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Alexander Cuntz,
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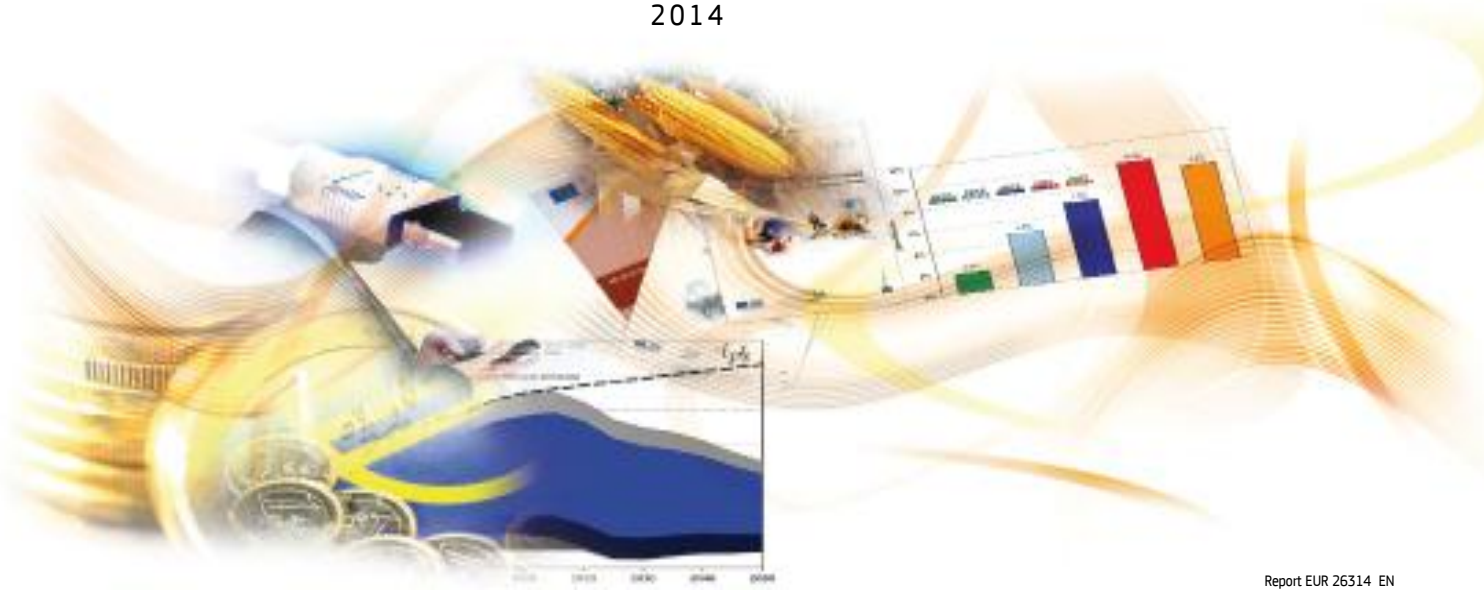

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The Country Report 2012 builds on and updates the 2011 edition. The report identifies the structural challenges of the national research and innovation system and assesses the match between the national priorities and the structural challenges, highlighting the latest developments, their dynamics and impact in the overall national context.

The author gratefully acknowledges concise assessment and discussion in earlier analytical country reports. More specifically, sections 4 and 5 are largely based on information and analysis already provided by Klaus Schuch (2011, 2012).

The first draft of this report was produced in December 2012 and was focused on developments taking place in the previous twelve months. In particular, the report has benefited from comments and suggestions of Alexander Kleibrink from JRC-IPTS who reviewed the draft report. The contributions and comments from DG-RTD and the ERAWATCH National Contact Point, namely, Silvo Korez, Armin Mahr, Irene Eder (all Austrian Federal Ministry of Science and Research) and Brigitte Weiss (Austrian Ministry of Transport, Innovation and Technology), are also gratefully acknowledged.

The report is currently only published in electronic format and is available on the ERAWATCH website. Comments on this report are welcome and should be addressed to jrc-ipts-erawatch-helpdesk@ec.europa.eu.

EXECUTIVE SUMMARY

Austria is one of the smaller and richer EU Member States representing only 1.7% of EU's total population (2012) and with a GDP per capita well above the EU-27 average. The Austrian economy has a focus on low- and medium-technology and applied R&D. After the downturn of the economic and financial crisis in 2009 the Austrian economy experienced a fast recovery in 2010 and 2011, but is on a more moderate growth path since 2012. The estimated GDP share of gross domestic expenditure on R&D (GERD) in 2011 is 2.75% (2012 estimate: 2.8%). Even though this constitutes a weak decrease relative to 2010, Austria is still comparable to innovation leaders in the EU and, in addition, increasingly finances R&D with public funds. Most public R&D budgets have been successfully ring-fenced during the crisis and partially even increased in some areas.

Among the supply- and demand-side structural bottlenecks for growth, the following challenges exist (Ederer and Janger, 2010):

1. *a weak human capital basis for innovation*;
2. *a low number enterprises conducting research and a strong concentration of R&D expenditure*;
3. *improvable quality of university research* and *low volume of basic research*;
4. *competition bottlenecks* concerning limited competition intensity and low start-up dynamics in specific industry sectors;
5. *deficits in labour participation* concerning the labour quota of the elderly and of migrants, and low qualification of persons with a migration background;
6. *a weak private* domestic demand (both in terms of household investment and consumption) and low export orientation towards emerging countries.

In the government's RTDI Strategy launched in 2011, a substantial number of these structural challenges have been actively addressed and systematically monitored, but a few challenges have not been highlighted in the strategy:

- first of all there is no roadmap with budgetary indications and responsibilities, which would be required to implement the activities proposed in the strategy;
- consideration of the grand/societal challenges in RTDI funding is still expandable and current governance structures are not adequate for horizontal implementation;
- limited coherence and coordination of strategies in Austria's R&D internationalisation policy portfolio;
- little emphasis on systemic evaluations of RTDI interventions, despite a well-developed RTDI evaluation culture and evaluation of individual measures.

Regarding the policy mix, well-known structural deficits, such as the lack of venture capital, remain, as evidenced by the IUS 2010. Most of these deficits, however, are at the focus of public interventions. To date, the share of implemented policy measures and initiatives associated with the strategy is fairly high. This is due to the fact that roughly a third of all associated measures have been already in place before the strategy's official launch. The current emphasis of public intervention is in the areas of "innovation finance", "innovation capacity of firms" as well as "educational reforms". In contrast, relatively little focus is put on the strategy's priority "efficiency of political governance".

Despite the fact that private R&D funding is considered to be the most essential element to reach the 3.76% R&D target in Austria by 2020, little additional stimulus has been provided to companies to increase R&D expenditure and their share of R&D financing during the last three years. This is not surprising, however, because the available portfolio of instruments is already advanced, and the share of public financing of R&D in the business enterprise sector (BES) is among the highest in Europe.

Among the recent policy measures are the reform of the tax allowance system which enables a higher public funding quota, while eligibility criteria and criteria enforcement have been tightened simultaneously. Several measures aimed at technology and knowledge transfer have been implemented or prolonged. In addition, the most recent reform of laws governing competition and cartels passed in early 2012 address competition bottlenecks and are likely to unlock innovation potential in monopolised industries and to allow for easier market access of entrepreneurs in the long term.

The most important developments in educational policies include the new secondary school reform and its implementation, measures to improve the quality of teacher education for primary schools and the establishment of the Austrian Higher Education Plan.

With respect to smart specialisation, only 2 out of 9 Austrian Federal States have developed regional innovation strategies based on a comprehensive assessment of the regions' strength and weaknesses, namely Lower Austria and Upper Austria. To date, however, none of these strategies has been peer-reviewed. Most other Federal States have developed strategies, but are not registered on the S3 Platform at present. An overarching national approach to smart specialisation is currently not in place nor planned. However, the Austrian government, more specifically, the Ministry of Science and Research (BMWF) together with Joanneum Research, took an active role as leading/coordinating country in a recent OECD-TIP project on smart specialisation. In general, regional strategies and regional funding agencies complement RTDI policies and activities on national and EU levels.

Austria is a small but open European economy, also in terms of its labour market. There are hardly any either codified or informal restrictions for researchers from abroad (especially from the EU) to move to Austria for work. Cross-border cooperation and European knowledge transfer are well established at the level of researchers, research organisations from industry and academia, and research funding agencies. Knowledge sharing and open access as key European Research Area (ERA) dimensions are also well established in Austria. The absence of an aligned scientific infrastructure strategy makes a coordinated local, national, European and international approach difficult. Thus, the availability of, and access to, research infrastructures may hamper further development of research in Austria.

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1 INTRODUCTION

Austria is one of the smaller and richer EU Member States representing only 1.7% of EU's total population (2012) and with a GDP per capita of €35,700 (2011) well above the EU-27 average (2011: 25,200). Its total GDP amounts to €300.7bn in 2011 and an estimated €309.3bn and €317bn in 2012 and 2013, respectively. This accounts for 2.7% of the EU's total GDP. The Austrian economy experienced a fast recovery from the crisis, with a 2.1% (2.7%) GDP growth rate in 2010 (2011) after an economic downturn in 2009 (-3.8%). Current forecasts, however, suggest only moderate growth for the upcoming two years, with annual rates just below 1%. Nevertheless, Austrian GDP growth as well as growth prospects range well above EU-27 averages (2009: -4.4%; 2011: 1.5%; 2012: -0.3%; 2013: 0.4%).[1]

With regard to R&D funding, the estimated GDP share of gross domestic expenditure on R&D (GERD) in 2011 was 2.75% (EU-27: 2.03%). This constitutes a weak decrease relative to 2010 (2.79%). However, only very few Member States among the innovation leaders show higher current GERD per GDP percentages, namely Sweden, Denmark and Germany. By performing sectors, business expenditure on R&D (BERD) as a share of Austrian GDP stood at 1.87% in 2011. This is significantly higher than EU-27 average (1.26%). Thus, businesses performed on 68% of total GERD. In addition, government intramural expenditure (GOVERD) and expenditure on higher education R&D (HERD) accounted for 0.15% and 0.72% of GDP in 2011. Again, comparison with EU-27 yields relatively lower average rates for HERD (0.49%), but higher rates for GOVERD (0.26%). In this context, the Austrian private sector finances an estimated 45.5% of overall R&D expenditure in 2011 (EU-27: 2010[2]: 53.9%), while the public share in GERD finance is 38.1% (EU-27: 2010: 34.6%). More specifically, the estimated public contribution in 2012 breaks down to €2.87bn spent at national level (roughly 85%), a total of €0.4bn spent by Federal States and €0.1bn spent by other public entities (local governments, professional chambers or social security institutions).[3] The considerable share of GERD financed from abroad is around 16% in 2010. This is twice as high as the EU-27 average, but has been constantly decreasing since 2005 (19%).

In sum, periodic data on post-crisis years 2010 and 2011 shows a minor shift from private to public R&D sources of finance and, thus, provides first evidence on a counter-cyclical R&D expenditure policy in Austria. Overall economic performance and outlook will make it difficult to comply with R&D goals outlined in the national RTDI strategy[4] and national reform programme[5] for Europe 2020, e.g. the GERD aim of 3.76% of GDP by 2020.

Average turnover from innovation[6] by Austrian businesses is at 11.2% (EU-27: 13.3%) according to the Community Innovation Survey (CIS) 2008. This means a loss of more than 2% when compared to CIS 2006 data. In addition, the overall rate of innovating firms in Austria is around 56%, both in CIS 2008 (EU-27: 51%) and CIS 2010, and is mainly driven by the innovation

[1] All data in this paragraph from EUROSTAT, accessed on December, 18th, 2012.

[2] Latest available data on EUROSTAT.

[3] Cf. Statistik Austria (2012a).

