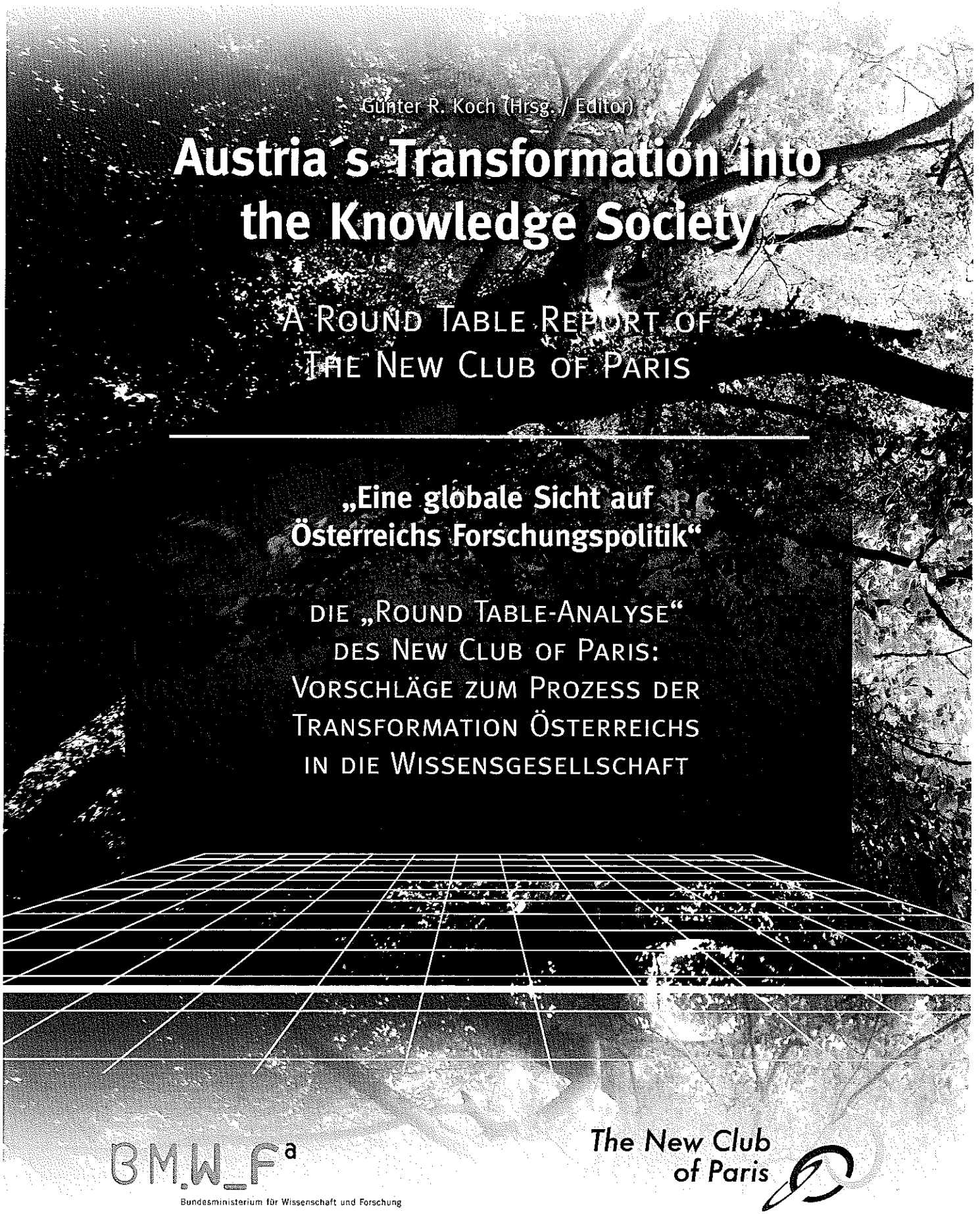

Günter R. Koch (Hrsg. / Editor)

Austria´s Transformation into the Knowledge Society

A Round Table Report of The New Club of Paris

„Eine globale Sicht auf Österreichs Forschungspolitik“

die „Round Table-Analyse“ des New Club of Paris: Vorschläge zum Prozess der Transformation Österreichs in die Wissensgesellschaft

BMWF

Bundesministerium für Wissenschaft und Forschung

The New Club of Paris

HOLZHAUSEN
DER VERLAG

6. National Perspectives

6.1 K. Aiginger: Evaluation of Government Funding in RTDI from a Systems Perspective in Austria - Towards a New policy for Innovation, Science and Technology in Austria

The following section is an extract from the so called 2009 "Synthesis Report" (known in Austria as "Systemevaluierung"). It is recommending to the Government of the Republic of Austria a "New Policy for Innovation, Science and Technology". The report has been commissioned by the two Austrian ministries bmwfj (economy) and bmvit (innovation & technology). The overall report has been compiled from contributions from many experts affiliated with the following institutions: WIFO (Austrian Institute of Economic Research), OeNB (Central Bank of Austria), KMU Forschung Austria, prognos AG and convelop gmbh plus a series of external experts closely co-working with this consortium. Therefore some references made in this section may not be satisfied, because they may relate to the complementary text.

The following compilations have been produced by the following three authors from WIFO.

Karl Aiginger, Rahel Falk, Andreas Reinstaller

Executive Summary of the Final Report

The Austrian Innovation System has by and large worked quite well in the past. Together with other favourable political and economic conditions, it helped Austria's income and productivity catch up with the most advanced countries by the nineteen seventies. It was instrumental in the following decades as Austria forged ahead relative to the average of the European Union. As a consequence Austria is now one of the top five countries in the EU as measured by income per capita and is ranked among the top ten industrialized countries worldwide.

Complacency is, however, the greatest danger to future prospects. Several strains are now noticeable in the Austrian Science and Technology System which make it necessary to increase innovation efforts, to boost efficiency and to foster radical changes in the innovation system. Challenges come from new global framework conditions (globalisation, EU enlargement, internationalisation of research; see Jürgen Janger). We are confronted with intensive competition both from neighbours and Asian countries Radical change is urgent, specifically as a result of past success; a high-income country has to compete in sophisticated markets and products. Other countries are now moving into Austria's position as medium-tech specialists, deriving their competitive edge by adapting technologies imported from abroad and producing at somewhat lower labour costs In addition, we see that higher innovation inputs in Austria have not been met by higher market shares and exports specifically in the highest quality segment of fast growing sophisticated industries. The number of firms innovating continuously remains small. Business research expenditure is highly concentrated on a small number of firms.

Twice as much business research, as compared to the EU average, is financed by foreign resources in Austria, and multinational firms increasingly source research facilities and capacities at the low end of the spectrum from the globalising world. Maybe the largest challenge to the system stems from an internal weakness: the Austrian innovation system is only loosely interlinked with, and insufficiently supported by, the education system. The gap between human capital available and the demand of firms is increasing at least with respect to the highest education level. More generally and most importantly, innovation and education are separated too much at all levels.

A radical strategic shift in six dimensions

We recommend a radical strategic shift in innovation policy in the following six respects:

From an innovation policy in the narrow sense to a comprehensive innovation policy. The latter is interlinked with education policy and includes improvements of the framework conditions (e.g. competition, international openness, mobility); while the former only concentrates on the measures and institutions directly involved in science and technology.

From an imitation strategy to a frontrunner strategy. In a frontrunner strategy firms and researchers strive for excellence and market dominance in niches and high quality segments, increasing market shares in sophisticated industries and technology fields, and in areas or missions of particular relevance to society.

From fragmented public interventions to coordinated and consistent interventions derived from a vision which specifies economic objectives, external and internal challenges and the type of (market or system) failures which call for public intervention

From a multitude of narrowly defined financial programmes to a flexible, dynamic policy defining broader tasks and priorities. Some broad technology and research fields important for society (missions) should be defined top down in the vision, but clusters and centres of excellence will grow bottom up, and should be funded sufficiently so as to attain international leadership.

From a blurred division of responsibilities between and within ministries (and other "players") to well defined responsibilities. Ministries devise sub-strategies for their area of responsibility from the top-level vision, are coordinated on the government level by a high level commission and monitored by a Council for Science, Research and Innovation.

From managing public intervention by bureaucratic procedures to modern public management techniques. Goals are pursued either by internal competence centres in ministries or by delegation to outside agencies (agencification). Agencies are free to choose instruments and are controlled according to pre-defined output criteria, not by means of micro-interventions.

The report summarises about fifty recommendations for major or minor improvements of the Austrian System of Science, Research and Innovation which will enable a strategy

shift and make the system fit for future requirements.

The reference point: an overarching vision

The preconditions of a new innovation policy are i) a commonly shared belief that research, technology and innovation are crucial for the welfare, growth and competitiveness of the Austrian economy and ii) a consensus on the policy changes necessary to increase the effectiveness of Austria's innovation policy to its highest level. Therefore it is necessary to develop a general strategic "vision", which will define the mission and the goals of the Austrian System of Science, Technology and Innovation, including its relationship to the educational system, to societal and economic goals and the framework conditions needed for innovation.

We strongly recommend developing such a strategic "vision" at the highest level of government. It will serve as a reference point for all sub-strategies of ministries, regions, institutions and agencies and thus forms a blueprint for a new science, technology and innovation policy ("New STI"). The vision should be prepared by a team of national and international experts, but finalised and "owned" by the government. It should be put into legislation by parliament and monitored by a "Council of Research, Science and Technology" (see convelop/Gerhardter) as an external control. The "vision" has to define the mission and goals of the innovation system, its interaction with the education system, but also to other societal and economic goals. It is the base for all sub-strategies of ministries, regions, institutions and agencies.

Coordination and monitoring: reformed institutions

Implementation of a New STI policy does not end with the creation of a vision but needs consistent coordination between the policy strands defining the new comprehensive innovation policy. We propose to set up a "high level coordination commission" which presses ahead with the implementation of the strategy with the ministries responsible for innovation and education as core members. The chair should rotate between the three ministries. The commission should meet about twice a year. The chancellor, the vice chancellor, and the minister of finance attend every second meeting. The government should be accountable to a new permanent "parliamentary committee for science and technology" (a merger of two existing committees; see convelop/Gerhardter). The parliamentary committee should also discuss an annual report of the "Council for Science, Research and Innovation" on the progress of the vision.

Better governance: new role of ministries

The change in strategy calls for a new and better defined role of the ministries in charge of innovation policy. They will devise sub-strategies from the overall vision to implement the vision in their respective areas of responsibility, focusing on the frontrunner position and on links with other policies. They decide which part of the sub-strategy has to be fulfilled "internally" (e.g. (i) linking the innovation system and the education system, (ii) improving the framework conditions), and which part has to be delegated to agencies or institutions. Each ministry should be responsible for the implementation of well defined parts of the new strategy. Their activities should be coordinated by the

"high level coordination commission" on research and technology that defines also the goals and milestones for each ministry.

Better governance: increased aurtonomy of agencies

We recommend increasing the autonomy of the agencies in a process of agencification (e.g. according to the concept of "earned autonomy"; see Sabine Mayer). This will require new governance procedures. At the administrative level we need to systematically build up competency to actually manage the agencies and to coordinate the intra-ministerial processes of policy development. Processes should be implemented that coordinate policy development activities across departments in order to avoid overlaps and conflicting assignments to the agencies. Broad tasks should be delegated to the agencies instead of narrowly defined programmes and the delegated tasks should be monitored according to output goals whenever feasible. For these tasks actual goals and outcomes should be specified. With these in mind the agencies themselves should develop suitable support measures which fit into their overall portfolio. If actual programmes rather than tasks are still delegated, they should be much broader defined and undergo a strict need-based test. The strategic governance level should exercise its control functions via ex ante definition of targets and ex post evaluations of outcomes, and not via intermittent micro interventions. For this process to be efficient new and compatible reporting systems across ministries are needed, as well as within and across agencies.

Changing the track: Switch to a frontrunner strategy

The New STI policy for Austria should be a frontrunner strategy. A frontrunner strategy aims at supporting Austrian firms to achieve and sustain economic leadership through product innovation and productivity growth in niche markets. This requires an increasing number of Austrian companies to build up a winning margin in technological and market competencies over their principal competitors. This can only be achieved through more and more ambitious research and development in the business sector, more and better qualified people, and leading edge scientific research. Education is the driver which enables change in firms and institutions.

Government commitment: ambitious goals for 2020

We support the goals set by the Austrian government to increase research expenditures to 4% and expenditures for tertiary education institutions to 2% of GDP by 2020 (the two numbers should not be added up, since part of the second is included in the first). Europe is trailing the USA and Japan in research, and has set the 3%-of-GDP goal for 2010 without any chance of reaching it soon. Austria as a high-income country should be more ambitious. The Austrian government should take the necessary steps to make available sufficient financial means in the public budgets to finance the tax credit and direct support for R&D, to sufficiently finance university research, and to improve the quality of education and the number of graduates from higher education institutions. Economic growth and competitiveness of a country on the technological frontier according to the EU Commission is defined by (i) a high level of expenditure for innovation and education, (ii) their respective efficiency and (iii) intensive synergies between high-

will happen over-proportionally in multinational firms. Empirical evidence shows that research expenditures are highly pro-cyclical; and even more so in Austria. The elections and the deferrals in the budgeting process for 2009 have already delayed spending by public funds and institutions (e.g. FWF, FFG, AWS) Other sources are drying up as the crisis deepens, and public money will be scarce in the further course of the crisis and thereafter. It would, however, be extremely important to keep the dynamics of research expenditures, since this is essential for a frontrunner strategy and for competitiveness in a tough environment. The current expenditure path for the next year is definitely lower than planned and as necessary to arrive at the 3%-of-GDP target in 2010

A strong driver for more investment into R&D is necessary if the 4%-of-GDP goal is to be reached in the foreseeable future, especially considering the economic constraints in the crisis, since multinationals make a high financial contribution to R&D expenditures in Austria. Total investment in R&D must increase by approximately 8.2% between 2008 and 2020 (in nominal terms) to reach the target of 4% of GDP by 2020.

