



Evaluation of the Austrian Industrial Research Promotion Fund (FFF) and the Austrian Science Fund (FWF)

Synthesis Report

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Erik Arnold (ed.)

Evaluation Team

KOF

Martin Wörter

Joanneum Research

Michael Dinges, Nikolaus Gretzmacher, Wolfgang Polt,
Andreas Schibany, Gerhard Streicher, Klaus Zinöcker

Technopolis

Erik Arnold, Patries Boekholt, Leonhard Joerg, Fritz Ohler,
Shonie McKibbin, Geert van der Veen, Shaun Whitehouse

Universiteit Twente

Barend van der Meulen

WIFO

Martin Falk, Rahel Falk, Norbert Knoll, Hannes Leo, Gerhard Schwarz

Panels

FFF

Frieder Meyer-Krahmer (Chair)
Kari-Pekka Estola
Haim Harari
Jens Rostrup-Nielsen
Jan-Eric Sundgren

FWF

Ben Martin (Chair)
Haim Harari
Hubert Markl
Peter Nijkamp
Helga Rübsamen-Waigmann

Summary

This synthesis report summarises a major evaluation of Austria's two most important funders of research and innovation: the Austrian Industrial Research Fund (*FFF – Forschungsförderungsfonds für die gewerbliche Wirtschaft*) and the Austrian Science Fund (*FWF - Fonds zur Förderung der wissenschaftlichen Forschung*). It has been conducted by a large international team of evaluators and two panels of senior scientists and research administrators.

Austria faces significant challenges in connection with research and innovation. The proportion of Gross Domestic Product devoted to research and development (R&D) must increase, if Austria is to be competitive as production becomes increasingly knowledge-intensive. While scientific performance has been improving, attaining increased critical mass in key areas of research and reducing the volatility of funding are among the challenges faced by the scientific community. The institutions that fund R&D in Austria are fragmented and there is overall a lack of a national research and innovation strategy that is authoritative, and against which institutions can safely plan.

The Funds were created under the Research Promotion Act of 1967, and were then very modern institutions. They were given a strongly 'autonomous' status, which is to say that they were given governance structures that were dominated by their beneficiaries, rather than by ministries. This reflected a lack of confidence that they could be kept free from inappropriate, detail-level interference within a more conventional system of governance, and this worry is still very evident in discussions about the Funds today.

In the period since the Funds were set up, ideas and theories about how to manage R&D funding have changed. Increasingly, we see R&D and innovation as activities involving networks of actors, who are interlinked in 'national systems of innovation' – of which scientific systems and networks are vital components. This means that, in most countries, research councils (like FWF) and innovation agencies (like FFF), have changed their funding practices to address not only individual researchers in companies and universities but also networks and links in the bigger systems of research and innovation. At the same time, the New Public Management movement among governments internationally has increasingly emphasised the importance of clear and arms-length governance of agencies like the Funds, with ministries keeping firmly out of the detail but instead managing by objectives. What the Research Promotion Act set out to do through autonomy, is elsewhere being achieved through increased clarity about the respective roles of ministries and agencies.

An unfortunate effect of 'autonomy', in the sense of governance by the beneficiaries, has been conservatism. The Funds today are extremely good at doing the things they were originally set up to do, and at a limited set of newer activities. But they have not kept pace with the broadening of activities and problems tackled abroad by equivalent agencies abroad. Rather, through a combination of decisions made by ministries and the Funds themselves, Austria has evolved a range of other R&D funders, which perform many of the newer roles. As a result, the funding landscape is now rather fragmented – especially with respect to support for innovation, where there is a clear need for reform.

Thus, FFF is a fast and efficient deliverer of subsidy to individual R&D and innovation projects. Its ‘core mission’ of providing so-called ‘bottom-up’ (that is, unprogrammed) funding brings important benefits to companies, especially when it tackles the R&D and innovation deficits associated with small firms. Overall, however, it tends to take too little risk, favouring ‘good’ projects in ‘good’ firms. It needs to review its policy in this respect. FFF has huge potential to contribute to an improved R&D and innovation funding system in Austria, provided its strategic capabilities are strengthened and its governance is reformed.

FWF performs a specialised function – funding more or less fundamental research in an efficient and high-quality manner. Its beneficiaries are largely happy with its performance, and the evidence suggests that the research it funds is productive and of good quality. It, too, has great potential to use its capabilities in a broader way to help develop the Austrian science system. To do so, it will – like FFF – need more analytic and strategic capability, and should become more willing to tackle change through the use of programmes, complementing its traditional strengths in ‘bottom-up’ funding. In Austria, the proportion of university research funded through the research council – FWF – is lower than in most other countries. It needs to be higher, in order to have a greater influence on the whole community that performs fundamental research. The recent reform of the universities also means that cost structures in the university sector are becoming more transparent. FWF will need, like many research councils abroad, to start paying overheads on the grants it gives, otherwise there will be a disincentive for universities to apply for them. Both of these factors point in the direction of increasing FWF’s budget significantly, as does the current decline in the proportion of applicants whose projects can be funded.

In this report, we consider a number of options for the future. In addition to the more detailed recommendations we make about the Funds, we reach some wider conclusions

- Both Funds require additional resources to generate strategic intelligence and their own strategies, strengthen their international roles and improve their communication within the Austrian funding system
- FWF’s role should be organically expanded to tackle use-oriented and thematic research. It will need a substantial budget increase to cope with this, and with the need to pay overheads on research grants in future. Its positioning within an industry, rather than an education, ministry is an advantage in arguing for such increased resources
- FFF should be merged into a broader innovation agency. The proposed merger with TIG, BIT and ASA appears to be a reasonable option for achieving this, although other configurations would also be possible
- The Funds should be transformed into agencies and the power of their beneficiaries in the governance structures should be limited

Improving the performance of the Funds also requires important changes in their context. With the best will in the world, it is hard for an agency in a complex system to act effectively in isolation. Our brief analysis of that wider system suggested a need for a stronger **arena** function and for some kind of **referee** within research and innovation governance in Austria, roles which could potentially be tackled by the Austrian Council. Efforts should be made to increase the ratio of FWF spending to

spending through the General University Fund. In Austria, as in many countries, there is also a need for greater predictability in budgets, so that agencies can plan more securely.

The other key requirement is clearer and reliable governance. We interpret the Research Promotion Act of 1967 as a vote of ‘no confidence’ in the Austrian state’s ability to govern R&D agencies in a modern manner. To reverse that vote, the ministries and political level need to demonstrate that they can

- Manage by objectives and properly delegate authority to agencies, without seeking to interfere in daily operations such as project assessment. This should include delegation of programme design as well as management. Ministries can then focus on policy questions, rather than operational ones
- Maintain the ‘strategic intelligence’ needed to do this
- Professionalise leadership and personnel decisions in the agencies, so that appointments are made in fair and open competition, and there is no risk of the modern principles of management by objectives and the use of performance contracts being subverted by personal or political influence, as seems to have been a concern of those framing the 1967 legislation
- Develop reasonably standardised ways of instructing agencies, so that ministries can use different agencies to achieve different policy objectives

For the foreseeable future, there needs to be agreement on a funding model where there are two main pillars: a research council and an innovation agency. Not everything has to be neat and tidy, but these main pillars should co-operate and co-ordinate with each other and other funders, while essentially doing different things and being able to plan on continuing to do so. The process of ‘agencification’ of R&D funding needs to be completed, placing operational responsibility for programmes within agencies and abolishing the unhelpful distinction between ‘ministry programmes’ and ‘agency programmes’.

Agencies should be able to develop strategies that allow them to obtain economies of scope as well as scale, tackling policy needs of multiple ministries where appropriate. This in turn implies a relatively general agreement about limiting the role of ministries in relation to programme and instrument design – leaving the agencies free to use common instruments to serve policy needs, while still enabling valuable analytic and policy input to come from the ministries where that is helpful. In the longer term, the agencies should propose, design and implement programmes and other instruments that answer to policy needs. A period of time and a managed process will be necessary in order to make this transition.

Ministries need nonetheless to retain enough analytic capability to support their policy needs, including the ability directly to commission research relevant to defining these policies. Thus the ministries as well as the agencies need to be equipped to monitor relevant parts of the science and innovation system, undertaking ‘bottleneck analysis’ in order to identify problems, as well as listening to more direct signals from stakeholders.

This sets an agenda for radical change not only in the Funds but also in the whole system of governance of research and innovation funding in Austria.

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1 Introduction and Method

An evaluation such as this is an unusual event, and a significant opportunity. Its central purpose is analysis and reflection about the national institutions responsible for funding one of the driving forces of economic and social development: the production and reproduction of knowledge. Policymakers should be able to take action based on this analysis. It brings a partly foreign and deliberately comparative perspective to bear on how these institutions function in Austria. It offers a significant contribution to the international debate about the role of the state and its institutions in promoting social and economic development through knowledge (which is why we are writing in English). Inherently, it is difficult to learn how to improve such national systems, since each nation tends to have experience only of its own. Internationalism and openness are therefore needed.

No less important, such an evaluation provides a rare opportunity to report to the taxpayer about how these institutions work, and about how well they work. In writing a report, one has to imagine who the expected readers are and to try to set a tone that will make the writing accessible to them all. We have tried to write in a way that fulfils our obligations to the taxpayer, given the limitations of language and the fact that many of the questions we address are inherently rather complex. In addition to the policymaking community, therefore, we have tried to make this report intelligible to the interested and intelligent non-specialist. Partly for this reason, we have therefore structured the report so that in the beginning of the report we give the reader the background needed to tackle the later chapters. For example, in our conclusions we say that the strengths and weaknesses of the Funds today are strongly influenced by their history. Since few readers will know the history, we discuss that first, before analysing the current strengths and weaknesses of the Funds.

1.1 Background

The Austrian Industrial Research Fund (*FFF – Forschungsförderungsfonds für die gewerbliche Wirtschaft*) and the Austrian Science Fund (*FWF - Fonds zur Förderung der wissenschaftlichen Forschung*) were set up under the Research Promotion Act of 1967. This was a radical and in its time modern initiative, to separate R&D funding from the creation of research policy and from politics. The Law gave the Funds a special, autonomous status, under which they have continued to operate to this day. Up to this point, however, the Funds have never been evaluated.

The Austrian Federal Ministry of Transport, Innovation and Technology (BMVIT) commissioned this evaluation shortly after Easter 2003, following an international call for tenders. A consortium of foreign and Austrian specialists in research and innovation policy and evaluation with significant international experience of similar assignments has performed the evaluation. Two panels of senior scientists and research administrators visited the Funds to discuss the way they operate. Their reports, together with the reports of the individual work steps of or overall evaluation, are published as free standing documents. The role of this report is to synthesise all the elements of the work into an overall evaluation.

During the course of our work, the Austrian administration began work on a project to merge FFF with three other Austrian innovation agencies: the *Technologie Impulse Gesellschaft* (TIG); the *Austrian Space Agency*, ASA; and the Bureau for International Research and Technology Co-operation (BIT). At the time of writing, this project is still in progress, so we are not in a position to comment upon its eventual outcome. However, the resulting agency should be in a position to take on many of the challenges this report envisages for FFF and innovation policy more generally.

1.2 Terms of Reference

Our formal terms of reference specify that the evaluation shall consider the following two main questions

- 1 Are the instruments, procedures and structures adopted by the funds – according to their mission (FTFG) – appropriate to support the investigational and innovational behaviour of the relevant actors in an efficient and effective way?
- 2 What is the position of the two funds in the national, international and especially European science and innovation system and what recommendations can be made for future strategies?

More specifically, it is to consider

- 1 Are the objectives, the legal mandate and the strategic orientation of the funds appropriate to pursue the intended effects of research funds? How are they positioned in comparison with corresponding international funds?
- 2 What are the strengths and weaknesses in the performance of the funds? What is the impact of the funds' activities on the corresponding science system and industrial RTDI?
- 3 Are the principles which underlie the choice and mix of instruments adopted appropriate to the objectives of the funds?
- 4 Are the funds' instruments, procedures and structures (including the autonomy and election procedures of the institutional organs) appropriate to the objectives of the funds and the needs of the funded? How are they to be evaluated in international comparison?
- 5 Do the funds employ appropriate procedures to secure the quality of the supported projects and to adapt to changes in the context conditions?
- 6 Is the coordination of the funds with other national research and funding instruments and institutions suitable to realise feasible synergies and to guarantee the proper handling of trans-institutional topics and projects? To what extent does this have an impact on the effectiveness of the funds' activities (i.e. synergies vs. core activities)?
- 7 How do the funds co-ordinate, co-operate and communicate with the relevant actors of the science and innovation system, especially with each other and the corresponding ministries?
- 8 How is the interdependence of the funds' performance and the context conditions? How are the characteristics of the Austrian institutional and funding system influencing the performance of the funds?
- 9 What are the strategies of the funds to secure their positioning and integration in the European research and innovation system? What are the steps taken to secure

the realization of synergies with institutions in other countries and with European institutions and programmes?

We answer these questions in the last chapter of this report.

However, here as elsewhere, there are both formal and informal terms of reference. Immediately prior to the start of this evaluation, the Austrian General Audit Office (the *Rechnungshof*) audited both FFF and FWF. It wrote two ambitious reports, which dealt with many matters that stretch well beyond the core competences of an audit office, and proposed, *inter alia*, that the two Funds should be merged. While we would in any case have considered this possibility, this necessitated that we should address the question.

Perhaps more important is the fact that the two Funds comprise a major block of Austrian state spending on R&D support. Institutions work in particular contexts. That is why one cannot simply transport institutional designs from one place to another and expect them to work in the same way. We therefore are obliged to evaluate FFF and FWF **within the Austrian system** – not only the R&D funding system but also the Austrian system of innovation more widely. Whether we like it or not, therefore, this evaluation therefore becomes a partial assessment of the whole system.

Some final observations on the nature of evaluation are also necessary. Evaluation involves using as robust and scientific methods as possible (given the available time and budget) to answer questions about social matters: here, about research and innovation policies. We try to provide as rounded an overall judgement as possible, based on the evidence we can collect, but it is important also to recognise that there **is** also an element of **judgement** involved. The judgement offered here is based on the considerable experience of a rather large and well qualified team and of two very senior and extremely experienced scientific panels. The reader takes this lightly at her peril. However, when all is said and done, what we offer here **is** judgement – the ‘truth’ (if there is such a thing) is not available to us.

Just as medical doctors focus on what they think is wrong with their patients, so evaluators also tend to focus on the negative in making diagnoses, because we, too, like medical doctors also aim to help people get better. In an evaluation such as this one that considers a very long history, we need also to recognise that we use today’s theories and understanding as the spectacles through which we view the history. For example, we point out that the Funds were established on the basis of theory about research and innovation that was modern in the 1960s. Today, our understanding of the innovation process has evolved, as has the evaluation process itself, and we prefer to see the Funds acting in line with current understanding. This does not mean that we ‘blame’ those who in the past decided things at the Funds for using the ideas of their own time, rather than those of the future.

1.3 Methods

We used a wide range of instruments to evaluate the Funds, for two reasons. One was simply the fact that we needed to know many different things. The second, methodologically important, reason is that the kinds of instruments we can use in this type of investigation can each only provide a partial view. Nor can we rerun history and experiment with different versions of the past. It is therefore helpful to look across the results from several different methods and see whether the signals they give tend to converge – as they do in this case. In our work, we explored

- The context of the Funds, by mapping how their instruments relate to the larger set of actions by other funding agencies
- Their history, largely through interviews with key people and documentary analysis
- The Austrian context, in terms of challenges to science and innovation policy, based on existing analyses, especially from the annual *Technologiebericht*, which provides an overview to the parliament
- The governance and processes of each Fund, through interviews and documentary analysis
- Their effects, through surveys of beneficiaries and analysis of operational and financial data provided by the Funds
- Collecting information about how roles equivalent to those of the Funds tend to be performed abroad
- Working with two panels of senior scientists and research administrators, who visited the respective Funds and produced reports based on their understanding from a one-day meeting
- Finally, we generated an earlier version of this synthesis report and invited comments from the Funds and BMVIT

This work is documented in detail in a series of background reports, which are listed in the Appendix, together with details of how to obtain them.

We gratefully acknowledge the help of many hundreds of people who filled in questionnaires, were interviewed or supplied data to us. The staff of the Funds have been very generous of their time and goodwill. We owe a special debt to Klaus Schnitzer at FFF and Rudi Novak at FWF, who were volunteered to act as ‘link people’ to the evaluation team, and who performed this difficult task magnificently.

2 Challenges for the Austrian Innovation System

As two of Austria's central R&D funding agencies, FFF and FWF need necessarily to act, not according to some abstract set of needs, but in order to tackle specific problems and opportunities in the Austrian national system of innovation. Here, we consider in turn important socio-economic and institutional challenges, as well as some challenges that emerge from history.

2.1 Socio-Economic Challenges

In the following, a brief account of the main characteristics of the Austrian Innovation system is given in the form of 'stylised facts'. In the Austrian debate, these are quite robust findings, as they re-appear in a number of recent documents and analyses¹, especially in the annual reports on research and technology, studies stemming from the tip research programme as well as policy documents of the main actors in S&T policy. Here, we discuss a selection of those most relevant to this study.

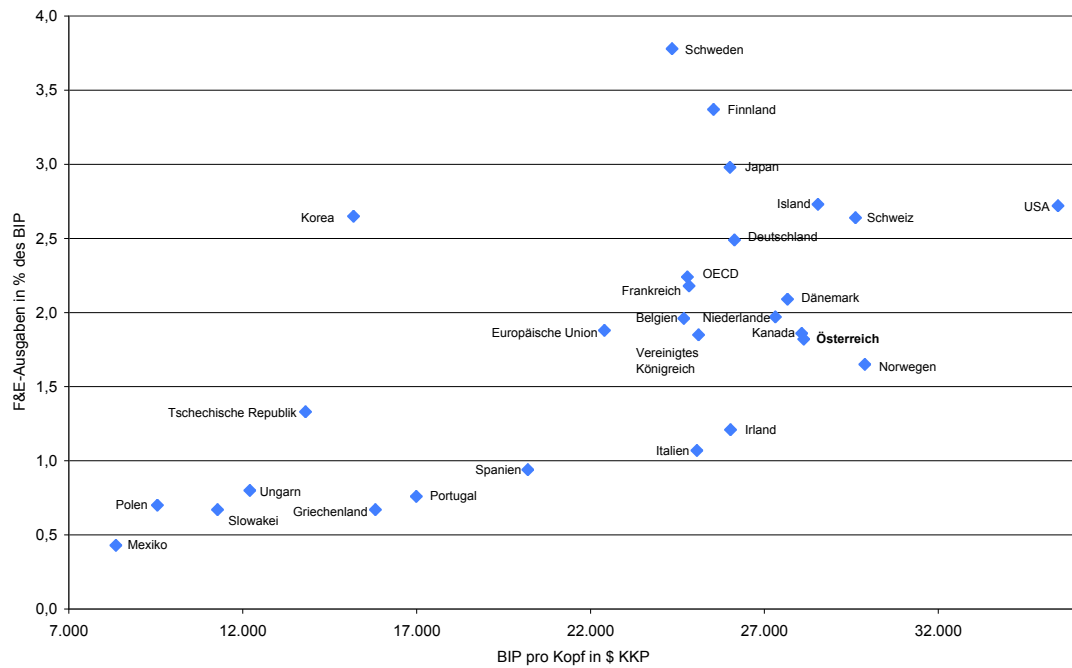
2.1.1 R&D and Economic Performance

As **Exhibit 1** indicates, Austrians are wealthier than most other OECD citizens, but devote a much smaller fraction of national income to R&D than leading R&D performers. However, there are signs that the other factors driving the good economic performance may be insufficient to make up the deficit in knowledge generation and absorption, and that there are important barriers to industrial modernisation. The structure of Austrian industry is rather traditional, with the proportion of high-technology industry lying below the OECD average (**Exhibit 2**).

Recent years saw the erosion of what has been labelled as the 'Austrian Paradox' (good performance in GDP growth despite low R&D intensity and predominance of traditional industrial structures). In the 1990s this growth advantage was lost, not least because of the low representation in growth sectors (ICT) and emerging technologies (e.g. Biotech).

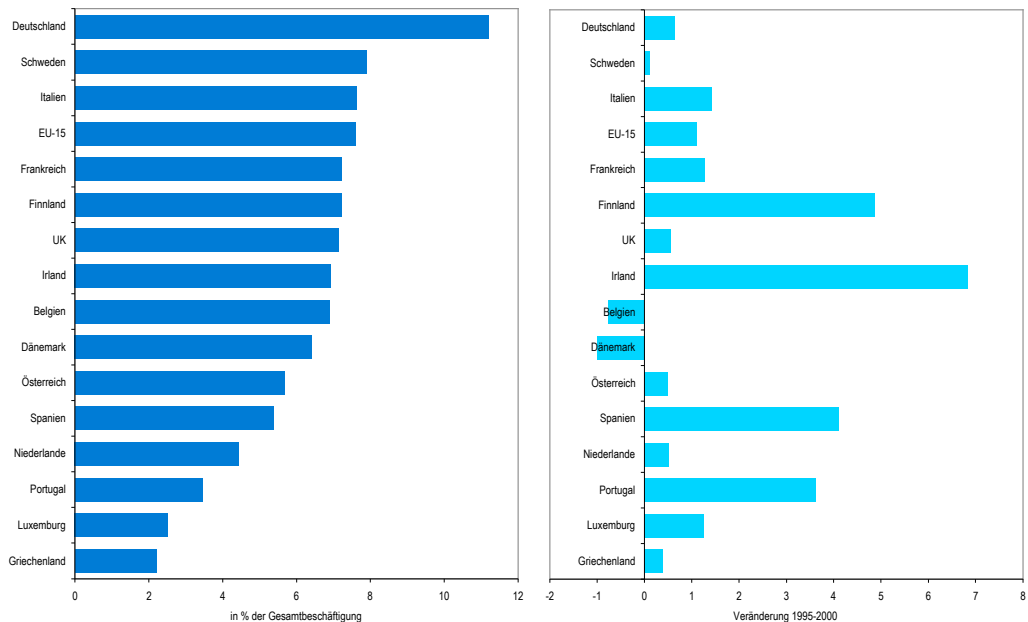
¹ See especially *Österreichischer Forschungs- und Technologiebericht 2003. Bericht an den Nationalrat gem. §8(2) FOG über die Lage von Forschung, Technologie und Innovation in Österreich*. Wien, Mai 2003-10-13

Exhibit 1 National R&D Expenditures and Wealth



Source: OECD, own calculations. Data are for 2000, except Belgium, Denmark, Greece, Ireland, Mexico, Norway, Portugal and Sweden (1999)

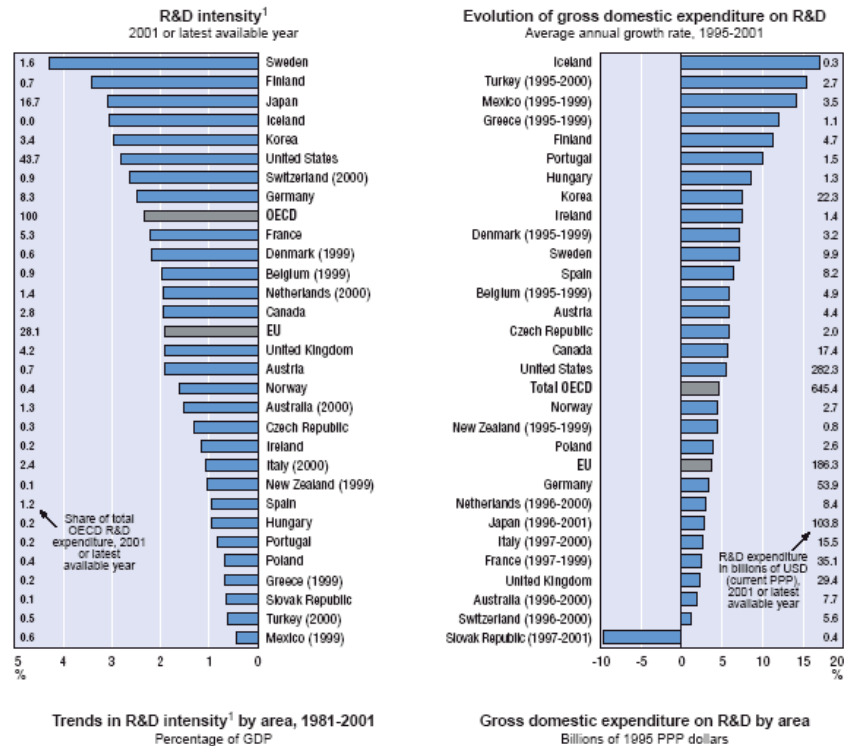
Exhibit 2 Shares of High- and Medium Technology Branches in Total Employment, 2000



Source: European Commission. Data for Austria and EU are for 1999

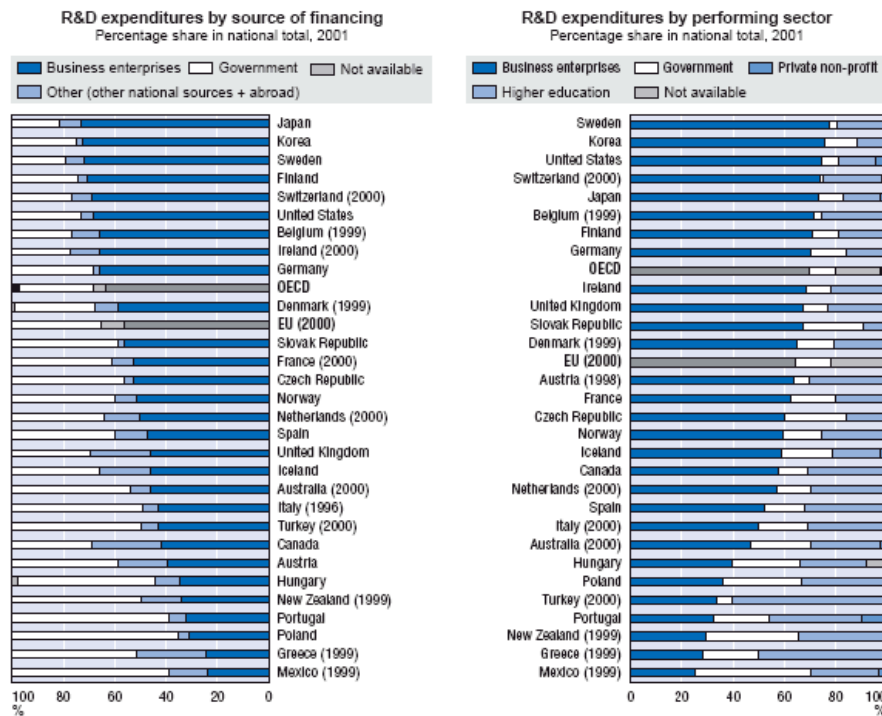
In the second half of the 1990s, Austria experienced a slow but steady growth in R&D intensity, moving towards the EU average, but this growth was insufficient to keep pace with comparable small open economies like Denmark, Finland, Ireland or Sweden (**Exhibit 3**). Thus, it might be fair to say that the Austrian Innovation System, though taking steps in the right direction, was lacking dynamism and speed in structural change towards new/emerging fields in science, technology and industry. The improving trend in economic performance has flattened in the last 5 years or so (**Exhibit 4**).

Exhibit 3 International trends in R&D expenditure



Source: OECD Science, Technology and Industry Scoreboard 2003, p. 19

Exhibit 4 R&D financing and performance

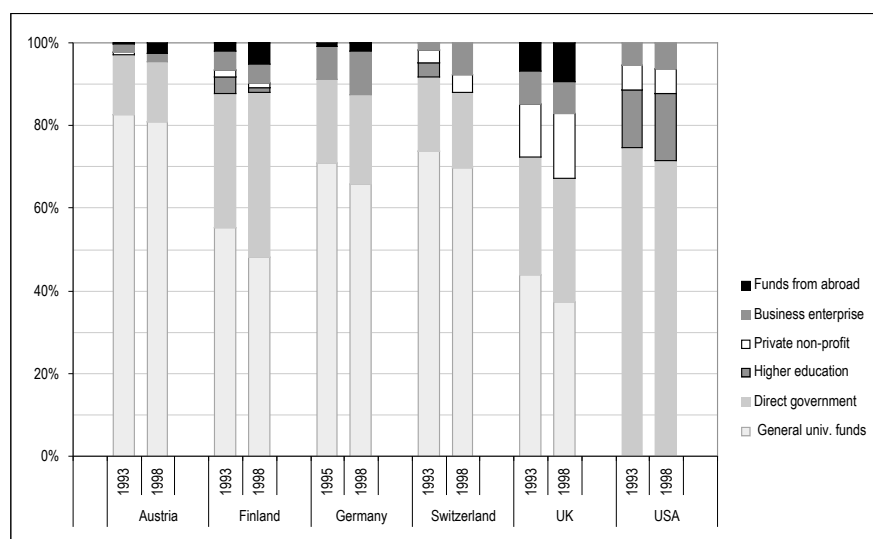


Source: OECD Science, Technology and Industry Scoreboard 2003, p.21

2.1.2 Science and Research

The higher education sector traditionally has a strong position in the Austrian Innovation System. The university sector comprises the major part of public R&D funding, most of which goes to the ‘general university fund (GUF)’. This money is allocated within the universities, and its distribution is in most systems strongly influenced by educational priorities. Other financial sources for R&D at the universities are small by international standards. Correspondingly, a low proportion of the state’s R&D expenditure via the universities is externally quality controlled—for example by FWF. The share of external funds (i.e. funds other than the General University Fund, GUF) is rather low and GUF in 1998 still represented more than 80 % of HERD, a higher share than in all OECD countries with comparable data. Adding external funds from public sources (direct government: public research funds, public research contracts) raises the ‘public share’ of higher education expenditure on R&D to 95 %, a higher share than in any OECD country bar Slovakia (and on a par with Denmark). In Germany, Finland and Switzerland, the respective public share is between 80 and 90 %, which, though substantially lower than in Austria, is still markedly above Anglo-Saxon values of 70-75 %.

Exhibit 5 Sources of Higher Education Expenditure on R&D (HERD) ², 1993³ and 1998



Source: OECD; own calculations

The mix between GUF and direct government funding (which can be employed in a much more targeted fashion than GUF) is similarly skewed. In Austria, the ratio between these two sources of funding is about 85:15; among other OECD countries with comparable data, typical rates would be 50 to 80 % for GUF (only the Netherlands has a higher GUF share, of some 90 %. On the other hand, the Netherlands' total public share, at 83 %, is much lower than Austria's 95 %).

Despite this, the quality and quantity of Austrian science has improved in the last decade (as it has in most countries), approaching average EU levels but not yet in most fields moving beyond them. There are important individual 'high points' in university research performance, as the high share of foreign research funding in the Exhibit above suggests. But the university system as a whole continues to suffer from fragmentation (too few centres of excellence or large concentrations of capabilities in specific fields within the research-performing institutions) and lock-ins to traditional disciplines (because there are too few incentives to bypass old structures). Women remain under-represented in the universities and research institutes – in fact, Austria has one of the worst records in Europe in this respect. The recent university reform, releasing them from the civil service and increasing their autonomy and their responsibility for managing their own affairs, places pressure on the universities to develop and implement strategies. In the longer term, it can be expected to improve the division of labour in the university system, attune universities' operations better to the needs of their customers (of which the state is only one) and increase quality through more competition. In the shorter term, there appears to be little or no external support available to help them co-evolve strategies, link strategies to future needs (for example, through foresight) or start new activities⁴.

² Higher Education Expenditures on Research and Development

³ Deutschland: 1995; Schweiz: Durchschnitt 1992/1994

⁴ In contrast, The Research Council of Norway (RCN) for example funds 'Strategic University Programmes' to allow universities to establish footholds in new research areas

In the last decade or so, there was strong growth in the volume and quality of output from the science sector, as measured by standard indicators of publications and citations (although the catching-up with respect to citations and impact-factors faltered in the middle of the 1990s)⁵. International scientific linkages have been growing, as measured by increased number of international publications, increases in international co-publication and a growing share in international R&D programmes (most notably the participation in the EU's 4th and 5th Framework Programme for RTDI and in COST).

These tendencies can be observed in the majority of disciplines and fields. But they have only helped Austria to reach the EU average and convergence towards EU specialisation patterns. A number of weaknesses and challenges remain, which are singled out in various studies

- Sub-critical size of many institutes and research groups, and a correspondingly low number of internationally renowned “centres of excellence”
- Lack of cooperation between the disciplines and fields of research, especially in the new/emerging areas
- Weaknesses in the development of human resources, most notably the low shares of S&T graduates, the low share of women in R&D personnel and the attractiveness of scientific careers
- Uncertainties (and volatility) with respect to availability of public monies of R&D, which make mid-term planning difficult

2.1.3 Technological Development and Innovation

The share of the enterprise sector in R&D is low in international comparison (**Exhibit 4**), which is mainly due to the industrial structure (low share of high-tech branches) and the size distribution of Austrian enterprises. This distribution is characterised by a high share of SMEs, and a small number of large R&D –intensive firms, which account for the majority of business expenditure on R&D [BERD]. These firms are also the main cause for the high share of R&D financed from abroad in Austria. This situation has often been labelled as the ‘technology gap’ in Austrian industry.

On the positive side, one could observe

- A relatively high share of innovative SMEs, and a high degree of ‘flexible specialisation’, often leading to commanding shares in niche markets
- The ability rapidly to absorb new technologies resulting in fast diffusion (spurred by the comparatively high rates of investment)

While, in the post-war period, this pattern of innovation has contributed to good Austrian economic performance, it is increasingly becoming a barrier to further growth. The fastest growing branches are underrepresented in Austria.

⁵ *Österreichischer Forschungs- und Technologiebericht 2003*, Lagebericht gem. §8 FOG über die aus Bundesmitteln geförderte Forschung, Technologie und Innovation in Österreich, Bericht der Bundesregierung an den Nationalrat, Mai 2003

The number of new technology-based firms and fast growing small enterprises is comparatively low, which is amongst other things, a reflection of the size and structure of venture capital markets in Austria. While networking and co-operation have been growing between enterprises (e.g. in the growing number of ‘clusters’ in Austria), and between enterprises and universities, the channels of industry-science relations are weaker in Austria than in comparable countries (measured by the ‘science linkage’ of industrial patenting or the use of university research in industrial innovation). Also, as innovation surveys have shown, innovation activities in Austrian enterprises are strongly geared towards incremental innovation, which is characterised by comparatively low technical risk and shorter time horizons for commercialisation mainly in existing markets.

2.1.4 A Major Challenge for the Austrian Innovation System: Reaching the 2.5% Target

One of the main challenges for the Austrian Innovation System is to meet the targets agreed upon by the heads of EU member states at their summit in Barcelona, to increase R&D spending to 3% per GDP by 2010. The Austrian government in its work programme has set an intermediary target of 2,5% by 2006.

The slow increases in Austrian R&D-intensity of recent years have been supported by some *Technologiemilliarden* (technology billions) and recently by two *Offensivprogrammen* (offensive programmes). The latter have increased the available funds by 508 M€ and 600 M€ respectively. The latest initiative was launched at the end of 2003 as part of a package of measures to stimulate the still sluggish Austrian economy. This *Konjunkturpaket* improved the attractiveness of fiscal measures and secured funding by the Austrian National Bank while additional funds were taken from the ERP fund. Consequently public spending on R&D was the most dynamic factor in overall R&D spending. Between 1998 and 2003, federal expenditures increased by about 5% annually while the provinces increased their investment by about 15% annually. The enterprise sector devoted 4.6% p.a. more to its R&D outlays.

Exhibit 6 Austrian R&D expenditures 1998 - 2003

in billion €	1998	1999	2000	2001	2002	2003	annual %- Change 1998-2003
Federal State	1,098	1,201	1,225	1,351	1,405	1,409	5,1
Local governments	0,142	0,206	0,249	0,280	0,271	0,291	15,4
Other public sources	0,045	0,047	0,049	0,050	0,052	0,054	3,7
Enterprise sector	1,418	1,486	1,558	1,630	1,701	1,774	4,6
Foreign sources	0,685	0,719	0,748	0,763	0,782	0,802	3,2
Private non profit sector	0,012	0,013	0,013	0,014	0,014	0,014	3,1
Total	3,400	3,671	3,842	4,087	4,225	4,343	5,0

Source: ST.AT

The question remains whether these measures are sufficient to achieve the Austrian and European targets for R&D spending: Austria wants to shift the level of R&D spending to 2,5% in 2006; the EU aims at 3,0% in 2010. Speculating on the specific of how this might be achieved is well beyond our brief here. Recently, a fiscal incentive has been introduced to encourage additional industrial R&D expenditure.

For this report, WIFO extended work published in the 2001 *Technologiebericht* and reached the conclusion that, with current policies, Austrian R&D might end up in the range 2.0 to 2.1% of GDP by 2006, leaving a shortfall of some 2 billion€ in R&D expenditure for the period 2004 – 2006, compared with the government's target of 2.5%.

Whatever the final increase achieved, most of the greater R&D outlay has to come from the enterprise sector, whose levels of R&D expenditures are most of all a function of industrial structure. The low proportion of high-tech industries in Austria is the dominant explanation for the low R&D spending of enterprises. The major contribution thus has to come from faster structural change.

Structural change can be the result of start up activities, diversification efforts of established firms and the attraction of R&D intensive subsidiaries of multinational enterprise. To some extent established firms can support this process by adopting more risky and less imitative R&D strategies.

An increased share of high tech firms will increase demand for co-operations with the university sector. Attractive universities are a precondition for attracting science-based subsidiaries of MNCs. Developments in the higher education sector will therefore be crucial for the Austrian development path in a number of ways: openness to co-operation; funding of universities; number and quality of graduates.

Governments have at their disposal a range of policy measures to encourage this increase in R&D intensity. These include

- **Direct measures**, such as R&D funding through FFF and FWF
- **Indirect measures**, such as increased tax benefits to companies for performing R&D, or for **increments** to R&D expenditure
- **Catalytic measures**, such as risk-sharing with seed and venture capital, so that the state induces others to improve the enabling conditions for performing R&D

This evaluation is concerned with specific kinds of direct measures. While the policy trade-offs between direct and indirect measures are important, they are beyond the scope of our terms of reference and of the evidence we have collected. Our focus here is therefore implicitly on the question: How can FFF and FWF best contribute Austria's role in reaching the Lisbon and Barcelona goals?

Further important European dimensions emerge from the evolving idea of a European Research Area (ERA), whose characteristics are by no means yet specified, but will surely include more cross-border co-operation, funding and working within the boundaries of the extended European Union (with its 25 members) and beyond. In 'basic' research, this extends also to the idea of setting up an European Research Council. For this evaluation, it follows that we are interested in whether FFF and FWF are capable of pursuing Austrian participation and interests in the ERA.

