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JOANNEUM RESEARCH

The Role of Special Funds in Catching-up R&D Strategies

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Study by the Austrian Institute of Economic Research and Joanneum Research commissioned by the Austrian Council for Research and Technology Development

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1. Introduction

The Lisbon strategy has highlighted the intention of the European Union to emphasize research and development as a key driver of economic growth. The ambitious European goal of 3% R&D expenditures per GDP in 2010 requests all member states to develop strategies to increase national spending on R&D. In many European countries – but also on a worldwide scale - science and technology policy has received increasing attention even before the European Union published its ambitious strategy. The European target thus reinforces strategies which were already identified by national policy makers as an important building block for economic development.

The starting position of the European member states could not be more diverse: on the one hand side are the Scandinavian countries (most notably Finland and Sweden) which already surpass the Lisbon target. On the other hand side are Southern European countries which are well below the European average in R&D spending and which have a substantial weight in the calculation of the average European R&D intensity. In between falls the remainder of countries. Most worrying in the European case is the absence of large member countries which would pull ahead and stimulate other member countries. Germany and France are troubled by the restrictions set out in the stability pact and have not shown tendencies to dynamically increase their R&D spending. Except the remarks on the stability pact the same applies to the UK.

Given the fact that most European countries are still far away from the Lisbon target the answer to the question on how to raise R&D spending in a relatively short period of time is all but obvious. Even when the institutional factors, economic structures etc. do not enter the equation, general guidelines which hold for all countries are difficult to define. This was the starting point for this project: by identifying countries with dynamic developments of their R&D spending and consequently analyzing their strategy some general lesson for Science and Technology policy in Austria should be developed. The study is organized as follows:

In the second section (written by Joanneum Research) recent development in R&D spending among OECD countries are reviewed. Based on this survey countries with dynamic spending patterns were identified and more thoroughly analyzed in section 3. The actual level of R&D spending is also the starting point for a scenario which calculates a deterministic path to the Lisbon goal for all European Member states.

In section 3 the WIFO-team analyses the main drivers of business R&D spending as the success of catching up strategies is determined in the business sectors. This section is introduced by an overview of main policy tools and their impact on R&D spending. This is followed by an econometric panel model which estimates the impact of different support channels on R&D spending. This model is then used to simulate the impact of the Austrian special funds for R&D. Furthermore a spending scenario for Austria to achieve the Lisbon goals based on the model is calculated.

Section 4 presents catching-up strategies for six countries. The emphasis is on describing policy actions (funding, strategies, measures, evaluation and impact) and the resulting impact on RD& spending. The main text contains brief summaries of the developments in these countries. More detailed country studies can be found in the annex.

The project was jointly elaborated by Joanneum Research (JR) and WIFO. JR analysed the major developments in R&D spending and calculated the scenario for the achievement of the Lisbon target (section 2). WIFO was responsible project management and for the analysis of main drivers of R&D expenditure (section 3). The case studies for Hungary, Ireland and the Netherlands were elaborated by JR, those for Canada, Finland and Iceland by WIFO. The interim report in the Annex was prepared by JR.

2. Development of R&D Expenditures in the European Union

2.1 Expenditure Trends

The overall trend of R&D expenditures at EU-level in the 90ies shows a stagnant, yet even declining (in the first half of the 90ies) pattern. However this overall trend masks quite divergent patterns at the level of individual countries. Since the huge bulk of R&D expenditures is concentrated on the three biggest EU member states (namely Germany, France and UK which together account for roughly two thirds of total R&D expenditures of the EU-15) the overall pattern is determined by the development of these three countries. All these countries experienced declining R&D quotas (% of GDP) during the nineties (or at least, in certain significant sub-periods of this decade): Germany's R&D quota fell from about 2.7% of GDP (1990) to 2.5% in 2002 (the trough was about 2.3% in the mid 90ies); France moved from slightly above 2.3% to slightly above 2.2% and UK fell from 2.2% to slightly below 2.0%.

However, to understand the complexity of the European development of R&D expenditures, it is necessary to grasp the quite divergent patterns which are to be found at the level of individual member states:

First, huge disparities in the relative level of resources devoted to R&D still exists within the EU-15 (and this degree of disparity is now much more pronounced within the EU-25). The minimum is marked by countries with a R&D quota of about 0.7% (e.g. Greece, Portugal, Poland), whereas the maximum is well above the principle aim of 3% (Sweden 4.3%, Finland 3.4%).

These huge disparities concerning the level of R&D are accompanied by huge disparities in the growth rates of R&D expenditures. During the last decade two countries (Sweden and Finland) experienced rather dramatic growth rates. Sweden increased her R&D quota from 2.5% (1990) to the mentioned record high of 4.3% in 2002 and Finland from ca. 1.9% in 1990 (then well below the EU-15 average) to its recent point of 3.4% in 2002. Since Sweden was at the top already in 1990 (albeit only by a small margin) her development throughout the 90ies may be characterised as forging ahead, whereas Finland started below the EU average. Hence Finland may best be characterized as first catching up (80ies), then overhauling (early 90ies) and last forging ahead (late 90ies up to the present date)

Beside these two examples of rapid increase in R&D expenditures growth rates of R&D have been rather modest in most countries. At least three other countries (namely Denmark, Belgium and Austria) achieved continuous growth rates high during the 90ies first to catch up and then to overhaul (at least slightly) the EU average. Although these countries had been below-average R&D intensities their level of GDP/capita was above the average. So to some extent, their R&D intensity “lagged behind” their overall “state of development”, so their convergence process concerning R&D may not be surprising.

The southern member states of the EU-15 (with the addition of Ireland) experienced traditionally low R&D intensity (the R&D quotas in 1990 vary between below 0.5% for Green up to about 1.3% for Italy). The record for these countries is rather mixed. Up to the middle of the 90ies these countries suffered from stagnant R&D growth rates (R&D quotas) or even experienced a decline (Italy fell from 1.3% to 1% in 1995). Since then their R&D intensities show signs of a continuous rise, albeit at a very modest pace, with R&D quotas recently in the range of 0.6% (Greece) to 1.1% (Italy).

The accession of the new member states emphasises the pattern of the uneven landscape within Europe. All new member states do have below-average R&D intensities. Slovenia and the Czech Republic are on the top of the new member states concerning R&D intensities with R&D quotas of 1.3% (Czech Republic) and 1.6% (Slovenia). The other countries are in the range of the “old” Southern member states like Greece, Portugal and Spain with R&D quotas of 0.4% (Latvia) and 1.0% (Hungary). Despite their rather divergent level of R&D intensity these countries share the common experience of a rapid structural transformation of their respective national innovation system due to their general political-economical transformation throughout the late 80ies/90ies. Interestingly, the initial phase of transformation, namely the phase of down-scaling seems to be passed through in those countries, since after the rapid decline of R&D intensities came to halt in those countries in the second half of the 90ies. Since then, these countries experienced moderate growth or at least stagnant growth concerning their R&D quotas. Nevertheless, their growth rates are below the necessary rates to catch up with the (currently stagnant) EU-average.

Thus, given the trends of the 90ies and early 00s the great European divide concerning R&D patterns will be sustained for decades to come.

The aggregate development of the R&D expenditures masks the shifting contribution of the main financing contributors to these overall R&D expenditures, namely the public sector on the one hand, and the private business sector on the other hand. Today, the private business sector accounts for the major bulk of R&D expenditures. This is especially pronounced in those states which have the highest R&D intensity, as in Sweden and Finland: about 70% of GERD is financed by the private business sector in those countries. On the contrary, countries with low R&D intensities do have typically a significant smaller share of private business financed R&D (e.g. only about 30% in Portugal). Austria's position is between those extremes (share of business financed R&D of 40%). However, this figure masks the fact, that a considerable amount of Austria's GERD (namely 20%) is financed by abroad. These funds mainly stem from the foreign private business sector and flow to Austria to finance the R&D activities of Austrian subsidiaries of multinational firms.

Throughout the European Union there is a general trend of a disproportional fast growth rate of private financed R&D expenditures (in relation to public funded R&D) leading to these ever increasing shares of private funded R&D of GERD as mentioned above. Indeed, the main part of the growth of R&D expenditures stems from R&D financed by the private business sector. This holds especially true in Sweden and Finland, where the growth of private R&D outpaced public funded R&D to a huge extent. To sum up, a significant increase of the R&D intensity was only possible in those countries which experienced dynamic growth of private financed R&D.

2.2 Achieving the Barcelona Goal in the year 2010: some basic scenarios

To assess the path to achieve the Barcelona Goal of a R&D quota of a GERD of 3% of GDP a simple basic scenario has been calculated. Following information can be obtained from these scenario calculations:

(a) Necessary annual growth rate for R&D to achieve the Barcelona goal of 3.0% in 2010

(b) Amount of additional funding (in absolute terms) required to achieve the Barcelona goal (annual, cumulative)

The data sources and premises for the scenario calculations are as following:

- OECD-Main Science and Technology Indicators (R&D figures, structure of R&D expenditures)
- Annual nominal GDP growth between 2000 and 2010 of 4%
- In general the year 2010 is defined as year of achievement. If a country has an alternative goal (R&D quota, year of achievement) this country-specific goal is used for the scenario calculations. Such country-specific goals are to be found especially among the new member states.
- Assumption of a constant annual growth rate of R&D expenditures. Thus the necessary R&D growth rate is defined as following:

$$GR = \left(\sqrt[8]{\frac{R\,\&\,D_{2010}}{R\,\&\,D_{2002}}} - 1 \right) \cdot 100$$

- Assumption of a constant financing structure of GERD.

The results of the calculations are given in Figure 1 and Figure 2 (see Table 1 for the numerical figures). Concerning the status-quo the differences in R&D intensity are significant. Currently, two countries (Finland and Sweden) are already above the Barcelona target of 3.0% R&D expenditures on GDP. Both countries have been experiencing strong and sustained growth rates of R&D throughout the 90ies (and Sweden was, traditionally, a high R&D intensity country). Therefore for those countries the EU Barcelona target does not apply, Finland has set her own target of 3.5% (2010) whereas Sweden just declares to sustain her already achieved high R&D intensity around the level of 3.0%. Also, Finland and Sweden had been a notable exception with regard of the trend of the development of their R&D intensity throughout the 90ies. Most other countries (especially the bigger EU member states like Germany, UK and France) actually experienced a decline of their R&D intensity at least in some periods of the 90ies.

However, some smaller countries (notably Belgium, Austria and – at least in the first halt of the nineties - Ireland) were able to achieve a pronounced increase of their R&D intensity. Belgium and Austria converged to the EU-15 average in 1996 and 1998, respectively and are even bypassing the EU average since then. The southern member states of the EU are still lacking behind with regard of their R&D intensity. Nevertheless, they were able to achieve a – at least to a certain degree - catching up process.

Obviously, the new EU member states do play a special role, since (with the exception of Cyprus and Malta) they experienced a fundamental transformation in their economic, and hence their innovation system throughout the 90ies. The nature of this profound structural transformation process is often characterized as an idealized „3-phase-model" characterised as follows:

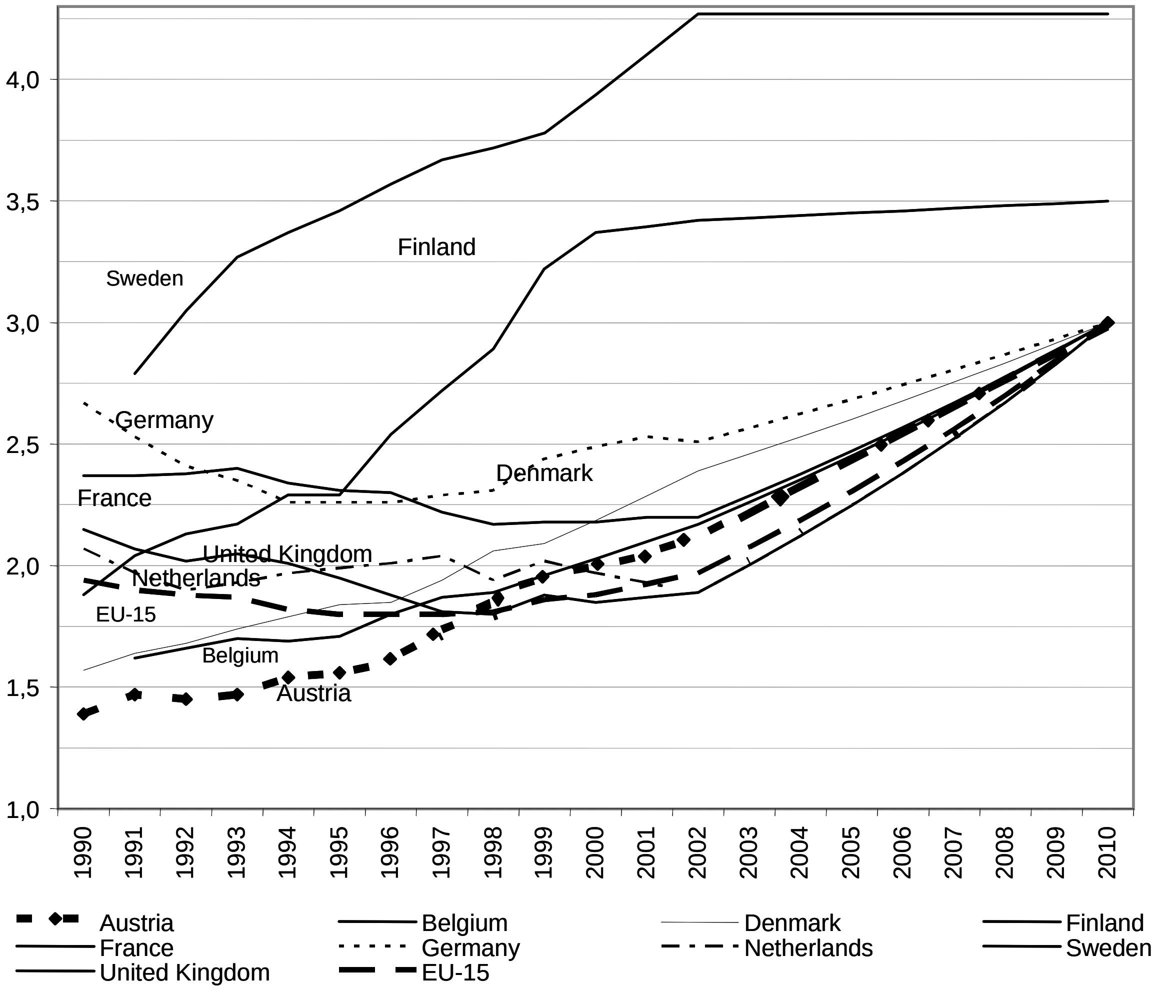
- Phase 1: Abandoning/De-scaling of the former centrally-planned institutions of research and technological development and a de-coupling of the R&D system from the economic system associated with a sharp decline in indicators measuring the quantity of inputs (R&D expenditures, R&D employment, both public as well as business R&D).
- Phase 2: Consolidation and founding of new (often scattered) institutions. The R&D system in this stage is characterized as very uneven with the potential danger to degenerate into a somewhat "divided" economic system as a whole: Some (mainly foreign-owned) modern business sectors (based upon inflow of FDI) but with very weak linkages to the regional environment (weak embeddedness) are confronted with a huge bulk of local indigenous industries with no or low R&D activities and hence low absorptive technological capabilities.
- Phase 3: Re-Integration of institutions into new national innovation system paralleled with a (Re-)Internationalisation under different premises and – eventually - technological catching-up.

As Figure 2 shows there has been indeed a somewhat u-shaped development of R&D intensity in the new EU member states. It appears that the trough has been around the mid to late nineties. Since then, the R&D intensity has been stabilized and in some countries there are signals for a new and sustained growth of R&D intensity (albeit at a very modest pace).

Concerning the necessary development to achieve the afore mentioned aim of 3% R&D of GDP following conclusions can bee derived:

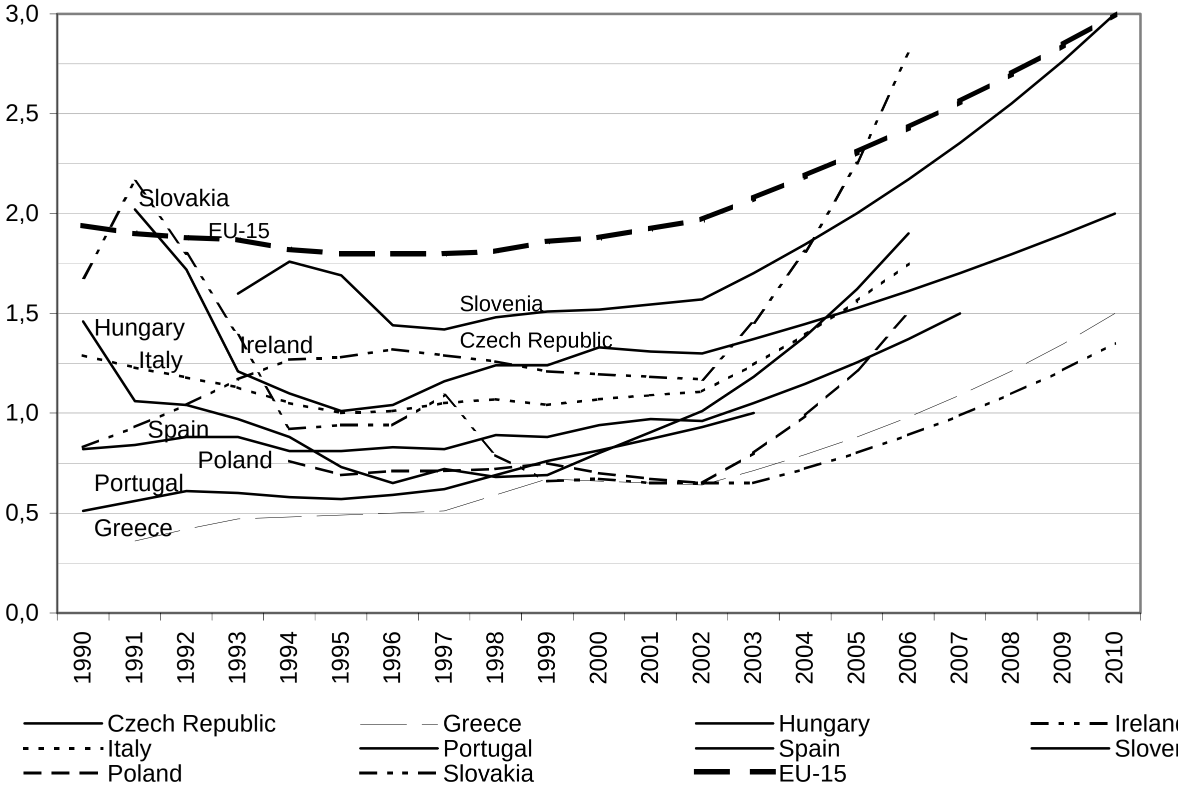
- At the EU level a significant change in the trend would be required to achieve the Barcelona goal. This holds true especially for the big countries which dominate the EU R&D expenditures in absolute terms (and hence do have the greatest statistical weight in calculating the EU averages). The necessary annual growth rates of R&D expenditures for those countries would be between 8% (France) and 10% (UK).
- For those “old” EU member states with traditionally low R&D intensities (Italy, Spain, Portugal, Greece) the 3% goal seems to be over-ambitious. Indeed, some of these countries do have individual goals which are significant below the EU-wide 3% goal.
- Some smaller countries (Denmark, Belgium, Austria) seem to be on the track to achieve the 3% goal at least approximately given a sustained continuation of their recent growth path of R&D expenditures.
- The new CEEC member states are still in the transformation process of their RTD system. Although their R&D expenditures are increasing recently the gap is still too far to achieve the 3% goal in a foreseeable future. Thus, sustaining their first signs of increasing R&D expenditures should be the main goal for those countries and should have priority over setting a too-far-away quantitative goal.

