Jürgen Janger, Michael Böheim, Martin Falk, Rahel Falk, Werner Hölzl, Daniela Kletzan-Slamanig, Michael Peneder, Andreas Reinstaller, Fabian Unterlass

Research and Innovation Policy after the Crisis

The strain on the public budget caused by the economic crisis requires a more efficient focus on research and innovation policy measures in order to make sure it is still possible to implement a frontrunner strategy. This implementation hinges on an intrinsic increase in the efficiency of the system in order to better leverage resources and improve the education system, as well as the environment for innovative companies. This paper outlines a possible innovation policy framework for the implementation of a frontrunner strategy using limited public resources, which is based on the results and recommendations of WIFO's evaluation of the Austrian innovation system.

This paper is based on the following WIFO study: Jürgen Janger, Michael Böheim, Martin Falk, Rahel Falk, Werner Hölzl, Michael Peneder, Andreas Reinstaller, Fabian Unterlass, Daniela Kletzan-Slamanig, Forschungs- und Innovationspolitik nach der Krise. WIFO-Positionspapier zur FTI-Strategie 2020 (August 2010, 33 pages, 20 €, free download: http://www.wifo.ac.at/wwa/jsp/index.jsp?fid=23923&id=40225&typeid= 8&display_mode=2). • The authors are grateful to Gunther Tichy for useful and constructive comments • The data were processed with the assistance of Karolina Trebicka •
E-mail address: Juergen.Janger@wifo.ac.at

The economic crisis has resulted in significant costs for the public budget. By accepting an increase in public debt and an increase in government spending, Austrian budgetary policy has been able to cushion the recession. As the economy is slowly regaining momentum, the time has come to carry out a necessary consolidation of the public budget, with budget cuts of 1.3 percent planned until 2013 in the areas of science, research and education. In light of the previously planned increase in spending in this area, the extent of these cuts is dramatic. These restrictive conditions present a great challenge for Austrian research and innovation policy. On the basis of WIFO recommendations proposed in a system evaluation (see *Aiginger – Falk – Reinstaller,* 2009), we have developed innovation policy options for the implementation of a "frontrunner" strategy under the pre-condition of limited public resources.

The recommendations of the system evaluation

The three main recommendations outlined in the evaluation of the Austrian innovation system by WIFO included:

- a shift from a narrow to a comprehensive approach in innovation policy,
- a shift from an imitation strategy to a frontrunner strategy[1],
- and the improvement of the governance of the innovation system: moving from fragmented to coordinated and consistent public interventions by applying a frontrunner strategy, a revised governance system and a new definition of the relationship between the ministries and agencies.

Even in a period of budget consolidation, public funding for research and innovation in the private sector and the education system should continue to increase. The

[1] In a frontrunner strategy, firms and researchers strive to achieve market leadership in niche segments and high-quality, market segments, as well as market share gains in advanced industries and technology fields or activities in socially relevant areas. The frontrunner strategy focuses on companies, not industries (*Aiginger – Falk – Reinstaller,* 2009, *Tichy,* 2010). Research, development and innovation only play a greater role for fast-growing companies in countries at the technological frontier than they do for companies with average performance (*Friesenbichler – Hölzl,* 2010).

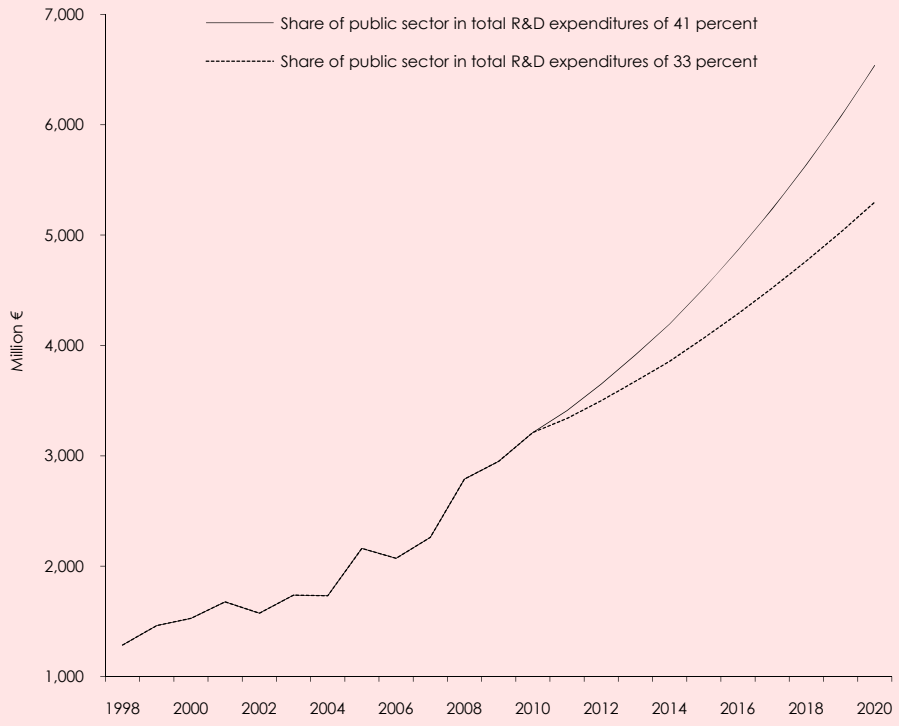
underlying reason for this is the crucial significance of innovation and education as investments for the future and drivers of growth in a highly developed economy.