2.1.5 Major challenges for Research and Innovation Policy

From this short discussion of the main characteristics and developments in the Austrian Innovation System, some important challenges emerge, in which one would expect national research councils and innovation agencies to play important roles

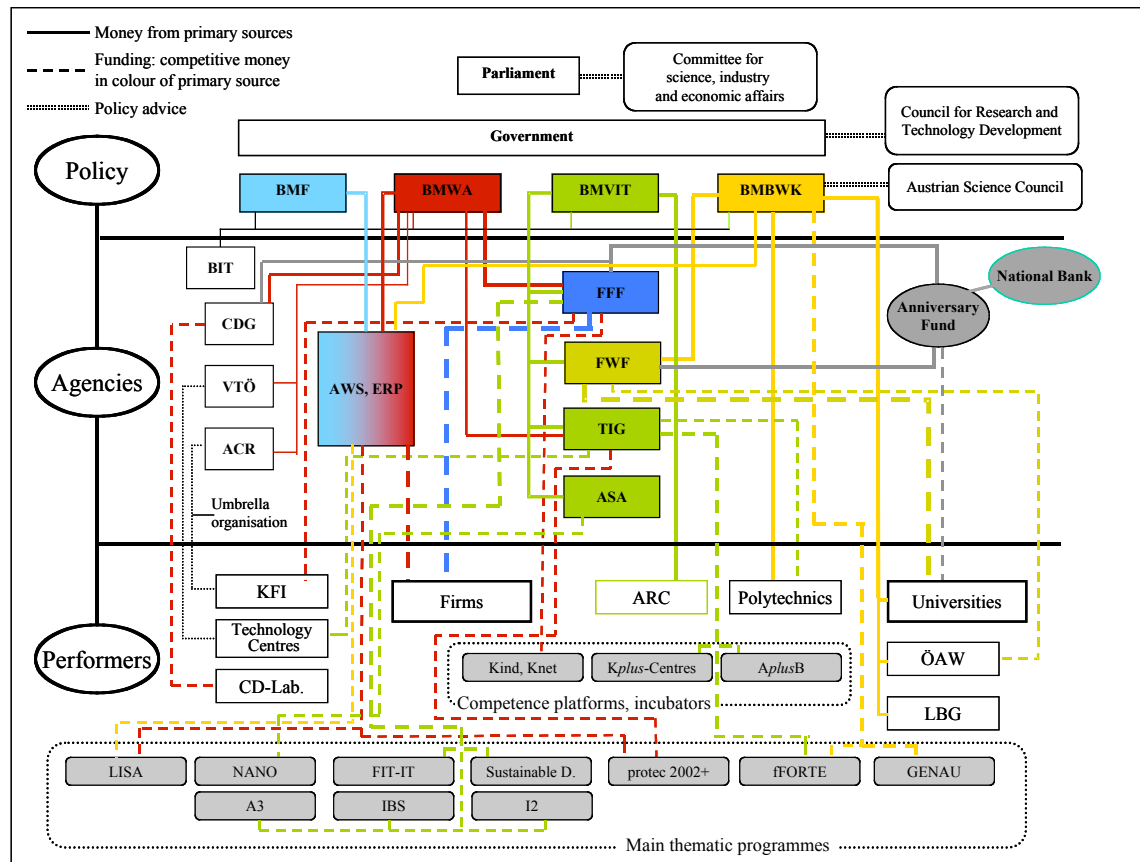
- Identifying and using the right policy mix and instruments to raise the national investment in R&D
- Correspondingly, promoting industrial restructuring by generating growth in more knowledge-intensive industries – both through new firm creation and by raising the knowledge-intensity of existing industry – while sustaining the innovativeness and competitiveness of the more traditional branches
- Increasing national strengths and capabilities at the junctions between disciplines, which is where most of the growth points are today to be found
- Reducing the waste of talent represented by the under-representation of women in the knowledge infrastructure
- Creating and strengthening more points of strength and excellence in both fundamental and use-oriented research within the ‘knowledge infrastructure’ of universities and research institutes
- Improving the framework conditions and culture for innovation and entrepreneurship
- Supporting the process of modernising the universities
- Building further links between industry and the higher education and research sector, and the internal capabilities needed to create and use such links

2.2 Institutional Challenges

Exhibit 7, which shows the main actors in the Austrian R&D funding system and their interrelationships, speaks volumes. In the next Section, we discuss some of the historical reasons why it has attained this impressive level of fragmentation and complexity. Here, it is important to note that this pattern represents a real policy challenge

- Overly fragmented policy delivery limits the opportunities for building scale and for learning – both about policy delivery and about policies themselves
- It makes the funding system hard to understand – which is a problem both for those who have to live in it and in terms of connecting it to developments in European R&D funding and performance (see next section)
- With many small agencies, it is hard to build critical mass and especially hard to afford the needed investment in capabilities for analysis and strategy development (‘strategic intelligence’)

Exhibit 7: Austrian Funding System, structure and flow of public money



Source: Technopolis

- There is a wide diversity of governance practice and therefore unclear interfaces between the ministries (as principals) and the agencies (their agents). In some cases, a ministry even simultaneously maintains different governance styles in its relationship with a single agency about different activities. This incoherence helps prevent ministries and agencies alike from building the right amount of strategic intelligence to maintain a coherent division of labour
- Differences in governance styles limit the possibilities for individual agencies to serve multiple ministries. The growing importance of knowledge and research in the responsibilities of all ministries means that such agencies working for multiple principals will increasingly be needed

While this description paints a rather black picture of the situation, it is nonetheless clear that there have been many qualitative improvements in recent years.

- Increasing, if by no means consistent or perfect, separation of policy making and policy implementation levels within the R&D funding system
- Increasing use of competition in allocating R&D monies to beneficiaries
- Increased and deliberate use of programming, as a way to manage R&D conducted with some use or social purpose in mind
- Growing use of evaluation

In addition to FFF and FWF, some of the major agencies involved in the system are as follows.

AWS and ERP-Fonds

The Austrian Wirtschaft Service was created through the merger of the previous FGG, Innovationsagentur and the Bürges development bank and defines itself at the 'special bank for company support' in Austria. It is legally separate from, but operationally integrated with, the ERP Fund, established under the Marshall Plan for European reconstruction after the Second World War to support business development. AWS plays a major role in funding company start-up, providing both business support and innovation support. In the area of innovation, AWS is especially important for its services to entrepreneurs ahead of start-up, its high-tech start-up programme and seed capital provision. It also has a programme to support universities and researchers obtain patent protection for their inventions. ERP focuses on supporting technology transfer, R&D and innovation projects that are rather close to market and require significant investments in order to be realised. Support is primarily in the form of loans and guarantees.

Technologie Impulse Gesellschaft (TIG)

The TIG was established in order to run the *Kplus* competence centres programme, which brings together industrial consortia and academic research over a seven-year period. TIG has since grown to become the specialised agency dealing with programmes that aim to create some degree of structural change or change in the way institutions work. Thus, several of its programmes address science-industry links. The most recent initiative aims to increase the proportion of women in industrial and non-university research. All TIG's instruments use very modern and rather formal calls for proposals and competitive processes for selecting projects. While it does not formally have a separate analysis or strategy department, TIG is unusual among the Austrian agencies in having a degree of programme design capability. Its 2002 budget was some 15 M€.

Christian Doppler Gesellschaft (CDG)

The CDG was established in 1989 and supports fairly small-scale co-operations between industry and academic research, using on-campus CD laboratories for the purpose. These are, in effect, similar to the *Kplus* competence centres, but operate on a much smaller scale. In 2003, the CDG had a budget of 11.3 M€ and supported a total of 44 companies and 9 universities across 33 individual 'CD Laboratories'.

Austrian Space Agency (ASA)

ASA was set up in 1972. In recent years, it has edged into a wider role in high technology innovation programme management (for example in nanotechnology) and operating innovation-related awareness and information campaigns on behalf of BMVIT.

BIT

BIT was set up in 1993, in order to handle the R&D aspects of Austrian membership of the EU. It provides information and practical help to Austrian applicants to the EU R&D and innovation programmes. Its beneficiaries include both companies and parts of the knowledge infrastructure. It hosts the Austria Innovation Relay Centre, providing technology and partnership brokerage.

Ludwig Boltzmann Gesellschaft

This network of research institutes tackles mid-term, use-oriented research, but do not involve industry. The 135 Boltzmann institutes together employ only 200 people, and are mostly located within universities. The Society is at present relaunching its activities, aiming to link research better with research users and to reduce the fragmentation of the institute system it manages. It has an annual budget of 12M€.

Contract Research for Ministries

In addition to funding R&D through FFF, FWF and other agencies, the Austrian ministries have a strong tradition of themselves directly funding R&D of various types. While the volume of such activity has declined in recent years, in 2002 the ministries collectively funded some 750 projects with a total cost in that year of about 35M€. These projects provide a parallel source of financing to FFF and FWF but are more fragmented and involve different quality and proposal assessment routines, where peer review is less significant than in a research council.

In the past 4 years, ministry-funded contract research has tended to be ‘bundled’ into programmes, rather than being contracted project by project. Current programme examples include

- GEN-AU – a national effort in genome research, funded by bm:bwk with the aim of selectively strengthening national research capabilities in this important field within the universities. The programme lasts for 9 years and currently has a budget of 10.5M€ per year. It has a management office in the ministry but is partly implemented by the Funds
- FIT-IT – a fairly typical thematic programme that concentrates on high-quality research in the area of information and communications technologies. FIT-IT is an initiative of the BMVIT and offers about 10M€ over two years, concentrating on topics such as embedded systems that are likely to be of importance in the future. It uses an external contractor to manage programme implementation, while administration is done by FFF
- ProVision – a programme for innovative scientific contributions to sustainable local and global change – and Node, a programme that addresses the future of democracy in Europe

Anniversary Fund of the Austrian National Bank

This fund had 65M€ at its disposal in 2002, which was used partly to finance FWF and CDG activities and partly to fund projects directly. These are primarily in the areas of business and economic research and medical research. To a lesser degree, the Fund also supports projects in the social sciences and humanities and the purchase of scientific instrumentation. In 2002, it provided directly some 12.4M€ to 226 projects, in addition to the 52.6M€ it provided to other funders to distribute.

Regional and Other Funds

In addition to the national activities discussed above, there are a number of regional R&D funding agencies, such as the *Wiener Wirtschaftsförderungs-Fonds*, the *Steirische Wirtschaftsförderungs-Gesellschaft*, which invested € 10.6m in 2002 in 74 projects, spanning the research and industrial communities in the *Land Steiermark*, the *Tiroler Zukunftsstiftung*, the TMG in Upper Austria and the *Wiener*

Wissenschafts-, Forschungs- und Technologiefonds, which provided 5.7M€ in support to university life sciences research projects in 2003, and intends in the future also to cover a number of other fields.

2.3 History and Context

How did the Austrian situation become so complex? And what was the role of the Funds in making it so? So that we can avoid reliving history, it is perhaps worth reading a little of it.

In the 1950s and 1960s, R&D funding in Austria was largely provided by the ministries – via the General University Fund as well as large-scale and (apparently) rather poorly controlled contracting on a project by project basis between ministries and research performers. Additional funding was provided in a rather fragmented way through the Austrian Academy of Sciences and the Ludwig Boltzmann Gesellschaft. There was general dissatisfaction with the failure to separate project decisions from the political and policy levels.

The current debate about whether to have a single research and innovation funding agency is not new in Austria. It became a live political discussion in the mid-1960s, when there was a growing awareness of the need to modernise the public sector and the policy system among the two big parties, the ruling Austrian Peoples Party (Österreichische Volkspartei, ÖVP) and the Austrian Socialist Party (Sozialistische Partei Österreichs, SPÖ). The SPÖ favoured a single research council, governed by representatives from the research system, the social partners, and the political sector, hoping for more influence upon the funding of research and thus of the university sector⁶. The ÖVP, on the other hand, had to contend against two powerful fractions within its own political domain: on the one hand the research system (represented by the predecessor of the FWF, the Research Council (*Forschungsrat*)); and the industrial system on the other (represented by the Austrian Chamber of Commerce).

The outcome of the debate was not a single agency but a balanced system of two funds, respectively governed by the two sets of beneficiaries: the social partners and the academics. The basic principles were laid down in 1967, when FFF and FWF were established under the **Research Promotion Act**. Major parts of the political debate prior the enacting of the Research Promotion Act dealt with funding of basic science⁷. The Austrian science system suffered from many shortages.⁸ Reformist powers and political pressures aiming at the reform of the research (policy) system came largely from the academic sector, and to a much lesser extent from the industrial

⁶ As a historical reminder: The **Ludwig Boltzmann Gesellschaft** was implemented in the late 50ies / early 60ies as a reaction to the conservative dominance among the universities and the Academy of Sciences.

⁷ Cf. for an comprehend analysis of the origins of FWF and FFF: Michael Stampfer, Sprachbilder des Fortschritts: Die Gründung von FWF und FFF, in: Pichler, R. (Hg.) Innovationsmuster in der österreichischen Wirtschaftsgeschichte. Wirtschaftliche Entwicklung, Unternehmen, Politik und Innovationsverhalten im 19. und 20. Jahrhundert (Innsbruck - Wien - München - Bozen) 2003, 271 - 289

⁸ To illustrate the precarious situation it is helpful to recall the installation of the so-called **Notgemeinschaft**.

sector⁹. Swiss and German research council models (SNF and DFG) were important influences on the design of FWF, as can be seen in its strong operational autonomy and its rather weighty governance structures. As a consequence, the directions of the reforms were primarily inspired by the re-organisation of basic science funding, and FFF's design was effectively done by analogy to the basic science funding model.

Already with the creation of a **Science Ministry** in the early 1970s, the pre-1967 pattern of project funding by the ministries began to reassert itself. The 1973 oil price shock led to a programme of ministry-funded energy research, since the Funds' bottom-up style of operations was incapable of responding to this kind of policy challenge. By the late 1980s, the ministries' R&D programmes were spending about as much as the Funds, but their expenditures have since fallen away from this peak.

Responsibility for FFF and FWF shifted over the years between ministries. FFF was in the fief of the Ministry of Economic Affairs (industry ministry) from 1995 – 2000. Especially since Austria effectively has two industry ministries (currently BMVIT and BMWA, though the names and precise roles have changed under various governments), there has been continuous policy competition, where ministries without agencies to control have been tempted to set up competing initiatives. A good recent example is the BMWA's launch of competence centres programmes (*Kind*, *Knet*) as a riposte to BMVIT's *Kplus* programme.

However, the proliferation of actors and measures in the Austrian R&D funding scene results not only from policy competition but also from the policies of the Funds themselves, which have used their quasi-autonomous status to remain true to their origins. While, until the Austrian Council for Research and Technology Development was set up in 2000, FFF and FWF had a joint 'umbrella' committee, intended to allow them to co-ordinate, this was in practice largely used to allocate activities to one or the other of the funds. Few joint activities were defined, of which the chief survivors are today's *Impulsprojekte*. The main point of consensus between the funds has been on the need for more money, and they have consistently campaigned with one voice for increased funding.

In 1982, FFF took on additional resources from the Austrian National Bank, essentially to pay for projects similar to the ones it already funded. Co-operation was established also with the ERP Fund, which increasingly aimed to fund projects where innovation was an important element. In 1987, the Innovation and Technology Fund (ITF) was established, so that the Ministry of Public Economy and Transport could integrate innovation into its activities and in order to allow the funding of larger innovation projects than those contemplated by FFF – while, in fact, FFF played a central role in the administration and implementation of research-based projects approved by this new fund. ITF gave the ministries a potentially powerful instrument for bypassing FFF's focus on 'bottom-up' funding by running their own 'top-down' programmes and for developing a national research and innovation strategy, though its resources were in practice rather limited.

⁹ Austrian industry at that time, enjoyed a remarkable progress from 'incorporated technological change' and 'continuous improvement' strategies. From hindsight, this was a tremendously influential and successful policy, which exerted their positive effects until the 90ies.

But in 1985, FFF had declined to take on the role of Austrian EUREKA office, which was established as a separate office, financed by FFF's major stakeholders. With the imminent entry into the European Union, a similar support infrastructure for supporting Austrian applicants to the EU R&D programmes, now exercised by BIT, was never offered to FFF. Until the recent past, the FFF Kuratorium rejected the idea of operating top-down technology programmes. In the process, it reinforced its very strong 'bottom up' funding ideology, while – in practice – it has (more or less reluctantly) been operating various kinds of programmes since the first half of the 90ies.

In recent years, FFF has become increasingly willing to act as programme manager and even, to a degree, to define its own 'technology programmes' – which amount to focused marketing of the bottom-up project concept in particular technologies and clusters. FWF, meanwhile, has stayed rather outside the process of policy development and proliferation. It has internally taken on some of the challenges accepted by other research councils in recent years, especially responsibility for centres and networks of excellence, young researchers and for gender balance in the research community. Scientific prizes and research networks have been added to its repertoire, but it abstains from developing programmes or strategies in relation to thematic or use-oriented research. It has taken on a mission from BMVIT to fund the placement of people with doctoral degrees in firms. While the scope of FWF's activities today has expanded from that in 1967, it has done so comparatively slowly.

3 Understanding and Managing the Production and Use of Knowledge

An up-to-date understanding of how research and innovation systems work is a necessary precondition to analysing the roles of FFF and FWF in Austria. Such an understanding is especially important because the popular understanding – that basic science leads to applied science, which in turn leads to engineering, production, jobs and wealth – is a misleading oversimplification that encourages us to make poor policy decisions. In this chapter, we summarise what the current research literature tells us about how research and innovation systems work, following the established scientific principle that explanations should be ‘as simple as possible, but no simpler’. We therefore discuss in turn

- How knowledge is produced and some of the different types of knowledge involved
- Current thinking about how knowledge production and re-use are organised within society, in what we refer to as National Research and Innovation Systems
- Typical failures and problems that arise in such systems
- The roles that the state can play in managing and improving these systems

Finally, we describe the essence of the New Public Management (NPM) movement in government and governance, which aims to improve the performance of the state and which has had a very strong influence on R&D funding (as well as many other important aspects of government) in many countries. Armed with these understandings, we can then tackle the specifics of FFF and FWF in the following chapters.

While much of this chapter is concerned with the link between the production and the use of knowledge, we must also remember that science does not only have an economic meaning. We do not do science only in order to create wealth. Most countries fund science, in part, as a **cultural** activity, and fund the humanities for the same reason. FWF acts, in part, as a patron and an assurer of quality for these activities, on behalf of the wider society. This is a proper role for a research council.

3.1 Knowledge Production and Use

3.1.1 How Research Relates to Innovation

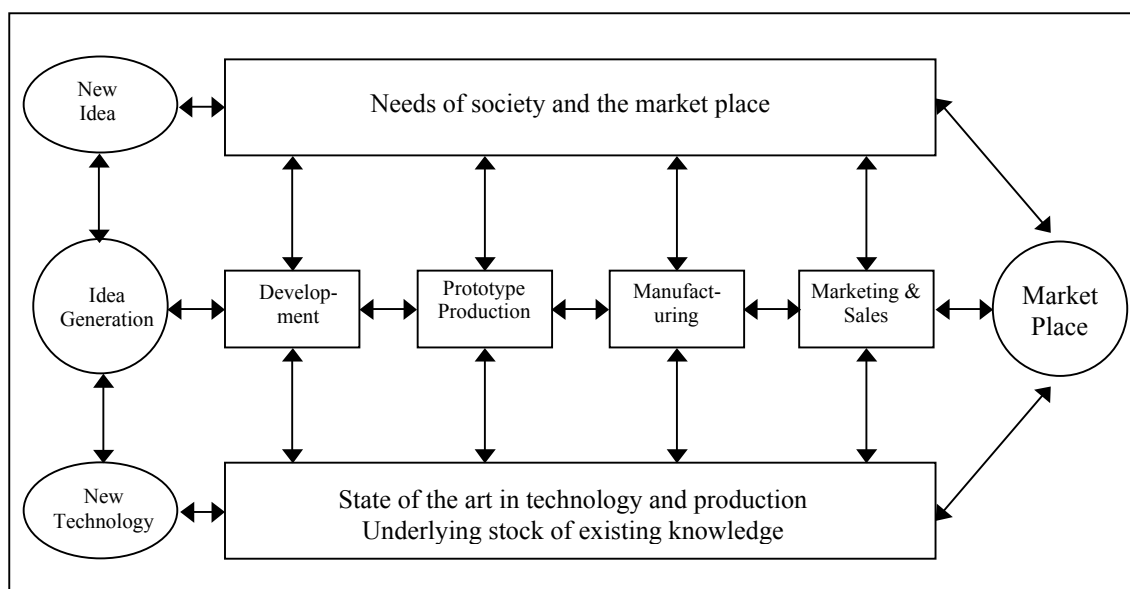
The popular mental model – the so-called ‘linear model’ – suggests that basic science **leads to** applied science, which causes innovation and wealth. While there was some limited research support¹⁰ for this ‘technology push’ or ‘science push’ view in the 1950s, in its crude form it does not stand up to much scientific scrutiny. Nonetheless, it was an important foundation for the idea of ‘bottom-up’ R&D funding central to both FFF and FWF, though already in the 1960s, when the Funds were being set up,

¹⁰ This account of successive generations of innovation model is partly based on Roy Rothwell, ‘Successful Industrial Innovation: Critical Factors for the 1990s’, *R&D Management*, :3 , p 221-239, 1992

empirical work¹¹ was pointing to the need for more emphasis to be placed on the role of the marketplace in innovation. This led to market-pull or needs-pull models of the innovation process.

By the late 1970s, Mowery and Rosenberg¹² largely laid the intellectual argument between push and pull to rest by stressing the importance of **coupling** between science, technology and the marketplace. Their coupling model constituted a more or less sequential process linking science with the marketplace, but with the addition of a number of feed-back loops and variations over time in the relative importance of ‘push’ and ‘pull’ mechanisms. This is shown schematically in **Exhibit 8**. Subsequent innovation models tend to be variations on this theme. Innovation processes do not always ‘start’ at a particular place (‘basic’ science, or the market) but can be prompted by changes anywhere.

Exhibit 8 Modern ‘Coupling’ Model of Innovation



3.1.2 The Intentional Fallacy In Research

The scientific community, which tends to control research councils such as FWF, likes to describe ‘basic’ research as ‘free’, curiosity-driven or ‘blue skies’ and other types of ‘downstream’ research and development as being in varying degrees tied to some final use. The OECD’s Frascati manual¹³, which defines how international R&D statistics are to be collected, defines ‘basic research’ in the same way and the fact that ‘basic research’ has therefore become an accepted international statistical

¹¹ Carter, C. and Williams, B., *Industry and Technical Progress*, Oxford University Press, 1957; Schmookler, J., *Invention and economic growth*, Harvard University press, 1966; Myers, S. and Marquis, D.G., *Successful Industrial Innovation*, National Science Foundation, 1969

¹² Mowery, D.C. and Rosenberg, N., ‘The Influence of Market Demand upon Innovation: A Critical Review of Some Recent Empirical Studies’, *Research Policy*, April 1978

¹³ *The Measurement of Scientific and Technological Activities: Propose Standard Practice for Surveys of Research and Experimental Development -- Frascati Manual 1993* (OECD)

category¹⁴ may help to explain why this definition persists. In scientific practice, scientists use the term to mean many different things¹⁵. In R&D funding after World War II, it has tended to mean ‘researcher-driven’, so that in research councils the taxpayer functions as a disinterested **patron** of research. The ‘social contract’ between the scientific community and society in the 1960s when the Funds were set up was based on this view, but the terms of that contract began in many countries to shift towards demands for increased socio-economic relevance already from the 1970s.

If, instead of the one-dimensional ‘linear’ view of ‘basic’ research, applied research and then development, we take a two-dimensional view of fundamental research (**Exhibit 9**) we are reminded that in fact very large amounts of fundamental scientific knowledge have been generated through use-oriented work. The idea that ‘basic’ research is necessarily researcher-driven is not a description of reality but a political demand by the scientific community to control its own funding, explicitly excluding criteria other than scientific quality.

Exhibit 9 Sources of Research Inspiration

Quest for fundamental understanding	Yes	Pure basic research (Bohr)	Use inspired basic research (Pasteur)
	No		Pure applied research (Edison)
		No	Yes
		Considerations of use	

Source: Modified from Donald Stokes, *Pasteur's Quadrant*, Washington DC: Brookings Institution, 1997

Stokes cites Niels Bohr as a leading and productive example of pure, curiosity-driven research. Bohr's Quadrant is important, both because curiosity about fundamental

¹⁴ B Godin, ‘Measuring science: Is there ‘basic research’ without statistics?’ Project on the History and Sociology of S&T Indicators, Paper No 3, Montreal: Observatoire des Sciences et des Technologies INRS/CIRST, 2000

¹⁵ Keith Sequeira and Ben Martin, *Physics and Industry*, Science Policy Research Unit, University of Sussex, 1996

things has a cultural value and because it often turns out to produce useful results as well. (And it is certainly a good training school, as the wealth of socially and economically useful work that physicists do in other fields amply illustrates.¹⁶) Stokes is a bit derisive about Edison's Quadrant – pure applied research – saying that Edison ruthlessly avoided fundamental explanations of scientific phenomena, focusing always on invention based on the existing state of scientific knowledge.

Stokes' important contribution is to remind us of 'Pasteur's Quadrant' – use-inspired basic research – which has huge economic importance. Just as with thermodynamics – a science that essentially appeared in order to explain why the new steam and atmospheric engines of the late eighteenth century worked, and only later became interesting as a source of knowledge about how to make better designs – the limitations of a wholly empirical approach can encourage work in 'Pasteur's Quadrant' and many fields of technology and engineering are becoming more 'scientific' as a result. Pasteur's Quadrant is a central responsibility neither of FWF nor of FFF – a fact that may partly underlie the widespread perception that there is a 'funding gap' in the Austrian system. Of course, in reality both do fund some activities in Pasteur's quadrant, but there is also a little truth in the idea that the **values** of FWF and FFF focus respectively in Bohr's and Edison's. In many countries both research councils and innovation agencies more explicitly fund work in Pasteur's segment.

3.1.3 How Knowledge is Produced

Michael Gibbons and colleagues¹⁷ brought together a lot of recent thinking about how research is done in a distinction between two modes of knowledge production. Theirs is a simplification¹⁸ of a complex reality, but one that gives us some useful concepts for tackling policy and research administration. **Mode 1** is disciplinary science, and can often be 'basic' science, though applied science can be done in Mode 1, too. Its logic comes from its internal organisation and control mechanisms. Its institutions tend to be centralised and stable. In terms of education, Mode 1 tends to provide 'basic training' and a disciplinary 'entry ticket' (such as a PhD) for people to qualify as credible researchers in either Mode. However, Mode 1 is not the same as 'basic science.' Research that is in some sense fundamental or long-term can be done in either Mode. **Mode 2** includes not only the practice of applied science in universities and other research institutions but also the generation of research-based knowledge elsewhere in society. Mode 2 work tends to be transient. It forms and re-forms around applications problems. Calling on different disciplines and locations at different times, it is hard to centralise. The sharp distinction between Mode 1 and 2 can make it appear as if they are alternatives. Many researchers, however, do both, so they take closely related research problems to different research agencies to ask for funding. The connection between the modes seems especially important in the two technological paradigms that currently dominate: ICT and biotechnology.

¹⁶ Keith Sequeira and Ben Martin, *Physics and Industry*, Brighton: SPRU, 1996

¹⁷ Michael Gibbons, Camilla Limoges, Helga Nowotny, Schwartzman, S., Scott P. and Trow, M., *The New Production of Knowledge*, London: Sage, 1994

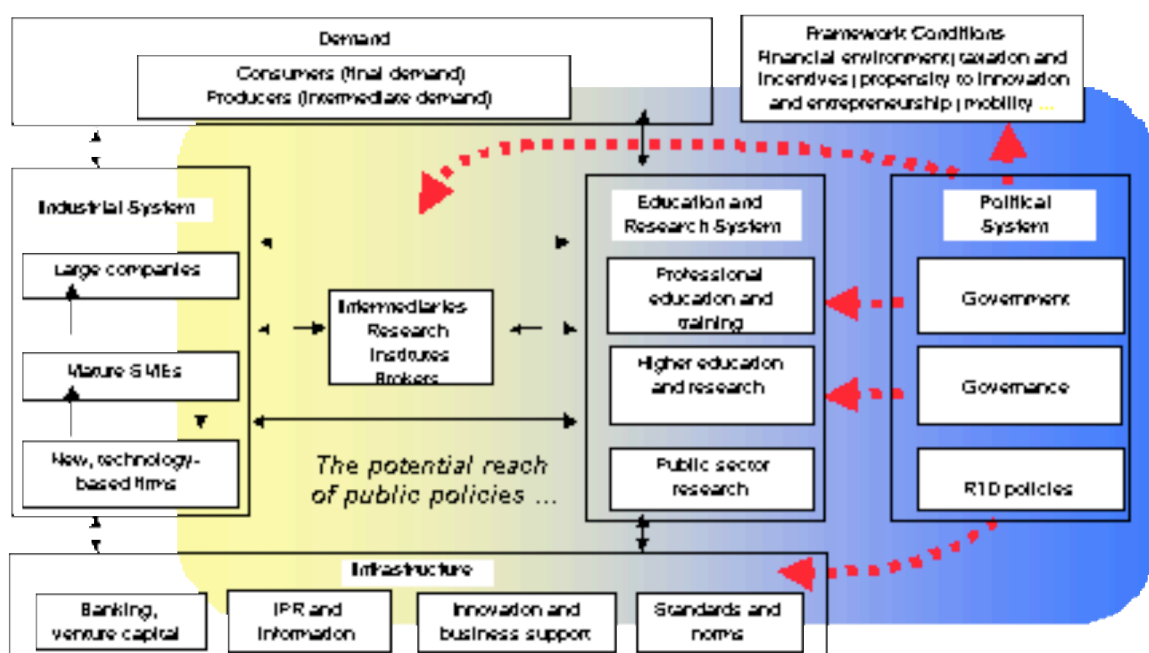
¹⁸ Gibbons and colleagues also get their history wrong, claiming that Mode 2 is new. In fact, it is Mode 1 that is historically new, while Mode 2 is the traditional form of science, as practised for many hundreds of years

The growth in R&D funded by industry, compared with that funded by the taxpayer, in developed countries is a symptom that Mode 2 is becoming more important. State R&D funding structures must be able to cope with fundamental knowledge production in both Modes. In particular, they must deal with a world of constantly changing networks of knowledge producers, spanning not only the knowledge infrastructure but also many other parts of society.

3.2 National Research and Innovation Systems

Over the past fifteen years or so, there has been a revolution – a ‘paradigm shift’ – in the way we understand the relationship between research, innovation and socio-economic development.

Exhibit 10 An Heuristic: The National Research and Innovation System



Source: Erik Arnold and Stefan Kuhlman, *RCN in the Norwegian Research and Innovation System*, Background Report No 12 in the Evaluation of the Research Council of Norway, Oslo: Royal Norwegian Ministry for Education, Research and Church Affairs, 2001

The current orthodoxy is that economic well-being is founded on well-functioning national research and innovation systems, in which not only the actors shown in **Exhibit 10**, but also the links between them, perform well. Earlier views focused on entrepreneurs and scientists as individual heroes - a view that was built into the original design of the Funds, as funders of individual scientists and firms. Innovation and learning are now seen more as **network** or collective activities. This has been strongly reflected in the policies of innovation funders internationally, who increasingly fund **networks** of innovators – often comprising a mixture of companies and institutions in the knowledge infrastructure. In Austria, the Funds have begun to move in this direction too, but the newer view has had more influence on other funders.

The now orthodox National Innovation Systems¹⁹ approach to understanding the generation and use of knowledge in economic and social production stresses the idea that firms and other actors have ‘bounded rationality’ and this makes knowledge, learning and institutions key to overall performance. Learning means there is ‘path dependency’: what you can do tomorrow depends upon what knowledge and resources you have today and what you can do to adapt these. Interventions to improve knowledge and capabilities can change the trajectory of the innovation system and therefore its performance. Correspondingly, R&D funding internationally increasingly is concerned to improve participants’ capabilities, promoting learning or ‘behavioural additionality,’ as opposed simply to ‘helping firms’ or ‘funding science.’

Cumulated capabilities and experience can ‘lock in’ parts of the system to configurations that perform badly. ‘Unlearning’ as well as learning may be needed. Successful innovators (and, since we increasingly conceive science as a collective and not an individual enterprise, also successful researchers) are not successful solely because of their personal qualities and actions but also as a result of their interplay with the research and innovation systems they inhabit, and the quality of those systems.

3.3 Market and Systems Failures

The idea that ‘market failure’ leads to under-investment in research²⁰ has been the principal rationale for state funding of R&D since the early 1960s, though governments had been funding research long before the economics profession produced a reason. The idea behind ‘market failure’ is that capitalists invest too little in research because the uncertainties are too great and it is difficult to monopolise the new knowledge that results. Arrow’s argument was particularly relevant to more generally applicable forms of knowledge.²¹ The presence of bottlenecks or other failures that impede the operation of the innovation system can constitute crucial obstacles to growth and development²².

- **Capability failures.** These amount to inadequacies in potential innovators’ ability to act in their own best interests
- **Institutional failures.** Failure to (re)configure institutions so that they work effectively within the innovation system

¹⁹ See Christopher Freeman, *Technology Policy and Economic Performance: Lessons from Japan*, London: Frances Pinter, 1987; Bengt-Åke Lundvall, *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, London: Pinter, 1992; RR Nelson, *National Innovation Systems*, New York: Oxford University Press, 1993

²⁰ Ken Arrow, ‘Economic Welfare and the Allocation of Resources for Invention,’ in Richard Nelson (Ed.) *The Rate and Direction of Inventive Activity*, Princeton University Press, 1962; see also Richard Nelson, ‘The simple economics of basic scientific research,’ *Journal of Political Economy*, 1959, vol 67, pp 297-306

²¹ His argument is conceptually flawed (actually, circular). It simply **assumes** that there is under-investment in basic research compared with an imagined welfare-economic optimum. It makes this assumption because it implicitly accepts the ‘linear model’ account of the role of science in economics and development promoted by Vannevar Bush and others: the idea that basic science causes technological and eventually economic development. In fact, no one has observed or calculated what such an optimum would look like

²² Erik Arnold, Research evaluation: A systems world needs systems evaluations, *EVA Conference*, Håholmen, Norway, September 2001

- **Network failures.** These relate to problems in the interactions among actors in the innovation system
- **Framework failures.** Effective innovation depends partly upon regulatory frameworks, health and safety rules etc as well as other background conditions, such as the sophistication of consumer demand, culture and social values

These failures justify state intervention not only through the funding of research, but more widely in ensuring that the innovation system performs as a whole. Because systems failures and performance are highly dependent upon the interplay of characteristics in individual systems, there can be no simple rule-based policy as is possible in relation to the static idea of market failure.²³ Rather, a key role for state policy making is ‘bottleneck analysis’ – continuously identifying and rectifying structural imperfections.²⁴ Modern research councils and innovation agencies tackle both this analytic need and to some degree act as ‘change agents’ in the research and innovation system.

3.4 Roles of the State in the NRIS

If we bring together these arguments, we can identify a small number of key roles for the state in supporting both innovation and research and in maintaining this web of interrelationships in knowledge generation. These roles are

- **Developing absorptive capacity.** This involves fostering the capabilities that companies and other institutions need in order to make good use of knowledge
- **Promoting technological development.** As the discussion earlier showed, there are several types of systemic failure, which impede the development of technology and its productive use
- **Funding strategic research.** Equally, it is necessary to make choices about where to build up capabilities in the research system, not least because this produces the manpower that is needed elsewhere in the economy. This involves a kind of **change agency**, working to alter the structure of the research system
- **Funding ‘basic’ research.** The market failures associated with fundamental research still persist, justifying the state’s investment. As long as the strengths of the national research infrastructure correspond to the needs of national ‘users’ of knowledge, it is easy for basic research to be useful because basic research is at the same time strategic research. Divergence can represent an undesirable lock-in
- **Bottleneck analysis** is a crucial function of the state. This provides the overall ‘intelligence’ to decide where and how to intervene. Multiple sources of intelligence will be needed to inform policy makers about needs at different points of the innovation system, so bottleneck analysis needs to involve **arenas** where new ideas and analyses can be considered
- **Governance**, in the sense not only of managing individual parts of the state’s effort but also in co-ordinating across the system and mobilising resources

²³ Johan Hauknes and Lennart Norgren, *Economic Rationales of Government Intervention in Innovation and the Supply of Innovation-Related services*, STEP Report 08 1999, Oslo: STEP Group, downloadable from www.step.no

²⁴ Erik Arnold, Stefan Kuhlmann and Barend van der Meulen, *A Singular Council: Evaluation of the Research Council of Norway*, Oslo: Ministry of Education, Research and Church Affairs, 2001

In evaluating FFF and FWF, we need to consider not only their positions **within** this set of functions but also the adequacy with which other roles are performed, in order to make recommendations about the future role, governance and activities of the Funds.

3.5 The New Public Management

In most OECD countries over the past two decades, there have been significant changes in the structure of the institutions funding and performing research for the state. These are part of a wider series of administrative reforms, which have been pursued with varying degrees of enthusiasm. In many cases, the need for reform has been driven by concerns about informal (and inappropriate) influences on policy making, politically based recruitment and informal interference in detailed decisions, such as the funding of individual projects.

Collectively known as the New Public Management²⁵ these reforms include

- Professional, management oriented leadership, decentralisation and increased local autonomy in resource allocation
- Management by objectives, using quantitative indicators
- Increased use of competition and markets, as well as privatisation
- Separation among customers and contractors in the production of public services
- De-integration of traditional administrative institutions
- A focus on the state as a producer of public services
- Increased use of incentives, contracting and local autonomy on wages
- Reduced costs and increased budgetary discipline²⁶

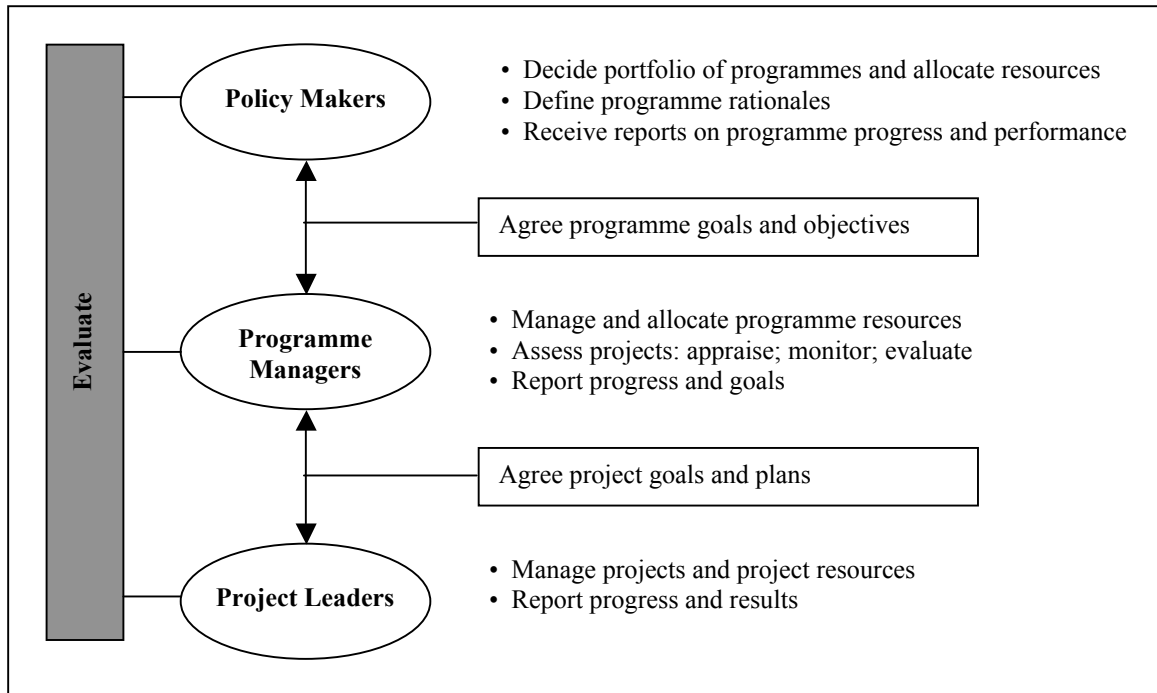
To this list, we would add the use of evaluation as a key instrument, both in ensuring accountability and in fostering learning and therefore process improvement. Many actions of the state are not subject to competition, so evaluation is often needed to play the role of criticism that elsewhere would be taken by market forces. The Government Performance and Results Act passed in the USA in 1993 was a major impulse also internationally in making the state more of a learning organisation.