[4] Cf. Federal Government (2011).

[5] Cf. Europe 2020 (2011).

[6] This is defined as the ratio of turnover from products new to the enterprise and new to the market as the percentage of a company's total turnover. Latest available data on EUROSTAT is based on Community Innovation Survey (CIS) 2008 covering innovation activities between 2006 and 2008.

activity of larger companies in manufacturing rather than service sectors.[7] In turn, arguably, this makes a successful 10% increase of R&D active companies by next year (2013), as proposed in the national RTDI strategy, fairly unlikely. At the industry level, "IT, electronic and optical devices, and electronic equipment", followed by "chemical and pharmaceutical industries", "publishing houses, telecommunication, IT services", "machine building industries", and "automotive industries" show particular high innovation rates that are likely based on relatively higher R&D intensities[8] in these industries, i.e. 3-10% R&D investment of total turnover (Austria-wide average, 2010: 1.7%). At present, it is unclear how much these knowledge and R&D intensive industries contribute precisely in terms of added value to the overall economy. However, the share of high-tech patent applications in total applications at the European Patent Office (EPO) of approximately 11% (EU-27: 2009: 14%; AT: 2006: 17%) and the high-tech share in total exports of 11% in 2006 (EU-27: 16%) already indicate a low- and medium-tech orientation of the overall economy.[9]

Human resources in science and technology (HRST) account for 40.5% of the Austrian working population in 2011, which is fairly close to an average of 42.3% in the EU-27 but, comparatively lower than in innovation leaders and followers among Member States. Similarly, tertiary educational attainment of only 16.5% among the adult population (aged 15-64) in Austria is much lower than European averages of 23.6% in the same period. This difference is mainly driven by the cohort of young adults between 25 to 34, comparatively high drop-out rates in tertiary education (e.g. ISCED 5A, 2010: Austria: 30% vs. EU-21: 40%) as well as an attractive and elaborated upper secondary education system unique to Austria.[10] In 2009, 56,438 full-time equivalents (FTE, EU-27: 91,846) were active in R&D, of which 67.9% were employed in the business sector, 26.7% in the higher education sector, 4.7% in the government sector, including public research organisations (PRO), and 0.7% in the private non-profit sector.[11]

A further look at patenting statistics reveals a weakly declining but above EU-27 (2010: 109 applications per 1 million inhabitants) performance of Austrian inventors (188 applications). This is in line with a general trend across the EU-27 since 2006. In this way, Austria still lags behind patenting performance of innovation leading economies with regard to its RTDI strategy ambition: With the exception of Finland, it even has lost some ground on all other leading economies between 2006 and 2010. With regard to scientific production, Austrian scientists increasingly publish within the top 10% scientific publications worldwide in terms of citations. The number of such high-quality publications has grown in the period between 2000 and 2007 by an annual 9.2%, outperforming EU-27 average growth (5.9%) as well as innovation leading Member States. This suggests a catching-up to innovation leaders with regard to scientific production.[12] This positive trend is also reflected in comparatively high success rates for European Research Council (ERC) grant applications of Austrian scientists in 2011.[13] In

[7] Cf. Statistik Austria (2012b).

[8] R&D intensity is defined as innovation expenditures as percentage of total turnover according to CIS 2010.

[9] Latest available data on EUROSTAT.

[10] Cf. OECD (2012).

[11] Cf. Statistik Austria (2012c).

[12] Cf. Innovation Union Competitiveness report (2011).

[13] Cf. Austrian Council for RTD (2012).

addition, Austria's advantageous position in Europe regarding community trademark and design (intensities) indicates a general orientation of the economy towards applied R&D.[14]

The design of RTDI governance structures was fundamentally reshaped at the beginning of the century. It has not changed significantly over the previous 3 years (see Fig. 1). The main development of the last two years with respect to RTDI governance was the publication of the Austrian RTDI Strategy "Becoming an Innovation Leader: Realising Potentials, Increasing Dynamics, Creating the Future" in March 2011. This strategy builds on the exchanges of ideas among the most relevant stakeholders and an analysis of the innovation system as a whole: The Austrian "Research Dialogue" (2008), the "System Evaluation" of the R&D support and funding system (2009), and the strategic recommendations of the Austrian RTDI Council (2010). It introduces a coordinated vision and strategy across all ministries in charge of RTDI.[15] In order to avoid duplication and to better address horizontal policies, as well as ensure the strategy's overall implementation, a task force of senior officials was installed in mid-2011. It has established a total of nine (inter-ministerial) working groups active in 2012. In addition, the Austrian Council for RTD ("Rat für Forschung und Technologieentwicklung") as an independent STI advisory body has the main task to monitor progress of the strategy's implementation and reports to the Parliament (National Council) on an annual basis.

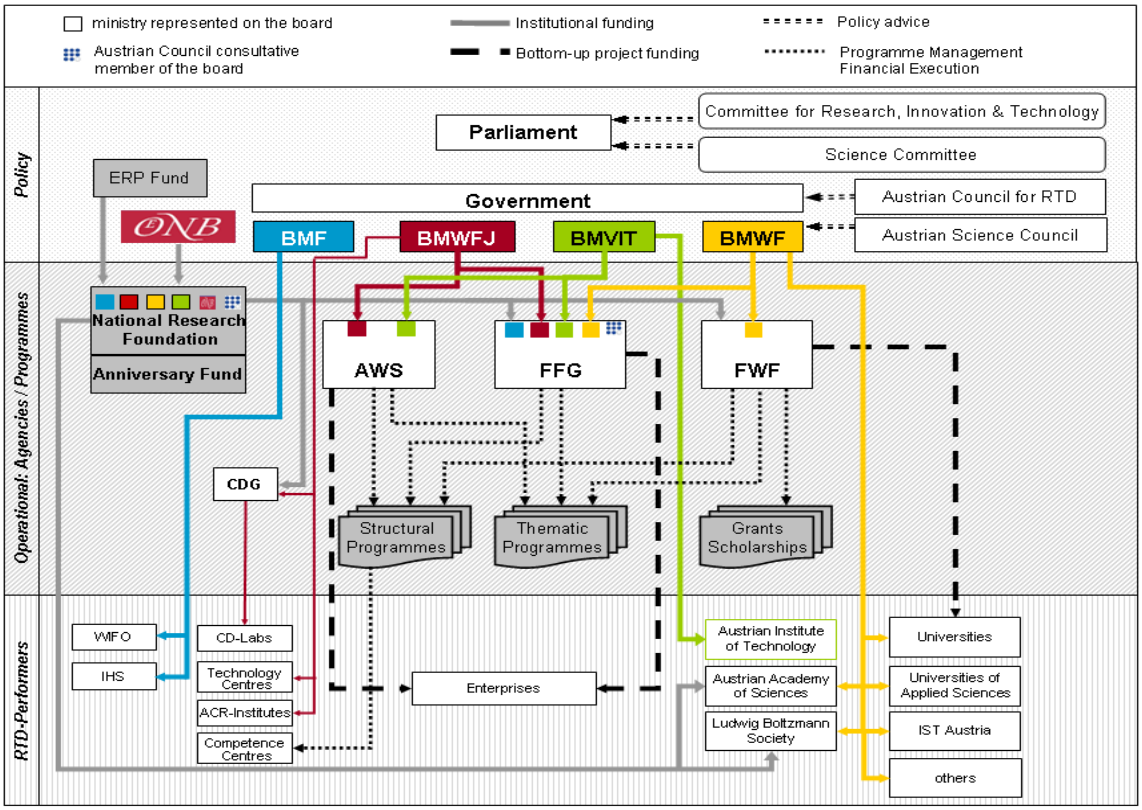
The need for coordination of governance levels in Austria's Federal system is limited because, as argued before, policy actors on national level distributes the majority of public funds available within the science and innovation system. In this way, multilevel governance often follows a top-down approach.[16] However, as far as formal coordination of RTDI policies on national and Federal State levels indeed occurs, it is organised on the RTDI platform Austria ("Plattform FTI-Österreich"), a semi-annual conference involving stakeholders on all levels, first launched by the Austrian Council in 2007. In addition, several ministries (including Ministry of Science and Research (BMWF), Ministry of Life (BMLFUW), Ministry of Economy, Family and Youth (BMWFJ)) regularly meet with representatives from Federal States, or information exchange takes place on an informal but regular basis.

[14] Cf. BMWF, BMVIT and BMWFJ (2012).

[15] This includes the Federal Chancellery, the Federal Ministry of Finance, the Federal Ministry for Transport, Innovation and Technology, the Federal Ministry of Science and Research, the Federal Ministry of Economy, Family and Youth, and the Federal Ministry of Education, Arts and Culture. Under the oversight of the Federal Chancellery and co-headed by the by the Austrian Federal Ministry of Finance, representatives from these ministries also constitute the related task force.

[16] Cf. Aiginger et al. (2009).

Figure 1: Structure of the Austrian Research System



Legend: ÖNB (Austrian Federal Reserve), BMF (Ministry of Finance), BMWFJ (Ministry of Economy, Family and Youth), BMVIT (Ministry of Transport, Innovation and Technology), BMWF (Ministry of Science and Research); AWS (Austria Business Service), FFG (Austrian Research Promotion Agency), FWF (Austrian Science Fund), CDG (Christian Doppler Research Society), WIFO (Austrian Institute of Economic Research), IHS (Institute for Advanced Studies), ACR-Institutes (Austrian Cooperative Research Institutes), IST Austria (Institute of Science and Technology Austria)

2 RECENT DEVELOPMENTS OF THE RESEARCH AND INNOVATION POLICY AND SYSTEM

2.1 National economic and political context

After the downturn resulting from the economic and financial crisis the Austrian economy experienced a fast recovery in 2010 and 2011, but has been on a more moderate growth path since 2012.

General public consolidation efforts have led to a first budgetary stability agreement launched in mid-2012. This became necessary due to public debt limit laws established on national level at the end of 2011 and a stability agreement signed among Federal States within Austria in May 2012.[17] Both, even though not constitutionally fixed, request balanced public budgets on all government levels by 2016/2017. Hence, these efforts also put pressure on specific budgets dedicated to R&D.

In recent years, the fluctuation of Ministers of Science and Research (BMWF) in charge in Austria accelerated. In April 2011, Professor Töchterle, former rector of the University of Innsbruck, became new Minister of Science and Research, replacing Beatrix Karl who became Minister of Justice.

Implementation of on-going, public budgeting reform progresses in accordance with its major milestones in 2009 and 2013 ("Haushaltsrechtsreform"). This may also affect to a certain degree the allocation to public R&D budgets and their composition, at least in the medium and long term. Efficiency and effectiveness concerns of this multi-annual, binding budgetary framework could, in turn, further increase performance and impact-orientation of STI policies in general.

In addition, in early 2012, a reform of laws governing competition and cartels was introduced by the Federal Ministry of Economy, Family and Youth (BMWFJ) and the Federal Ministry of Justice (BMJ) that strengthens the role of government agencies and increases transparency of regulatory procedures. In turn, according to the Austrian Council (2012), expected higher levels of competition may also serve as a new impetus to innovation activities in the Austrian economy in the medium and long term.

2.2 Funding trends

The Austrian government's strategic goal is to continue increasing the R&D ratio over the next decade to up to 3.76 % in 2020. After almost a decade of constant growth, R&D funding from the public sector reached its highest level ever in 2012 (in absolute terms),[18] with a 38.1% share of overall national R&D funding. In particular, contributions from federal government grew by more than 8% over 2011, while contributions from regional governments grew nearly 2% over 2011.

[17] This most recent agreement among Federal States sanctions excess deficits. Surcharges are distributed among those Federal States that comply with deficit rules.

[18] Budgetary provisions foresee a further increase of 4.5%, i.e. from €3.85bn in 2012 to approximately €4.02bn in 2013 (press release BMWF, 2012).