WIFO therefore principally supports the objective of increasing research and development expenditures to 4 percent of GDP ("4 percent target"), expenditures on tertiary education institutions (universities) to 2 percent of GDP and the share of basic research to 1 percent of GDP as guideposts to help mobilise the necessary public resources for innovation and education in the political process. Public resources should only contribute one third of total R&D expenditures. Currently, public funding makes up 41 percent of overall R&D expenditures (global estimate by Statistics Austria), not least due to the economic crisis.

The 4 percent target could be achieved by 2020 by implementing two alternative development scenarios in public spending (Figure 1). The first scenario assumes a continuation of the current 41 percent share of public funding in research and development expenditures.

Figure 1: Development scenarios for public R&D expenditures until 2020

Goal to increase R&D expenditures to 4 percent of GDP



Source: Statistik Austria, WIFO calculations. GDP growth: 2011-2014 according to WIFO prognosis, 2015-2020, assumption 4 percent.

The second development scenario links the 4 percent target with the objective of reducing the share of publicly subsidised R&D expenditures to 33 percent and assumes corresponding efficiency gains through an improved leveraging of public funds. The expenditure path for this "33 percent target" follows an almost linear trend and the average annual growth rate of public research and development expenditures decreases from 7.9 percent in the years 1998 to 2010 to 5.1 percent on average in the years 2010 to 2020. This increase in public funding should be possible if an ambitious strategy is pursued.

WIFO has developed extensive proposals for how to increase public research and education spending during budget consolidation (*Aiginger et al.,* 2010, *Pitlik et al.,* 2010). With respect to the three major areas of public research funding – direct and indirect funding of business R&D and tertiary education – and the framework conditions for innovation, we present the WIFO recommendations based on the system

evaluation. These include a connection between nine goals on the level of policy (reform of instruments) and five goals on the level of outcome (impact of the instruments). These can constitute elements of the implementation of a frontrunner strategy and show the intended effect of the proposed reforms on the performance indicators of the innovation system (Table 1).

Indirect research funding

Indirect funding provides a "basic financing" of corporate research and development – in the sense of compensation for positive external effects – and provides support for non-project-related R&D, which can lead to the development of new projects. In the system evaluation, WIFO proposes replacing the current 8 percent tax credit for a company's research and development expenditures and the existing research allowances with a tax credit of 12 percent. This would, first of all, result in an intensification and sustaining of R&D expenditures as a "quantity" target and, second of all, create incentives to secure the foreign financing of R&D in Austria, which is high by international comparison (locational competitiveness). Furthermore, the cap on funding for commissioned research now set at € 100,000 should be abolished.

Direct research funding

Direct research funding, particularly for businesses, should be more focused and selective[2] than indirect funding. The reform of direct research funding has three main objectives. For the purpose of the implementation of a frontrunner strategy, direct funding should primarily pursue "class" targets, in other words, qualitative leaps in innovation and excellence in research ("deepening"). It should therefore particularly focus on high-quality projects with above average risk[3]. The second goal also pursues high social returns: the increased focus of direct funding on problems relevant to society such as climate change and population ageing. The third objective, which can be considered a "quantity" target, involves a broadening of the innovation base (increase in the number of companies performing R&D research). Such goals are much more difficult to achieve than a purely quantitative increase and perpetuation of innovation projects.

Higher education and research

Tertiary education – teaching and research – and the education system as a whole have been identified as a "bottleneck" in the innovation system. In its system evaluation WIFO recommends two objectives: first, strengthening the "breadth" of the human capital base for innovation and, second, strengthening "excellence". In other words, increasing the graduation rates of upper secondary programmes and tertiary education ("quantity")[4] and improving the quality of university teaching and research. The quality of universities is a determining factor in achieving a frontrunner position: mass and class objectives are substantially dependent on the availability of appropriately qualified human resources and high-quality university research as a source of ideas, cooperation partner and driver of structural change, as well as a guarantor of excellent training of researchers[5]. An increase in the quantity and quality of university research is also seen as a way to achieve R&D spending targets (*van Pottelsberghe,* 2008)[6].

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[2] 73 percent of the companies surveyed in the course of the system evaluation said that they do not change their project goals according to funding criteria from public support programmes, but make use of public funding available once they have decided internally on their project.

[3] Within this context, "risky projects" are projects that involve taking a greater risk than private companies are normally prepared to take. This could be due to a low probability of success or the fact that positive external effects cannot be completely internalised. If these social effects are high and sustainable, such market failure can be reduced through state intervention in the market mechanism in the form of subsidies (*Böheim – Gretschmann,* 1998).