Figure 1: R&D intensity in EU member states: trend and scenario



Source: OECD; Statistik Austria; own calculations

Figure 2: R&D intensity in EU member states: trend and scenario



Source: OECD; own calculations

Table 1: Key figures of R&D scenarios

Country	R&D 2002 Mio US$	R&D Quota 2002	Target Year	R&D Target %	Annual Growth Rate %	R&D Target Year
Austria	5115,61	2,19	2010	3,00	8,90	8536,16,68
Belgium	5373,66	2,17	2010	3,00	8,30	10167,14
Czech Republic	904,68	1,30	2010	2,00	9,75	1904,79
Denmark	4177,67	2,39	2010	3,00	7,00	7176,69
Finland	4473,27	3,42	2010	3,50	4,30	6265,18
France	31011,29	2,20	2010	3,00	8,11	57874,21
Germany	49603,62	2,51	2010	3,00	6,34	81138,63
Greece	850,14	0,64	2010	1,50	15,68	2726,89
Hungary	665,01	1,01	2006	1,90	21,80	1463,51

Ireland	1403,01	1,17	2006	2,80	29,35	3927,97
Italy	13108,22	1,11	2006	1,75	16,54	24176,43
Netherlands	7819,71	1,89	2010	3,00	10,18	16987,01
Portugal	1128,01	0,93	2003	1,00	11,83	1261,43
Spain	6238,00	0,96	2007	1,50	13,71	11858,56
Sweden	9811,25	4,27	2010	4,27	4,00	13427,37
United Kingdom	29341,06	1,89	(ns) 2010	3,00	10,18	63738,52
Slovenia	331,39	1,57	2010	3,00	12,77	866,62
Cyprus	24,65	0,27	2006	0,50	21,32	53,41
Estonia	50,66	0,79	2006	1,50	22,08	112,54
Latvia	36,98	0,44	2010	2,00	25,67	230,07
Poland	1219,92	0,65	2006	1,50	28,18	3293,39
Slovakia	154,05	0,65	(ns) 2010	1,50	15,46	273,77
Lithuania	92,44	0,67	2006	1,50	32,30	283,22
EU-15	169143,70	1,98	2010	3,00	9,62	352590,93

Source: OECD; Statistik Austria; own calculations

3. Drivers of R&D Expenditures

3.1 Government assistance and business sector R&D

The previous section has shown that the world's leading R&D countries, most notably Sweden and Finland, but also the U.S. are typically characterized by a very high share of the corporate sector in total R&D expenditures, while public R&D outlays account for only a minor fraction. This suggests that it is not public R&D outlays per se that drives the aggregate R&D-level or the R&D-quota, respectively, but its importance rather arises from providing the right stimuli for private sector R&D. With respect to a most effective and efficient allocation of government (special) funds it is therefore vital to identify the key drivers of the business sector's R&D engagement. Accordingly, this section identifies the main determinants of private sector R&D expenditures for a panel of some 20 OECD countries in the 1980-2002 period. Specifically, the aim is to evaluate the relative impact of direct, indirect as well as implicit government measures on the aggregate enterprise sector's R&D expenditures and then to derive guidelines on how to spend special funds for R&D most effectively and most efficiently. In the following some conceptual links between publicly financed R&D stimuli and private sector performance will be drawn and thereafter some empirical evidence will be presented.

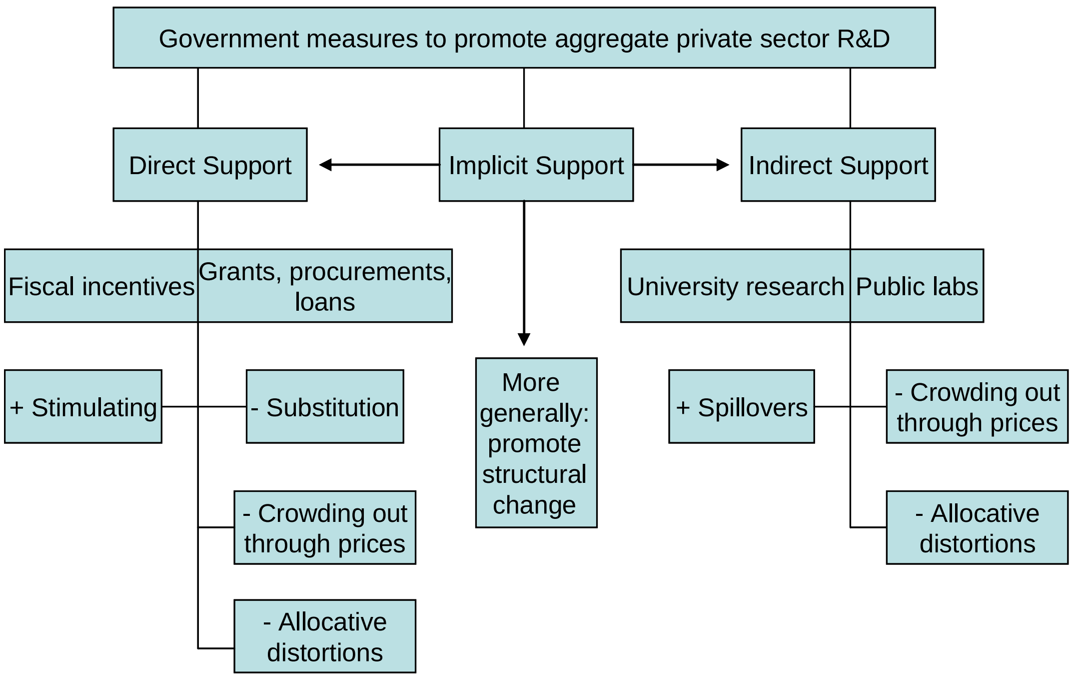
3.1.1 Main policy tools towards business R&D and their potential impact

A great number of factors potentially impact on the business sector's R&D intensity. Arguably, it is first and foremost the dynamics of output growth and the given industry structure that matter. If a country is specialised in industries typically characterised by a sound degree of R&D intensity, then aggregate business R&D intensity will generally be high as well. Accordingly, relevant government measures to stimulate R&D undertakings at the firm level would have to address the external environment under which firms are operating so that research pays. Relevant policies include for instance competition and (de)-regulation policies, as well as patent protection. In a more narrow sense the government provides for a research-prone, favourable business setting by funding universities as well as research performed in public laboratories. The rationale is that scientific knowledge from academic research generates positive knowledge spillovers and thereby facilitates private business R&D and fosters productivity of the corporate world. Apart from those indirect measures, the government can also stimulate business R&D in a more direct way, either through fiscal incentives, or by means of direct financial support.

The empirical literature evaluating the net effects of such intervention is concerned with basically three sources of negative (side-)effects. First, studies on so-called "additionality" address the question in how far public R&D-assistance induces companies to spend more own *additional* resources on R&D than they would have spent anyway. If private funds are only substituted by public funds, then the net impact is arguably low (if not zero). Likewise, indirect support through the promotion of R&D performed by universities and government research institutions may substitute for R&D projects which otherwise would have been undertaken by the corporate world. If private firms undertake less R&D because they cannot successfully compete against government funded research then allocative distortions are said to prevail.

Another potential source of crowding out arises if there is a shortage in the most decisive factor of the R&D process, viz. if high-skilled labour is scarce. Rising demand for high-skilled human resources by universities and government research organizations reduces the availability of the same for private sector usage. In this case R&D subsidies could drive up the wages of scientists and engineers enough to prevent significant increases in real R&D. For the United States Goolsbee (1998) finds that increases in funding for public R&D significantly raise the wages of scientists and engineers so that eventually part of the gross R&D volume increase is explained by an increase in its unit price (crowding out through prices). Figure 3 illustrates various types of public intervention and their potential impact on business R&D. Whether the positive stimulation and spillover effects dominate the negative effects discussed above is ultimately an empirical question which will be examined below.

Figure 3: Main Policy tools towards business R&D and their potential impact



Source: adapted from van Pottelsberghe et al. (2003)

3.1.2 A brief literature survey

Much empirical work has been undertaken to evaluate the effectiveness of government intervention. In this context the concept of input additionality addresses the question in how far direct R&D subsidies induces business companies to spend more own additional resources on R&D than they would have spent anyway- and if so, whether private R&D expenses exceed the amount of taxpayers' money which was used in this way. If such was the case the relationship between public R&D assistance and business R&D is said to be complementary in nature and if the reverse holds true and public money is in fact crowding out privately financed R&D activities, then the relationship is said to be substitutive. The standard econometric approach to input additionality is to regress measures of private R&D-resources (mostly expenditures, but also scientific labour input) on public assistance controlling for other variables that influence private R&D expenditures (depending on the level of aggregation) of either firms, sectors or countries, respectively. David et al. (2000) and more recently Garcia-Quevedo (2004) survey the empirical literature. A simple vote-counting of the obtained results is listed in Table 2 and suggests the good news that crowding-out effects are rather the exception than the rule.

Table 2: Relationship between public and private R&D expenditure: Summary of the econometric evidence

	Number of studies reporting			
Level of disaggregation	Complementarity	Inignificance	Substitutability	Total no. of studies
firm	17	10	11	38
industry	8	3	1	12
country	13	6	5	24
Total	38	19	17	74

Source: taken from Garcia-Quevedo (2004)

In view of the scarcity of public funds public R&D assistance is to be allocated according to the principle of greatest leverage. Hence, applied work that aims to identify the most effective policy tools is of special interest.

A highly acknowledged paper done by Guellec and van Pottelsberghe (2003) estimates the impact of various public sector intervention measures as outlined in Figure 3 on R&D expenditures of the business sector. To be specific, the demand for total business sector R&D expenditures (BERD) as a percentage of GDP is modelled by the following regression equation:

$$\ln\left(\frac{BERD_{it}}{GDP_{it}}\right) = ß_i + ß_1 \ln\left(\frac{SUB_{it}}{GDP_{it}}\right) + ß_2 \ln(BINDEX_{it}) + ß_3 \ln\left(\frac{HERD_{it}}{GDP_{it}}\right) + ß_4 \ln\left(\frac{GOVERD_{it}}{GDP_{it}}\right)$$
$$+ ß_5 \ln\left(\frac{GDP(PPP\$)_{it}}{L_{it}}\right) + ß_6 time + u_{it}.$$

Direct support may be provided either in kind of a generous tax treatment of R&D, or in kind of direct grants and (subsidized) loans. The latter is captured by SUB_{it} / GDP_{it}, government financed R&D expenditures in the business sector as a percentage of GDP.

The stimulating effect of fiscal incentives on the corporate sector's R&D performance is evaluated by including Warda's B-index (Warda, 1996). The value of the B-index depends on a country's income tax treatment of R&D. The more favourable the tax treatment of R&D, the lower is a country's B-index. Technically speaking, the B-index is calculated by dividing the after-tax cost (ATC) of a $1 expenditure on R&D by 1 less the corporate income tax rate t,

B = ATC/(1-t), where t = corporate income tax rate.

With respect to the more indirect public support measures $GOVERD_{it}/GDP_{it}$ gives the ratio of intramural government sector R&D expenditures to GDP[1] and $HERD_{it}/GDP_{it}$ denotes the ratio of R&D expenditures within the higher education sector to GDP. Authors such and Lederman and Maloney (2003) have shown that the quality of academic research institutions and collaboration between enterprises and universities are of eminent importance for increasing R&D activities of the corporate world. Last, since any input factor demand ultimately depends on output, Guellec and Van Pottelsberghe eventually include GDP per capita in constant PPP-$ as a regressor. They run the above regression on a panel of 17 OECD-countries for the 1983-1996 period.

3.1.3 Methodical approach of this study and main hypotheses

To derive international evidence on the role of various government assistance measures on business sector R&D, *and* to evaluate the net effect of Austria's latest special fund initiative in particular, the Guellec/van Pottelsberghe-approach is adjusted as follows: first (trivially), Austria needs to be included in the country sample. The chief data source for international studies on science and technology

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[1] The somewhat cumbersome concept of government intramural expenditure on R&D captures research activities undertaken in institutions that do not purvey higher education and do not sell their output at an economical price. Instead, these institutions are generally controlled and mainly financed by the government, where control is the ability to determine the institution's general policy or programme by having the right to appoint its management. Even if the case of government control is not clear, such non-profit institutions are classified under GOVERD, if they are mainly financed by the government (see the Decision tree for sectoring R&D units in the OECD's Frascati Manual, OECD (2002), chapter 3, figure 3.1).

performance is the OECD's MSTI-database. However, until very recently Austria has reported respective figures only periodically to the OECD. For that reason the study of Guellec and Van Pottelsberghe excludes Austria. Contrary to the above study we therefore do not feed the model with annual data but use (five-year, and three year) averages. Though the rationale for doing so is first and foremost grounded in limited data availability, most notably with respect to Austria, one might also argue that the B-index displays little variation from year to year and that only a longer period interval is suitable to capture the effects of *changes* in the fiscal system. Anyway, this average approach leaves us with up to five data points for each country, viz. averages for the 1980-1984 period, for 1985-1989, 1990-1994, 1995-1999 and for 2000-2002. The average approach reduces the total number of valuable observations to a substantial degree. To end up with a sample of relevant size, a country would be included whenever the availability of respective data would allow for, i.e. no particular selection criteria apply. Furthermore, to not unnecessarily waste on the degrees of freedom, the impact of direct and indirect government intervention measures are assessed in two separate regressions. For the former a sample of 27 OECD countries applies.[2] In the dynamic specification Korea leaves the sample, as it is missing three consecutive years of observables for the left hand side variable. The impact analysis of direct public intervention measures is limited to the set of countries with ready for use data on the B-index. Here we lose the new EU member states Hungary, Poland, the Czech as well as the Slovak Republic. Again, in the dynamic specification Korea and likewise Greece are excluded for lack of data availability.

Except for these "technicalities" which by and large result from the inclusion of Austria, more importantly, the above model is extended to capture the link between industry structure and R&D. For obvious reasons BERD is expected to be the higher the greater the inherent R&D intensity of the industry structure. The point is not so much to verify a positive coefficient on the latter, but to control for the effects of a given R&D intensity when evaluating the impact of various public intervention

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[2] Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, United Kingdom, United States

measures. Specifically, the main research question is to asses the effectiveness of special fund initiatives given some industry structure that is fixed in the short run. The inherent R&D intensity of the industry structure is modelled by a country's share of high-tech manufacturing exports in total manufacturing exports. The former includes pharmaceuticals (ISIC Rev. 3 code is 2423), office, accounting and computing machinery (30), radio, television and communication equipment (32), aircraft and spacecraft (353) and medical, precision and optical instruments (33). These data are available from the OECD STAN database.[3]

To begin with we focus on the more indirect channels of public R&D assistance (i.e. on the right side of Figure 3) and address the impact of HERD and intramural GOVERD. Overall we expect the positive spillover effects to dominate the potentially negative impacts discussed above so that the net effect of public sector R&D on business sector R&D is positive. If, on the other hand, public sector R&D is generally crowding out private R&D, then the sign on both variables $HERD_{it} / GDP_{it}$ and $GOVERD_{it} / GDP_{it}$ will be negative.

Second, we investigate the impact of the direct support measures on business sector R&D. Again, the prime interest refers to the question of whether government funded R&D performed by the business sector is a complement (inducing) or a substitute (crowding out) for private R&D. If the marginal effect exceeds 1.0, then publicly funded R&D is a complement for private R&D. A marginal effect of exactly 1 point at a neutral effect and the substitution case would be indicated by effects of below 1. Furthermore, we aim to get some insight into the triggering role of tax credits. Decreases in the B-index mean that fiscal incentives for R&D have been increased, or equivalently, that the cost of R&D-activities at the enterprise level haven been fallen. Other things being equal, the lower the B-index, the greater the amount of R&D that will be undertaken by the corporate sector, the estimated coefficient is thus expected to display a negative sign.

[3] Attempts to capture the industry structure by employment figures or value added turned out unsuccessful. The reason is that in STAN many countries do not provide for sectoral data, but only turn in aggregate figures (total manufacturing, total services, gross total).

Originally, both specifications would also include slope dummies for Austria on SUB/GDP, BINDEX, HERD/GDP and GOVERD/GDP to allow the country of particular interest to deviate from the norm. Since the respective coefficients turned out insignificant without exception, they were eventually deleted in the final specification.

Evidence on the role of the more indirect support measures are estimated for an unbalanced panel of N = 27 OECD countries and T = 5 time intervals which results in 119 observations in total. As for the estimation approach first the fixed effects within estimator has been employed and second a dynamic panel data model is applied using a one-step GMM estimator in first differences. Results are displayed in Table 4. Table 5 gives inference on the R&D stimuli resulting from direct government intervention (the left side of Figure 3), i.e. from tax incentives and direct R&D subsidies. Since the B-index is unavailable for four countries, we are left with N=23 (21) OECD countries and 102 (73) observations in the static (dynamic) specification. Before proceeding to the empirical results, some summary statistics and descriptive evidence is presented in the next section.

3.1.4 Summary statistics and descriptive evidence

Table 3 displays mean figures on R&D expenditure items in selected sub-periods for Austria and (unweighted) averages of these for the total sample, respectively. The underlying data source is the OECD's MSTI-database in its most recent update. Austria's position in total R&D spending has significantly improved throughout the entire period. With an average annual percentage change of 2.54% its most recent GERD/GDP-ratio in fact outperforms the respective R&D-ratio of the total sample. R&D activities are primarily undertaken by one of the following three sectors: by the business enterprise sector, by the higher education sector (universities) and by government-run research institutions. Accordingly, the relevant measures are BERD (enterprise expenditures on R&D), HERD (higher education expenditure on R&D) and GOVERD (government expenditure on R&D), each of these expressed as a share in GDP.

Looking at gross R&D expenses by R&D-performing sectors it becomes evident that the bulk of R&D projects are increasingly undertaken in business firms. By 2000-2002 the respective shares come up to two-third, both in Austria and a tiny bit lower within the total sample. While in Austria government intramural R&D expenditures play only a minor and in fact a diminishing role, more than 30% of its gross domestic R&D expenditures are made up of HERD throughout the last two decades. The Austrian share of GOVERD in GERD is falling from about 9% to below 3% within the same time period. For the total sample, government expenditures on R&D are likewise falling, but the average annual percentage decrease turns out significantly lower with a mean value of -0.87% as compared to -2.98% for Austria. In the last interval the mean value of GOVERD in GDP still accounts for 13%.

Given the significance of business R&D as a key component in total R&D activities, it is worth asking about the trend in respective government support, including direct R&D subsidies, as well as fiscal incentives. Government financed BERD is generally very low, in 2000-2002 it amounted to only 0.07% (Austria) and 0.08% of GDP (total unweighted sample). Note that the respective ratios are converging throughout time, i.e. Austria has been increasing its direct R&D subsidies within the last two decades, while for the total sample the ratio of government funded BERD to GDP has constantly decreased during the same time span with an average annual percentage decline of 2.82%.

Table 3 shows that Austria's tax policies reward R&D performers relatively generously as compared to the OECD average.[4] In particular from 2000 onwards the business sector appreciates various kinds of tax incentives when undertaking research projects.

[4] Hall and Van Reenen (2000) present an overview of the tax treatment of R&D across 26 (mostly OECD) countries. For a more up-to-date survey for Austria, compare Hutschenreiter (2002).