A new simple tax credit: broadening the base and shifting the level

A frontrunner strategy needs a broader base: a larger number of innovating firms, more firms innovating regularly, more innovative business start-ups, intensified research activities of innovating firms, a larger number of firms locating research facilities in Austria, and more firms cooperating with research institutions. As a driving force for broadening and shifting the level we propose providing a single tax incentive, namely a volume-based tax credit of 12% on R&D expenditures as defined by the OECD's Frascati Manual, including contract R&D. This new tax credit facility should replace all existing schemes. The new scheme would set much better incentives for the vast majority of R&D active firms; it would involve lower compliance costs, and higher planning reliability. It would be simple, transparent and visible.

Deepening and changing the track: the role of direct support

To increase the effectiveness of direct support we recommend (1) reducing the number of programmes (not the money spent) and to allow agencies more discretion in the choice of instruments; (2) defining output goals for agencies rather than input goals; (3) that thematic programmes do not define narrow sub-fields, but allow these to develop and cluster bottom up; (4) basic, open programmes to increase and promote the quality component, to enforce clustering and cooperation with universities, (5) science programmes to support thematic fields if defined in the vision, and to foster cooperation, competence centres, excellence programmes in a bottom up process, if the chance for excellence exists. Given the overall goals of 4% and 2% of GDP, it is necessary to increase funds for direct support at a rate exceeding GDP growth by far.

We need to move away from a culture where support measures run forever to one where they can end in the wake of positive or negative evaluations. Evaluations should focus on outcomes (target achievements).

Direct and indirect support: building on complementarities

Tax incentives are instrumental in broadening the innovation base which provides the basis for a frontrunner strategy (the "necessary" condition). It is equally or even more important to support the peaks of excellence (the "sufficient" condition). Coherence of the intervention system as a whole crucially depends on the complementary effects of both funding approaches. The mission of indirect support is to foster R&D in general and to make investments in research more attractive than investments in other activities. The mission of direct measures is to promote structural shifts and the deepening of innovation. On this account it should address firms with high innovation and knowledge intensity, innovation in services and innovative start-ups. By focussing on areas of high societal importance it is also instrumental in offering solutions to problems beyond the narrow sphere of the immediate beneficiaries of support. Direct support furthermore enables a learning process, provides information and a certain degree of consulting. It is therefore important for firms starting or upgrading innovation ("changing the track").

Direct and indirect funding instruments are no substitutes for one another – far from it. There is strong evidence that funding effects materialise only if companies make use of tax incentives and also rely on more challenging measures of direct support. This applies especially to successful introduction of true market novelties. In this sense both measures work complementary and complementarities should increase through the reforms.

Higher educations: new funding rules and additional research money

The quality of universities, universities of applied sciences and non-university research institutions is a crucial determinant of a frontrunner position. Quality is related to the financial means of higher education institutions and proper incentives. Currently these are not funded sufficiently to ensure a high quality of research or teaching. Incentives do not lead to excellence centres.

We therefore recommend increasing spending for tertiary education to the level recommended by the European Commission (2% of GDP). The current lack of tertiary graduates especially in the field of science and technology is an important bottleneck for industry and academia.

To increase the funding efficiency of tertiary institutions (i) expenditure for research and teaching should be separated, (ii) the funding of teaching at universities should be in line with the provisions applying to the universities of applied sciences, and (iii) additional research money (that should not reduce the funds for the Austrian Science Fund, FWF) should be allocated to universities on the basis of performance criteria. These criteria should also include research co-operations with firms.

Money should be distributed within universities in a more competitive manner (inter alia to persons, and specifically to young scientists, not to institutes). A new tenure track system based on international best practice should be envisaged and career steps in universities should depend on international experience and be under a competitive framework.

The budget of the Austrian Science Fund should be partly used to finance thematic programmes (if defined by the vision). Research infrastructure should be supported e g. by increasing the overhead costs covered in FWF projects from 20% to 50% (case and performance dependant).

Block grants to non-university research institutions should depend on the existence of a mission and well-defined milestones for academic research and infrastructure.

A career path from apprenticeship to the universities of applied sciences should be developed, marketed and promoted by organisational instruments and financial support.

R&D cooperation between university and industry should be stimulated since radical innovations often arise from academic research and scientific discoveries.

Guiding principles of a new policy: non-exclusivity, learning and mobility

The new strategy should be built on the principles of openness, non-exclusivity and mobility between firms and institutions. Openness for change and drawing knowledge from external sources should be overarching principles in education. Funding and policy decisions should be less influenced by the weight of interested parties, insider knowledge, and entropy (defined as the system's non-permeability of the system to information from external sources; see convelop/Gerhardter). The system should be open for experiments (e.g. pilot calls; see Sabine Mayer), and a culture moving from programme based to task based intervention should be established which would make it easier to end programmes. Continuous assessment and external evaluations (by international teams) should ensure that if the economic environment changes the system changes with it. The insiders and users of the current system are not overly critical of it as it is. They complain about administrative costs, but emphasize that they are guided well within the system, probably because direct funding did not dramatically affect their decisions. In comparison the new strategy allows new techniques to be learned, provides information and control and helps with planning. The strategy has to be implemented top down, information has to be gathered bottom up.

Regional, national, European: coordination and agenda setting on all levels

The Austrian research promotion policy should be redesigned and anchored within a multi-level system between the European Union, the federal and regional level. Deficits in coordination and specifically in agenda setting as well as the problem of cross-policies should be tackled Demand for action exists specifically at the interface to the European level: while reflux of funds is working excellently (Austrian firms and institutions get more money back than government pays), there is no strategic, active co-design of the STI policy in the European Commission by Austrian authorities.

At the federal level we recommend the integration of further policies like educational, health, and environmental policies.

At the regional level a reorganisation of the one-way communication from the federal level is

required. A two-way exchange of information and combined learning as well as possible support from cross-region activities should characterise the new system.

The case for radical change: a task beyond policy borders

Change is necessary, not because the Science, Research and Innovation System in the narrow sense has not worked, but because of new challenges and the new position of Austria as a high-income country. A successful innovation policy for a frontrunner has to be much more comprehensive and needs to interlink with other policies. The system should react to external as well as internal challenges, and to economic as well as societal trends. The changes needed are not minor changes. They need the attention of the top political level and an overhaul of current management and monitoring techniques; they rely on human capital, and build on the quality of the education system. In addition, we now enter into a critical period in which firms, specifically multinational ones, will reduce research expenditures because of the crisis. At the same time, competitiveness of firms will depend even more on education and innovation in the crisis and thereafter, so that switching from an imitation strategy to a frontrunner position is absolutely necessary.

Policy Conclusions: An Agenda for a New Policy

Preamble

The ministries commissioning the System Evaluation set two main project goals:

- understand the rationale and the actual functioning of public intervention in the Austrian research, technology and innovation system (RTI), especially on the systemic level, not on the level of individual interventions and programmes and
- suggest major and minor improvements for the innovation system in general, and the current RTDI funding system in particular

The nine special reports briefly summarised in the preceding sections tackle the first objective and provide the main basis for the policy recommendations drafted in this chapter which is tackling the second objective. The recommendations are also based on the findings of past (evaluation) studies of the Austrian Science and Technology system. Last, new results of the innovation literature were taken into account as well as the challenges Austria is facing in the globalising world economy and in the current economic crisis.

The evaluation proved to be no easy task for three reasons:

Firstly, any assessment of a subsystem of economic policy, such as the innovation system, crucially depends on the ultimate goals of the socio-economic system as a whole. The objectives of a society or an intervention system cannot and should not be defined by researchers, but by society at large and its legitimate representatives (politicians). Unfortunately, there is no generally accepted and politically sanctioned strategy for the Austrian Innovation System. This system is complex in nature and characterised by many opaque interdependencies to other sub(systems) – a trivial statement, which however gives rise to some rather non-trivial implications as far as the choice of an appropriate benchmark for strategy formulation and hence policy recommendation is concerned.

Our approach was formed by recent advances in economic theory of innovation, which establishes that an economy that is close to the technological frontier is essentially driven by science, technology, innovation and education. The final goal of the innovation system of a high income country such as Austria should therefore be to promote scientific discovery and technology development rather than the absorption and improvement of know-how and technologies developed elsewhere. We have called this a „frontrunner strategy". In order to render this guiding principle operational for the current purpose of evaluation and strategy formulation, chapter 2 of this Synthesis Report elaborates on the critical factors conflicting with the pursuit of a frontrunner strategy. This puts the findings from the nine special Reports into frame. By reflecting these findings against the established benchmark we arrived at the policy conclusions.

Secondly, the terms of references of this System Evaluation were such ambitious and broad in scope that they certainly challenged any expert's day-to-day business. We opted for the "pooling of experts"-approach and deliberately set up a rather heterogene-

ous consortium. Quite a number of researchers from different scientific fields in different institutions and from different countries worked on the System Evaluation offering a broad variety of methods and rich results. In principle, the team arrived at a common understanding of the functionality of the intervention system, owing not least to inspiring as much as challenging feedback from the external experts and a wider circle of clients and other stakeholders. Also, there is overall consent with respect to the directions future policies should take and the consortium partners agree to most of the more specific lines of policy conclusions drafted in this chapter. At the same time it remains true that whenever two people agree they each place emphasis on about three different aspects.

Thirdly, the quality and availability of relevant data proved to be far worse than expected (and these expectations were already low at the outset). It is a well-known fact that in general output indicators for all types of research and development activities are difficult to find However, also data on direct and indirect support were either unavailable or proved to be of low quality or inconsistent - not only across agencies, but sometimes also within agencies across programmes. These problems should be tackled in a decisive way to base empirical work on reliable and robust data and allow for evidence-based policy making.

Recommendations for Policy

Introductory Remark: Coherence in Policy Targets all Relevant Fields
(§0) Recommendations normally address the client. In the current context it is important to distinguish between innovation policies in the narrow sense, referring to measures and institutions directly involved in research, innovation and technology policy, and innovation policies in the wider sense, most noteworthy policies directed at the formation and attraction of human capital. Innovations depend very much on framework conditions, like regulation, the incentive and reward system of individual researchers and the openness and mobility of an economy. The evaluation commissioned refers primarily to the innovative system in the narrow sense; given the crucial importance and path-dependencies in the wider system for the performance of the system calls automatically for a broader view.

The Point of Departure: Favourable Position Based on Past Achievements
(§1) Basically, the Austrian economy has been performing well. The long-run growth differential (including an appreciating currency) has put Austria into the group of the top 3 countries in the EU-27 as far as GDP per-capita is concerned. Merchandise trade is broadly balanced and the current account is in the surplus. However, long-term as well as short-term success over the past five years has been based more on a favourable relation between costs and productivity and on markets dynamics (in Eastern and southern Europe) than on the growth drivers which usually define the competitive edge of high income countries. A number of relevant indicators is lagging far behind the leading countries, for instance, the numbers of research departments in firms, the number of patents in the triad, Pisa ratings, expenditures for basic research, or the number of university departments. The same holds for vertical mobility in education, the share of persons engaged into life-long learning activities,

gender equality and investment in pre-school activities.

Standing Stil is a Step Backwards
(§2) Competitiveness and economic dynamics of rich countries depend on many „growth drivers" or „decisive" (cutting edge) factors. Firstly, they depend on a number of crucial inputs like research and development, education and life-long learning. Secondly and equally important is the efficiency of such expenditures, the incentives provided, the institutions supporting innovation and the matching of innovation policies with the need of innovation players (firms and research organisations) and society at large. Thirdly, competitiveness and dynamics depend on systemic conditions such as the coherence of the innovation system with the educational system, where education ranges from Kindergarten and school to universities. Finally, economic dynamics depend on the mobility of individuals as well as on the domestic and international transfer of knowledge, on the co-operation of firms and institutions as well as on the openness of the economy and its subsystems.

It is our understanding that economic dynamics do not stand for economic growth only, but also for the pursuit of broader societal and economic goals. The welfare function includes social goals, e.g. risk coverage by a solidary society, environmental goals including sustainability, as well as health, security and other intangible goods. By the same argument, competitiveness is not based on low wages and prices, but refers to the ability to provide goods and services satisfying national or international preferences under conditions of a high income level.

The Point of Reference: the Frontrunner Economy
(§3) As has been argued elsewhere (see Aiginger et al., 2006) Austria has completed its technological catching-up process during which physical investment and incremental innovations were important to foster productivity growth. Austria has become one of the leading countries as measured by per-capita income. Also the political and economic environment has changed: Austria has joined the European Union and its borders to central and eastern European countries have been opened. This development has offered many opportunities to the country´s economy, but it has, at the same time, put pressure on the innovation system.

(§4) Innovation systems look very different (i) for countries with low wages and low productivity (catching-up countries); (ii) in middle-income countries, still lagging as compared to the leading countries (followers) and finally (iii) in the countries with top income and productivity (frontier countries). Austria is now part of the group of the „frontier" countries as far as per-capita income is concerned. Therefore, the innovation system should also be changed from a system relying on imitation and incremental innovation to a frontrunner strategy (see Leo et al., 2006). In this respect there is still much room for improvements as can be shown by analysing the industrial structure, the type of services supplied, the low share of knowledge intensive industries and many other indicators.

(§5) Countries at the technological front differ from follower-countries in several respects:

- the relation between radical innovation and gradual, stepwise innovation,
- the share of high-tech or knowledge intensive industries in total employment, value added and exports,
- the excellence in complementary production-related and quality-increasing services,
- the share of output in the highest quality segment within industries,
- the share of output in fast growing industries and industries with quality competition,
- the excellence in technological niches,
- knowledge creation as measured by the number of patents, specifically high-tech and triad patents
- the share of basic research in GDP
- the leading role of human capital for innovation,
- co-operation and research networks between firms and between firms and universities

Frontrunner strategies can, to some degree, be different across countries, excelling in some of the listed characteristics more than in others; but excellence in the majority of these lines defines countries at the technological frontier.