[4] In particular because the employment of "top-level imports", that is, the most highly qualified foreign researchers, is insufficient in Austria (*Bock-Schappelwein – Bremberger – Huber,* 2008).

[5] See, for example, *Janger* (2009). In Austria the employment of human resources with higher qualifications (high school or higher) measured in the number of hours worked increased by 50 percent between 1990 and 2004, while the employment of human resources with mid-level qualifications (professional school, apprenticeship) increased by 3 percent, and the employment of poorly qualified human resources (schooling required by law) sank by 26 percent (*Peneder et al.,* 2006).

[6] "Provided effective technology transfer systems are put in place, academic research is probably the most effective source of new ideas, which in turn induce further research for the business sector" (*van Pottelsberghe,* 2008, pp. 7).

In Austria, tertiary sector institutions, in particular universities, are currently not adequately funded and have adverse incentive structures. Both of these conditions present obstacles to quality-orientated education and research. An extension of the funds in this area must therefore go hand in hand with structural reforms of university funding. Under these conditions, however, the budget for university research and teaching should grow more rapidly than public funding of corporate R&D spending[7].

Table 1: Instruments and goals of a frontrunner strategy

	Effect of the instruments				
	Increase in R&D expenditures	Increased efforts towards innovation	Broadening of innovation efforts	Securing of business location	Focus on socially relevant problems
Goals of the instruments					
Tax credits					
Simplification and increase	X			X	
Abolishment of upper limit for project research			X		
Direct subsidies					
Increase in selectivity		X	X		
Focussing			X		X
Improved control		X	X		
University teaching and research					
Increase in number of graduates with higher secondary education and tertiary education	X	X	X	X	
Increase in quality of university teaching and research	X	X		X	
Framework conditions					
Greater competition	X		X		
Improved private company financing	X	X	X		X

Source: WIFO.

Coherence of recommendations

WIFO emphasises the systemic nature of these recommendations: they should not be considered in isolation. Together, they strive toward the holistic and coherent improvement of the innovation system. Merely changing the funding system will not result in a leap to an innovation-based growth regime. Innovation at the technological frontier, as well as start-up and growth dynamics, requires a broad combination of support measures and framework conditions, including strong universities, competitive product markets and a strong private venture capital sector.

More generous tax credits, could therefore contribute to the first goal of increasing private R&D spending without any further adjustments of the innovation system, under the assumption of correspondent leveraging of public to private funds. However, if these additional research funds cannot be absorbed by companies for lack of qualified research staff, their effect on innovation will be minimal. The diffusion of research results into the economy, which triggers the growth effects of R&D, could suffer from an insufficient breadth of the human capital base.

The second objective, to make Austria attractive as a business location, cannot be achieved through tax incentives alone. The comparative cost advantages of India, China or Brazil, as well as Austria's Eastern European neighbours cannot be met, especially if these countries also offer high tax credits (over 25 percent in Brazil and the Czech Republic). Instead, the most important location factors for research-intensive corporations are the availability of qualified human resources, strong patent systems and the local presence of university research (*Riemer – Haidinger – Schneider,* 2009, *Thursby – Thursby,* 2006).

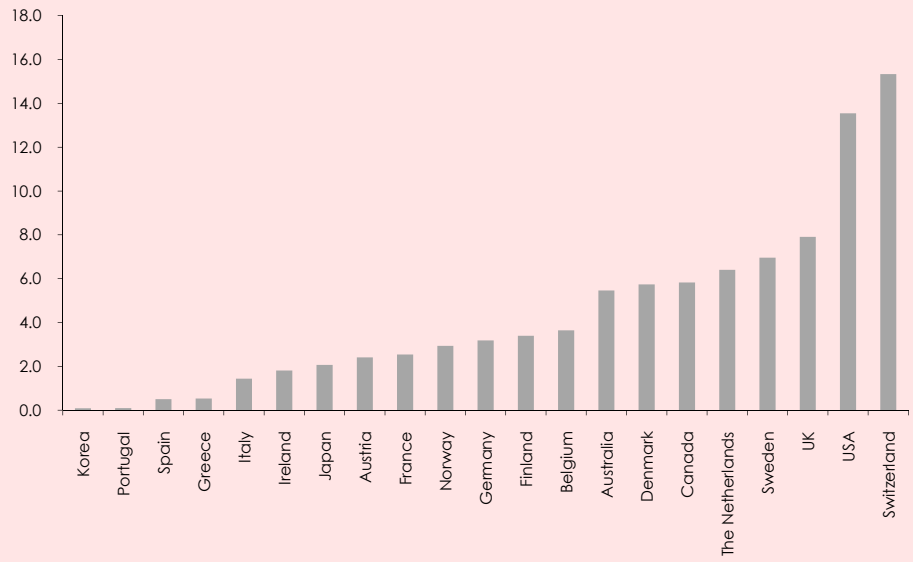
Countries without high public support and with a lower quality of university research (measured in the number of highly cited researchers per capita, see Figure 2) usually have low foreign research financing (for example, Finland and Germany), while countries with high quality university research but little public support, such as Sweden and Switzerland, tend to draw more foreign-financed corporate R&D (11 per-

[7] Special financing needs arise in the area of university research infrastructure.

cent and 7 percent). This Figure is even higher in countries with a high quality of academic research and well-developed public support, such as Great Britain (22 percent).