One of the important consequences of the new public management for R&D funding institutions has been an increasingly clear separation between ministries as setters of policies, goals and as paymasters, and the day-to-day functioning of the organisations that implement these policies. It has also meant a growing consistency of role definition and governance, with one set of performance contracts governing relations between ministries and funding agencies, and a second set governing those between agencies and research performers (**Exhibit 11**).

²⁵ An important focus is the PUMA (Public Management) group at the OECD. See www.oecd.org

²⁶ Tom Christensen and Per Lægred, *Den moderne forvaltning*, Oslo: Aschehoug 1998

Exhibit 11 Policy, Programme and Project Management with Evaluation



Source: Erik Arnold, Patrix Boekholt and Patrick Keen, *Some Good Ideas in R&D Programme Management*, Report to the European Commission VALUE Programme, Brighton: Technopolis, 1996

With this increased consistency comes the possibility both to use competition – among potential programme implementers, as among potential project performers – as a way to encourage improved system performance. The consistency also has a second important implication: that it is possible for agencies to build broad competences that enable them to serve multiple (ministry) customers. The most extreme example of which we are aware is the Research Council of Norway, which in varying ways delivers programmes and project funding for fifteen ministries.

4 FFF

FFF is **the** major state R&D and innovation funding agency in Austria. According to the OECD-MSTI database, Business Expenditure on R&D (BERD) amounted to 2,107 M€ in 1998, the most recent year for which official BERD data are available. Of this sum, 5.5 % or about 116 M€ were financed by government (64.4 % were financed by industry, 30.1 % were financed by abroad. 0.1 % were financed by other national sources.

In 1998, the FFF supported business R&D with subsidies and loans worth a total of 187 M€, equivalent to a present value of 76.7 M€. Thus, the FFF accounted for about 66 % of that part of Austrian BERD, which was financed by government. Adding those funds which are provided by other sources but which are managed by the FFF, viz. 8.5 M€ from the OeNB, the Austrian National Bank, and 8.4 M€ by the ITF, the Ministry of Innovation's *Innovation and Technology Fund*, raises the FFF's share in government-financed BERD to more than 80 %.

Given this impressive statistic, it is probably safe to assume that the FFF can count the overwhelming majority of innovating firms in Austria amongst its beneficiaries. Of innovating firms, which have applied for public R&D subsidies, probably all have approached the FFF at least once during the last decade.

In 2002 (the most recent year for which there are complete statistics), FFF funded 816 projects, providing a mixture²⁷ of grants, loans and guarantees worth 247 M€, and with a cash value of 118 M€.

4.1 FFF Description

The Research Promotion Act of 1967 lays down the objectives of the FFF as follows

"Section 11. [1] The objectives of the Industrial Research Promotion Fund shall be:

- a) to promote and assist research projects of individuals or corporations (applicants for assistance); such assistance shall be provided by the Fund in its capacity as a private corporation in any manner which it deems appropriate, and in particular, by making promotion grants or loans for specific, precisely defined research projects, including the erection of buildings and the procurement of research equipment directly required for as specific research project;
- b) to administer the monies received by the Fund in accordance with their appropriation;
- c) to prepare an annual report on the Fund's activities in the preceding calendar year and on the state of research in the field of trade and industry as well as the probable needs in this field in the ensuing calendar year, including a relatively long-term forecast of the requirements of research in the area of trade and industry, with special regard to the economic, social and cultural significance of these matters; the report shall be submitted to the Federal Ministry of Trade, Commerce and Industry not later than March 1st in each year;
- d) to inform the public about the significance of research in the field of trade and industry and its promotion."²⁸

²⁷ Including funds of the National Bank

²⁸ Research Promotion Act, 1967, p. 188f.

In relation to FFF, the Act remained unchanged for long periods. It was amended in 1981 to add socio-economic, cultural, and ecological aspects to the criteria list for project appraisals and in 2001 to allow FFF to implement programmes, mandated by the Federal Government (although it had, in practice, already been doing this for several years).

Three aspects of this legal basis are startlingly modern

- **Project orientation.** While it is standard practice today to carry out research and innovation work as projects, this must be regarded as rather progressive forty years ago
- **Foresight, Strategic Intelligence.** The FFF was obliged to prepare annual reports

"on the state of research in the field of trade and industry as well as the probable needs [...] including a relatively long-term forecast of the requirements of research in the area of trade and industry, with special regard to the economic, social and cultural significance of these matters."

In today's language we call these activities 'foresight exercises' or 'strategic intelligence' and regard them as core principles of good practice in technology policy making
- **Public Understanding of Science and Technology.** Allocating this as a responsibility was an act well ahead of its time

A striking characteristic of the text of the law is its focus on '**research**' and not on 'innovation' or 'technological development', expressing, on the one hand, a symmetry between the academic FWF and its counterpart, the industrially oriented FFF, and, on the other hand the prevailing thinking about technological development in the 1960s, which was dominated by the linear model, emphasising technology push.

In practice, FFF has broadened this concept of 'research' by including additional aspects, such as feasibility studies, licensing assistance and supporting research to demonstrate the inefficiency of current regulation. However, the great growth in innovation-related policies and instruments in Austria and abroad has largely passed FFF by. Examples of what has been missed by FFF include the large numbers of competence centre and impulse programmes of the BMVIT and the BMWA, the cluster programmes at the levels of the provinces, the activities of the *Wirtschaftsförderungsinstitut* (WIFI) in the field of innovation management, the EU support activities provided by the Bureau of International Technology Co-operation (BIT), and the Innovation Relay Centres (IRC).

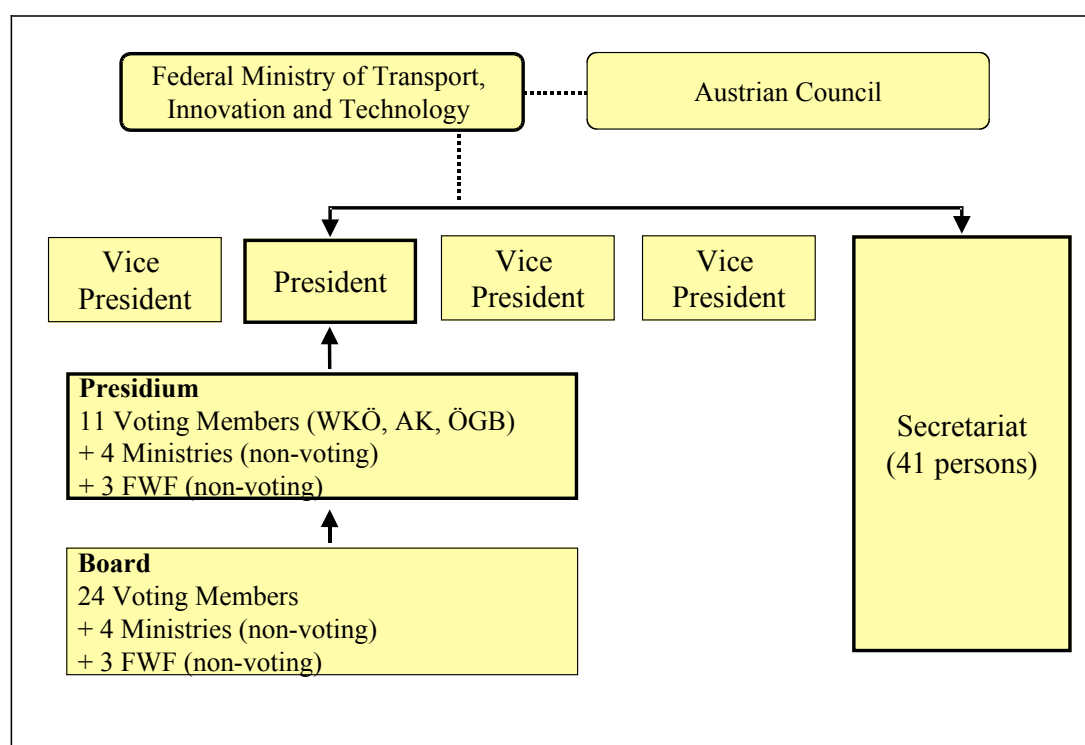
To sum up, the mandate of the FFF provided an excellent basis for becoming **the** agency with wide responsibilities for innovation policy in Austria. FFF was equipped with a set of instruments which would have provided it with a powerful institutional as well as intellectual base. However, until the very recent past, it has consistently failed to seize the available opportunities, preferring to stick closely to its original and narrowly-defined mission, rather than to develop with the evolving needs of the innovation system and innovation policy in Austria. It did not exploit the opportunities provided by its enabling legislation, to carry out prospective activities and the opportunity to build up strategic intelligence. Instead, its exercise of these responsibilities was limited to projecting the need for 'more money' each year. In

effect, this narrow approach amounts to an ‘institutional failure’: specifically, a failure of governance, where the strength of the social partners (especially the industrial lobby) caused ‘lock in’ to an increasingly inappropriate *modus operandi*.

While the Law safeguards FFF’s institutional autonomy, its degree of financial autonomy is rather limited²⁹. Unlike in particular the ERP Fund³⁰, the budget of the FFF is highly dependent on the annual federal budget.

The internal organisational structure of the FFF is shown in **Exhibit 12**.

Exhibit 12 FFF – Organisational structure



Source: FFF

As required by the Research Promotion Act, the FFF is governed by the **Presidium**, chaired by the President and three Vice-Presidents. The **President** is the legal representative of the FFF and elected by the Presidium. The **Presidium** itself consists of 18 members, of which 11 are voting members. The voting members of the Presidium are a subset of the Board, elected³¹ by the Board in such a way that a certain distribution of power amongst the social partners is maintained.

²⁹ Cf. Thomas Kostal, *Öffentliche Fonds in Österreich. Bestandsaufnahme und finanzpolitische Beurteilung der Bundes- und Landesfonds*. Manzsche Verlags- und Universitätsbuchhandlung, Wien 1995.

³⁰ The ERP Fund can be considered as a so-called para-fiscal fund due to their managerial independence and an endowment based on own budget, being thus independent from the regular federal budget.

³¹ In the presentation to the international evaluation panel, the voting members of the Presidium are not elected, but appointed. This of course contradicts to the written law, but, however, does truly reflect the real-world processes. (Herbert Wotke, Presentation to the international panel, 28 October 2003)

Exhibit 13 Membership and Functions of FFF Governing Committees

Board has 24 members, appointed by	Functions of the Board
<p>Voting members</p> <ul style="list-style-type: none"> • 15 members by appointment of the Austrian Federal Economic Chamber • 3 members by appointment of the Austrian Federal Chamber of Labour • 3 members by appointment of the Austrian Federal Chamber of Agriculture³² • 3 members by appointment of the Austrian Trade Union Federation <p>Non-voting members</p> <ul style="list-style-type: none"> • 4 Ministry representative • 3 FFF representatives 	<ul style="list-style-type: none"> • "to adopt the rules of procedure for the administration of the Fund; • to approve the report to be submitted under S. 11, c) • to approve the annual budget estimate and the final accounts; • to elect voting members and alternates of the Presidium"³³
The Presidium is a sub-set of the Board	Functions of the Presidium
<p>Voting members</p> <ul style="list-style-type: none"> • 6 out of the 15, appointed by the Austrian Federal Economic Chamber • 2 out of the 3, appointed by the Austrian Federal Chamber of Labour • 1 out of the 3, appointed by the Austrian Federal Chamber of Agriculture • 2 out of the 3, appointed by the Austrian Trade Union Federation <p>Non-voting members</p> <ul style="list-style-type: none"> • 1 by appointment of the Federal Ministry of Transport, Innovation, and Technology (BMVIT) • 1 by appointment of the Federal Ministry of Economic Affairs and Labour (BMWA) • 1 by appointment of the Federal Ministry of Education, Science, and the Arts (BMBWK) • 3 by appointment of the FWF 	<ul style="list-style-type: none"> • "to take decisions on the funding of R&D projects • to submit motions to the Board on the matters specified in S. 13 2) • to convene the Board • to implement the decisions of the Board • to determine matters concerning the staff of the secretariat • to determine all matters not explicitly reserved to the Board"³⁴

While the Research Promotion Act formally states that the 11 voting members of the Presidium shall be elected by the 24 members of the Board, in practice the members of the Presidium are **appointed** by the social partners, not elected. The Act further

³² The full title is read: 'Standing Committee of the Presidents of the Austrian Chambers of Agriculture'

³³ Research Promotion Act (1967), S. 13 [2]

³⁴ Research Promotion Act (1967), S. 14 [2]

stipulates that one vice president has to be from among the Board members appointed by the Austrian Chamber of Labour or by the Austrian Trade Union Federation, which implicitly makes clear, that the President is elected from among the Board members appointed by the Austrian Federal Economic Chamber³⁵. **In effect, therefore, FFF is entirely governed by the social partners**, while the taxpayer provides its economic resources. Seven out of 11 members of the Presidium represent specific Lobbies³⁶.

Members of the Presidium are volunteers and act in an unpaid capacity. In the past, they would generally have been people active in research or management positions. Today, most are from representative or lobby organisations, and the few company people come from the world of big firms, especially multi-nationals. The under-representation of SMEs is widely recognised as a defect, but is difficult to rectify because a serious engagement is rather time-consuming (on the average half to one day per meeting, 8-9 times a year). Few SME managers can afford to make such a commitment, while large companies can more easily afford such an investment in ‘good citizenship’ – especially as it involves an organisation that provides significant subsidies for R&D projects, making it easy to justify the investment internally³⁷ in the big companies involved.

4.2 FFF Activities and Instruments

FFF was established as a ‘bottom-up’ or ‘responsive mode’ funder of industrial R&D projects, and has remained remarkably true to this mission. It has experienced fairly continuous growth in its activities since it was founded with, as **Exhibit 14** illustrates, with plateaux in the 1970s, 1980s and 1990s.

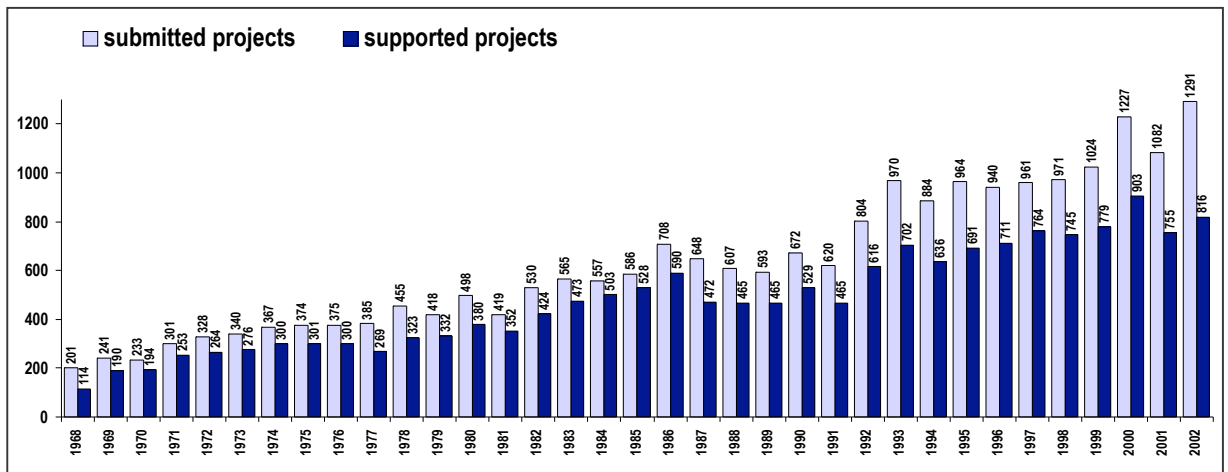
FFF has assumed various kinds of partial responsibility for ‘top down’ programme implementation since 1995. These have involved a range of different management styles and differing roles for FFF within the overall division of labour – sometimes with ministries, sometimes with a ministry and an external programme management contractor. However, the concept of running technology programmes on its own initiative found its way into FFF only in recent years, since FFF has become involved in the programme management of a series of technology programmes designed and launched by BMVIT. **Exhibit 15** illustrates the strong focus on bottom-up project funding and the increasing role of technology programmes in the last years.

³⁵ As a matter of fact, the nomination of the President is informally agreed with the Association of Austrian Industrialists

³⁶ Unlike to most lobbies, in particular in other countries, some lobby organisations are mandatory, e.g. each company has to be a member of the Austrian Federal Economic Chamber, each employee of the Austrian Chamber of Labour.

³⁷ There is absolutely no suggestion here that the involvement of these representatives is corrupt. Rather, they bring immensely valuable perspectives as well as access to international industrial and R&D networks, and carefully abstain from involvement in decisions about applications from their own companies

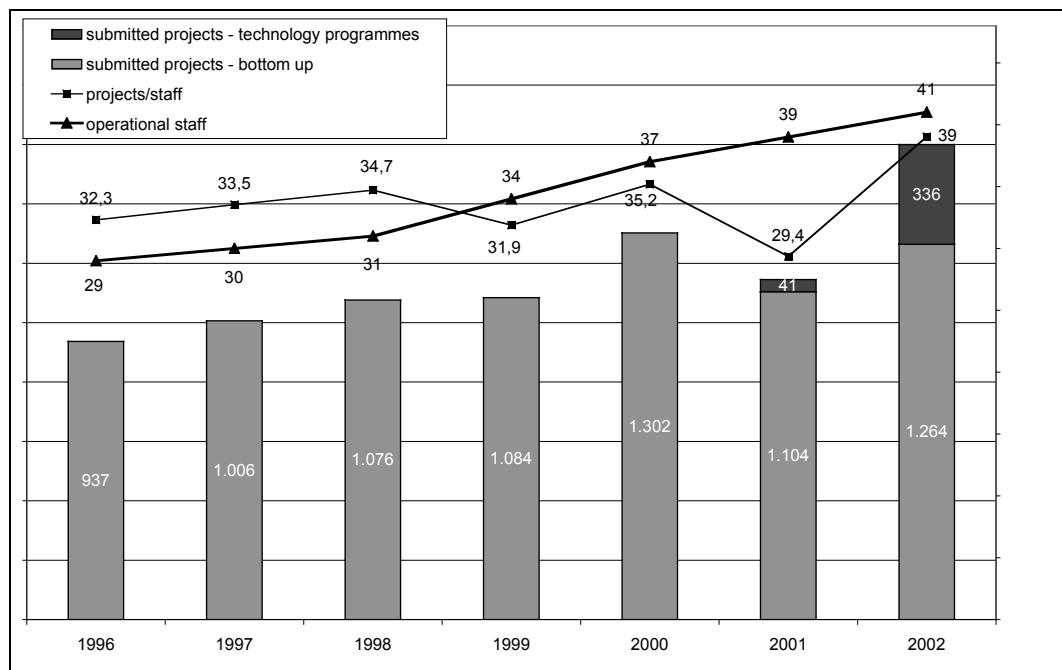
Exhibit 14 FFF Project Volumes 1968 - 2002



Source: FFF

Exhibit 15 shows that the last seven years have been a period of growth for FFF. This holds both for the number of projects submitted (1996: 937; 2002: 1.600) and for the number of staff employed in the FFF secretariat. The number of projects per employee has been fairly stable but increased substantially to 39 in 2002.

Exhibit 15: FFF, Submitted Projects by Type of Funding



Source: FFF, own calculations

The Exhibit underlines the strong focus on bottom-up project funding. However, FFF does also use measures to target specific technology areas or specific types of R&D-project settings (e.g. science-industry cooperation).

Exhibit 16 provides an overview of mandated programmes and own initiatives over the last 9 years. At first glance, the number of activities (31) is impressive. However, a more detailed analysis reveals a rather incoherent patchwork, governed by a variety

of mostly contingent factors both from inside the FFF as well as from the larger policy context.

Exhibit 16 FFF: Mandated programmes and own initiatives [1994-2002]

	Own initiatives	Programmes contracted to FFF		94	95	96	97	98	99	00	01	02
		Fully	Partly									
ITF			x									
OeNB (since 1982)		x										
Siedlungswasserwirtschaft		x										
Impulsförderung (ACR)			x									
Wachstumsförderung (ACR)			x									
Impulsförderung FHS-Wirtschaft			x									
Impulsprogramm Nachhaltig Wirtschaften			x									
Industrielle Kompetenzzentren (K _{ind}), Kompetenznetzwerke (K _{net})			x									
E-Content			x									
BIOMED		x										
TAKE OFF Aeronautics			x									
Innovatives Bahnsystem (IBS)			x									
A3 Austrian Advanced Automotive Technology			x									
FIT-IT			x									
COST			x									
EUREKA			x									
EU-Projektvorbereitung bei KMUs	x											
Holzforschung	x											
Lebensmittelinitiative	x											
Mikrotechnik Österreich	x											
Nachwuchsförderung	x											
Feasibility Studies	x											
F&E Dynamik	x											
Start-up Förderung	x											
Foren für VC	x											
Technology Rating	x											
TIN (JISSY)	x											
PR-Offensive für innovative KMU	x											
LES	x											
TAFTIE	x											

Source: FFF, Annual Reports

The first steps towards using top-down elements in its funding activities were taken during the course of implementing **ITF-programmes** such as the ITF-transport programme and ITF Flex-CIM programme during the mid-1990s. ITF was set up as a virtual fund dedicated to the implementation of technology programmes. FFF and ERP³⁸ were responsible for project assessment and the financial management of the programmes. Design and steering however were either directly in the hands of the ministries responsible, or contracted out by them to external experts.

ITF provided an important test and learning environment for implementing the concept of technology programmes in Austria. Doing so within the rather complex ITF-setting was not as easy as most protagonists might have hoped.³⁹ Nevertheless, since this time, technology programmes have become an important element in the

³⁸ ERP was the second major fund for the Austrian enterprise sector at the national level. Unlike FFF, with its unclear clear focus on research, ERP is positioned closer to the market focusing on financial support for development and investment projects. However the border between FFF and ERP has not always been clear-cut.

³⁹ Fritz Ohler, Erik Arnold, Leonhard Jörg, Daniel Corsten, *Evaluation of the ITF Transport Technology Programme*, Austrian Research Centers, Technopolis, Institut für Technologiemanagement, Universität St. Gallen, OEFZS-A—4285, 1998

Austrian R&D-funding system as a way to bundle scarce resources and to create R&D-communities in specific themes. The role of FFF in this development was to some extent ambiguous. On the one hand many observers have seen FFF as fairly reluctant to take up top-down programme activities. On the other hand FFF has built up a degree of programme management competence and actually provides programme management services for several technology programmes, competence networks (*Knet*) and industrial competence centres (*Kind*) on a contract basis.

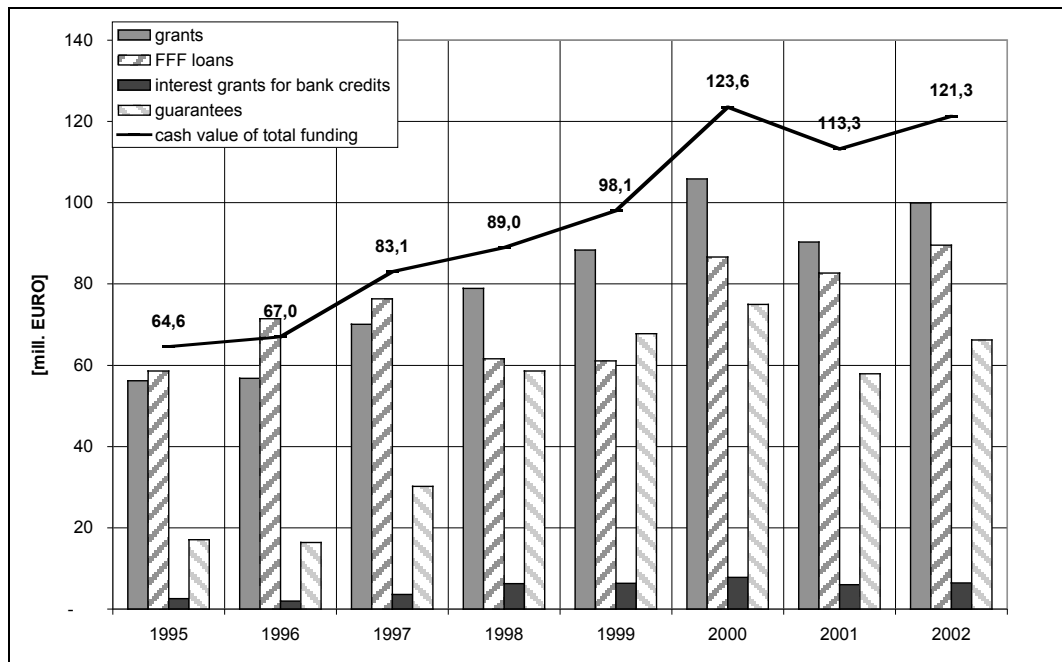
A more detailed view of programmes, classified in **Exhibit 16** as 'mandated programmes', reveals a more complex situation. Many of these programmes⁴⁰ are only partially contracted out to FFF. While administrative and financial matters and in some cases the economic evaluation of projects are delegated to FFF, other programme related activities such as marketing, umbrella management or the organisation of evaluation panels are often contracted to research, consulting, lobbying organisations, or agencies. Interestingly, this splitting of delegation is a rather recent phenomenon and occurred in parallel to the amendment of the Research Promotion Act, allowing the ministries, in particular the BMVIT to contract out programme management to FFF.

In addition to playing a role in implementing others' programmes, FFF has in effect devised ways flexibly to use its 'bottom up' project funding to address a range of needs. FFF has begun to introduce programmatic elements into its bottom-up funding activities. In practice FFF has launched a range of funding themes. Examples include various **funding lines for specific sectors** or technology clusters such as microsystems technology, the wood and textile industries. They are primarily used as marketing and communication tools, to help to reach sectors with perceived research or innovation deficits. Projects submitted under such an initiative are treated the same way as other bottom-up projects. No fixed budget is allocated, but a programme manager devotes additional effort both to marketing the idea of participation and to building contacts among those undertaking projects.

FFF has four support mechanisms at its disposal: (i) grants, (ii) loans, (iii) subsidies for bank loan interest, (iv) bank loan guarantees. **Exhibit 17** shows the relative importance of these over time. The two core instruments directly served by the FFF budget are grants and loans. While in the first three years of observation (1995 – 1997) the funding volume of loans exceeded that of grants, this pattern changed in the year 1998, since when grants have become more important.

⁴⁰ Impulsprogramm Nachhaltig Wirtschaften, E-Content, TAKE OFF Aeronautics, Innovatives Bahnsystem (IBS), A3 Austrian Advanced Automotive Technology, FIT-IT

Exhibit 17: FFF Funding Instruments, 1995 - 2002



Source: FFF, own calculations. 'Bottom-up' funding only. Excludes BMVIT technology programmes

FFF has tried to standardise its use of funding instruments. As a general rule, up to 50% of accepted project costs are funded. In this context 'funding' means 'provided cash flow'. The cash value of funding depends on the mix between the cash grant and other instruments, rewarding high risk and technical challenge. A higher than normal proportion of cash is provided for

- **High risk projects**
- **Know-how augmentation:** outstanding projects (representing a big technological step for the individual company)
- **Companies with limited financial capability** (provided their position is not so weak as to represent a danger of bankruptcy – which is treated as a 'Knock-Out' factor in considering project applications). Start-up firms also benefit from a higher cash grant

Overall the maximum share of grant as proportion of total funding is 78% for start-up companies with a high risk project, corresponding to 39% of the total project cost.

At first sight the way FFF tailors its funding instruments complies with the normal funding rationale: FFF rewards high risk. What remains questionable however is the way FFF deals with the second important innovation barrier: access to financial resources. As the funding volume is preset (50% of project costs) and both risk and learning are addressed purely by the share of grant in the total funding provided, there is no room for individual adjustments in relation to the third dimension: financial capability. In cash flow terms, all firms get the same amount of funding: namely, 50% of project costs, irrespective of their financial capabilities.

In order better to align FFF funding to all three relevant dimensions – risk, learning and access to financial resources – we suggest that FFF should use grants as the predominant instrument for covering risk and learning effects (as is now the case).

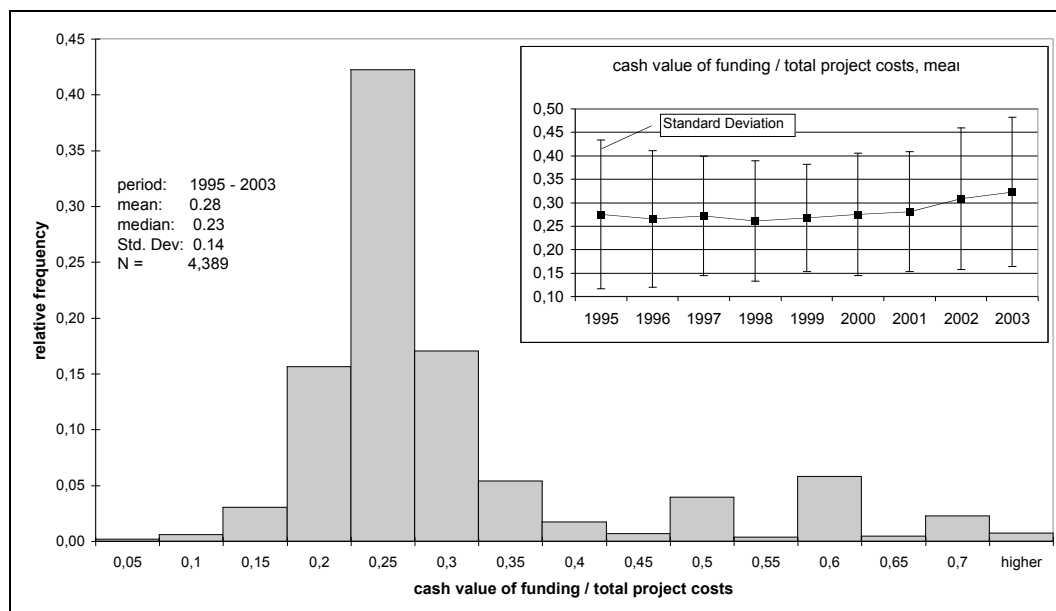
This is reasonable and keeps financial administration of funding efficient. There is however no reason for constraining the total funding (including loans) to a fixed level. We suggest that FFF removes the preset target of providing 50% of the cash needed to pay for project funding and abandons the forced mix of instruments.

Loans and guarantees are valuable instruments for overcome difficulties of access to capital to finance R&D-projects. FFF should be able to issue loans whenever this is a barrier and irrespective of the level of the grant provided. The message here is, to use the two different types of instruments independently in order to address different types of market failures (risk averse firms and risk averse capital markets). Naturally, the funding limits set by the EU apply.

A further differentiation involves the option to contract out parts of projects to universities, research institutes or polytechnics. Those costs are covered 100% by grant and must be in the range 20% - 50% of total project costs. Other deviations occur for specific project types. For example feasibility studies generally receive a higher share of funding.

Exhibit 18 illustrates the distribution of cash value as fraction of total project costs. Over time, relatively more small projects have been receiving higher cash funding while relatively more big projects receive lower funding. If we take the whole period, the distribution of funding intensity is nonetheless rather concentrated: 42% of projects receive between 20% and 25% cash funding coverage of total project costs.

Exhibit 18: Cash value of funding as share of total project costs



Source: FFF, own calculation

In seven of the nine Austrian Länder, the region automatically provides an additional cash grant to projects funded by FFF, increasing the value of the award to the individual firm.

Our survey of beneficiaries shows that the companies involved are broadly satisfied with the funding mechanisms used. Unsurprisingly, they would prefer the subsidies

to be bigger and to contain a higher cash element. Since they continue to apply to the Fund, however, it appears that this objection is not decisive.

Exhibit 19 Beneficiaries' Degree of Satisfaction with FFF Terms of Support

Terms of FFF-support	yes, indeed	basically yes	indifferent	basically no	not at all	missing	Total
The modes of (re)payment	395 34.92	411 36.34	165 14.59	45 3.98	14 1.24	101 8.93	1131 100
Amount of financial assistance in relation to the effort if took to write the proposal	274 24.23	432 38.2	237 20.95	77 6.81	23 2.03	88 7.78	1131 100
The recognition of project cost allowable for deduction	273 24.14	394 34.84	228 20.16	83 7.34	40 3.54	113 9.99	1131 100
Amount of financial assistance in relation to the cost of the project	140 12.38	434 38.37	296 26.17	143 12.64	25 2.21	93 8.22	1131 100
Amount of non-repayable grants in relation to the provision of soft loans	146 12.91	319 28.21	303 26.79	179 15.83	38 3.36	146 12.91	1131 100

Basis: Survey of FFF beneficiaries

FFF's administration costs as a proportion of total funding have been stable in the range 3,3% to 3,5 %. The only recent exceptions were in 1996 (4,3%) and 2000 (2,8%). This is low, since the international reference level for similar funding organisations is in the range 5 – 10%. The low costs are probably driven by the fact that FFF does not devote resources to strategic intelligence, programme design or many of the wider aspects of programme management handled by equivalent agencies abroad. In so far as we believe these are important functions, which FFF should be performing, we argue that FFF's administrative costs are **too low**.

While FFF's staff is undoubtedly competent, it is not reasonable to expect such a small number of people to have a complete and up-to-date technological and commercial overview of the position in so wide a range of areas as FFF handles. It would make sense to put more resources into external review, where needed, in line with practice in some foreign agencies. TEKES, VINNOVA and RCN's innovation department, for example, all in principle evaluate innovation funding proposals in house, but nonetheless invite external technical opinions where they are not sure of their internal understanding.

Staff turnover is also an important area here. TEKES has quite high staff mobility, since working at the agency is seen by many as a useful and high-status intermediary career step. RCN combats its inherently low staff mobility by using quite a number of people with technical experience in relevant domains as temporary staff members. Both mechanisms provide ways to refresh the knowledge of the organisations, and reduce the risk of mental lock-in to out-of-date ideas about industrial need and the technological state of the art.

4.3 FFF Processes

Since FFF considers itself essentially to be a project-funding organisation, project assessment is **the** core activity of the Fund. Project assessment in FFF is done exclusively in-house with half of FFF staff (20 out of 41) devoting most of their

capacity to it. To work ‘hands on’ with this process is so central to what FFF is, that even the managing director handles a small number of projects.

FFF has established a software based project assessment tool which integrates a large set of funding criteria. Important input for further standardising and codifying the project assessment came from an international technology-rating project in which FFF together with national experts (WIFO) took part.

The project assessment procedure addresses: (i) technological quality of the project itself, (ii) technological quality in relation to the submitting firm, (iii) economic value of the project and finally (iv) economic and managerial performance of the company.

Exhibit 20: FFF, Funding Criteria

	Technical evaluation	Economic Evaluation
Project	1. Novelty 2. Technological challenge 3. Practical value / benefit 4. Environmental effects	1. Market prospects 2. Commercialisation 3. Market experience 4. Social impacts (implications) Other external effects (e.g. job creation)
Firm	5. Increase of Know-how 6. R&D dynamics 7. Feasibility	6. Financial performance 7. Management

Each criterion is built up by scoring sub-criteria, each of which in turn is supported by detailed scoring criteria. Possible scores are preset, including one knock-out possibility (“0” = KO) for each sub-criterion. Different weights are employed among the set of 14 different criteria. The four basic dimensions are balanced so that the possible maximum score in each is the same (50).

The highest ranking sub-criteria are: “financial performance” (max. 30 points), “increase of Know-how” (max. 25 points), “technical challenge” (max. 20 points) and “management” (max. 20 points). This is interesting: Only one (“technical challenge”) of the four most important criteria is related to the project itself. The remaining dimensions refer to the importance of the project to the company and its financial and managerial ability eventually to tap the economic potential of the proposed research work.

These assessment criteria do not only have an instrumental character, however, they represent in an important sense the **intellectual capital** of FFF, reflecting its current understanding of its practices. They represent its **standardised stock of knowledge** and provide a highly explicit tool for passing on to more junior staff the organisation’s experience-based understanding of what makes firms and projects successful.

As for the organisation of the workflow each project is assessed in-house by one technical and one business expert. Incoming projects are allocated once a week (Friday) among staff members. For the technical evaluation FFF has build up teams covering specific technological fields. Ideally each technological field should be

covered by at least two experts. As regards business project assessment, no specialisation (sectors, product clusters) pattern has been developed. On the contrary, FFF procedures ensure that evaluators rotate on a regular basis.

Having allocated incoming project proposals to the evaluation team, projects are assessed sequentially: first on technical then on commercial grounds. Project assessment is first done individually by the responsible team member. The result and the proposed funding decision is then discussed in the team meetings. These discussions usually take place in preparation for the next meeting of the Presidium. They are crucial as they help to build up a shared perception of quality and funding objectives.

The assessed project portfolio together with recommended funding decisions is then presented to the Presidium. The Presidium holds meetings 8-9 times a year, which typically runs for half a day: 1-2 hours are mainly spent by the president and the directors of the secretariat to inform the Presidium about internal affairs as well as trends and events outside the FFF with relevance to FFF. In most cases, not only the regular members of the Presidium attend the meetings, but also most of their alternates. Major parts of the regular meetings are devoted to discussing project applications and deciding about funding. They handle about 100 projects per meeting, though the Presidium does not discuss each project case by case. Instead, the secretariat typically lists three types of projects: (i) for funding, (ii) not for funding, (iii) to be discussed. A fourth group is the so-called continuation projects, which are handled as new projects.

