regional clusters, Joanneum Research	Lunch and group discussion continued
14:30 – 15:30	Review Team and Christian Seiser	Final debriefing

Appendix 2

Timetable for Scoping Mission by Review Team Leader, 10-11/4/2008

Timing	Austrian Discussants	Discussion Topics
Thursday, 10 April		
10:00 – 11:30	Christian SEISER, Wolfgang NEURATH, Armin MAHR: Ministry of Science and Research Rupert PICHLER: Ministry for Transport, Innovation and Technology, Ulrike UNTERER: Ministry for Economics and Labour Wolfgang POLT: Joanneum Research Matthias WEBER: Austrian Research Centres Seibersdorf	Kick-off Exchange of views on the objectives and the procedures of the country visit in May Role of ministries during the country visit in May
12:00 – 13:30	Wolfgang AIGINGER (+ 1 colleague): Austrian Institute of Economic Research (WIFO) Wolfgang POLT: Joanneum Research Matthias WEBER, Austrian Research Centres Seibersdorf Christian SEISER, Armin MAHR: Ministry of Science and Research	Analytical view on Austrian NIS Reflection on broader context of the policy-mix in the Austrian NIS from the perspective of Austrian research institutes
13:45 – 14:30	Austrian Science Fund (FWF) Christoph KRATKY: President,	Role of Austrian Science Fund
14:30 – 15:30	Austrian Science Board (Österreichischer Wissenschaftsrat) Lorenz FRITZ, Herbert MANG: Members of the Council, Julia PRIKOSZOVITS: Secretary General	Role of Austrian Science Board
16:30 – 17:30	Austrian Council for Research and Technology Development Ludovit GARZIK: Managing Director	Role of Austrian Council for Research and Technology Development
17:30 – 18:30	Ministry of Science and Research Elmar PICHL: Head of Cabinet's Office of Minister HAHN Stefan ZOTTI: Member of Cabinet's Office of Minister HAHN Peter KOWALSKI: Director General Armin MAHR: Project Manager	Austrian Research Dialogue; Political Dimension of the Peer Review

Friday, 11 April		
08:15 – 09.30	Vienna Science and Technology Fund (WWFT) Michael STAMPFER: Managing Director	Reflection on broader context of the policy-mix in the Austrian NIS
10:00 – 11:00	Austrian Research Promotion Agency (FFG) Michael BINDER: Head of Strategic Unit	Role of Austrian Research Promotion Agency (FFG)
11:00 – 12:00	Universities Austria (Universitätenkonferenz) Wolfgang NEDOBITY: Secretariat General	The position of universities in Austria
12:00 – 13:30	Austria Wirtschaftsservice (AWS) Wolfram ANDERLE: Deputy Head of Technology & Innovation	The role of AWS
14:00 – 15:00	Federal Ministry of Finance Department for Economic Affairs and Innovation Ilse HOHENEGGER (+ 1 colleague):	Indirect support measures
15:00 – 16:00	Christian SEISER	End credits; follow-up

Appendix 3

ERAWATCH Analytical Country Reports 2008: Austria

Final version to be attached once sanctioned by IPTS after September 14, 2008