Table 3: Evolution of R&D expenditure items and their key determinants

	1980-1984	1985-1989	1990-1994	1995-1999	2000-2002	Av. annual percentage change from mid 80-84 to mid 2000-2002 [a)]
	Gross expenditure on R&D (GERD) as a percentage of GDP					
Austria	1.18	1.30	1.46	1.70	1.90	2.54
Total[b)]	1.51	1.71	1.68	1.64	1.81	0.94
	Business enterprise expenditure on R&D (BERD) as a percentage of GDP					
Austria	0.65	0.74	0.82	1.13	1.31	3.80
Total[b)]	0.89	1.07	0.99	1.01	1.14	1.32
	Higher education expenditure on R&D (HERD) as a percentage of GDP					
Austria	0.37	0.44	0.51	0.53	0.63	2.82
Total[b)]	0.30	0.33	0.35	0.34	0.37	1.21
	Government expenditure on R&D (GOVERD) as a percentage of GDP					
Austria	0.10	0.10	0.13	0.11	0.06	-2.98
Total[b)]	0.27	0.27	0.27	0.25	0.23	-0.87
	Government financed BERD as a percentage of GDP					
Austria	0.05	0.05	0.08	0.06	0.07	2.47
Total[b)]	0.14	0.15	0.10	0.08	0.08	-2.82
	B-index (generosity of the tax system)					
Austria	0.95	0.99	0.94	0.91	0.83	-0.69
Total[c)]	0.98	0.96	0.97	0.95	0.93	-0.25
	Share of high-tech manufacturing exports in total manufacturing exports					
Austria	0.07	0.09	0.10	0.12	0.16	4.17
Total[b)]	0.12	0.13	0.15	0.18	0.20	3.02

a) period covers 19 years, i.e. from 1982 (= mid 1980-1984) to 2001 (= mid 2000-2002)

b) unweighted average, N = 27

c) unweighted average, N = 23, data is missing for Poland, Hungary, Czech and Slovak Republic

The 2004 tax reform provides for 3 different schemes that may be partially combined (see Heitzinger/Silber, 2003):

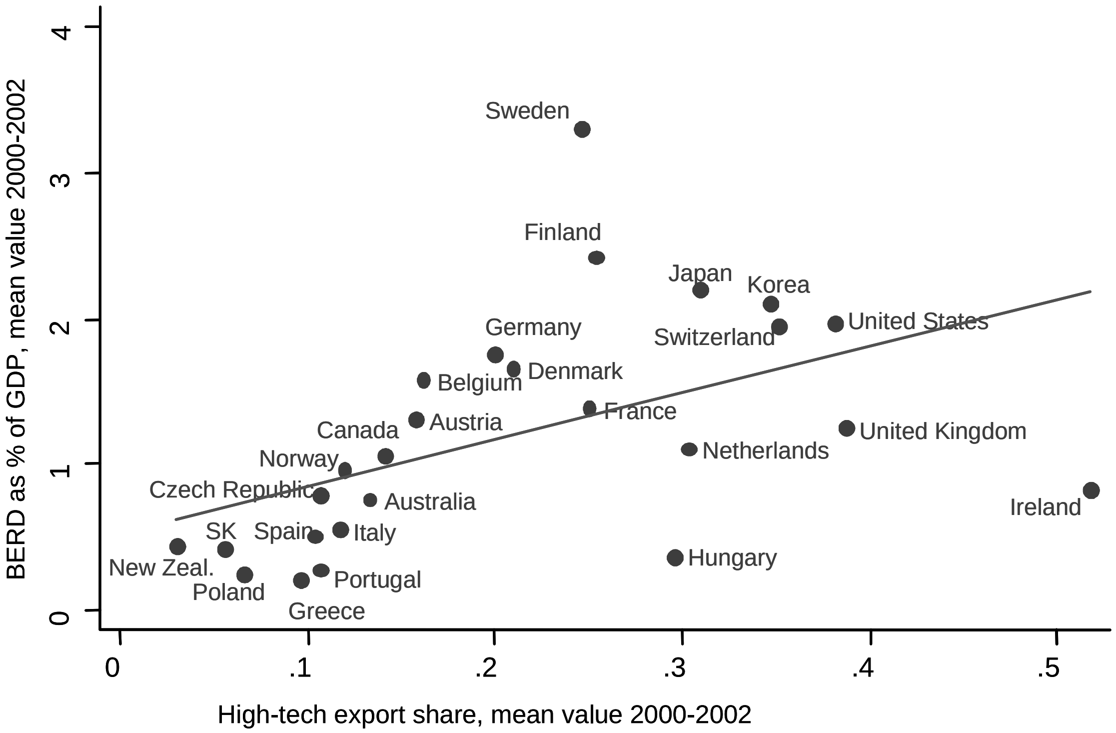
- Companies may deduct up to 25% (instead of up to 12% before 2000) of their R&D expenditures from their profit-before-tax statements, thus reducing the basis for taxation. The definition of R&D expenditure items follows the OECD Frascati Manual.

- Alternatively, a tax allowance is granted for "economic useful inventions", which allows for a broader recognition of respective expenditures. In this setting the tax allowance is again 25% of R&D expenditures and in addition expenditures exceeding the average annual level of the last three years are deductible with a rate of 35%.
- If firms are not profitable they can draw on an R&D premium of 8% of R&D spending as defined by the Frascati Manual. This R&D premium is the post tax equivalent of the 25% tax allowance and therefore cannot be applied simultaneously with scheme 1. A company may, however, combine schemes 2 and 3, e.g. if one project is profitable but the other is not.

Overall, Austria's position in respect of several direct and indirect public intervention measures in favour of corporate R&D performance seems quite promising.

A dampening effect is most likely to result from the given industry structure with an inherent R&D-intensity clearly below the sample average. Figure 4 below presents some bivariate evidence on the relationship between business sector R&D expenditures and industry structure, as measured by the share of high tech exports in total exports. Arguably, the positively sloped fit displays tautological evidence: by definition the manufacture of high tech products is R&D intensive. It is, however, interesting to look at the country-specific deviations from the fit and to relate these to the effectiveness of public R&D support schemes. The empirical section will shed some light on two competing hypotheses: either the business sector within countries "above the line" is particularly responsive to R&D stimuli. In this case a favourable industry structure works like a multiplier. On the other hand one could argue that if for a given industry structure the R&D intensity of the enterprise sector is already over-proportionally high, then more government support on behalf of R&D investments are expected to show only moderate effects. Results will be presented in the next section.

Figure 4: Correlation between business sector R&D expenditure and industry structure



Source: MSTI/OECD (2003), own calculations

3.1.5 Estimation results

From Table 4 unambiguous evidence emerges that both government and university R&D significantly contribute to the R&D intensity in the business sector. As expected we find a higher impact of HERD than for intramural government R&D which plays only a minor role. In fact, the coefficient on the latter turns out statistically insignificant in the dynamic specification which is the preferable one (highly significant lagged dependent variable). We find a long run elasticity of the business sector R&D intensity with respect to higher education R&D expenditures of 0.39. This means that a 10 percent increase in the HERD to GERD ratio is associated with a 3.9% increase in the ratio of BERD to GDP.

Most interestingly, GDP per capita in constant ppp-prices does not contribute anything to the explanation of BERD. Note that the static approach rendered ambiguous results on that issue (coefficient on GDP is significant only at the 10% level). What does drive business sector R&D to a considerable degree is the industry structure, instead. This result remains valid regardless of specification and estimation technique.

Table 4: Evaluating the impact of indirect public intervention measures on business sector R&D

	Fixed effects model (1)		Dynamic panel data model (2)		
	coeff.	t-value	Short-run coeff.	t-value	Implied long-run coff.
log BERD % GDP (t-1)			0.31	2.72	
log HERD % GDP (t)	0.32	3.32	0.27	2.19	0.39
log GOEVRD % GDP (t)	0.23	2.43	0.12	1.51	(0.18)
log GDP per capita (t)c	0.19	1.84	-0.14	-1.09	(-0.20)
log (hightech exp./tot.exp.)	0.38	3.98	0.21	2.06	0.31
period dummy 1985-1989	0.13	2.17			
period dummy 1990-1994	0.09	1.16	-0.26	-3.84	
period dummy 1995-1999	0.06	0.58	-0.10	-1.78	
period dummy 2000-2002	0.06	0.52	-0.10	-1.91	
Constant	0.63	2.17	0.15	3.13	
# of obs (countries)	119 (27)		82 (26)		
R^2 (within)	0.65		Partial adjustment coefficient: 0.69		

Notes: The dynamic panel data model is estimated using the one-step GMM estimator in first differences. Dependent Variable is log BERD % GDP (within-transformed or in first differences). Estimation period: 1985-2002 with three five year interval and one three year interval data.

With respect to the impact of the direct interventions we note that again GDP per capita contributes nothing to the explanation of the BERD-GDP ratio and the export share enters highly significant and positive regardless of specification. Table 5 shows that the lagged dependent variable is significantly positive and hence the discussion of the results relies on the dynamic panel data estimates. Furthermore we find that changes in fiscal incentives for R&D as measured by the B-index do significantly impact on the demand for R&D in the business sector. A long-run elasticity[5] of about

[5] Long-run effects are caluclated as the ratio between short-run effects (i.e. estimated beta-coefficients) and the partial adjustment coefficient. The partial adjustment coefficient is defined as (1 – coefficient on the lagged endogenous variable).

-1.61 indicates that a 1% reduction in the prices of R&D (increase in generosity of tax incentives for R&D) leads to a 1.61% increase in the amount of R&D in the long-run. This finding is consistent with former evidence on the, though arguably a bit on the high side. The European Commission (2003) in its recent report suggests a median price elasticity of -0.81. Guellec and Van Pottelsberghe (2003), however, find the long run elasticity of the B-index to be somewhat lower. Using OECD data for 17 countries they derive a coefficient of about -0.31. These results are consistent with the ones of Bloom et al. (2002) who followed a somewhat different route and captured the triggering effect of fiscal incentives by the tax component of the user cost of capital. Their estimates are based on data for nine OECD countries for the 1979-1994 period and proved to be highly significant in the expected way.

Finally the results show that government funded R&D in the business sector have a positive and significant impact on total business enterprise R&D. The elasticities range between 0.21 based on the fixed effects specification and 0.31 (calculated as 0.19/(1-0.39)) in the dynamic panel data setting. In order to test whether government funded R&D in the business sector is a complement or a substitute to private R&D in the business sector the estimated coefficients have been transformed into marginal effects. Recall that the dependent variable is *total* R&D expenditures in the business sector, i.e. government financed BERD is included. Hence, if the marginal effects associated with government R&D exceed unity, then a complementary relationship is prevailing. This is generally the case in the long-run perspective, a single exception being the United States throughout the 1980s when government financed BERD was crowding out the enterprise sector's own outlays on R&D. For the 1980s short-term marginal effect are below unity in France, Norway, the UK and, obviously, in the US (untabled results).

Table 5: Evaluating the impact of direct public intervention measures on business sector R&D

	Fixed effects model		dynamic panel data model		
	coeff.	t-value	Short-run coeff.	t-value	Implied long-run coeff.
log BERD % GDP (t-1)			0.39	4.15	
log government funded BERD % GDP (t)	0.21	4.85	0.19	4.91	0.31
log B-index (t)	-0.81	-3.11	-0.98	-4.78	-1.61
log GDP per capita (t)c	0.14	1.07	0.00	0.03	(0.01)
log (high-tech exp./tot.exp.)	0.41	4.53	0.22	2.30	0.36
period dummy 1985-1989	0.09	1.70			
period dummy 1990-1994	0.10	1.83	-0.13	-2.13	
period dummy 1995-1999	0.11	1.49	-0.06	-1.29	
period dummy 2000-2002	0.14	1.66	-0.05	-0.96	
constant	0.70	1.71	0.09	2.08	
# of obs (countries)	102 (23)		73 (21)		
R^2 (within)	0.76		Partial adjustment coefficient: 0.61		

Notes: The dynamic panel data model is estimated using the one-step GMM estimator in first differences. Dependent Variable is log BERD % GDP (within-transformed or in first differences). The partial adjustment coefficient is given by 1-0.39. Estimation period: 1985-2002 with three five year interval and one three year interval data.

3.1.6 Summary and Conclusions

The empirical results of this section have widely demonstrated that both, direct support in kind of fiscal incentives and government grants, as well as indirect support in kind of higher education R&D expenditures are effective in raising aggregate R&D expenditures of the enterprise sector. The hypothesized positive effect of government intramural R&D expenditures, however, is only verified within a static estimation framework. In light of this component's moderate and in fact diminishing contribution to gross national R&D expenditures, this result does not seem too surprising. Second, the results unambiguously suggest that the demand for total business sector R&D is not so much driven by a country's aggregate economic performance as reflected by its GDP-figure, but that above all an R&D-intensive industry structure is crucial. Moreover, we found public support measures to work increasingly effective the more favourable a country's industry structure.

Several empirical studies on innovation activities have pointed at the rather low share of high-tech industries in Austrian value added or employment (Peneder et al. 2001, Österreichischer Forschungs- und Technologiebericht, 2003). Irrespective of this technology gap it remains true that by international comparison aggregate trends in Austrian employment, growth, or national income have not evolved below average within the last three decades. Strangely enough, Austria even succeeded to increase its share in EU value added ("the Austrian paradox"). As Peneder notes, the technology gap is still to be taken seriously, because structural deficits in kind of little specialization in dynamic, technology-intensive sectors will dampen the long run perspectives of economic growth.[6] At this point we add that an unfavourable industry structure does not only hamper long-term growth, but that the realization of intermediate aims such as an R&D quota of 3% by 2010 is challenged as well. The special funds could unfold much greater positive stimuli within a more favourable industry structure.

3.2 Austrian initiatives to meet the Barcelona goals

Outstanding R&D performances of the private corporate sector do not descend upon countries like "manna from heaven". Instead, large publicly financed initial investments have often laid the grounds for subsequent success. For instance, several authors suggest that the favourable outcome of Finnish R&D performance in these days took its starting point when the government introduced an urgent action plan for the promotion of research and technology development in 1996. Within the three years period 1997-1999 more than FIM 3 billion of fresh funds had been disbursed to enhance the operation of the national innovation system. The fist evaluation of this program has come to the conclusion that the additional appropriation for research has been highly rewarding: the private business sector expanded its research investments; company profitability rose through increased research input; the number of product innovations grew, productivity was positively affected through a better trained workforce etc. (Prihti et all, 2000).

[6] Österreichischer Forschungs- und Technologiebericht 2003, p. 23ff

At the turn of the millennium the Austrian innovation system had been characterized by considerable overlaps in functional responsibilities and extensive inefficiencies in the funding system were prevailing (Leo et al., 2002). To meet the challenge of an R&D quota of 2.5% or 3%, respectively, Austria has since then undertaken great efforts to simplify and reorganize its funding structure and to increase its budget for R&D measures.[7] In 2000 the establishment of a Council for Research and Technolgy Development (RFT henceforth, abbreviating *Rat für Forschung und Technologieentwicklung*) marked the beginning of the overdue streamlining process. Since then and in contrast to former advisory bodies, RFT advises all ministries involved in science, research, and development and comments on all major projects before a final decision is made. The RFT defines the priorities of the Austrian innovation policy and has published a "National Research and Innovation Plan" as the nowadays most important strategic document for Austrian Innovation and Technology Policy. An update is planned for the very near future. It should be emphasized, however, that neither the Council's strategies, nor recommendations are binding – except for its recommendations on the use of the special funds, with which is has been entrusted since January 2001 (see next section). Starting from September 2004 the Council is run as an independent legal entity.

In September 2002 the umbrella fund AWS (Austria Wirtschaftsservice GmbH) was set up merging the former promotion schemes BÜRGES Förderbank, Finanzierungsgarantiegesellschaft (FFG), Innovation Agency, and the labor market promotion schedules for enterprises which had formerly been administered by the BMWA.[8] Another new player in the Austrian Innovation System is the "National Foundation for Research, Technology and Development". It has been founded in spring 2004 by the three technology ministries (viz. BMWA, BMVIT, BMBWK)[9], by the

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[7] Details of the following passage can be found in Leo et al., 2004.

[8] The administration of the ERP fund, however, remains within the responsibility of the BMWA. Nonetheless, the AWS's chief executive officer is at the same time the top-manager of the ERP fund thus providing for sufficient coordination of the respective programs.

[9] BMVIT = Federal department for traffic, innovation and technology, BMBWK = Federal department for education, science and cultural affairs, BMWA = Federal department for economic affairs and employment (BMWA)

ministry of finance (BMF) and the Austrian Reserve Bank, where the latter provides for the funds (in concert with the ERP-Fund). The new foundation will concentrate on middle- and long-term goals of research and technology policy and promote qualitatively high-standing projects with an annual budget of approximately 125 Mio €. To optimise existing structures, the RFT Council submits non-binding proposals to the foundation on how to distribute the money.

Finally, in June 2004 the BMWA and the BMVIT established the *Forschungsförderungsgesellschaft* (FFG), another umbrella organization that groups the formerly independent institutions Austrian Space Agency (ASA), the Bureau for Innovation and Technology (BIT), the Industrial Research Promotion Fund (FFF) and the *Technologie Impulse Gesellschaft* (TIG) under one roof. The 2004 budget of the FFG amounts to 12.12 Mio €, but will be significantly increased during the next years (within three years an increase of about 50% is envisaged.) Additionally, part of the special funds for science and technology will be channelled into the economy through the FFG.

3.2.1 Special funds for Research and Development

In December 2000 the Austrian Federal Government announced an urgent action plan, the so-called “Offensiv-Programm I” to promote the goal of increasing the R&D quota in terms of gross domestic product (GDP) from 1.8% in 2000 to 2.5% of GDP in 2005. Additional funds amounting to € 508.7 Mio were agreed to in order to boost Austrian sciences and technology developments. These additional funds were to be evenly distributed within the next three years so that in each year 2001-2003 extra money of some € 169 Mio would be available. In relative terms fresh funds of € 169.57 Mio accounted for about 13.8% of the federal state’s R&D expenditures in 2000 and of some 4.2% of total Austrian R&D expenditures in 2000 (Forschungs- und Technologiebericht 2004, Appendix, table 1).

Commitments

In January 2001 the RFT started to give recommendations on how to spend the special funds, by April of the following year the distribution process had been completed (compare Table 6 below).

Table 6: The Process of Allocating Extra Funds

Date of RTF-meeting	Number of Programs awarded[a)]	Amount of funds allocated (in Mio. €)	Cumulative in Mio €	Cumulative in % of total
January 15ths, 2001	18	86.29	86.29	17.0
March 27ths, 2001	7	102.49	188.78	37.1
June 27ths, 2001	18	161.82	350.6	68.9
November 20ths, 2001	6	77.21	427.81	84.1
Febuary 15ths, 2002	12	60.34	488.15	96.0
April 4ths, 2002	6	20.55	508.7	100.0
Total	67	508.7		

Source: RTF

a) Double counting: for various programs initial support has been raised in subsequent meetings

The distribution process has been ruled by competitive criteria and it is worthwhile to note that by Austrian standards alone this element of competition between various public units introduced a novelty. In particular, the three R&D-related federal ministries (BMVIT, BMBWK and BMWA) developed various new programs, or turned in existing promotion schemes, respectively, while the independent RFT had been charged with the evaluation process and would only reward the most promising proposals

The Council's 2000-2002 annual report lists allocations of the special funds in great detail, at this place only summary results will be presented (see Table 7).

When classified by purpose 32% of the funds have been channelled to basic research programs, 35% mainly benefit applied research, 22% was spend to promote market-oriented research and development and 12% was allocated to advance technology transfer and innovation (RTF Annual Report 2000-2002, pp. 32-33.) In absolute terms these shares translate into figures of approximately € 161 Mio, € 176 Mio, € 113 Mio and € 60 Mio, respectively.

Table 7: Distribution of Funds by Department, Performance Sector and Purpose

	in Mio. €	in %
Distribution by departments		
Federal department for traffic, innovation and technology (BMVIT)	230.01	45.2
Federal department for education, science and cultural affairs (BMBWK)	188.62	37.1
Federal department for economic affairs and employment (BMWA)	79.79	15.7
Comprehensive programs	10.28	2.0
	508.71	100.0
Distribution of funds by performance sector		
Universities	180.95	35.6
Non-university research institutes	140.47	27.6
Companies	187.29	36.8
	508.71	100.0
Distribution of funds by purpose		
Basic research	160.51	31.6
Applied research	175.91	34.6
Experimental development	112.57	22.1
Technology transfer, innovation, others	59.72	11.7
Total	508.71	100.0

Source: Austrian Council for Research and Technology Development, Annual report 2000-2002

With respect to the implementation sectors roughly the same shares of the *Sondermittel* have been channelled to companies (37%) and universities (36%). The remainder of 28% was spent in favour of non-university research centres which encompass both public sector institutions as well as establishments organized under private law.

The Council has launched initiatives to promote emerging technology fields for the future. Recommendations on biotechnology (15.5%), information- and communication technologies (12.2%) as well as on mobility/traffic (11.1%) account for considerable shares of the total of 508.7 Mio €. Other trendsetting industries such as nanotechnologies only attracted € 184 thousand (2.6%) of the first special funds tranche, but will be considered to a much higher degree within the 2004-2006 period (Offensivprogramm II, furnished with 600 Mio €). In December 2003 the Council recommended to spend 12.6 Mio € of the new special funds on the Nano-initiative jointly run by the BMVIT and the BMWA.

Some of the research promotion schemes endowed with special funds are new (such as FIT-IT, GEN-AU, the Austrian space application program ASAP, ARTIST for satellite development, the aeronautic program TAKE OFF or the most recent PROKIS program) and arguably owe their initiation to the availability of fresh funds. Nonetheless, large shares of the special funds have been used to secure financing of existing programs. Most notably the two major federal support schemes addressing R&D promotion in the private corporate sector (FFF) and in the public domain (FWF) have been awarded with additional funds amounting to € 58 Mio and € 36 Mio, respectively. In relative terms assistance to these institutions account for 19% of the total sum allocated. Allowances to the advantage of the competence centres are of similar magnitude (approximately € 80 Mio in total). But newly set up research initiatives such as the genome research program GEN-AU, or the BMVIT's impulse program FIT-IT also managed to attract funds of two-digit order.