Figure 2: Quality of academic research in international comparison

Highly cited researchers per million inhabitants, 1981-2007



Source: ISI Highly Cited. Population size has been chosen as a reference point, because it is available for all countries. If the number of university researchers is used as a reference point, nearly the same ranking emerges.

In the medium term, the quality of university research and human resources will be the key argument for Austria's locational competitiveness, not least due to the immobile nature of universities. As long as the university sector in Austria is not sufficiently developed, tax credits can temporarily compensate for this disadvantage, as foreign funding of business R&D is particularly high in Austria (22.6 percent; the share of foreign-controlled business R&D expenditure is even higher at 55 percent)[8].

A one-sided emphasis on direct funding also carries the risk of strongly diminishing returns, as it is extremely difficult to convert the additional funds into effective research and innovation performance without an appropriate human capital base. Moreover, in Austria, direct funding has not yet provided sufficient proof of its potential to set priorities and selectively support projects with high societal returns (*Falk,* 2009A).

Isolated efforts toward reform in individual areas therefore do not correspond with the systemic nature of the WIFO recommendations. One exception is the education sector, which has been identified as a significant "bottleneck" for the further development of Austria's innovation system and therefore deserves priority.

Main features of a frontrunner strategy with limited public resources

Despite the strained state of public budgets, it is still possible to pursue the implementation of a frontrunner strategy. The growth impact of innovation efforts will facilitate budget consolidation in the medium term.

This "frontrunner strategy under budget constraints" further pursues those objectives named in the above implementation framework. Within this framework, however,

[8] The state of development of the Austrian university sector has been analysed by *Janger – Pechar* (2010), *Janger* (2009), *Reinstaller – Unterlass – Prean* (2008), *Federal Ministry of Science and Research – Federal Ministry of Transport, Innovation and Technology – Federal Ministry of Economy, Family and Youth* (2010).

the leverage effects of the instruments should be increased. The focus should also lie on increasing the efficiency and effectiveness of the system of R&D subsidies, because the intensity of public funding of business R&D in Austria is relatively high by international standards[9].

Increasing the additionality of public R&D expenditures

An increase in the additionality of public R&D expenditures can be realised using the following measures:

- To reduce abuse or windfall gains, while increasing the predictability of planning for the companies in question, the system evaluation recommends establishing a Pre-Approval Service on the one hand, and more stringent ex-post controls on the other. It is essential that these positions be occupied by independent R&D experts who can distinguish between worthy and unworthy investments.
- For a complete assessment of efficiency and effectiveness, we need to carefully evaluate the achievement of the second objective of tax credits, namely the intensification of R&D spending. Windfall gains can be assessed using the multiplier of fiscal R&D funding (revenue loss in relation to additionally generated R&D expenditures). For Austria, so far no empirical evaluation of fiscal R&D funding has been carried out following the example of the Netherlands or Canada, in part because there is no suitable data[10].

Indirect research funding

To increase the leverage effects of tax credits, several approaches are used internationally. In Austria, their implementation would require in-depth preparation. For example:

- Focussing tax incentives on the non-wage labour costs of research personnel rather than total R&D expenditures (the Netherlands). Cost reduction through tax credits can thus more readily be linked to R&D activities. As a result, the consideration of tax credits in process calculation becomes possible (activity-based costing). In group-wide comparisons of research costs, this effect would become directly visible and the location effect would be greater. However, there is a risk of inefficient use of labour: R&D projects in companies that had previously been partly awarded externally (for example, to universities), might be more likely to be carried out internally, thereby discouraging co-operation. Furthermore, in Austria the share of R&D personnel costs in company spending on R&D is already quite low at just over 50 percent. This can probably be attributed to the substitution of R&D personnel with physical research infrastructure due to limited human resources (*Nickell – Nicolitsas,* 1997). The subsidising of non-wage labour costs would therefore only further accentuate this shortage.
- WIFO takes a critical view of a size differentiation of tax credits (the Netherlands, Canada, UK)[11]. There is no empirical evidence or theoretical argumentation to prove that external effects are larger for smaller firms than large firms. Instead, most studies show the opposite (see *Holtz-Eakin,* 2000). In surveys, only about 15 percent of Austrian companies name access to external finance as a central obstacle to innovation (European Innovation Survey 2004-2006). This permits assumptions on the extent of windfall gains. In overcoming funding limitations, tax credits are less effective than direct measures (*Peneder,* 2008). These can selectively target small, innovative companies and are well represented in the Austrian funding system (AWS, FFG).
- A restriction of tax credits to basic research (Japan), increasing the intensity of funding when companies award research contracts to basic research institutions (Denmark, France) appears less effective than supporting basic research where

[9] For an estimate of the rate of increase in subsidies, see the WIFO study used as a basis for this article (*Janger et al.,* 2010).