We recommend:

Shifting to a frontrunner strategy
We recommend shifting from a follower towards a frontrunner strategy decisively and quickly. A frontrunner strategy necessitates changes in the organisation, finance and careers of universities and non-university research. It implies changes in many different subfields of innovation policy, but above all it calls for a deepening of the interaction between the innovation and the knowledge system, as well as between innovation and educational policy. It necessitates lower barriers for mobility on all levels: national/international, vertical/horizontal, private sector/public sector.

To make this strategy operational, the number of firms innovating has to be increased (this is the base), then the type of innovation in firms has to be changed (every firm has to "climb up the innovation ladder"), and finally the depth of innovation has to be intensified. On all steps, but specifically at the highest level, the interaction between firms and universities and between applied research and basic research has to deepen

Adressing the Botteneck: Human Ressources
(§6) The future performance of the Austrian innovation system very much depends on giving top priority to educational policies. Without addressing the bottleneck „human capital" in its various forms, a further upgrading of Austria's innovation system is doomed to failure. It is very difficult to boost competitiveness through additional R&D expenditures by firms if at the same time universities do not provide well-trained graduates in science and technology. Top-level research is not only an important source of new knowledge, but excellent scientists are also often involved in the foundation of new firms. The quality and the quantity of excellent human capital define the capacity of technical innovation, while the quality and the quantity of broad, innovation-relevant skills matter for diffusion and absorption of innovation

quantity of broad, innovation-relevant skills matter for diffusion and absorption of innovation. This highlights the importance of policies targeting insufficient knowledge transfer or focussing the interface of basic and industrial research. Single measures taken to increase innovation inputs and outputs will only have a low impact and diminishing returns, if they do not go along with other measures to improve the educational system. Whereas the broadening of the base requires that more people successfully complete secondary education and graduate from higher education institutions, shifting towards the technology frontier calls for an upgrading of the quality of teaching at universities by better funding of the teaching at universities and by raising the quality of research at universities. A coherent policy tries to implement measures in all relevant fields and it does not rely on single measures, but on both, complementary and mutually enforcing policies and instruments. The design of a forwardlooking and growth-oriented innovation policy therefore needs a thorough analysis of the educational system, basic research and labour market performance, tax incentives and the involvement of the public sector in innovation policies.

We recommend:

Removing the Botteneck in Human Capital
There are deep interactions between the innovation system and the educational system. Without appropriately qualified employees and researchers, it is difficult to develop or adopt innovations. Innovation activities in general, the level of R&D-expenditures, diffusion and absorption of knowledge and technologies, start-up activity and firm location decisions are to a large extent influenced by the quantity and the quality of available human capital. Reforming the educational system, from kindergarten to universities, is of key importance. Specific attention should be paid to gender aspects, the integration of migrants and the attractiveness of Austria for highly-qualified researchers. These tasks fall within the remit of various ministries and therefore require a co-ordinated approach. Furthermore, the relation between basic research and applied research has to be addressed. In particular, it is necessary to define the distinctive role of (i) universities, (ii) universities of applied sciences and (iii) non-university research institutions.

Government Commitment: Ambitious and Long-Ranging
(§7) The EU Lisbon agenda has proclaimed the goal of raising R&D expenditures to 3% of GDP by 2010. This has been criticized from two different perspectives. Some critics underscore that such input goals say little about innovation output performance of the EU member states. Others have pointed out that higher research expenditures are far more important for more technologically advanced countries than for catching-up economies. So far the Lisbon agenda has had little impact. When pooled across member states, R&D expenditures as a share of GDP have not increased; actually the quota even dropped slightly because of the accession of the new member states, but also due to a stagnation or slight decrease in the large economies. The Austrian government has acknowledged the necessity that a highincome country should have a higher R&D quota and that the upward dynamics in research expenditures should be continued. Accordingly, it set the goal to reach 4% by 2020. This target should be pursued despite the current crisis.

(§8) In the current crisis a more restricted access to financial means has quickly become a critical constraint for firms, in particular for small, newly established and innovative ones. R&D is highly pro-cyclical, and declines in profits and cash flows imply that firms focus their R&D activities more on development and less so on research. High-risk projects are more likely to be abandoned in favour of projects with relatively secure returns. As consumers buy less expensive goods, firms react by becoming more reluctant to introduce innovations because it is more difficult to reap a price premium Moreover, as banks reduce credits, process innovations that could reduce costs (e.g energy-saving equipment) are more difficult to implement as they imply capital investments. In addition, new entry is limited due to declining market prospects. Especially in the high-tech segment, the shortage of venture capital will curtail the expansion of existing and the entry of new firms. It is therefore not only necessary to strengthen the capital market, but also to increase expenditures on R&D in a counter-cyclical way.

(§9) In recent years public financing of S-T-I-R-D is increasingly based on short run commitments and sources vary from year to year. This is a big drawback since agencies and institutions face a severe problem of long-term commitment. The current situation is particularly delicate owing to the late enactment of the federal budget for 2009. As of April 2009 contracts had not been signed and pending funding decisions had to be further postponed. Terminating structurally important (basic) research projects due to short-time finance constraints entails first and foremost large sunk cost

(§10) Given an assumed starting level of R&D-expenditures of 2.6% to 2.8% of GDP in 2010 the growth-path to the 4% goal for 2020 requires an increase in publicly financed R&D expenditures of approximately 8% per year on average. The required amount of public money will be the lower the more effective funding is in stimulating private R&D (i.e. the greater input additionality). However, the "necessary rate of increase" to reach the 4% target could also be higher, since in Austria a rather large part of the R&D expenditures comes from abroad. The contribution of foreign financed R&D expenditures could go down in the future, firstly in the aftermath of the financial crisis, secondly because of the growing trend in offshoring of R&D activities of multinational enterprises to emerging countries. These off-shoring activities primarily comprise product adaptation and new product development as well as applied research and to a lesser extent basic research.

We recommend:

Confirming the 4% Goal for 2020
The commitment of the Austrian government to reach the 3% goal of research expenditures in GDP by 2010 has been crucial for the boost of R&D expenditures over the past years. We also welcome the new commitment of the Austrian government to set the target at 4% by 2020. A rich country should have higher ambitions than the average of the EU-27, and the dynamics of research expenditures – rising considerably faster than nominal GDP – should be maintained.

An expenditure goal is a mere input goal; on the positive side, however, input goals are easier to promote and to monitor. Similarly, a 3% (or 4%) target is no goal as such but

an input benchmark which is instrumental in underlining current and future importance of R&D. Such targets are necessary in order to track the priority given to the goal, if output cannot be measured easily or if the output effect of inputs comes with a long time lag.

In Face of Crisis: Keeping up Dynamics
It seems extremely difficult to reach the 3% goal in a period of a severe recession, since firms - domestic and even more the multinational ones - tend to reduce investments in bad times, specifically those with a long-run effect. Alternative sources like private funds or funds of the Austrian National Bank, appear to be less reliable sources of finance in a recession and interest rates for commercial loans are especially high. Nevertheless, it is important to keep the impetus in the face of crisis. The case of Finland overcoming its severe recession in the 1990s may serve as a prominent example. Inevitably, public incentives and direct funding have to be increased in a recession. The view that R&D quota goals can be reached more easily as the denominator (nominal GDP) declines is naive or cynical (depending on the expertise of the person in question); it's a fallacy by all means. International evidence shows that R&D expenditures are cyclically declining in periods of low demand and high interest rates. This is specifically risky for Austria, since a large share of R&D is financed or performed by multinational firms (60% to 70% according to Hanisch und Turnheim, 2007).

On the political level the strong commitment to the Lisbon goals should be confirmed.

Ensuring longer-term planning perspectives
The amount of financial resources available for public funding should be guaranteed over a longer period of time. Ideally institutions/agencies should be able to base their funding decisions and strategies on three year contracts which are renewed one year before termination. Not least the innovation actors in academia and business need a stable framework for planning and realising R&D projects and hence a long-run development path of public support is of key importance.

Growth paths of resources consistent with defined goals
Since a frontrunner strategy places high emphasis on basic research it seems advisable that funding thereof appreciates higher priority; in other words funding of research institutions should grow faster than the overall trend.

Commitment to a Vision: Defining Mission and Goals
(§11) Currently, there is no explicit and commonly shared innovation strategy in Austria. It is necessary to develop such a strategy at the highest level of policy i.e. federal government; the ministries responsible for innovative systems should be involved in the formulation of the strategy and then base their work on this strategy; agencies and institutions defining the national innovation system must understand their specific role in promoting the implementation process. Such a strategy or „vision" should also be communicated to and supported by the scientific as well as the economic community and the other layers of government. Several attempts that were made in the past to achieve a consensus have shown little success.

(§12) A strategy change cannot be enforced without political commitment at the highest political level. The operationalisation of a strategy needs massive support by all ministries and all levels of the government. This is specifically true for a small country, for a country with a rather low share of tertiary educated people in the workforce, for a country with deficits in basic research, and where a large share of applied research is done in multinational firms with headquarters in other countries. This strategic realignment of the innovation system should become self-sustaining and endogenous in the long run; it has to be initiated top down, but then it should become an intrinsic goal of stakeholders, agencies, firms, and university departments.

We recommend:

Establishing and implementing a strategic vision
We recommend that the Austrian government commissions the drafting of an innovation strategy ("the vision") which defines the mission and the goals of the innovation system, its relationship with other fields (above all with educational, but also societal and economic goals such as social cohesion, sustainability, health...). Some necessary inputs for such a strategy are already available (Forschungsdialog, Crest monitoring, Forschungs- und Technologieberichte, Strategy of RFTE, System Evaluation).

The strategy should be based on four pillars:

(i) linking innovation to all levels of education,
(ii) broadening the innovation base,
(iii) drafting sub-strategies for excellence and technology leadership in some niches,
(iv) and attaining high market shares in some growth industries and technology lines.

The strategy should be commissioned by the government and devised by a group of national and international experts. Then it should be discussed in several feedback loops with government representatives and stakeholders and finalised. The final strategy or vision has to be enacted and "owned" by government. All ministries and levels of government should commit themselves to the strategy and parliament should put it into legislation. It should set quantifiable sub-goals and be evaluated and revised after five years.

Sustainable Commitment to the Vision: Building up Strategic Intelligence
(§13) Developing a strategy is by no means a one-off activity. As environments change, policy has to change as well necessitating continuous effort to check whether current policies are still appropriate. Independent and strategic intelligence at the system level is key to the dynamic alignment of the system. High level advisory bodies should reflect on achievements of objectives and remaining challenges and – if necessary – recommend changes in the strategy.

(§14) For the time being the existing advisory bodies, namely the Austrian Council for Research and Technology and the Austrian Science Board, fulfil similar tasks – except that the first one focuses on applied research and the second one focuses on basic

research It is very important to have a strong and highly respected advisory council which (i) monitors the strengths and weaknesses of the innovation system as a whole, (ii) increases the awareness for innovation, (iii) and reflects on the progress and implementation of the vision Having two councils lessens the importance and reputation of each of them. Moreover, having one for applied research – working closely together with stakeholders of applied research – and having a different one for basic research – working closely together with academia – aggravates existing borderlines between basic and applied research

We recommend:

Forming a comprehensive Austrian Council for Science, Research and Innovation
We recommend setting up one comprehensive Austrian Council for Science, Research and Innovation (smart solution). A joint Council for applied and for basic research is preferable to the current split to maintain coherence with respect to the basic design of the new innovation policy outlined before. Moreover, the boundaries between basic research and applied research are becoming more and more blurred ("applied basic research"). The soft solutions would entail merging the two existing Councils step-by-step: allowing for cross memberships, establishing a bicameral system, organising joint annual sessions or awareness campaigns etc. If advisory bodies cannot be reformed immediately in the smart way, then at least a future date should be fixed for such an undertaking. In the meantime merging should proceed in two steps

Either way, the members of the new Council are nominated by government, where stakeholder groups may propose their favourite candidates. To combine the elements of continuity and change in an optimal way, half of the members and the president should be appointed by every new government.

The primary role of the new Council is to give advice to government and other actors of the innovation system. The new Council surveys the implementation of the vision and reflects on past achievements of objectives and remaining challenges. Theses reflections are published in an annual report. If necessary, the new Council recommends changes in the vision/strategy. The annual report is open to public; it is debated in parliament and discussed with the federal government. A second and more general task of the new Council relates to promoting public awareness on the overall importance of research, innovation and science

Vertical Alignment of Innovation Policy: Coordination over different territorial levels
(§15) Since Austria joined the EU it is part of a larger European research area. Today, Innovation policy takes place in a complex setting: there are different actors at the European, national, but also at the regional level (Länder), there are different target groups and policy fields which sometimes run across all those different layers To that effect innovation policies have become a typical multi-level policy area as regards agendas, budgets and institutions; resources and competences have become increasingly dispersed across territories and governance levels. Such a setting calls for extensive coordination efforts, viz. horizontal coordination among various policy fields, as well as

vertical coordination across the different territorial governance levels – regional, national and supranational (European) governance in STI.

(§16) For the time being similar tasks are often performed on the national level, on the regional level and on the international level (European Union). The strategy developed for each intervention by a federal or regional agency should be aligned with respective European programmes as much as possible. The recommended policy shift is mostly about increasing coordinated efforts (vertical cooperation) to improve the efficiency of innovation support actions at all levels. Building upon comparative advantage and on the principle of subsidiarity, are key to this approach

We recommend:

Enforcing coordination and agenda-setting on the European level
Austria is very successful in participating in and getting research money back from European programmes. However, it would be at least as important to influence European agenda setting. The Austrian research promotion policy should be redesigned into a multi-level system between the European Union and the regions. Deficits in co-ordination and especially in agenda setting and cross-policies should be tackled. Demand for action exists

- *at the interface to the European level: above all in the informal phase of active codesign of the STI policy in the European Commission;*
- *at the federal level: integration of further policies like educational, health, environmental and further policies for comprehensive problem solutions and design capability in the NIS;*
- *at the interface to the provinces: this level requires a reorganisation of the one-way-communication from the Federation to the provinces towards a two-way exchange of information and joint learning in terms of an enriched innovation system at the federal and state level as well as possible support from cross-state activities*

On a more practical level, combining regional, national and European support should be made as easy as possible. The least that should be done is to provide relevant information, e.g., by referring to respective programmes at a higher/lower governance level. The national agency should offer to do the selection of projects also for the regional programmes. Furthermore we recommend earmarking a specific part of each programme's budget for activities that connect the funding seekers with the international scientific community and with international high-level research programmes.