Thus, so far, most public R&D budgets have been successfully ring-fenced and partially even increased in some areas. Only one out of the three budgets of Federal Ministries mainly in charge of R&D funds, namely the Federal Ministry of the Economy, Family and Youth (BMWFJ), has not increased, but weakly decreased its total R&D budget from 2011 to 2012 and is expected to further decrease in 2013.[19]

In general, public funds in Austria are more often distributed via institutional than project-based modes,[20] roughly accounting for 2/3 and 1/3, respectively, of total funding. According to the IU Competitiveness Report (2011), national public funding performed in the higher education sector is mostly institutional (including general university funds), i.e. accounting for more than 90% of all institutional funding in Austria. Competitive project-based funding is relatively scarce in the higher education sector, whereas more than 60% of these public funds are performed by Austrian businesses. In turn, only a very small fraction of institutional funds is performed in government and private non-profit R&D sectors. This top-ranks Austria internationally next to Switzerland, Denmark and Germany with regard to the emphasis on institutional funding in higher education, at least for the latest data available.[21] In contrast, institutional funding in countries such as the Netherlands, Belgium or Korea is more often performed in government and private non-profit sectors; Higher education institutions (HEIs) in these countries more frequently receive public project-based funding for their R&D activities. However, it should be noted that some of these trends in funding modes are due to size and structures of R&D performing sectors in these countries.

Direct R&D subsidies via project-based funding have been mostly ring-fenced in Austria and, thus, (with a few exceptions) remain on comparative levels since 2010. Budgets and policies that support scientific excellence have also been ring-fenced, e.g. continuation of funding for the Institute of Science and Technology Austria (IST), established in 2009, and the industry co-funded Austrian Institute of Technology (AIT). The Austrian Science Fund (FWF) as a main funder of basic research in Austria and with a total grant portfolio of €195.2m in 2011 and 2012 will refinance and stabilise the budget in 2013 with own financial savings. Therefore, it does not fully depend on public budget and consolidation efforts.

Starting in 2011, additional annual funds ("Offensivmittel") of €80m have been directed to the science system, largely benefiting (institutional) global university funds, e.g. financing the provision of admission place at universities of applied sciences. For 2013 to 2015 budgetary provisions foresee further annual amounts of €150m. These will feed into universities' institutional finance and will be distributed on the basis of newly introduced performance criteria. Thus, in sum, increased HEI funding in the most recent years has likely further strengthened the already existing emphasis on institutional rather than project-based funding in Austria.

With regard to indirect government support to businesses, the ceiling of the research premium for the acquisition of R&D has recently been increased from € 100,000 to €1m, effective as of 2012. At the same time, eligibility criteria and criteria enforcement have been tightened. Thus, at present, it is difficult to assess whether these most recent tax incentive changes will alter the overall balance between R&D subsidies and tax incentives. Latest available data for 2008 implies

[19] Cf. BMF (2012), p.46.

[20] The share of project-based funding in total public funds in Austria almost doubled between 2000 and 2008. For further details please refer to Steen (2012).

[21] Cf. OECD (2011).

that roughly half of government's funding for business R&D is direct, while all other is indirect, i.e. tax incentives for R&D.[22]

Austrian RTDI policy also aims to achieve a distribution of public and private financing by 2020 in which one-third is public and the other two-thirds are private.[23] This has led to continuous modifications of the research premium[24] and a number of other, indirect and direct strategic measures, in particular those that address incentives for private R&D activities. Here, national strategy corresponds to the EU's Barcelona target that two-thirds of R&D spending should come from the private sector, but it further specifies a 25% increase in the number of Austrian businesses performing R&D by 2020. However, even though more than 60% of Austrian R&D (2012: estimate) is currently funded by the industry sector, i.e. by Austrian businesses and foreign funding of multinationals, the recent shift towards public funds, as highlighted before, makes a successful change in overall funding structures less likely.

[22] Cf. IU Competitiveness Report (2011).

[23] More precisely, the national STI strategy is in some places even more ambitious and states that "in accordance with the international model, to increase this to 70% wherever possible".

[24] In 2011, the research premium had been increased from 8 to 10%, while simultaneously disposing tax allowances under § 4 Para 4 of the Austrian Income Tax Act.

Table 1: Basic indicators for R&D investments in Austria[25]

	2009	2010	2011	2012 (estimate)	2020 national target	EU-27 average 2011
GDP growth rate (%)	-3.8	2.1	2.7	0.8	n.a.	-0.3 (2012)
GERD as % of GDP	2.71	2.79	2.75	2.8*	3.76	2.03
GERD per capita (€)	895.2	953.3	983.2	1019.8*	n.a.	510.5
GBAORD (€ million)	2150.0	2270.0	2408.1	2471.6	n.a.	91,277.1 (EU-27 total)
GBAORD as % of GDP	0.78	0.79	0.8	0.8	n.a.	0.73
BERD (€ million)	5092.9	5436.3	5626.5	n.a.	n.a.	5925.0
BERD as % of GDP	1.84	1.9	1.87	n.a.	n.a.	1.26
R&D performed by HEIs (% of GERD)	26.2	26.2	26.2	n.a.	n.a.	24.1
R&D performed by PROs (% of GERD)	5.2	5.4	5.5	n.a.	n.a.	12.8
R&D performed by Business Enterprise sector (% of GERD)	67.9	68.1	68.0	n.a.	70	62.1
Share of competitive/project-based public funding for R&D	28.9** (2008)	n.a.	n.a.	n.a.	n.a.	n.a.

*Source: Statistik Austria, accessed online on December, 18th, 2012, http://www.statistik.at/web_en/statistics/research_and_development_r_d_innovation/global_estimate_r_d_intensity_annual/index.html. Calculations by the author.

**Source: Steen (2012)

2.3 New policy measures

With regard to the modernisation of the Austrian education system and better coordination between the education and innovation spheres, current initiatives address adverse early and social selection in primary schools and permeability[26] in the overall education system (e.g. dual training initiatives). This includes, among other, the reform of the new secondary school ("Neue Mittelschule")[27] replacing the grammar school ("Hauptschule") by 2019, and the "Lehre mit

[25] Eurostat, accessed on December, 18th, 2012, unless otherwise indicated.

[26] Efforts currently focus on improved information services to students and young professionals such as the online portals "MaturantInnenberatung" or the "studienchecker".

[27] This school type foresees a differentiation between basic general education and advanced general education in the field of German, mathematics and a first foreign language in the last 2 years. The assessment of advanced general education should correspond to the Gymnasium

Matura" programme, i.e. assistance for graduation examination of apprentices that gives university access, launched in 2011 and 2009, respectively.

At the level of HEIs, structured doctoral programmes have been introduced ("Doktoratskolleg"), with an additional budget of €18m of Austrian Science Fund (FWF) funds, as well as a new, but small-scale grant scheme for excellent post-docs ("sub auspiciis Praesidentis", €9,000 for 2 years). These initiatives complement existing (post-) doctoral fellowship programmes mainly run by the Austrian Academy of the Sciences (ÖAW). In addition, excellence-in-teaching prizes at public universities ("Ars docendi") will be awarded annually, starting in 2013.[28]

More importantly, core elements of the 'higher education plan' ("Hochschulplan") by the Minister of Science and Research presented at the end of 2011 foresee a radical reform of the financing systems of universities in the years to come. This includes enhanced incentives for third-party funding and private co-finance (e.g. sponsoring and donations); access and capacity limitations for certain fields of study; a re-introduction of tuition fees and compensation payment for non-Austrian students (the latter as a response to "asymmetric mobility" patterns in Austria). More specifically, at the end of 2012 (December), semester tuition fees for students with long study periods of more than €350 were introduced (effective as of summer 2013) – after long controversial public discussion. Non-Austrian students from third countries have to pay twice the amount of nationals. Total fees collected by higher education institutions (HEIs) will amount to approximately €5m. The potentially adverse effect of higher fees on social selectivity at HEI entry level is likely reduced by a simultaneous increase of publicly financed student grants by a total of €2.5m. Access and capacity limitations for certain fields of study and corresponding reallocation of resources and funds are currently being integrated in the overall HEI performance contracts (2013 to 2015). E.g. capacity planning foresees an expansion of up to 4000 student places available at universities of applied sciences in the next 3 years.

Another line of measures focuses on the quality of teacher education in primary school: All future teachers will have to study at universities (within the framework of the programme "PädagogInnenbildung NEU"). Primary schools now are obliged to increasingly hire foreign-born teachers in order to reduce drop-out rates of immigrant pupils. In addition, the faster recognition ("Nostrifizierung") of foreign diploma or training qualifications has been implemented, e.g. the EU-driven initiative "ENIC NARIC AUSTRIA", and proves relatively successful.[29]

The latter measures link to the overarching policy ambition to increase participation of presently underrepresented groups in the science and innovation system. This not only seeks to activate migrants, but women and elderly as human resources for R&D. As discussed before, only a few initiatives have been launched and budgeted to attract female students to MINT[30] disciplines and also create career models for MINT position in the industry, compatible with career and family concerns of women.

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qualification level and, thus, should make the transfer into higher secondary schools easier. Team teaching and additional six hours of school education are foreseen to attain this qualification level.

[28] This is a joint initiative by the BMWF, the Assembly of Universities ("Universitätenkonferenz", UNIKO) and the Austrian Student Representatives (ÖH).

[29] In the first half year 2011, 1,036 foreign diplomas were approved; for the same period in 2012, already 1,239 were approved.

[30] MINT subjects or scientific disciplines include mathematics, information technology, natural sciences and technology.

Recent initiatives in the context of enhancing human resources for R&D also include additional funding by the BMWF for 2011 and 2012 aimed to strengthen participation in MINT subjects, with a total amount of €40m. Other new, ministerial initiatives seek to improve cooperation between secondary and tertiary education systems via direct contacts of pupils and researchers ("Young Science" networks or the pre-university programme "Sparkling Science"), enhance skills training of existing R&D staff in small medium enterprises (SMEs) as well as increase female participation in industry innovation in the long-run ("FEMtech internships" providing scholarships to female MINT students).

The national government currently plans to expand its portfolio of and budget for entrepreneurship policies, in particular venture financing conditions. According to public budgetary provisions for 2013,[31] €15m of (public) risk capital will contribute to a semi-public European Business Angel Fund fostering growth of young innovative entrepreneurs, a fund with a total budget of €45m. Another €65m will feed into a purely public fund for early stage capital ("Gründerfonds") during the next 6 years. However, most recent, low-budget policies to foster start-up activities include, among other, awards and prizes for (female) entrepreneurs, e.g. "Phönix" and "Phönix Women" (both initiated by BMWF).

2.4 Recent policy documents

Major steps were taken last year with the implementation of priority and portfolio management in Austrian public funding administrations (Ministries, agencies etc.): calls for proposals in the individual programmes were successively integrated into the new annual schedule for announcements. This envisions two windows in spring and autumn for announcing competitive calls for proposals, along with the current application procedure. Furthermore, 2011 saw the successful introduction of the first package of new instrument guidelines. These are meant to ensure that, regardless of programme and topic, similarly structured projects will meet with identical conditions and frameworks everywhere. A decisive step has been taken by the Federal Ministry for Transport, Innovation and Technology (BMVIT) and the Federal Ministry of Economy, Family and Youth (BMWFJ) along with the Austrian Research Promotion Agency (FFG), towards the objective of treating similar projects in the same way.

2.5 Research and innovation system changes

In the context of the implementation of the national RTDI strategy, a task force of senior officials was installed in mid 2011. It has established a total of nine inter-ministerial working groups active in 2012. Two of these working groups focus on thematic priorities outlined in the strategy, namely "climate change and scarce resources" and "quality of life and demographic change". Another seven working groups review existing and create new policy measures in the areas of human potential, research infrastructures, knowledge transfer and start-ups, business enterprise research, the international and European dimensions of research agendas, and international rankings.