[10] An evaluation would also be helpful, because the research premium does not appear in the federal budget and therefore cannot be considered part of effect-orientated budgeting.

[11] In Austria, for example, *Schibany – Gassler* (2010) propose introducing a size differentiation to the research premium.

it is primarily carried out (at universities) and fostering the exchange of knowledge between companies and universities (see below).

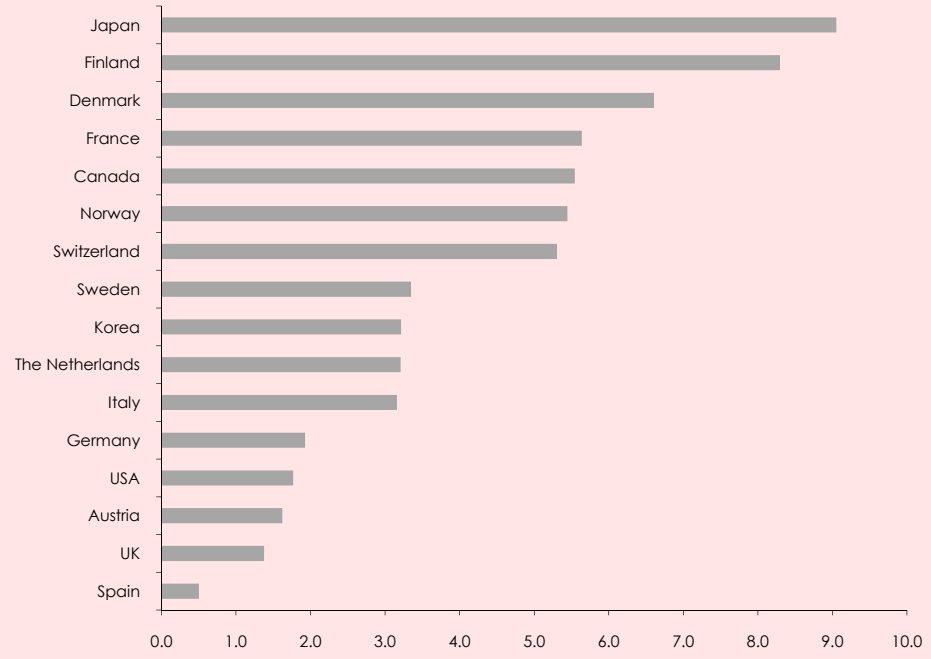
Direct research funding

To make direct research funding more efficient and effective, the following measures can be considered in addition to those listed above[12]:

- Windfall gains can be reduced through a concentration on those projects with the highest entrepreneurial risk and highest social returns (*Reinstaller,* 2010). As shown in international studies (*Giebe – Grebe – Wolfstetter,* 2006, *Blum – Kalus,* 2003), windfall gains can be reduced by using auctions to allocate direct R&D subsidies. This would be an important step towards increasing the selectivity of direct funding.
- High social returns, in particular, can be gained from the direct support of projects aimed at combating climate change and a shortage of resources. Market surveys predict large production increases in the field of environmental technology and clean energy by 2020 (*Kletzan-Slamanig – Köppl,* 2009). The size of the growth potential in Austria will ultimately also depend on research efforts in this area. According to the available data, the Austrian public sector spends relatively little on energy research (only about 2 percent of total public research spending in 2008; *Indinger – Katzenschlager,* 2009) – much less, for example, than Finland, Denmark, Sweden or Switzerland (Figure 3).

Figure 3: Share of energy research expenditures in public research spending in the year 2007

In percent



Source: IEA, OECD, WIFO calculations.

- According to *Aghion – Hemous – Veugelers* (2009), the global establishment of markets with associated prices for CO_2 emissions alone is not sufficient to mitigate climate change. The public funding of "clean innovation" is necessary in order to develop corresponding technologies. There has, for example, been a proposal to support application-orientated basic research (green basic R&D). Energy re-

[12] For a concrete application in Austria, these ideas require detailed development and an adaptation to Austrian practice.

search therefore appears to harbour great potential for a thematic focussing of public funding, which would also serve to meet the EU-2020 targets. One might, for example, consider the thematic funding of the FWF which was proposed in the system evaluation. In this scheme, the concentrated appointment of professors at universities would quickly support the establishment of thematically focused research centres.

- For Austria, there are no detailed (micro-econometric) analyses of the effects of tax credits and direct R&D funding. It is therefore not possible to make any statements about the relative effectiveness of tax credits compared to direct R&D funding. Although the necessary data are being collected, they are not being put together for evaluations. Transparent impact analyses are essential for a sustainable and effective economic and innovation policy. In this context, the establishment of an independent evaluation agency should be considered, in order to make the data accessible for analyses.