Horizontal Alignment of Innovation Policy: Coordination over different Policy Domains
(§17) Establishing a vision and setting objectives are good starting points for policy but not sufficient by themselves. It is of key importance to outline how the overall goals are broken down to more operational targets, which measures are to be used to achieve these subtargets, how these measures are going to be implemented at the different layers of the innovation policy system, who is going to be responsible for the overall coordination of efforts and how the resulting developments are to be evaluated.

(§18) Beyond the task of drafting the innovation strategy, some more co-ordination of research policy is strongly recommended. For the time being, programmes constitute the predominant tool for policy intervention. Nearly each new thematic or structural priority recognized by government, administration or the firm community results in a „programme", i.e. a certain amount of "ordinary funds" or out-of budget sources are sidelined to respond to the newly perceived challenge. Consequently, a multitude of programmes (co-)exist and many of them are endowed with little financial means. The resulting plethora of programmes primarily reflects severe deficiencies in the governance of STI. STI-agenda setting increasingly takes place at the European level. At the national level, there are few commonly shared visions and targets beyond mere quota goals and inter-ministerial competitive behaviour is rather the rule than the exception. When vertical and horizontal policy co-ordinations are doomed to failure or take too much time, the scope for successful and prompt policy action is increasingly confined to individual intervention. To overcome some distinctive barrier to innovation, the staff of either of the three innovation ministries regularly comes up with a well thought-out measure that is tailored towards the needs of a specific target group - which is often closely involved in the design of the programme. Taken by itself, the new programme might be smart. However, such kind of fragmented policy response does not necessarily promote the functioning of the overall national innovation system. Seen from a systemic perspective, the new line of action too often is not linked up to other piecemeal intervention. Moreover, allocating financial resources in homeopathic quantities and not paying attention to overall funding portfolios is aggravating the scope for further policy fragmentation from which eventually severe inefficiencies arise. The effects on the system level accrue through the interplay of individual interventions, their complementarities and contradictions. Coherence in strategy and action and compatibility of distinct intervention measures require first and foremost a commonly shared vision and co-ordinated policy making to fulfil a multitude of tasks.

We recommend:

Establishing a High Level Coordination Commission across Ministries
A smart version of a renewed governance approach provides for a permanent high-level government commission which presses ahead with the implementation of the strategy. Ideally, the three ministers mainly responsible for the innovation system take on the role of a steering group. The chair should rotate between the three ministers. The steering group meets two times a year to review which goals of the strategy need special attention or measures and which strategy lines should be intensified. The chancellor, the vice chancellor, and the minister of finance attend every second meeting of the steering group. If necessary, other ministers in charge of a specific part of the comprehensive innovation strategy are invited as well.

Regular input to the steering group meetings should come from the team drafting the strategy, from the renewed Council for Science, Research and Innovation responsible for outside monitoring and from the parliamentary committee on Science, Research and Innovation (the latter is also a merger of two currently separated bodies).

Concentration of Innovation Competences at the Strategic Governance-Level
(§19) The segregation of competences between four or five ministries has often been complained about. This problem will be less aggravating once a vision and a high-level coordination committee are established. The coordination of innovation-related activities would improve and the division of labour between the ministries would be more clear-cut. The very new budget procedures add to the disentangling of competences in strategic innovation governance. Budgets are defined over a longer period and with more leverage for the individual ministries and agencies

We recommend:

Radical reform: Locating innovation competencies in two ministries
A radical reform would concentrate the innovation activities in two ministries, e.g. a Ministry of Research would be in charge of basic research, including research performed in universities and a Ministry of Economics and Technology would be responsible for applied research and innovation activities of firms. However, a Ministry of Economics and Technology does not exist in Austria; for the time being, competencies on framework conditions for firms and industries are split in two ministries (at least). Furthermore, a split between basic and applied research is not completely in line with the view that innovation is created in a systemic, non-linear process. Concentrating research agendas in just two ministries will become less important once innovation policy is based on a commonly shared vision, and a permanent high-level government commission is set up to co-ordinate all tasks related to innovation policies.

Realistic reform: Restructuring the competencies of three ministries
A realistic reform takes into account the fact that the current split between the two ministries in charge of applied research and innovation is hard to overcome. It accepts the current division of labour, but improves the division of responsibilities, fosters common strategies and similar governance procedures. It restructures historically grown competencies according to the new vision, for instance at the start of a new legislative period, when shifts in competences are quite common. It develops common management tools and competencies relevant to the steering of research and innovation in an administration.

There is Plenty of Work to Do: Separating the Tasks
The Ministry of Economy, Family and Youth focuses on the following strategic RDTI-issues: cooperation between industry/SME and science; start ups; innovation and RDTI-capacity; internationalisation; human ressources) In this sense it aims at the broadening and widening of innovation. It puts core emphasis on framework conditions related to the financing of innovation - especially of innovative start-ups - and attracting foreign direct investment - especially in knowledge intensive industries. Further fields of responsibility include the commercialisation of innovation, and deregulation policies. Main indicators for successful policies of this ministry include, first, an increase in the innovation base ("more firms are engaged in innovation activities"); and second an increase in the number of firms establishing innovation activities as regular parts of their business activities ("firms are more engaged in innovation activities"). In this regard the Ministry of Economy, Family and Youth will in practice be mainly concerned with innovation in

small and medium sized firms. Knowledge transfer through co-operation in innovation are key (business-to-business as well as between business and co-operative research centres or Universities of Applied Sciences) Fields of action relating to larger companies include the worldwide marketing of Austria as a research location.

The Ministry of Transport, Innovation and Technology focuses on the upgrading and excellence of innovation. Its overarching strategic mission is to promote the shift to the knowledge and technology frontier. On this account the Ministry of Transport, Innovation and Technology should be primarily concerned with the needs of firms that already do research. For instance, community building and branding of emerging key technologies are key measures to enhance innovation performance; especially the performance of small research firms with limited own capacities in this respect will benefit. Further prime task of this Ministry include the cultivation of a competitive profile in selected technology segments, promoting co-operations between industry and the scientific community and providing an attractive location for international research centres The latter first and foremost relies on sufficient amounts of high-skilled labour; it is a sine qua non. The restructuring of competences thus involves co-operation with the Ministry of Research and with labour market policies in order to attract the best researchers available.

The Ministry of Science and Research is responsible for basic research, universities and Universities for Applied Science. More specifically, it is responsible for the knowledge transfer from and to universities, for an ideal mixture of bottom-up and top-down research and for the monitoring of extra-mural basic research.

Enforcing the Process of Agencification

(§20) Management literature suggests to rely on the principle of agencification to fulfil such complex tasks as the public support of innovation. An agency is a body (agent) which is operationally independent from the public administration. It works under different framework conditions (labour law, own management, autonomy) and mostly deals with a very specific, if not single purpose activity - such as implementing public support for innovation. The main advantages of agencification relate to professionalisation, increased efficiency and flexibility. On the other hand, agencification may lead to an uneven distribution of knowledge (asymmetric information) between the agency and the principal. The latter suffers from informational deficits as regards the need of the target groups, the functionality, effectiveness and efficiency of some support measure etc giving rise to classical principal agent problems.

(§21) Agencification has been started but has not been fully implemented. A full implementation would imply that specific tasks are delegated to an agency, not only an amount of money plus request for routine administration, that the overall goals and the indicators on progress are fixed ex ante, and that the agency develops an operational plan (operation strategy) on how to perform the task. The core idea of agencification relates to the division of work On this account the principal (originator of the task) does not intervene in any details of task fulfilment; instead it only controls targets achievements of the agency according to pre-specified schedules and rules to which the agency should obey to. The agency is responsible for making decisions on the type of support,

on eligibility criteria, on members of the jury and acceptance/rejection of proposed projects. These jobs can only be accomplished if agencies provide excellent human capital, internal structures, mobility and adaptability; recruiting of personnel including the top level must follow best practice and monitored by recurrent external control.

We recommend:

Let agencies earn more autonomy
The process of agencification should be revived, reshaped and reinforced. This requires clearly defined roles for both, the principal and the agent. The use and transfer of knowledge in both directions are key to the well-functioning of innovation governance, as is development of mutual trust between the different levels of innovation governance. Increased agencification should occur step-by-step so that the extent of "earned" responsibilities and non-responsibilities, respectively, shift gradually along a process of earned autonomy leading to more operational freedom of the agencies and more room for strategic governance on the side of the principal.

Defining a clear division of labour between principals and agencies
We strongly recommend a more pronounced division of work between the strategic level and the operational level of governance. The principal (ministry) has to set the strategy and the goals. It should neither be allowed to, nor be forced to interfere at the micro level. The originator of some policy measure should certainly have no voice in nominating jurors and experts and accepts eventual funding decisions or rejection of proposed projects. Agencies decide on the operationalisation of policy objectives and are responsible for proper administration procedures which go quite into the details, e.g. applying uniform cost schedules. Agencies monitor the measures they implement for fulfilling assigned tasks, they reflect on target achievements and learning processes – and they share their gained insight into the functionality or dysfunctionality of intervention measures with the strategic governance level. Consistent reporting and building of mutual trust are key to this model of earned autonomy.

Once the gradual process of agencification is completed, only the accomplishment of assigned tasks matter. The agency is continuously controlled by a board and should be evaluated every now and then. In these evaluations an agency's decisions can be investigated, but not changed ex post. If the number of wrong decisions is large and the instruments are chosen badly this will have consequences for the management of the agency.

Implementing Tools of Steering
The agencies' assigned budgets will ultimately be included in a quasi-autonomous area, being governed by performance agreements. The agencies' autonomous areas / budgets should also be included in strategic performance agreements and therefore be subject to strategic goals. Existing framework contracts between ministries and agencies (such as the "Rahmenvereinbarung" between FFG and BMVIT/BMWFJ) can form a basis for the performance agreements. The process as such will have to include a permanent revision of the progress made and feedback loops to allow adjustments where necessary. In order for the ministries to be able to effectively govern (and therefore, control) the

process, to provide incentives for the agencies to perform their tasks as agreed and to consolidate the necessary trust, a mechanism to revoke certain steps in case of underperformance has to be developed in parallel. Furthermore, one of the main problems in the relation between agents/agencies and principals/ministries needs to be tackled: the information and knowledge asymmetries. We therefore recommend establishing mechanisms and procedures that allow for a steady, transparent (thus institutionalised) and open exchange of knowledge between agencies and ministries. These mechanisms should be obligatory for all participating organisations.

Upgrading of management skills
The new governance structures require specific knowledge and capabilities on both sides. On the side of the ministries, strategic capabilities and experience in professional controlling should be increased and fostered. On the level of agencies the capabilities must change from operating very detailed programmes at very different, but narrowly defined rules, to a more strategic, independent approach. Similarly, instead of spending money for prespecified programmes, agency staff should be able to design and pursue operational strategies.

Specifying the Roles of the Agencies
(§22) Three agencies are currently of utmost importance for implementing the strategies of the three ministries involved in innovation policy: FFG, AWS, and FWF. All three of them are publicly owned and constitute legally separated entities. The fourth funding agency in federal public ownership is the Christian Doppler Research Association (CDG) which supports cooperative research projects of the scientific and the corporate world. All of these agencies fulfil partly different and partly overlapping task. FFG and AWS evolved from mergers of smaller agencies. In fulfilling their tasks they build on different types of contracts for individual programmes and activities. AWS concentrates on the financing of smaller firms and funding is not restricted to innovation. Among other things, the AWS finances firms which suffer from credit constraints – an important role in the current crisis. The AWS is currently applying for a full banking concession. In contrast, FFG is concentrating on the financing of innovation projects: partly it engages in general bottom-up programmes (basic programmes, "Basisprogramm"), partly it engages in sophisticated structural programmes and partly in thematic programmes. FWF is financing university and non-university research mainly on the basis of a bottom-up strategy, without prior definition of thematic priorities by a ministry.

We recommend:

Streamlining of Operational Governance and Allowing for Specialisation
The current ownership structure of agencies is appropriate if the mission of each agency is aligned with the responsibilities the "vision" assigns to each ministry. In this case the strategy of the ministry defines focus and scope of tasks, some of which may be delegated to agencies. These tasks should be clearly defined in terms of their aims and required outcome. Drawing on the funding expertise of any of these agencies should follow similar rules, but there is still some scope for remaining differences. Assignment of tasks to either of the agencies should draw on the principle of specialisation and

comparative advantage

Harmonising procedures over all agencies
All procedures, forms and statistics should be brought in line across agencies as far as possible. The forms should be based on modules, which are partly similar across all product lines and agencies. Reports should also be similar and compatible with the requirements in the reports to Statistic Austria. Post project statistics have to be provided for at least five years or the firms can allow the statistical office to transmit their reports as required by law to the agencies if they want to prevent additional reporting. All records should be transmitted to the Austrian Statistical Office, which then allows agencies as well as universities and research institutions to make use of the micro material anonymously.

(§23) The roles for the three agencies should be stated in the vision with a clearly defined general task and a streamlining of the current division of labour.