The structural reform of the Austrian Academy of the Sciences (ÖAW), Austria's largest non-university R&D organisation, continued in 2011 and is still on the political agenda. On the basis of a strategic development plan for the ÖAW a multi-annual performance agreement has been concluded with the Federal Ministry of Science and Research (BMWF) which comprises the period of 2012-2014.

[31] Cf. BMF (2012).

This agreement and associated organisational change foresees a concentration of ÖAW's research activities on six major thematic priority research areas: European identities and protection and interpretation of cultural heritage; demographic change, migration and integration of people in heterogeneous innovative societies; bio-medical fundamental research; molecular plant biology; applied mathematics including modelling and bio-informatics; quantum optics and quantum information. In addition, the formerly 63 research units of the ÖAW have been concentrated to 29 institutes (16 for the Humanities and 13 for the Natural Sciences).

A global budget of €224m has been agreed for the three-year period of the performance contract (plus additional dedicated funds for fellowships and international programmes as well as membership fees). This results in a deficit of around €38m to €40m due to liabilities of previous years and increasing personnel costs. Accordingly, a reduction of ÖAW's total R&D staff in the coming years can be expected.

One year after the agreement's conclusion (2012) 14 institutes and research groups of the ÖAW have been shifted and integrated into a number of universities. E.g. the ÖAW-Institute of Limnology was transferred to the University of Innsbruck and the ÖAW-Institute of Integrated Sensor Systems by the Technical University of Vienna.

In October 2012, the ÖAW decided to renew its organisational structure by separating the learning society ("Gelehrtengesellschaft") from its research performing organisation ("Forschungsträgereinrichtung") under a common roof of the ÖAW, thus setting up two organisational parts that may act in an autonomous way as well as reducing potential conflicts of interest across organisational sections. Both sections will be equipped with a separate budget and, accordingly, separate performance agreements with the BMWF.

2.6 Regional and/or National Research and Innovation Strategies on Smart Specialisation (RIS3)

Only 2 out of 9 Federal States have registered on the Smart Specialisation Platform, namely Lower Austria and Upper Austria. All other Federal States (with the exception of Vorarlberg) have also developed economic and innovation strategies, but are not officially registered on the S3 Platform at present, e.g. Styria or Carinthia.[32] Interestingly, strategy development in many of these regions has been co-financed with EU funds (e.g. under the Regional Innovation and Technology Transfer Strategies (RITTS) programme).

The regional government of Lower Austria has a dedicated Economic Strategy Lower Austria 2015[33] launched in 2010. It also includes an updated innovation strategy. Based on a SWOT and comparative regional analysis the latter identifies a number of strategic "technopoles" (clusters) and sets out explicit RTDI targets, e.g. an increase of regional human resources in science and technology by 2015. Thus, it is based on a rather comprehensive assessment of the region's strength and weaknesses. The strategy was mostly developed bottom-up with SMEs located in the region. In addition, it lists a number of on-going or planned policy measures encouraging regional R&D, e.g. training for R&D staff in SMEs and coaching services for entrepreneurial ventures.

[32] Cf. Styrian Government (2011) and Carinthian Government (2009).

[33] Cf. Lower Austrian Government (2010).

Similarly, Upper Austria has launched regional economic and science strategy ("Innovatives OÖ 2010plus"[34]) for the period 2010-2013. The strategy focuses on 5 main thematic fields and sets out specific targets for each and across themes, e.g. an increase of regional R&D expenditures or being among the top 3 innovative regions in Austria by 2013. It also lists in greater detail a wide range of policy initiatives relevant to the regional innovation system. The strategy has a dedicated total programme budget of €150m for the three-year period (another €300m is intended to come from federal funds and industry investment). In addition, the existing R&D funding agreement between the national funding agency FFG and Upper Austria, first established in 2006, was prolonged in 2010 and is an important milestone for the strategy's implementation. The agreement involves funds from FFG's basic programme and is complemented by regional public funds dedicated to eco-, cooperative and start-up innovation.

To date (December 2012), none of the two regional strategies registered on the Smart Specialisation Platform has undergone peer-review in the process organised by the S3 Platform since the beginning of 2012. A national approach to smart specialisation is currently not in place nor planned. However, the Austrian government, more specifically, the Ministry of Science and Research (BMWF) together with Joanneum Research, took an active role as leading/coordinating country in a recent OECD-TIP project on smart specialisation.[35] In general, regional strategies and regional funding agencies complement and adjust to RTDI policies and activities on national and EU levels. Nevertheless, multilevel governance structures have led to significant overlap of activities and limited horizontal coordination in some specific areas: E.g. there are currently more than 40 cluster initiatives run on Federal State and national levels, but virtually no funds available for innovation clusters that span across Federal States.[36]

2.7 Evaluations, consultations

Eight major evaluations relevant to federal policy and publicly accessible have been undertaken in 2010 and 2011.[37] This selection of those evaluations published in 2010 includes:

- A formative and quantitative evaluation of the "Laura Bassi Centres of Expertise" (commissioned by the Federal Ministry of Science and Research): The programme establishes centres of excellence under the leadership of female scientists and seeks to increase visibility of female accomplishments in science as well as increase female participation in the long-run.[38] Evaluation results suggest that not only the female researchers' scientific achievements to date should be taken into account in the candidate selection process, but also capacity and potential in the areas of management, team leadership and career planning of the candidate.
- A qualitative evaluation of the pilot programme "Josef Ressel Centres" (commissioned by the Federal Ministry of Science and Research): The latter sponsors long-term cooperation (up to 5 years) between universities of applied science and local enterprises

[34] Online information platform at http://www.ooe2010plus.at/index.php; official policy document: Cf. Upper Austrian Government (2010).

[35] Cf. project website as well as draft synthesis report: https://community.oecd.org/community/smartspecialisation .

[36] Cf. Aiginger et al. (2009).

[37] Cf. BMWF, BMVIT and BMWFJ (2012, 2011).

[38] Cf. SME Research Austria (2011).

in applied R&D projects and teaching agendas. Positive evaluation led to an expansion of the pilot.[39]

- A qualitative and quantitative evaluation of the "supervision structures of the FP7 and EUREKA and efficacy analysis of the European Research programmes on the Austrian innovation system" (commissioned by the Federal Ministry of Science and Research and other ministries along with the Austrian Federal Economic Chamber):[40] The evaluation analyses effects of EU level R&D initiatives on the national innovation system and assesses Austria's supervision structures for FP7 and EUREKA.[41] It proposes the establishment of an "EU general coordination office" across ministries and a revision of the strategy and commitments specific to EUREKA.

In addition, evaluations completed in 2011, include (among other):

- A qualitative evaluation of the "Headquarters Programme" (commissioned by the Federal Ministry for Transport, Innovation and Technology, BMVIT), the latter funding R&D projects of 66 multinational enterprise (MNE) at the time:[42] The (negative) assessment concluded that public funds did not affect location and R&D choices of MNEs and, thus, policy expectations on measure impact were not fully realistic or too high. Accordingly, the programme has been redesigned in 2011, with a new, more structural focus on long-term strategic cooperative ventures of MNEs with Austrian research institutions.

- An evaluation of the Innovation-Voucher programme (commissioned by the Federal Ministry of Economy, Family and Youth (BMWFJ) and the BMVIT), the latter addressing technology transfer and cooperation of SMEs and public research institutions:[43] The programme successfully encouraged participation of SMEs not publicly funded before, but not cooperation among partners with no joint prior experience. The evaluation argues for a binding ex ante funding commitment by the funding agency and for a permission of subsequent cheques for the same corporate entity. In addition, it recommends not to change the maximum voucher amount of €5,000. To date, the first two recommendations have not been addressed in the existing programme. However, in contrast with results from the evaluation, an additional programme "innovation voucher plus", with a maximum voucher amount of €10,000, was set up in 2012.

- An evaluation of the "COIN" programme (commissioned by the BMVIT and the BMWFJ):[44] Both funding schemes of the COIN programme ("build-up" and "cooperation and networks") should be modified but continued. On the one hand,

[39] Cf. Convelop (2010).

[40] Cf. Technopolis (2010).

[41] It documents networking, reputation and incremental innovation effects among Austrian FP7 participants as well as complementarity of EU and national programmes; effects from EUREKA are comparatively weaker and the programme has limited compatibility with national funding structures; the assessment of supervision services (i.e. primarily the European and International Programme (EIP) area of the Austrian Research Promotion Agency (FFG)) is mainly positive.

[42] Cf. Technopolis (2011a).

[43] Cf. Technopolis (2011b).

[44] Cf. Technopolis (2011c).

current heterogeneity of target groups should be reduced, i.e. universities of applied sciences as well as cooperative research centres. On the other hand, selection and evaluation criteria of R&D projects, eligible for voucher reimbursement, need further refinement. In addition, the evaluation positively acknowledges integration of ERA-SME (Era-NET) into COIN and recommends opening up of overall COIN funds to international partners.

- A qualitative evaluation of the "uni:invent" programme (commissioned by the Federal Ministry of Science and Research (BMWF) and the BMWFJ):[45] It argues for a centralised agency (i.e. an Austrian-wide "technology transfer office (TTO)") in charge of university patent exploitation rather than the current, fragmented IPR consultant model. In similar, entrepreneurial culture at universities needs further improvement, e.g. via a spin-off sabbatical or via inclusion of patenting and founding activities to scientists' promotion criteria.
- A quantitative, survey-based evaluation of the Christian Doppler Research Agency (CDG) and related knowledge-transfer orientated CD laboratories, each with a maximum funding duration of 7 years (commissioned by the BMWFJ):[46] The clearly positive assessment – based on assessment of programme efficacy, cost-benefit analysis and overall RTDI system relevance - highlights the form-follows-function approach to funding modes, i.e. a high flexibility, and only calls for a reduction of administrative costs.

[45] Cf. Schibany et al. (2011).

[46] Cf. Alt et al. (2012).

3 STRUCTURAL CHALLENGES FACING THE NATIONAL SYSTEM

Results from the Innovation Union Scoreboard (2011) and earlier versions from recent years have shown that the basic order of EU Member States has largely stayed unchanged since the benchmark was introduced: the group comprising the "innovation leaders" includes four to five countries (Sweden, Denmark, Germany and Finland). Austria is positioned among a group of nine "innovation followers" (namely, Belgium, United Kingdom, Netherlands, Luxembourg, Ireland, France, Slovenia, Cyprus and Estonia), but has the policy ambition to catch-up with Innovation Leaders in long term. In general, past and present changes in the relative positioning of Member States primarily take place within these groups. This is also true for Austria.

Austria occupied 7th place in the 2010 rankings of the Summary Innovation Index (SII). Austria's current position in 8th place in 2011 is "technically" a decline, yet a closer look shows that great caution must be exercised when interpreting the rankings (as well as possible position changes): in terms of the IUS value, there is less difference between positions 5 and 11 than there is between positions 4 and 5 (the transition between the Innovation Leaders and Innovation Followers).[47]

Table 2: Innovation Union indicators for Austria, indicator values relative to the EU27 (EU27 = 100).

Human resources	
New doctorate graduates (ISCED 6) per 1000 population aged 25-34	140
Percentage population aged 30-34 having completed tertiary education	70
Open, excellent and attractive research systems	
International scientific co-publications per million population	349
Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country	106
Finance and support	
R&D expenditure in the public sector as % of GDP	114
Firm activities	
R&D expenditure in the business sector as % of GDP	153
Linkages & entrepreneurship	
Public-private co-publications per million population	156
Intellectual assets	

[47] Cf. BMWF, BMVIT and BMWFJ (2012).