Exhibit 21 shows that for the vast majority of projects the Presidium follows the suggestions of the staff. The Presidium reversed the proposed funding decision in only 18 of 9,967 cases.

Exhibit 21 Proposed and Actual Funding Decisions

Proposed by FFF-secretariat	Definitive decision (Presidium)				total
	rejected	rejected (empty budget)	funded	Withdrawn	
<i>Number of submitted projects [1995 – 2003]</i>					
Rejection	2,323	7	10	3	2343
rejection (empty budget)		126			126
Discussion	112	3	232		347
Funding	7		4,732		4,739
funding-prolonged	1		2,376	1	2,378
funding highlights			34		34
Total	2,443	136	7,384	4	9,967

Source: FFF, own calculations

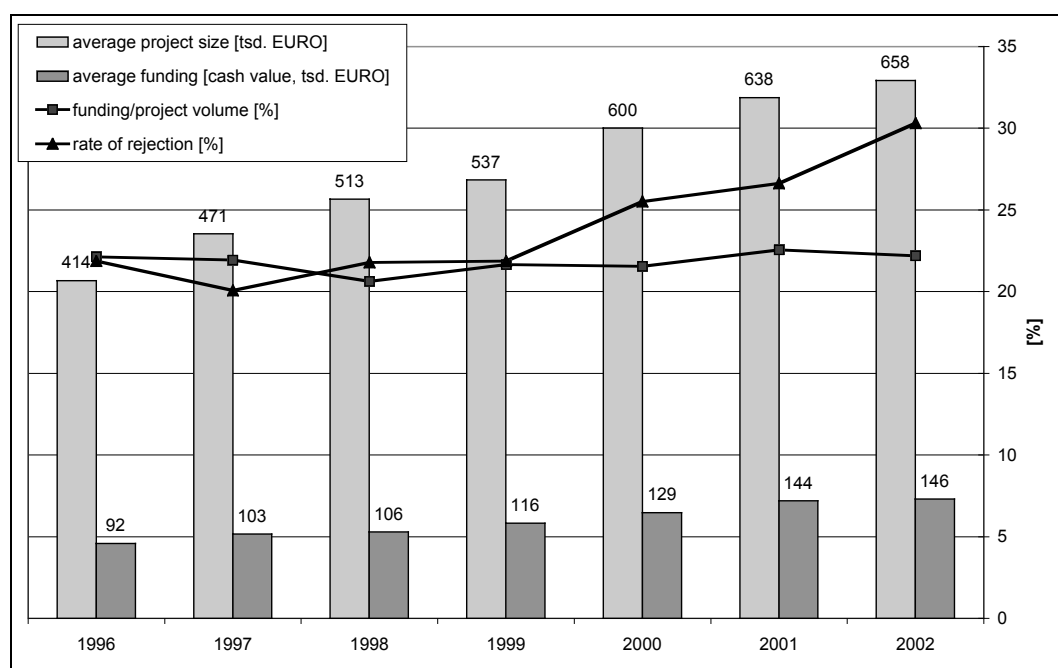
Given the number of project proposals and frequency of meetings the Presidium cannot discuss more than a few individual proposals in depth. The discussion on this very small sample of projects however is seen as crucial, since they are said to draw the line between “good” projects and “bad” projects, but we could see no systematic feedback from these decisions to the assessment criteria or FFF processes. In practice, the fact that there are large numbers of applications means that the real project decisions are largely taken by the secretariat, backed up by the many years of

tacit knowledge build into FFF’s decision criteria. Deviations between the secretariat’s view and that of the Presidium tend to result from the greater appreciation of the ‘additionality’ concept by the secretariat. The members of the Presidium are more inclined to take a common sense view that ‘firms know best which projects to pursue’ and to favour funding projects which largely satisfy industry’s investment criteria – and which, as a result, involve little additionality.

FFF carries out this process of project assessment – including the meeting with the Presidium – very quickly. On average, applicants receive a response to their proposal in 70 days and 80% of applicants have an answer within 95 days. This places FFF comfortably within the normal international range.

In the last few years, available FFF funds have not grown as fast as applications. FFF has chosen to reduce the proportion of applications being funded, rather than to reduce the amount of funding granted to individual projects (**Exhibit 22**). This appears to be part of an implicit strategy to increase the level of aspiration in project selection.

Exhibit 22: Average Project Size and Funding Intensity



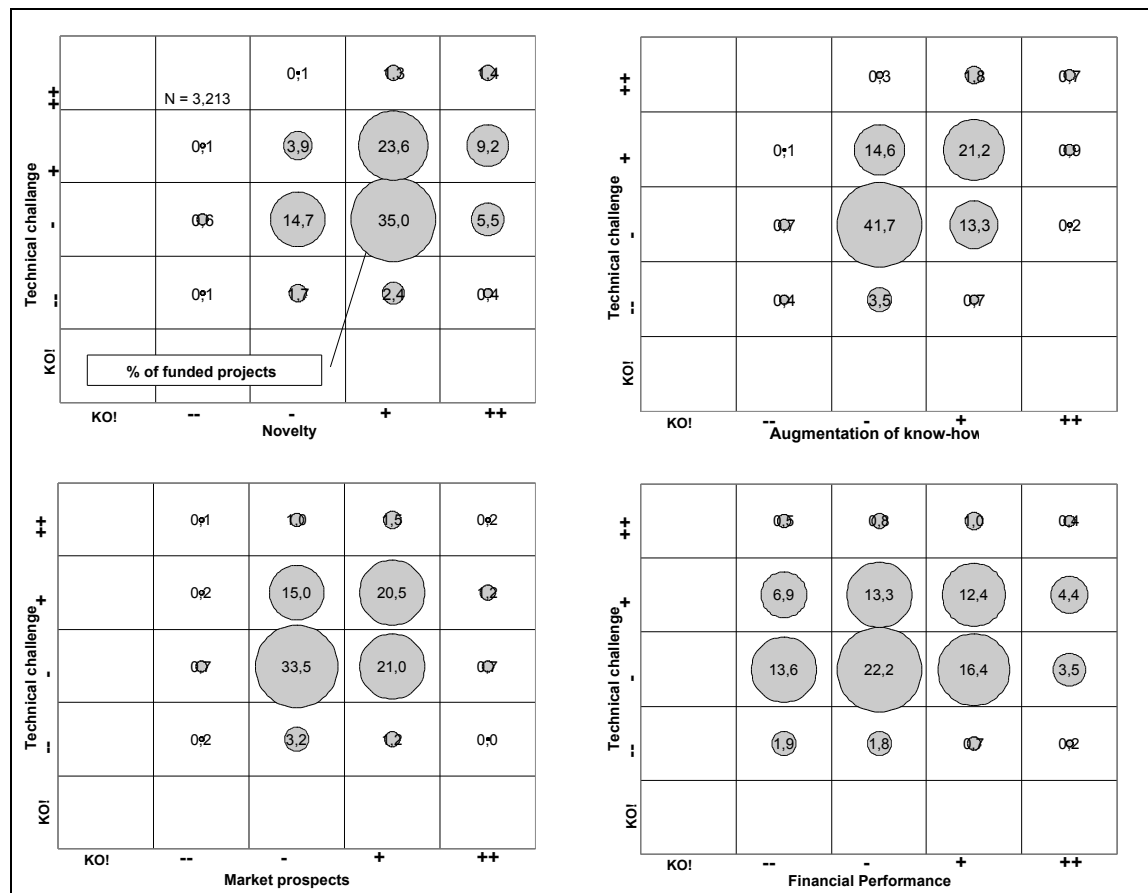
Source: FFF, own calculations

In practice, the project selection process focuses on filtering out inadequate proposals: first, through the KO criteria; second, through the use of an aggregate threshold score at the level of the four major appraisal dimensions. Normally, any project that does not exceed this minimum score on all four dimensions is rejected, even if its **total** scores are higher than those of some accepted proposals. The focus on commercial dimensions means that the technical quality of many funded proposals may be modest (**Exhibit 23**). Some 55.6% of funded projects lie on the negative side⁴¹ of the scale with respect to “technical challenge”. A similar picture can be seen in the criterion

⁴¹ FFF changed the scoring scheme in 1999. The major change was to take out the neutral position in the scale and reducing the number of steps above the KO-threshold from 5 to 4.

“augmentation of know-how”: Use of the assessment criteria suggests that about 60% of funded projects seem not to trigger an upward move in the technological capability of the submitting firm. On the face of it, these indications support the idea that many of the projects FFF funds do not involve especially high technological risks. Unfortunately, there are no indicators that tell us about the technological ‘points of departure’ of the firms. However, the companies’ responses to our survey suggest that many of them perceive a higher level of technical challenge in the projects than does FFF. This is consistent with the idea that FFF projects could involve ‘behavioural additionality’ – helping companies learn and increase their capabilities – without at the same time being near the state of the art. But it is not evidence that this is the case.

Exhibit 23: Quality of project portfolio, funded projects 1999 - 2002



Source: FFF, own calculations

We have conducted a factor analysis to understand whether FFF’s list of 14 criteria could be simplified. Three major factors emerged: a cluster of commercial aspects; a second cluster of technical aspects of the firm and its project; and a third small group of logically unrelated criteria (Practical value, environmental effects and R&D dynamics). These results are not conclusive, but do strongly suggest there is scope for some simplification of the assessment scheme. Nonetheless, as it stands, the scheme does have a number of important virtues. It is comprehensive, transparent, easy to use and to develop as needs change, rather standardised and provides a powerful monitoring tool that generates data, which FFF can use for improving its

own processes. FFF could (but does not today) also use it in a didactic sense, as a way to help companies define good projects.

The assessment scheme itself embeds an important paradox in FFF’s goals and behaviour. It is designed to identify those projects with the best chances of leading to a commercial success – which are precisely the projects least in need of subsidy. (For example, one important assessment criterion is that the possibilities for protecting intellectual property in the project should be high. Yet the failure FFF needs to address is the risk associated with situations where intellectual property protection is harder to obtain and potential externalities are therefore high.) It has been developed in response to the needs and views of its beneficiaries, in their role in the governance of the Fund. Such a scheme is precisely what one would expect an honest group of well-intentioned industrialists to implement, using sound business judgement and common sense. The scheme does not adequately address the market and systems failure rationales for innovation funding, such as weak technological capabilities in individual firms, high technological risk or the availability of large externalities. Nor can it do so if it is used as a ‘one size fits all’ assessment.

Much of this is recognised in FFF’s practice. With these rules, on a level playing field, large and capable firms would walk away with most of the funding, so FFF has an informal process of agreeing annual funding maxima with key customers, who can then submit only their most important projects for assessment and subsidy. FFF also relaxes ‘financial performance’ and ‘augmentation of knowledge’ criteria for new and small firms. The reason for doing these things is not ‘to be more fair’ but an implicit recognition that FFF’s role should not, finally, be the allocation of subsidy to the (more or less) undeserving, but that its purpose is to raise innovation capabilities and iron out systems and market imperfections that act as barriers to innovative enterprise.

As **Exhibit 24** indicates, beneficiaries generally approved of the way FFF handles them as customers and goes about proposal assessment. (Naturally, those whose projects had been rejected were less enthusiastic.) The main area of low satisfaction was the monitoring and support given to projects once they were in train.

Exhibit 24 Beneficiaries’ Views on FFF Project Administration

	very good	good	satisfactory	bad	very bad	missing	Total
Availability of information about support schemes	500 38.58	460 35.49	194 14.97	68 5.25	40 3.09	34 2.62	1296 100
Consultancy services for writing the proposal	394 30.4	416 32.1	281 21.68	101 7.79	59 4.55	45 3.47	1296 100
Competence to judge the project on technical grounds	487 37.58	397 30.63	208 16.05	91 7.02	66 5.09	47 3.63	1296 100
Competence to judge the project on commercial grounds	435 33.56	417 32.18	237 18.29	95 7.33	62 4.78	50 3.86	1296 100
Speed of treatment	373 28.78	449 34.65	291 22.45	86 6.64	55 4.24	42 3.24	1296 100
Confidentiality	777 59.95	262 20.22	124 9.57	19 1.47	12 0.93	102 7.87	1296 100
Consultancy during implementation phase of the project	246 18.98	346 26.7	386 29.78	144 11.11	60 4.63	114 8.8	1296 100

Source: Survey of beneficiaries

We were troubled to learn that 23% of those whose projects were funded had paid a consultant to help them write their proposal. A further 16% had received such help without having to pay for it. We are concerned about this for three reasons. First, experience in other schemes where consultants play such a role is that project definitions can become consultant-led, better reflecting the needs of the consultants than those of the intended beneficiaries. Second, the presence of the consultant can prevent the company from learning the skills in problem and project definition it needs in order to define and implement a useful innovation project. Third, it can provide FFF with a false impression of the applicant's capabilities – though FFF's practice of visiting applicant companies where practical and where the company is not already known to the Fund should minimise this problem.

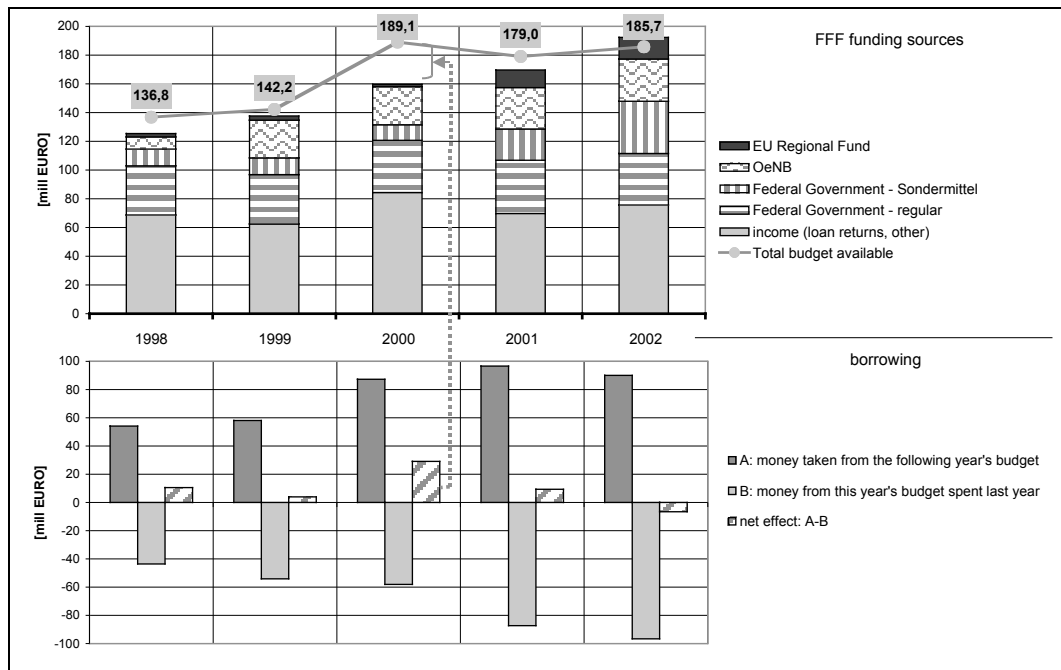
Almost 60% of those answering our questionnaire, whose project proposals had been rejected by FFF, felt they had not received a reasonable explanation. Clearly, some people will not regard any explanation as reasonable. However, this percentage is so high that it seems likely to point to a real problem – which could partly be addressed by more explanation and partly by better communication about how to define good projects.

4.4 FFF Budgets and Finance

FFF obtains its budget from a variety of sources (**Exhibit 25**). The regular contribution of the Federal Government together with income from loan redemption are the largest and most stable income sources for FFF. The Austrian national Bank (OeNB) as well as EU-Regional Funds have contributed to the FFF budget. Moreover the Federal Government has provided additional financial resources in the course of various initiatives (“Technologiemilliarde”, “Offensivprogramm”). **Exhibit 25** summarizes the development of the budgetary situation over the last five years and shows the contribution of the different sources.

As can be seen, the total budget available increased significantly from 1998 to 2002. This is not the result of increased funding being made available, but the consequence of one boost in 2000 when the available budget was increased by 33% (46.89 mill EURO) compared with the preceding year. Most of this increase was obtained by borrowing from next years budget (29.14 M€). **Exhibit 25** indicates that FFF has increased its exposure to credit capital substantially during recent years. Only in one year did the borrowing practice of FFF lead to a significant increase of the budget available for project funding. In the following years the net effect remained at a low level and was negative in the last year of observation (2002).

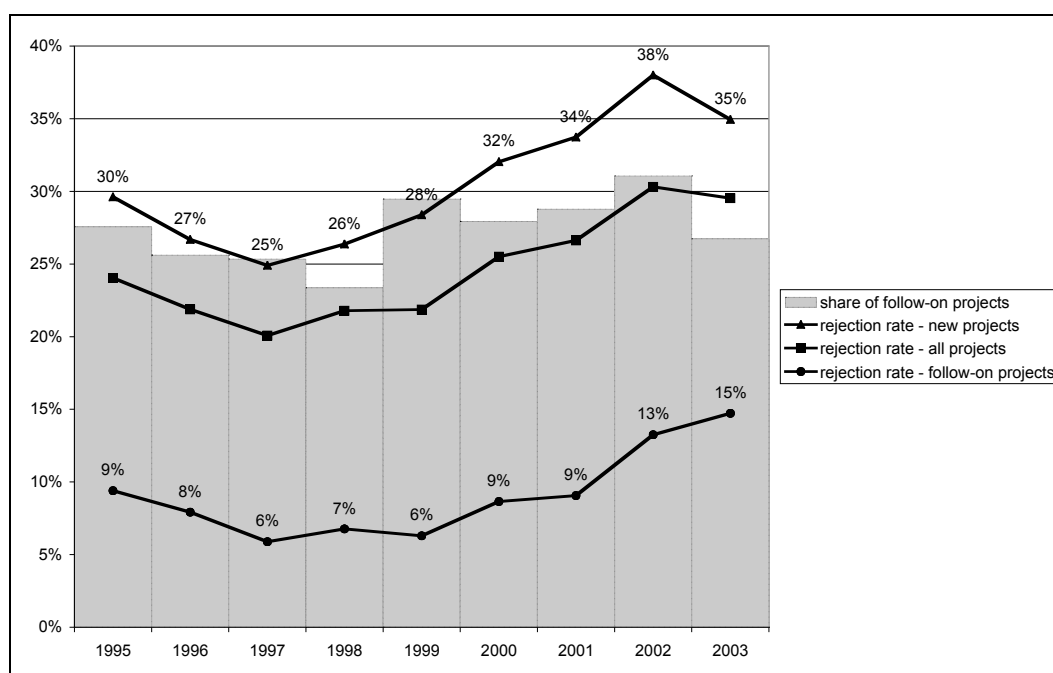
Exhibit 25: Sources of FFF budgets [1998 - 2002]



Source: FFF, own calculations

Because FFF budgets annually, it also takes annual decisions about projects. Internationally, practice varies in this respect. Almost all innovation funding agencies have annual rather than multi-annual budgets. Swedish agencies can take multi-annual project funding decisions despite having annual budgets, because parliament permits them to commit a certain fraction of future budgets each year. In other cases, multi-annual projects are renewed more or less automatically when a new annual budget is granted. FFF is among the agencies that re-assess projects before renewing them. It is internationally unusual in regarding project termination in mid-life as an acceptable outcome. In most funding bureaucracies, such an outcome is seen as scandalous; in industry, it is perfectly normal, since needs and plans change, and R&D projects generate new information. As **Exhibit 26** indicates, the rejection rate for projects in their second (or, very occasionally, subsequent) year is fairly low, rising most recently to 15%. At this level, the savings from, in effect, cancelling projects massively outweigh the additional administrative costs of re-assessing the projects involved.

Exhibit 26: Rejection rates of new projects and follow-on projects



Source: FFF, own calculations

The apparent extra bureaucracy of annually approving projects appears therefore to be well worth the extra cost.

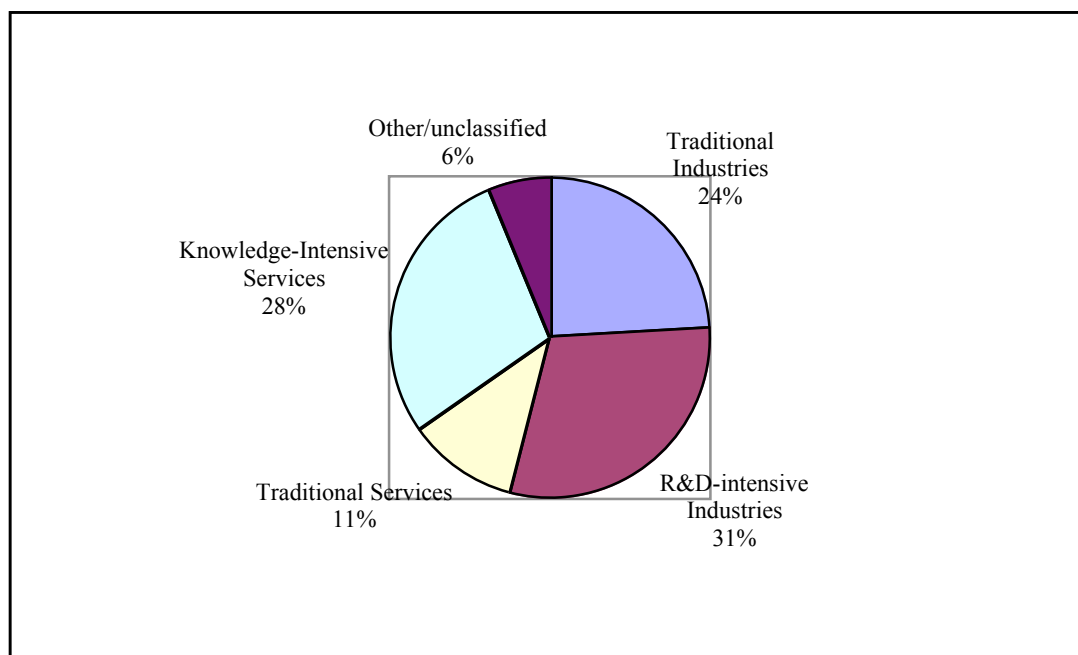
We are more concerned about FFF's practice of borrowing against future income in order to generate a one-time increase in the amount of funding it could provide. The cost of this is permanent exposure to the capital market, and – unless something is done to refinance FFF – therefore a permanent annual interest cost. This amounted to 1.5 M€ in 2002 and 1.4 M€ in 2003. Living on borrowed capital makes a great deal of sense in the private sector, since the borrowings can be used to increase the rate of profit beyond the rate of interest on the capital. In a non-profit organisation, which by definition does not have this opportunity, it is not prudent. In so far as FFF is in practice an agency of government, its freedom and ability unilaterally to take such an action – potentially frustrating the will of government – is also problematic.

The budgeting practice described can only be explained in the light of the specific setting of the Austrian funding system with autonomous funding organisations. It is the result of allocation processes that are not based on long term strategy, taking into account various funding instruments and types, but on yearly negotiations between the Federal Government and beneficiaries of single funding types. In the long run this lack of overall strategy reduces the performance of the Austrian RTD-system.

4.5 FFF's Beneficiaries

FFF funds projects broadly across the economy (**Exhibit 27**) – though it should be pointed out that in any sensible classification of branches of industry, much of software (which makes up 12.3 percentage points of the 'knowledge-intensive services' category) would be classified as manufacturing rather than services.

Exhibit 27 Distribution of FFF Projects by Industrial Sector, 1995-2003

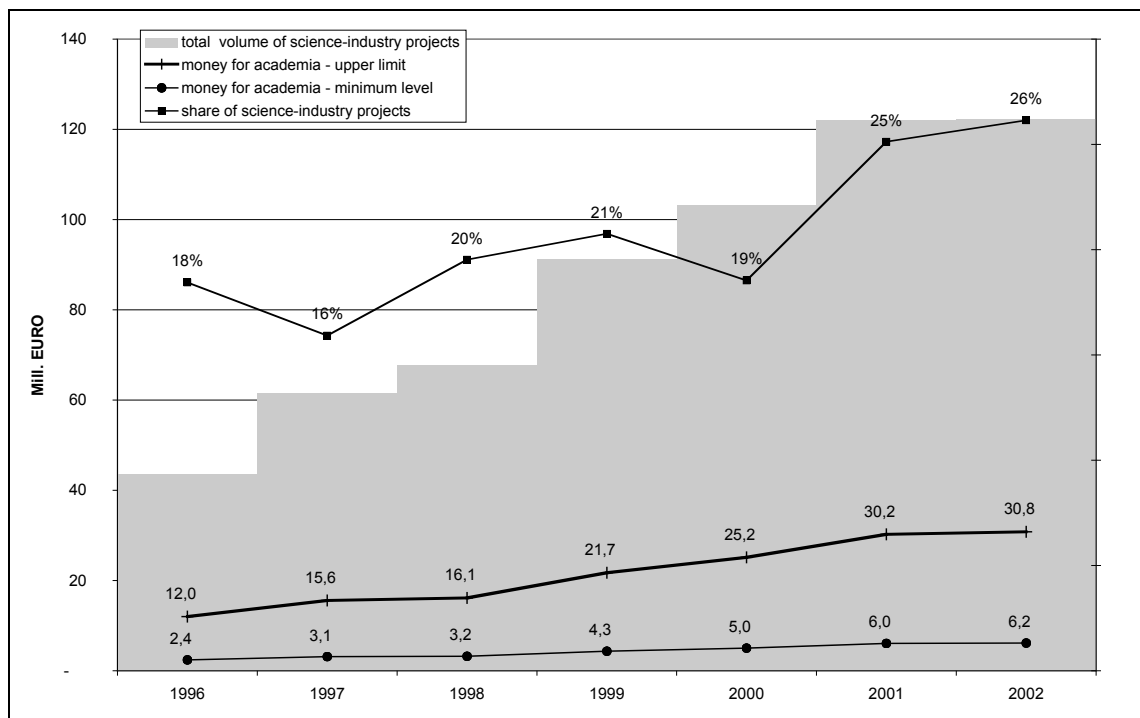


Source: FFF data, Joanneum / WIFO / KOF analysis

At the more disaggregated level of individual NACE branch codes, the greatest number of projects (20 %) are *computer-related* projects (NACE 72), followed by NACE 29 (*machinery and equipment*; 16 %). The top 4 activities (which, besides the ones already mentioned, comprise *medical, precision, and optical instruments* and *chemicals and chemical products*, NACE 33 and 24) account for 52 % of all submitted projects. The average R&D intensity of companies supported by FFF is 5%, and this intensity was clearly rising in 2001 to 2002. These data suggest that FFF is selectively funding innovation-oriented companies. Correspondingly, it is not funding those companies who lack a certain level of technological capability, and who therefore cannot engage in R&D.

FFF statistics are not kept in a way that allows us to understand who its final beneficiaries are. It makes agreements with companies, which then function as 'prime contractors', so that the division of budget between the prime beneficiaries and any other companies and research-performing institutions is invisible to FFF. **Exhibit 28** shows the proportion and value of projects that involve an external scientific partner, and the likely range within which the funding for these partners falls: namely, between the 20% of the project subsidy that, according to FFF's rules, must be passed to the scientific partner and the whole of the PV of the subsidy – at which point, the company would itself not take any cash out of the project funding.

Exhibit 28: FFF Funding of Science-Industry Projects



Source: FFF, own calculations and estimates

On average, FFF provides funding to its beneficiaries, equivalent to about 45% of project costs. However, since about half of this is in the form of loans rather than grants, the mean present value⁴² (PV) of FFF funding is 20-23% of project costs. The inherent assumption is that innovation by the beneficiary firms in, in general, inhibited both by lack of free cash and by their perceptions that innovation projects are risky. The fact that neither the cash nor loan component of FFF funding is especially large as a proportion of total cost, also suggests that these constraints are not seen as very severe overall.

Disaggregating the pattern of loans and grants, however, shows that FFF treats different categories of beneficiaries in a more differentiated way. It tackles riskier situations by granting more cash – in particular, to SMEs (which are typically cash-constrained) and to smaller projects under 50K€, which receive an average PV of 47% of their costs in cash. In contrast, large firms and large projects of 500K€ upwards, receive a present value of only 20% of their costs.

The ‘typical’ beneficiary firm applies repeatedly for funding: on average, in 1995 to 2003, each firm applied 2.8 times. However, this average hides huge variability: 1622 (52%) of the 3138 firms applying did so once only. 75% of firms applying did so only once or twice. On the other hand, there are clearly also some ‘usual suspects’ in the system. 39 firms submitted more than 20 applications (one firm even managed 110 proposals). Large firms apply more often than small ones, ask for more money per project and are more likely to be funded – though the PV of the funding provided

⁴² That is, the amount of cash FFF provides less the (discounted) value of the capital and interest that have in the future to be repaid

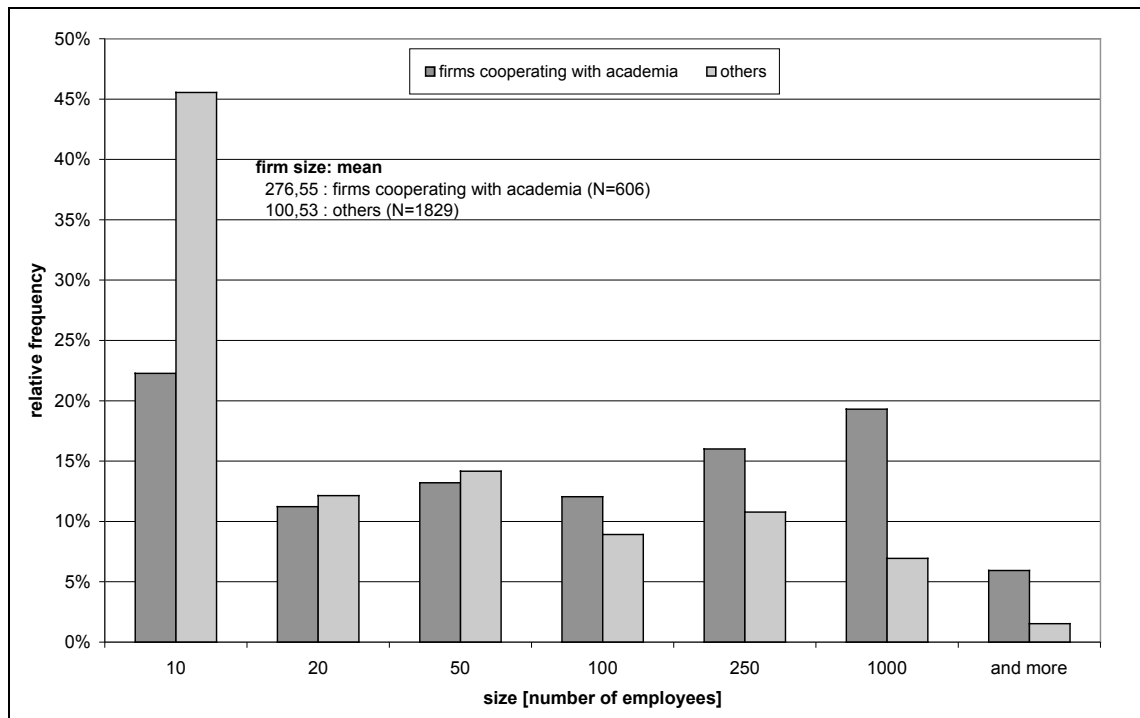
will be a smaller proportion of project cost, compared with that offered to small firms. Single applications, on average, amount to € 130 000; at firms with more than 20 submissions, the average project size is almost € 950 000. The largest firms (which are also those with the highest export rates) face above-average approval rates of 80 % vs. 75 % for all projects (although firms with 4 to 20 applications experience even higher rates). The lowest approval rate, at 55 %, is experienced by firms with single applications. In other words, experience and size matter in winning FFF projects.

These patterns are consistent with the idea that FFF essentially has a single principle for deciding whether to support projects: namely, whether they are likely to lead to commercial success. A second principle then comes into play to decide on the way the project will be funded, with the strongest receiving the least cash, and the weaker and more riskier situations being handled using a higher proportion of cash in order to compensate for the risks.

In a North European perspective, this funding pattern is unusual. It follows general practice in focusing grants on smaller companies whose high-potential innovation ideas will be blocked by market failures, risk and poor access to resources. It is less usual to devote significant innovation subsidy resources to the high-potential internal projects of large and well-resourced companies. While such firms do receive innovation funding, it is more typically provided in cases where the state-funded part of a project is performed in the knowledge infrastructure, or is in some other way connected with achieving externalities – for example, through developing the capabilities of firms in their supply chains. Increasingly, too, the R&D funding for larger firms focuses on more fundamental types of research than they would normally contemplate. In this way, foreign agencies will typically treat small and large firms differently, focusing resources on the different kinds of market and systems failures they respectively experience.

The way FFF maintains statistics means that we cannot say how much FFF money goes to the knowledge infrastructure. **Exhibit 29** shows that the larger the firm receiving funding, the more likely it is that some of that money will end up in the research sector, hopefully strengthening the capabilities of both sides. Correspondingly, there is also quite a big proportion of large firms that are subsidised to do internal R&D and innovation projects.

Exhibit 29: Science-Industry Relation, Size of Co-operating Firms



Source: FFF data; Technopolis / Joanneum analysis

Many small firms, however – including many that are so small that they must be start-ups – also receive support for projects that have an academic component.

Internationally, R&D and innovation funding agencies have significantly increased the share of their budgets devoted to **groups** or networks of beneficiaries during the 1990s. In part, this responds to the growing importance of the idea of National Innovation Systems in shaping policy. In part, it amounts to a growing perception that the leverage for beneficiaries is potentially high: rather than typically paying half the cost of a subsidised project, membership of a larger group means that for a much smaller proportion of project cost they can access the results from quite large number of organisations' work. Our survey suggests that the companies doing the projects are quite well networked⁴³. Just over half (52%) of the project ideas were conceived together with organisations outside the firm. About as many (50%) were conducted with help from research institutions or involved working together with other firms (55%).

4.6 Additionality

We have, in this evaluation, devoted considerable effort to estimating the 'input additionality' associated with FFF funding: that is, the amount of extra R&D effort that beneficiaries conduct, because they receive subsidy. In principle, beneficiaries could

- spend the entire subsidy they receive on additional R&D
- pocket the subsidy and do no more R&D that they would in any case have done (in which the subsidy would go straight to the shareholders in the form of profits)

⁴³ see Schibany et al, Table 20

- spend the whole subsidy on R&D, and add additional resources of their own. In general, this is what is happening
- or take up an intermediate position between these extremes

Based on a series of regression analyses on a sub-sample of projects and FFF beneficiaries, our surveys and calculations suggest that FFF's regular customers spend about € 1.40 on R&D for every € they receive in subsidy⁴⁴. We took no account of any complementary funding provided by the taxpayer. Seven of the nine Länder use European Structural Funds to top up FFF grants by varying percentages, which range from 7% of project cost in the Tirol to whatever is needed to bring the subsidy up to the maximum allowed under EU rules in Carinthia. The total value of these supplements in 2002 was 14.857 M€, compared to a total cash value of FFF funding in those Länder of 63.029 M€ in the same year. Taking account of these additional public funds in the seven Länder, the amount of input additionality is substantially reduced, so that 1 € of taxpayers' money triggers € 1.13 in additional R&D. In the hypothetical case of an 'average' project receiving a PV of 23% of its costs in subsidy from FFF, a supplement of 10% via the Land would be enough to eliminate the input additionality.

However, we are convinced that our results on input additionality are unduly pessimistic. A crucial problem in our analysis is that, in order to generate the data we needed, we effectively excluded the more occasional users of FFF funds and focused on the 'usual suspects' who come back repeatedly for more. (This was the only way to get hold of the time series data we needed about company activities and performance that would let us make additionality calculations.) In doing so, we have almost certainly focused on the low additionality situations. It is precisely the smaller, younger companies facing riskier situations and where project funding will be a large fraction of R&D investment that we would expect the biggest additionality.

We found some circumstantial evidence for this view. Some of the companies in the sample performed R&D only part of the time. We estimate that these firms spent € 1.56 on R&D for every € provided by the Federal government. It seems reasonable to suppose that, for companies that did R&D less frequently, the input additionality is higher. Our questionnaires to FFF beneficiaries also clearly indicated that the smallest firms were the most dependent upon FFF subsidy to perform R&D projects.

Interestingly, it is not the largest companies but those in the range 100 – 250 employees whose are least affected by whether FFF funds their projects or not. Very large firms generally have a large supply of alternative projects at any time, so FFF funding may be more decisive for **which** project gets done, rather than for whether any R&D is done at all.

While it is interesting to know that subsidies encourage companies to spend more of their own money on R&D, it is perhaps more important to understand whether anything useful happens as a result. We were able to calculate that increments to both subsidies and to private spending on R&D by the firms concerned lead to increases in

⁴⁴ There is a quite wide range of uncertainty around this number. The rather technical reasons for this, together with the methods of survey and calculation, are discussed in detail in the background report by Andreas Schibany et al, *Evaluation of FFF Funding for Industrial R&D*, Joanneum, WIFO and KOF, 2004

labour productivity. We estimate that an increase of 10% in the ratio of R&D subsidy to sales would lead to an increase of 0.5% in labour productivity, so the effects of public subsidy can be quite important.

Our survey suggests that just under a third of firms cancel projects if FFF rejects their application for funding. But the loss of funding generally makes it more difficult to do the project. Of the two thirds of firms that carry on with projects without FFF funding⁴⁵

- 32 – 43% delay the start of the project
- 51 – 61% do the project over a longer period of time
- 60 – 74% reduce the size of the project
- 40 – 49% make the project less technically ambitious
- 63% get the results of the project later than originally planned

In other words, the effects of FFF funding are in about one third of cases to make the projects possible. In other cases, the subsidy helps firms deal with bigger technical risks and get faster to market. Some 15 – 22% of the firms that carry on with projects claim that the project remains unchanged. This means that 10 – 15% of the firms whose projects were rejected were attempting to ‘free ride’ on the FFF subsidy: that is, to take the subsidy and translate it directly into increased profit. We cannot, of course, know what proportion of the **funded** projects involve free riding.

Some aspects of the projects allowed companies to learn, in the sense that their capabilities increased (over and above any new knowledge the got from the projects). Just under one third said that the project allowed them to build new research networks. There was a small but positive effect of subsidy on the employment of R&D staff, and therefore on companies’ future ability both to specify and to do R&D and innovation projects. (This seemed to be important for small firms, while FFF funding appeared to have no effect on whether large companies hired more R&D personnel. Again, we are here limited by lack of time-series data on the companies that have only a small amount of interaction with FFF – and where this effect is most likely to occur.)

4.7 Characteristics of FFF-Funded Projects

FFF funded projects typically aimed to create new or improved products (just over half the cases – 54%) or processes (just over a quarter – 27%). In two thirds (67%) of the cases, this was intended to lead to the opening of a new market, and about the same proportion (65%) expected the new product or process to be on the market within two years of the project finishing.