We recommend:

FWF: well-balanced funding of bottom-up and top-down approaches
The FWF should give more room for developing thematic areas focusing on societal priorities and on broad technologies in which Austria strives for international excellence. Scholarships and awards should also be more closely linked to priority areas While the very missions or priority areas are defined top-down in the vision, the specific research lines and topics should develop from a bottom-up approach. Whenever the dominating bottom-up approach leads to spots of excellence, the FWF should further such fields of research and make a report to the ministry, which will then decide whether additional measures should support the strength of this field

The support of excellence, internationalisation, and cooperative research in science should remain the principal goals of the FWF. Excellent researchers coming to Austria should be supported specifically. To increase the internationalisation of research an extension of the D.A.CH agreement to other countries should be enforced

FFG: less thematic programmes and more bottom-up approaches
It is recommended to strengthen the role of FFG as the central research promotion agency pressing ahead with a frontrunner strategy, particularly in the area of applied research. The current programme lines with their very specific funding logics should be brought to an end New and more flexible support measures should be developed. The following measures should be taken immediately and independently on later decisions regarding the continuation of specific programme lines.

The number of thematic programmes should be reduced (not the amount of money spent) Within all programmes there should be more bottom-up approaches, less stringent a priori definition of programme lines and less pre-specification of the instruments to be applied. The differences in procedures stemming from the time before the merger process setting up the FGG should be eliminated. The personnel of FFG should be more mobile across the programme lines. FFG should become the agency promoting excel-

lence and bringing firms nearer to the technological frontier in the applied sector. FFG should try to increase cooperation with FWF, specifically looking for the creation of similar clusters and excellence spots in applied and basic research.

Current basic programmes should be upgraded. Funding should specifically support service firms facing severe difficulties in tapping indirect funding. It should draw more attention to risk taking and projects in the pre-competitive stage. The support for individual projects should be increased and money given for longer periods to allow for the development of human capital and, more generally, to enable behavioural additionalities to emerge from support.

Structural programmes should be evaluated every fifth year, again according to ex ante known criteria. Structural programs in the area of cooperative research have to be dissolved at the latest after 10 years, since only this will put pressure on persons and firms to go into the market phase (making profits). Structural programmes as well as thematic programmes should be fixed in three years performance contracts (with an evaluation after two years). The room for choosing instruments should be larger. The bottom-up approach should dominate within structural and thematic programmes.

AWS: Encouraging the access to venture, seed capital and innovation entrantss
The role of AWS could be defined as a bank on the one hand, and as an agency supporting the start-up of companies on the other hand. For start-ups and innovative new firms they should provide and encourage the access to venture and seed capital and offer and promote the innovation check. This task includes counselling, networking, project management and change support. Functions related to deeper innovation may be shifted to FFG. AWS should also be in charge to support firms that have not engaged into innovation so far to develop primary innovation capabilities and to integrate respective activities in day-today business. As the innovation voucher supports innovation newcomers, it should be moved to AWS. It may also be worthwhile to consider delegating operational responsibility for the Headquarter Programme to AWS.

New Goals: Focus on Output
(§24) To some extent, output goals have entered both, the strategic level of innovation policy as well as its operational level. More recent programme documents list a number of targets and related output indicators or spell out to-do-lists on the basis of which funding recipients may tick off supposed output of some support measure item by item. The general performance of the innovation system might be assessed with reference to the number of patents and publications, the speed of technology diffusion, competitiveness in high-tech industries and in the highest quality segment of individual industries. More specifically, output goals for a scheme devised to promote innovative start ups may be defined in terms of the number of firms entering a market, the dynamics of employment in new firms, the growth of firms after five years, the number of firms developing new products or innovating continuously. Output goals for a strategy to deepen innovation may be given by the number or size of innovations new to the market, the number of firms which realise successful innovations in an emerging key technology, the number of newly initiated research co-operations with (foreign) universities, the share of patents in the triad (USA-Japan-Europe), revenue accrued from licenses, etc.

Any attempt to specify the ultimate goal of intervention is very much appreciated for they offer more orientation with regard to contents of innovation policy and gear more towards the efficient allocation of public money than mere input goals would. It is also in line with the new budget law. Above all, output indicators stimulate increased action and put issues on top of the agenda. At the same time, however, we note that in many cases it is simply impossible to attribute well-defined, observable, and above all meaningful output indicators to discrete measures of intervention; this holds true at least at the programme level, and certainly at the level of national innovation policies. On the other hand, the "to-do list approach" simply measures what is measurable. At best, this might be a device for internal bureaucratic control, but it is certainly not rather conducive to efficient output steering of the NIS.

We recommend:

Adding output goals wherever feasible
Lacking efficiency of current expenditures in Austria is indicated by the fact that Austria's position in innovation output indicators is less favourable than its position for input indicators. This may not be surprising after a prolonged phase of rapidly increasing R&D investments. However, political representatives should not ignore this development. Steering the innovation system mainly by input goals tends to lead to inefficiencies. For this reason, we recommend to include output measures in the formulation of policy goals and the implementation of specific instruments whenever possible. Public interventions should therefore be assessed on a mixture of output goals, administrative guidance and provided inputs.

In particular, beneficiaries of direct funding should be aware that their post-funding performance will be increasingly benchmarked against output-based indicators. In light of the difficulties to define universally valid output indicators that apply to all funding beneficiaries, it is suggested that applicants themselves specify their output targets along a list that varies between individual intervention measures. As currently the majority of policy instruments still follow an input-based funding logic, the change towards steering by output goals whenever possible introduces some cultural change to current funding practices.

Direct and Indirect Support: Separating the Tasks
(§25) The analysis of the Austrian innovation system indicates that the innovation base is not broad enough and that innovations are not sufficiently profound for a high-income country. Broadness of the innovation base can be defined by the number of innovative firms, and by the number of firms innovating on a regular base (instead of casual innovations), or the share of firms with research personnel or research departments. Excellence of innovation activities may be indicated with reference to applied technology levels, e.g. respective projects are based on off-the-shelf technologies, on technology beyond the normal operating window or on next generation technology. The depth of an innovation may also be assessed by its distinctiveness, or service features.

Whatever the definition of high-value innovations might be, they are often based on

basic research and certainly on high-skilled labour. Both, increasing broadness and excellence (depth), equally require human resources and financial incentives. Different instruments should be used to fulfil the two goals.

(§26) Direct support measures involve the direct transfer of financial means such as grants, subsidies, or conditional loans, but also non-financial support, e.g. access to information and advice, brokerage schemes, or funding for networks. The distinctive feature of direct support is that specific measures are granted for well-defined projects. Support depends on some commission's discretionary case-by-case decision where pre-specified funding criteria and selection rules apply. The budget allotted to agencies and programmes is predetermined and often varies from year to year.

By contrast, claims against tax liabilities – via allowances or a tax credits – are subsumed as indirect support. They allow companies to reduce their tax payments as a reward for carrying out research activities. There apply no prior selection criteria.

(§27) The final mission of direct measures is to channel support to those activities which generate the highest social returns. By focussing on excellence, direct support is the right approach to promote the deepening of innovation. By focussing on areas of high societal importance it is also instrumental in offering solutions to problems beyond the narrow sphere of the immediate beneficiaries of support. Furthermore, direct support enables learning processes, provides information and induces a certain degree of consulting.

(§28) The mission of indirect support is to foster R&D in general and to make investments in research more attractive than investments in other activities. The rationale for this kind of support is derived from the importance of R&D for the growth of firms, for the competitiveness of the economy and the creation of external benefits connected with research. Firms and institutions should know that indirect measures make all expenditures related to research and development cheaper than if paid at market prices. It is advantageous for setting up research departments in Austria, if research incentives are high and reliable. Structural effects within the research expenditures are not intended and do in general not exist (with the exception of low support for innovation in the service sector).

We recommend:

Broadening the base and deepening the scale for innovation
Broadening the innovation base and an upward level shift can be best supported by indirect support mainly via tax incentives. This holds primarily for increasing the number of firms which engage in innovation-related activities on a regular basis, for setting up research departments or attracting foreign firms to locate research facilities in Austria. The tax credit is a very efficient instrument because it provides incentives for firms not yet profitable and it induces a cash effect in recessions (as opposed to tax allowances).

However, for new start-ups and for firms with no experience in innovation at all, some additional direct project funding including a service and a consulting component is es-

sential in addition to or instead of tax funding. More generally speaking, "changing the track" – supporting innovation entrants, and encouraging the deepening of innovation and the transition from imitative activities to innovation activities at the knowledge frontier - can be better accomplished through direct project funding. Both the scale and the scope of such projects regularly call for a high concentrated subsidy component. In particular, direct funding should focus on radical/new-to-the-market innovations, on risky projects, on research co-operation with universities and other firms and on broadly defined thematic priorities. Direct funding may also be instrumental in removing major structural deficits of the innovation system.

For broadening plus level shift we propose a simple and generous tax credit for research. For deepening and changing the track we recommend substantial reforms in the governance of funding (mainly) applied innovations of firms and changes in funding of basic research, university- and non-university research. We furthermore recommend to continuously measure the degree of additionality of public funding, to monitor the degree to which the deepening of innovation occurs via direct funding and to regularly assess the impact of tax credits on innovation, on the use of human capital, on research output and economic performance at the firm level.

Increasing complementarities, reducing overlaps
The dichotomy between direct and indirect funding is well-founded and should be continued. Both of these basic funding approaches meet distinct objectives and follow different funding logics which should be made more complementary to each other. Direct and indirect funding instruments are no substitutes for one another – far from it. There is strong evidence that funding effects materialise only if companies make use of tax incentives and also rely on more challenging measures of direct support. This applies especially to successful introduction of true market novelties. In this sense both measures work complementary and complementarities should increase through the reforms.

The role of indirect support is to further the width of innovation and to facilitate complex continuous innovation activities which cannot be easily divided into individual projects. Firms should be able to rely on public support independent of the decisions of agencies, their shifting priorities and annual funding budgets.

The role of direct support is to differentiate between firms and projects according to the priorities of the vision or the ministry designing a programme, and to give support in cases of extraordinarily high expenditures (core projects, start of a new phase) and high risks (radical innovations). Thematic priorities – as defined in the vision- supporting successful clusters, or concentrating research on certain areas as to gain international leadership should be a priority task for direct support, too. Support for research in the precompetitive phase should be strengthened. Structurally important projects should build on reliable and dynamically increasing sources of finance and not on irregular ones. Similarly, the short-time (non-) availability of public money should not have an effect on stop-or-go decisions of such projects. Tying the funding of basic research to unstable sources (e.g. to the National Foundation) involves some unpleasant side effects once the flow of these funds falls below prior notice and funding slows down or ceases. Breaking ongoing research projects off first and foremost entails sunk costs.

It is very difficult to predict the future use and hence the cost of indirect funding instruments (and the cost of public funding as a whole). Recent projections of the Ministry of Finance proofed to be highly overrated Direct funding needs a continuous, foreseeable perspective of increasing funds to pursue the frontrunner strategy and to contribute to attain the 3% goals in 2010 and the 4% goal in 2020. On this account the practice of trading direct funding budgets off against (over)estimated expected costs of indirect funding undermines (if not damages) respective statements of the current government programme. Furthermore, basic research does hardly benefit from indirect funding provisions

Reform of Direct Support
(§29) Throughout the last years a comprehensive set of intervention measures has been developed, where the programme-approach is dominating. As has been argued in §16 the resulting plethora of programmes primarily reflects severe deficiencies in the governance of STI. These programmes meet all kinds of specific needs of target groups and, as a consequence, the recipients of (direct) support are not overly critical of the current system. On the contrary, the customers are quite content They do not get lost in a funding jungle, but deliberately pick from the best offers of a funding supermarket. The strong orientation towards customer satisfaction dampens the readiness and willingness to change, even more when the direction of change by itself is controversial On the other hand moderate performance in innovation output puts severe doubt on the overall effectiveness and efficiency of the current system.

(§30) Today, a typical programme is administrated partly by an agency and partly by the originator (a department in a ministry). The originator of the programme is still able to intervene or at least to co-determine in detail how the money is invested and what funding criteria apply. While such control does, in principle, comply with the division of work between the strategic and the operational level of governance, the level of intervention and the driving force for intervention are in dispute. Agencies informally complain about micro interventions, i.e. in-detail control of funding guidelines and specifications of programmes. Similarly, agencies themselves voice their continued interest in established programmes. Sure enough „cosy relations" between the originator/ implementer and the target group of interventions are very much appreciated by the beneficiaries. However, without discrimination between projects, industries, technological content etc. the structural effect – the very objective of direct support – cannot be fulfilled. Now and again, interventions are necessary in order to achieve a structural effect – the ultimate objective of direct support

We recommend:

Improving Governance will put an End to the Plethora of Programmes
In general the number of programmes should be substantially reduced, but not the money spent The objectives of each intervention – the broad tasks – should be clearly stated. Ideally these tasks are derived from the vision or at least they should be based on the sub-strategy of the ministry delegating some task. Tasks are defined as broad issues, e.g. "building a cluster or a community for a certain topic". We recommend

reversing the burden of proof for initiating new programmes. Whenever a new policy goal (task) comes up it has to be investigated first whether there are other options for policy response than building on the familiar, yet mostly little sustainable programme-logic. This approach involves tight co-operations with policy areas outside the sphere of innovation policies in a narrow sense; fields of action include the formation and attraction of human capital, intellectual property rights, standardisation, (de)regulation, public procurement and probably much else besides. Ministries meet regularly to co-ordinate tasks and to prevent overlaps in the assignment of tasks remaining in the responsibility of agencies.

Mitigating Role Conflicts and Benefiting from Synergies
In fine-tuning the provisions for direct support and assessing the role of various steakholders, it is important to pay close attention to potential role conflicts and synergies. While the knowledge gained through the management of RTDI funding schemes can be key for creating suitable information tools for the target groups, a too close ("cosy") relation between funding agencies/ministry staff on the one hand side and target groups on the other hand side, raises some concern on issues such as transparency and unbiased fairness and, above all, on the coherence of the intervention system as a whole. We recommend shifting (or leaving) responsibility for the implementation of monetary funding modules to agencies; agencies should also be in charge of information brokerage, consulting and monitoring of funding. Community building on the other hand should not primarily be located with the support agencies due to the above mentioned potential role conflict. In principle, the same argument applies to ministries. However, once ministry staff sticks to strategic governance and agenda setting, this role conflict becomes less severe. In the meantime the ministries could commission community building to other (private) institutions and expertise.