Tertiary education

The following options could be considered for an increase in the leverage effect:

- A unified budget for funding teaching at universities and professional colleges would have to be based on a student admission system, and would therefore constitute a per capita funding of students, which already exists in the field of universities of applied sciences[13]. This system implies an upper limit to the number of students in the individual studies to match existing teaching resources. This would ensure high quality education and provide the teaching staff sufficient time for their research activities. In the case of an increase in the number of students beyond this limit, the number of teaching resources would have to be increased and funded. This system requires a student admission system at universities, which also provides guidance for the period after the first degree and ideally sets in one to two years before eligibility for university[14]. As part of the student admission system, universities could be required to proactively offer students from disadvantaged backgrounds special support during their studies (for example, using a coaching or a tutoring system).
- A per capita funding system could support the urgently needed qualitative expansion of the tertiary sector in Austria. This expansion should take into consideration the demand for qualifications on the labour market. The financing of the expansion should, however, mainly draw on private funding and fees, and go hand in hand with income-contingent loans and a generous scholarship system. The involvement of private financing is appropriate, because tertiary education leads to substantial private returns for graduates[15].
- In accordance with international best practices, student loans should not only cover student fees, but also the cost of living, which is usually much higher. An income-contingent student loan defers payment until after graduation, so that there is no financial burden during the studies. Once a graduate's income exceeds a threshold amount, loan repayment begins; if the graduate's income falls below that amount again, for example due to unemployment, loan repayment temporarily halts. A student loan system separates the financial situation of students from that of their families, and is therefore an important step towards the socially just expansion of the tertiary sector.

These proposals for the reform of higher education must be considered within the overall context of the Austrian education system. An increase in the selectivity of the education system at the transition to university should be accompanied by a reduction in the selectivity of the education system up to university, and must also be accompanied by an increase in the number of student places that matches the demand for qualifications on the labour market. A qualitatively and quantitatively well-

[13] This also requires a separation of the funding for research and teaching.

[14] International student admission models can be found in *Badelt – Wegscheider – Wulz* (2007).

[15] In contrast, kindergarten attendance should be free, because private returns are low and social returns high.

equipped, free kindergarten system and a non-differentiated all-day school in the lower secondary level, which is supported by nationwide standards and the autonomy of individual schools, could also contribute significantly to a reduction in selectivity at an early age.

An increase in the qualified workforce, even in the short term, would also greatly benefit from:

- a diversification of choice of the apprenticeships, in particular for young women, in the direction of modern, in-demand qualifications,
- further efforts in schools to encourage girls to pursue vocations in science and technology,
- work permits for non-EU citizens who have graduated from an Austrian university[16],
- better acknowledgement of qualifications earned abroad.

University research

Currently, both the performance agreements and the formula-orientated budget contain few indicators that would make the distribution of funds dependent on the quality of university research[17].

A simple tool for improving the quality of university research would be the provision of overhead allowances for FWF-projects, which lie within a range of 20 to 50 percent of the project amount[18]. This overhead support would increase the visibility of high quality research at universities and set strong incentives for universities to actively recruit researchers who are likely to get FWF funding due to the quality of their work. Younger researchers should, however, be able to carry out research using basic funding and not be responsible for applying for FWF funding themselves, while established researchers should be required to draw on FWF funding more frequently[19].

With the exception of the Institute of Science and Technology Austria (IST Austria), the current organisation of research at Austrian universities is not designed in such a way that it systematically recruits the best researchers worldwide. The current collective bargaining system does not foresee international appointments for tenure track positions. If appointments were made at the beginning of tenure track position (rather than at the full professor level), the timing of the appointment would shift to the assistant professor level, which would favour women due to the earlier timing of the mandatory change of university. The Austrian tenure track stops at the rank of associate professor, not "full professor", as is the case internationally, essentially not offering continuous career perspectives. The position of "full professor" still entails inconsistent rights, resulting in hierarchical gradations in the system. This system acts as an impediment to Austria's best researchers and is not attractive enough to interest the best young researchers from abroad (*Janger – Pechar,* 2010).

Another way to emphasise the quality of university research is to enable several universities to share the same university infrastructure. Additionally, the private funding of research and teaching could be increased through a reform of foundation law[20].

Cooperation between universities and companies

Research collaboration between companies and universities presents a relatively short-term option for gaining a double dividend from additional public funding for university research, as companies also stand to benefit indirectly. Cooperation be-

[16] As a guarantor of quality, this could only apply to those courses which have been certified accordingly by the Austrian quality control agency (AQA).

[17] For a measure of quality in research, see *Hölzl* (2006). The quality assessment must take into consideration the special characteristics of individual academic disciplines.

[18] In other words, a premium of 100 percent on the direct project funding costs.

[19] In the USA this is also called the "venture capital model of research". In this model, young researchers are allotted funds and time from the university in order to be able to research freely without the pressures of securing additional funding. After an evaluation (usually the tenure track evaluation) they have to draw increasingly on third-party funds (*Janger – Pechar,* 2010).

[20] A student loan system would strengthen the bond between graduates and their universities. If they receive high quality treatment, they are more likely to support their universities later in life.

tween universities and companies has improved considerably in Austria since the 1990s[21].