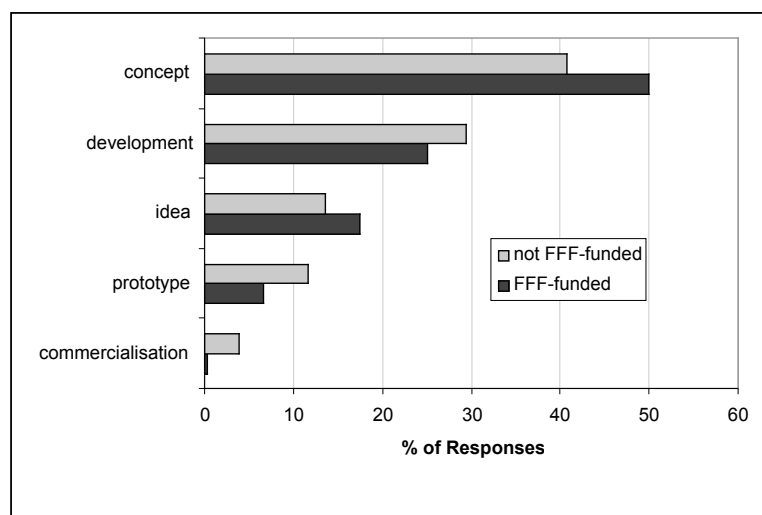
Our survey of FFF beneficiary firms shows that the most important reason for seeking subsidy is the high cost of R&D (85% of firms say this is important), ahead of technical risk (which 66% of firms said was important). Small firms saw cost as an especially important barrier, while for large firms risk was more important. Over two-thirds (71%) of firms said that FFF-funded projects let them extend their R&D into new fields.

⁴⁵ see Schibany et al, Table 19

57% of firms said their project involved co-operation with external research organisations. Small firms were less likely to work with external research organisations, while 71% of firms employing over 250 people did so. These large firms' projects were more oriented towards fundamental research issues than their normal R&D projects, while for other size categories there was no difference in the nature of the work between FFF-funded projects and other R&D projects. FFF projects were, however, typically bigger, more technologically difficult and longer than in-house projects. Like the companies' views on additionality, this confirms that firms feel FFF helps them to 'push the envelope' beyond their normal type of R&D activity.

As **Exhibit 30** shows, the closer a project is to market, the less likely it is to receive funding.

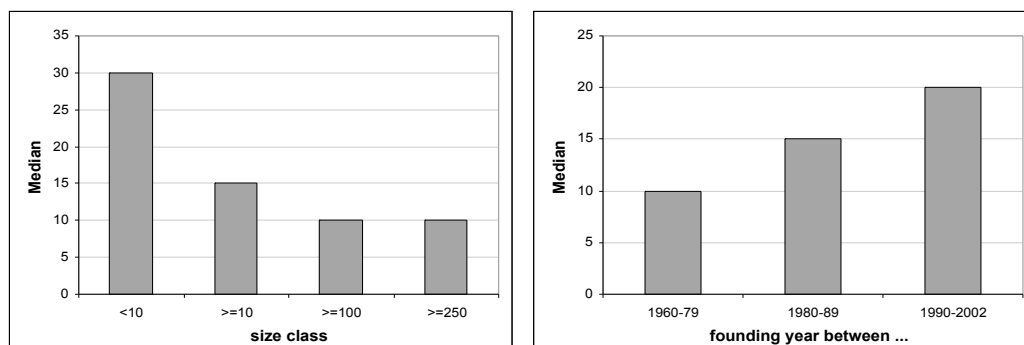
Exhibit 30 Proportion of Projects Funded at Different Development Stages



Basis: All respondents to company survey

However, our questions about past product innovation showed that FFF funding could have a dramatic effect on young and small firms, as **Exhibit 31** illustrates by showing the proportion of their last year's turnover that they attribute to FFF-funded new products.

Exhibit 31 Share of FFF-Funded New Products in Company Turnover



These messages from the company survey tend to contradict the impression we obtained from the FFF assessment scheme that, overall, FFF was rather risk-averse in its project selection and that there was not necessarily a great deal of increase in technological capabilities being produced through the funding. Taken together, the two sources suggest that

- In many cases, FFF funded projects represent a step towards riskier projects **for the individual firm**, irrespective of whether the projects are risky in a more ‘objective’ sense
- Among smaller and younger firms, FFF projects can have a dramatic effect on the development of new products and processes, and therefore upon the survival rate of the firms
- FFF to some extent follows international practice in connecting innovation projects of the larger beneficiaries with more fundamental R&D activities in the knowledge infrastructure – though this seems to be a less important part of FFF’s practice than is the case in equivalent foreign agencies
- Similarly, FFF is promoting networked forms of innovation, but again probably to a lesser extent – and certainly in a less explicit way – than agencies abroad

All these positive effects are, however, achieved by the intelligent use of a general funding instrument that aims primarily at funding ‘good’ (low-risk, commercially high-probability) projects. Failure to adapt the instrument so as to make these newer kinds of goals, such as science-industry linkage and networking, explicit, probably means that FFF reaches these aims less effectively than its foreign counterparts, which are more explicit in the way they design and use instruments.

4.8 FFF: Views of the Peer Panel

As part of this evaluation, FFF was visited by a review panel made up of senior innovation funding managers and practitioners. The panel’s report is available as a free-standing document. In summary, its findings and conclusions were as follows.

FFF was established in the 1960s as a new type of funding organisation, with an independent status that guaranteed its freedom from political or bureaucratic interference in the detail of project funding decisions. Its role was the ‘bottom-up’ funding of proposals from companies that wanted industrial innovation support. The Fund’s significant strengths today reflect this central mission. The panel views FFF as having performed its historical mission well and as a cornerstone of the needed modernised system.

In the meantime, needs and practices in industrial innovation funding have changed. Both FFF and the wider system within which it operates need to change in order to reflect the new circumstances such as the increased importance of industry/university interaction. A more holistic approach to the innovation system is needed, guided by a clearer national strategy and with a wider and more modern range of instruments at its disposal.

The panel encouraged FFF to develop a longer-term vision (FFF 2010). FFF is in transition from a model of supporting individual projects to a far more holistic

approach, dealing with the future requirements of industrial R & D, innovation and renewal of the Austrian economy. This will involve

- A balance of bottom-up / top-down strategies
- Overcoming the internal fragmentation of current programmes
- More proactive and stronger programme management
- New instruments and incentives (instead of ‘help’) for firms to invest more in R&D, innovation and renewal, reflecting the interplay of research, technology, marketing, production, work-force and management
- Far more focus on all kinds of integrative efforts such as integration of different technologies, production and services, basic and applied research, new and old economy, technology / organisation / qualification and so on. Part of this will involve increasingly funding networks and clusters of beneficiaries, and not just single companies
- New project evaluation and selection procedures, adapted to the new instruments
- Developing and implementing new roles for FFF (beside funding), with the Fund acting as moderator, networker, trust developer, platform for programme planning and policy discourse
- Adopting new information tools such as foresight, benchmarking, evaluation, programme design and development
- Introduction of long-term budgeting, because multi-annual financial stability is a key requirement for a modern R & D and innovation support management
- Involvement in programme design as early as possible

Special measures are needed to tackle the increasing need to link innovation with science and technology. Especially in relation to larger firms and larger projects, there is a growing need to develop new instruments that can forge this link.

Because FFF is already in transition, it already practises some aspects of such a new approach. The core competence of FFF is – and should be – to be a funding management organisation. In developing this competence, it has evolved admirable and very ‘hands on’ processes for reviewing not only project proposals but also the companies making them. This is very important, in so far as innovation projects more often fail as a result of managerial and commercial than technological factors. FFF has the potential to become a modern, proactive and problem-oriented fund, which is able to act in the way described by the panel. This is why the panel was convinced that the development of a longer-term vision is a helpful step to reach this aim.

Implementing the panel’s suggestions would involve increased empowerment of staff, the addition of analytic capabilities (sometimes referred to as ‘strategic intelligence’) and modernisation of the internal governance structures. In particular, the presidium should focus more on strategic issues and delegate day-to-day decisions to the staff. Human resource policy will need to take account of the skills needed in strategic intelligence and in strong programme management functions. Some of the skills needed may be obtained by bringing in people from industry for a period to manage particular programmes, in the expectation that they would then leave FFF again at the end of the relevant programme.

4.9 FFF Conclusions

We conclude that, while FFF's design and autonomous status was a useful and radical innovation in the 1960s, the Fund needs to evolve, in order to deal with the changing needs of the national research and innovation system. Most of the innovation in the Austrian innovation funding system has taken place outside FFF, which has remained largely 'locked in' to its old role, not least through the dominant influence of the 'social partners' and the need to provide equal opportunities to all to obtain subsidy. In so far as FFF has begun to administer R&D programmes on behalf of ministries, it has begun to broaden its capabilities, but this also means that FFF is simultaneously subject to different governance mechanisms for different tasks.

FFF has proved to be a fast and effective deliverer of its 'core mission': namely, 'bottom-up' funding of company-based R&D subsidy projects. It has well-established methods and processes for doing this. Both the methods and the process are core to FFF's culture, the way it defines itself and its mission and to the way it trains people. While FFF's staff operates efficiently, resulting in low financial costs of administration, the process is wasteful in that it uses a great deal of unpaid time in the governing committees.

Despite the opportunities provided by its legal basis, FFF has not developed a prospective role or the internal 'strategic intelligence' needed to undertake significant problem analysis and programme development. Correspondingly, FFF has been unable to have anything but a reactive strategy, in response to the changing needs of its customers in the ministries.

FFF has chosen to fund its ongoing activities through deficit financing – in effect borrowing against future income to offset volatility in its allocations from the government budget and fund current projects. This is not an appropriate way for a state agency to operate. FFF needs some degree of budget predictability, in order to strategise and operate effectively.

It is clear that FFF subsidy brings significant value to the Fund's beneficiaries. It prompts companies to perform additional R&D. In a third of the cases, it allows projects to be performed that would otherwise not have been undertaken, and in most of the remaining cases it allows projects to be bigger, quicker and to take more technical risks than would otherwise be the case, allowing companies faster to bring improved products and processes to market. On average, however, projects do not take especially high technical risks, and this is consistent with the rather modest value of the average subsidy provided. The increment to the amount of technological risk and technical challenge that the individual firm is able to take on can be more important than this low overall level of risk-taking would suggest. The projects certainly lead to increases in productivity and to small increases in the employment of R&D personnel. Some of these projects play a role in discussions with multinational companies about whether they conduct R&D in Austria. But, overall, FFF appears to us overly risk-averse. This aversion is embedded in its assessment criteria, which inherently provide a way to find good projects in good companies where the internal rates of return are likely to be high – exactly those where the market failure arguments for subsidy are weakest, and where externalities are likely to be somewhat limited.

The large short run effects of FFF subsidy occur when it is funding small firms. Here, the Fund can enable significant and lasting changes in both the rate of innovation and innovation capabilities. But we can see no reason why the passive ‘top-up’ funding provided by most of the Länder should improve the effectiveness or additionality of FFF funding. These resources could more usefully be devoted to schemes that address the need to help companies build a certain level of technological and managerial capability – providing the ‘absorptive capacity’ required to conduct R&D projects (with or without FFF subsidies).

We recommend as follows

Funding principles

- The idea that FFF funding is somehow a ‘reward’ to good firms for doing good projects needs to be eradicated. The market already does an adequate job, in this respect. FFF should reorient itself to tackling market and systems failures relating to innovation
- FFF should therefore undertake – with its parent ministry – a fundamental review of its funding principles, with a view to moving away from funding low-additionality projects and increasing the technical risks it enables its beneficiaries to take. This will apply especially in relation to medium and large companies, and should increasingly allow these companies to apply more radically new types of knowledge, through improved interaction with the knowledge infrastructure
- FFF should separate its use of grants and loans, using grants to tackle risk averseness and the need for learning among firms, and loans to combat risk-version in the capital markets. This implies abolishing the 50% limit to the proportion of project costs to which the Fund is prepared to contribute

Instruments

- FFF should also increasingly devise and use new instruments to build company capabilities, so that learning (‘behavioural additionality’) amongst beneficiaries is increased across FFF’s range of activities

Processes

- FFF should review its project assessment procedures in the light of changing needs and of the differing needs of different market segments, and seek to simplify them, while taking care of the considerable intellectual capital that they represent
- FFF should improve the feedback it gives to rejected project proposers, and introduce other measures to use its intellectual capital to help companies themselves identify and address innovation opportunities

Organisation and capabilities

- FFF should exploit its closeness to industrial reality to develop and build more prospective capabilities and the ability to design programmes (strategic intelligence), which may be offered to its parent ministry as inputs to policy formulation
- Given such increased capabilities, FFF should develop a medium-long term vision and plan, to guide its activities and link them to national research and innovation strategy

- FFF has the potential to provide programme implementation and management services to multiple principals, exploiting its intellectual capital and process synergies, where applicable. In order to do this, it needs to enhance its programme management capabilities and provide clear ways of interfacing with such customers

Finances

- The scope of FFF's budget should be set in advance for a longer period of time. This implies increasing the share of regular financial contributions from the main financing bodies and reducing the exposure of FFF to financial inflows from temporary sources
- A longer-term strategy developed by FFF would form a useful basis for planning financial expectations with FFF's parent ministry, and should be used by both to increase mutual ability to plan over periods longer than one year
- Financial flexibility using credit capital is valuable as long it remains at relatively low levels. The observed exposure to credit capital is too high and causes significant costs at the expense of resources available for project funding. It should be reduced. Limits for future budgeting are needed
- Currently the budget available for project funding is not linked to the selection process or decisions about funding intensity. Thus, budgeting is mostly demand driven. Under these circumstances, allocation of overall budgets among different funding instruments remains difficult. Mechanisms should therefore be put in place that link project funding processes with the overall available budget
- FFF's capabilities and its range of instruments need to be increased. Since FFF will then be delivering more, the parent ministry should accept that this will involve a modest increase in administrative costs

Governance

- Governance mechanisms should be streamlined, so that the professional staff can take responsibility for more of the operational decisions, while ensuring that there is adequate steering and oversight
- Recognising that FFF distributes taxpayers' money for social ends, the balance of power in its governance structure should be changed so that more representatives of the taxpayers and not the beneficiaries have control. This includes various representatives of other parts of the national innovation system, not least the scientific community. The role of the governing committees should be strategic and advisory. They should therefore not be involved in detailed operational decisions, especially not in respect of project funding
- Ministries are the paymasters – in effect, the real **customers** – of agencies such as FFF. The relationship between FFF and the ministries should involve a clear performance contract, against which FFF's performance is annually reviewed. While there is every reason for FFF and the ministries to maintain close contact, the ministries' role in its governance should not go beyond this. Thus, while for the sake of good communications, the ministries should be represented in FFF's Board, their representatives should not have voting rights. They already hold the purse strings

5 The Austrian Science Fund – FWF

In many ways FWF is an organisation of and for the Austrian scientific community, and in its profile and publications it puts strong emphasis on this characteristic. The Board of the organisation consists of scientists; the other organs of governance consist mainly of representatives of scientific organisations; and its main process - the peer review of proposals and allocation of research funds - is run mainly by researchers.

5.1 Description of FWF

The Research Promotion Act of 1967⁴⁶ specifies that FWF's tasks are to

- Fund non-profit oriented research that will develop science in Austria, while taking into account the research strategy of the government
- Inform the public about the importance of science and disseminate the results of the research it funds
- Administer its budget and report annually to the responsible minister

Currently, in the words of its own mission statement “*The FWF (Austrian Science Fund) is Austria's central body for the promotion of basic research. We invest in new ideas that contribute to an advance in knowledge and thereby to further developments. We are equally committed to all branches of science and the humanities and are guided in our operations solely by the standards of the international scientific community.*”

FWF's corporate policy (**Exhibit 32**) formulated in 2002 elaborates this mission in terms of the Fund's responsibilities, aims, values and working procedures. **Exhibit 33** shows the governance structure of FWF, and the numbers of people involved in each function. The highest body – the assembly of delegates – meets only annually. It appoints the executive board to run the Fund day to day, and has a sub-committee – the Kuratorium – which makes funding decisions. In order to deal with the volume of applications, the executive board appoints referees, who obtain judgements of scientific quality from foreign scientific peers for each proposal, and advise the Kuratorium on the fundability of each proposed project. The secretary general and the administration report to the FWF President, who heads the executive board.

⁴⁶ Paragraphs 2, 4 and 18 – summarised here

Exhibit 32 FWF Corporate Policy

“We strengthen the science and the humanities in Austria”

Our mission:

The FWF (Austrian Science Fund) is Austria’s central body for the promotion of basic research. We invest in new ideas that contribute to an advance in knowledge and thereby to further developments. We are equally committed to all branches of science and the humanities and are guided in our operations solely by the standards of the international scientific community.

Our **responsibilities** are the promotion of:

High-quality scientific research, which represents a significant contribution to society, culture and the economy.

Education and training through research, because support for young scientists represents one of the most important investments in the future.

Knowledge transfer and the establishment of a science-friendly culture via an exchange between science and other areas of society.

Our **aims** are:

A continued improvement of science in Austria and an increasing of its international competitiveness.

An enhancement of the qualifications of young scientists.

A strengthening of the awareness that science represents a significant aspect of our culture.

Our **values** are:

Excellence: progress in science requires the best minds. We thus concentrate our funds on projects that are of internationally recognized quality.

Independence: creative research requires scientific independence. We provide the freedom to protect science from the direct influence of politics and vested interests.

Transparency and fairness: trust in our working procedures is our most important commodity. We ensure that conflicts of interest are avoided and give clear information on our working procedures and the criteria on which our funding decisions are based.

Integration: Science is part of modern society. We facilitate cooperation across national borders and consider ourselves to be part of the international scientific community.

Our **working procedures** are based upon:

Assessing the quality of research solely by means of international standards.

Treating all scientific disciplines equally.

Paying attention to the observance of the rules of good scientific practice and of internationally accepted ethical standards

Holding an open dialogue with all interested groups.

Cooperating to help network different branches of society and to improve the cooperation with the economic sector

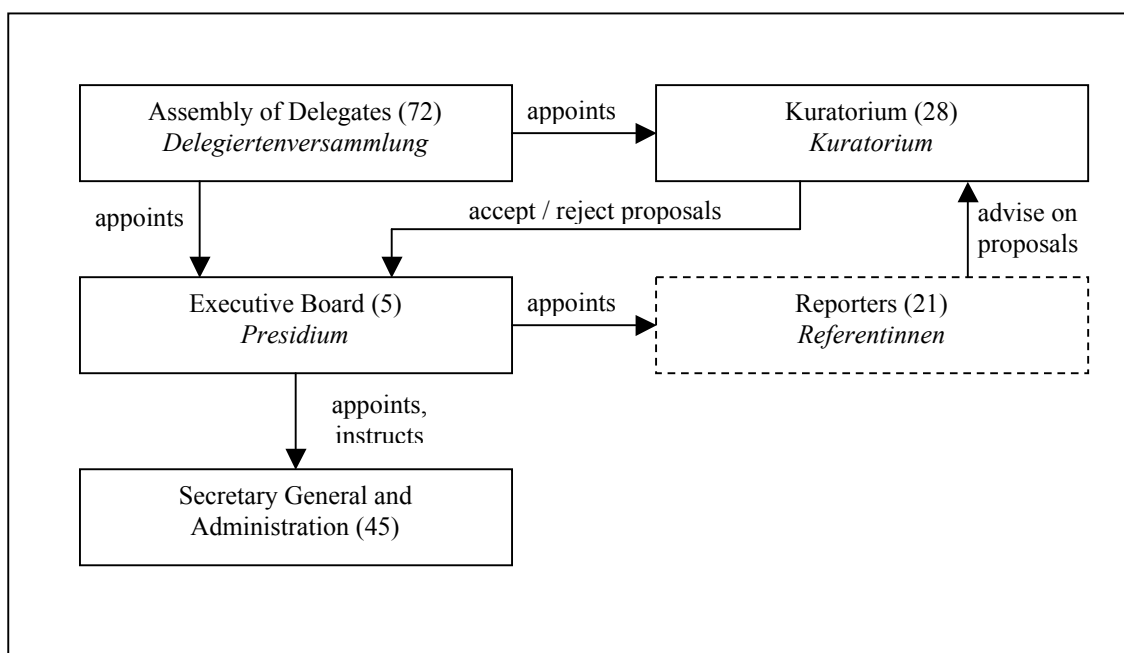
Applying a range of different funding instruments designed to take into account the varying requirements of research.

- Continuously monitoring our operating procedures and instruments and their developments.
- Handling the finances entrusted to us efficiently and unbureaucratically.

We see ourselves as a service organization and our work as directed to helping science in Austria.

*FWF Corporate Policy; 18-11-2002

Exhibit 33 Governance of FWF



The Assembly of Delegates consists of representatives of the faculties of the universities, social partners (minority) and government and FFF (non-voting). It is responsible for the Annual Report, the Financial report and budget, and appoints the Board and the *Kuratorium*.

Exhibit 34 Membership of the Assembly of Delegates

Membership of the <i>Delegiertenversammlung</i>	
Voting Members (except FWF Board)	62
From the 18 Universities	50
From the Austrian Academy of Sciences	2
Social partners *)	6
Scientific Institutes	2
Non university Institutes	2
FWF Board	5
Non voting members (BMBWK, BMVIT, BMF, 2 FFF)	5
Total	72

*) Representatives of employees and employer organisations ('social partners').

The *Kuratorium*, consists of representatives of the universities, social partners, the government and FFF (non-voting). It decides about all matters concerning research funding, including the final decision in the selection procedure. Its decisions are prepared by the Reporters who manage the peer review procedure for the FWF. The *Kuratorium* meets six times a year in two-day sessions, during which most of the allocation decisions are made.

Exhibit 35 Membership of the Kuratorium

Membership of the Kuratorium	
One representative of each university (including universities of arts, etc)	14
A representative of the Austrian Academy of Sciences	1
Scientific institutes	1
Non-university research institutes	1
Social partners	6
Total of those with voting rights	23
Those without voting rights (BMVIT, BMBWK, BMF, 2 FFF)	5
Total	27

The Executive Board consists of the President of the FWF, two vice presidents; the president of the Austrian Academy of Sciences (OeAW) and the president of the *RektorenKonferenz*. The latter two are members of the Board ex officio. The President and vice-presidents are elected by the Assembly of Delegates, based on the recommendations of a search committee.

There is a fourth group of 21 scientists, the Reporters, involved in the governance. They are not part of the official structure, but play a key role in the review process and allocation decisions. They sit at the Kuratorium meetings as advisors and prepare the decisions on funding of proposals. The reporters are either members of the Assembly of Delegates or their deputies. The majority of them are also voting members of the Kuratorium, and the others are co-opted as non-voting members. Formally, they are appointed by the Executive Board, but there is no clear selection procedure. As a group they have to cover all disciplines in order to be able to handle the broad range of scientific areas in which applications may fall. Some overlaps are needed to handle possible conflicts of interest. The group has also to be balanced in terms of universities, faculties and regions. De facto this implies that if a Reporter resigns she will be succeeded by someone with a similar profile.

FWF has a small staff of 45 employees, of which 11 are scientific staff, who have come into the FWF after a scientific career up to post doc level. The scientific staff was introduced in 1994 to support the Reporters in scientific matters. But compared to peer review processes in other research councils, staff play a marginal role in terms of selection of reviewers and interpretation of the reviews. Some of the scientific staff have taken on management responsibilities for non-scientific, organisational tasks and have initiated strategic discussions.

The administration of the organisation is divided three departments (Bereiche). The largest, “Fachliche Angelegenheiten der Forschungsförderung” manages the research projects and all funding programmes except for FWF’s role in selecting peer reviewers for TIG’s *Kplus* programme. This activity is formally run by the department on “Spezielle Angelegenheiten der Forschungsförderung”, but the two staff members responsible for it, are also within the first department. The second department on *Spezielle Angelegenheiten der Forschungsförderung* is a small department of 4-5 real staff, responsible for the external relations and includes the special work groups of which the members have their main tasks in the other departments. The third department is responsible for finances, law, statistics and personnel. Though most members of staff work in one of the departments, at the

level of the heads of departments and sections the organisation is partly a matrix, in which responsibility for specific scientific disciplines is combined with responsibilities for administrative matters. The matrix implies that most of the strategic issues, such as internal affairs, evaluation, statistics, public relations are headed by scientific staff members. The combination of disciplinary responsibilities for proposals and projects as well as for other organisational affairs is seen as an asset by the staff but will not be viable if FWF grows.

The internal organisation is complex for a small organisation but is workable because of the size and collegial culture. If in future the role of FWF expands beyond its current focus on 'basic' research, it will be necessary to expand the sections on Wissenschaft/Wirtschaft as well as the Working Groups (including the ad hoc ones) that work on strategic issues and the capacities for handling international affairs. At present, FWF's staff capacity is too small if it wants to play a significant role in the European Research Area and in the interaction of science and society (which embraces more than the cultural value of science).

FWF has very little structure or capability for interacting with society and has no strategy for dealing with this. Its role in relation to the public is small, and limited to publicising scientific achievements in the 'Public Understanding of Science' tradition. Most research funders are now moving to a 'science communications' paradigm, where the relation between funders and citizens is more interactive.

More broadly, FWF's structure is highly focused on its historical core task of evaluating and funding research proposals. Most research councils have increasingly taken on some level of responsibility for the health of the scientific research system, in two respects. First, they tend increasingly to monitor and act in relation to ageing and renewal of the research population and gender balance. Here FWF has launched a number of activities. Second, they increasingly tackle renewal and strengthening of important fields or emerging research areas. In this respect, FWF does comparatively little (and uses instruments such as SFBs, which are essentially **reactive**). FWF organisationally lacks the capacity ('strategic intelligence') to devise strategies in these areas, and its governance structure is one, which does not grant legitimacy to such activities. There are no structures or routines within FWF that are able to react to the government's research strategy. For most of FWF's history this has not mattered: it can scarcely be said that governments have had such a strategy. However, since the creation of the Austrian Council, it seems at least possible that such strategy will be developed, and FWF will need means to accommodate to it.

Most of FWF's co-operation with other bodies is in the form of co-operation with ministries and other national agencies. The extent of delegation from ministries to FWF varies between instruments. For example, the START and Wittgenstein prizes involve much closer supervision than other funding activities. Not only FWF's own governance but its relations with the ministries therefore have potential for modernisation.

Because of fluctuations in the total budget it is difficult to give a stable figure for the percentage of administrative costs. In 2001 and 2002 the budget for administration and administrative costs of international cooperation was 3.2 and 3.5 M€ respectively, which in these years equals about 3% of the total budget. These costs do not include

the full costs of the work of the Reporters, and of the peer review system, which operates like most of the peer review processes in science on a professional quid pro quo basis. Compared to other councils, FWF is even compared to councils with similar missions efficient in this respect. Councils with broader missions like NWO, RCN and most of the UK councils need higher percentages of administrative costs.

Exhibit 36 Administrative Costs of Research Councils

Administrative costs of Research Councils		
Country	Research Council	% Administrative costs of total budget
Netherlands	NWO	7.3%
Norway	RCN	5%
		(8% outsourced tasks included)
UK	BBSRC	5%
	EPSRC	5.3%
	ESRC	5.4%
	MRC	3.5%
Sweden	Vetenskapsradet	7.7%
Belgium	FWO Vlaanderen	4.3%
Germany	DFG	3,6%

Source: Synthesis report RCN evaluation, websites

We can conclude that the governance structure of FWF is dominated by its beneficiaries, and that this (together with its ‘autonomous’ status) has been key in keeping the Fund independent of the Austrian political culture of ‘social partnership’. As FWF begins to react to the new role of the universities, and potentially to take into account strategies proposed by the Austrian Council, having a governance structure in which universities are **represented** will become problematic. Just as universities generally find it hard to set priorities because all faculties are represented in the governance, so FWF will suffer a similar lock-in by the university representatives. Options to tackle this include having the government appoint senior researchers **as individuals** or holding elections.

Any growth in FWF’s role will put the Reporter system under severe pressure and it will have to be professionalised. Scientific staff will need to play a bigger role in the project acquisition process.

FWF will need to be engaged in the developments in ERA, which remain unpredictable. Increased capacity will be required in order to deal with the Europeanisation process.

5.2 FWF Activities and Instruments

The main function of FWF is allocation of funding. In university systems with a ‘binary support’ funding, the function of research councils is not just to assure that the best research is funded, but also that it organises its allocation model in a way that it induces incentives for the whole system to develop. Three conditions must obtain for such a research council to operate well

- 1 The share of research council funding in total funding (that is the money available from research funders plus the research component of the General University Fund) must be big enough to have some ‘leverage’. As indicated in Chapter 2, this ratio is abnormally low in Austria
- 2 Competitive funding from the research council needs to be sufficiently attractive compared with institutional funding via the General University Fund to ensure that the quality control by the research council has ‘leverage’ over the system as a whole. Internationally, there is consensus (though no scientific evidence) that an acceptance rate of not much below 30% is needed to maintain this attractiveness, though this rate can be lower for individual attractive schemes (as low as 10%) for prizes or even lower for high-status awards
- 3 Funding needs to be open to ‘new players’, and avoid lock-in to funding only an established elite based on its strong track record

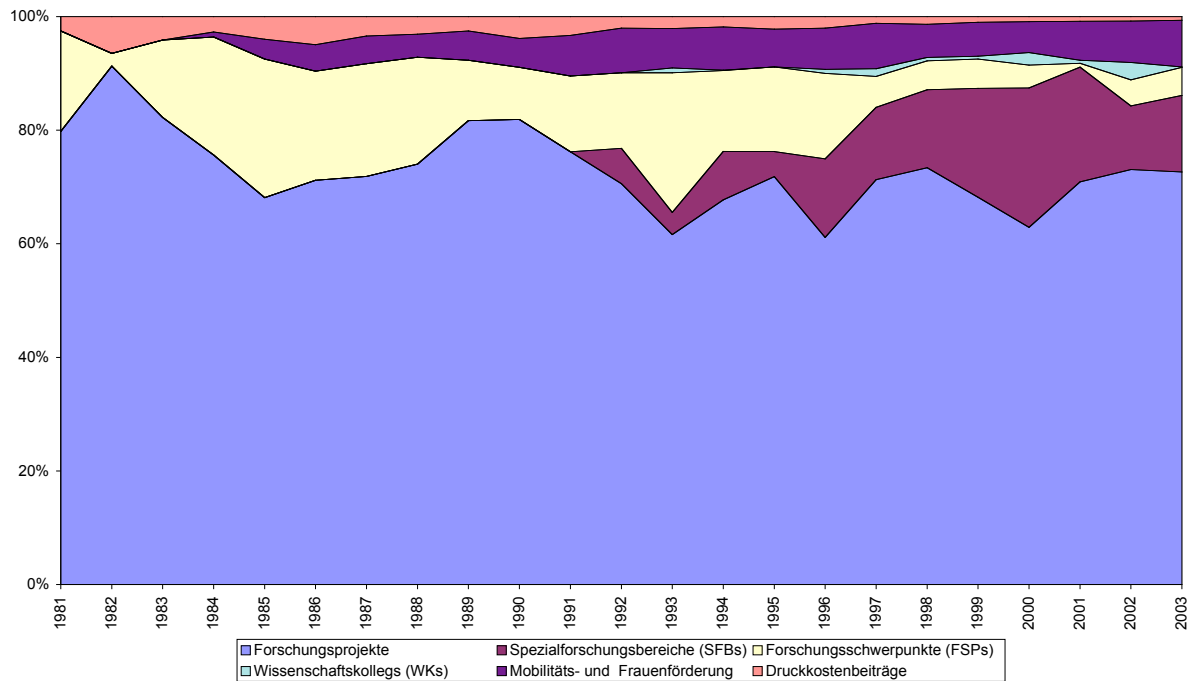
Most of FWF’s budget is allocated to individual research projects and research networks but the total funding portfolio is much broader. Until 1990 the funding portfolio of FWF consisted of Research projects, Joint Research Programmes (*Forschungsschwerpunkte*), Publication costs and the Schrödinger program. Since then, the number of funding schemes has increased substantially. This is in line with developments in some other countries, in which research councils also have broadened their funding portfolios. However, FWF has done so in a rather fragmented way.

Exhibit 37 Date of Introduction of FWF Programmes

Year	Program
1967	Forschungsprojekte; Druckkosten
1972	Forschungsschwerpunkte
1984	Erwin Schrödinger Stipendien
1992	Charlotte Bühler Stipendien; Lisse Meitner Stellen
1993	Spezialforschungsbereiche; Wissenschaftskollegs
1996	START; Wittgenstein
1997	Impulsprojekte
1998	Herta Firnberg Stellen
2000	Erwin Schrödinger Rückkehrstellen
	International Programmes: EUROCORES; EURYI Award; ERA-Net

This raises questions about the efficiency of having so many funding programmes, as well as whether there is a systematic strategy behind the development of this portfolio. We have not found such strategy, and FWF seems not to have the systematic “strategic intelligence” on the dynamics of the Austrian research system to develop a portfolio, which reflects a vision on the Austrian research system and identifies the needs for specific incentives. Instead the development of the portfolio seems to be a result of ideas for instruments raised ad hoc within the council and/or seen at sister organisations. For each instrument there has been consultation with relevant stakeholders, but there is no overall check on the appropriateness of the portfolio. Also lacking is a view on appropriate levels of funding for each of the categories within the portfolio – a matter on which FWF does not seem to have formally taken a view, arguing that these amounts are set by the funding ministry.

Exhibit 38 FWF Programmes



Source: FWF Annual Report, 2003

Exhibit 38 shows the relative importance of the different types of instruments in recent years. The ‘bottom-up’ project funding and the newer ‘network’ instruments dominate the portfolio. The result of the proliferation of instruments is shown in **Exhibit 39**.

Our analysis of the FWF database ⁴⁷ and the 4242 applications for projects and network funding indicates that the approval rate for large projects is substantially higher than for small projects. For very large grants this is not so much due to their size but to otherwise favourable conditions for the approval rate, viz. that they are from the Natural Sciences and coordinated by a professor. Since 1996 the average size of the grants has increased: FWF’s budget has risen, while the number of projects has gone down. However, FWF has a strong tendency to grant less than the whole sum requested. The average size of the applications for FWF funding is in the range of 175-210 k€ for the natural and engineering sciences, medicine and agriculture and around 150 k€ for social sciences and humanities. Such applications are on average cut by about 20% of the budget applied for. Larger proposals above 350 k€ face cuts of on average 35%.

⁴⁷ Joanneum Research, Evaluation of FWF funding for scientific research, Report this Evaluation.

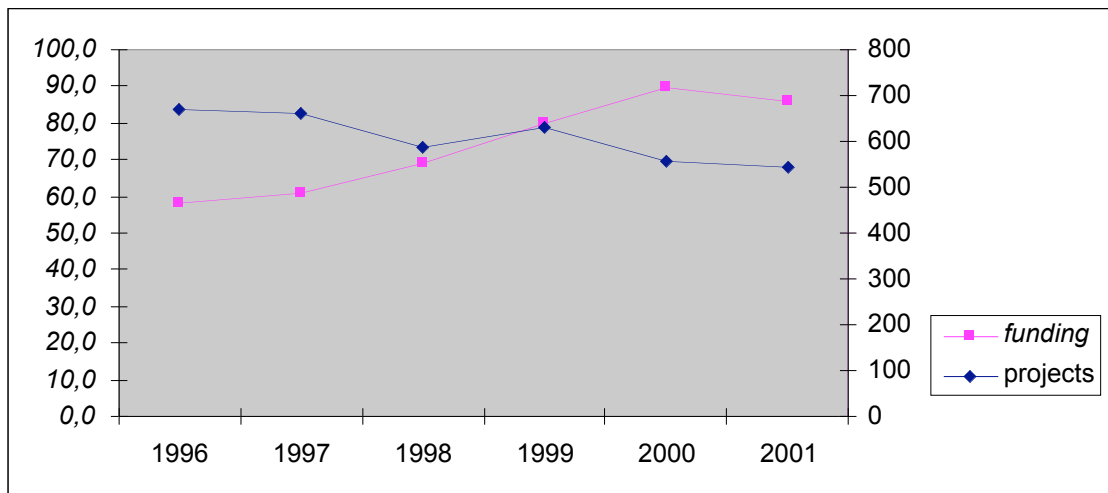
Exhibit 39 FWF's Current Instruments

Aims and objectives of FWF's funding categories		
	Target group	Objectives
Einzelprojektförderung	Scientists	Funding of excellent individual research projects not oriented at financial profit
Drückkosten	Scientists	Promotion of the publication of scientific work
Research Networks		
Forschungsschwerpunkte	Scientists at universities and public research institutes	Promotion of the establishment of "priority" research areas, by building up nation-wide research networks
Sonderforschungsbereiche	Groups of scientists of international standing at a university or research institutes	Establishment of extremely productive research centres at a single university for long-term and interdisciplinary research.
Graduate Programmes	Groups of excellent scientists collaborating within thematically defined framework;	Establishment of centers for the education of first-rate young scientists, in scientific areas where the productivity in Austria is exceptionally high.
International Mobility		
Schrödinger Fellowships	Young, highly qualified scientists under 35.	<ul style="list-style-type: none"> ▪ Promotion of scientific work at leading foreign research institutions ▪ Facilitation of access to new scientific areas and methods, to contribute - following return to Austria - to the further development of science in Austria
Schrödinger Follow up	Post-docs who have spent at least two years researching abroad and wish to return to an Austrian research institution but have no position	Facilitation of re-integration into the Austrian research career path following a stay abroad
Lise Meitner Program	Highly qualified scientists aged under 41, from abroad who want to work at an Austrian research institution.	<ul style="list-style-type: none"> ▪ Strengthening of the quality and the scientific know-how of the Austrian scientific community ▪ Creation of international contacts
Promotion of Women		
Hertha Firnberg program*	Highly qualified female scientists of any scientific discipline aged under 41	Improvement of the career prospects for women in universities
Charlotte Bühler Program	Highly qualified female scientists who are hoping to complete Habilitation	<ul style="list-style-type: none"> ▪ Promotion of future female university lecturers in Austria
Outstanding Researchers		
START*	Outstanding young researchers aged under 36	Long-term and extensive financial security to plan their research and to build up own research groups
Wittgenstein*	Outstanding researchers aged under 51.	To guarantee excellent researchers the greatest possible freedom and flexibility in the performance of their research
Cooperation with Industry		
Impulse Projects**	<ul style="list-style-type: none"> ▪ University graduates ▪ Austrian companies 	<ul style="list-style-type: none"> ▪ Improvement of knowledge transfer ▪ increasing the number of firms in Austria that perform R&D

*On behalf of the BMBWK

** On behalf of BMVIT, in cooperation with FF

Exhibit 40 Development of FWF Budget and Number of Projects



5.2.1 Individual Projects

This is FWF's core business, and its beneficiaries tend to see it as the most valuable role of FWF. By and large, these projects are parts of applicants' longer term research agendas. 80% of respondents to FWF's recent 'customer satisfaction' survey indicated that project ideas had existed for some time. Only 25% of approved proposals represent new research projects specially developed for FWF. Funded projects complement existing strengths of the university system. Broadly, then, the project funding allows the university system to reproduce itself in a quality-controlled manner, but plays little role in creating change. Correspondingly, we can see that big shifts in research direction – such as the strengthening of genomics represented by the GEN-AU programme cannot take place within the FWF structure.