PCT patents applications per billion GDP (in PPS€)	119
PCT patents applications in societal challenges per billion GDP (in PPS€) (climate change mitigation; health)	112
Outputs	
Economic effects	
Medium and high-tech product exports as % total product exports	108
Knowledge-intensive services exports as % total service exports	51
License and patent revenues from abroad as % of GDP	35

Source: Innovation Union Scoreboard (2011: 43).

In 2010, the Austrian Institute of Economic Research listed among the supply- and demand-side structural bottlenecks for growth:[48]

1. *a weak human capital basis for innovation*, expressed by a low tertiary education rate; a low number of science and engineering graduates (especially women) and a strong concentration on traditional crafts (especially by women);
2. *deficits in R&D* concerning a low number of research conducting enterprises and a strong concentration of R&D expenditure on relatively few companies; low start-up and growth dynamics of innovative enterprises; improvable quality of university research and low volume of university-based basic research;
3. *competition bottlenecks* expressed by a low competition intensity in certain service sectors (liberal professions, energy sector, banking and insurance sector, crafts, estate agents and property management, pharmacies, railways); sporadic limited competition in the productive sector (e.g. through cartel formation); low start-up dynamics of innovative companies to advance competition intensity in established industries;
4. *deficits in labour participation* concerning the labour quota of the elderly and of migrants, and low qualification of persons with a migration background.
5. *a weak private* domestic demand (both in terms of household investment and consumption) and low export orientation towards emerging countries.

By and large these structural challenges are common knowledge. Thus, it was not surprising that many of them were openly addressed by the Austrian Federal Government's Strategy for Research, Technology and Innovation for the next decade (March, 2011). It addresses measures to strengthen national research structures with a focus on excellence, to foster the innovative capacity of companies, enable thematic priority setting, raise the efficiency of governance, and to link research, technology and innovation to the education system. The strategy should also help to mobilise research, technology and innovation for tackling the grand challenges of society and the economy. Hence, with its 2020 perspective, the national strategy is explicitly embedded in Europe's 2020 growth strategy and contributes to the implementation of the Innovation Union.

In the government's RTDI strategy quite a substantial number of structural challenges are featured which the national innovation system is confronted with. Among them are several which – from a systemic RTDI perspective – constitute major bottlenecks for a prosperous future RTDI development, such as

- a strained university system with unfavourable student-to-teacher ratios, limited scientific career options (no sufficient tenure track), and especially a persistently low number of

[48] Cf. Ederer and Janger (2010).

S&E graduates: A fact which is aggravated by a declining age cohort of pupils between 15 and 19 years of age, a definitive gender imbalance in S&E studies and, thus, low entry and high drop-out rates in tertiary education;

- a relatively narrow financial base for fundamental research, accompanied by deficiencies in medium and large-scale research infrastructures and in competitive research funding, and characterised by little differentiation of research profiles at and between universities and insufficient cooperation between universities and non-university research organisations, as well as between universities and universities of applied sciences; in turn, PROs and HEIs in the Austrian science system are not top-ranked in international rankings[49] and, thus, do not largely attract global talent in R&D and science;
- a stagnating share of R&D financing from the business-enterprise sector (with increasing R&D expenditure in absolute terms), faced with a slightly but steadily declining share of corporate R&D funding from abroad (although still from a high level), partially balanced by transfer of a relatively high amount of public funds into the corporate R&D sector (compared to the EU average), well based on a developed science-industry cooperation portfolio, but with little impact on structural economic change in terms of added-value and high-tech orientation;
- low dynamics in increasing the intensity of private equity and venture capital in the formation of technology-based, innovative firms (although improvements are expected soon), aggravated by a deficient regulatory (VC) framework, administrative hurdles in the areas of enterprise formation and service regulations, and characterised by a hardly developed entrepreneurship culture (which gets little support from innovation-related education and training curricula), a weak competition policy with yet few concrete actions and outputs concerning demand-side policies and measures, innovation procurement, service and public sector innovation (beyond eGovernance, which is fairly well developed in Austria) as well as social innovation.

In addition, there are a number of challenges which are not highlighted in the strategy:[50]

- first of all there is no roadmap with budgetary indications and responsibilities, which would be required to implement the activities proposed in the strategy;
- consideration of the grand/societal challenges in RTDI funding is still expandable – although eventually beginning;
- limited vertical RTDI governance coordination is not addressed, i.e. insufficient coordination of RTDI strategies and policies across national and Federal State levels.
- little emphasis on impact evaluations of RTDI interventions despite a well-developed RTDI evaluation culture; evaluation of research institutions is missing or is only relatively "light";
- limited coherence and coordination of strategies in Austria's R&D internationalisation portfolio (despite a good integration in specific coordinated European activities; e.g. international ERA-NETs);

[49] E.g. according to the most recent Times Higher Education Ranking (2012), the first Austrian university, i.e. University of Vienna, ranks only 162nd.

[50] Cf. Schuch (2011, 2012); Austrian Council for RTD (2012).

- current RTDI governance insufficiently establishes continuous dialogue in the nexus of policy, society and science stakeholders aimed at increasing participation and acceptance.

4 ASSESSMENT OF THE NATIONAL INNOVATION STRATEGY

4.1 National research and innovation priorities

The Austrian RTDI Strategy is a comprehensive and multi-annual framework, but without a dedicated budgetary roadmap. It clearly signposts the following national research and innovation priorities:

- a sustainable **reform of the Austrian education system** and better coordination between the education and innovation spheres;
- **enhancing basic and applied research** and their respective institutions;
- **improving the innovation capacities of companies** (increasing technological capabilities, intensification of R&D and technology transfer, increased use of demand-side measures such as innovation procurement);
- **increasing the efficiency of public RTDI governance** (clear structures, high leverage effects of interventions,);
- and **broader base for innovation finance** (public and private R&D expenditure balance, impact-oriented usage of resources and evaluation, an explicit budgetary target for HEIs)

With this RTDI Strategy, the criticism that has repeatedly been voiced for many years concerning the lack of clearly established procedures for priority setting within the complex Austrian RTDI governance system has come to a halt.

The present strategy builds on some of the country's well-functioning and highly developed mechanisms for policy analysis, evaluation and monitoring, among which the publication of the results of the System Evaluation of Austria's R&D support and funding system in 2009 fed substantially into subsequent policy debates and decision making. This System Evaluation concluded that in order to advance from an "innovation follower" to an "innovation leader", the country must (a) apply a broader STI governance approach, including linkages with educational policies and other social and economic framework conditions, (b) design coordinated and consistent public interventions based on a shared vision and a joint strategy, and (c) move from imitation to a more radical innovation strategy.

This "modernised" governance approach, in particular the added value of horizontal coordination and coherent STI policy interventions, is partially reflected in the way on-going implementation of the national RTDI strategy is processed: Nine inter-ministerial working groups were launched in 2012. Two of these working groups focus on thematic priorities outlined in the strategy, namely "climate change and scarce resources" and "quality of life and demographic change". Another seven working groups review existing and create new policy measures in the areas of human potential, research infrastructures, knowledge transfer and start-ups, business enterprise research, the international and European dimensions of research agendas, and international rankings.

First, given that the latter seven working groups have obviously been selected according to the major structural bottlenecks in the Austrian innovation system (see section 3), they have now become an integral (i.e. institutional) part of STI governance structures themselves which potentially better assures continuous policy effort in the respective bottlenecks. In turn, this increases the likelihood of actually resolving the latter in the long-run. Second, the foci of the other two working groups on climate change as well as demographic change, in a similar way, institutionalises and reinforces policy efforts towards "grand challenges" by providing an

adequate mechanism for continuous horizontal policy coordination across ministries on these issues.

In general, the more than 100 policy measures and initiatives associated with the national RTDI strategy are equally distributed across the 4 main strategic areas (reform of the education system, basic and applied sciences, innovation capacity of firms as well as efficiency of political governance), i.e. each area with around 20-30 measures. Only 2 measures currently address the issue of innovation finance.

An indicator-based monitoring system[51] has been put in place in 2012 in the course of the strategy's implementation. It was originally developed and is continuously refined by the Austrian Council for RTD and the Austrian Institute of Economic Research (WIFO) and links all targets outlined to specific indicators. However, it is still too early to assess the strategy progress in the ultimate 2-3 years on the basis of recent indicator changes.

To date, the share (or degree) of implemented policy measures and initiatives associated with strategy in 2012 is fairly high according to the monitoring scheme of the Austrian Council for RTD (2012). Partially, this is due to the fact that roughly a third of all associated measures were already in place before the strategy's official launch in 2011. However, not all of these have undergone evaluation and quantitative assessment. More specifically, in the area of educational reforms almost 50% of all measures were in place in advance. The way policy priorities are addressed in the course of implementation, two years after the strategy's launch, reflects the current emphasis on the areas of "innovation capacity of firms", in particular knowledge and technology transfer, as well as "educational reforms". In contrast and notwithstanding the establishment of a task force and specific working groups in the context of the Austrian RTDI Strategy's implementation process, so far too little focus is put on the priority "efficiency of public RTDI governance" according to the Austrian Council.

4.2 Evolution and analysis of the policy mixes

The RTDI policy mix can be defined as a combination or set of policy instruments. Under this definition, policy instruments include all programmes, organisations, rules and regulations with active involvement of the public sector which intentionally or unintentionally affect R&D investments.[52]

The "Policy Mix Project" identified the following six "routes" towards stimulating R&D investment:

- **promoting the establishment of new indigenous R&D performing firms;**
- **stimulating greater R&D investment in R&D performing firms;**
- **stimulating firms that do not yet perform R&D;**
- **attracting R&D-performing firms from abroad;**
- **increasing extramural R&D carried out in cooperation with the public sector or other firms;**
- **increasing R&D in the public sector.**

[51] Cf. Austrian Council for RTD (2012).

[52] Cf. Guy et al. (2009).

In general, the policy mix in Austria over the last 3 years has not changed significantly. Well-known structural deficits, such as lack of venture capital, remain, as evidenced by the (Innovation Union Scoreboard) IUS 2011. Most of these deficits are at the focus of public interventions, but a certain degree of inertia is caused by underlying structures rooted in the inherited economic structure and culture of the country, with – for instance – an R&D risk-averse banking sector, a hardly developed high-tech orientation, a broad consensus to preserve the status-quo rather than to reform inefficient lock-in structures, or a rather risk-adverse entrepreneurial attitude (to name just a few examples).

The Austrian policy mix, which includes a broad assortment of measures, covers all routes,[53] but slightly different weights are given to the individual routes.

Route 1: Promoting the establishment of new indigenous R&D performing firms

According to estimates by the Austrian Council, only 5-10% of approximately 30,000 annual start-ups are knowledge-intensive, technology-oriented firms.[54] The proportion of young, fast growing firms is significantly below average by international comparison. The number of academic spin-offs, however, has increased in recent years and can be estimated at around 500 academic spin-offs yearly.[55] In order to enhance the readiness to set up academic spin-offs, the Austrian Council of RTD (2011b) encourages the introduction of formal return-options for failed academic spin-offs to their original academic host institution.

Due to poor market conditions on the stock exchange, in venture capital and private equity segments, Austria's firms, and especially its innovative entrepreneurs, lack crucial sources of financing for R&D investments. In Austria, financing structures have traditionally been oriented towards loans, which tend to prevent financing high-risk innovation activities.[56]

To improve entrepreneurial behaviour and enhance the foundation of enterprises, the Austrian government began to support the foundation of innovative and technology-oriented firms with different policies already in the last decade (TrendChart (TC) 2008). Initial activities to support the formation of R&D performing firms were centred on the creation of technology, innovation and start-up centres that are now residing under the umbrella organisation known as the Austrian Association of Technology Centres (VTÖ). Later on, measures were implemented to support entrepreneurial behaviour (e.g. with the AplusB Impulse Programme or with the JITU initiative) and instruments for financial support during start-up and early growth were introduced. These are now covered by the AWS ("Austria Wirtschaftsservice").[57]

Route 2: Stimulating greater R&D investment in R&D performing firms

For more than one decade, stimulating instruments for R&D performing firms has been a clear strength in the Austrian portfolio of R&D policies. Most direct measures and funds allocated, whether generic or thematic in orientation, support this route .[58] The General Programme of the

[53] Cf. Hofer (2009); Schuch (2011, 2012).