The share of university research financed by companies in Austria "only" corresponds with the OECD average at 5 percent (ahead of the USA). However, this indicator underestimates the actual intensity of cooperation, because in the official statistics the competence centres (Kplus, COMET) are attributed to the business sector, while these are effectively platforms for cooperation between universities and companies (*Janger – Friesenbichler,* 2008). The extent of this underestimation is reflected in the percentage of large companies that cooperate with universities. According to the results of the Community Innovation Survey, Austria ranks third in Europe with a share of 35 percent[22]. A further intensification of cooperation between companies and universities can result in an increase in the amount of public funding for universities. Related proposals focus on three areas:

- If the quality of university research is higher, there are greater incentives for companies to cooperate with universities. The improved quality of university research and teaching would result in short and medium term benefits for companies through multiple channels. Graduates would contribute their expertise to companies as qualified staff. Furthermore, research collaborations, university technology transfer centres, the continued training of employees at universities, informal contacts, informal consulting and academic spin-offs would all serve to strengthen the economy. Austrian companies that use universities as an external source of knowledge are much more likely to patent than those which do not use universities (*Falk, M.,* 2010).
- Based on the now extensive international literature on best practice approaches for university technology transfer centres (see *Debackere – Veugelers,* 2005), the effectiveness of the Austrian centres ("external institutes") could be evaluated.
- The cooperation between small and medium-sized enterprises and universities is much less intense than that between large companies and universities, in part because fewer university graduates work at smaller companies. Instead, these employees tend to come from upper secondary vocational schools, so there is less contact with universities. In the long term, the situation will improve through an increase in the number of university graduates; in the short term, regional innovation policy initiatives, such as "innoregio" can promote a better connection between small and medium-sized companies and universities.

Improvement of the framework conditions for research and innovation

Direct funding and tax-based funding for companies that conduct research uses monetary incentives to increase private R&D activities and principally enable the implementation of R&D projects. The efficiency and effectiveness of this support depends on the framework conditions for entrepreneurial R&D activity. The following two priority reform areas could help to maximise the effects of public R&D funding on the innovation system and the overall economy.

Competition policy

Incentives to extend innovation efforts need not always be monetary. They can also be the result of increased competition. An increase in the effectiveness of competition policy and measures to intensify competition in branches with a low intensity of competition can also provide incentives. Such reforms can be carried out at relatively low public cost, yielding substantial, positive effects in the medium and long term.

Starting points for reform can be found in the following areas (see *Böheim,* 2008A, 2008B, *Janger,* 2009, 2010):

[21] In the 1990s, the lack of cooperation between the two areas was identified as a weak point in the Austrian innovation system (e.g., *Federal Ministry of Science and Transport,* 1997). Subsidy programmes such as Kplus and the 2002 University Law supported cooperation, and the increase in competition resulting from Austria's entry to the EU provided an incentive for companies to draw on external sources of knowledge.

[22] Based on the survey carried out in the system evaluation, out of 1,208 companies that carried out innovation projects between 2005 and 2007, a total of 75 percent (also) took part in cooperative research projects. A total of 11 percent of these projects only involved companies, 11 percent involved universities and scientific institutions, and 53 percent were carried out by both companies and universities.

- competition policy,
- general regulation of the economy – entry regulations, professional qualifications, etc.,
- sector-specific regulation (energy, liberal professions, etc.),
- revitalisation and intensification of competition through private consumption.

Private company financing

Public funding can only account for a fraction of actual innovation performance. Innovation is largely financed through private means, with the majority of companies finding appropriate sources of financing. However, there is a bottleneck in terms of private financing for small, young companies with especially high growth potential and low cash flow or little collateral. While pure growth financing generally far exceeds the potential volume of public funding, venture capitalists specifically focus on this group of companies (*Peneder,* 2010A, *Lerner – Hall,* 2009). By fostering the growth of innovative enterprises, they also strengthen overall economic innovation performance.

In Austria, private venture capital funds continue to operate without a legal basis comparable to international best practice. For years, venture capital activity in the Austrian economy has been lower than in almost all of the EU-15 countries. Venture capital can be very important, e.g., for environmental technology companies, as environmental technology harbours great growth potential at the level of the firm due to the global dimensions of climate change. Public research efforts may therefore not exhaust the potential growth and employment effects in this area. The creation of an appropriate legal basis is essential to a "crowding in" of private venture capital. In contrast to many funding programmes, this reform would place little burden on public budgets, while significantly increasing their effectiveness.

Further specific measures to revitalise the venture capital market are discussed in *Janger* (2009), *Marchart – Url* (2008) and *Peneder – Schwarz* (2008). They include an easing of investment regulations for life insurance and pension funds, which would increase the share of investment in venture capital funds. Another cost-effective measure for generally strengthening the Austrian capital market would be to align the protection of minority investors with that of leading EU countries.