Disbursements

Table 8: R&D Funding of the Technology Ministries: Special Funds vs. Ordinary Funds

	1997	1998	1999	2000	2001	2002	2003
BMVIT: total R&D budget	9.834	8.1	5.489	140.347	235.004	204.45	230
of which							
Technology Billions	0.839	0	0	18.291	7.922	3.107	0.006
Special Funds Initiative 2001-03					77.4	70.4	35.7
Ordinary R&D budget	8.995	8.1	5.489	122.056	149.682	130.943	194.294
BMBWK: total R&D budget	759.077	817.28	866.619	933.332	1005.205	1078.902	1000
of which							
Technology Billions	12.666	15.788	25.776				
Special Funds Initiative 2001-03					39.4	61.8	36.6
Ordinary R&D budget	746.411	801.492	840.843	933.332	965.805	1017.102	963.4
BMWA: total R&D budget	59.687	58.439	61.568	11.641	12.691	22.425	28
of which							
Technology Billions	12.177	17.808	20.935	8.471	0	0.033	0
Special Funds Initiative 2001-03					11	15.8	21.2
Ordinary R&D budget	47.51	40.631	40.633	3.17	1.691	6.592	6.8

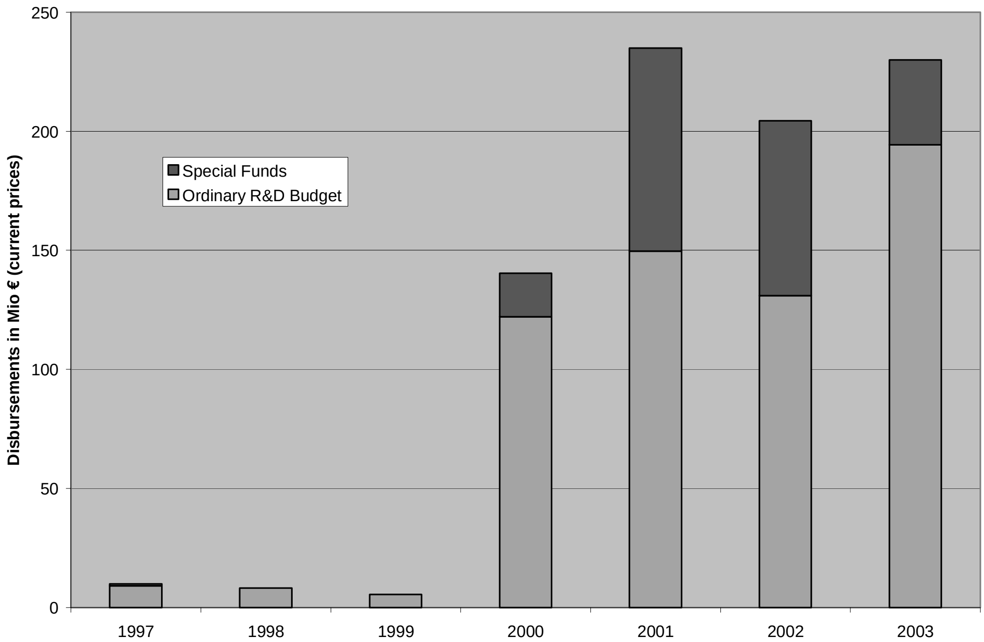
Source: Beilage T, table b, 1999-2004, and private communication with the BMF.

The original plan was to spend the special funds of the Offensivprogramm I within the three-year period 2001-2003. However, actual disbursements for the accounting periods 2001-2003 amounted to roughly 370 Mio € only (73% of the total sum). The BMVIT assisted special funds funded programmes with 183.5 Mio € (disbursement ratio of 80%), the BMBWK disbursed 137.8 Mio € (73%) and the BMWA spend 48 Mio € (60%) on special funds initiatives (see Table 8). The rest will be spent on R&D activities in 2004.

Table 8 splits the total *domestic*[10] R&D budget within the three technology ministries (first line) into provisions from the recent special funds initiative as well as from the preceding special fund initiative "Technology Billions" (*Technologiemilliarden*) and calculates the regular or ordinary R&D budget as the residual. Figures on the Technology Billions and on the total R&D budgets are taken from the federal estimates of R&D expenditures, 1999-2004, table b (*Bundesvoranschlag, Beilage T*); only total R&D disbursements for the last year are unpublished and yet tentative results communicated from the ministry of finance (BMF). By the same token figures on the disbursements of the recent special funds initiative are also unpublished yet but were communicated from the ministry of finance. The respective *Beilage T*, the primary source of federal R&D expenditures in Austria, is vastly incomplete when it comes to the budgeting of the special funds. Only about 100 Mio € of the total amount have been properly assigned and it turned out extremely difficult to trace back the exact amount of funds that have been spent and to find out what they have been spent for. Clear improvements are called for in this regard.

[10] meaning funds disbursed to Austrian (as opposed to international) R&D promotion schemes

Figure 5: R&D-funds of the BMVIT (domestic R&D organizations only)



Figures 5 - 7 give a graphical illustration on the relative size of ordinary R&D funds and special funds where the latter include funds from the recent 2001-2003 R&D-initiative, as well as from the preceding Technology Billions. In relative terms special funds are of only marginal importance for the BMVWK; they contribute to 4-6% of this ministry's total domestic R&D budgets between 2001 and 2003. Within the BMVIT, about one third of the 2001 and 2002 budgets are made up of special funds, in 2003 the respective share comes down to 15%. Historically special funds have been most decisive for the BMWA. In particular, its dependency on extra, non-regular funds has become highly crucial since 2000 when the two major Austrian R&D support schemes, the FFF and the FWF, were transferred to the BMVIT. There is little exaggeration in stating that the BMWA would have ceased to be an active R&D player without the provisions of the special fund initiative.

Figure 6: R&D-funds of the BMBWK (domestic R&D organizations only)

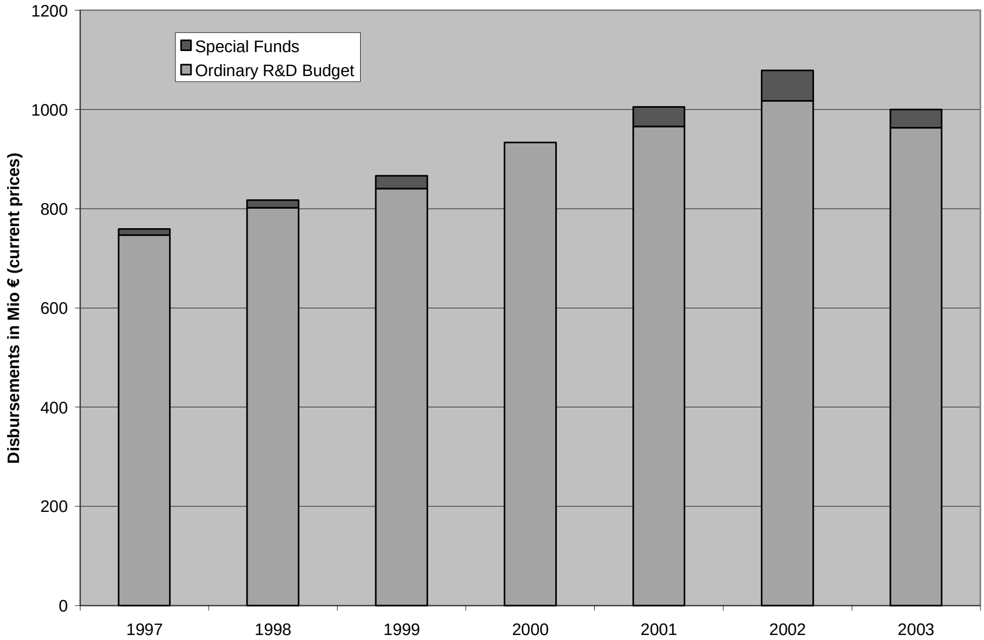
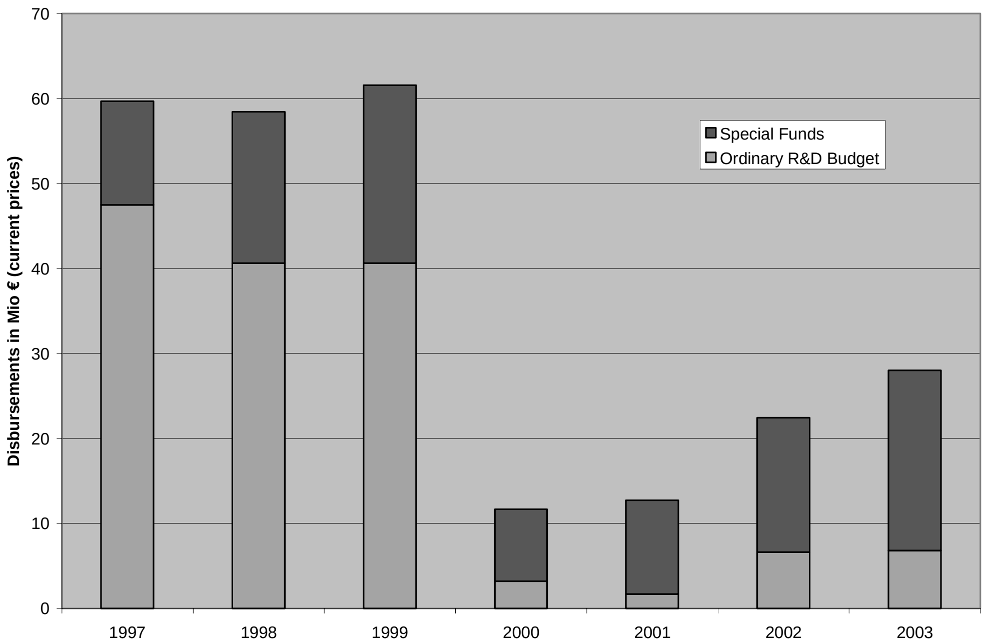


Figure 7: R&D-funds of the BMWA (domestic R&D organizations only)



3.2.2 *Impact Analysis at the macro level*

We assess the role of these extra funds in increasing Austrian business R&D expenditures within the general framework as outlined in the previous section. Since the ultimate purpose of this exercise is to quantify the leverage of the entire set of public intervention measures on business enterprise R&D and not to determine the most effective means, we now include the three general support categories simultaneously, viz. direct, indirect as well as implicit support measures. For second, regressions are run without including GDP per capita, as preliminary exercises showed that the respective coefficient would turn out invariably insignificant in this setting. Table 9 below displays the results.

Table 9: Evaluating the impact of public intervention measures on business sector R&D

Nature of public R&D support		Fixed effects model		dynamic panel data model		
		Coeff.	t-value	Short-run Coeff.	t-value	Long-run Coeff.
	Log BERD % GDP (t-1)			0.25	2.25	
Direct	Log government funded BERD as % GDP(t)	0.12	2.97	0.16	4.84	0.22
Direct	Log B-index (t) [a)]	-0.50	-1.86	-0.86	-4.15	-1.14
Indirect	Log HERD as % of GDP (t)	0.35	2.81	0.23	1.74	0.31
Indirect	log GOVERD as % of GDP (t)	0.05	0.69	0.01	0.2	(0.02)
Implicit	log high-tech export share (t)	0.46	5.34	0.27	2.8	0.35
	period dummy 1985-1989	0.05	1.04			
	period dummy 1990-1994	-0.01	-0.12	-0.14	-2.4	
	period dummy 1995-1999	-0.02	-0.2	-0.06	-1.38	
	period dummy 2000-2002	0.01	0.13	-0.04	-0.83	
	Constant	1.54	5.75	0.08	1.88	
	# of obs (countries)	102 (23)		73 (21)		
	R^2 (within)	0.78				

[a)] B-index significant at the 7% level

The log-formulation of the above model implies that the estimated coefficients are to be interpreted as elasticities, i.e. $\varepsilon_{yx_j} = \frac{\partial \ln y}{\partial \ln x_j} = \frac{\partial y}{y} \cdot \frac{x_j}{\partial x_j} \quad \forall j$.

To calculate country- and time-specific marginal effects, the estimates are multiplied by $(\bar{y}_{it} / \bar{x}_{ijt})$, the average (y_{it} / x_{ijt}) for country i in Period t, where y_{it} denotes the i-ths country's mean BERD intensity in period t, and the x_{ijt} give any of the included BERD-determinants included in the model. For Austria these averages are listed in Table 3, section 3.1.4 and the marginal effects are presented in Table 10 below (only if estimates turned out statistically significant).

Table 10: Marginal effects for Austria

Estimation Approach	1980 -1984	1985 -1989	1990 -1994	1995 -1999	2000 -2002
	Government Financed BERD				
Fixed Effects	1.67	1.82	1.24	2.20	2.14
GMM, short-run		2.44	1.66	2.95	2.86
GMM, long-run		3.24	2.20	3.93	3.81
	B-Index				
Fixed Effects	-0.34	-0.37	-0.43	-0.61	-0.78
GMM, short-run		-0.64	-0.75	-1.06	-1.36
GMM, long-run		-0.85	-1.00	-1.41	-1.81
	Higher Education Expenditure on R&D				
Fixed Effects	0.61	0.59	0.56	0.75	0.73
GMM, short-run		0.39	0.37	0.49	0.48
GMM, long-run		0.52	0.49	0.65	0.64
	High-Tech Export Share				
Fixed Effects	4.11	3.83	3.78	4.42	3.84
GMM, short-run		2.19	2.17	2.53	2.20
GMM, long-run		2.91	2.88	3.36	2.92

Notes: own calculations

Given the marginal effects rough estimates can be derived on the net effect of the special funds initiative on R&D expenditures of the business sector: a share of 35.6% of the extra funds has been allocated to universities and 36.8% to companies (see Table 7). Multiplying these shares by the amount of money that has actually been disbursed between 2001 and 2003, we get approximate values for the additional R&D expenditures of the higher education sector, HERD, and the additional amount of government financed BERD, viz. 128 Mio € and 132 Mio €, respectively. Solving the marginal effects for ∂y we find that the business sector will/has increase(ed) its net

R&D expenses by about 307 Mio € in the short run. Of these about 61 Mio € are due to positive spillovers from research undertaken in universities and 246 Mio € of additional BERD is stimulated by directly funding R&D activities in the enterprise sector with some extra 132 Mio € (by means of grants or loans).

In the above exercise estimates for a 20-year period are rigorously combined with presumed average values of the very last time period. Since the relationship $\frac{\partial y_t}{y_t} \approx \sum_{j=1}^{J} \varepsilon_{yx_j} \cdot \frac{\partial x_{jt}}{x_{jt}}$ holds for the entire period, presumably it makes more sense to ask how much of the observed change in the BERD intensity between the very first and the last period can be attributed to the respective actual changes of the explanatory variables of the model. The results of such a decomposition analysis appear in Table 11.

The first thing to note is that the actual growth rates of the endogenous variable come in fact very close to the predicted ones, in other words: the model results in very good fits. This holds especially true for the dynamic specification where the predicted BERD-change only marginally deviates from the observed growth rate. Second we find that structural changes have had the greatest impact on BERD in both specifications. Results from the static fixed effects approach suggest that more than half of the observed increase in the BERD-GDP ratio between 1980 and 2002 is attributable to rising export shares of high-tech products. Moreover, if the lagged endogenous variable is included in the model, the contribution of the fitted high-tech export share to the predicted change in BERD-intensity is still the greatest, though falling from 54% down to 27%. Now, the lagged endogenous variable accounts for a considerable share of the predicted change in BERD, but this is more or less a technical relationship; ultimately a percentage contribution of some 22% for the lagged endogenous variable does not explain anything. We conclude that most of the observed change in BERD throughout the last 20 years is attributable to gradual changes in the industry structure.

In contrast, the stimulating effects of direct R&D-support in kind of loans and grants seem modest. Only between 8.4 and 11.7% of the observed change in the BERD intensity can be attributed to such support schemes. Indeed, among the suitable policy instrument to trigger increased R&D activities of the business sector, these measures turn out as the least effective.[11] With respect to the role of tax incentives and the spillover effects from public R&D funds to universities, the results are ambiguous. In a dynamic setting it pays more to set appropriate fiscal incentives, while the static approach suggests that university funding has been a more effective way to foster the business sector's R&D engagement. Anyway, in qualitative terms there is broad evidence that the observed change in the BERD intensity is more attributable to both, changes in tax incentives as well as spillover effects from the higher education sector, than to direct R&D subsidization within firms. The greatest effects, however, have been realized through a steady movement in favour of a more R&D-intensive industry structure.

Table 11: Sources of change in Austrian BERD intensity

	Static approach: 1980-2002		Dynamic approach: 1985-2002l	
Observed %-change (BERD/GDP)	3.80		4.22	
Predicted %-change	3.57		4.20	
... of which contributions from	Percentage points	Percentages	Percentage points	Percentages
BERD/GDP (t-1)			0.95	22.5
Gov. funded BERD/GDP(t)	0.30	8.4	0.49	11.7
B-Index (t)	0.34	9.6	1.04	24.8
HERD/GDP (t)	0.99	27.7	0.61	14.5
High-tech. export share (t)	1.94	54.3	1.12	26.5

Notes: own calculations

3.2.3 Impact Analysis at the micro level

From a theoretical point of view impact studies at the firm level are preferable. After all, the firm is the decisive agent whose expenditure responsiveness to public R&D support is to be evaluated. As for now it is too early to make a micro-level based statement on the effectiveness of the special funds. Though the total sum had been allocated by April 2002, disbursements took place later and are in fact still taking

[11] Government intramural R&D expenditures are again neglected from the decomposition analyses as the respective coefficient turns out statistically insignificant regardless of specification.

place up to date. According to a recent survey on the impact of direct public R&D assistance on Austrian R&D-performers 40% of the respondents claim that effects are measurable within the first year after the supported project has been initiated. 38% figure that it takes up to two years and the remainder claims a period of 3-5 years until the merits of public R&D support become visible. [12] Until the effects come into full scope it takes some more time so that a careful assessment of the total net effects can only be undertaken with several years delay.

As mentioned, however, great shares of the extra funds have been channelled into formerly existing programs. Though the culture of evaluation is at an infant state in Austria, some of the major public R&D-promotion schemes have been recently evaluated, such as the FFF and the FWF. Arguable, the donor source is irrelevant for the beneficiaries of R&D assistance, but all that matters is the amount of received support. In this sense special funds are not expected to unfold special effects and we might as well look at the impacts of any previously evaluated R&D support program on private sector R&D.

For a sample of some 495 firms being registered with the FFF in at least four distinct years between 1997 and 2002, Streicher (2004) estimated that for each Euro of public funding additional private R&D expenditures of 40 cents were spent. FFF funding and private R&D are thus found to be complementary in nature with a leverage effect of about 40%. Furthermore, some disaggregated analyses by firm-size verified that it is the largest firms with more than 250 employees and the smallest firms with less than 10 employees that generate the greatest leverage effects (95% and 62% respectively). In comparison to our estimates these figures establish lower benchmarks. Recall that the fixed effects approach of this study estimated that one Euro of public support to firms' R&D activities would induce additional privately financed BERD of order 1.2 € for the 1995-2002 period. In the early nineties, however, our model predicts a leverage of only 0.24% (see Table 10).

Within the concept of input additionality a recent refinement introduced so-called "behavioural additionality". Here, the main concern is devoted to permanent

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[12] Leo et al. (2002)

changes in the conduct of a company, possibly mirrored in a more formal institutionalisation of innovation and R&D-activities. Descriptive evidence from recent survey data on some 1300 firms revealed that around 80-85% state that without FFF-sponsoring the project in concern would have been/has been cancelled, or carried out on a reduced scale (Falk, 2004). Apart from such project additionalities[13] the merits of public R&D sponsoring also come through the realization of so-called scope additionalities.[14] To be specific, 63% of the surveyed firms extended their R&D activities to new areas within the course of the FFF-funded project. Furthermore, at least every other firm reports scope additionalities to have arisen from collaboration with either research institutes and/or other companies. These results fit well into the picture that emerges from the estimates of this study: the long-term merits of public R&D support are substantially higher than the short-run effects.

The above study on behavioural additionality found out, however, that additional public money for R&D projects undertaken in the enterprise sector does only marginally affect the demand for R&D-personnel. This disappointing result is very likely to be attributed to the strong sample bias in favour of more or less continuous R&D performers.[15] Even if routine R&D performers persistently changed their R&D related behaviour so as to continuously strengthen their absorptive capacity with respect to new knowledge, eventually the need for an ever greater R&D-staff does not depend so much on financial assistance from the government. Instead, the stock of R&D employers is rather determined by fundamental economic indicators such as number, size and nature of awarded contracts and total turnover.

Finally, a recent survey on FWF-assisted projects revealed that -by self-assessment- about 41% of the responding project-managers regard the respective results as relevant for industry (Streicher et al., 2004). Though the question on commercial

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[13] Project additionalities are said to prevail if the project's implementation hinges upon public assistance.

[14] Scope additionalities arise whenever the coverage of some R&D activity is extended to a wider range of applications, markets or partners.

[15] This line of argumentation is implicitly confirmed by Streicher's analysis (Streicher, 2004) who found that firms with intermittent R&D performance realized a significantly higher funding leverage as compared to the continuous R&D performers.

usability is answered affirmative in many cases, contacts between FWF-supported project teams and industry representatives have been realized only in about 20% of the cases. Most noteworthy, while close to 80% of the project managers in engineering sciences report to undertake industry-relevant research, only 10% are in touch with business sector agents. In light of the fact that (in total) only 13% of the research results are deemed suitable for commercialization straight away, but 45% of the surveyed scientists consider co-operation with industry as vital to commercialize the results, many benefits arising from successful collaboration of the academic and the business world seem to lie idle.