5.2.2 Research networks

Between 1991 and 1994, two programmes for research networks were added, (1) the Special Research Programmes (*Spezialforschungsbereiche*), which funds interdisciplinary research programmes at a single location for a maximum of 10 years; and (2) the Graduate Programmes (*Wissenschaftskollegs*), which funds research centres with the specific aim of training excellent young scientists at PhD level. The Special Research Programmes (SFB) have gained considerable importance, and the accepted sum for SFB's increased between 1996 and 2001 from 8.72 and 17.35 M€. At the end of 2001 a total of 17 SFB's were running. The accepted sum for the Joint Research Programmes decreased in the same period from 8.01 M€ to only 0.7 M€. In 2001, 7 of these programmes were running. Owing to the strict requirements of the scheme, only 3 Graduate Programmes have to date been approved. Rather than aiming at improving the graduate education in general in Austria, the aim of the programme is to establish such education in only those areas of Austria where it has a leading international position.

We analysed the composition of the networks, and found that they have so far created only a modest degree of agglomeration of research capabilities. (More detailed results should soon be available from ongoing evaluations of these programmes.)

In the FWF ‘customer’ survey, the appreciation for the network programmes is not high. Only 56% of the respondents find the SFB and FSP very valuable. Their opinion of the Graduate Programmes is even lower: only a third of the respondents consider this funding instrument to be very valuable. Austrian scientists seem to find small individual projects more attractive than larger grants to set up collaborations with colleagues and create nuclei and networks of excellent research.

This low appreciation for network funding is in contrast to the important function these funding schemes can have for the implementation of the university reform. Internationally, larger grants from research councils are seen as a way to provide excellent researchers with the conditions for autonomous scientific work, without being too much troubled by pressures of the competitive system. They contribute to critical mass and allow the accumulation of funding necessary to create a more competitive system.

FWF expects that the number of Graduate Programmes will remain very limited by the nature of the scheme and its requirements. Clearly, this contributes to the success of the scheme in creating international scientific excellence, but it prevents it from playing a role in the development of new concentrations of high-quality capabilities. The Fund has therefore decided to redesign the Graduate Programmes. So-called ‘*Doktoratskollegs*’ with a stronger focus on education and a less elite specification should result in a much larger number of funded grants.

The difference between the *Sonderforschungsbereiche* and *Forschungsschwerpunkte* seems negligible. There seems to be no reason why they should not be merged into a single scheme.

5.2.3 Career schemes

A major development in the funding categories of FWF has been the extension of career awards: mobility schemes, schemes for supporting female researchers and individual prizes. While these each tackle important issues, it is not clear that the proliferation of schemes is necessary, not is the division of labour with the Austrian Academy of Sciences (which has its own career schemes – see **Exhibit 41**) and with the universities self-evident.

Exhibit 41 Scholarships and Prizes of the Austrian Academy of Sciences

Scholarships and prizes of the OeAW	
DOC	Grants for excellent PhD students
DOC fFORTE	Grants for excellent female PhD students in science, engineering and medicine
APART	Three year grants for excellent researchers at post-docs level
APART Extra	Three year grants for excellent researchers at post-doc level who have had an alternative research career. The scheme aims especially at female researchers with career breaks.
Max Kade	Scholarships for research stays of a year in the US

Rationalisation should be done in consultation with OeAW, the BMBWK and the universities. In the assessment of the number of funding schemes, one should also take into account the accumulation effects at network level. For the START and Wittgenstein prizes, one should take into account the publicity for science that such prizes generate.

5.2.4 University – industry

For BMVIT, FWF runs the *Impuls* scheme "*Forscherinnen für die Wirtschaft*", which aims to transfer researchers from universities to industry, together with FFF, which does the economic assessment of the firms involved. Since its inception, 74 applications were sent to FWF, of which 6 were withdrawn by the researchers and 21 were declined. In 2002 the first set of 24 finalised *Impuls* projects was evaluated ex-post. Firms and researchers who took part in the program assessed it positively. *Impulsprojekte* were criticised due to insufficient firm participation.

Parallel to the *Impuls* scheme, there are several Innovation Assistance Programmes on the regional level in Austria, which experience high demand from companies. Differences between the two types of programmes are target groups (Graduates / Postdocs - definition of SMEs) and flanking measures of the program. Because of these duplications and the small number of applications received, FWF should reconsider its role and the design of the programme.

The other university-industry funding scheme where FWF is involved is the *Kplus* centres, a scheme also of BMVIT, run by the TIG. The *Kplus* program aims to improve cooperation between the business and research sectors through the establishment of competence centres, for a period of seven years. FWF does the evaluation of the scientific quality for this scheme, but bears no overall responsibility.

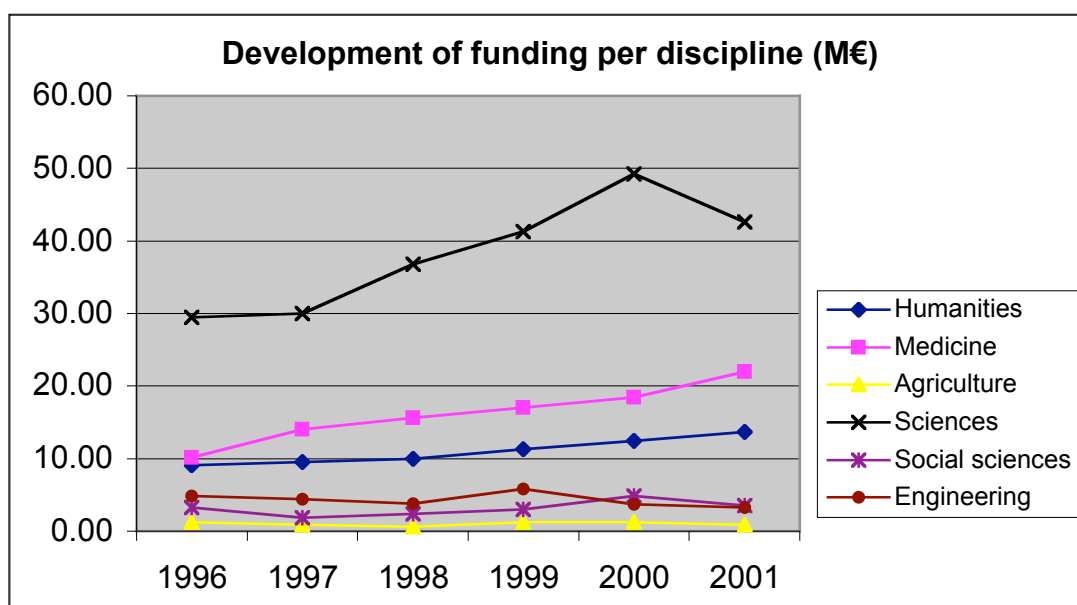
5.2.5 Scientific Renewal

Since FWF does not, as a matter of principle, allocate money top-down to individual disciplines, it has in the past effectively isolated itself from important developments in sciences relating to 'Pasteur's Quadrant'. These could only be tackled by FWF in response to proposal pressure, so FWF itself inherently has difficulty playing a 'change agent' role. It is a bit surprising to find that the lead in proactively building an initiative in genomics is taken not by FWF but by the education ministry (BMBWK), which has intervened and launched the GEN-AU programme, endowed with 10,5 M€ per year and organized as a Public Private Partnership. Other initiatives

have been taken by the *Wiener Wissenschafts-, Forschungs- und Technologiefonds* (WWTF), launching calls in the fields of Life Sciences (with a budget of 5,67 M€) and Science for Creative Industries.

A related issue arises from FWF's policy of being neutral in respect of disciplines. In principle, it funds the 'best' projects, irrespective of their subject. Nonetheless, there are clear trends in the development of distribution per discipline. Most of the funding goes to sciences, followed by medicine and humanities, the two disciplines that have grown in importance steadily. Science got more than 50% of the funding in 2000, and a bit less than 50% in 2001. Medicine has grown to a funding position of more than 25% and Humanities to more than 15%. Social sciences, engineering and agriculture have marginal positions in FWF's budget. This is expected to change, as the budgets of the government for social research have been cut, and social scientists will be more in need for FWF funding than before.

Exhibit 42 Development of FWF Funding per Discipline



The low position of engineering appears remarkable, as the engineering sciences have made considerable progress in the past decades and have grown internationally to become as important as the 'basic' sciences. Internationally one can see increasing budgets for the engineering sciences, also because of funding for typical priorities at the end of the 20th Century, like ICT, biotechnology and materials science, and, currently nanotechnology and genomics. FWF's published funding pattern, in contrast, suggests an important degree of 'lock-in' to traditional scientific structures. However, FWF have prepared a special analysis for us, which separates out the engineering components of other disciplines, notably mathematic/informatics, physics, chemistry and biology. Together with the more traditional engineering subjects tracked in the published statistics, these make up about 20% of the funding granted.

In abstaining from more strategic initiatives, we would argue that FWF is not fulfilling its legal mandate to develop Austrian science. A key policy decision is

whether FWF's activities should be broadened so that it can take on this responsibility or whether other institutions should continue to handle them. As the system stands today, there is no other significant agency with the established capabilities, routines and databases needed to implement such strategic **scientific** initiatives at the high quality level that is characteristic of FWF's bottom-up funding process. This argues strongly for extending FWF's role.

5.3 FWF Processes

Here, we consider three key processes: acquisition of projects and the role of peer review of proposals; evaluation; and international management of research.

5.3.1 Peer Review Process

Peer review is a basic issue for all research councils. But it is not homogeneous: there are three main points of difference between councils⁴⁸

1. Choice about the number of stages in the peer review process.
2. Selection of external reviewers
3. Different weighting given to the actors and stages in the peer review process. In some cases, the judgements of external mail reviewers are decisive; in others they only provide advice. Academic committees sometimes only perform an advisory role, with decisions taken by professional staff

In FWF, most of the allocation decisions are based on reviews of the applications by peers, who are selected by the Reporters. The number of peers ranges from 2 for applications less than 240 k€ to 5 peers for applications above 480 k€.

The procedure for the peer review is the same for all disciplines and funding schemes that FWF has designed itself. The administration checks the application for appropriateness and then sends it to one of the Reporters, who decides whether the proposal is within his or her competence, and whether there are any conflicts of interest. Subsequently peers from abroad are asked to review the proposal and give a score on a scale from 0-100. Reviews and scores are collected by the Reporter, who uses them to make a proposal to the Kuratorium. Applications can be sent in throughout the year, and six times a year the Kuratorium meets to decide on those applications that have gone through peer review.

The overall approval rate of project proposals is high by international standards – conforming more to Swiss/German practice than that elsewhere. In 2001 they were 54.1% for the sciences, 59.2% for humanities and social sciences, and 45.2% for the life sciences. According to FWF, the higher rejection rates in social and medical sciences are caused by the larger proportion of proposals in these fields that are 'descriptive' rather than 'scientific' and that many applicants fail because they are not socialised in how to write high-quality proposals. It is notable, however, that these fields which experience higher rejection rates are somewhat applied, and that many of the methods and questions addressed fit less well with a physics-based paradigm of 'basic' research than with actual practice in these fields.

⁴⁸ See: Guidelines for Managing with Uncertainty in the Funding of Research, Report from STRATA Accompanying Measures – MUSCIPOLI, August 2003.

Internationally, approval rates for research councils are tending to fall and research councils are developing new procedures to manage low acceptance rates. Many councils cope with approval rates below 30%, which is often seen as the bottom line. For FWF the rates have been rather stable until recently, when they have fallen dramatically.

The acceptance rates imply that in principle most proposals with a high score in the peer review process can be funded. In the social sciences 55.5 % of the proposals get a score of 90 or higher. In the life science 52% receive a score of 85 or higher. In the sciences 58% of the proposals get a score of 85 or higher.

Exhibit 43 Approval Rates for FWF Applications

<i>Approval rates for research projects</i>		
<i>Year</i>	<i>Requested funding</i>	<i>Number of proposals</i>
1997	46 %	59 %
1998	37 %	50 %
1999	41 %	53 %
2000	43 %	53 %
2001	40 %	51 %
2002	41 %	49 %
2003	37%	43 %

Source: Statistikhefte 2001 - 2003

The review criteria used by FWF have been

1. Scientific quality of the project
 - a. Position in the appropriate international scientific community
 - b. Extent to which the project could break new ground scientifically
 - c. Importance of the expected results for the discipline
 - d. Clarity of the goals
 - e. Appropriateness of the methods
 - f. Quality of the co-operations
2. Scientific quality of the scientists involved
 - a. Scientific qualifications and/or potential of the scientists involved
 - b. Expected importance of the project for the career development of the participants
3. Financial aspects
 - a. Appropriateness of personnel and non-personnel costs of the worthwhile parts of the project
 - b. What cuts could be made without jeopardizing the success of these parts
 - c. Suggestions for improvement to the equipment requested
4. Other suggestions to increase the project's chance of success.

In 2003, additional criteria were added

- Can the project be expected to have implications for other branches of science?
- Is the project expected to have implications that go beyond basic science (potential industrial applications, results of relevance to society etc.)?

However, these aspects play no part in the decision about whether the project should be funded.

The FWF survey of beneficiaries suggested that researchers wanted to see more emphasis on scientific quality, international publications and research track record. While broadly supportive of the international peer review process, only 11% of those surveyed found the assessment process completely transparent. 42% of researchers felt the application process took too long. For research projects the time needed for this process grew on average between from 4.67 to 5.17 months between 2000 and 2002.

Of the researchers who were critical of this length of time needed to reach project funding decisions, 71% had experienced a review and decision process that took more than 6 months. 7% had experiences with review process below the average. The periods different Reporters need vary considerably. In the period between 2000 and 2002, the fastest Reporter handled 125 applications and needed on average 119 days between the time the proposal was sent to FWF and putting a recommendation before the Kuratorium. The slowest Reporter needed 185 days on average for 56 projects. This tends to confirm our structural perspective that the assessment process should be professionalised.

5.3.2 Evaluation

In recent years FWF has on its own initiative increased its efforts in evaluating its instruments and practices considerably. For the Networks, Impulse and Competence centres, appropriate evaluation procedures have been developed to assess the quality mid-term (with possibilities to end the funding) and recently also ex post evaluations. FWF also contributes to the *Kplus* programme by providing peer reviewers. Last year FWF commissioned an evaluation to consider its network programmes as funding instruments. Earlier the FWF had commissioned a survey of its image among its main beneficiaries: the researchers. Moreover FWF has started to collect ex post reports of networks and research projects to look for specific patterns.

FWF is member of the Austrian Platform for Evaluation of Research and Technology, and has adopted its standards of good evaluation practice. It has taken important steps towards modern evaluation practice, but others remain to be taken. Most notably, unlike many research councils, FWF does not conduct field reviews as part of its task of developing science in Austria. Such reviews are a key requirement if the Fund to is to develop a strategy for funding science.

5.3.3 International management of research funding

FWF is positively involved in some international collaborations

- The D-A-CH (Deutschland, Austria, CH /Switzerland) scheme, which allows researchers to use money from one country/council in another country
- The involvement of Austrian researchers in 22 scientific programmes of ESF and the involvement of FWF in EUROCORE for excellent European research
- Participation in the ESF ‘European Collaborative Research Projects in the Social Sciences’ programme
- FWF has also joined the European Young Investigator Awards (EURYI) established by the EuroHORCS to enable and encourage young researchers from all over the world to work in a European country

An asset in the international context is FWF’s well organised system of ex ante assessment, which can easily fit into international programmes. Involvement in programmes such as the EUROCORES is more problematic. Collaboration in such international programmes may require that FWF needs to be pro-active and explicitly invite researchers to submit proposals that fit into the programme. The coordination of international review processes also requires more time from administrative staff than national procedures. A typical example was the preparation of the programme on Self-Organized Nanostructures (SONS), which took considerable time, while in the end no Austrian researcher was funded from the programme. Such programmes imply that FWF has to some extent to abandon its strong principle of bottom up funding and introduce some programme funding.

The internationalisation of science policy, and more specifically the development of the ERA and moves towards a real European research council, raise questions and needs to which the FWF is not well able to respond (though it aims to participate in ERA-Net projects), since it lacks an International Affairs department, an internationalisation strategy and – at present, at least – the willingness to programme. If FWF wants to operate on the international level, it needs organisational changes to create capacity for dealing with international affairs and find ways that it can increase the likelihood of successful participation.

5.4 FWF Budgets and Finance

FWF’s budget over the past years comes from three sources. The main source was the *Bundesbudget* provided by the government. In 1997 this budget was reduced, but complemented by so-called *Sondermittel* (special budget), also provided by the government. Between 1996 and 2003 the sum of these budgets fluctuated between 50.9 M€ and 66 M€. Recently it was reduced from 64.7 M€ to 48.9M€, because of the discontinuation of the *Sondermittel*.⁴⁹

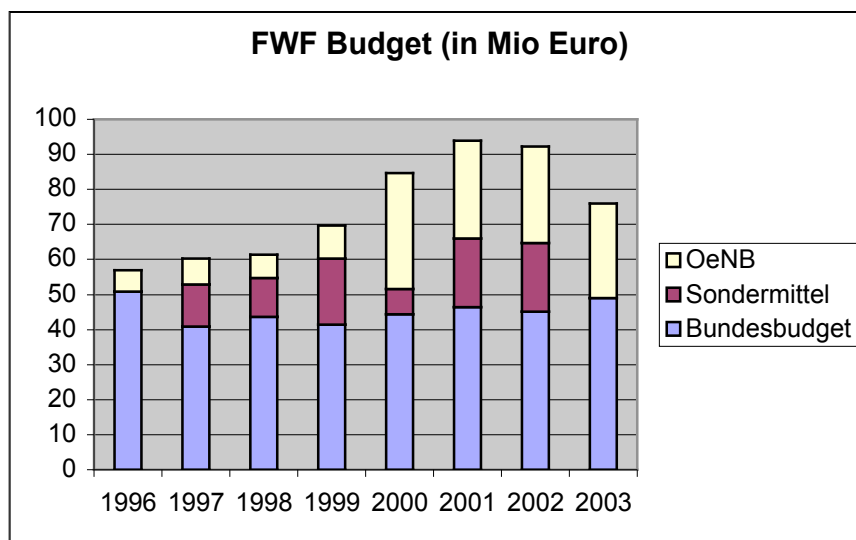
The third budget source for FWF is the OeNB Anniversary Fund. This finances research in economics, clinical research, social sciences, the humanities and industry-

⁴⁹ These budgets are excluding the budgets for those programmes of which the FWF manages only the review process for the government, as is the case for the *Kplus* competence centres

oriented research. For the latter category the OeNB Anniversary Fund has delegated the review and allocation decisions to FFF, FWF and the *Christian Doppler Forschungsgesellschaft*. In 2000 the OeNB increased its fund to 65,4 M€ of which 30 M€ is available to FWF.

In practice, the restrictions on OeNB funding have no meaning. FWF allocates OeNB money to projects it selects that happen to fall within the OeNB priority areas. The effect of the OeNB money is therefore not (as presumably is intended) to **augment** FWF funding in certain categories, but to **displace** Federal money from those categories.

Exhibit 44 FWF Budget, 1996-2003 (MEuro)



The FWF beneficiary survey shows that 70% of those applying for funds from FWF also applied to other funders. Of these, the National Bank's Anniversary Fund is favourite, especially in the medical sciences. In the humanities and social sciences the Ministries are important other sources. In science and engineering, the EU is another important source, as is to some extent also the FFF.

FWF therefore has a central position in the Austrian research system in terms of competitive funding, but this position is rather weak relative to the institutional funding. Moreover, FWF has to face fluctuations in the total funding, which limit its ability to develop longer term funding strategies.

5.5 FWF Beneficiaries and Effects

5.5.1 Project approval data

FWF provided us with project data for the period 1997 (when the electronic database was established) to September 2003. This is the source for the statistics in this section. The database lists 3997 individual project coordinators, who submitted a total of 6723 proposals to a total of 18 programmes at the FWF. As **Exhibit 45** indicates, the success rate of proposals is very high over the period as a whole, though

they have dropped sharply after 2002, with the disappearance of the *Sondermittel*. Few research councils internationally would be able to fund half the proposals they receive. Acceptance rates are highest in the natural sciences and humanities (58%) and lowest in the agricultural and social sciences (35% and 34% respectively).

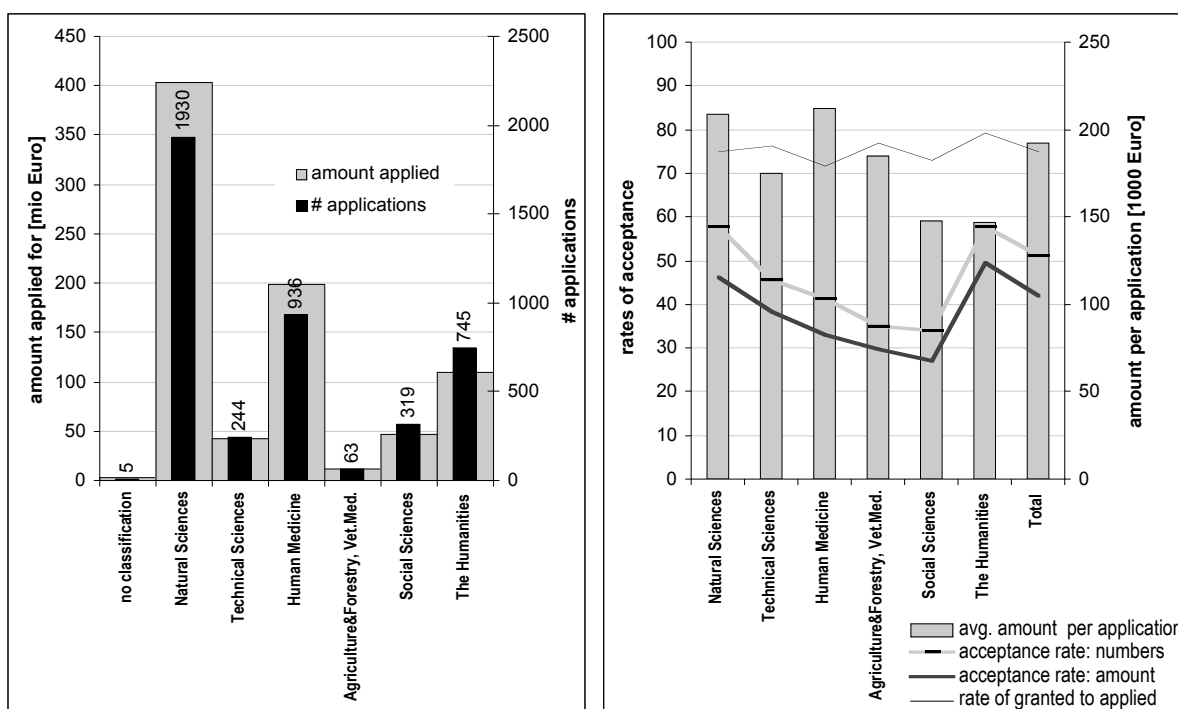
Exhibit 45 Possible Outcomes of the FWF's Decision Process

Code	Decision		share [%]	
			all programmes	programmes P, F, S
A	abgelehnt	<i>rejected</i>	39.1	43.0
W	bewilligt	<i>accepted</i>	49.3	49.6
B	bedingt bewilligt	<i>conditionally accepted</i>	2.9	1.6
Z	zurückgestellt	<i>decision deferred</i>	0.0	0.0
C	abgesetzt	<i>rejected on technical grounds</i>	7.6	5.0
D	zurückgezogen	<i>proposal retracted</i>	1.0	0.7

Source: own calculations on the basis of FWF data

Typically, applicants receive about three-quarters of the money they request (**Exhibit 46**).

Exhibit 46 Applications and Participations: FWF-funded Projects, 1998-2003



Source: Joanneum calculations on the basis of FWF data

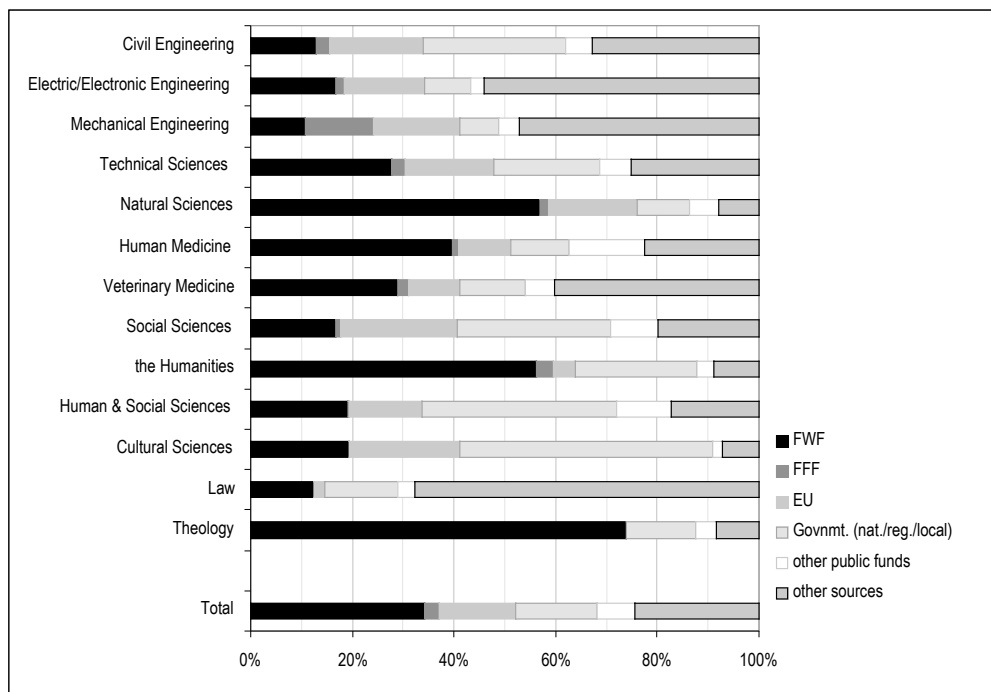
The largest proposals (which tend to be in the natural sciences) have the highest probability of being funded, but are also cut the most fiercely by FWF. In total, of the 4242 applications which were submitted to the FWF since 1997, about 51 % were approved. Among the Austrian Universities (which account for about 84 % of all applications), the University of Linz, at 62 %, exhibits the highest approval rate; the lowest rate of 37 % can be observed for the University of Veterinary Medicine.

Public R&D organisations, at 52 %, face the same approval rates as the average Austrian University. Incorporated R&D organisations⁵⁰ experience appreciably higher (63 %), “non-profit” R&D organisations (38 %) lower rates of approval.

With 176 applications, the Austrian Academy of Science’s approval rate of 57 % seems more significantly above-average.

Principal investigators in their 40s were most likely to succeed, with both younger and older investigators being less likely to be funded. Women’s success rate was very marginally higher than men’s. We were unable to find any evidence that the assessment process was biased, with the major variations in success rates being ‘explained’ by broad scientific field and the institution from which the applications come.

Exhibit 47 University Faculties: Structure of External Funding, 2000-2002



Source: ABIV (OeUK), own calculations

As was shown above, some 85 % of applications for FWF funding are submitted by coordinators affiliated with an Austrian University. This already hints at the eminent relevance of the FWF for the University system in Austria. To further clarify matters, **Exhibit 47** shows, for faculty groups of Austrian Universities⁵¹, the structure of

⁵⁰ Incorporated R&D organisations include (independently registered) research departments of private or public companies, institutes of the Austrian Research Centres, or the International Institute of Applied Systems Analysis in Laxenburg

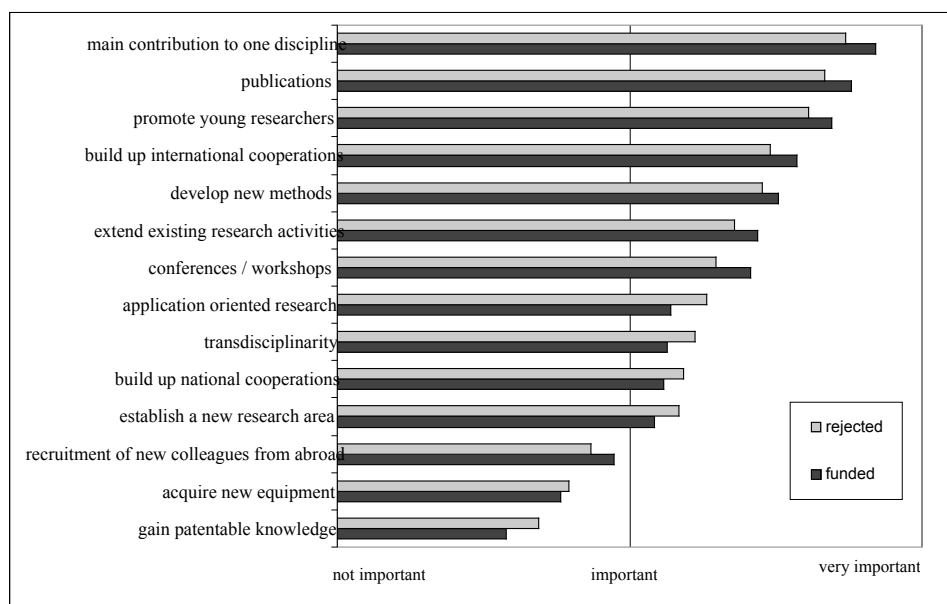
⁵¹ At Austrian scientific Universities, institutes are organised in faculties, whose scientific “themes” broadly coincide with one of the 6 i-digit fields of science (cf. above). In total, there are 18 different faculties, plus 4 Universities which are not organised along faculty lines (*Montanuniversität Leoben*, *Universität für Bodenkultur*, *Wirtschaftsuniversität Wien*, *Veterinärmedizinische Universität*). These 22 units were aggregated into the 13 “faculty groups” used in this chapter.

external funds. Six sources of external funds are distinguished: FWF, FFF, European Union (EU), the Government (on the national, regional, or local level), other public funds, and “other sources” (meaning, in essence, private research contracts. Private charitable endowments, which would also fall into this category and which in other countries, notably the USA, are of major importance, are almost non-existent).

5.5.2 Beneficiaries’ views

Our survey of FWF beneficiaries indicated that, in addition to the goals of contributing to science and producing publications, which are the sine qua non of science funding, key objectives included promoting young researchers and developing international contacts. The researchers see FWF funding as playing an important **development** role, in addition to providing routine funding.

Exhibit 48 Assessment of the Research Project Objectives



Source: survey

The major effects beneficiaries claim as a result of the FWF funding are

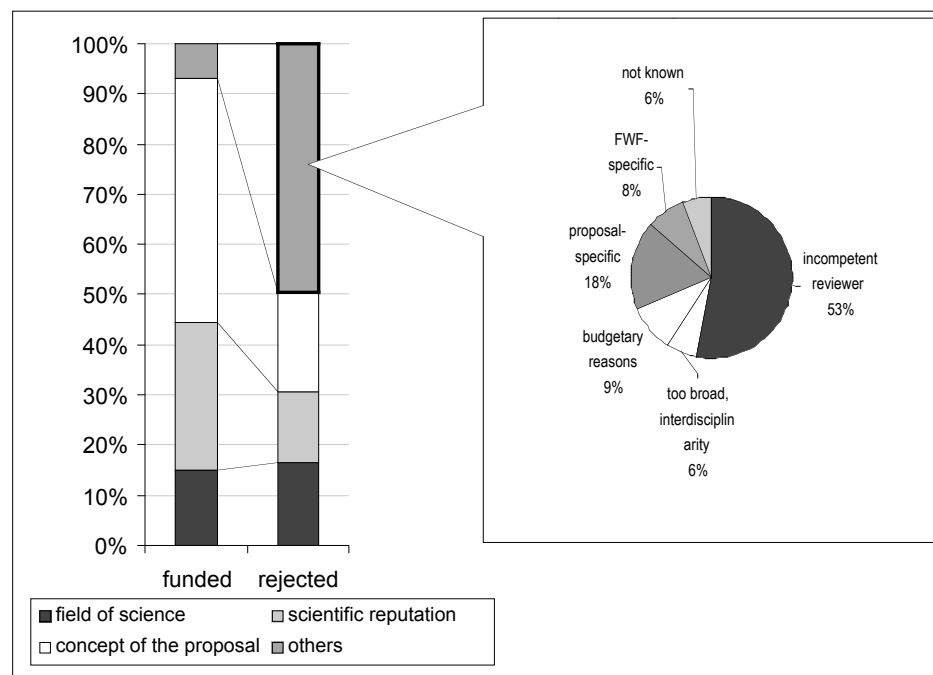
- Strengthening her position in the scientific community
- Establishing or strengthening important contacts
- Making substantial contributions to conferences
- Publishing important articles in scientific journals
- Strengthening the researcher’s position within her institution

Over 80% of the researchers said the project for which they had sought FWF funding was part of a longer run strategy, and almost the same proportion had sought funding elsewhere. Only just over 20% of projects were developed especially for the FWF scheme. Generally, the researchers have their own ‘real projects,’ and look around to various funders to provide means to assemble the means to undertake these longer-term projects and strategies. Some 48% of rejected projects were carried out in any case, almost always using the internal funds provided via the GUF. Since, until

recently, such a high proportion of FWF applications were funded, this raises the question of the quality of these ‘rejected’ projects, which are nonetheless conducted using public funds, and suggests that the ratio of research funding from quality-assured external sources to GUF might not only be unusual internationally but also be problematic for the overall quality level. It also emphasises the importance of FWF’s developmental role, since the ability to allocate GUF funds to research projects tends to be limited to established researchers, especially at professorial level.

66% of the coordinators of successful projects (and 48% of those with rejected proposals) claimed to be operating at the world leading edge in their field. Proposers generally found it difficult to accept that there could be objective reasons for the rejection of their proposals (**Exhibit 49**).

Exhibit 49 Proposers’ Interpretation of Reasons for Funding / Rejection



Source: survey

For 9 % of the coordinators, a perceived lack of financial resources (mainly on the part of the FWF) is the main reason for rejection. 18 % of the submitters are self-critical: they regard some deficiencies of the proposal (lack of time for the preparation, lack of quality, ...) as the crucial reasons for rejection. Another 8 % mentioned the FWF itself in their explanation (FWF as a “closed club”, insider relationships, lack of willingness to cooperate with the project coordinators...) for rejection.

In a separate question to researchers whose proposals had been rejected, systematically addressing perceived sources of weakness in the proposals, a number of categories of explanation were important that can be tackled through improved information and training in how to write proposals (**Exhibit 50**).

Exhibit 50 Researchers' Perceptions about the Reasons for Rejection by Field of Science (only rejected proposals)

	Natural Science	Technical Science	Human Medicine	Agriculture, Forestry, VetMed	Social Sciences	Humanities
incompetent reviewer	55	75	62	60	41	25
too broad, interdisciplinarity	6	0	1	0	26	7
budgetary reasons	10	8	6	10	4	16
proposal-specific	15	13	17	10	26	27
FWF-specific	9	0	8	20	0	9
not known	4	4	6	0	4	16
Total	100	100	100	100	100	100

Source: survey

Both the ABIV database and our own survey suggest that FWF funding is productive, especially in terms of peer-reviewed publications, and tends to produce PhDs rather than diploma work (except in the social sciences). There are of course variations in this kind of 'productivity' among fields, which themselves differ in their patterns and practices.

In general, participants felt their work made a contribution to the public understanding of science – especially in the social sciences and humanities – but few identified specific mechanisms through which this would take place.

We asked about immediately realisable commercial results such as the number of prototypes, Spin-Offs etc. The total of FWF projects in the sample accounted for 43 national patents, 38 international patents, 153 prototypes, 32 registered designs ("Gebrauchsmuster") and 5.5 Spin-Offs. Immediate commercial results evidently occur mainly in the *Engineering Sciences*, the *Medical Sciences* and the *Natural Sciences*.

In addition we asked whether the research results had any relevance for industry or not. The result is somewhat surprising, as on average about 41 % of the respondents regard the results of the research projects as relevant for industry. At about 80 % this value is highest for the *Engineering Sciences*, followed by the *Medical Sciences* (50 %) and the *Natural Sciences* (45 %). Even in the *Social Sciences* and the *Agricultural Sciences*, a third and a quarter respectively consider the research results as relevant for industry.

Though the relevance of research results for industry is rated relatively high, researchers apparently do not see the need or do not have the opportunities to forge links with industry. The *Agricultural Sciences* and the *Medical Sciences* seem to have the strongest links. Even though the *Engineering Sciences* report the highest relevance for industry, there seems to be some deficiency in realisation of contacts.

5.6 FWF: Views of the Peer Panel

Like FFF, FWF was visited by a panel of international research and research management specialists, which has produced a separate report of its views. In summary, the panel found that FWF is performing its niche role as a basic research

funder very well, and to the clear satisfaction of the scientific community. There is scope to simplify both the internal organisation and the governance structure, which is not only overly complex but ties up too many people.

However, FWF has not changed with the evolving needs of the research and innovation system, and it needs deliberately to do so in order to justify a greater role for itself in an increasingly knowledge-intensive society. Other research councils abroad now play broader roles, in line with the broader needs of the research performing system. In particular, they increasingly operate in ‘Pasteur’s Quadrant’ of fundamental, use-oriented research, and no longer stick rigidly to the idea that all their funding should go to curiosity-driven or researcher-initiated research. FWF therefore needs to develop strategies, which allow it to programme additional funds towards areas of fundamental but use-oriented research, and the interdisciplinary areas that increasingly provide sources of dynamism in knowledge generation.

More generally, FWF needs to be better linked into the national process of research and innovation strategy and policy making, and to co-operate more with other research and innovation funders. It needs to adjust to the recent university reforms in part by beginning to provide overhead contributions as part of its grants. It also needs to help the research performing sector change and create concentrations of research capability through increasing grant sizes, and developing policies to fund centres of excellence over longer periods.

A greater role for FWF implies increased budget, but also an obligation to devote the increase to the newer needs identified. FWF should remain autonomous, in the sense of being free from political influence, detailed steering or interference with project-level decisions. The panel saw no grounds for a merger with FFF.

5.7 FWF Conclusions and Recommendations

FWF performs a specialised function – funding more or less ‘basic’ research – in an efficient and high-quality manner. Its beneficiaries are largely happy with its performance, and the evidence suggests that the research it funds is productive and of good quality.

Like FFF, FWF is very much a child of its time. Its autonomy from the political system was initially a significant success-factor for the Fund, which has been reinforced in the last decade by the exclusive use of foreign peers, increasing the transparency and objectivity of project assessment, which is always a difficult problem in a small country. FWF remains tightly controlled by its beneficiaries, and this is probably the key reason why it has not followed the practice of research councils elsewhere and diversified its activities into thematic and, in part, more deliberately socially relevant programmes. In this respect, FWF does not appear adequately to be fulfilling its mandate to develop the Austrian science system. Rather than acting as a change agent, it tends to reinforce lock in to existing structures.