[54] Cf. Austrian Government (2011).

[55] Cf. Schibany and Gassler (2010).

[56] Cf. Austrian Government (2011).

[57] Cf. Hofer (2009).

[58] Cf. Hofer (2009).

FFG has remained Austria's most important source of public funding for R&D carried out by industry in terms of funding budget, efforts to promote R&D in all economic sectors and industries, areas of technology, and sizes of companies.

The most important change in the last 3 years has been the reform of the tax allowance. As highlighted before, the allowance was increased on 1 January 2011 from 8% to 10%.

Route 3: Stimulating firms that do not perform R&D yet

Companies, especially SMEs not yet performing R&D, are among the most strongly "wooed" target group for R&D and innovation policy in Austria.[59] They are addressed by a large number of technology centres, incubators, national and regional funding bodies, emerging regional innovation strategies, and business advice providers.[60]

The Innovation Voucher Instrument, which was implemented in Austria in 2007, has been evaluated recently.[61] Overall, the Innovation Voucher Programme was well accepted by SMEs. The evaluation recommends a binding ex ante funding commitment by the funding agency, a permission of subsequent cheques and leave the maximum voucher amount of €5,000 unchanged. To date, interestingly, the first two issues have not been implemented yet but an additional programme "innovation voucher plus" introduced in 2012, offering twice the voucher amount outlined in the original programme.

Route 4: Attracting R&D-performing firms from abroad

The fourth route is essential for Austria, because about one sixth of financial resources for R&D performed by enterprises are funded from abroad. Primarily, this occurs when Austrian R&D is affiliated with a multinational company. This seems to indicate that Austria has become an attractive research location,[62] but with a decreasing tendency of funds from abroad in the most recent years. Public interventions to attract R&D performing firms can be direct (e.g. targeted programmes) or indirect (e.g. by providing an adequate material and immaterial infrastructure). Regarding the latter, Austria in general offers a competitive infrastructure in the centre of the EU with a tradition to act as a regional hub to Central and Eastern Europe. Accordingly, one important policy priority outlined in the national RTDI strategy is the improvement of national research infrastructures as well as Austria's integration and commitments to international infrastructures (e.g. ESFRI). Thus, one of the task force's working groups mainly focuses on this priority.

Many multinational enterprises coordinate their Central European business from Austria, especially from Vienna and its vicinity. With increasing locational advantages in the newer EU Member States, however, this traditional lead is being challenged and is shrinking. A recent study confirmed that – for the time being - the availability of qualified personnel and the skill level are still considered as main locational assets by multinational enterprises in Austria.[63] However, in educational and science policy terms, an excellent science base can offer additional indirect incentives for MNE's location choices based on high-skilled labour availability. In this way, the

[59] Cf. Hofer (2009).

[60] Cf. Tiefenthaler (2009).

[61] Cf. Good and Tiefenthaler (2011).

[62] Cf. Hofer (2009).

[63] Cf. Sieber (2010).

recent long-term budget commitments for the IST Austria are an important step. Nevertheless, at the same time, the excellence cluster initiative is long-planned, but not implemented yet.

To attract R&D performing firms from abroad more directly, the so-called "Headquarter Strategy – R&D", a prominent element in the General Programme of FFG, is of particular importance in this context, not least because of the fact that it belongs to the Austrian RTDI programmes with the highest amount of funding (€27,193m in 2010). As highlighted in the above section on recent evaluations, a (negative) assessment of the programme concluded that public funds did not affect location and R&D choices of MNEs because policy held unrealistic expectations on measure impact. Accordingly, the programme has been redesigned in 2011, with a new, more structural focus on long-term strategic cooperative ventures of MNEs with Austrian research institutions.

Route 5: Increasing extramural R&D carried out in cooperation with the public sector

There are various measures in place aiming at academia-industry transfer of knowledge and technology (e.g. COMET, COIN, BRIDGE or CDG programmes) in the Austrian innovation system. In general, these measures, all established during the last decade, are considered effective and have led to a high level of transfer activities. Austria ranks 3rd among OECD countries in this respect.[64] Maybe due to the "saturation" of this particular policy mix route, only few new initiatives have been introduced in the last three years. Among the latest support measures in this respect are the thematic programme "Leuchttürme eMobilität" (Lighthouses of E-mobility), the Josef Ressel Centres, and the Laura Bassi Centres of Expertise.

More specifically, however, technology and knowledge transfer involving SMEs and respective, recently evaluated programmes and schemes (see section on recent evaluations, e.g. J.R. and L.B. Centres) still leave room for improvement and require evidence-based modifications or strategic reorientation (uni:invent and COMET). In addition, notwithstanding a positive evaluation, the temporary budget halt for the BRIDGE programme is a step in the wrong direction. The programme "bridges" the gap between basic and applied science,.

Route 6: Increasing R&D in the public sector

There have been no serious changes on this policy mix route in the last three years. Overall, route 6 receives considerable attention in the Austrian research system, yet the focus remains primarily on institutional funding. By far the largest share of institutional funding in the public sector goes to universities. While performance agreements for universities were already introduced in the middle of the last decade, the first full-fledged performance agreement with the Austrian Academy of Sciences (ÖAW) launched in 2011 is presently adjusted in response to recent structural reforms and strategic reorientation of the organisation in 2012. Similarly, the Austrian Institute of Technology (AIT), Austrian Cooperative Research (ACR) and the Institute of Science and Technology (IST) Austria also face on-going structural reforms and a review of their respective financing structures, e.g. current revision of the performance-based institutional funds of the IST Austria.

Despite a broadly recognised understanding that competitive R&D funding for universities and public research organisations is low compared to other similar countries ,[65] the budget of Austria's largest basic research fund FWF stagnated over the last 3 years (€177m in 2010 to

[64] Cf. OECD (2011).

[65] Cf. Schibany and Gassler (2010); Leitner et al. (2007).

€195m in 2011 and in 2012), but has been successfully ring-fenced during the crisis so far. However, budgets in 2011 and budgetary provisions for Austrian HEI foresee an increase in performance-based institutional funds. In this way, funding for basic research in Austria is still comparatively humble,[66] but generally on the rise.

4.3 Assessment of the policy mix

Reaching the 3.76% R&D target by 2020 will depend on how well mobilisation of private R&D investment will be become effective, in particular via routes 1 to 4 which focus on the structural deficits in R&D. This, in turn, is largely influenced by financial framework conditions for innovation, i.e. regulatory incentives for risk capital supply as well as public trust regulation. Currently, in particular R&D investment by SME is insufficient and private R&D investment is concentrated among only few companies.

With regard to entrepreneurship policies (route 1), the existing policy mix is currently focused on direct grants and advisory services. In this way, the framework for finance of start-ups needs further improvement, in particular at early and later financing stages, setting the right incentives for professional private venture capitalists and private investors with specific tax incentives and the introduction of internationally competitive private-equity laws. Such laws are currently discussed on policy level (IGG and IGG light).[67] In addition, the current policy discussion on entrepreneurial framework conditions in Austria also addresses reduced taxes (e.g. exemption from social security contributions) for start-ups in their first years of operation as well as a reform of existing company laws in favour of new ventures, e.g. the introduction of a new cost-efficient, legal status for limited-liability companies ("GmbH light"). Both aspects, increased incentives for risk capital providers and reform of existing company laws, would enhance the overall policy framework towards a broader financial base for innovation of young ventures in Austria, but have not been implemented so far.

As mentioned before, recent reform of laws governing competition and cartels strengthen the role of government agencies and increase transparency of regulatory procedures. In addition, the planned competition monitoring in this context may help to reap benefits from increased competition, associated with higher levels of innovation. These recent legal changes may ease market entry of entrepreneurs in medium and long term, and may, thus, reduce structural competition bottlenecks in the system.

With regard to greater R&D investment in R&D performing firms (route 2), the Austrian Council recently called for a further upgrading of the research premium for smaller enterprises. The Council also encourages the introduction of "proof-of-concept" measures and a generally more benevolent evaluation of risky R&D projects submitted to public funding programmes that may lead to more radical innovation output in the system in the long-run. Similarly, with a few exceptions,[68] the present public funding system puts only little emphasis on innovative services which, in turn, could complement the existing portfolio mainly focused on established manufacturing sectors in the future.

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[66] Austria has positioned itself in the middle range of OECD countries.

[67] Cf. AVCO (2008).

[68] A set of policies addressing this particular issue is currently being developed and further improved, e.g. the "evolve programme" for creative industries, launched by the BMWFJ in 2008 (see http://www.evolve.or.at/mission_statement/index.php?lang=EN).

More generally, in the last decade the number of direct policy measures has increased leading to an increased complexity of the overall funding system: even though, as a response to this trend and as outlined in the system evaluation exercise, some of the funding is now shifted to indirect measures such as research premium, only little effort is put into the consolidation of the direct funding portfolio. In this process of consolidation there is too little emphasis on systemic evaluations, rather continuation or termination of programmes is decided on the basis of individual programme assessment. Similarly, to date, the interaction and its effects of direct and indirect funding are not fully understood and, hence, are not taken into account by policy-makers in Austria.

With regard to firms that do not perform R&D yet (route 3), innovative policy measures that address the R&D investment potential of these companies, in particular inactive SMEs, are relatively scarce. In case already existing programmes were evaluated, this did not necessarily lead to a modification of the programme as recommended by the evaluation (see section 2.7 and e.g. the evaluation of the innovation voucher scheme).

With regard to R&D funding from abroad and MNE activity in Austria (route 4), not all recent policies have proven effective (e.g. "Headquarters Programme"), but have been redesigned accordingly. However, it is too early to assess the effects from these modifications. In summary, the Austrian policy mix in route 4 may, nevertheless, benefit by a shift from indirect to direct measures to attract MNEs and their R&D funds. E.g. public funds dedicated to basic and excellent science can offer higher returns not only to MNEs, but also for domestic firms and overall welfare.

With regard to an increased knowledge and technology transfer from academia to industry (route 5), the policy mix seems, at large, effective and has contributed to a constantly high level of transfer activities. However, some of the technology and knowledge transfer schemes in place require evidence-based adjustments or strategic reorientation and, thus, should remain high on the policy agenda.

With regard to basic and applied science in public research organisations (PROs) and higher education institutions (HEIs) (route 6), the national RTDI strategy foresees an increased planning reliability, i.e. a longer time-horizon of funds committed, that safeguards R&D activities of all publicly funded stakeholders in the innovation system. However, this is currently only the case with respect to the budget planning of the IST Austria (2017–2026). Many of the stakeholders like PROs face less stable financing conditions for the future. The latest funding commitment to HEI (2013-2015), in turn, is a small step in the right direction and is also in line with the EU Commission and national government's 2-percent-target for HERD.[69]

Regarding the deficits in labour participation, Austrian policy aims to increase the participation of presently underrepresented groups in the science and innovation system. This not only seeks to activate migrants, but women and the elderly as human resources for R&D. Under the RTDI strategy framework, only some existing initiatives and schemes (e.g. "gender budgeting") address the frequently low rate of female participation in science and industry. These were continued; however, since the publication of the strategy, no new and potentially more effective measures have been launched so far.