Structural change as a measure of the success of the frontrunner strategy

The success of a frontrunner strategy should ultimately be measured in the resulting acceleration of structural change. Austrian industry has currently largely exhausted its existing structural R&D potential (*Reinstaller – Unterlass,* 2008). Companies have little room in which to intensify their R&D spending. In Austria, the term "structural change" has recently been frequently associated with industry-specific, thematic funding activities, or with "high-tech versus low tech". Should R&D funding prefer certain industries or technologies over others? WIFO takes a differentiated position on this issue:

- A country with high per capita income must pursue a frontrunner strategy in innovation policy and focus on specific areas while doing so. The goals of a frontrunner strategy are excellence and market leadership with high-quality goods and services. They should increase the share in markets with a sophisticated knowledge base and in-demand technology fields that are of increasing importance to society. When resources are limited, it makes sense to focus direct funding programmes on areas with high innovation intensity and greater social relevance, such as, for example, combating climate change.
- WIFO does not characterise industries using the traditional OECD method based on average R&D intensity, but rather based on the distribution of innovative companies. These can be found in all sectors, although with varying frequency (*Peneder,* 2010B). Membership in a particular industry or a specific technology field should therefore not constitute a reason for exclusion from general R&D funding. The frontrunner strategy is not a sector-specific strategy; it is targeted at innovative enterprises.

Some of the above measures, such as increasing tertiary education enrolment, venture capital activities and the quality of university research, as well as increasing competition in product markets, are essential components of an acceleration of

structural change. They support the emergence of "gazelles" – rapidly growing companies that contribute significantly to job creation and the dynamics of the economy (*Hölzl – Friesenbichler,* 2010, *Hölzl – Böheim – Friesenbichler,* 2010). At the same time, they are essential elements of a strategy that makes a country attractive as a location for research centres.

Summary and prioritisation

Even within the context of a necessary consolidation of the public budget, a policy that is only orientated towards cutting public expenditures for research, innovation and education does not provide a good foundation for a sustainable, successful consolidation and the economic growth required to achieve it. Income from investments in research, innovation and education is certainly disproportionately higher than that resulting from other forms of physical investment[23]. WIFO therefore supports a further intensification of research activities until 2020 (for example, an increase in the total R&D expenditures to 4 percent of GDP). This will require both an increase in public funding for R&D and an increase in efficiency in terms of additionality on private R&D spending.

The coherence of the recommendations in the system evaluation is of great importance. Isolated reforms in individual areas cannot contribute to the implementation of a frontrunner strategy. A sustainable, innovation-based growth regime with high start-up dynamics, structural change and attractiveness for research centres requires a broad mixture of funding and a supporting framework, including strong universities, competitive product markets and a strong private venture capital sector.

Within the context of the shortage of public funds, the present analysis reveals opportunities for exhausting the potential to increase efficiency and effectiveness in individual areas, as well as activate the private financing of innovation. WIFO proposes the prioritisation of reforms aimed mainly at increasing the leverage effects of public resources and instruments to spur on the implementation of the frontrunner strategy. Due to the urgent need for measures that combat climate change and the large international backlog with respect to public research expenditure on environmental technology and energy research, this area should also be given special priority. By 2014, a restructuring of public resources will be necessary in this field.

If Austria wants to become an innovative frontrunner by 2020, one area requires absolute priority, not least because of its long lead time: In knowledge-based economies, knowledge is the most important competitive factor. In order to ensure competitiveness, those institutions responsible for producing and transferring knowledge must therefore be of excellent quality. They are just as important for young, innovation-intensive businesses as they are for research centres. In light of the EU-2020 goal, university teaching and research in Austria should match that of the best countries of comparison – both quantitatively and qualitatively. To make use of this great potential, reforms should be introduced at stages in the school system that precedes the tertiary level.

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[23] To put this into perspective, the planned construction costs of the Koralm tunnel (over € 4 billion) would approximately cover the annual additional expenditures for assumed public R&D goals from 2011 to 2017.

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Research and Innovation Policies after the Crisis – Summary

Consolidation measures will shape budgetary development until 2014. However, despite consolidation efforts reforming education and training policies as well as innovation policies is still possible and necessary. This is because these form the basis for sustainable growth. Increases in public funds in order to implement a front runner strategy can be achieved via a growth friendly consolidation.

In terms of concrete reforms we propose compulsory controls of R&D tax credits, which should decrease any dead weight loss and increase the ability of firms to make secure plans for the future. Direct subsidies should be a lot more selective and focused. A starting point could be the development of innovative ways to award direct subsidies for particular projects (the use of auctions). Furthermore, direct subsidies can be focused on areas with high social returns, e.g., "clean energy" – public expenditure on research in this area is small by international comparison.

As regards higher education institutions we suggest a per capita funding system including a student admission system, so that the tertiary sector can expand qualitatively and in accordance with the qualification demands of the job market. Due to the private returns from investment in tertiary education, we recommend introducing tuition fees together with a means tested loan system and a system of grants. At the same time it is important to reduce the social selectivity of the education system before tertiary education, for example via well-equipped free kindergarten places, as well as full day and comprehensive schooling at lower secondary levels guided by Austrian-wide standards and autonomous schools. To improve the quality of research, it could be more strongly weighted in public funding schemes for universities and by introducing international competitive selection procedures for tenure track positions.

As a rule, public subsidies cannot fully finance the growth of young innovative firms. Therefore, creating a legal basis for private venture capital funds to be active in this area as well as other measures could be regarded as urgent.

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