3.2.4 Summary and Conclusions

The Council's influence on the Austrian innovation policy agenda has definitely been strengthened as compared to the role of former advisory bodies. Most noteworthy are its binding recommendations with respect to the use of the special funds. However, even if these additional funds had been completely distributed within the 2001-2003 period, the approximate annual amount of some extra 169 Mio € accounted for only 12% of the federal state's R&D expenditures. While the Council's authority within the most important technology ministry, the BMBWK, is limited to a modest fraction of the total R&D outlays, its stake in the BMVIT is considerable, but it totally controls the BMWA.

The Council's ambiguous role becomes obvious in the newly established FFG and the National Foundation for Research, Technology and Development. In both bodies, the Council has only a consultative position, its recommendations are not binding for the executive organs. The Council's influence on the politically responsible ministers seems smaller than the original announcements would have suggested.

Based on a panel regression of some 20 OECD countries for the period 2000-2002 this paper evaluated the effectiveness of various support schemes. Though the implied marginal effects for Austria suggest that direct government subsidies to R&D-performing firms unfolded great leverage effects especially since 1995, the impact of an R&D-prone high-tech industry structure on the BERD-intensity is at least equally important. In fact, when evaluated over the entire period, the role of the respective industry structure proves to be most crucial and key to the stimulation of business enterprise R&D expenditures. This result calls for a more strategic appropriation of public R&D funds and for a more strategic approach to technology and innovation policy in general. In this context the recent abolishment of all inscription fees by the Chamber of Commerce is highly acknowledgeable as it reduces the start-up costs of new and innovative enterprises significantly. Similarly, the recent debate on intellectual property rights and the attempts to make them more incentive compatible goes in the right direction as well.

4. Catching-up Strategies in Selected Countries

4.1 CANADA

Canada has made substantial efforts since the middle of 1990s to increase its technological position and to manage the transition towards knowledge based economy (KBE). Canada aims to be one of the top five countries in the OECD by 2010. The Canadian government attempts to achieve this ambitious goal by doubling the federal R&D spending up to the year 2010.

Between 1995 and 2000 Canada remodelled the governance structures in the national innovation system and has increased the budget allocation for Science & Technology (S&T) from 3.5 to 4.3 percent of the overall budget. The reforms of the Science & Technology system resulted in a modest increase of the R&D to GDP ratio – which is just below the 2% mark - up to the year 2000. In 2001 reduced R&D spending of the business sector resulted in a reduction of R&D spending.

Since 1995 the dynamic element of the Canadian Innovations system was the public sector which increased its investments share in overall R&D spending while the business sector's share was on the decline. Most of the reductions of the business sector were compensated by foreign sources which increasingly contribute to the financing of R&D in Canada.

Canada has systematically redesigned its Science and Technology Policy since the publishing of the Federal strategy in March 1996: *Science and Technology for the New Century* laid out the strategy for improving the federal government S&T

performance and aims at enhancing the ability of the federal government to make its distinct contribution to the Canadian innovation system.

It focussed on three inter-related goals for building the innovation system: sustainable job creation and economic growth, improved quality of life, and advancement of knowledge. The intended transformation of the way S&T were managed in Canada was supposed to evolve around two themes: "The first was improved governance: Making better use of external advice, improve support to decision making, enhancing horizontal coordination, and making intergovernmental cooperation and coordination more effective. The second was improving the outcomes from federal S&T through the elaboration of a number of operating principles. These principles ranged from increasing the effectiveness of federally supported research and capturing the benefits of partnerships, to promoting a stronger science culture in Canada."

The implementation of this strategy resulted in a number of new programmes, initiatives, advisory councils, etc. of which the most important were: the Canada Foundation for Innovation was founded in 1997, followed by the Millennium Scholarships, Canada Research Chair Program, Genome Canada and, most recently, the Canadian Institutes of Health Research and the Canadian Foundation for Climate and Atmospheric Science. Other institutions received substantial increases of their funding which enabled them to contribute to the achievement of the overall Canadian goals.

Canada also emphasises sustainable development as major dimension of S&T policy and intents to promote a stronger science culture.

Canada has not committed additional non-budgetary funds for its S&T policy but finances the increase in the traditional way by increasing the share of funds devoted to this policy area. Canada is a good example of how the national innovation system can be reformed in a strategic and well structured manner. The achieved changes are impressing but so far not matched by increased R&D spending in the enterprise sector. While this may still come it nevertheless highlights the need to coordinate reforms in the public sector with intended changes the enterprise sector if overall increases of R&D expenditures are to be achieved.

4.2 FINLAND

Since the recession of the early 1990s, the development of the Finnish innovation system and knowledge-based society has been at the top of the policy agenda for growth and competitiveness. Finland has become internationally known as an exemplary case for forward looking innovation policymaking, a country in which the concept of national innovation system (NIS) was adopted as a basic element of science and technology policy already in the early 1990s. The ideas included in the concept of NIS — innovation process and related policies are looked from a broad perspective covering education and science, innovative activities of companies and commercialisation of technological innovation — were introduced into science and technology policymaking amidst of deep depression of the early 1990s. In this complex system new knowledge is produced by universities and polytechnics, research institutes and business enterprises, among others. The principal users of knowledge are enterprises, private citizens, and policy-makers and administration responsible for societal development.

The share of GDP spent on R&D expenditure increased from 2.0 per cent in 1991 to 3.5 percent in 2002 and is now among the highest in the world. In money terms expenditure on research and development was 4.8 billion euros in 2002 as well as in 2003. Pace of growth in R&D performed by the Finnish business sector has been internationally remarkably high between 1995 and 2002. During the period average annual growth rate of business R&D in Finland was above 10 per cent, whereas within EU-15 the average growth was 4.6 per cent annually.

In 1996 the Finnish government decided on the "Additional Appropriation for Research". Between 1997 and 1999 Finland invested FIM 3 billion into the national innovations system. The money was distributed mainly through the traditional channels, i.e. Tekes and Academy of Finland. Targeted research funding for the Technical Research Centre (VTT) and to universities was also to be stepped up. Moreover, additional funding was to be granted to R&D projects that aim to foster the development of the country´s industrial clusters. These projects were implemented in collaboration between the sectoral ministries, the science and technology administration and individual business enterprises. Overall the additional fund were allocated to the following institutions and programmes:

Table 12: Structure of the Finnish Additional Appropriation for Research

Institutions	**Share of funds in %**	**Programme**
Tekes	54	Cluster programmes and impact assessments
Universities	20	Equipment and other research conditions and facilities
		Expanding existing and establishing new graduate schools
		Expansion in training
		Data transfer, information services and cooperation with industry
		Bioteknia II
Academy of Finland	20	Centres of Excellence
		Research programmes
		Doctor-researchers
		Internationalisation
Sectoral ministries	4	Cluster programmes
VTT and Ministry of Trade and Industry	2	Cluster programmes and impact assessments

Source: SITRA 2000

Since 1999 the ordinary budget was increased to match the level achieved by the additional appropriation. This program effectively increased public R&D spending by 25% from 1997 onwards. The evaluation of the marked increase in S&T financing can be summarised as follows:

- The additional public appropriation for research seems to have had a positive impact on private research investments.
- Increased research input has led to the growth of company profitability, a rise in the know-how level of personnel and a larger number of product innovations.
- Besides research investments, productivity has been improved by personnel training, renewal of organisational structures, more effective management culture and companies' improved capacity to take a new information.
- The effects of research input on employment have been clearly positive, but of a dual character: demand for highly educated personnel has increased rapidly, but no job opportunities have emerged for employees with lower educational level.
- Integration of the new and old economy is considered very important. Encouraging small and medium-sized enterprises to take up new technology calls for new measures.
- Additional funding has positive effects on regional development, but only in the regions where research investments have been focused.

- Quantity and quality of Finnish basic research was developing very positive and rapid.
- The cluster programmes have made in possible to initiate a fruitful co-operation between various sectors and to provide a valuable link between technology and public services.
- The development of TEKES has been rapid and in many ways successful, but new strategic assessment should be carried out.

Finland is a good example of a well organised national innovation system based on ongoing strategy development, coordination between actors, high political involvement and transparency. The success of the Finnish is last but not least based on consistency: the catching-up strategy was followed over almost three decades and has been maintained even in times of severe economic crisis.

4.3 ICELAND

In recent years the size and composition of R&D expenditures in Iceland have undergone significant changes. Starting from a relatively low level, and with a predominant part financed by the public sector, the latest figures show that not only is the total R&D in per cent of GDP is among the highest in Europe (3%) but nearly two-thirds come from the private sector. The increase in private financing brings Iceland in line with the general European trend. However, there is a reason for concern because more than half of the private R&D comes from one single company. Therefore a strengthening in public funding of R&D is still considered as very important.

To increase co-ordination within research, technology and innovation policy and to make more efficient use of public R&D appropriations, new legislation on the organisation of science and technology policy and the funding of research and technology development has been enacted in 2003. The legislation composed of three separate Acts, replacing the Act of the Icelandic Research Council of 1994 and introducing new structures and organization.

- **The Science and Technology Policy Council** (STPC)
  The legislation established the STPC as a ministerial-level co-ordinating body headed by the Prime Minister. The Council, formally replaces the Icelandic Research Council, provides for the permanent seat of three other ministers

namely Minister of Education, Science and Culture and Minister of Industry and Commerce. The council comprises 14 other members with scientific, technical and other relevant qualifications appointed from higher education institutions, labour market organisations and ministries.

- **Research Fund** and **Technology Development Fund**
  The new legislation also set up a two-stringed public funding structure to support scientific research and technology development and innovation. Each Fund (the Research Fund and the Technology Development Fund) will be governed by a Board appointed from among the non-ministerial members of STPC by the Minister of Education, Science, and Culture and the Minister of Industry and Commerce, respectively. The Research Fund was created through the merger of the Science Fund and the Technology Fund.
- **Icelandic Centre for Research (Rannis)**
  At the end of 2003, a new administrative "framework" for the whole science and technology policy in Iceland was introduced by act of parliament. Rannis operates under the auspices of the Council for Science and Technology Policy headed by the Prime Minister and including the Minister of Education, Science and Culture, the Minister for Trade and Industry, the Minister for Finance and two other government ministers as occasional members. Its mission is to give administrative and operational support to the boards and funding bodies, to manage the international connections, monitor the effects and impacts of policies and to provide intelligence and informed advice to the Science and Technology Policy Council and its boards and sub-committees.

4.4 THE NETHERLANDS

Characterisation of R&D Performance

Over the past decade R&D intensity has stagnated around 2%. The Netherlands is far from reaching the Barcelona target of investing 3% of the GDP into R&D. In fact, according to data of the Trend Chart 2003 Innovation Scoreboard of the European Commission the Netherlands is losing momentum, as almost all innovation indicators show negative trends.

The Dutch university sector accounts for about 27% of R&D performance and hence is of higher importance than in EU reference countries (e.g. Germany, France, Finland, Denmark)[16]. The rate of external funding from the private sector is traditionally high and even increased significantly from a 20% share in the early 1990s to 27% in 2000 (NOWT 2003). Overall university-industry links are better developed than in the average EU country.

Despite the mediocre R&D intensity the Netherlands can be characterised as a high-level performer with respect to both quantity and quality of scientific output. The volume of scientific output accounts for 2.1% of the worldwide scientific publications (rank 12) and the Netherlands rank third in the ‘relative citation impact’ worldwide behind Switzerland and the United States. Thus the Dutch R&D system can be considered as very efficient.

A major part (ca. 80%) of total business expenditures on R&D are spent by the so called „Big Seven“ of the Dutch industry (Philips, Unilever, Akzo Nobel, Shell, ASML and Océ). The Big Seven tend to increase expenditures on R&D in foreign countries leaving R&D spending inside the Netherlands stagnant (cf. NOWT 2003). Therefore, the main impulses for a future increase in business expenditures on R&D will have to stem from SMEs.

Innovation Policy – Trends and Measures

In May 2003 the Government Balkenende II announced intense cuts in public spending for all policy domains except for „the knowledge economy“. The ambition of the government is to become “one of the best knowledge economies of the world”.

For the period 2004-2007 the government announced that it would set aside an additional 800 million Euros in the regular budget for „education and knowledge“, of which 515 million Euros are to be invested in the higher education sector. The remainder of 285 million Euros is to be devoted to innovation policy of which

- The Research and Development Promotion Act (WBSO) accounts for 100 Million Euros and

[16]) In the Southern European Countries, which show low overall R&D intensity, universities account for even a bigger share of R&D spending

- 185 million Euros for knowledge and innovation mainly at disposal for the Ministry of Economic Affairs, which is responsible for innovation policy.

The R&D promotion act reduces the wage costs of employees directly involved in R&D via a reduction of payroll tax and social security contributions or tax deductions for self-employed persons. The WBSO is the most important fiscal measure promoting R&D: The maximum WBSO payments are 403 million Euros in 2004 and 453 million Euros from 2006 onwards.

The 185 million Euros reserved for knowledge and innovation in the coalition agreement will contribute to government priority themes such as: human resources (knowledge-workers), start-ups in the high tech sector and research collaboration between research centres and firms, though one must remark that not the entire amount will contribute to R&D expenditures (e.g. it is not yet clear how much the measure "techno-starters" contributes to R&D).

The additional regular budget dedicated to the knowledge economy does not lead to an intensification of public spending on R&D. Until 2006 a nominal reduction on R&D expenditures of about 66 million Euros even occurs.

This cutback is mainly due to the reduction in R&D expenditures in 7 out of twelve departments, with major cutbacks taking place in the Department of Economic affairs. To a minor part the reduction in R&D appropriations is also the consequence of a narrower definition of R&D expenditures.

However, the regular budget expenditures do not include the indirect R&D promotion measures of the WBSO funds and the additional funding outside of the regular budget of the ministries via the "ICES/KIS-3" measure. ICES/KIS-3 provides an additional public funding of 800 Mio Euros on R&D until 2010, which finally leads to an intensification of public R&D spending.

Additional Funds - The ICES/KIS Initiatives

Since 1994 all additional funding measures geared towards innovation and R&D stem from the ICES/KIS initiatives. In 2002 the Dutch government launched a third round of calls for proposals.

The third generation of this programme is implemented by the Dutch innovation agency Senter and funded by the Economic Structure Funds (FES). It's primary aim is the funding of investment projects in the economic structure of the Netherlands. The Ministry of Economic Affairs and the Ministry of Public Finance administer the fund and the Netherlands Court of Audit controls the management and spending of the fund.

The financial sources from the funds stem mainly from the revenue of the state owned gas-enterprises and from proceeds of the sale of several state-owned enterprises. In 2002 the expenditures of the funds accounted for 2.4 billion Euros, the revenues accounted for 2.0 billion Euros. At the end of 2002 the account balance of the FES was about 1.7 billion Euros (Source: Algemene Rekenkamer 2003).

Motivation-Objectives

The aim of the ICES/KIS-3 initiative is to stimulate high-quality basic-strategic and industrial-applied research networks. The objective is to promote a more dynamic innovation system for better use of future chances and developments. Therefore the knowledge, which will be developed in the ICES/KIS-3 projects, must produce a long-lasting effect on the existing knowledge infrastructure. Furthermore it has to be assured that others can apply the new knowledge in a useful way (cf. OCenW, 2003). Public-Private-Partnerships are a major term in the third investment impulse. The issues are:

- To encourage collaboration between knowledge users and knowledge producers;
- To combine public and private sources of funding;
- To bundle knowledge, expertise and innovative capacity in flexible networks on the supply-side and the demand-side.

The 800 million Euros for the investment period 2004-2010 are allocated along 5 priority themes in 34 projects[17]:

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17) Three additional projects are still in the process of being developed. Hence no budget assigned yet.

ICT (215 Mio Euros)

The priorities for the ICT theme are: Broadband-Technology, Informatics and Software, Embedded and distributed systems, multimedia, ICT-networks and “grids”.

Spatial Use (104 Mio Euros)

The Netherlands exhibits scarcity of land. Efficient spatial use is therefore central. The focal points of spatial use are: system innovation and spatial use, water and space, climate and space, geo-information, sustainable use of resources and networks.

Sustainable System Innovations (86.1 Mio Euros)

The concrete topics of the theme are: knowledge and competences for sustainable system innovations, system innovation in construction processes; transition to sustainable mobility, sustainable farming and sustainable use of energy, sustainable chemistry and resources.

Micro-systems and Nano-Technology (130 Mio Euros)

In the field of Micro-Systems and Nano-Technology three projects are subsidized by the ICES/KIS-3 measure: BioMade (7 mio Euros), NanoNed (95 mio Euros), MicroNed (28 mio Euros).

Health, Food, and Life Sciences (164, 7 Mio Euros)

The focal points in the field are genomics, quality of food and biomedical technology. The following projects are going to be subsidized by the ICES/KIS-3 initiative.

4.5 HUNGARY

As in all other so-called transition countries the Hungarian techno-economic system has been experiencing a major, rather dramatic structural change. The nature of this profound structural transformation process may be characterized as an idealized „3-phase-model“ leading from a de-scaling period (phase 1) over a consolidation period (phase 2) to a final phase in which the fundamental institutional steps towards a new national innovation systems and the major adjustment processes have been achieved and thus the ground for a tracks towards technological catching up are laid (phase 3). Currently, the national innovation system of Hungary may be described as being in a crucial stage of phase 3, meaning that major consolidation and re-integration processes have been completed and the principal seedbeds for technology-driven growth and catching-up processes might have been laid down. After almost two decades of declining R&D employment, Hungary is experiencing at least modest growth concerning R&D employment. The industrial structure has been modernized by an influx of a vast amount of foreign capital investment (FDI) leading to a export structure characterized by a high share of technology-intensive products. However private business financed R&D expenditures in relation to GDNP are still below the EU average albeit a modest increase in recent years. And still there is a potential danger of a divided economy: the modern foreign-controlled economic sector (albeit still based upon imported technologies and knowledge) may be contrasted by a traditional (often small-scale) indigenous economic sector with low absorption capacities and limited innovative potential and with weak backward and forward linkages between these two distinct sectors.

Technology policy makers in Hungary are well aware of this problem and to increase the engagement of the private business sector in R&D related activities is one of the main aims of Hungarian technology policies. Thus some measures to increase the incentives for private businesses to engage in R&D activities have been established already (notably indirect measures using the tax scheme).

The accession of Hungary to the EU has made some adjustment processes necessary concerning funding of R&D to avoid redundancy of schemes. Thus some technology oriented schemes have been integrated into the Community Support Scheme. However this leads to an increase in available funds since now more “European money” via the ERDF is now available for similar aims/schemes.

In addition to the EU co-financed schemes to promote R&D a “pure” Hungarian measure to increase the incentive for R&D, both, directly as well as indirectly, has been established recently via the so called Research and Technological Innovation Fund (RTIF). The fund itself is very innovative, both concerning its financing as well as its allocation of available money. The fund (created by law in 2003 and became operative in 2004)

- Companies have to pay a levy based on their net value added (so-called innovation contribution). – The amount of the levy depends on company size. Micro firms (less than 10 employees) are exempt from any contribution, small firms (10 to less than 50 employees) have to pay a smaller amount per cent as large firms. R&D expenditures (both intramural as well as extramural) can be deducted from the payments. Thus the levy may be characterized as having an re-distribution effect with non R&D firms as payers and R&D firms as possible receivers (via the activities of the fund itself). Currently (2004) the levy is 0.05% for small firms and 0.2% for large firms. It is to be raised continuously during the next years. For the fiscal year 2007 the levy is planned to be 0.2% for small and 0.3% for large firms.
- this income generated by the levy is then (at least) doubled with public money from the central budget18.

Due to this specific setting of the Fund's financing, the RTIF is independent from the annual budget cycle which enhances the predictability and sustainability of its actions. The size of the Funds (in terms of money to be distributed) is quite significant and it is estimated that the fund accounts for about 30 – 40% of the size of the total R&D fiscal year 2004 budget.

Concerning the funding principles following premises have to be fulfilled:

- Financial resources of the Fund shall benefit RTD activities undertaken directly or indirectly by private companies.
- 95% of the financial resources of the Fund shall be spent through competitive calls, thus a lean management of the Fund shall be realized (operational costs are estimated at about 2% of total resources, 3% are commitments under separate legislation).
- At least 25% of the resources shall be used for regional innovation purposes (addressing the regional disparity problem)

The main priorities of the RTIF for 2004 are as follows:

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[18]) In addition to these two major sources the fund shall receive voluntary donations as well as income through left-overs and refunds. However the share of these additional funding will remain tiny.