A Need Test for each New Programme
When tasks are delegated to agencies, there should be a strict need test before implementing a new programme. In particular, it has to be investigated which programmes become redundant after the introduction of a new one and whether assigned tasks can be fulfilled via existing programmes (taking into consideration the aggregate programme portfolio of all agencies). For instance, new policy issues or missions could be fostered by measures of stimulation, consulting, management, partnering, awareness etc. (which may be specifically customised for distinct target groups), while monetary support could draw on existing instruments and measures. This approach seems particularly reasonable when the capacity of a new initiative is unclear, the target group is small, and when the features of the new initiative are not very distinct from available measures.

In view of the long time it takes to design new measures, experimental approaches (pilotcalls, learning experiments) are encouraged, especially if there remains uncertainty on the capacity and scope of a new initiative. After the "experiment" has come to an end, the next step involves a "stop-or-go"-decision based on ex ante defined success criteria

Phasing out Existing Programmes
In order to increase the structural effect of direct support we recommend not only

Indicators defining the success or failure of an intervention have to be developed ex ante and a set of "exit" criteria should be defined which build the basis for any decision concerning the closure of funding programmes. Each programme should be evaluated according to these pre-defined criteria after five years, and terminated after six years if the specified task could not be fulfilled. (There may be arguments for longer or shorter time spans). Above all, if there is no structural effect the financial resources spent for direct support lose their most important justification. The findings of positive evaluation reports should be reflected and fed back to the potential restart of the programme in concern. In particular, updated objectives induce new strategies for operationalisation.

Defining Top-down Areas

(§31) While it should be no longer possible to establish narrowly-defined thematic programme lines, nor programmes for narrowly-specified technologies, it can and should be possible to define broad priority areas in the vision. Agencies should determine the details of implementation. Agencies should carry out periodic calls to support the development of scientific and technological capabilities in areas of social interest and to promote strategic technologies defined in the "vision". Given the urgent challenges many advanced economies like Austria face (e.g. Kyoto Targets and global warming, ageing of population, health issues, security issues) research funding should also support societal goals. It is evident that a small country has to economize on scarce resources and will achieve leadership only in small areas and niches. The first argument in favour of top down programmes is that markets not always provide scientific or technological know-how to fields of societal concern ("mission argument"); the second argument is that top down programmes can contribute to make production and research more effective by bundling resources ("scale argument"). On the other hand it is well known that the information level of the government on prospective future developments and on chances for success in a competitive environment may be insufficient. This is even more the case if basic research and radical new fields are involved. Due to this uncertainty governments of advanced innovation systems tend to pick programme lines for similar new generic technologies (or "future technologies"), or they focus on similar societal goals irrespective of grown domestic capabilities and specific domestic needs. Moreover, often thematic programmes result from extensive lobbying of interest groups with little reference to research areas of national strength, nor mission arguments.

One solution to this problem is to determine a few broadly defined themes and strategic technologies in specific domains of application on which Austria should concentrate either on the basis of prospected excellence or on the basis of policy preferences (societal needs). All these priority areas (top-down priorities) should be clearly stated in the vision, including the very reason for choosing whatever priority area of intervention. It is further necessary to outline criteria by which both success and termination should be assessed.

We recommend:

Defining Priority Areas in the Vision

In the vision focus should be directed on a small number of priority areas aiming mainly

societal goals (including ecology, health etc.). The rationale for identifying some priority area of action should be made explicit and the motivation for intervention should reflect a wider social consensus. It is important to define thematic programmes on a broad basis and avoid subdividing money according to narrowly defined programme lines or pre-defined instruments. Specific research topics within the broader thematic areas should not be specified but follow from a bottom-up process Additionally the agencies should try to identify hot spots or topics which are defined by a cluster of bottom-up projects. FWF as well as FFG should co-operate and work out framework conditions for successfully strengthening an existing or newly created cluster of competence. These are to be reported annually and the ministries in charge of the agency can decide if there are measures to be taken to further encourage a centre of excellence with measures in the realm of their political sphere.

Seed finance and Start-ups

(§32) One of the most pressing deficits in the framework conditions for innovation in the Austrian innovation system refers to the undersupply of venture capital This shortage of risk capital is related to the specific medium-tech profile of the Austrian business sector More generally, information asymmetries are hard to overcome despite intensive screening of the projects as managers of technology firms and start-ups have always better information on the actual quality of their business plans and the technologies they develop than potential investors Investors are prone to herding such that their investments are concentrated in a few sectors and as a result, not enough variety is supported by the capital market. Private venture capital investors tend to focus on the less risky late stages of the start-up process such that not enough private capital is available for the early phases of business creation. Finally, also the classical argument for the support of R&D is valid for start-ups as start-ups may underinvest into R&D if returns cannot be completely appropriated.

(§33) In Austria a number of policy instruments have been developed to support early stage financing needs and other support measures for start up firms. These programmes are administered by two different agencies. The AWS provides financing instruments, research, consulting and certifying services, and guarantees for venture capital funds as well as venture capital intermediation services. The FFG in turn offers instruments to support business start-ups by academics (AplusB programme), innovation vouchers and thematic R&D funding programmes accessible to start-ups Thus, start-up firms are able to access a large number of programmes; however, the fragmentation increases the administrative burden to firms. The proposed instrument could also be adapted to promote the building up of research and development capabilities by innovation newcomers

We recommend:

Simplifying Support for Start-Ups and Focusing on very Early Stages

Public support for start-up financing should be simplified in order to reduce the administrative burden. Support should concentrate on the very early stages such as the pre-seed and the seed phase, when firms assess the feasibility of their business plans, develop their product concept and assess their market potential. With slight adaption

innovation newcomers.

Pooling Instruments to Cover all Phases of the Early Stage
A possible solution to simplify early stage financing is to pool different existing instruments to allow for a financing that covers all phases of the early stage business start up process. This would reduce administrative burden considerably. Such a support scheme should

- *split the process in several stages to reduce the risk of the investment for the public investor,*
- *ensure that external expertise on markets, technologies, management and finance are involved from the very beginning,*
- *ensure that only projects are chosen that need private equity or venture capital*

Furthermore the commercialisation strategy should form an integral part of the proposal and the evaluation should also be based on this aspect even though this stage should not be funded.

Early stage start up support should

- *address start-ups of firms*
- *award money for the proof of concept phase (innovation vouchers + additional funds for more demanding proofs of concept; up to 30,000 Euro)*
- *award money for the prototype development phase paid out for the achievement of predefined milestones of the project with an ongoing assessment of the continuation of the project after each milestone has been passed (up to a maximum of 500,000 Euro).*

(§34) The present institutional and legal framework conditions for the establishment of venture capital funds are not satisfactory. With the phasing out of the Mittelstandsfinanzierungsgesellschaft as legal form for venture capital funds the legal conditions concerning private equity are ambiguous. It is therefore necessary that this situation is cleared as soon as possible. (§35) The Federal Ministry of Finance has presented a bill to strengthen Austrian capital markets and innovation (Kapitalmarktstärkungs- und Innovationsgesetz -- KMStIG 2008). The bill promotes the establishment of investment companies for which special taxation rules should be applied that are particularly relevant for private equity/venture capital markets. The provisions of the bill are to ascertain the free flow of risk capital without fostering speculation. There are, however, a number of reservations concerning the types of acceptable investments (some forms of investment are not considered), the minimum and maximum durations of the investment stipulated in the bill that would complicate IPOs, information disclosure obligations, or requirements for managers that are not clear. Despite the fact that this bill represents a contribution to considerably strengthen the Austrian capital market, further amendments are necessary.

We recommend:

Improving the Legal Framework Conditions for Private Equity/Venture Capital
A baseline solution to improve the conditions of the Austrian venture capital market is to amend the bill for the Kapitalmarktstärkungs- und Innovationsgesetz 2008 and pass it into law in order to ensure that Austria has an internationally competitive private equity law.

The Ministry of Finance should take action to improve the legal framework conditions for the operation of venture capital funds: it should advance an independent and internationally competitive private equity law, create reporting standards for more transparency and reassess the investment rules for life insurances. The Oesterreichische Kontrollbank should assist in collecting relevant data.

Establishing Funds of Funds and Extension of Capital Guarantees by AWS
In order to increase options for diversification and to attain larger funds we recommend establishing a fund for public participations in private venture capital funds focusing on early stage finance. This would ensure higher liquidity in the early stage venture capital market. The participation would be at market conditions. The public should only act as minority investor with a participation of up to a maximum of 30%. Extending the AWS capital guarantees would facilitate protecting venture capital investments while fund volumes are too small.

Support to Small and Medium-Sized Firms
(§36) Broadening innovation means that more firms, specifically smaller firms, engage in innovation and research. Tax incentive schemes cover small firms quite well – provided that they invest in R&D. The crucial point is that innovation activities of small firms are mostly less technical in nature and hence they mostly do not meet the criteria for (Austrian) tax funding. As for direct support, administrative burden of application procedures seem daunting. This is especially true for small firms with little (or no) innovation experience; such firms face an unfavourable cost-benefit ratio of insecure funding prospects some time in future and initial fix cost of application. By contrast, the innovation voucher offers easy (and in many cases: first time) access to direct funding, including consulting services.

We recommend:

Continuing the innovation voucher scheme
The innovation voucher is an easy, non-bureaucratic measure to encourage innovation activity of small firms. We recommend continuing the innovation voucher scheme and encouraging its actual use. It is instrumental in raising awareness that innovation is both necessary and feasible in small firms The scheme should be evaluated after three years

of allowance schemes differs between incorporated companies and non-incorporate firms. Calculation of allowances is mostly based on volumes of eligible expenditure, but there is also an additional subsidy for incremental expenditure. Two different bases of assessment co-exist, one relates to inventions valuable to the economy, the other one relates to R&D expenditure as defined by the OECD's Frascati manual. Firms can choose between different bases of assessment and may also opt for a combination of both. The provisions for contract R&D vary substantially depending on the scheme chosen. Seen from a system perspective, the major concern is to increase R&D in general and to promote open innovation. Integrating external knowledge in the process of innovation will speed up and improve its function.

In order to increase the effectiveness of tax incentives they should be easy to understand and to communicate, for otherwise companies will not respond to the incentives set. The present structure of tax incentive schemes is highly complex and in fact it is much more complex than necessary.

We recommend:

Implementing a Single, General Tax Credit
We recommend relying on only one single instrument, namely a tax credit (tax premium). Eligible claims should be based on Frascati R&D and include commissioned research - without the current cap of 100,000 Euro per year. The more generous provisions on contract R&D would promote knowledge and technology transfer, research co-operation and co-operation with universities would improve. There should be no further provisions for incremental expenditure; the new scheme should be volume-based.

(§38) While the relative generosity of R&D tax treatment in Austria used to rank top by international comparison, today it is only average or even slightly below. This downward shift is due to the reduction of corporate tax rates (in 2005), but also due to improved tax incentives elsewhere. Recommendations on the desirable generosity of tax funding of research ultimately hinge on the willingness to trade present loss in tax revenue off against future tax revenue; it is a bet on future economic success of current research investment and hence there can be no correct let alone optimal assignment. From an economic point of view the tax credit should be considerably higher than today in order to keep - and renew - the attractiveness for research in Austria in a more competitive environment and to draw near to the targeted R&D quotas set by the government. The political implementation of a new regime will be the easier the more companies will find the new scheme no less advantageous.

We recommend:

Raising the Tax Credit to 12%
If the tax premium is raised to 12% (smart solution) all firms in the corporate tax scheme will be better off to a substantial degree. It is less attractive for firms liable to income tax- but only if they formerly drew on the increment-based allowance scheme

that applies to expenditures relating to economically useful inventions. The number of reform losers would be very small.
If the tax premium (tax credit) is increased to at least 10% (soft reform), incorporated companies would still be better off, but non-incorporated firms that formerly drew on any of the allowance schemes would generally lose.

(§39) Irrespective of the rate of the new tax credit the recommended reform in tax incentive schemes would entail losses to companies which used the old allowance scheme primarily with reference to economic usefulness, and less so with reference to research activities. Such policy change is quite in line with the recommended focus shift (i.e. from a catch-up to a frontrunner strategy)

(§40) In fine-tuning the new structure of tax funding there is an argument for more ex post controls as well as for a pre-approval facility. A tax credit of 10 or 12% is non-negligible, nor are the accumulated cost of fiscal funding. On this account ex post controls should prevent the misuse of the tax credit and thereby strengthen the credibility of this instrument. At the same time, the beneficiaries of the tax credit (who still bear 88-90% of the research cost) sure enough have a high preference for some planning reliability. To counter the argument that the liquidity effect is provided only ex post (with the delivery of the tax declaration), research outlays could be claimed at the beginning of the year (during the year), comparable to the „reductions of expected profits clause"[28] if there are good reasons. However, it is most important that the new premium is easy, understandable and reliable. The quest for reliability applies last but not least to ex post auditing practices which reforms in the tertiary education system.

28 Firms pay a certain sum for business taxes during a year, estimated on the basis of last period profit. If there are good reasons for expecting lower profits the firm may ask to reduce these ex ante payments. This could be extended to reduction of profits or extra cost due to research expenditures. This would also help the research department to argue the value of its activity within a firm (this is not the case to the same extent if the expenditure is used to get a tax rebate ex post)

We recommend:

Granting preapproval facilities and enforcing ex-post control
We recommend granting a pre-approval facility to increase planning reliability of potential users of the new tax credit. We also recommend responding to concerns about misuse of tax incentives by improving ex-post control. This would strengthen the credibility of tax funding instruments and thereby increase its acceptance beyond the still-narrow sphere of immediate beneficiaries. Finally we recommend responding to firms' concerns of improper auditing, for greater legal certainty constitutes a core advantage of tax funding as opposed to discretionary funding via agencies.