In addition, considerable effort is directed to improvement of the human capital basis for innovation by Austrian RTDI policy. Nevertheless, it is too early for a full-fledged assessment of the medium and long-term effects of current reforms such as primary/new secondary school

[69] According to the OECD (2012), Austria's HERD per GDP is just above the OECD average (1.4%), and, thus, is comparable to Germany's, Ireland's or the UK's (all 1.3%).

reforms or the introduction of structured doctoral programmes by the FWF.[70] However, most importantly, notwithstanding a few low-budget initiatives and a recent upward trend mentioned before, excellence orientation of funds for the Austrian science system is still comparatively low.[71] E.g. the excellence cluster initiative is long-planned, but not implemented yet. In addition, existing career paths in science and organisational HEI structures are not fully internationally competitive and, thus, not very attractive to excellent young (male and female) scientists.[72] In this way, too little is done to catch up with EU's innovation leaders with respect to the quality of the science base.

As discussed before, consideration of the grand and societal challenges in Austrian RTDI funding is still expandable. Notwithstanding efforts by the task force (and respective working groups) to address grand challenges, a horizontal (cross-ministerial) theme management is currently missing in RZDI governance. In addition, most policies directed towards grand challenges lack continuous evaluation as well as identification of new challenges is not based on systematic assessment.

Arguably, limited vertical coordination hampers effective RTDI governance, i.e. insufficient coordination of RTDI strategies and policies across national and Federal State levels. In similar, the establishment of the task force and its working groups in the course of the RTDI strategy's implementation is an important step towards effective horizontal policy coordination. Nevertheless, the coordination and responsibilities between strategy/programme owners (ministries) and project management (agencies) often requires further clarification, in particular by an increased operational autonomy of agencies and task attribution in line with subsidiarity principles.[73] In addition, the current discussion also foresees a simplification of RTDI governance structures on ministerial levels based on a categorisation of tasks according to science- or industry-technology-orientation (i.e. leading to a two ministry structure common to RTDI governance in most innovation leader nations). However, such a simplified structure is not in place yet.

Lastly, the dialogue in the nexus of policy, society and science stakeholders**,** aimed at increasing participation and acceptance of science and technology, is limited. In the first two years of the strategy's implementation only a few new initiatives (with limited budget attached) challenge this problem, namely the "Aula of Sciences", "Children's University" or the "Long Night of the Sciences".

[70] Increases of third-party funding at universities as well as high success rates of Austrian scientists in international funding schemes can be regarded as early indicators, showing an upward trend in the most recent years.

[71] E.g. total annual funds dedicated to scientific excellence programmes in Germany amount to more than €500,000m in the years to come (cf. DFG, 2012).

[72] Cf. WIFO (2012), Universities 2025: developing a vision.

[73] Cf. Austrian Council for RTD (2012).

Table 3: Structural challenges

Challenges	Policy measures/actions[74]	Assessment in terms of appropriateness, efficiency and effectiveness
Weak human capital basis for innovation	There are several policy measures in place, and much has been done in the last years in this respect. Educational issues are also a top priority of the newly established Research, Technology and Innovation Task Force. For reasons of space, only the most recent initiatives are mentioned: • reform and implementation of the new secondary school ("Neue Mittelschule") and measures to improve the quality of teacher education at primary school • establishment of the Austrian Higher Education Plan ("Hochschulplan"), e.g. introduction of tuition fees in 2013 • initiatives with a focus on excellence and young scholars: introduction of additional structured doctoral programmes; grant scheme for excellent post-docs and teaching excellence awards, both launched in 2012 • major steps implemented in the structural reform of the ÖAW, i.e. the largest non-university R&D organisation • unlock human resource potentials: (a) migrants benefit from faster recognition of foreign diploma or training qualifications; (b) female participation in science and industry: e.g. MINT information campaigns to attract students or "FEMtech internships" in industry, launched in 2010/2011.	To improve the availability of science and technology graduates, several initiatives have been launched or are being planned. However, an essential problem from the perspective of R&D policy - beyond the difficulties of keeping students in the system (and not producing drop-outs) and attracting them especially to MINT subjects (engineering and natural sciences) - is that the Austrian tertiary education system is faced with the basic problem that the quota of young people with "Matura" (which is the final secondary education exam that confers the right to study) entering the tertiary enrolment circle is already too low, i.e. remains well below EU average. Therefore, to improve the system effectively, the pre-tertiary sector has to be reformed. Recently several large reform initiatives have been launched in this respect, like the "Neue Mittelschule". In general one can say that a decades-long agony in education policy seems to be coming to an end. Further important steps would be to establish a better division of objectives and functions within the university sector as stipulated in the framework report for the Higher Education Plan.

[74] Changes in legislation and other initiatives not necessarily related to funding are also included.

Challenges	Policy measures/actions[74]	Assessment in terms of appropriateness, efficiency and effectiveness
Limited corporate R&D funding	Despite the fact that private R&D funding is considered to be the most essential element to reach the 3.76% R&D target in Austria by 2020, little additional stimulus has been provided to companies to increase R&D expenditure and their share of R&D financing during the last three years. This is not surprising, however, because the available portfolio of instruments is already advanced, and the share of public financing of R&D in the business enterprise sector is among the highest in Europe. Among the recent policy measures are: • reform of the tax allowance system which enables a higher public funding quota, while eligibility criteria and criteria enforcement have been tightened simultaneously; • introduction of the new Innovation Voucher plus scheme to accelerate the entry of SMEs in R&D activities; • A positive evaluation of the Josef Ressel Centres[75] led an expansion of the pilot programme. • Recent evaluations induced a redesign of the cooperation-orientated "Headquarter" and "COIN" programme structures in 2012.	During the last three years the share of R&D financing from the business-enterprise sector has been stagnating (with increasing R&D expenditure in absolute terms), in the face of a slightly but steadily declining share of corporate R&D funding from abroad (although still from a high level). This has been partially balanced by a transfer of a relatively high amount of public funds into the corporate R&D sector (compared to the EU average), and based on a well-developed science-industry cooperation portfolio. The impact on structural economic change in terms of added-value and high-tech orientation has remained limited. It has not been possible to remedy the strong concentration of R&D expenditure (incl. public R&D appropriations) on relatively few companies. R&D financing of companies for basic research remains very limited. Innovation procurement has just started to advance from the level of a policy of promises to an operative procedure, with a first pilot initiative implemented by FFG in the field of mobility.

[75] Centres aim to bridge the gap between industrial needs and research opportunities at universities of applied sciences.

Challenges	Policy measures/actions[74]	Assessment in terms of appropriateness, efficiency and effectiveness
Competition bottlenecks	The most recent public initiatives in this field were primarily focused on mobilising private risk capital to enhance access to financing young, innovative SMEs in the early stages, and to improve the technological capacities of growing companies: • reform of laws governing competition and cartels passed in early 2012, likely triggering innovation potential in monopolised industries and easier market access for entrepreneurs in medium-/long-term; • budgetary provisions for 2013 foresee €15m of (public) risk capital to semi-public European Business Angel Funds; another €15m will feed into a purely public fund for early stage capital; • new, low-budget initiatives to foster start-up activities also include awards and prizes for (female) entrepreneurs ("Phönix" and "Phönix Women"); • continuation of the JITU initiative and IPR consultancy and capital match-making services for entrepreneurs (e.g. i2-market for business angels).	The last years were characterised by low domestic private demand (both in terms of investments and private consumption) and limited export orientation towards emerging countries. Competition in the productive and service sectors and start-up dynamics within these sectors is still comparatively low, but recent legal changes in regulation of competition and cartels may reduce competition bottlenecks on the supply side. Despite recent advances in venture and equity capital financing and increased public funding contributions, the legal environment for venture capitalists has not improved significantly.

5 NATIONAL POLICY AND THE EUROPEAN PERSPECTIVE

Austria's RTDI policy and its national policy mix are aligned with the ERA priorities and objectives to a large extent, namely, a more effective national research system, optimal transnational co-operation and competition, open labour market for researchers, gender equality and gender mainstreaming in research, and, lastly, optimal circulation, access to and transfer of scientific knowledge including via digital ERA.

More effective national research system: In terms of research organisations, much progress towards autonomy (also in financial terms) has already been made in the university sector in the last decade. However, there is a need to reform the university financing model and to make research financing in general more competitive and project-based. This should also lead to the establishment of more pronounced individual profiles of universities with clusters of excellence. The cooperation and division of labour (and objectives) between universities and the non-university sector (incl. universities of applied sciences) still leaves room for improvement. By now the government does not provide sufficient practical incentives to improve coordination and profile-building. There are also hardly any performance agreement systems in place for non-university research organisations, which is partly due to the lack of significant indicators capable of covering the thematic wealth of the non-university research sector in Austria. However, recent measures introduced in 2012 such as the establishment of a new and single agency (Agency for Quality Assurance and Accreditation Austria) or revised evaluation quality standards published by the bottom-up Platform for Research & Technology Policy Evaluation (FTEVAL) likely improve future institutional assessments and general evaluation practice in Austria in medium- and long-term. This may, thus, increase efficiency of public spending in STI policy. In turn, however, increases in HEIs institutional funding, even though allocated based on performance, arguably, do not sufficiently consider criteria for scientific excellence.

Optimal transnational co-operation and competition: Austria is involved in a large number of ERA-NETs, which contribute not only to a more efficient allocation of funding but also to enhanced cross-border relations with researchers from other EU Member States. However, due to the limited involvement of some of Austria's neighbouring countries in ERA-NETs and other European cross-border initiatives, these programmes have not yet been made the best use of in order to capitalise on the potentials of cross-border cooperation. Unilateral initiatives to counterbalance these shortcomings have been gradually downsized during the last couple of years. In addition, Austria made recent commitments to a number of Joint Programming Initiatives (JPIs) focusing mostly on grand challenges such as an aging society or climate change (e.g. initiatives "More Years, Better Lives", "Healthy Diet for a healthy life", "Water Challenges").. In turn, Austrian scientists have been very successful in third-country EU-level programmes such as ERASMUS MUNDUS II partnerships or EU TEMPUS projects.

On national level, consideration of the grand and societal challenges in Austrian RTDI funding is still expandable. Notwithstanding efforts by the task force implementing the national RTDI strategy since 2011 (and its respective working groups) to address grand challenges, a horizontal (cross-ministerial) theme management is currently missing in RTDI governance. In addition, most policies directed towards grand challenges lack continuous evaluation as well as identification of new challenges on national level is not based on systematic assessment. However, with its 2020 perspective, the national strategy is explicitly embedded in Europe's 2020 growth strategy and contributes to the implementation of the Innovation Union.

Research infrastructure for basic science in Austria is well developed. However, only a very limited number of such locations are recognised internationally. Although Austria has actively committed itself to participating in several ESFRI initiatives, the absence of an aligned research infrastructure strategy, which has repeatedly been requested by the Austrian Council (2011a), makes a coordinated local, national, regional, European and international approach more difficult. A public consultation on research infrastructures (RI) and a repository of RI in Austria have been commissioned by the Austrian Council to create pressure in favour of a faster resolution of this issue. The availability of, and access to, research infrastructures represent a bottleneck for the development of research in Austria.

In general, Austria is, nevertheless, well engaged in international R&D exercises and participates in international large-scale research programmes and infrastructures such as CERN, ESRF, EMBO, CISM, ILL, ELETTRA, IIASA, ISTC/STCU, WMO, and has signed intergovernmental bilateral S&T agreements with China, FYR of Macedonia, India, Korea (mainly in the EU project KORANET), Croatia and Ukraine. New or reinforced bilateral cooperation was established in 2012 with, among other: Slovenia (in the context of Erasmus, Erasmus Mundus and CEEPUS), Slovakia, France, China, Saudi Arabia, Albania, Singapore, Montenegro and Indonesia. This not only includes bilateral agreements on federal government level, but also cooperation on university or PRO levels, the national exchange services (OeAD) or Austria's main funding agencies, e.g. the ÖAW and its Slovenian counterpart. In addition, a multilateral (and "macro-regional") strategic communique was signed in 2012 by eleven countries in the Danube region, addressing potential R&D synergies for Horizon 2020 and Structural Funds.[76] Austria's main area of international cooperation is support for the mobility of researchers, based on jointly defined projects. However, most of the existing internationalisation programmes are subcritical and rarely facilitate comprehensive research collaboration. To add critical momentum, Austria successfully participates in international INCO-NETs to establish and support the policy dialogue with third countries. It also participates in a number of international ERA-NETs to fund research activities with third country partners. However, there is hardly any involvement of more applied and industry-oriented funding partners under these schemes.