- enhancing the competitiveness of the Hungarian economy by direct and indirect support to innovation at firm level, as well as by boosting demand for innovation
- promoting industry-academia co-operation (since extra-mural R&D can be deducted from the mandatory levy there is an implicit incentive for industry-academia co-operation by the very financing setting of the RTIF itself).
- contributing to costs of commercialisation/exploitation of R&D
- supporting RTD services, innovation bridging and networking activities
- developing RTD infrastructures

To summarize, the stimuli of this fund are three-fold: First, it raises the incentive for private business sector R&D indirectly, since R&D active firms are freed from the levy, second it directly promotes private business R&D activities via subsidies and third, industry-academia relations are promoted both indirectly (tax deduction) and directly (subsidies).

4.6 IRELAND

Characterisation of R&D Performance

Ireland is an interesting example for policy learning, because it is among the countries which have drastically increased its R&D spending in recent years: the level of business R&D expenditures have already been on the rise throughout the 1990ies (at growth rates of approximately 15 per cent between 1993 and 1999), but as GDP and GNP also experienced very rapid growth in this period, R&D intensity grew very little if at all. Recently (2001 figures), R&D intensity was 1.4%, still well below the EU average of 1.9%. Business expenditure on R&D accounted for some 0.9% of GNP (EU average: 1.25%), while R&D spend in higher education and public research sector equalled 0.4% of GNP (EU average: 0.66%) (FORFAS and OST, 2004).

Also the peculiarities of the Irish National Innovation System make for an interesting example for policy learning: the strong role of multinational corporations, the low level of R&D spending of indigenous corporations, a relatively high importance of the EU’s Framework Programme and – until recently - the very low level of domestic public R&D expenditure.

While the enterprise sector spends two-thirds of all R&D expenditures, multinational co-operations account for two-thirds of all business R&D, of which again two-thirds stem from just19 firms. Of indigenous firms, only a small number has significant R&D expenditures. Public R&D expenditures have been low from the outset and have been rising at a much slower speed than business R&D in the 1990ies, but experienced a major push at the turn of the century, when expenditures roughly doubled between 1999 and 2001. Conversely, the importance of funding from the Framework Programme declined (but still amounts to some 12 per cent of all funding in the HEI).

In terms of output, the Irish business sectors has very high shares of high-tech and high-medium tech production and exports. Here, Ireland ranks among the top countries in the EU. These high shares have preceded the rise in enterprise R&D, pointing to the fact that they are mainly due to the strong manufacturing base of the multinational corporations. Output indicators for the public research sector show that the current output of graduates compares very favourably with other EU countries (especially in terms of S&E graduates and female participation), but the share of researchers in the total work force is still low (5,1 compared to an OECD average of 6,5). With respect to scientific output, the Irish authorities recognise, that “ [t]hroughout the 1980s and 1990s, there was little scope to carry out high quality research in universities in Ireland due to a lack of research infrastructure and a lack of funding to support researchers” (Inter departmental Committee 2004, 13).

Thus, with respect to S&T expenditures, Ireland can be seen as a country which strives to rapidly catching up, with a strong increase in business expenditure on R&D upfront, which is now thought to be matched by an equally string rise in public R&D. As the latter is happening at a much higher speed, the strain on the Irish system of S&T policy formulation and delivery is considerable. Such a rapid increase in public R&D spending needs a well laid out strategy and institutions well in place to be absorbed in a sensible way.

Science, Technology and Innovation Policy – Trends and Measures

A strategic decision has been taken on the side of Irish policy to heavily invest into ‘building Ireland’s knowledge economy’ (Inter Departmental Committee, 2004), epitomized in the National Development Plan (NDP)[19] for the period 2000-2006, which sets the target to increase Government spending on R&D from 0,5 bn € over the previous period (1994-1999) to 2,5 bn €. (ICSTI, 1999). In this plan, as well as in a number of other policy documents (see e.g. DETE, 2002 Inter Departmental Committee, 2004), R&D and innovation was given highest priority for future development in Ireland. This went along with a general re-orientation of state-aid, which saw a significant re-orientation from sectoral to horizontal objectives, among which R&D figures prominently.

After the launch of the NDP, though, economic conditions deteriorated (e.g. growth has slowed, unemployment rose slightly and the budgetary position worsened) and spending targets became increasingly hard to meet. Also administrative inertia (delays in getting approval from the EU, delays in setting up new programmes and sometimes changes in the institutional set-up) contributed to a slow start. Thus, in 2002, only 64 per cent of the planned spending was effectuated in the Higher Education sector and only 27 per cent in industry (of total planned spending: 38 per cent) (Indecon, 2003).

Nevertheless, the new 'action plan' sets the targets even more ambitious: e.g. among others for GERD/GNP to reach 2,5 per cent by 2010, for the number of indigenous companies performing R&D to more than double and for the number of researchers as a share of employment to almost double from currently 5,1 to 9,3. In order to meet these targets, the current rapid increases in R&D spending must be sustained beyond the current NDP and carried over also in the next one.

Additional Funds

Motivation-Objectives

The mayor thrust of the increased spending is meant to foster the R&D potential of public research in Ireland, to support indigenous enterprises (mostly SMEs) to engage in R&D, to increase the number of graduates and to foster closer links between

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[19]) The national development plan sets out development targets for all areas of economic policy, including R&D.

industry and science. This policy rationale is well in line with the perceived needs of the Irish Innovation system.

Main channels

A large number of different institutions and programmes have been created (or adjusted) to channel these additional resources. The most important are:

- *Science Foundation Ireland* (SFI) was established in 2001, became independent in 2003 and funds 'excellent' research, mainly in ICT and Biotech. In these areas, SFI has created centres for Science, Technology and Industry to foster scientific excellence and industry science-cooperation. In addition, two research councils were created - one for Humanities and Social Sciences (in 2000) and one for Sciences, Engineering and Technology (in 2001). Financing for SFI increased by 62 per cent in 2004, totalling 113.4 Mio €.
- The Programme for Research in Third Level Institutions (PRTLI), launched in 1998 received additional funding. It main tasks is the strategic development of institutional research capabilities in scientific institutions. Funding covers also the design of strategies in TLIs in response to their need for profiling and specialisation.
- A considerable number of programmes are addressing enterprise R&D under the heading of the 'Productive Sector Operational Plan 2000-2006, e.g. the Competitive Research, Technology Development and Innovation (RTDI) scheme, the R&D capability scheme, or the RTDI for collaboration scheme. Under these schemes, several sub-programmes were created or merged with existing initiatives – e.g. the Programmes in Advanced Technology (PATs). While according to the NDP, these initiatives should have also seen a steep rising in funding, pick-up was slowest here, partly because of administrative and institutional reasons, partly because of the limited adoption capabilities of firms.
- In 2004, the department of Finance introduced a 20 per cent *tax credit on incremental R&D expenditures* by enterprises. ICSTI, in its most recent priority setting (ICSTI 2004), has asked for modifications to specifically target SMEs in this realm. The budgetary effects of the tax measures remain to be determined.

Along these measures, a number of others have sprung up recently, contributing to an increasing fragmentation of support programmes for R&D. Some clearly have the danger of producing overlap and redundancies.

Conclusions

Irish S&T policy has to respond to the challenge of increased competitive pressures in the manufacturing industries pushing towards increased knowledge intensity. Irish policy accepted that challenge and made S&T a cornerstone of its development strategy (see Inter Departmental Committee, 2004 and ICSTI 1999). Ireland had to start from a low level of R&D intensity in international comparison. Irish enterprises have responded by substantial increases in enterprise R&D in the 1990s, though mainly confined to multinational firms. Main tasks for policy thus were (a) to improve the indigenous knowledge base and supply of highly-skilled personnel by expanding the public research base and the higher education sector, (b) to trigger R&D efforts by indigenous enterprises (mainly SMEs) and (c) to increase the interaction between enterprises and the public sector. To this avail, a large number of programmes and initiative have been created (for more details see the country case study in the Annex).The effect of most of these programmes cannot be properly assessed at this time. Nevertheless, some first indications point to difficulties of the Irish system of policy implementation and delivery: the increase in public spending (though remarkable in international comparison) stayed behind the ambitious targets – due to difficulties of the existing institutions to administer such a rapid increase (see Indecon 2003). Also, institutional changes and the establishment of new programmes at the beginning of the phase did not make the task easier. Some of the programmes do not seem to be designed in line with 'best practice' in other countries. E.g. main parts of the RTDI for Collaboration Programme follow the now out-dated 'linear model' by conceiving technology transfer as a simple one-way street of ready made knowledge in public research to be transferred to enterprises, while truly co-operative element remain rare in the programme (see Technopolis 204). Also, there is a proliferation of programmes which is hard to keep track of, some of which potentially could overlap. Partly, this finds an explanation in the fact that – though each public institutions regularly issues 'strategy statements' - these statements might not add up to a coherent overarching strategy. Irish S&T policy recently currently tries to respond to these difficulties by setting up a Cabinet Committee on S&T supported by an Inter Departmental Committee and a Chief Science Advisor.

Apart from the adjustments of the policy system, ICSTI (2005) has pointed to need to sustain the expenditures to meet the Lisbon targets.

Thus, policy learning from the Irish example would conclude that:

- S&T policy can be put on top of the political agenda even in times of deteriorating economic situations,
- Even very substantial increases of public spending on R&D can be agreed upon
- Before injecting an large increase of public R&D expenditure into the system, one has to get the system ready to digest these monies, both in terms of having the institutions in place to implement the policies and instruments as well as being conceptually prepared to employ the instruments in a 'best practice' manner. In both cases Ireland seems to have had some difficulties.
- Instead of such a 'sprint', a more continuous rise of R&D expenditure is preferable.
- Strategies of individual institutions should be brought into more coherence.

5 Summary and Conclusions

5.1 Starting Point and Catching-up Scenarios[20]

The Lisbon strategy has highlighted the new European Union intention to emphasize research and development as key driving factor for economic growth. The ambitious European goals of 3% R&D expenditures per GDP in 2010 request all member states to develop strategies to increase national spending on R&D. In many European countries – but also on a worldwide scale - science and technology policy has received increasing attention even before the European Union published its ambitious strategy. The European target thus reinforces strategies which were

[20] The project was jointly elaborated by Joanneum Research (JR) and WIFO. JR analysed the major developments in R&D spending and calculated the scenario for the achievement of the Lisabon target (section 2). WIFO was responsible for the analysis of main drivers of R&D expenditure (section 3). The case studies for Hungary, Ireland and the Netherland were elaborated by JR, those for Canada, Finland and Iceland by WIFO.

already identified by national policy makers as an important building block for economic development.

The starting position of the European member states could not be more diverse: on the one hand side are the Nordic countries (most notably Finland and Sweden) which already surpass the Lisbon target. On the other hand side are Southern European countries which are well below the European average in R&D spending and which have a substantial weight in the calculation of the average European R&D intensity. Most worrying in the European case is the absence of large member countries which pull ahead and stimulate other member countries. Germany and France – two of large European member countries – are troubled by the restrictions set out in the stability pact and have not shown tendencies to dynamically increase their R&D spending. The same applies – except the remarks on the stability pact - to the UK. In between are some rather small countries (including Austria, Belgium, Denmark) which experienced sustained increase of (relative) R&D spending and which already surpassed the EU average. However, their increases are rather small in comparison with the above mentioned Nordic countries and they are still far below the Lisbon target.

Hence the Lisbon target seems quite ambitious for the EU as a whole and for some member countries in particular. This holds true especially for the big countries which dominate the EU R&D expenditures in absolute terms. The necessary annual growth rates of R&D expenditures for those countries would be between 8% (France) and 10% (UK). For those "old" EU member states with traditionally low R&D intensities (Italy, Spain, Portugal, Greece) the 3% goal seems to be not realistic to achieve in the mid-term future. Some smaller countries (Denmark, Belgium, Austria) seem to be on the track to achieve the 3% goal at least approximately given a sustained continuation of their recent growth path of R&D expenditures. The new CEEC member states are still in the transformation process of their RTD system. Although their R&D expenditures are increasing recently the gap is still too far to achieve the 3% goal in a foreseeable future. Thus, sustaining their first signs of increasing R&D expenditures should be the main goal for those countries and should have priority over setting a too-far-away quantitative goal.

5.2 Drivers of R&D Expenditures

The Lisbon strategy to increase R&D spending raises the question of how this could be accomplished. Adding new money is of course a straightforward answer but how should this be allocated? To come up with some tentative answers we have developed an econometric model which assesses the impact of major determinants of business R&D expenditures and we have conducted case studies for six countries. The latter are screened for evidence on the governance of catching-up or forging-ahead strategies.

5.2.1 Econometric results

The empirical results have widely demonstrated that both, direct support in kind of fiscal incentives and government grants, as well as indirect support in kind of higher education R&D expenditures are effective in raising aggregate R&D expenditures of the enterprise sector. The hypothesized positive effect of government intramural R&D expenditures, however, is only verified within a static estimation framework. In light of this component's moderate and in fact diminishing contribution to gross national R&D expenditures, this result does not seem too surprising. Second, the results unambiguously suggest that the demand for total business sector R&D is not so much driven by a country's aggregate economic performance as reflected by its GDP-figure, but that above all an R&D-intensive industry structure is crucial. Moreover, we found public support measures to work increasingly effective the more favourable a country's industry structure.

Several empirical studies on innovation activities have pointed at the rather low share of high-tech industries in Austrian value added or employment (Peneder et al. 2001, Österreichischer Forschungs- und Technologiebericht, 2003). Irrespective of this technology gap it remains true that by international comparison aggregate trends in Austrian employment, growth, or national income have not evolved below average within the last three decades. Strangely enough, Austria even succeeded to increase its share in EU value added ("the Austrian paradox"). As Peneder notes, the technology gap is still to be taken seriously, because structural deficits in kind of little specialization in dynamic, technology-intensive sectors will dampen the long run perspectives of economic growth.[21] At this point we add that an unfavourable industry structure does not only hamper long-term growth, but that the realization of intermediate aims such as an R&D quota of 3% by 2010 is challenged as well.

This study has also simulated the net impact of the recent special funds initiative on the R&D engagement of the enterprise sector. About 35.6% of these extra funds have been allocated to universities and 36.8% to companies. Multiplying these shares by the amount of money that has actually been disbursed between 2001 and 2003, we get approximate values for the additional R&D expenditures of the higher education sector, HERD, and the additional amount of government financed BERD, viz. 128 Mio € and 132 Mio €, respectively (or 160 Mio in total). Using these numbers to simulate the impact we find that the business sector will/has increase(ed) its net R&D expenses by about 307 Mio € in the short run. Of these about 61 Mio € are due to positive spillovers from research undertaken in universities and 246 Mio € of additional BERD is stimulated by directly funding R&D activities in the enterprise sector with some extra 132 Mio € (by means of grants or loans).

5.2.2 Case Studies

The following country case studies have been selected because of recent major policy initiatives to raise R&D spending. The contexts were deliberately chosen to reflect very different settings in terms of starting points, structure of the STI policy system and type of policy initiative.

The ongoing monitoring of national strategies in Science and Technology is an important source of information for policy learning. While developments in other countries may be inspiring by themselves it has also become increasingly obvious that it is not possible to transfer "systems" to other countries. National systems of innovations usually function based on rules and routines developed over many years and depend strongly on the national context. What can be transferred are management/governance styles and principles, methods and measures. In this

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[21]) Österreichischer Forschungs- und Technologiebericht 2003, p. 23ff.

respect the case studies conducted in this study contain some important insights although each of the countries surveyed has focused on different aspects to be improved in their national system of innovation depending on the perceived weaknesses and problems. None the less there are some interesting features which are of particular interest in the Austrian context:

Finland is in general regarded as a prime example for a well organized catching-up country which has surpassed most European countries not only in terms of R&D expenditure but also with respect to the diffusion of information and communications technologies, and the generation of productivity and output growth. The strength of the Finnish approach lies in a well organized national innovation system based on ongoing strategy development, coordination between actors, high political involvement, transparency, and short lead times between strategy formulation and implementation. The success of the Finnish system is last but not least based on consistency: the catching-up strategy has been followed over almost three decades and has been maintained even in times of severe economic crisis. Overall Finnish science and technology policy has been original in many ways and has been characterized by workable – sometimes pragmatic – solutions to perceived problems. The additional appropriations for science and technology which were disbursed during the 1997 to 1999 period have been consequently channelled through existing institutions based on recommendation of The Science and Technology Policy Council of Finland and awarded by means of competitive biddings. It has led to an increase of 25% of public R&D spending. The raised level of public spending was maintained after the special appropriations had expired.

Canada has reformed the structures in the public research sector systematically and profoundly since the mid 90s. The Canadian approach was strategy based on the formulation of a national strategy for science and technology in 1996. This strategy aims at improving the federal government’s science and technology performance by enhancing the ability of the federal government to make its distinct contribution to the Canadian innovation system. It focused on three inter-related goals for building the innovation system: sustainable job creation and economic growth, improved quality of life, and advancement of knowledge. The intended transformation of the way science and technology were managed in Canada was supposed to evolve around two themes. The first addressed improved governance: making better use of external advice, improving support to decision making, enhancing horizontal coordination, and making intergovernmental cooperation and coordination more effective. The second major issue referred to improving the outcomes from federal science and technology policies through the elaboration of a number of operating principles. These principles ranged from increasing the effectiveness of federally supported research and capturing the benefits of partnerships, to promoting a stronger science culture in Canada. The Canadian reform process is – at least from an outside position – a benchmark case for rational policy development and implementation.

Hungary is a good example for a transition country which had to bring its science and technology structures in line with the rapid changes of economic structure following the implementation of a market economy and the access to the European Union. Hungary has created innovative financing structures for innovations in the business sector, most notably, a special Research and Technological Fund to foster private business R&D has been established. To finance this fund, companies with no R&D activities have to pay a levy based on their net value added (so-called innovation contribution). The amount of this levy depends on company size with smaller firms contributing a smaller percentage based on their net value added than larger ones. Thus the levy may be characterized as having an re-distribution effect with non R&D firms as payers and R&D firms as possible receivers (via the activities of the fund itself). This income generated by the levy is then (at least) doubled with public money from the central budget. Thus, the monetary size of the fund is independent from the annual budget cycle which enhances the predictability and sustainability of its actions. The size of the Funds (in terms of money to be distributed) is quite significant and it is estimated that the fund accounts for about 30 – 40% of the size of the total R&D fiscal year 2004 budget. Via the fund R&D projects of private business firms (both intramural as well as extramural) are financed based upon competitive calls. To summarize, the stimuli of this fund are three-fold: First, it raises the incentive for private business sector R&D indirectly, since R&D active firms are freed from the levy, second it directly promotes private business R&D activities via subsidies and third, industry-academia relations are promoted both indirectly (tax deduction) and directly (subsidies).

In recent years the size and composition of R&D expenditures in Iceland have undergone significant changes. Starting from a relatively low level, and with a predominant part financed by the public sector, the latest figures show that not only is the total R&D in per cent of GDP among the highest in Europe (3%), but that nearly two-thirds come from the private sector. The increase in private financing brings Iceland in line with the general European trend. However, there remains some reason for concern because more than half of the private R&D originates from one single company. Therefore a strengthening in public funding of R&D is still considered as very important. To increase co-ordination within research, technology and innovation policy and to make more efficient use of public R&D appropriations, a new legislation on the organization of science and technology policy and on the funding of research and technology development has been enacted in 2003. The legislation composes of three separate Acts, replacing the former Act of the Icelandic Research Council of 1994 and introducing new structures and organizations: the Science and Technology Policy Council, the Research Fund, the Technology Development Fund and the Icelandic Centre for Research. Thus the technology policy structures in Iceland now follow some well anticipated organizational principles in science and technology policy.

Irish S&T policy has to respond to the challenge of increased competitive pressures in the manufacturing industries pushing towards increased knowledge intensity. Irish policy accepted that challenge and made S&T a cornerstone of its development strategy. Ireland had to start from a low level of R&D intensity in international comparison. Irish enterprises have responded by substantial increases in enterprise R&D in the 1990s, though mainly confined to multinational firms. Main tasks for policy thus were (a) to improve the indigenous knowledge base and supply of highly-skilled personnel by expanding the public research base and the higher education sector, (b) to trigger R&D efforts by indigenous enterprises (mainly SMEs) and (c) to increase the interaction between enterprises and the public sector. To this avail, a large number of programs and initiatives have been set up. The effect of most of these programs cannot be properly assessed at this time. Nevertheless, some first indications point to difficulties of the Irish system of policy implementation and delivery: the increase in public spending (though remarkable in international comparison) stayed behind the ambitious targets and this is due to difficulties of the existing institutions to administer such a rapid increase. Also, institutional changes and the establishment of new programs at the outset did not make the task easier. Some of the programs do not seem to be designed in line with 'best practice' in other countries. For example, major parts of the RTDI for Collaboration Programme follow the now out-dated 'linear model' by conceiving technology transfer as a simple one-way street of ready made knowledge in public research to be transferred to enterprises, while truly co-operative elements remain rare in the program. Also, there is a proliferation of programs which are hard to keep track of and some of these do overlap. Partly, this finds an explanation in the fact that each public institutions regularly issues 'strategy statements' but these do not add up to a coherent overarching strategy. Irish S&T policy currently tries to respond to these difficulties by setting up a Cabinet Committee on S&T supported by an Inter Departmental Committee and a Chief Science Advisor.