These concerns should be addressed by establishing a pool of highly qualified auditors. Auditors should hold a university degree in engineering or natural science; they should be independent from the tax authority.

Control (auditing) should be enforced on the basis of a random selection process where any user of tax incentives faces close ex-post examination at least once in five years.

(§41) The quality of the tertiary educational system is of overarching importance for the innovation system of a country. This specifically holds for high income countries that

only promote industry research, but it is also a source for new businesses. Improved university research enhances and deepens the innovation base in firms. Good universities with specialised knowledge attract also foreign direct investment and foreign research labs.

We recommend:

Increasing in accordance with progressing reforms
We recommend increasing funds for tertiary education to the level required by the European Commission (2% of GDP). Spending on higher education institutions should increase more dynamically than other forms of public R&D expenditures. However, additional spending for higher educational institutions should be accompanied by further reforms of the organisation of higher education institutions and by an expansion of the number and quality of study places.[29]

29 This recommendation states that the total funding for the university system is supposed to increase over the next years to 2% of GDP. However, this increase in spending needs not to be carried by the taxpayer alone. Beneficiaries of the tertiary educational system should also contribute to the increase in spending e.g. through tuition fees together with income contingent loans. Given that the cost per graduate in Austria lies well above the OECD average, but the average budget per student is below the OECD average, there is substantial room to increase the efficiency of studies. Graduates in Austria are more cost-intensive because the average duration of studies is also longer.

(§42) The priority for improving the educational system at the secondary and the tertiary level is very high and a protracted slow pace of reforms as observed in the past years will harm Austria's long term competitiveness and prosperity. The quality of university research and teaching has to be drastically improved and many universities still have to find their own profile. By advancing knowledge of science and technology, universities create the foundation for economic growth and material well-being and improvements in human health. As the principal locus of basic research, universities play a key role in sustaining competitiveness and economic growth; if knowledge will overtake capital and labour as the key production factor in the 21st century, knowledge-producing institutions such as universities will become the main drivers of economic growth.

(§43) Given the overall medium tech profile of Austrian manufacturing, universities of applied sciences should play the important role to broaden the technological basis of the Austrian industry. Universities of applied sciences provide a specialised higher education with a professional focus and they contribute to the transfer of knowledge and technology. Cooperation with enterprises and local communities are important, small scale innovations should be encouraged. Further studies should assess the need of study places offered at universities and universities of applied sciences. An extension of the system of universities of applied sciences may be necessary for two reasons:

(i) for the switch towards a sciencetechnology-innovation driven growth paradigm more graduates from both universities and universities of applied sciences are needed, and

(ii) the expansion of the system of universities of applied sciences increases the competitive pressure on universities to provide higherquality education.

(§44) Austria's educational system is characterized by an early selection of students between an educational track leading to tertiary education (secondary schools, universities) and an educational track leading to vocational training (Hauptschule, apprenticeship). The selection takes place at the age of ten. For pupils, choosing the vocational track, education ends at the age of 15, and a switch to the tertiary educational track is

no longer possible. This early selection corresponds also to a social selection, as the children who enrol on the vocational track, in many cases derive from a socially disadvantaged background. Although there are ongoing reforms to reduce the early selection and increasing links between secondary schools and an apprenticeship career, the split will to some extent continue and it is necessary to reduce this selectivity of the educational system by enabling people to upgrade their education up to the tertiary level.

We recommend:

University: Primary institutions for government-funded research
Universities have to remain the primary institutions in which government-funded research is carried out. Universities should continue to convey Bachelors, Masters, PhD and postgraduate training degrees. The PhD degree is to be conceived as a pure research degree suitable to pursue a scientific career based on extensive training in scientific research methods. The PhD thesis should in all instances replace the "Habilitation" thesis as the main proof of capability to undertake independent research and teaching.

University of Applied Sciences: Degrees focused on professional profiles
Universities of Applied Sciences are the top level in an education line from vocational training to applied secondary schools (Berufsbildende Schulen). All the degrees awarded by universities of applied sciences have to be specific and focused on a precisely defined professional profile. Universities and universities of applied sciences should not be closed for each other, but remain open in principle to students who want to switch between the two of them.

Organising and supporting an "applied career track"
There should be an educational track (applied carrier track) from apprenticeships to vocational secondary schools (awarding general qualification for university entrance) and further on to Universities of Applied Sciences. This educational track should be as flexible as possible. Employment and upgrading education could alternate several times during a (in the course of a) career.

Harmonising the funding principles
(§45) To achieve the functional division of responsibilities in providing knowledge as public good, a closer administrative and functional integration of the two types of higher educational institutions seems to be necessary. This should be achieved through a harmonisation of funding principles between universities and university of applied sciences. The Bologna process has led to an alignment of the types of degree programs offered by universities and universities of applied sciences. Now both institutions offer Bachelor and Masters Degree programs which have contributed to a consolidation of the landscape of higher educational degrees, but, in terms of the budget allocation the two types of institutions are treated in a very different way.

Universities negotiate with the Ministry of Science a three-year global budget (Globalbudget) that covers all types of cost. It is allocated on the basis of a three-year forward looking performance agreement („Leistungsvereinbarung" 80% of funds) and

30 Some universities of applied sciences will waive student fees starting in fall 2009.
31 For to quantify in excellence see Hölzl (2006)

a „formula" or „allocation" budget („Formelbudget") that is based on eleven back-ward looking indicators. Universities of applied sciences are funded on the basis of standardised costs per study place and student fees.[30] These differences in funding across higher educational institutions make the funding of this sector opaque This makes the monitoring of performance difficult and as a result it is also difficult to implement a coherent strategy and set coherent incentives across all institutions of higher education and research.

We recommend:

Harmonising the budgeting process for tertiary institutions
We recommend to change the ways institutions of higher education are financed in order to provide coherent incentives to increase the number of graduates as well as improve the quality of their education and the research carried out at Austrian institutions of higher education. These goals should be achieved by harmonising the funding of tertiary education across all institutions of tertiary education based on the current funding model of the universities of applied sciences.

(§46) It is necessary to amplify the effect and performance-related part of public university funding – which has been implemented with the University Organisation Act (UOG 2002) – through separated calculation of research and teaching costs. In the first three years the University Organisation Act (UOG 2002) is not able to set coherent incentives and supervise the implementation of goals because negotiation of performance agreements is characterised by a situation of asymmetric information as universities are in a better position (than the ministry) to influence the allocation of funds by defining their future development plans and goals. As the „formula budget" mirrors the topics that are subject to negotiations for the performance agreement, expected losses in the formula budget can be compensated by a specific prioritisation of goals in the performance agreement and vice versa.

(§47) With exception of the indicator capturing grants awarded by the FWF no other indicator entering the calculations for the formula budget captures the quality and quantity of scientific output directly, and most indicators for teaching reflect purely quantitative goals.[31] It is also not clear what impact evaluations should have on the budget allocation. While the University Organisation Act (UOG 2002) demands from universities to develop quality control systems and to carry out both internal and external evaluations of their activities, nothing is said on the consequences these evaluations are having on the budget allocation. The University Organisation Act (UOG 2002) does not support or encourage technology transfer activities or industry-university linkages sufficiently

We recommend:

Separate budgets for teaching, research and infrastructure
We recommend to define distinct budgets for teaching, research and infrastructure for

both types of higher educational institutions (universities and universities of applied sciences). The weight and the endowment of each of these budget positions is to depend on the division of labour between the universities and universities of applied sciences and specific social functions envisaged by the government.

(§48) The budget per student varies considerably across universities and universities of applied sciences. It ranges from about 3,000 Euro (Wirtschaftsuniversität Wien) to more than 35,000 Euro (Veterinärmedizinische Universität). In general, the most expensive universities in terms of cost per student are the medical universities. Universities of applied sciences are funded on the basis of standardised costs per study place and student fees.32 The standardised costs vary in dependence of the thematic focus of each degree program and range between 6,400 Euro per study place for business-related studies and 7,600 Euro for technical studies. The government funds 90% of these standard costs. Government funding for the universities of applied sciences therefore varies linearly with the number of study places offered. Universities of applied sciences in the field of business therefore get about twice the budget per student of the Vienna University of Economics and Business (Wirtschaftsuniversität Wien), whereas universities of applied sciences in the technical field get somewhat less than the technical universities. Considering that universities have to cover ongoing infrastructure expenditures, teaching and research from their global budget these rates compare rather favourably relative to those of universities. Universities of applied sciences cover their infrastructure and research costs from student fees (363.36 Euro per semester) and subsidies from the federal states that on average make for 30% of their total revenue. However, there are considerable variations across federal states ranging from a few to more than fifty percent. Given these differences, a high quality of teaching, especially at universities, cannot be guaranteed.

We recommend:

Standard cost based funding of teaching in higher educational institutions
Teaching budgets should be based on standard costs (given actual costs and warranted class size). The standardised cost funding rate should be adjusted in a back-ward looking fashion based on the average number of students per class in each degree course over a three-year period. The outcomes of teaching evaluations, the duration of studies in each degree course and drop-outs in each degree course should feed into this procedure.

(§49) Even though the allocation of research funds should be competitive, this does not imply that all research funds should be allocated through agencies. Universities should have their own budgets for research financed by the general university fund. This is important for universities to develop autonomously their research profile without a-priori depending on external sources. One way to allocate this research budget across universities could be based on merit established by following the general principles of the formula budget as established in the University Organisation Act (UOG 2002) but using different indicators capturing research quality rather than quantity.

We recommend:

Allocate a dedicated research budget to higher educational institutions
In order to support universities to define a precise research profile independently from external agencies they should receive a dedicated research budget through the general university fund. The total research budget for all universities could be allocated according to different indicators in a backward looking fashion and central attention should be given to indicators capturing both, the quality of scientific research and the quantity of research output as well as indicators for acquired external research grants (including also research grants for collaborative research with industry in pre-competitive fields). The R&D budget granted to each university should be allocated in a competitive process focusing on the merit of proposals from individuals rather than the quality of departments or institutes, as the latter tends to support of excellence. These dedicated research budgets should be used by universities to prepare younger research staff (post-docs) and to eventually apply for the more demanding FWF grants as well as to reward good researchers with a reduction of their teaching load.

Universities of applied sciences should receive small budgets for the preparation of project proposals and the maintenance of the given R&D support infrastructure. These funds should only be allocated after the FHPlus program has been used to start up the R&D activities at any university of applied sciences and if follow-up projects can be documented. Public funding should also be made available to cover losses of teaching income that accrue if R&D personnel of a university of applied sciences are involved in R&D projects. As most universities of applied sciences are by and large involved in development projects, these costs should largely be covered by co-operation partners from businesses that benefit from the cooperation. The remaining cost should be funded by the Federal government and the government of federal states and the latter should carry the larger part.

(§50) The costs of infrastructure vary greatly across universities. The global budget per student for technical universities is on average close to 11,000 Euro a year, for the University of Mining (Montanuniversität) it is approximately 14,000 Euro a year and for medical universities it is more than 26,000 Euro a year. On the lower end we find general universities with a budget of about 5,300 Euro a year or the Vienna University of Economics and Business with just above 2,900 Euro a year. These differences largely reflect the varying costs for infrastructure that have to be paid from the global budget. Since 2002 the government has made available funds for a program supporting the renewal and upgrading of immovable property amounting to 141m Euro. With this money 254 infrastructure projects have been realised. Much of this extraordinary funding has become necessary because equipment and buildings were either out of date or unsuitable for current duties. This indicates that in the past continuous investment and upgrading of large scale and expensive equipment and immobile property at universities has been neglected. For achieving excellence in research and teaching but also as a location factor for international business firms, a good research infrastructure and good research equipment are very important. It supports also inward mobility of top-level researchers. Ongoing investments in infrastructure should therefore at least equal the amount of write-offs of both, equipment and basic infrastructure.

We recommend:

Infrastructure budget at minimum covering write-offs
The infrastructure budget for universities and universities of applied sciences should cover at least the amount of write-offs of both, equipment and basic research infrastructure. For very expensive and large scale investments that have to be covered by extraordinary budget from extraordinary budget allocations, as a general rule it should be assessed in all cases whether it would be more convenient to pool the resources of several university partners and government laboratories for the investment in question and whether to set up a joint use centre, where the partners have alternating access to the equipment. The maintenance of the research infrastructure for universities of applied sciences should be financed by the Federal government jointly with the federal states. It should be covered to the larger part by the federal states. Given that both the Austrian Cooperative Research institutes and the universities of applied sciences primarily contribute to technology transfer to SMEs at the regional level, it should also be assessed whether it makes sense to merge some of these institutes with universities of applied sciences.

Non-university Research Organisation: heterogeneous missions
(§51) As in all developed countries we observe a highly heterogeneous sector of non-university research institutes also in Austria. The heterogeneity stems from the high variety of missions that research laboratories outside the higher educational sector have to accomplish. The mission of these organisations usually goes beyond the performance of basic research. Capabilities are typically concentrated in engineering and technology, followed by natural sciences, but more specialised capabilities are also evident in agricultural sciences, social sciences, medicine and humanities. In the past decades new government research priorities and pressure on public funding have contributed to reshape the system. The debate in Austria has followed the global trend to demand from these organisations to generate commercial income and emulate business practices.

The Austrian public R&D sector seems to be quite large as compared to other high income countries and that the R&D subsidy ratio for the private enterprise sector is only moderate as compared to other EU countries since a significant bulk of R&D subsidies is devoted to the public R&D sector. This raises the question on the contribution of the public research conducted in these institutes to private innovations; a question that has not been investigated to date.