Open labour market for researchers: Austria is a small, but open economy, also in terms of its labour market as well as relative availability of public funds to foreign researchers.[77] There are hardly any codified restrictions for researchers from abroad (especially from the EU) to move to Austria for work, but fundamental deficits in terms of (faster) recognition of educational achievements attained abroad remain. The immigration laws for qualified personnel have been considerably improved recently by introducing the "Rot-Weiss-Rot-Karte" ("red-white-red card"), inspired by the U.S. green card, in 2011. Especially public research organisations can easily benefit from improved immigration regulations. Third-country students who graduated in Austria are now allowed to enter the Austrian labour market directly.

Cross-border cooperation and European knowledge transfer via researcher mobility are well established at the level of researchers, research organisations from industry and academia, and research funding agencies. In the field of basic research, there is a high propensity and readiness to finance also research conducted outside Austria. E.g. FWF, Austria's largest basic research fund, has already spent more than 10% of its funding abroad. Austrian researchers in more applied sciences are only allowed to move their publicly-funded grant to another ERA country to a fairly moderate extent as portability largely depends on the specific research funding

[76] see http://www.bmbf.de/pubRD/BMBF_Konferenz_Kommunique_Ulm_Draft_09_07_2012_EN_clean_final.pdf .

[77] Cf. Peuckert et al. (2012).

organisation. In general, grant portability is frequently limited to individual grant merits rather than organization associated grants. Additionally, scientist affiliation to a recognised institution is often more relevant than residency criteria with regard to individual grant portability.

Gender equality and gender mainstreaming in research: Although more than half of all university graduates and nearly 42% of all PhDs are women, their level of participation in research careers is among the lowest in the EU. This is especially the case in the business enterprise sector but also in higher education. The representation of women in leading positions is also very low. Here the "leaky pipeline" phenomenon is blatantly visible. Austria has one of the thickest "glass ceilings" in the EU, although a look at other economic or societal sectors reveals that it is not restricted to careers in R&D.[78] Although the law prescribes that maternity leave must not be a discriminating factor in Austria, statistics also reveal that children are a risk for careers[79]. The long grace period for maternity leave and the lack of nursery schools and kindergartens in Austria have led to a gradual retreat of women with young children from the labour market. A voluntary long maternity leave is also supposed to lead to de-qualification and leads to lower scientific output in any case. The law stipulates that women have the right to return to an equal (not necessarily the same) position to the one held before their maternity leave. There are some other precautions deemed to be advantageous for reconciling work and family life (but not necessarily for career advancement), such as that women are for instance legally entitled to have a part-time position when they end their maternity leave. Pregnancies also automatically freeze temporary contracts in Austria unless there are legal reasons or unless this is duly justified.[80] Austria has put various measures in place to increase the rate of women in science and industry. In the Universities Act a women quota in university committees of 40% is stipulated. This entered into force on 1 October 2009. Activities encompass a variety of measures, such as human resource development measures, recruiting of female scientific personnel, and implementation of gender monitoring and gender budgeting. A number of instruments have also been launched under the umbrella of the inter-ministerial action programme "fForte" ("Women in Research and Technology"), to counteract the low rate of women in R&D.

Optimal circulation, access to and transfer of scientific knowledge including via digital ERA: As regards knowledge transfer, knowledge sharing and open access as key ERA dimensions are well established in Austria. Regarding open access, all major research funders are signatories of the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities (2007). In 2012, similarly, the "Open Access Network Austria" was founded as a joint activity under the organisational umbrella of the Austrian Science Fund (FWF) and The Austrian Rectors' Conference (UNIKO) which coordinates open access activities and develops nation-wide recommendations for research institutions, funding organisations and research policy. Like the majority of EU countries, Austria addresses knowledge transfer through overarching laws on the research system, obliging both research funders and public research organisations to play a full role in supporting national innovation and competitiveness (ERALAW 2011). Researchers from public organisations are entitled to patent their inventions, provided that their employer is not willing to file the patent application themselves. Austria has special regulations, based on soft law, that guide research funding organisations when supporting academic spin-offs agglomerated in special centres ("AplusB" Centres). These guidelines offer advice on a variety of relevant areas, including management, eligibility, and funding for such activities (ERALAW 2011).

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[78] Cf. Tiefenthaler (2009), Schuch (2011).

[79] Cf. Lind and Banavas (2008).

[80] Cf. Schuch (2011).

However, the Austrian funding portfolio is still too focussed on technological research and technology transfer, while only recently more emphasis has been directed towards non-technological innovations in manufacturing and in the service sector. Public sector innovation and social innovations are not tackled by the existing funding portfolio. Innovation procurement is still at a pilot stage (pre-commercial procurement in the field of mobility).

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7 List of Abbreviations

ABA	Austrian Business Agency
ACR	Austrian Cooperative Research
AIT	Austrian Institute of Technology
AQA	Austrian Agency for Quality Assurance
ASO	Austrian Science and Research Liaison Offices
AVCO	Austrian Venture Capital Organisation
AWS	Austria Business Service
BBMRI	Biobanking and Biomolecular Resources Research Infrastructure
BERD	Business Expenditure for Research and Development
BES	Business Enterprise Sector
BMBWK	Former Austrian Federal Ministry of Education, Science and Culture
BMLFUW	Austrian Federal Ministry for Agriculture, Forestry, Environment and Water Management
BMUKK	Austrian Federal Ministry for Education, Arts and Culture
BMVIT	Austrian Federal Ministry of Transport, Innovation and Technology
BMWF	Austrian Federal Ministry of Science and Research
BMWFJ	Austrian Federal Ministry of Economy, Family and Youth
BRIC	Brazil, Russia, India, China
B-VG	Austrian Federal Constitution Act
CDG	Christian Doppler Research Society
CEE	Central and Eastern Europe
CENTROPE	Central European Region Platform
CERN	European Organisation for Nuclear Research
CESSDA	Council of European Social Science Data Archives
CIR-CE	Cooperation in Innovation and Research with Central and Eastern Europe Programme
CISM	Centre International des Sciences Mécaniques
CLARIN	Common Language Resources and Technology Infrastructure
COIN	Cooperation and Innovation Programme
COMET	Competence Centres for Excellent Technologies
COST	European Cooperation in Science and Technology
D-A-CH	Germany, Austria and Switzerland
DFG	German Research Foundation ("Deutsche Forschungsgemeinschaft")
ECRIN	European Clinical Research Infrastructure Network
ELETTRA	International multidisciplinary laboratory specialised in synchrotron radiation
EMBO	European Molecular Biology Organisation
EMRP	European Metrology Research and Development Programme
ENIAC	European Nanoelectronics Initiative Advisory Council
ENIC	European Network of Information Centres
ENQA	European Association for Quality Assurance in Higher Education
EPO	European Patent Office
ERA	European Research Area
ERA-NET	European Research Area Network

ERDF	European Regional Development Fund
ERP Fund	European Recovery Programme Fund
ESA	European Space Agency
ESF	European Science Foundation
ESFRI	European Strategy Forum on Research Infrastructures
ESRF	European Synchrotron Radiation Facility
EU	European Union
EU	European Union
EU-27	European Union including 27 Member States
EU-27	European Union including the 27 member states
EUROCORES	European Collaborative Research Programmes
FAFB	Food, Agriculture, Fisheries and Biotechnology
FAIR	Facility for Antiproton and Ion Research
FDI	Foreign Direct Investments
FEMTECH / FFORTE	Women in Research and Technology Programme
FFG	Austrian Research Promotion Agency
FP	European Framework Programme for Research and Technology Development
FP	Framework Programme
FP7	7th Framework Programme
FTE	Full-time Equivalent
FWF	Austrian Science Fund
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GOVERD	Government Intramural Expenditure on R&D
GUF	General University Funds
HEI	Higher Education Institutions
HERD	Higher Education Expenditure on R&D
HES	Higher Education Sector
HRST	Human Resources in Science and Technology
ICT	Information and Communication Technologies
IHS	Institute of Advanced Studies
IIASA	Institute for Applied Systems Analysis
ILL	Institut Laue-Langevin
INQAAHE	International Network for Quality Assurance in Agencies
IP	Intellectual Property
IPR	Intellectual Property Rights
ISCED	International Standard Classification of Education
ISTA	Institute of Science and Technology Austria
ISTC	International Science and Technology Centre
IUS	Innovation Union Scoreboard
JITU	Young, Innovation and Technology Oriented Companies Programme
JTI	Joint Technology Initiative
KORANET	Korean Scientific Cooperation with the European Research Area

MINT	Mathematics, Informatics, Natural Sciences and Technology (initiative to promote the enrolment of students in these subjects)
MORE	Mobility of Researchers
NARIC	National Academic Recognition Information Centres
NMP	Nanosciences, Nanotechnologies, Materials and New Production Technologies
NOW	Netherlands Organisation for Scientific Research
ÖAW	Austrian Academy of Sciences
OeAD	Austrian Agency for International Cooperation in Education and Research
OECD	Organisation for Economic Co-operation and Development
ÖH	Austrian student representatives ("Österreichische HochschülerInnenschaft ")
PhD	philosophiae doctor
PISA	Programme for International Student Assessment
PPP	Public-private Partnership
PRACE	Partnership for Advance Computing in Europe
PRO	Public Research Organisations
R&D	Research and Development
RI	Research Infrastructures
RTDI	Research, Technological Development and Innovation
S&E	Science and Engineering
S&T	Science and Technology
SF	Structural Funds
SHARE	Survey of Health, Ageing and Retirement in Europe
SME	Small and Medium Sized Enterprise
SNF	Swiss National Science Foundation
STCU	Science and Technology Centre Ukraine
STE	Science, Technology and Engineering
TC	TrendChart
UNIKO	Assembly of Universities ("Universitätenkonferenz")
VC	Venture Capital
VCI	Venture Capital Investment
VTÖ	Austrian Association of Technology Centres
WIFO	Austrian Institute of Economic Research
WMO	World Meteorological Organisation
ZSI	Centre for Social Innovation

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Abstract
This analytical country report is one of a series of annual ERAWATCH reports produced for EU Member States and Countries Associated to the Seventh Framework Programme for Research of the European Union (FP7). The main objective of the ERAWATCH Annual Country Reports is to characterise and assess the performance of national research systems and related policies in a structured manner that is comparable across countries.
The Country Report 2012 builds on and updates the 2011 edition. The report identifies the structural challenges of the national research and innovation system and assesses the match between the national priorities and the structural challenges, highlighting the latest developments, their dynamics and impact in the overall national context. They further analyse and assess the ability of the policy mix in place to consistently and efficiently tackle these challenges. These reports were originally produced in December 2012, focusing on policy developments over the previous twelve months.
The reports were produced by independent experts under direct contract with IPTS. The analytical framework and the structure of the reports have been developed by the Institute for Prospective Technological Studies of the Joint Research Centre (JRC-IPTS) and Directorate General for Research and Innovation with contributions from external experts.

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As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new standards, methods and tools, and sharing and transferring its know-how to the Member States and international community.

Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security including nuclear; all supported through a cross-cutting and multi-disciplinary approach.

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