Thus, policy learning from the Irish example would conclude that:

- S&T policy can be put on top of the political agenda even in times of deteriorating economic situations,
- Even very substantial increases of public spending on R&D can be agreed upon
- Before injecting large additional public R&D expenditures into the system, one has to get the system ready to digest these funds, both in terms of having the institutions in place to implement the policies and instruments as well as being conceptually prepared to employ the instruments in a 'best practice' manner. In both cases Ireland seems to have had some difficulties.
- Instead of such a 'sprint', a more continuous rise of R&D expenditure is preferable.
- Strategies of individual institutions should be brought into more coherence.

The Netherlands on the other hand side have been struggling to maintain their R&D spending level although the higher education sector is highly competitive on an international level. In the enterprise sector R&D spending is highly concentrated: About 80% of total business expenditures on R&D are spent by the so called „Big Seven“ of the Dutch industry (Philips, Unilever, Akzo Nobel, Shell, ASML, DSM and Océ). The Netherlands have thus implemented a number of measures to improve their position by stimulating an increasing number of enterprises to perform R&D. An important measure in this context is the Dutch Tax Credit system. The Netherlands have also created financial resources outside the budgetary appropriations: The financial sources stem mainly from the revenue of the state owned gas-enterprises and from proceeds of the sale of several state-owned enterprises. In 2002 the expenditures of the Economic Structure Funds accounted for 2.4 billion Euros, the revenues accounted for 2.0 billion Euros. At the end of 2002 the account balance of the Economic Structure Funds was about 1.7 billion Euros. The Netherlands have so far implemented three funding rounds based on the resources. The programs are implemented by the Dutch innovation agency Senter. Its primary aim is the funding of investment projects in the economic structure of the Netherlands. The Ministry of Economic Affairs and the Ministry of Public Finance administer the fund and the Netherlands Court of Audit controls the management and spending of the fund. The programs are focused on technologies or on specific other objectives (mission oriented programs).

Although these country studies can by no means be taken as a 'representative' picture of developments in STI policies, a few observations emerge which might serve as a basis for policy learning:

- Countries have opted for the regular budget as the channel for the additional appropriations.
- Most countries have coupled the process of substantially increasing funds with some form of strategy formulation (resulting in strategic policy documents like white papers, action plans or laws). This strategy formulation serves for the basis of multi-annual orientation of behaviour and expectations.
- In most countries (with the notable exception of Finland) the increase in funding was accompanied by changes in institutions and instruments, in some cases even by the complete overhaul of the system of 'policy delivery'.
- In a number of countries, a main thrust of the funding was to strengthen the public research base and the science system – if only to 'match' the developments in the private sector and to allow for a 'balanced development' of the Innovation System.

5.2.3 Recommendations

Austria has embarked on ambitious goals to increase its R&D spending in line with the Lisbon objectives of the European Commission. The results of the most recent R&D

survey are encouraging: Austria will probably increase the R&D spending level to 2.27% of GDP in 2004. Simultaneously, Austria has started a number of new programs which are financed out of the Offensivprogramme I&II (additional appropriation for R&D outside the federal budget) and has established the National Foundation for Research, Technology, and Development.

The special funds are allocated based on the recommendations of the Council for Research and Technology Development which was established in 2000. While the actions have created new momentum and increased public attention, a number of issues are still not solved. Most importantly, a coherent and binding national strategy for R&D is still missing, the competencies between the three involved ministries need to be better coordinated and streamlined, financing of the catching-up process in science and technology has to be secured in a longer run perspective. Finally, there should be paid much more attention to governance criteria and still more emphasis on evaluations for S&T policy measures.

The strategy issue is still pending and no major initiatives to remedy this situation are visible at the moment. Presently only the Council for Research and Technology Development bases its decisions on a formulated strategy paper. While this is sufficient for allocating the special funds it encompasses only about 12% of resources devoted to science and technology in Austria. The remainder of funds is allocated based on decentralized decision making processes which are hardly coordinated and which rather reflect the interests of the involved ministries and bureaucrats. There is no overall monitoring in this process which thus may or may not contribute to the achievement of overarching STI policy goals.

A well formulated strategy which is agreed upon by the most important actors in the national innovation system should be the basis for further structural changes in the innovation system. This concerns the unsatisfactory competency mix between the three involved ministries. In this context the developments in Finland and Canada could serve as good examples on how to run a system or implement reforms. Of course, merely copying these systems or processes does not suffice to make them work in Austria. The Austrian history and the present structures call for solutions which work in the Austrian context. Innovations in the system governing science and technology policy should not be the exception to the rule but live up to the standards expected from other actors in the national innovation system.

The Irish example nonetheless raises some issues which are relevant in the Austrian context too. An efficient institutional framework may be a precondition for increased public spending on R&D. If the system is not yet optimized then new investments may be less efficient. Thus institutional reform should take place before substantial increases in public R&D spending occur. This was clearly not the case in Austria. Some reforms took place alongside the new appropriations for Science and Technology and thus induced traditional reactions of the "technology policy system". While this may be the path dependent Austrian way it is far from satisfactory. The number of promotion programs has not declined but substantially increased. The system is thus very complex and hard to assess and - more worryingly - hard to access especially for small companies. The increasing number of programs is of course difficult to manage and to monitor as the responsibilities are dispersed throughout the system. Overlaps between programs (old and new), different governance principles and standards, lack of cooperation and an unclear evaluation strategy are still pending tasks for policy makers which have to be addressed in the near future.

The interplay of strategic action, institutional reform and additional resources is a complex area. On the level of the policy delivery system (funding organizations, agencies etc.), the country examples demonstrate that it is favourable to have the institutional setting in place before the additional funds are being made available (as was the case in Finland) or to have a well-structured plan for institutional overhaul to be carried out alongside with the funding (as seem to have been the case in Canada or Iceland). Such a 'kick-start' is often seen as a chance for institutional change. In the case of the Netherlands and Ireland, this change might have added to the already complex system, in Hungary it has contributed to the sustained institutional changes which nevertheless might not have led to an optimal or stable situation. The lesson for Austria could be that the strategy formulation, the institutional change and the selection of instruments should be brought into sync with the additional appropriations of funds.

A strategy, of course, has to outline the most important action lines which are then to be broken down into operational measures. The econometric modelling of the determinants of business R&D spending has demonstrated that there is no trade off between investments in the academic sector and the enterprise sector: R&D activities in the academic sector stimulate business R&D. Furthermore, both, direct and indirect support measures do have a positive impact on R&D spending in the business sector.

The model estimates also highlight the importance of structural change. In the context of the present catching-up objectives this is probably the most important issue. Structural change is an ongoing process which increases the weight of high-tech and/or innovation intensive industries in the composition of industries. This creates an autonomous upward move of R&D spending. Consequently, strategies which aim at increasing R&D spending will be more successful if they stimulate structural change and thus reinforce the already existing tendency towards R&D and innovation intensive industries. To be less abstract, structural change boils down to activities which foster the creation of new enterprises, facilitate the location of research divisions of multinational enterprises or support enterprises in their activities to diversify into new business areas.

The Finnish case is a good example to illustrate this issue. Starting form an industry structure with a large share of resource based industries Finland has dramatically increased its share of high tech industry. A large part of this ascent is due to the rise of Nokia to the leading mobile communications company. Nokia has increased its R&D spending alongside the growth of the company and thus contributes more than 20% to Finnish R&D spending. While the success of Nokia is easily visible, many other Finnish companies have similar success stories to tell but not the same visibility. Thus structural change, even if there is no flagship company comparable to Nokia, may in sum produce similar results. Thus activities in the field of start-up companies, attraction of international R&D units and diversification by established companies should be high on the agenda.

The positive impact of special appropriation in Austria would be reversed if these funds will not be continued. In the past they have assured that the public outlays for science and technology increased – the notable exception was the year 2003.

Consequently, the special appropriations should be part of the regular budget after 2006 when the second slice of the offensive program elapses.

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7. Annex

7.1 CANADA

7.1.1 Starting Position and Challenges

Canada has made substantial efforts since the middle of 1990s to increase its technological position and to manage the transition towards a knowledge based economy (KBE). Between 1995 and 2000 Canada remodelled the governance structures in the national innovation system and has increased the budget allocation for Science & Technology (S&T) from 3.5 to 4.3 percent of the overall budget. The reforms of the Science & Technology system resulted in a modest increase of the R&D to GDP ratio – which is just below the 2% mark - up to the year 2000. In 2001 reduced R&D spending of the business sector resulted in a reduction of R&D spending.

Since 1995 the dynamic element of the Canadian Innovations system was the public sector which increased its investments share in overall R&D spending while the business sector's share was on the decline. Most of the reductions of the business sector were compensated by foreign sources which increasingly contribute to the financing of R&D in Canada (see table A.1).

Table A.1: Federal S&T Indicators (calendar-year basis)

Canada	**Units**	**Calendar Year** 1997	1998	1999	2000	2001	2002
GDP	$ millions current	882 733	914 973	980 524	1 064 995	1 092 246	1 122 712
GDP implicit price index	1997=100	100.0	99.6	100.9	105.2	106.3	-
Population	Thousands	29 987	30 248	30 509	30 791	31 111	31 414
GERD	$ millions current	14 639	16 082	17 465	19 585	20 828	20 744
"Real" GERD	$ millions 1997	14 639	16 147	17 309	18 617	19 594	
GERD/GDP	%	1.66	1.76	1.78	1.84	1.91	1.85
"Real" GERD/capita	$ 1997	488.2	533.8	567.3	604.6	629.8	-
GERD funding sector							
Federal government	%	19.2	17.6	18.4	18.2	18.4	19.1
Provincial governments	%	4.5	4.0	4.4	4.5	4.5	4.9
Business enterprise	%	48.1	45.7	44.3	42.5	41.9	40.0
Higher education	%	13.5	14.5	15.2	14.5	15.0	16.5
Private non-profit	%	2.5	2.3	2.2	2.3	2.3	2.6
Foreign	%	12.3	15.9	15.9	18.1	17.8	16.9
GERD performing sector							
Federal government		11.7	10.8	10.6	10.6	10.6	10.7
Provincial governments		1.5	1.3	1.3	1.3	1.2	1.3
Business enterprise		59.7	60.2	58.6	58.5	57.5	54.2
Higher education		26.5	27.2	29.1	29.3	30.3	33.5
Private non-profit		0.6	0.5	0.4	0.3	0.3	0.3
Federal intramural spending as a % of federal funding		61.12	61.59	57.82	58.48	57.84	56.08
"Real" federal contribution to GERD	$ millions 1997	1720	1750	1842	1977	2086	-

Sources: Statistics Canada, 2002, *Science Statistics*, Vol. 26, No. 7 [Cat. No 81-001-XIB].
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Canada aims to be one of the top five countries in the OECD by 2010. The Canadian government attempts to achieve this ambitious goal by doubling the federal R&D

spending up to the year 2010. The following sections outline the major developments in Canadian Science & Technology policy, describe the most important institutions and give an overview of the actual allocation of fund for the years 2003 and 2004.

7.1.2 Canadian Science and Technology Policy

Canada has systematically redesigned its Science and Technology Policy since the publishing of the Federal strategy in March 1996: *Science and Technology for the New Century* laid out the strategy for improving the federal government S&T performance and aims at enhancing the ability of the federal government to make its distinct contribution to the Canadian innovation system.

It focussed on three inter-related goals for building the innovation system: sustainable job creation and economic growth, improved quality of life, and advancement of knowledge. The intended transformation of the way S&T were managed in Canada was supposed to evolve around two themes: "The first was improved governance: Making better use of external advice, improve support to decision making, enhancing horizontal coordination, and making intergovernmental cooperation and coordination more effective. The second was improving the outcomes from federal S&T through the elaboration of a number of operating principles. These principles ranged from increasing the effectiveness of federally supported research and capturing the benefits of partnerships, to promoting a stronger science culture in Canada."

The implementation of this strategy resulted in a number of new programmes, initiatives, advisory councils, etc. of which the most important were: the Canada Foundation for Innovation was founded in 1997, followed by the Millennium Scholarships, Canada Research Chair Program, Genome Canada and, most recently, the Canadian Institutes of Health Research and the Canadian Foundation for Climate and Atmospheric Science (see below).

Since 1996, the Canadian government hat made substantial strides in reshaping its Science & Technology institutions and mechanisms of governance. There has been a shift from "industry advisory bodies" to more inclusive "science advisory boards". All departments have adopted a far more structured approach to receiving and acting on scientific advice. The government, up to the Cabinet, has taken a more proactive approach to ensuring that it receives broadly based advice on horizontal Science and Technology issues. Consequently, a number of new advisory bodies have been created:

- The Prime Minister's Advisory Council on Science and Technology (ACST) was established in 1996. It provides the Prime Minister with expert, non-partisan advice on national S&T goals and policies, and their application to the Canadian economy. The Council's role is to:
  - Advise on the transition to a Knowledge Based Economy (KBE) and assist in determining the necessary adjustments
  - Advise on how to increase the number of Canadians with the skills necessary for a KBE
  - Advise on how government and industry can work in partnerships to incorporate new technology into marketplace products, processes or services
  - Provide direct advice on S&T issues to the Cabinet Committee for the Economic Union, and
  - Respond to specific questions or tasks requested by the Prime Minister

The Council has the ability to establish expert panels and has published a number of reports (see acst-ccst.gc.ca).

- The Council of Science and Technology Advisers (CSTA) aims at incorporating more external advice into the formulation of the Canadian S&T strategy. The CSTA was founded in 1998 and provides the federal government, specifically the Cabinet Committee for the Economic Union, with external expert advice on internal federal government S&T issues requiring strategic action. The CSTA has undertaken a series of reviews of the federal S&T system and has issued a number of reports that have had a significant impact on the way federal S&T is conducted and managed (see csta-cest.gc.ca).
- The Assistant Deputy Ministers´ Committee on Science and Technology (ADM Committee) has the following mandate:
  - To implement the cross-government commitments made in the S&T strategy, i.e., the wise use of federal investments in S&T and sharing of best practices

- To develop proposals and advice to the government on key horizontal S&T policy issues, and
- To provide a forum for interdepartmental consultation on S&T policy and program directions, sharing of information, and coordination of efforts and initiatives across the federal S&T system.

The ADM Committee has helped to develop a stronger sense of community across federal S&T, fostering information-exchange and raising the profile of S&T issues within the government. The ADM Committee has released a series of reports on S&T in Canada (see www.innovation.gv.ca)

Additionally the Minister of Industry funded the Information System for Science and Technology Projects at Statistics Canada. The indicators developed in this project provide a background against which federal government departments and agencies can measure how effectively they are applying the operating principles of the federal S&T strategy. These indicators complement the measures used for accountability and priority setting within individual departments and agencies and across government. In addition, they begin to show how the Canadian S&T system works.

Important other measures – which are not presented here – aimed at:

Management and operating principles: the management of human resources for federal S&T, the formulation of operating principles for S&T policies and programmes initiatives to increase the effectiveness of federally supported research and the promotion of partnerships and cooperations.

Sustainable development: Canada also emphasises preventive approaches and sustainable development as a major dimension in its S&T policy.

Promoting a stronger science culture: fostering a strong science culture was seen as a foundation for building the Canadian innovation system and thus an important part of the strategy. Consequently a number of exhibitions, conferences and museums have been funded to strengthen the science culture.

The Canadian government sees an important role for itself in applying scientific advice to its policy, stewardship and economic development challenges as critical to the innovation system’s ability to function efficiently.

In January 2001, the government committed itself to further strengthen Canada’s investments in science and technology (S&T). The goal is for Canada to become one of the top five countries for research and development (R&D) by 2010. As its contribution to this challenge, the government will at least double the current federal investment in R&D by 2010.

The strategy includes an enhancement of expenditures for research and development in general and the provision of additional appropriations.

Atlantic Innovation Fund

The first institution working explicitly with additional appropriations is the Atlantic Innovation Fund (AIF), a $300-million, 5-year program designed to strengthen the economy of Atlantic Canada by accelerating the development of knowledge-based industry. It started in June 2000. The AIF should help increase the region's capacity to carry out leading-edge research and development that directly contributes to the development of new technology-based economic activity in Atlantic Canada. Therefore, it invests in the Atlantic region’s innovation infrastructure, particularly Atlantic universities and research institutions in order to strengthen the capacity of the region to develop and commercialise new technologies.

The AIF will focus on R & D projects in the area of natural and applied sciences, as well as in social sciences and humanities where these are explicitly linked to the development of technology-based products, processes or services, or their commercialization.

Investments made through the AIF will focus on, but will not be restricted to, these growth sectors. For instance, the AIF will also encourage the development of technologies that allow sectors, such as oil and gas, agriculture and agri-food, fisheries, forestry and mining, to improve their competitive positions.

The AIF is guided by an Advisory Board that makes recommendations on specific project proposals and provides advice to the Minister of Industry and Minister of State for the Atlantic Canada Opportunities Agency (ACOA) on strategic decisions for the AIF. ACOA provides administrative support to the Advisory Board.

Canada Foundation of Innovation (CFI)

The Canada Foundation for Innovation (CFI) is an independent corporation created in 1997 by the Government of Canada to fund research infrastructure. The CFI's mandate is to strengthen the ability of Canadian universities, colleges, research hospitals, and other non-profit institutions to carry out research and technology development that will benefit Canadians.

In 1997, the federal government provided an up-front investment of $800 million, which allowed the Foundation to provide about $180 million on average annually for research infrastructures until 2002. Currently, the CFI has a budget of $3.65 billion until 2010 and funds up to 40 percent of a project's infrastructure costs. The money comes from budgetary sources.

The CFI distributes its funds according to the following program lines:

- The "Innovation Fund" enables eligible institutions to strengthen their research infrastructure in priority areas as identified in their strategic research plan. The fund promotes multidisciplinary and inter-institutional approaches.
- The "New Opportunities Fund" provides infrastructure support to newly recruited academic staff. The fund helps universities attract high-calibre researchers in areas that are essential to the institutions' research objectives.
- The "Infrastructure Operating Fund" contributes to the incremental operating and maintenance costs associated with the infrastructure projects funded by the CFI.
- The "Canada Research Chairs Infrastructure Fund" provides infrastructure support to the Canada Research Chairs Program. The Program is establishing 2,000 research positions at Canadian universities.
- The "Research Hospital Fund" is designed to contribute to research hospital based projects that focus on innovative research and training. It supports large-scale infrastructure projects that take a multidisciplinary approach—involving biomedical, clinical, health services, and population health research.

- In 2000, the CFI established two International Funds, each with a one-time $100 million budget. The Canadian portion of projects that qualified under both these funds were eligible to be financed up to 100 percent.
- The “International Joint Ventures Fund” enabled the establishment of research infrastructure projects in Canada—to take advantage of unique research opportunities with leading facilities in other countries.
- The “International Access Fund” provided support to Canadian institutions and researchers—to enable them to access major international collaborative programs and facilities in other countries.

Research Chairs

The Canada Research Chairs Program (see www.chairs.gc.ca) is an important building block of the national strategy to make Canada one of the world's top five countries for research and development. In 2000, the Government of Canada allocated $900 million to establish 2,000 research professorships—Canada Research Chairs—in universities across the country. Chairholders advance the frontiers of knowledge in their fields, not only through their own work, but also by teaching and supervising students and coordinating the work of other researchers.

By helping Canadian universities and their affiliated research institutes and hospitals become world-class centres of research and research training, the Chairs Program contributes to enhancing Canada's competitiveness in the global, knowledge-based economy, improving Canadians' health, and enriching our social and cultural life.

The Chairs Program also seeks to:

strengthen research excellence in Canada and increase Canada's research capacity by attracting and retaining the best researchers;

improve the training of highly qualified personnel through research;

improve universities' capacity to generate and apply new knowledge;

promote the best possible use of research resources through strategic institutional planning, and through collaboration among institutions and between sectors.

Canadian universities both nominate Canada Research Chairs and administer their funds. Each eligible degree-granting institution receives an allocation of Chairs. For each Chair, a university nominates a researcher whose work complements its strategic research plan and who meets the program's standards. There is also a special competition for small universities.

Three members of a college of reviewers, composed of experts from around the world, assess each nomination and recommend whether to fund the position.