Earlier in this chapter we formulated three conditions for a well functioning research council within science systems. The first requirement is a substantial level of competitive funding. It is clear that FWFs funding is small compared to the general university funding and its rather small budget is even not stable. If a more

competitive system is a policy objective, it seems appropriate to raise FWFs budget (potentially at the expense of the General University Fund), though there are also indications which point in the other directions. Until recently, FWF has had a high acceptance rate, even if application pressure is increasing, and it seems still to be an attractive funding source compared with other possibilities. Another reason to increase FWF's budget is the need to pay overheads on university research. Now that the universities have been set free from the civil service, they are in the process of beginning to understand their own cost structures. If FWF cannot pay realistic overheads, it will create a **disincentive** to universities applying for research funds, since each € of FWF money will require cross-subsidy in order to pay its full costs. We cannot, of course, within the scope of this study say how much the needed overheads are, but note that in other countries realistic university overheads are often thought to be in the range 40-50% of external grant income.

As it stands, however, FWF is not in a position to use a significant increase in budget, because it lacks a strategy for developing its funding portfolio. Our findings on the impact of the individual bottom up projects do not legitimate that FWF spends 70% of its budget on this funding mode – especially if in the near future performance incentives are attached to the research component of the General University Fund.

The second requirement is that competitive funding for the researchers needs to be sufficiently attractive compared to institutional funding to allow FWF's quality-controlled funding to exert leverage over the quality of the whole system. The results in this respect are somewhat ambiguous. It is clear that FWF has a good image among Austrian researchers, which is probably due to its consistent positioning as a scientific council and its robust review procedure. Apart from the mobility and gender schemes, FWF's position is unique in the Austrian system. Acceptance rates have been high hitherto, though they are now declining. The analysis of the network funding moreover indicates that these funding modes indeed result in some accumulation of funding and concentration of excellence, which makes FWF also attractive for top scientists.

However, the average size of the grants is relatively small, and FWF usually cuts the funding applied for. Paradoxically, the network grants, which provide large grants, seen less appreciated by the researchers, who appear to prefer that FWF continues its business as usual within its niche of funding basic science. The changing contexts of FWF suggest another response: using the network modes and international programmes as stepping stones for the development of a funding portfolio that is appropriate for the Austrian research system. FWF may also reconsider its career grants, to overcome the current fragmentation.

The third requirement is that the competition for funding is sufficiently open for new 'players', so that those not yet funded feel it is worthwhile to apply. Our analysis indicated that proposals generally find a level playing field and that there are no natural losers or winners. In other words, researchers with different backgrounds will have a fair chance of getting their proposal approved. An important exception appears to be the Graduate Programmes, whose assessment criteria are so stringent that they lock out new entrants.

FWF's current portfolio is a result of a period in which the number of funding schemes increased dramatically. Without a clear strategy, we expect that the number will increase further because of international programmes and because of pressures to operate at the science and industry interface. In the same period as the number of schemes increased, the number of projects fell.

The findings point to two easy steps towards a more transparent portfolio. First, the difference between the *Sonderforschungsbereiche* and *Forschungsschwerpunkte* are too small to maintain the difference. These can be merged. Second, the decline in the Charlotte Buhler applications and approvals may indicate that this scheme is not so appropriate anymore. It should be noted that women researchers seem to have no specific disadvantage in the competition for other FWF funding. Because of the overlap in career schemes with those of the OeAW, it seems appropriate that FWF takes the lead in an overall reconsideration of these schemes and tries to coordinate the respective responsibilities on this issue of the research organisations, of the individual researcher and of FWF, OeAW and the government.

No changes in the peer review system seem to be necessary within the current regime. It is open to newcomers in terms of disciplines etc, while at the same time the portfolio of funding schemes allows for some accumulation of critical resources. There are no barriers set up in the decision procedures that would give some researchers better access than others. Even individual researchers with prestigious prizes have a moderate level of projects from the council. Accumulation of funding schemes and FWF sources occurs at network level and especially within the Graduate Programmes. However, the assessment process will need significant professionalisation if FWF is to operate at greater scale. Even at the current scale, processing times suggests the system of volunteer Reporters is under strain.

The strategic capacity of the council is low, and this is reflected in the lack of a clear strategy for its funding portfolio, the size of the strategy departments and lack of a strategy on crucial issues as public affairs/public understanding of science and on internationalisation. There are two assets FWF can build upon to improve its strategic capacity. The first is evaluation, incrementally making evaluation an integral part of the management of the funding schemes. Further development of this will create intelligence on the impact and value of the different funding modes and may help FWF to improve the funding portfolio. The second is the work done by FWF staff to look to some extent beyond the current organisation through "facts and position", as a base for a positioning paper of FWF. Such initiatives however should not be done on an ad hoc basis, but within a strategic unit in the organisation.

FWF has made some useful moves towards internationalisation, primarily within the German language area. As the European Research Area begins to become a reality and as the idea of a European research council is implemented, the role of national funders will begin to change. Clear gaps in the strategy of FWF are internationalisation and public understanding of science and we strongly recommend FWF to be clearer about how it will operate on these issues. For internationalisation it is urgent to create sufficient strategic capacity, as the developments in this context are fast moving. FWF needs to have the manpower and capabilities in place to tackle these changes.

Finally, like its counterpart FFF, FWF's 'bottom-up' orientation has historically meant that it has had little need of a 'strategic intelligence' function in the past. Tackling the newer, wider roles it needs to address means that FWF will also need a better understanding of its environment and the ability to design and implement new types of programme. It will need to be better linked – and a contributor to – national research and innovation strategy discussions. This implies both changes (increases) in the staff and a broadening of FWF's governance, which in future should not be so firmly in the hands of the beneficiary community.

Corresponding to this widened role for FWF is a need to clarify the division of labour with the ministries, in particular fully handing over programmes to FWF, which ministries want to see run on their behalf.

Our recommendations are as follows.

Funding principles

- FWF nonetheless normally imposes significant cuts on proposed budgets, tending to fragment its funding. FWF should review its practices to ensure that it limits cuts in project budgets to those situation where parts of the budgets are not eligible

Instruments

- FWF has proliferated a long list of instruments, to achieve a small number of things. It should rationalise and simplify the range of instruments used to tackle its current objectives in consultation with OeAW, the BMBWK and the universities.
- At the same time, if FWF is to play a more modern role in developing the science base in Austria, it will need to adopt new instruments and assessment criteria aimed at research in socially relevant fields. It should, in co-operation with the ministries, review instruments that improve linkage between the knowledge infrastructure and society and establish a broad division of labour with other agencies, since instruments that address social needs require competences currently not available within FWF
- FWF lacks instruments that can identify and address the need to nurture research capabilities in new fields, such as genomics. This will allow it to use its considerable skills to deliver programmes in the style of GEN-AU, on behalf of ministries – which may include not only the education and industry ministries, but also other sectoral ministries such as environment, health and agriculture

Processes

- FWF's project assessment and acquisition processes are of high quality. FWF should nonetheless investigate ways to professionalise a greater proportion of this work, while retaining the principle that final assessment is the business of researchers, not administrators

Organisation and Capabilities

- FWF's capacities should be increased in the areas of analysing and monitoring the health of the Austrian science system, strategic intelligence and programme design more broadly, international activities and science communications. The

extent of this increase depends upon whether FWF is to continue in more or less its current role, or – as we recommend – extend its activities also to encompass additional roles

- FWF should then, supported by an administration with increased capacities, develop a medium-long term strategy, that can be discussed and co-ordinated with others in the context of national foresight exercises and national research and innovation strategy. This should be a clear strategy to accommodate an increase in the competitive budget, with a transparent portfolio of funding schemes linked to a vision on the Austrian research system.

Finances

- There are two broad policy options for FWF: to improve its performance within its current rather narrow niche; or to extend its role to encompass fundamental but use-oriented research and linkage with social needs. In either case, FWF needs increased budget in order to pay university overheads on research projects and to increase its strategic capabilities. In the second case, there should be a further increase, since these activities would be additional to FWF's current role, and there is no reason to believe that its current activities should be reduced in scale
- Under either scenario, FWF's level of administrative cost is too low and should be increased in order to pay for the additional capacities needed
- The ratio of General University Fund to competitive funding – especially FWF – is too high. The ministries responsible should review this, in the light of budget changes required to reach the Lisbon and Barcelona goals, since – logically – achieving a better ratio can be achieved by increasing competitive funding, decreasing the GUF or both

Governance

- FWF's governance structures are unwieldy and consume amounts of time that are inconsistent with modern pressures on those involved. The governance structure should be simplified and the number of people involved should be reduced
- In the context of a liberalised university system, it is inappropriate to have representatives of the universities in the governance system. Their representative role should be replaced by a system of elections or independent appointments, and members of the governing committee(s) should sit in a personal, not an institutional, capacity. As with FFF, the customer ministry(ies) should be represented by non-voting members
- Steering of FWF by ministries should be simplified, so that FWF itself has responsibility for its strategy, its instruments and their deployment, and can make clear performance contracts with sponsoring ministries. This means, for example, that responsibility for the START, Firmberg and Wittgenstein prizes should be fully handed over to FWF. It also means that, where money is earmarked for specific purposes (as is the case with the OeNB funds), its use can be clearly monitored and reported. Equally, it can be made clear when resources are not earmarked, but placed at the disposal of the Fund in pursuit of a strategy it has articulated. (This should be the normal case, and will become more likely once the Fund actually articulates a strategy.)

6 FFF, FWF and the Austrian System in International Comparison

International comparisons are useful, because they provide inspiration for learning. But they also need to be treated with care. Institutions operate within specific (often national) contexts, and cannot necessarily be transplanted to, or imitated in, other contexts in an unproblematic way. We have therefore used the country and agency cases collected for this study, as well as a recent study⁵² on R&D governance in eight countries ways to understand **principles** relevant to assessing FFF, FWF and their context in the Austrian R&D funding system.

6.1 FFF⁵³

Many innovation agencies internationally are in a process of extending their activities to more complex networks of actors and the inter-linkages between firms and the knowledge infrastructure, increasingly taking account of the systems perspective in innovation. Mission statements and the real missions of innovation agencies are therefore increasingly couched in terms of improvements in the performance of national systems of innovation, rather than being seen narrowly as organisations that provide support to companies. In contrast, FFF's legally-defined mission is narrower: namely, "to promote and assist research projects of individuals or corporations" (FFG, 1967)

Unlike FFF, the other agencies considered are genuinely agencies, rather than having FFF's rather autonomous status. They are unambiguously under the control of a ministry, and normally receive some kind of performance contract or annual letter of instruction from that ministry that specifies what they agency is to do or achieve.

The range of tasks performed by the different agencies is wide – but always wider than that undertaken by FFF, whose comparatively narrow role is made possible by the proliferation of other innovation agencies in Austria. Elsewhere, this proliferation is handled by broadening the missions of the innovation agencies. IWT in Belgium and KTI in Switzerland, which were both set up initially to run bottom-up R&D subsidy schemes, have extended their ranges of activity over time. Many innovation agencies are to some extent able to position themselves as 'one stop shops' for innovation support. Typical other tasks are

- Industry-academic linkage
- Technology transfer
- Developing technological capability / absorptive capacity among companies

Many agencies outside Austria tend also to have a greater focus on supporting SMEs with capability development than does FFF, and to focus resources for science-industry interaction more on linkage programmes, where the bulk of the subsidy

⁵² Erik Arnold and Patries Boekholt, *Research and Innovation Governance in Eight Countries: A Meta-Analysis of Work for EZ (Netherlands) and RCN (Norway)*, Brighton: Technopolis, 2003

⁵³ Comparators for FFF are RCN (Industry and Energy Division), VINNOVA, TEKES, IWT, Senter and KTI

money ends up in the hands of the knowledge infrastructure rather than the beneficiary firm. In some countries this kind of basic capability support is provided by a broad ‘business and innovation support’ agency like Norway’s SND (which has a similar remit to Austria’s AWS).

The extent to which innovation agencies have strategic intelligence capacity – problem analysis, programme design, foresight – varies. Senter and FFF are at one end of a spectrum, with effectively no such capacity. VINNOVA, TEKES and RCN are at the other end, with quite substantial internal research departments. Most agencies are capable of making their own programme designs. On the other hand, foresight activities are normally done outside the innovation agencies, because foresights have national importance. Innovation agencies’ foresight work is more limited to developing their own agency strategies (RCN, VINNOVA, TEKES).

There is no clear pattern concerning the role of innovation agencies in the public understanding of science. Research councils more consistently have a responsibility to do this. Innovation agencies more often help in the specific task of persuading companies that innovation is good for them.

Generally, the agencies that have significant strategic intelligence also play a role in EU programmes, sitting on committees and providing National Contact Points, as well as funding EUREKA participation. Some incorporate Innovation Relay Centres and provide information about the EU programmes. FFF’s role is smaller than most others in these respects.

FFF’s focus on bottom-up funding is rather unusual. Some agencies combine bottom-up project funding with programmed R&D support. At VINNOVA and RCN, shortage of funds means that programmes have tended to squeeze out bottom-up funding – though RCN’s ‘programming’ in part consists of allocating bottom-up projects to various topics. TEKES deliberately mixes programme and bottom-up funding, and – where they feel it will be useful – TEKES project officers effectively **allocate** bottom-up projects to programmes after they have been approved. TEKES technology programmes themselves are structured in two parts

- A ‘company’ part, where companies are funded to do (often commercially sensitive) R&D, and where a big component of the TEKES funding may be in the form of loans
- A ‘research’ part, where there is co-operation between companies and the knowledge infrastructure, where externalities are higher and where the grant component of TEKES funding is much higher

Allocating bottom-up projects to programmes puts the project participants into a network of relationships with other firms and relevant parts of the knowledge infrastructure.

Innovation agencies fund applied research and development work in companies, institutes and universities, so the range of beneficiaries is generally wider than that at FFF. Little has so far been done anywhere to align funding rules and instruments with ERA, so on this dimension FFF is no worse off than many foreign agencies.

TEKES is the only agency we have identified so far to have invested significant effort in an internationalisation strategy.

There is a range of organisational models. Several agencies use ‘branch of industry’ or ‘technology’ as an organisational dimension, in order to build and maintain domain-specific knowledge. Personnel policy is another key element in maintaining competences. TEKES aims for a rather high labour turnover, and has achieved a situation where a period of 4 – 5 years at TEKES is a very positive element in a scientist or engineer’s *curriculum vitae*. This means TEKES’ scientific and industrial understanding is continuously refreshed. With lower labour mobility rates, RCN has tended to bring in technical consultants or industrial secondees to work in programme management for periods of time. All three Nordic agencies use programme boards or reference groups to help develop and implement technology programmes. Swedish and Norwegian practice is to involve these closely in project decisions, in part so as to access members’ technological and industrial understanding in assessing project proposals. Where beneficiaries are involved in programme boards, there are clear rules on conflicts of interest. TEKES’ loan-financed work is (like that of FFF) closer to market, so it is harder to involve such reference groups, which tend to focus more on the research than the industrial parts of the programme. High technological competence is therefore most important to TEKES.

Directors-general are sometimes appointed by ministers or ministries. Below this level, normal public service competitive personnel recruitment principles apply.

The sophistication of agencies’ strategies varies with the resources they can devote to strategic intelligence. Nordic agencies tend to be able to decide for themselves how much resource to devote to different technologies or branches. Further south, this is more determined by ministries, or left to emerge from the pattern of applications. FFF has no overall strategy concerning branches or technologies, but uses programming as a way to focus attention on areas of perceived deficit.

Agencies are steered through performance contracts or letters of instruction from ministries, but there is wide variation in how specific these instructions are and in the role of the agency in formulating them. Senter essentially does what it is told to do. VINNOVA and TEKES tell the ministry what they intend to do. Interference by ministries or the political level in individual project decisions is anathema in all the systems we have studied.

While beneficiaries are often strongly present in the governance bodies of innovation agencies, there is normally also an academic role. Members of governing committees sit in a personal capacity, and do not formally represent their own organisations. Governance is exercised within the degrees of freedom granted by the responsible ministry: top committees are always in this sense advisory, not ultimately in charge of things. Again, the FFF model, where the organs of governance are responsible for individual project decisions, is unusual here.

Assessment of proposals is normally done internally, for simpler instruments such as bottom-up project funding. Increasingly formal checklists are being used. FFF’s practice is at the formal end of the range, and is similar to that in RCN and TEKES. Where they exist, programme boards are normally consulted on project proposals, but

their decisions are usually advisory. More complex, network-oriented instruments and science-industry linkage instruments such as competence centres increasingly involve external peer review.

The authority to approve funding decisions is normally with the staff of the agency, typically with decisions having to be made at an hierarchical level proportionate to their size. Governing bodies are rarely involved in funding decisions, so FFF practice is very unusual.

Evaluation is widely performed at programme level and concerning new instruments. Little evaluation seems to have been done internationally of bottom-up projects, *per se*. Evaluation is seen as a key element in organisational learning. The agencies with highly-developed, computer-based proposal assessment systems see these as additional future sources of learning.

Administrative costs tend to be in the range 5 – 10% of agencies' budget. Agencies like TEKES (9%), RCN (Industry and Energy Division 13%) and VINNOVA (13%) that play a strong 'strategic intelligence' role are in the upper part of this scale. The more purely operational agencies like KTI (6%) and Senter (5%) and IWT (6%) are lower down. At 3.5%, FFF clearly falls below the normal range.

The speed with which applications are processed has been increasing generally (with exceptions, notably RCN, which has imposed academic-style calls for proposals). FFF is in the normal range here with the average project decision taking about 70 days. KTI takes 75 days. Vinnova and TEKES work more rapidly, in the range 40 – 60 days, while Senter is fast at 45 days. IWT can respond to requests for SME programme support in 7 – 29 days, while more substantial projects take up to 70 days to approve.

Senter approves 36% of submitted proposal and KTI 42%. In some programmes, TEKES' success rates can go as high as 98%. But the Nordic agencies tend to discuss project ideas extensively with proposers, and filter out applications unlikely to succeed. FFF's practice is in this respect quite Nordic, resulting in a success rate of about 70%. Newer, more complex instruments and those involving academic linkage tend to have much lower success rates.

We can conclude that, within its traditional role, FFF appears to be a rather good and efficient deliverer of subsidy to R&D projects. However, compared with many equivalent agencies abroad, FFF has a scope and a repertoire that is narrow, and it lacks the 'strategic intelligence' capacity needed to develop longer-term strategies, do problem analysis and programme design. It has not kept pace with others' actions to refocus on improving innovation systems performance, and therefore to extend its range of instruments. While such new instruments have appeared elsewhere in the Austrian funding system, FFF is unable to reap the learning and operational benefits that other agency designs suggest are available from a broader scope.

FFF stands out also because of its governance. It is very unusual in innovation agencies for institutionally organised beneficiaries to be involved in the detail of project assessment. Beneficiaries normally advise, in a personal role, while the principal for an innovation agency is normally a ministry.

6.2 FWF⁵⁴

Research Councils like FWF are generally very strongly under the influence of their stake-holding scientific communities. Bottom-up funding of researcher-initiated projects is the traditional ‘business,’ but has been increasingly supplemented by other programmed activities to tackle areas of perceived national importance. Mission statements reflect this changing reality, and often refer not only to scientific funding but also to the role of the agency in developing the scientific infrastructure and building strategic capabilities among the research performers.

Research councils tend to have statistical responsibilities concerning national science and its funding, and to be connected to a national strategy-making arena. For this, they need rather more internal analytical capacity than FWF possesses. Foresight exercises tend to be done outside the research councils, which may however contribute to them.

The scientific community is rather internationalist. Research councils are generally well connected into the international scientific organisations and communities, and to be actively engaged in the development of new international institutions. They tend to be involved in multiple bilateral research co-operation arrangements. FWF’s international engagement is therefore normal behaviour.

Research councils tend to be catholic in the disciplines they will fund. In larger countries (and some small ones), research councils are specialised by themes or disciplines, in order to cope with the problem of tackling large numbers of applications. FWF’s approach of trying to fund based on quality, without taking discipline into account, is admirable but is in most places not practicable. Research councils struggle themselves to draw budgetary lines between disciplines. All but the smallest, however, are defeated in the ambition of having all applications compete with each other by the sheer volume of proposals involved. Allocations of budget among broad groups of disciplines tends to be done in consultation with ministries, or to be reflected in institutional or departmental budgets handed down from above. FWF’s ability to be flexible about allocations to different disciplines is a rare luxury, connected with its small size.

The funding focus of research councils is normally on ‘basic’ and applied sciences (including, generally, the humanities and social sciences). Generally, ‘quality’ is the central value in the assessment process. Newer thematic approaches introduce other dimensions, but the importance of quality remains overwhelming. However, FWF is (together with the Swedish Science Council) unusual in not broadening its scope. NWO in the Netherlands has added cross-cutting and use-oriented themes besides its disciplinary activities, as well as an innovation-oriented theme jointly funded by the education and economics ministries. The Academy of Finland has added use-oriented programmes to its repertoire, some of which line up with TEKES priorities. RCN mixed basic and use-oriented research in most of its divisions during the 1990s, and has now been reorganised so that it has a department for basic research, one for innovation and one for thematic research. The EPSRC spans basic, use-oriented and applied work, and has taken the radical step of introducing not only a Technical Opportunities Panel (mainly academics) to advise the Council on future strategic

⁵⁴ Comparators for FWF are: the Academy of Finland, NWO, RCN, SNF and EPSRC

options but also a User Panel (mainly non-academics) to advise on knowledge needs. The SNF funds not only blue skies research but ‘oriented’ research, which is intended in part to be consistent with the national research foci (*Forschungsschwerpunkten*) and the National Research Programmes.

New types of instruments focus on renewing the research structures by launching young researchers on careers, improving opportunities for women, establishing and strengthening centres of excellence. FWF follows the international trend here. Research councils often play an important role in promoting the public understanding of science, but in this respect FWF’s efforts are limited.

Research councils tend to be foundations or agencies, but are guaranteed a high degree of autonomy through rather ‘hands off’ steering by their principals. Where thematic, applied or otherwise ‘relevant’ programmes are introduced, these may involve different steering mechanisms, with closer links to beneficiaries or the state. Academics dominate the governance of research councils. High-level committees can be very large – several tens of members – but play no role in the detailed management of councils, and are not often involved in project decisions. The role of the FWF Kuratorium is unusual here.

Project resources are normally allocated by the stakeholders, supported by the staff of the council. Clear conflict of interest rules have therefore evolved some time ago. Assessment rules focus on quality and track record, and are usually administered in conjunction with written peer review. Small countries have a preference for using foreigners.

Since research councils’ core values are scientific, evaluations often focus on the state of national science in particular disciplines. There is a trend to introduce surveys of beneficiaries, in order to improve service levels and identify problems. FWF follows the second, but not the first, trend – limited, as elsewhere, by its small strategic capacity.

Processing proposals tends to take longer in research councils than in innovation agencies (partly because of the use of external referees), and is more often tied to calls for proposals. In that projects tend to be conducted in rhythm with the academic year, there tends to be less perceived urgency in relation to processing times, which can take several months.

Acceptance ratios vary considerably, though there is a generally declining trend. FWF and DFG fund half the proposals they receive (albeit often with reduced budgets). The SNF has higher acceptance rates, varying between 61% and 84%. Many other councils work with lower rates: the Academy of Finland with 28% and EPSRC with 32%, for example.

Administration costs for research councils are lower than for innovation agencies, partly because they rely on large amounts of (more or less) unpaid time from academics. Typically, they are in the range 4 – 6% of budget. DFG works with 3.6%, FWO Flanders with 4.3%. The other data points we have are above 5% (RCN 5%, EPSRC and SNF both with 5.5%, NWO with 7.3% and the Swedish Science Council with 7.7% in 2003, down from 11% in 2001). At 3%, FWF is below the normal range, reflecting its focus on bottom-up funding and the fact that it uses

comparatively few resources on activities that do not directly support the operation of this core business.

We can conclude that, in international comparison, FWF is a small and rather traditional research council, operating very efficiently and well in this niche. Like FFF, FWF has tended to lag somewhat behind developments in equivalent organisations. It has ‘stuck to the knitting’, while others have added more use-oriented activities to their repertoire. (Important to note that these new activities are **additional**: traditional ‘basic’ research funding remains a high priority.) Increased efforts in science communications (as opposed to traditional Public Understanding of Science) are also needed if FWF is to play a similar role to its sister organisations in combating the ‘flight from science’ that affects Austria, as it does other OECD countries.

If, as would seem likely in order to reach Lisbon and Barcelona goals, as well as to extend FWF’s scope of action, FWF needs to grow, its current structures will need to change. By comparison with others, it lacks the analytic and strategic capacity to monitor the health of the scientific community, devise strategies to improve it and effectively to link FWF’s actions to a national research and innovation policy arena. Governance needs to be disentangled from operational funding decisions and the assessment process increasingly professionalised in order to enable growth. As with FFF, FWF’s administrative costs are too low to enable it to perform the more extended role taken on over the years by equivalent organisations abroad.

6.3 Research and Innovation Funding Systems

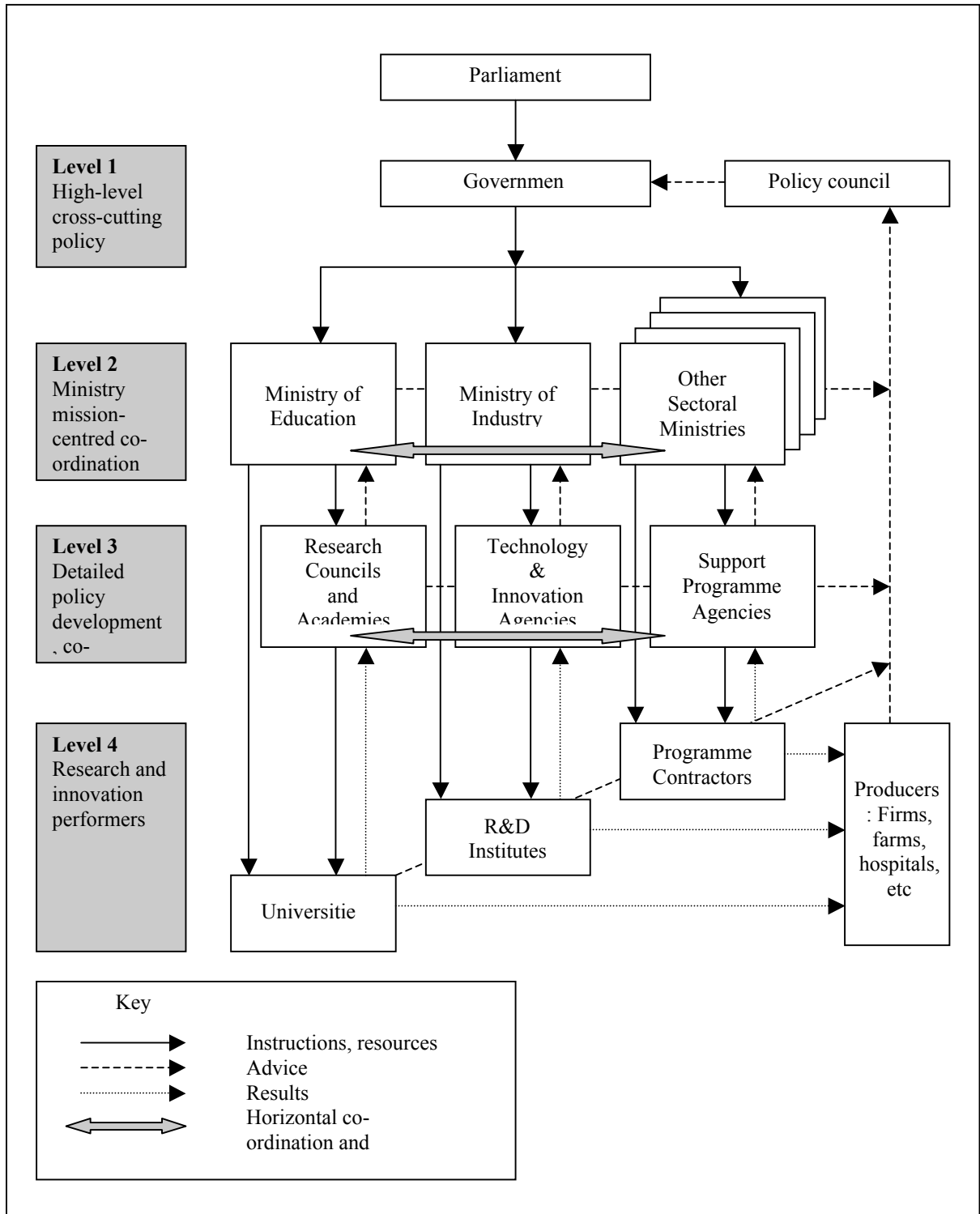
We described the Austrian funding system in the earlier Chapter on challenges for the Austrian innovation system. Here we place the system in international context in terms of three aspects – structure, roles and governance - before discussing emergent properties of research and innovation funding systems internationally and drawing conclusions about the Austrian situation – focusing on the roles of FFF and FWF.

Exhibit 51 provides a generic map of R&D funding and governance structures, to guide our discussion. It is therefore ideal-typical, rather than representing any particular national practice. In this scheme, there are four levels of policy co-ordination

- **Level 1** is the highest level. This involves setting overall directions and priorities across the whole National Innovation System. It may be achieved through advice to government or by more binding means, such as decisions of a cabinet sub-committee
- **Level 2** is co-ordination among ministries, whose sectoral responsibilities otherwise encourage them to pursue independent policies. In practice this level of co-ordination may involve administrative aspects, policy issues or both. Sometimes an inter-ministerial group also functions as the Level 1 co-ordination mechanism
- **Level 3** is more operational, in an attempt to make the actions of funding agencies into a coherent whole. This level, too, can involve administrative co-ordination as well as more substantive co-ordination of funding activities, such as co-programming

- **Level 4** involves co-ordination among those who actually perform research and innovation. Co-ordination at this level tends to be achieved through self-organisation rather than using formal mechanisms

Exhibit 51 Generic Organisational Structure for Research and Innovation Funding and Governance



Source: Erik Arnold and Patries Boekholt, *Research and Innovation Governance in Eight Countries: A Meta-Analysis of Work for EZ (Netherlands) and RCN (Norway)*, Brighton: Technopolis, 2003

Most of the vertical flows shown are formal. The exception tends to be flows into the policy council, which tend to be people-based rather than paper-based, and therefore to be informal. In many systems, especially among the smaller countries, informal co-ordination is also achieved through members of institutions sitting on each other's governing or internal advisory committees.

What in the UK is called the 'Rothschild' principle – namely, that government customers for R&D should not also perform the R&D (so that there can be explicit governance or markets for R&D performance) – is now widely implemented. So too is the principle of 'agencification': separating the operational aspects of R&D funding from the policy aspects, though the division of labour between ministries and agencies varies.

Within the various national versions of these structures, there are typically very separate 'research and education' and 'innovation and industry' empires, represented by separate ministries and agencies. In R&D funding, there is clear convergence on a two-agency model – often with an additional agency or agencies responsible for business development (which to a degree overlaps with innovation) such as AWS in Austria or SND in Norway. Normally the main agencies are dominant within their roles, but do not have monopolies. Some countries (UK, Sweden and Germany, where the Rothschild principle is less implemented than in many countries and major research performers auto-fund) choose to operate with more than two main agencies.

Norway is an outlier in having a single agency responsible for both the research council and the innovation agency function.⁵⁵ Crucially, the effectiveness of the Norwegian model is unknown. The recent evaluation⁵⁶ of the Council concluded that there had been little real integration of the two functions to date. It recommended that the 'experiment' of a single agency should continue because the benefits of de-merger seemed likely to be smaller than the costs and so that the experiment could be continued through the evolution of new structures and instruments. RCN has since been restructured into three areas: a 'basic' research funding division; an innovation division; and a thematic R&D division, intended to fund strategic research, evolve new instruments and act as a change agent in the research performing system. It will be some years before it is clear whether this new single- agency approach is successful.

While industry and education ministries were early in separating the policy function from funding and research, this principle has also been spreading to other sectors (health and medicine, agriculture and fisheries, environment, energy, defence...). This leaves open whether specialised agencies are created to handle these sectoral needs, or whether R&D funding agencies handle the needs of multiple sectors of government. (RCN is again the extreme case, serving 15 different ministries – not just industry and education).

Earlier, we identified various functions that need to be performed by the state in supporting research and innovation.

⁵⁵ So is Iceland, but with a population of 280 000 people, the reasons are perhaps self-evident

⁵⁶ Erik Arnold, Stefan Kuhlmann and Barend van der Meulen, *A Singular Council: Evaluation of the Research Council of Norway*, Oslo: Royal Norwegian Ministry for Education, Research and Church Affairs: 2002

Developing absorptive capacity is done in Austria by FFF, AWS, the industrial placement scheme of FWF as well as by various regional actors. In other countries, this responsibility is similarly diffuse, and is often tackled by both innovation and business development agencies. The boundaries between these kinds of agencies are in any case not always the same in different countries. For example, TEKES plays a significantly bigger business development role than many innovation agencies. (In Ireland, the innovation and business development agency roles are combined in Enterprise Ireland.)

Promoting technological development is a weaker function in Austria, in the sense that it is partly tackled by a number of agencies – FFF, TIG, Christian Doppler, as well as some of the activities of the BMWA such as *Kind* and *Knet*. What is missing is the more strategic approach to technology programmes that is found in countries whose innovation agencies have strong strategy-building capabilities or where there is a powerful agenda-setting **arena** in research and innovation policy (as in Finland).

Funding strategic research is a similarly diffuse function. Overall national strategy is weak in terms of setting out a systems-wide strategy for development, and the strategic intelligence needed to do this is not adequately available in the agencies. FWF deliberately abstains from this role, and the other instruments available to tackle strategic research (competence centres, CD labs, research centres of excellence and networks) are used in a bottom-up way, so there is no effective way to connect the pattern of development in the knowledge infrastructure to developing national needs. In other countries, this **change agency** function is spread across the broader research councils and the innovation agencies – illustrating that here, too, there is no hard and fast boundary that can be drawn between the scope of a research council and an innovation agency.

Funding ‘basic’ research is the business of FWF and the universities. While the balance of money between FWF and the General University Fund is wrong, this function is adequately covered by the Austrian structures.

Bottleneck analysis or strategic intelligence is a weak function across the Austrian system. This is rarely centralised to a single place abroad (once again, Norway is the exception) but is diffused across ministries and agencies – creating dissent, but avoiding the weaknesses of central planning.

Governance in the sense of formal co-ordination of research and innovation policy across the system is a weakness of the Austrian system. (It should not be forgotten, however, how small and socially networked that system is, so that the opportunities to achieve convergence through informal channels as well as through policy competition are better than in large systems.) Important governance functions are

- Setting directions
- A referee
- Horizontal co-ordination
- Co-ordinating knowledge production
- Intelligence
- Vertical steering
- Enhancing the profile of research and innovation

The new Austrian Council is an important opportunity for setting directions in the research and innovation system as a whole. It potentially provides the needed **arena** where needs and trade-offs can be discussed. Unlike the widely-admired Finnish Science and Technology Policy Council, however, it is purely an advisory body. Experience with such bodies in Austria in the past, as elsewhere, is that the key to their effectiveness is whether they have the ear of the most powerful ministers. The Finnish council works because key ministers (prime, education, industry, finance) are members – and because they are sufficiently interested in the business of the Council to attend its meetings. Other countries are trying to move towards the Finnish model, with varying degrees of success.

A key role of the Finnish Council is to play **referee** in the system – both explicitly and implicitly. Its members control the budgets, which gives it an explicit referee function – for example, in resolving which should be national focus technologies or setting the balance between investments in fundamental research and innovation. It is also argued that the fact that the prime minister chairs the Council provides a strong incentive to resolve co-ordination problems at lower levels, since the consequence of failing to do so is that one has to explain oneself to the prime minister.

The referee and arena functions are important because **horizontal co-ordination** among ministries and agencies tends to work poorly in all countries. Here, Austria is no exception to the international rule. There are no instruments for such co-ordination that have been shown to be effective in Austria.

Co-ordinating knowledge production involves providing arrangements for work at the boundaries between fields (where so much of the most interesting and productive research is done), strategic research and aligning strengths in fundamental and more applied funding of research and innovation. This is tackled internationally through a combination of broadening agency missions (for example, to include thematic priorities within the NWO research council) or co-ordination (such as the parallel programme activities of TEKES and the Academy of Finland in recent years). There appears to be no equivalent activity in Austria.

Placing pockets of strategic **intelligence** across agencies and ministries is a requirement for problem identification and high-quality policy debate as well as the

implementation of policy. This function is comparatively weak in Austria and needs to be strengthened both in FFF and FWF, as well as in other agencies and ministries.

Ministries have different styles for the **vertical steering** of agencies. The influence of the New Public Management is increasingly strong in clarifying the performance contracts between principals and agents but there are important differences – especially whether ministries or agencies tackle problem analysis and programme design. Logically, ministries cannot make coherent policy without some analytic capability but the programme design function can be performed at either level. EZ in the Netherlands and DTI in the UK both design their own programmes in detail. EZ then hands the designs on to the implementation agency Senter, while DTI tends to use private sector contractors to deliver programmes (hence the need to maintain in-house programme design capability). BMBF has the same need, when it uses *Projekträger* to deliver programmes. More generally, programme design is handled within the agencies. The Austrian system is characterised by inconsistent practices in steering agencies and programmes, with ministries sometimes taking a ‘hands off’ approach and at others seeking very detailed involvement. No system is perfect in this respect, but most of the other systems we reviewed are somewhat more consistent in their steering practices.