We recommend:

Research institutes should invigorate the innovation potential of firms
To pursue a front-runner strategy, it is necessary to broaden and invigorate the innovation base of Austrian firms and in particular SMEs. Research centres provide a natural route to reach this part of industry. The development of an overall strategic vision for the Austrian National Innovation System should provide guidelines and help larger research institutes to position themselves in the National Innovation System.

research institutes and the universities of applied sciences. It should also be assessed how larger research institutes can best complement the technology transfer activities of universities, and whether their current organisational structure is best suited to face this challenge. In areas where the call on expertise is intermittent, but important, it should be assessed whether the overhead costs of maintaining expertise and facilities in particular areas could be reduced by operating joint research institutions with European partner countries.

(§52) The large number of research institutes with an orientation towards industry and especially to SMEs show that the market (manifested by industrial contracts) has identified a need for their services. There is substantial empirical evidence that outsourcing of R&D by firms is increasing and that a significant share of this goes to industry-oriented research centres. There is also another role for research centres. They provide development and technical services to traditional firms which have little or no R&D capability of their own, many of these are SMEs. For this reason policies to enhance their capability to support innovation should be put on the agenda. In the execution of these activities research centres could also act as intermediaries between university research and industry through applied research and innovative development. There are, however, examples, where these activities are successfully carried out by universities (e.g. the Harvard Accelerator Fund). In this case an alternative role for research centres would be to focus exclusively on consulting activities to the support of partnerships and knowledge-sharing between academic institutes (example: Steinbeis foundation in Germany). At the present there is little systematic knowledge on how these different roles have developed in Austria, and more specifically on the nature of existing interactions between the business sector and mission-oriented research institutes.

(§53) A key difference between mission-oriented research institutes outside the higher educational sector and academic science is the extent to which scientific excellence is a goal in itself. While some research institutes try to maintain their professional standing through publications and conferences, this is not their primary purpose. Many of the tasks these institutes carry out such as taking long-term measurements are important science but mundane in research terms. The specialised role of these research institutions lies on the one hand in their potential to act as an instrument of diffusion of technology, and on the other hand in their importance to provide R&D for public goods and the provision of scientific advice to government. Both functions increasingly become also a goal for universities, but not their primary purpose.

We recommend:

Providing public goods not offered by universities
The specialised role of the mentioned above non-university research institutes outside the higher education is to provide public goods and knowledge-based services that universities do not provide. Non-university research institutes should therefore act as an instrument of diffusion of technology, provide R&D for public goods and scientific advice to governments and businesses and act as intermediaries to improve the linkage between university research and industry with the aim to broaden the knowledge base

and the innovation potential of the economy.

(§54) Research centres are also a potential source of new technology-based firms. Here, the greater contribution is likely to come from centres which are performing more basic and strategic research. In Austria this concerns mostly the larger research centres and the cooperative research centres (K-/Comet competence centres, as well as the Ressel and the Christian Doppler research laboratories). Mission oriented research centres are in the most favourable condition to start up businesses if they, not their clients, own the intellectual property of their technologies. The management of IPRs should therefore be given particular attention. Temporary research structures such as the competence centres have a high potential to support the creation of technology-based firms due to their temporary character and their operation at the interface between high level academic research and business. However, IPR aspects are likely to be crucial for these laboratories as well. Further research should study the start-up potential in the Austrian cooperative sector, and assess the main drivers and obstacles for spin-offs.

We recommend:

Support start-ups from non-university research institutes
Due to their strategic position at the interface between applied research and innovation non-university research institutes are a potential source of technology-based business startups. Studies should assess the potential for firm creation at public research institutes and evaluate how this could be systematically exploited to support structural change in the business sector. Non-university research institutes should develop capabilities to support the creation of start-ups.

(§55) A result of this evaluation shows a positive relationship between the share of budget research laboratories outside the higher educational sector get financed through block grants and their capability to successfully acquire grants and contracts from other sources. Institutional funding should, however, depend essentially on the extent that a research institute produces public goods or addresses specific systemic or market failures that lead to underinvestment in research and development, such as information asymmetries or technological interdependencies

We recommend:

Block grants are to be awarded for public goods and external effects
To get block grant funding non-university research institutions should provide a mission statement which should include a definition of the public goods and external effects they generate, as well as characterise the nature of research they are engaged in. They should also declare quantitative and qualitative objectives for the next period and specify the infrastructure that is of direct utility to private or public enterprises and the academic community. Evaluations after 5 years should assess if the targets have been fulfilled. In case of a negative assessment the block grant should phase out according

to a defined scheme. Geographic proximity to the clientele/and or universities or education facilities is recommended.

Guiding Characteristics for Change

Change as a process

(§56) Switching to a frontrunner strategy cannot be done by financial resources only. It requires a permanent positive attitude to change and learning. Change has many dimensions: change in the management techniques, in the behaviour of firms and individuals, in the competencies and government structures, etc. We specifically address some characteristics favourable for this strategy change: mobility, openness, innovation as a principle in education Cooperation, experiments should be important drivers of adaption to the challenges

Mobility as an asset

(§57) Mobility and knowledge are to a certain extent embedded in persons. The mobility of researchers, but also of human capital in general engaged in the innovation and knowledge system fosters the dissemination of knowledge and the cross fertilizing of innovation. Still mobility is often low due to rigidities, income schemes, non-transferability of benefits, and discrimination in favour of insiders, inertia and low entropy in general.

We recommend:

Mobility as Priority Principle of Public Policy
Mobility of persons and the spread of information should be a priority for public policy in general and for the framework conditions in the innovation and educational system in specific. This holds for the mobility between firms and universities, between agents of the innovation system and firms as well as universities, between domestic staff and international community. Universities and extra-mural institutions should be more attractive for international students and researchers, and they should have the possibility for sabbaticals, temporary breaks etc.

Openness for newcomers

(§58) There is evidence that endemic insider advantages exist in the Austrian innovation system. Firms which used to get direct support will continue to do so Firms which cooperate with universities continue and intensify contacts. The same holds for non university research institutes, cooperative clusters and networks. All institutions and actors have intensive contacts and know each other („network relations"). Openness to newcomers and activities attempting to include new firms, researchers should be a persistent feature of the Austrian innovation system.

We recommend:

Built-in Obligations to Open up for Newcomers
Each institution should be open to newcomers and have the obligation to actively try to get new members on board. This could be achieved by publishing entry conditions, offering information days, internet information or by defining active recruiting of new members as performance goals. There should be annual workshops (open to newcomers and the public at large) to discuss strategy and persistent problems. Pilot calls should stimulate new, unexpected developments

Innovation as a principle and goal in education
(§59) Innovation in firms depends crucially on the innovative capacity and innovative attitude provided in the educational system. Attitudes towards innovation and science are shaped in the Kindergarten, they are further developed in schools and deepened in universities and life-long learning. Teaching methods and schedules, and the organisation and structure of the school system are outside of this evaluation. However, innovation-friendly attitudes are a crucial complement of an innovation strategy.

We recommend:

Encouraging Engagement in Science and Technology
The interest in science and in enrolment in technical schools and studies should be increased. This holds for both genders and requires additional intervention. The future labour market demand for graduates of specific fields should be well known to each student. Additionally we recommend to indicate labour demand by a differentiation of study fees, credit schemes, scholarship programs according to expected labour demand (not costs per student alone). Currently a small share of students in Austria enrols in technical studies, a relatively large part in studies where demand is not buoyant and full-time employment chances are low. This is even more disadvantageous as the number of graduates is lower in Austria than in most other rich countries. A considerable share of tertiary educated people then takes jobs for which they are overqualified. If this is done on purpose and under full information, we can consider this as a decision for a special lifestyle and a welcomed feature of a post materialistic society. If due to the lack of information studies are chosen where labour market demand is low, it is a waste of resources and a public failure. In the long run the educational system should make these differentiations less important since the relevance of studies should be reflected already in the teaching syllabus

Boosting cooperation
(§60) Innovation cooperation used to be underdeveloped in Austria in the past. This held for cooperation between firms, cooperation between firms and universities, between basic and applied science, for international cooperation, sometimes even for cooperation between clusters in different regions and across universities or between basic and applied research. However, the number of university-industry R&D partnerships (UIPs) has increased considerably in Austria in recent years. This can be partly

attributed to the introduction of programmes initiating or reinforcing university-industry R&D partnerships by the funding agencies. The positive trend in innovation co-operations may also be related to the increasing role of science-based industries in the Austrian economy.

We recommend:

Enforcing Cooperation in Innovation
Programmes enabling cooperation between firms, but even more between firms and universities, should be further encouraged. Cooperation between domestic and international partners should be taken into consideration when allocating public funds to programmes and/or institutions. Universities, universities of applied science and non-university institutions should be encouraged to open their infrastructure to other institutions and firms. Universities successfully acquiring third party funds should get more money, or a bonus premium in general (e.g. a bonus of 10% can top of Third Party Funds acquired by university departments) in the performance budgets.

Promoting Non-Technical Innovations (in Services and SMEs)
(§61) Promoting innovation in the service sector is an increasingly important task. Austria has a specific deficit in sophisticated services and research in the service sector is rather low as compared to frontrunner countries. On the other hand the share of the service sector is increasing, and services contribute to the enhancement of the competitiveness in the manufacturing sector.

We recommend:

More Focus on Service Sector by Widening the Definition of Innovation
Direct research programmes should take a specific focus on enhancing innovation in the service sector. Projects in manufacturing could include the service components associated with industrial projects. Another approach would be to enlarge the definition of innovation. Current–ly support measures concentrates on research and technical innovation. In the service sectors - and this also applies for SMEs - important innovations are non-technical innovations e.g. changes in organisation. It should be considered to develop specific support measures for research and development activities in service firms. For tax incentives it should be verified whether an adaptation of the Frascati-definitions could improve the support for service firms. Direct support measured could focus on cooperative research projects that have the aim to develop new trademarks, designs or patents.

Conclusion: Elements of a new Agenda
Innovation Policies in the narrow sense refer to policies and institutions directly related to science, technology and innovation. Such policies should be transformed into a comprehensive innovation policy with close links to the educational system and to other policy domains such as labour market policy, competition policy etc. A comprehensive

Innovation Policy has close links to the educational system and put a higher emphasis on the framework conditions for innovation.

New challenges

The Austrian System of Science, Technology and Innovation in the narrow sense has by and large worked quite well in the past. It is however better suited for a country which features a rather closed economy and which is catching up in terms of income and technology. Austria has long since become a leading country in per capita income and is well integrated into the globalising world economy.

At present Austria faces major external and internal challenges. Externally we are confronted with intensive competition both from neighbouring and Asian countries. Radical change is necessary, this comes not least as result of past success; a high-income country can compete only in sophisticated markets and products. Other countries are now moving into Austria's position as medium-tech specialists, deriving their competitive edge by adapting technology at somewhat lower labour costs. In addition, we see that higher innovation inputs have not been met by higher market shares and exports specifically in the highest quality segment in fast growing knowledge intensive industries. The number of firms innovating continuously remains small and business research expenditures are highly concentrated on a small number of firms. As compared to the EU average, in Austria twice as much business research is financed by foreign R&D players, and multinational firms have already started to shop around more widely for research facilities at the low end of the spectrum in the globalising world.

Efficiency lacking versus leading countries

The efficiency of the Science, Technology and Innovation systems can be assessed either by looking at innovation output, or by looking at the dynamics of industry – which are, of course, not independent from each another. Industry growth has been high in Austria and aggregate growth of the economy is above the average of EU-15 countries, and specifically, it is much higher than in Germany, Italy and Switzerland. Although the industry structure has changed in the last decade, it is still biased in favour of less knowledge-intensive and medium-tech industries. Moreover, deficits in high tech production and exports are persistent if not growing. Industries with high dependence on educational inputs are losing market shares relative to other countries and are falling behind in productivity growth. Furthermore, there is a deficiency in the number of innovative start ups which hampers the adoption and development of new technologies (Werner Hölzl). For the majority of innovation performance indicators, Austria's position is well above EU-average – but it falls far behind the leading countries. Specific deficits exist in public-private co-publications, ICT investment, and receipts from licences and patents. Moreover, patents are concentrated on traditional industries (construction, mechanical engineering), but are rare in ICT, bio- or nanotechnology. Similarly, the efficiency of innovation processes as measured by the productivity of R&D stocks and R&D personnel is relatively high when compared to EU average, but there is still room for improvement as we are still below the benchmark set by the top countries. Major bottlenecks to close the performance gap – i.e. to enter the top league of innovation countries – arise from the poor number of researchers and spinoffs. Framework condi-

Shifting to a frontrunner strategy needed
The new position as a top income country and the new environment calls for a radical change in the innovations system from an imitation strategy to a frontrunner strategy. Radical change should be based on a vision of the new innovation policy, a vision created and owned by government, communicated to parliament and the public, and monitored by a new Council for Research, Science and Innovation.

Elements of strategy change
A strategy change includes the following elements:

- From an innovation policy in the narrow sense to a comprehensive innovation policy,
- from an imitation strategy to a frontrunner strategy,
- from fragmented public interventions to coordinated interventions derived from a vision,
- from a multitude of narrowly defined funding programmes to a flexible, dynamic police defining tasks and priorities,
- from a blurred division of responsibilities to well defined competencies,
- from managing public interference through bureaucratic procedures to modern public management techniques without micro intervention.

The need for change should not be underestimated
Based on the results of existing studies, on new analytical results in this document and on nine background Reports of the System Evaluation, we have proposed 50 recommendations, some for major improvements some for smaller ones, some for smart, some for soft reforms. Overall the rapid change in the economic landscape, including the current economic crisis, call for drastic changes in the Austrian System of Science, Technology and Innovation. The focus of policy must lie on the dynamic elements of the economy that support change. The most important drivers of change are:

- education and scientific research,
- the creation of innovative firms,
- (disembodied) technology in- and outflows as well as research cooperations,
- foreign direct investment by research intensive firms, and
- large firms conducting advanced research.

Of these factors education and scientific research are considered to be the most important factors. National investment in primary, secondary, and tertiary education provide the foundation of economic development in an innovation led growth regime as it provides a foundation for a portion of the indigenous population to secure advanced education and high-tech work experience.

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