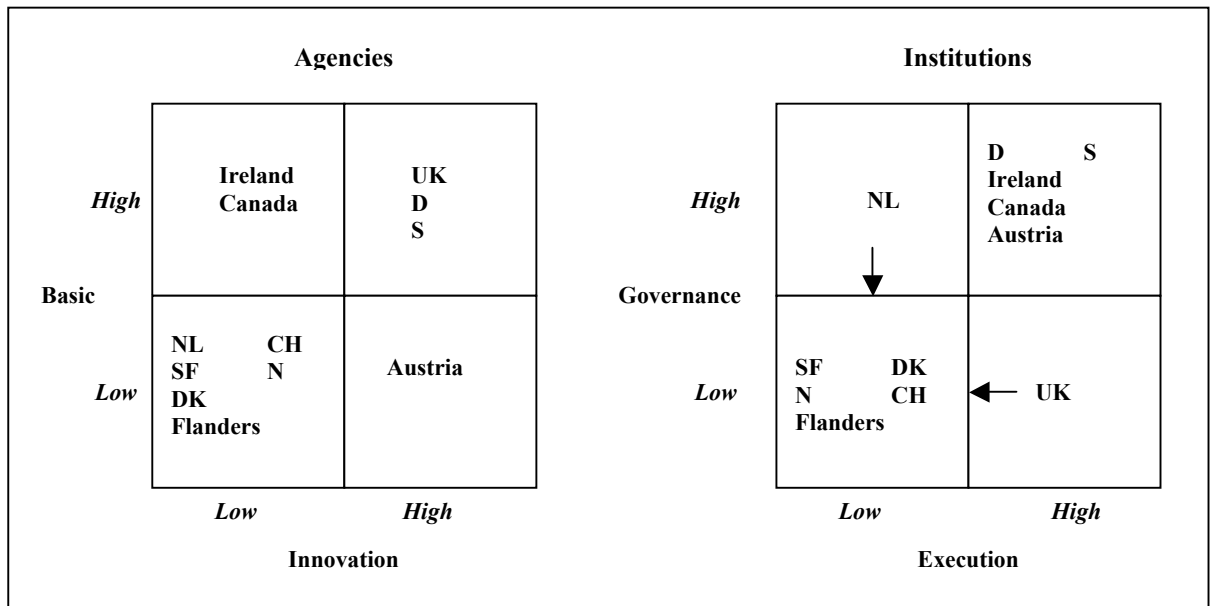
Outside Austria, beneficiaries rarely play an institutional role in steering agencies through membership of governing committees. While stakeholders are very influential in the broad governance of agencies, it is clear that ministries (on behalf of the taxpayer) are in charge.

Enhancing the profile of research and innovation is generally a rather diffuse function, with research councils playing an important role, though there are in some countries (eg the Netherlands and the UK) special organs for this purpose. The need to allocate clearer responsibility and improve this function is as great in Austria as in many other countries.

In other countries as in Austria, there is no single ‘one stop shop’ within the R&D governance system that can negotiate with large multinational companies about multi-faceted R&D support. The agency nearest to being able to do so is Enterprise Ireland, which has a wide range of very flexible R&D and innovation funding instruments at its disposal, but which nonetheless cannot also provide funding or infrastructure for strategic or basic research.

Classifying national systems is very difficult, as many of the interrelationships involved are more subtle than can be captured in organisational diagrams. **Exhibit 52** sketches the degree of fragmentation among the R&D funding agencies and within the governance structures in a number of countries.

Exhibit 52 Degree of Fragmentation in R&D Agencies and Governance



On the left, the Exhibit shows there is a cluster of small countries where both innovation and ‘basic’ research is concentrated and dominated by one or two agencies (one, in the case of Norway). The UK, Sweden and Germany are very much more fragmented in their agency structures – something the UK and Germany can arguably afford, given their scale, but which may not be rational in Sweden with a population of only 8 million people. In Austria, ‘basic’ research funding is rather concentrated in FWF, while innovation is scattered across several agencies. Ireland and Canada tend in the opposite direction.

The right hand side of the Exhibit summarises the degree of fragmentation among agencies (‘execution’) on the horizontal axis, and the degree of fragmentation in R&D governance on the vertical. The bottom-left cluster of countries has few agencies and a rather strong arena or referee function: the Finnish Science and Technology Policy Council; in Norway, the combination of a government research committee and a single agency; a single ministry in Denmark; central committees in Flanders and Switzerland. Austria belongs to a cluster of more decentralised countries where governance is not well co-ordinated. The UK and Netherlands have been off the ‘trend line’ in this Exhibit, but are moving towards it: in the UK through the creation of Research Councils UK, an umbrella to bring to research councils into a virtual organisation; and in the Netherlands through adding high-level advisory group, with the aim of creating a better arena for policy co-ordination.

Some of the trends in the international scene are suggestive of the way needs will also change in Austria. As the Rothschild principle is increasingly adopted, so there are increasing opportunities for agencies to serve multiple principals. This is reinforced by the growing importance of issues – such as environment and climate – that cut across ministries’ sectoral responsibilities and across scientific disciplines. This, together with the more general influence of the New Public Management, also increases the pressure for more consistent and transparent steering and interfaces between ministries and agencies. As the number and scope of instruments used in

R&D funding increases to tackle increasingly systemic questions, so the scope of individual agencies increases and there is inevitably some interpenetration: between business and innovation support agencies; and between innovation agencies and research councils.

From these international patterns, we can conclude that the particular ‘autonomous’ status of FFF and FWF is out of line with international practice, which is to use agencies. The agency structure is rather fragmented on the innovation side in Austria; less so on the side of more fundamental research. The way in which R&D funding agencies are steered lacks consistency, compared with international practice, and would benefit both from increased strategic intelligence capacity in the ministries and agencies, and from clearer principles about the division of labour between ministries and agencies in programme design. FFF and FWF are narrowly focused and somewhat inflexible, compared with international counterparts. At this stage in its life, the Austrian Council has yet to have a significant influence on national research and technology strategy, as evidenced by the lack of adaptation of the agencies to any such strategy. It is an open question whether it can develop the power and influence in the system to become an effective policy arena or to act as ‘referee’ in setting policy. On the face of it, its distance from government makes this unlikely, and this is exacerbated by the fact that there is a separate Austrian Science Council. This is likely to leave Austria with continuing problems in developing national strategy and in linking the development of strategic research and the knowledge infrastructure to national needs.

7 Conclusions, Options, Recommendations

In this final Chapter we consider how the Funds live up to the various challenges identified for them, how they perform and how the Austrian structures compare with those abroad. We specifically answer the eleven evaluation questions put to us in our terms of reference. Then we consider policy options and make recommendations for the future of the Funds and the contextual conditions they need in order to develop.

7.1 Meeting the Challenges to the Austrian Innovation System

7.1.1 The Challenge of History

The Research promotion Act of 1967 was in many ways a very forward-looking piece of legislation. It modernised R&D funding in line with then-current ideas about research and its relationship to society: funding on the basis of projects rather than some less well-defined entities; putting in place stringent quality controls; and defining an autonomous status for the Funds that would limit the scope for political interference in individual funding decisions and also in terms of setting directions ‘top down’. The Funds were invited to do their own prospective studies of needs and determine their own futures. The stakeholders and beneficiaries of each Fund were put firmly in charge, in what amounted to a vote of ‘no confidence’ in the ability of the Austrian state to provide responsible governance.

This proved to be a tragic flaw, because to a considerable extent it locked the Funds into their 1967 roles. With the beneficiaries in charge of giving themselves taxpayers’ money, there was insufficient incentive for the Funds to change with the changing times. Both Funds today work with a wider set of instruments than in their early years, but neither encompasses the breadth of action of many of their equivalents internationally. As a result, especially in innovation promotion, several other agencies (as well as private consultants) have grown and taken on many of the newer instruments, such as those dealing with science-industry linkage, commercialisation of ideas and company generation from the knowledge infrastructure. Already in the early-mid 1970’s, ministries started to re-establish their own R&D programmes, tackling ‘top down’ problems and opportunities that the Funds have not been able to tackle. The resulting proliferation of R&D funding actors is certainly untidy, though it does have the advantage of encouraging a high degree of experimentation, policy competition and the application of instruments such as competence centres, which are among the most modern internationally.

7.1.2 The Institutional Challenge

The proliferation of actors is, of course, also the result of decisions by the ministries. At the limit, the Funds’ autonomy is worthless if the ministries decide to cut off the money supply, though in any one case it may be easier for a ministry to find an alternative agency to do its work than to risk a pitched battle with the beneficiaries about the mission of the Funds. The ministries have nonetheless chosen a path of fragmented policy implementation, with a wide variety of different kinds of interfaces to their agents, in a manner from which R&D funding systems in many other countries have been retreating in recent years. If there is a need to reform the

structure of Funds and agencies, therefore, there is also a need to reform their governance and their relationships with the ministries.

Other countries (especially small ones) have chosen somewhat more centralised ways of structuring their R&D funding agencies, the dominant model being of two primary agencies – one research council and one innovation agency – with variations about where the boundary is drawn between them and the extent to which other agencies, funds and foundations are also involved in R&D funding. The proliferation of agencies in Austria limits the opportunities to build scale, to learn across the R&D funding system, to develop the concentrations of ‘strategic intelligence’ needed for agencies and ministries to develop good strategies

7.1.3 The Challenges for Research and Innovation Policy

We identified (in Section 2.1.5) a number of major challenges for research and innovation policy, in which one would expect the national research council and innovation agency respectively to play a role. How are they in practice contributing?

In a longer-term sense, both Funds make significant contributions to tackling the challenges. The research and innovation literature makes clear that one of the most important roles of the knowledge infrastructure (especially the universities) in supporting the health of the innovation system is to generate a supply of research-capable people. FWF clearly plays a key role in this. Its bottom-up principles allow it to reinforce the natural tendencies of some members of the scientific community towards renewal and growth, but not to combat the countervailing forces in the scientific community that lead it to reproduce itself (up to and including gender inequalities).

In the short term, FFF provides a mechanism for metamorphosing state money into private R&D expenditure. On our calculations, a € in FFF subsidy triggers 1.4 Euros in private R&D expenditure. But this needs to be complemented by other ways to raise business expenditure on R&D. In the longer term FFF funding plays a part in extending companies’ technological capabilities and horizons, providing a sustainable (but much less easy to measure) contribution to competitiveness. It plays an especially important role through the comparative generosity of its measures for small and new firms. To the extent that company birth and growth in Austria spontaneously occurs in high-potential industries, the FFF mechanisms will reinforce restructuring.

These aspects of the Funds’ work are important. What they do is to strengthen ‘business as usual’ within the research and innovation system. What they do not do is to offer mechanisms for increasing the rate of change beyond that which is already experienced.

The Funds’ limited strategic intelligence capacities today means that they play a negligible role in identifying new policies and instruments needed to raise the national investment in R&D. The limited range of problems they address and their conservatism in relation to extending these means the Funds are today of limited use implementing new kinds of measures. This is a matter of choice: the Funds are strong and capable organisations, and if they chose to expand key capacities they would be strongly positioned to make major contributions towards reaching the Lisbon and

Barcelona goals. Increasing the funding for their ‘core businesses’ would, in contrast, make only a limited difference.

Hastening the rate of industrial restructuring by generating growth in more knowledge-intensive industries is difficult. In so far as the support infrastructure can help, it can do so both by supporting individual initiatives and by focusing complementary activities (such as research, science-industry linkage schemes, industrial clustering) on high-potential areas, via an indicative strategy that is shared by several actors. FFF has in recent years shown itself willing to focus resources on technology programmes, which could be important elements of such strategies. FWF has yet to consider such strategic focus. Crucially, there is today no authoritative, higher-level strategy within which they could co-operate. In particular, it is not clear how **binding** the strategy of the Austrian Council is.

Many of the growth points in science and in industry are at the intersections of different disciplines. While FWF’s assessment scheme makes no reference to interdisciplinarity, while rewarding contributions to ‘the discipline.’ FWF has no strategy for interdisciplinary growth points, and no way to implement such a strategy. While there is no proper accounting for the way FFF money flows into the knowledge infrastructure, it is clear that a proportion ends up in engineering faculties, whose business is often rather interdisciplinary. In this sense, FFF may be addressing some of the interdisciplinary knowledge needs of established industry, but neither Fund is in a position to make a systematic contribution to reaping the renewal potential from interdisciplinarity. Again, without a wider strategy, it would be difficult to do so.

In an act of programming that runs directly counter to its core values, FWF uses instruments to support women researchers. We argue that more effective measures should be taken at the level of the universities, as fFORTE does. FFF does not have a female entrepreneurship or innovation programme, and the main (if sadly small-scale) action in the industrial area is the FEM-TECH (part of the fFORTE) initiative run by the TIG. Both Funds could be more active in tackling Austrian women’s pitifully low presence in academic and industrial R&D. In parallel, national action is needed to encourage girls as well as boys into technical subjects. This is again an action that needs to be launched at a higher level than the Funds, and is typically something that the Austrian Council could initiate.

FWF long ago implemented centres and networks of research excellence programmes, which are complemented in areas of use-oriented research by the competence centre programmes. All these actions are essentially bottom-up and could benefit from co-ordination with a wider strategy – if there were one. There is scope to use such schemes to help universities specialise to a greater extent, too, but this would involve allocating money on the basis of **prospective** achievements and not just track record. It would therefore represent a departure from existing practice.

Almost all efforts to improve science-industry links have been launched outside the Funds. A significant proportion of FFF’s money ends up in the hands of the universities, but this linkage appears to be more a by-product than a main objective of FFF funding. Both Funds could be considerably more active in building links between industry and researchers.

The other challenge we identified was framework conditions and culture for innovation. Much of this is outside the hands of the Funds, but ‘culture’ in the sense of interest in and willingness to undertake innovation can be addressed both through academically- and industrially-oriented schemes.

Overall, it seems that the Funds are hampered in their ability to tackle the key national challenges by their historical focus on ‘core business’ and by the absence of a wider strategy or context within which they can operate. Their potential to contribute is considerable, but does entail abandoning their traditional perspective that bottom-up funding is the Holy Grail of research and innovation policy.

7.1.4 Challenges from Theories of the Production and Use of Knowledge

In Chapter 3, we sketched some of the important developments in the way we think about knowledge production. How do the structure and performance of the Funds match with the challenges posed by theory?

The Research Promotion Act essentially defines the Funds as research funders, and is consistent with the ‘linear model’ idea that good social and economic things will automatically flow from investments in research. Ways to analyse and stimulate the more complex interactions that we now believe are vital for a healthy research and innovation system are largely absent from the Funds. The Funds primarily address market failures in knowledge production, and have few instruments that can help with various kinds of systems failures, some of which can in any case only be addressed by different actors working in concert. Correspondingly, the Funds address few of the state’s roles in promoting the health of the research and innovation system.

The central values of FWF relate to Bohr’s Quadrant of ‘basic’ research, while FFF is more focused on Edison’s (see **Exhibit 9**). Neither is especially concerned with Pasteur’s Quadrant, and the overall context lacks mechanisms to help decide where within Pasteur’s Quadrant it would make sense to focus funding.

FWF instruments focus on Mode 1 knowledge production, and explicitly disallow many economic actors from participating in more fundamental research – whether in Mode 1 or Mode 2. In contrast, FFF is willing to fund Mode 2 activities, essentially as by-products of company innovation projects.

In one of the funniest and most useful recent contributions to the professional literature, Pawson and Tilley pithily sum up a central lesson from evaluation: namely, that context is crucial, arguing that in any policy intervention

$$\text{mechanism} + \text{context} = \text{outcome}^{57}$$

This is a central observation from the innovation systems literature, too. The Funds perform their functions within a wider system of governance that lags somewhat behind the principles of the New Public Management. The division of labour between ministries and agencies is unclear and inconsistent. Performance contracts are ill-specified. Actors are poorly co-ordinated, and it is not clear what the overall strategy is.

⁵⁷ Ray Pawson and Nick Tilley, *Realistic Evaluation*, London: Sage, 1997

7.2 Performance

Overall, the performance of both Funds is strong, within the comparatively narrow space defined for them in 1967. If they are to operate as modern agencies, both need to broaden their scope and increase both their analytic capabilities and their administrative costs.

7.2.1 FFF

While the scope of FFF's activities has remained comparatively narrow, it is a fast and efficient deliverer of its 'core mission' of bottom-up funding for company-based R&D projects – an area in which it has been honing its skills and developing intellectual capital for almost four decades. However, it lacks enough analytical capability to fulfil its potential as a proactive innovation agency. It is today largely reactive, and does not have a strategy in a meaningful sense. Its governance structure is too large, wasteful of time and is overly dominated by the social partners. The fund needs a degree of financial predictability. It is unfortunate that it has moved into deficit financing, which does not provide the needed long-term stability.

FFF subsidy brings considerable benefits, triggering additions to firms' R&D activities and helping companies to do larger-scale and more timely R&D than would otherwise be the case. Economic benefits, including increased productivity, accrue to these firms. However, the levels of risk involved in the projects are somewhat modest. More could be done to increase companies' 'absorptive capacity'. FFF could tackle a significantly broader range of instruments than it uses today.

7.2.2 FWF

FWF is also a highly efficient and effective performer of its traditional mission to fund 'basic' research. It possesses and develops important skills and intellectual capital in relation to this mission (such as its knowledge of scientific referees outside Austria). It has tackled some of the problems, such as career development and gender balance that are emerging in many research communities, though in tackling a small number of problems it has proliferated an unnecessarily large number of instruments. But it has yet to use instruments that would allow it more actively to manage the development of the research community, and it does not have the analytic capacity to develop the strategy that would allow it to do so. It does not specifically tackle the use-oriented research that is increasingly handled by research councils elsewhere.

FWF's governance structure is too big, and the fact that many members **represent** their own organisation is problematic, especially in the context of the university reforms. The current assessment procedure is of a type that is widely admired, but is difficult to operate even at the present scale. Especially if FWF grows, it will be necessary to professionalise more of this process.

The balance between FWF's budget and the General University Fund is wrong. The quality-controlled part (FWF) should have a greater share, in order to exert 'leverage' over university research more generally, and so that it can pay the research overheads that will be necessary to avoid distortions as the newly reformed universities begin to understand their own costs in more detail. Aside from this rebalancing, there is also a case for the Fund's budget to rise, if it is given wider responsibility for use-oriented

research or Pasteur's Quadrant that will evidently contribute towards reaching the Lisbon and Barcelona goals.

7.3 Lessons from Abroad

As discussed earlier, differences in context mean we cannot simply identify 'best practice' and propose to transplant it to Austria. But we can try to understand why things are done as they are, and then consider whether similar practice makes sense in the Austrian situation.

7.3.1 The Funds

Internationally, there is a movement towards treating R&D and innovation funding in a systemic way. Instruments are moving away from the one-beneficiary-at-a-time models that dominated FFF and FWF at the outset and towards more complex interventions involving networks and, especially, industry-academic linkage. Agencies are becoming wider in scope. In international comparison, therefore, FFF and FWF appear somewhat narrow in their respective scope and to be faithful to a now rather out-dated set of views about how research and innovation work. The distinction between 'top down' and 'bottom up' funding is highly politicised in Austria. Many foreign agencies fruitfully mix both modes of funding. Few share the Funds' apparent allergy to programming.

While agencies outside Austria have broadened their scope over time, the model of having separate innovation agencies and research councils is almost universal. It will be some years before we know whether the second attempt to bring these functions together into a single organisation in Norway has been a success. Nothing in the international experience that is visible to us, therefore, speaks for merging FFF and FWF.

Austria has a surprisingly high degree of fragmentation among its innovation agencies. It clearly makes sense to explore whether the kinds of economies of scope and learning that have led other countries to limit the number of agencies in this area can also be obtained in Austria. On the research council side, the Austrian scene is less fragmented, and there is less of an apparent need for reform.

Agencies increasingly need strategic intelligence capabilities in order to decide how to reach their objectives. This intelligence needs to be matched by capabilities in the ministries. There is an emerging trend for agencies to be able to serve multiple ministries, as research and innovation questions become more visibly important components of more ministries' work – and as the principle of separating customers and contractors for government R&D is increasingly implemented.

The approaches FFF and FWF respectively use for assessing proposals and acquiring projects are very much standard practice internationally, although for many research councils FWF's approach is an ideal that cannot be implemented because the volume of applications is too big. Scientific administrators therefore play a bigger role in assessment than in Austria.

The narrow scope and limited strategic intelligence capacity of the Austrian Funds, as well as their inherent efficiency in executing functions they have practiced for nearly

40 years, mean that they have below-normal levels of administrative cost. Bringing their capabilities into line with international practice would increase these costs, but international practice suggests that the greater capabilities involved are essential ingredients of a funding practice that can handle the complexities of the early 21st Century.

7.3.2 Governance

The ‘autonomous’ status of the Funds is highly unusual, as is the effective control of the Funds by their stakeholders.

Abroad, R&D funders tend *de facto* to be agencies, and generally are so *de jure*, as well. The mechanisms of governance effectively ensure that these agencies have a considerable level of autonomy. The kind of worries about political interference and bureaucratic meddling in the detail of decisions that underpin concerns about the Funds’ autonomy in Austria are largely absent in the other countries we consider, where the influence of the New Public Management movement is increasingly pervasive. Amongst other things, this implies rather ‘hands-off’ steering and governance mechanisms (following the subsidiarity principle, that decisions should be taken as low down in hierarchies as is possible) and increased use of management by objectives. The constituencies involved in governance are also broadening, with stakeholders becoming less dominant, while still retaining a strong influence. Neither ministries nor members of governing bodies are expected to influence or in any other way to become involved in the detail of project-level decisions.

Were Austria to follow good foreign practice, this would involve more homogenous and orderly governance and steering processes, with increased standardisation of the level of detail at which agencies are steered. This would enable agencies to continue to serve multiple ministries, while allowing them to optimise internal processes.

7.3.3 The Wider Institutional Context

Despite the efforts of the new Austrian Council, Austria lacks a convincing national research and innovation strategy. The Council itself does not have the authority of some other organisations that aim to function as national arenas for research and innovation policy formulation. Unlike the powerful Science and Technology Policy Council in Finland, the Austrian Council does not have the political ‘clout’ to function as a referee in the system. It is nonetheless important that the Funds play their full parts in co-ordinating with the Council, based on significantly improved internal ‘strategic intelligence’ capacities.

Rapid changes are in progress in developing an European Research Area – even if the changes may not be as rapid as European commissioners might desire. Abroad, awareness is growing among research and innovation agencies and ministries alike that these changes will require greater activity and capacities at national level.

Abroad, technology foresight is generally a national function, and we would expect the Funds to make significant inputs to such an exercise in Austria. While foresight is quite well articulated internationally, however, few countries have a particularly convincing set of actions in place for science communications or the public

understanding of science. These are clearly areas where the Funds should be involved, but as parts of a bigger strategy.

While there is something of a convergence internationally, especially among smaller countries, on a two-agency model, this does carry a risk of ‘lock in’. In Finland, one of the roles of SITRA (which uniquely answers to Parliament, and not to a ministry) is to spot and remedy such situations. At about the same time as the Funds were established, Sweden set up its National Board for Technological Development (STU), partly as a research-focused innovation agency and partly to function as a disruptive change agent – funding technological developments⁵⁸ that had industrial potential but that could not be funded via the bottom-up processes of the research councils. In other cases, such as the appearance of genomics programmes in Austria and Norway, the agencies are simply unable to handle major shifts in direction, and ministries have intervened. Creating space for alternatives and change may be a more important facet of designing R&D support systems than may generally be recognised.

7.4 The Evaluation Questions

Our brief puts eleven specific questions to us. They are good questions, have guided the design of this evaluation and are answered elsewhere in this report in a way, which we hope is readable and understandable. Nonetheless, for the sake of good order, we explicitly – and deliberately briefly – answer the questions in this section.

The two over-arching questions are

- 1 *Are the instruments, procedures and structures adopted by the funds – according to their mission (FTFG) – appropriate to support the investigational and innovational behaviour of the relevant actors in an efficient and effective way?*
A The Funds’ instruments, procedures and structures are consistent with the objectives of the funds and do efficiently support the beneficiaries, as intended. However, the scope of the Funds’ activities is too narrow for them to serve their intended purposes

- 2 *What is the position of the two funds in the national, international and especially European science and innovation system and what recommendations can be made for future strategies?*
A The Funds are too isolated from the work of other actors supporting the research and innovation system, at both national and international level. They should develop their own strategies, in the context of a wider national research and innovation strategy, which is itself yet to be developed. For a small country like Austria, there is little choice but to join in developments in Europe. Both Funds need stronger analytical capabilities and more staff dedicated to international partnerships and internationalisation

The more specific questions are

⁵⁸ These include the underpinnings of Sweden’s currently strong positions in mobile telephony and aspects of biotechnology. VINNOVA, *The Impacts of R&D During 1975-2000. The Impact of VINNOVAs Predecessors’ Support for Needs-oriented Research*, Stockholm: VINNOVA, 2002

- 1 *Are the objectives, the legal mandate and the strategic orientation of the funds appropriate to pursue the intended effects of research funds? How are they positioned in comparison with corresponding international funds?*
 - A The objectives of the funds relate to an out-dated perception of the role of the state in the research and innovation system, and should be extended from the idea of supporting research to the idea of strengthening the performance of the research and innovation system as a whole, while leaving the foci of the Funds unchanged. This is supported by the way foreign agencies have developed, broadening their roles over time to handle interlinkages within the research and innovation system

- 2 *What are the strengths and weaknesses in the performance of the funds? What is the impact of the funds' activities on the corresponding science system and industrial RTDI?*
 - A The strengths lie in the efficient performance of their core activities. Weaknesses include: lack of strategic intelligence; strategy; integration into a national strategy or strategic process; domination of the governance by the beneficiaries. The Funds have a clear and positive influence on the science system and industrial RTDI. This influence would probably be stronger if they complemented their bottom-up funding activities with more top-down and proactive actions to promote structural change

- 3 *Are the principles which underlie the choice and mix of instruments adopted appropriate to the objectives of the funds?*
 - A These factors that underlie the choice and mix of instruments are not so much 'principles' as the history of the Funds' practices. They are appropriate to the objectives of the Funds, but these objectives are themselves too narrow

- 4 *Are the funds' instruments, procedures and structures (including the autonomy and election procedures of the institutional organs) appropriate to the objectives of the funds and the needs of the funded? How are they to be evaluated in international comparison?*
 - A The instruments and procedures are adequate to the goals of the Funds, but these goals are too narrow to meet the needs of the intended beneficiaries, let alone the research and innovation system as a whole. The structures give the beneficiaries too much power, and this has allowed the Funds to become locked into an out-dated approach to their tasks. Equally, the ministries have chosen not to tackle this problem but to encourage a proliferation of other agencies (especially in the field of innovation) in order to reach their policy goals

- 5 *Do the funds employ appropriate procedures to secure the quality of the supported projects and to adapt to changes in the context conditions?*
 - A Assessment and quality assurance procedures at the Funds are efficient and high quality, though the involvement of organs of governance in them is redundant. The slow rate of change in the Funds' instruments, processes and criteria suggest that the rate of adaptation to context conditions is also slow

- 6 *Is the coordination of the funds with other national research and funding instruments and institutions suitable to realise feasible synergies and to guarantee the proper handling of trans-institutional topics and projects? To what extent*

does this have an impact on the effectiveness of the funds' activities (i.e. synergies vs. core activities)?

- A The degree of co-ordination is very limited and seems to have had little effect upon the Funds. In the absence of a national strategy, vision or other framework for research and innovation policy, it is difficult to see how this could change
- 7 *How do the funds co-ordinate, co-operate and communicate with the relevant actors of the science and innovation system, especially with each other and the corresponding ministries?*
- A Until recently, the primary content of co-ordination between the Funds appears to have been the avoidance of double funding, rather than more significant questions of strategy. Immediately prior to the start of this evaluation, an *Arbeitsgemeinschaft* was formed between the Funds and TIG, but its content to date appears primarily to have been communication with the public. The Funds' autonomous status limits the scope of their communications with the ministries. However, there appears to be an unhelpful diversity of styles within and between ministries that would make it hard for the Funds to develop consistent strategies and interfaces to these important customers
- 8 *How is the interdependence of the funds' performance and the context conditions? How are the characteristics of the Austrian institutional and funding system influencing the performance of the funds?*
- A As the history shows, the Funds have changed little in response to changing context conditions. The policy choice is now whether to continue to operate the Funds in their rather narrow niches or to integrate them into wider policy actions and agencies
- 9 *What are the strategies of the funds to secure their positioning and integration in the European research and innovation system? What are the steps taken to secure the realization of synergies with institutions in other countries and with European institutions and programmes?*
- A Both Funds participate at a certain level in international activities. FWF is engaged in promising initiatives within the German-speaking area, as well as in ESF. FFF's role in the EU programmes is rather overshadowed by the BIT and the actions of the ministries, so it is more distant than it should be from events in the Framework Programmes. Neither Fund has begun to engage with the (admittedly shifting) European Research Area in a way that translates into new actions or instruments. Both would need additional resources in order to do so.

7.5 Options

Broadly, BMVIT has four kinds of option in relation to the Funds

- 1 Closure
- 2 Retain Current Roles
- 3 Expand Roles
- 4 Merge the Funds

7.5.1 Closure

This evaluation provides no grounds for closing either Fund. We have shown that, while they have imperfections, they both serve useful purposes and perform their functions well, as originally defined. They constitute important parts of the support infrastructure and are a required part of any strategy to approach the Lisbon and Barcelona goals.

7.5.2 Retain Current Roles

Retaining the Funds in something like their current shape and size is therefore a very real option. They meet certain needs. Their activities are a legitimate and positive exercise of the powers of the state and produce social benefits. They are embedded within a wider system of actors, who have co-evolved to take on many of the newer tasks that, in other countries, have largely been handled by a smaller number of research councils and innovation agencies. And in practice, this collection of actors has been muddling through for some time. However, the current situation has a number of important weaknesses that would need to be remedied within what would essentially be a 'no change' scenario

- Both Funds need additional staff resources to deal with analysis, strategy, communications within the Austrian R&D funding system and international affairs
- Correspondingly, it would be helpful if a more effective arena for research and innovation policy discussion were established, together with a national visioning or strategy-making process, within which the Funds could develop their own priorities and strategies
- Both Funds need to reduce the size of their governing committees and professionalise their assessment processes to a greater degree
- Both Funds need greater predictability in terms of budgets
- FWF cannot avoid tackling the consequences of the university reform, which implies the payment of overheads on grants
- Over time, either the ratio of FWF to GUF funds must increase in order to provide leverage over quality in the university sector, or some kind of research assessment exercise needs to be introduced within that sector, to increase competition
- The ministries and the Funds together need to develop a clearer division of labour concerning questions such as programme design, so that there is a comparatively homogenous 'steering' interface between them. This will allow the Funds to serve multiple principals, as additional ministries increasingly need to have R&D needs satisfied through external funding
- We have also identified a number of process improvement opportunities, which are discussed in preceding chapters and in the background reports to this evaluation

In this scenario, there is no great need to change the Funds' autonomous status. This involves recognising that (a) in the past couple of years, the willingness of the Funds to take on new activities and instruments appears to have increased, and (b) the dominant role of the beneficiaries is likely to continue to act as a brake on the development of the Funds, and that many of the new actions and instruments required

in the R&D support system will continue to be developed and implemented outside the Funds.

7.5.3 Expand Roles

The third option of expanding the roles of the Funds will involve all the improvements required for the ‘no change’ scenario, plus more.

- The first precondition for expanding the role of the Funds is that they need to be changed from quasi-autonomous bodies to **agencies** of the government. This frees them from the control of their beneficiaries and establishes a governance link back to the taxpayer, whose money they spend. Sister organisations abroad provide good examples of such relationships with government, which would prevent the Funds from becoming objects of short term politics
- Inevitably, in a system as densely populated as the Austrian R&D funding system, expanding the roles of the Funds would require an assessment of whether to merge one or both of them with other organisations, in order to achieve greater scope
- Agencies with wide scope are more likely to be able to work for multiple principals, increasing the pressure for a comparatively standardised governance mechanism and division of labour between ministries and agencies

A full assessment of expansion and merger potentials is outside the scope of this evaluation. FWF is close to holding a monopoly of ‘basic’ research funding in Austria. An expansion would involve adding more use-oriented research to its portfolio and programming at least some of the additional resources involved. The boundaries of an expansion for FWF would be set by the places in which its core capabilities are useful. In particular, it has a fine and operational understanding of universities but little exposure to the world of industrial research. Science – industry linkage activities such as the competence centres match much more closely to the capabilities of the various innovation agencies (TIG, FFF, ASA).

In contrast, any expansion of scope for FFF, while it raises the question of merger, also provides opportunities for an expanded organisation to exploit synergies such as understanding a common set of customers, understanding how industry and particular technologies work and sharing intellectual capital. Prima facie, the current effort to merge FFF with TIG, BIT and ASA makes sense. An equivalent case for FWF to merge with any one else is hard to make. Rather, it would need to expand organically, taking in and developing new funding routines related to internationalisation, for facilitating the objectives of the university reform and for use-oriented research, that to some degree falls between FWF and the innovation agencies today. This implies that FWF would need to introduce thematic as well as disciplinary research.

7.5.4 Merge FFF and FWF

This option in effect adds further elements to Option 3 – Expand roles. It would involve all the challenges set out for that option, plus some more. In particular

- It would require implementation of an organisational model that exists really only in one country and that is still, in effect, experimental even there

- It would require ways to find intellectual and process synergies between the scientific and industrial communities and the associated stakeholders
- It would involve finding additional synergies in terms of beneficiary groups
- Not least, it would involve overcoming massive opposition from the scientific community, and probably from the industrial community as well

Given that there already a number of rather modern instruments in place in Austria (notably at the TIG) which tend to link science with industry, it is unclear at this stage what particular problem an FFF/FWF merger would solve that is not already reasonably well being addressed.

7.6 Recommendations

The options set out above set out a clear agenda for change.

- A number of detailed recommendations for improvement have been made in this report and in background reports, which the Funds should consider
- Both Funds require additional resources to generate strategic intelligence and their own strategies, strengthen their international roles and improve their communication within the Austrian funding system
- FWF's role should be organically expanded to tackle use-oriented and thematic research. It will need a substantial budget increase to cope with this, and with the need to pay overheads on research grants in future. Its positioning within an industry, rather than an education, ministry is an advantage in arguing for such increased resources
- FFF should be merged into a broader innovation agency. The proposed merger with TIG, BIT and ASA appears to be a reasonable option for achieving this, although other configurations would also be possible
- The Funds should be transformed into agencies and the power of their beneficiaries in the governance structures should be limited

Improving the performance of the Funds also requires important changes in their context. With the best will in the world, it is hard for an agency in a complex system to act effectively isolation. Our brief analysis of that wider system suggested a need for a stronger **arena** function and for some kind of **referee** within research and innovation governance in Austria, roles which could potentially be tackled by the Austrian Council. Efforts should be made to increase the ratio of FWF spending to spending through the General University Fund. In Austria, as in many countries, there is also a need for greater predictability in budgets, so that agencies can plan more securely.

The other key requirement is clearer and reliable governance. We interpreted the Research Promotion Act of 1967 as a vote of 'no confidence' in the Austrian state's ability to govern R&D agencies in a modern manner. To reverse that vote, the ministries and political level need to demonstrate that they can

- Manage by objectives and properly delegate authority to agencies, without seeking to interfere in daily operations such as project assessment. This should

include delegation of programme design as well as management. Ministries can then focus on policy questions, rather than operational ones

- Maintain the 'strategic intelligence' needed to do this
- Professionalise leadership and personnel decisions in the agencies, so that appointments are made in fair and open competition, and there is no risk of the modern principles of management by objectives and the use of performance contracts being subverted by personal or political influence, as seems to have been a concern of those framing the 1967 legislation
- Develop reasonably standardised ways of instructing agencies, so that ministries can use different agencies to achieve different policy objectives

It would be a useful follow-on to this evaluation for BMVIT or another key actor in the Austrian funding system to undertake a brief review after a period of, say, two years, ensuring that progress has been made by the Funds and others in the directions we suggest.

7.7 Principles

The thrust of our conclusions and recommendations is that the Funds need to be modernised, departing from the specific 1960s models of R&D funding and governance in the German-speaking countries and becoming more consistent with current and wider international practice. We have shown that the Funds' current behaviours reflect their history and the evolving division of labour between themselves, the ministries and other agencies. With this in mind, it is perhaps worth stating some rather important, broader principles relating to their future – for changing the Funds without also addressing their context is a recipe for failure.

- For the foreseeable future, there needs to be agreement on a funding model where there are two main pillars: a research council and an innovation agency. On the principle 'as simple as possible, but no simpler,' not everything has to be neat and tidy, but these main pillars should co-operate and co-ordinate with each other and other funders, while essentially doing different things and being able to plan on continuing to do so
- They need to communicate with a single, influential, national 'arena' where Austrian society can, in effect, discuss its research and innovation priorities. There is nothing wrong with having other places separately to discuss more specialised aspects of policy and funding practice, especially as this produces intellectual diversity. But a situation where, for example, innovation on the one hand and education and research on the other have separate *fora* and do not meet is a good way to ensure fragmentation and inefficiency in the overall funding system
- The division of labour between ministries and agencies needs to be transparent and modern. It is the business of ministries to make policy, and of agencies to implement it – and this means that each needs to develop strategies at their own level. In a sensible world both sides have enough analytic capability to make the conversation an intelligent one. This means establishing clear performance contracts between the ministries and agencies in terms of objectives and how and when they are measured. Correspondingly, it means absolutely forbidding interference from the policy or political level in operational matters such as personnel and project decisions

- The process of ‘agencification’ of R&D funding needs to be completed, placing operational responsibility for programmes within agencies and abolishing the unhelpful distinction between ‘ministry programmes’ and ‘agency programmes’
- Ministries need nonetheless to retain enough analytic capability to support their policy needs, including the ability directly to commission research relevant to defining these policies. Thus the ministries as well as the agencies need to be equipped to monitor relevant parts of the science and innovation system, undertaking ‘bottleneck analysis’ in order to identify problems, as well as listening to more direct signals from stakeholders
- Agencies should be able to use their proximity to the ‘real world’ as an important input into their strategies, and use these to make recommendations to ministries, so that ‘bottom-up’ understanding meets ‘top-down’ policy objectives. In the longer term, the agencies should propose, design and implement programmes and other instruments that answer to the policy needs of the ministries. A period of time and a managed process will be necessary in order to make this transition
- Agencies should be able to develop strategies that allow them to obtain economies of scope as well as scale, tackling policy needs of multiple ministries where appropriate. This in turn implies a relatively general agreement about limiting the role of ministries in relation to programme and instrument design – leaving the agencies free to use common instruments to serve policy needs, while still enabling valuable analytic and policy input to come from the ministries where that is helpful
- Beneficiaries must be important in the governance of agencies, but not have overall control, which should be exercised by a wider range of stakeholders on behalf of the taxpayers

This sets an agenda for radical change not only in the Funds but also in the whole system of governance.

Appendix A List of Background Reports

The following reports provide the background analysis to this evaluation and may be obtained electronically from the organisations shown or from Technopolis at the Internet address shown below

- 1 The Innovation Systems Context [Joanneum Research]
- 2 FFF, FWF and Other R&D Funding Agencies and Instruments in Austria [Joanneum Research]
 - 3.1.1 FFF History and Governance [Technopolis]
 - 3.1.2 FFF Internal Functioning and Customer Satisfaction [Technopolis]
- 3.2 Evaluation FFF Impact Analysis [Joanneum Research]
- 4.1 FWF Governance and Processes [Centrum voor Studies van Wetenschap. Technologie en Samenleving, Universiteit Twente]
- 4.2 Evaluation FW Impacts [Joanneum Research]
- 5 Background materials on international R&D funding [Technopolis]
- 6.1 Panel Review of FFF
- 6.2 Panel Review of FWF
- 7 Achieving Austria's 2.5% of GDP Target for Research and Development [WIFO]

www.technopolis-group.com

info@technopolis-group.com