Genome Canada

Genome Canada (see www.genomecanada.ca) is the primary funding and information resource relating to genomics and proteomics in Canada. Dedicated to developing and implementing a national strategy in genomics and proteomics research for the benefit of all Canadians, it has so far received $375 million from the Government of Canada. The Government of Canada committed an additional $60 million to Genome Canada in the 2004 Federal Budget. Genome Canada has established five Genome Centres across the country (Atlantic, Québec, Ontario, Prairies and British Columbia) and has as a main objective to ensure that Canada becomes a world leader in genomics and proteomics research. Together with its five Genome Centres and with other partners, Genome Canada invests and manages large-scale research projects in key selected areas such as agriculture, environment, fisheries, forestry, health and new technology development. Genome Canada also supports research projects aimed at studying and analyzing the ethical, environmental, economic, legal and social issues related to genomics research(GE3LS).

To date, Genome Canada has invested more than $365 million across Canada, which, when combined with funding from other partners, is expected to result in more than $800 million in 79 innovative research projects and sophisticated science and technology platforms.

Genome Canada has held three national Competitions to date. The Applied Genomics and Proteomics Research in Human Health Competition projects, as with Competition II and Competition I projects, were selected based on their international competitiveness and scientific excellence in the framework of Canada's social and economic fabric. In fact, the research projects were selected following an in-depth evaluation process involving in each competition more than 150 international experts.

In January 2004, Genome Canada announced the results of the Genoma Espana – Genome Canada. The competition was the result of the Framework Agreement to Promote Scientific and Industrial Cooperation between Canada and Spain, which was signed in May 2002. Genome Canada also has international agreements with other leading European countries including, Sweden, the Netherlands and Denmark.

Genome Canada, through its International Consortium Initiative, is also part of the $95 million Canadian-led Structural Genomics Consortium (SGC). The SGC is an international partnership with the United Kingdom via the Wellcome Trust, GlaxoSmithKline and four other Canadian organizations. It is the first consortium of its kind, focusing its efforts on determining the three-dimensional structure of more than 350 human proteins.

Genome Canada is also involved in two other major international initiatives: the Haplotype Map project and the Bovine Sequencing project. The Haplotype Map project is a $150 million program to identify repetitive gene associations within the human genome. Announced in October 2002, it requires major financial and scientific contributions from the United States, the United Kingdom via the Wellcome Trust, Canada, Japan, China and others. The Bovine Genome Sequence project was announced in December 2003 and is a $53 million US international effort to sequence the bovine genome. This collaboration includes researchers from the US, Australia and New Zealand.

The Genome Canada Board of Directors is composed of 15 members from industry and the scientific community in Canada.

Other institutions benefiting from increased expenditures

There are several other efforts by the government to strengthen Canadian science and technology, but most of them are increases of regular R&D-budgets. For example, in the December 2001 Budget, the government decided on budget increases for the three national granting councils (Natural Science & Engineering Research Council, Canadian Institutes of Health Research and Social Sciences and Humanities Research Council), as well as to the National Research Council to strengthen university research and to extend the NRC's regional innovation initiative.

E.g. the Canadian Institutes of Health Research (CIHR), which was founded in April 2000 and absorbed the existing Medical Research Council, received new funding which nearly doubled federal investment in health research to $477 million in 2001-2002. A further increase of $75 million per year was provided by the government in the December 2001 Budget bringing the CIHR budget to $552 million per year.

Box 1: Overview of Canadian Budget 2003/2004

Canadian Budget 2003

S&T Highlights

Generating Knowledge:

- Increased funding to Canada's Granting Councils ($125M/yr)
- Funding for indirect costs of university research ($225M/yr)

Commercialization, Partnerships and Technology Transfer:

- Additional funding for the Industrial Research Assistance Program ($25M/yr)
- Purchase of Business Development Canada shares to improve access to venture capital ($190M)
- Additional funding for Aboriginal Business Canada ($20M/ two yrs)
- Funding for the MaRS (Medical and Related Sciences) Discovery Centre ($20M)

Health and the Environment:

- Funding for new diagnostic equipment in research hospitals through the Canada Foundation for Innovation ($500M)
- Funding for a special program for applied health genomics ($75M)
- Climate change initiatives ($1.7B, including $200M for new climate change technologies)

Innovative Communities:

- Funding for the National Research Council to establish two new innovation centres ($10M/yr)
- Additional funds for Community Access Program and SchoolNet ($300M)
- Funding for infrastructure supports ($3B/10 years)

Skilled Workers:

- 4,000 additional graduate fellowships ($270M/ 4 years)
- Funding for a fast-track system for immigrants with job offers, etc. ($41.4M)
- Funding for the Canadian Learning Institute ($100M)
- Additional funding for the Canada Student Loan Program ($60M/ 2years)
- New scholarship program for Aboriginal Canadians ($12M)

Business Climate:

- Elimination of capital taxes by 2008
- Support for External Advisory Committee on Smart Regulation
- Iimprove competitiveness of tax regulations and corporate governance standards

Canadian Budget 2004

S&T Highlights

- An increase of $90M/year for granting councils, with direction to triple current $10M/yr support for commercialization;
- Aadditional $20M/year to universities and research hospitals for their indirect costs with respect to commercialization;
- $250M for the BDC to augment pre-seed and seed funding, specialized venture capital, and risk capital;
- $50M/5 years to Industry Canada for a new pilot competitive commercialization fund;
- $25M/5 years to Industry Canada for a pilot competitive commercialization fund for federal (non-regulatory) research labs;
- $200 million to Sustainable Development Technology Canada; an addition to $100 million allocated in past Budget

You will notice a clear emphasis on commercialization in the 2004 budget.

7.1.3 Monitoring and Evaluation

Although there are regular evaluations of the Atlantic Canada Opportunities Agency, the organization which also administers the AIF, no evaluation specifically on the work of AIF could be found.

The CFI on the contrary has undertaken a number of formal evaluations of its programs since its creation. Each year, Canadian universities, colleges, hospitals and other not-for-profit research institutions that have received funding report on their accomplishments in reaching their strategic research goals. All reports can be downloaded from the CFI-website.

Most evaluations focus on special CFI-programs, and so far there is no long-term over-all evaluation of the Canada Foundation for Innovation. The latest report analyses the impact of projects funded by CFI from April 2002 until March 2003. It draws the following conclusions:

“The data provided in this impact report leave no doubt about the positive impact that the CFI program is having on building capacity for innovation. In addition to providing statistical information, the annual project and institutional reports denote a sense of enthusiasm and optimism, despite some of the challenges encountered in the implementation of projects.

By giving Canadian researchers the tools necessary to undertake riskier and more innovative research, the CFI program has already enabled enhanced research productivity and transfer of technology and knowledge to end users. Given the length of time required for the translation of knowledge into applications, this bodes well for the future and puts the CFI program in the vanguard of the tools that Canada has given itself to meet its target to become one of the most innovative economies in the world by 2010.” (Nicole Bégin-Heick, December 2003)

7.1.4 Institutional Overview

- Atlantic Innovation Fund (AIF)
    - 5-year program since June 2000: $300 million
    - Created to invest in the Atlantic region’s innovation infrastructure, particularly Atlantic universities and research institutions in order to strengthen the capacity of the region to develop and commercialise new technologies.
    - Investments mainly, but not exclusively in the development of technologies that allow sectors as the oil and gas industry, agriculture and agri-food, fisheries, forestry and mining to improve their competitive positions.
- Canada Foundation for Innovation (CFI)
    - created in 1997

  - up-front investment in 1997: $800 million, which allowed the Foundation to provide about $180 million on average annually for research infrastructure until 2002
  - Currently, CFI's budget is $3.65 billion until 2010
  - The money comes from budgetary sources.
- In the December 2001 budget, the government made further *commitments to strengthen Canadian S&T:*
  - budget increases for the three main granting councils: the Natural Sciences and Engineering Research Council of Canada (NSERC), the Canadian Institutes of Health Research (CIHR) and the Social Sciences and Humanities Research Council of Canada (SSHRC)
  - budget increase for the National Research Council (NRC) to strengthen university research, and to extend the NRC's regional innovation initiative.
  - The 2001 budget also allocated $40 million to extend SchoolNet & Community Access Program for the years 2003 and 2004, and $35 million per year for 3 years thereafter. The goal is to support broadband expansion.
  - $110 million are invested to build "CA*net 4", a new generation of Internet broadband architecture.
  - Additional funds of $200 million were announced for the support of the indirect costs of university-led research.
- Technology Partnership Canada (TPC)
  - established in 1996
  - TPC advances and supports government initiatives by investing strategically in research, development and innovation in order to encourage private sector investment, and so maintain and grow the technology base and technological capabilities of Canadian industry. TPC also encourages the development of small and medium-sized enterprises (SMEs) in all regions of Canada.
  - The initial budget was $150 million in 1996, in 2001 it operated with a budget of $300 million/year.

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7.2 FINLAND

7.2.1 Starting Position and Performance

Since the recession of the early 1990s, the development of the Finnish innovation system and knowledge-based society has been at the top of the policy agenda for growth and competitiveness. Finland has become internationally known as an exemplary case for forward looking innovation policymaking, a country in which the concept of national innovation system (NIS) was adopted as a basic element of science and technology policy already in the early 1990s. The ideas included in the concept of NIS — innovation process and related policies are looked from a broad perspective covering education and science, innovative activities of companies and commercialisation of technological innovation — were introduced into science and technology policymaking amidst of deep depression of the early 1990s. In this complex system new knowledge is produced by universities and polytechnics, research institutes and business enterprises, among others. The principal users of knowledge are enterprises, private citizens, and policy-makers and administration responsible for societal development.

In 1999, the finish government decided to increase government research funding with a view to raising the national research input to 2.9% of gross domestic product by 1999. A special aim of the increase in research resources was to intensify the operation of the innovation system to the benefit of the economy as a whole, enterprises and employment. The responsibility for planning the allocation of these funds rested with the Science and Technology Policy Council of Finland.

The share of GDP spent on R&D expenditure increased from 2.0 per cent in 1991 to 3.5 percent in 2002 and is now among the highest in the world. In money terms expenditure on research and development was 4.8 billion euros in 2002 as well as in 2003. Pace of growth in R&D performed by the Finnish business sector has been internationally remarkably high between 1995 and 2002. During the period average annual growth rate of business R&D in Finland was above 10 per cent, whereas within EU-15 the average growth was 4.6 per cent annually.

In 2002, the university sector experienced the largest increase in R&D expenditure. The sector's R&D expenditure rose by 90 million euros to 930 million euros. In the public sector, R&D expenditure grew by 29 million euros to 530 million euros in 2002. However, it is estimated from available preliminary data that in 2003 the R&D expenditure of the public sector declined for the first time since 1995 to 518 million euros. The standstill in the public R&D investments is although expected to be reversed because of decisions made by the Government of Prime Minister Matti Vanhanen (in power since June, 2003). The Government committed itself in its Programme to increase public appropriations on research and development during the Government period. For 2004 Government budget funding for R&D amounts to 1538 million euros. The funding is up by 93 million euros from the previous year. In nominal terms research expenditure is set to rise by 6.4 per cent and even in real terms by 3.6 per cent. This represents the biggest growth since 1997 when the Programme for Additional Appropriation for research 1997-1999 was launched.

7.2.2 Fundings and Institutions

Increases in government R&D funding mainly concern administrative branches that are major receivers of R&D funding. Funding will go up most in the administrative branch under the Ministry of Education. Funding under the Ministry of Trade and

Industry will also increase. R&D funding will decrease only in the administrative branches under the Ministries of Transport and Communications and Defence. The proportion of funding of the Academy of Finland will grow by nearly one percentage point in 2004, but the proportion of the other organisation awarding funding on competitive basis, the National Technology Agency (Tekes), will remain essentially unchanged.

In general, public R&D investments cover below 30 per cent of total R&D expenditures in Finland. Business enterprises' share of the total R&D input has been circa 70 per cent during the recent years. In 2002 the R&D expenditure of business enterprises grew by roughly 2 per cent compared to the previous year, in real terms to 3.4 billion euros. In the electronics industry, R&D spending rose by 31 million euros in 2002. The industry's share of business enterprises' R&D spending decreased slightly to 51 per cent. Among the manufacturing industries, the strongest growth in R&D investments, some 34 million euros, was in the chemical industry, whereas the R&D spending of the metal and mechanical industry decreased by the same amount.

Large investments in education over the past decades have led to a general rise in the educational attainment of the employed population. Currently in Finland well over 25 per cent of population aged 15-64 has completed tertiary-level education. Share of science and engineering degrees of total new degrees awarded was close to 30 per cent in 2001.

The Science and Technology Policy Council

The Science and Technology Policy Council of Finland played a particularly important role in integration of national innovation system thinking into national policymaking. It was established in March 1987 to continue, with a slightly different emphasis, the tasks of the Science Policy Council founded in 1963. The Council is chaired by the Prime Minister. The membership consists of the Minister of Education, the Minister of Trade and Industry, the Minister of Finance, four other ministers, and ten other members well versed in science or technology (representatives of the Academy of Finland, Tekes, industry and employers’ and employees’ organisations). The Government appoints the Science and Technology Policy Council for a three-year term.

The main tasks of the council include directing science and technology policy, dealing with the overall development of scientific research and education, and issuing statements on the allocation of public science and technology funds to the various ministries and fields. These guidelines and issue statements are made public in triennial key policy documents, in so-called science and technology policy reviews. The reviews analyse past developments, draw conclusions and make proposals for the future. The latest review came out in 2002 ("Knowledge, Innovation and Internationalisation"). The previous documents appeared in 2000 ("Review 2000: The Challenge of Knowledge and Know-how"), in 1996 ("Finland: a knowledge-based society"), in 1993 ("Towards an innovative society – a development strategy for Finland") and in 1990 ("Review 1990 – guidelines for science and technology policy in the 1990s").

Concerning the additional appropriation, the Science and Technology Policy Council drew up a plan for the appropriation whereby the bulk of funds were to be allocated to R&D through appropriate channels in the science and technology administration, notably by increasing the resources allocated to the National Technology Agency (TEKES) and the Academy of Finland by means of competitive tenders.

Ministry of Education and Ministry of Trade and Industry

The Ministry of Education and the Ministry of Trade and Industry are the two most important ministries in the Finnish national innovation system. Each administers approximately a third of the public research funding. Apart from these two ministries, the Ministry of Social Affairs and Health and the Ministry of Agriculture and Forestry, in particular, are also significant providers of finance for research.

The Ministry of Trade and Industry is responsible for technology policy and providing support for industrial research and development. It also exercises prime responsibility for issues related to EU research in Finland. The administrative field of the Ministry of Trade and Industry contains a number of organisations such as publicly supported research institutes, agencies and state-owned companies engaging in special financing, which are an important part of the national innovation environment. Some of these have innovation at the centre of their mission or focus on providing conditions for technology-oriented companies. Other agencies have more general tasks including promoting firms, internationalisation and export, and in some instances regional policies while at the same time also serving the needs of innovative firms to some extent (cf. Evaluation of the Finnish Innovation Support System, 2003).

National Technology Agency (TEKES)

Within the administration of the Ministry of Trade and Industry, TEKES, the National Technology Agency, has a central position in planning and financing research and development. It is the principal source of public funding for applied technological research and industrial R&D. TEKES prepares, funds and co-ordinates national technology programmes, and provides funds for applied technical research and risk-carrying R&D ventures in industry. It also contributes to the preparation of national technology policy. With its share of close 30% of Government appropriations for R&D (€399 million in 2003), TEKES is the largest organisation in the field.

The Technical Research Centre of Finland (VTT)

The Technical Research Centre of Finland (VTT) is an impartial expert organisation administrated by the Ministry of Trade and Industry that carries out technical and techno-economic research and development work. It is the largest governmental research institute in the Nordic countries and has about 3000 employees.

The additional appropriations allocated to Tekes and VTT are typically not earmarked, so it is seldom possible to identify whether projects were set up through the additional appropriations programme or by other means. A new feature in projects launched by Tekes is that the additional appropriation has given rise to new types of collaboration, notably in the form of cluster programmes, and has enhanced the position of service sector.

The Academy of Finland

The Academy of Finland is the central financing and planning body in the field of basic and university research. The main function of financing high-quality research is carried out through individual projects, programmes, centres of excellence, research posts and research training. In 2003, approx. 13 per cent (EUR 185 million) of all Government research funding were be channelled through the Academy. It has an important role in strategy formulation for basic research, research training and science policy, as is illustrated in its newly published strategy (2003). The Academy's strategy underlines the importance of investing in education and research as a key to achieving national success. According to its new strategy, the Academy is committed to promoting the development of Finnish society, to implementing the European Research Area and to strengthening global co-operation in such a way that it supports the developing information and education society.

The Academy's responsibilities also include the advancement of scientific research and the encouragement of its exploration, and the development of international scientific co-operation. Projects financed by additional funds from the Academy of Finland focus on fields such as economy, business environment and on activities that foster job creation.

Universities

In general, Universities have been major beneficiaries from the additional funding, receiving direct funding from all involved institutions: from the Ministry of Education, from the Academy of Finland and from Tekes that funded collaborative projects.

In 2000, the Government decided to make one more additional appropriation for universities in order to increase university funding to the targeted level. According to the Government’s plan, the universities’ core funding was to be gradually increased during 2001-2003 to about €42 million in total. The financing was based on the Government’s ‘future package’, consisting of the income derived from the privatisation of state-owned companies.

SITRA (Finnish National Fund for Research and Development)

Sitra is a relatively autonomous organisation that is subordinate to the Finnish Parliament. The organisation was founded in the late 1960's. Since then Sitra’s activities have expanded from the original task of financing technical research and development to cover a range of research, educational and venture capital activities that benefit the economy and society at large. Nowadays Sitra's operating segments are technology transfer and seed finance, the financing of growth companies, investments in venture capital funds, and strengthening of the links between research and societal decision-making through research and training.

Finnish Industry Investment Ltd (FII)

Finnish Industry Investment Ltd (FII) is a state-owned investment company, which is administered by the Ministry of Trade and industry. FII engages in equity capital investment and invests in venture capital funds, private equity funds and directly in selected target companies. The investment capital of Finnish Industry Investment Ltd is generated from the privatisation proceeds of state-owned companies.

The primary focus of FII, given in the current legislation and in the decision of the government, is to stimulate the Finnish venture capital market by addressing market failures particularly in early stage venture capital. FII's central role is to assist in the formation and growth of innovative young firms in Finland via support measures directed towards stimulating at greater supply of equity finance. At the end of 2001, the state's investments in FII totalled €227.9 million. The primary mode of operation of FII is to invest in individual venture capital funds as a limited partner.

Finnvera

Finnvera is a specialised financing company, which is entirely owned by the Finnish state. The company was created through the merger of Kera Corporation and the Finnish Guarantee Board in 1999. The two organisations were merged in order to make the state's specialised financing operations more effective and to be able to offer Finnish companies financing services to further domestic operations, exports and internationalisation through one organisation. Finnvera has 16 regional offices around the country.

Finnvera acts as a provider of complementary risk financing services in close association with banks and other financing organisations. The company also has a visible role to play in covering export financing risks: Finnvera works as Finland's Export Credit Agency, which offers services for export business.

In financing businesses, Finnvera is tasked with identifying viable business ideas and development and expansion plans for which insufficient funds are available from market players on reasonable terms. Finnvera bases its financing decisions on the vitality and potential profitability of the target companies. One of the aims of financing a company's domestic business is to support the creation of new companies and the growth of SME's. In June 2003 Finnvera established Veraventure Oy, an investment company responsible for capitalising and developing corporate regional investment funds. All Finnvera holdings in regional investment companies are being amalgamated into the new subsidiary.

Finnvera's regional offices are mainly responsible for financing decisions pertaining to the domestic operations of companies and for the associated management of customer relations. The regional offices of Finnvera also market financing schemes to support the internationalisation or exports of companies. In addition the regional offices co-operate with other stakeholders to achieve the regional goals of business and industrial policy.

The Foundation for Finnish Inventions

The Foundation, founded in 1971, supports and promotes invention work and the development and exploitation of inventions in Finland. The staff includes a network of innovation managers in the main universities and in the regional Employment and Economic Development Centres all over Finland. The Foundation’s main tasks consist of consultancy, evaluation and protection of inventions, funding product development and marketing as well as other promotional activities for commercialising inventions. The key criteria for funding are the market potential, inventiveness and protection of the invention, and its level of technology. The objective of funding is to develop the inventions of private individuals, researchers and small entrepreneurs into products for the market either in the inventor-entrepreneur’s own production or under a licence or other exploitation agreement.

Other public service providers

Other public service providers supporting innovation include Finpro, the Employment and Economic Development Centres (TE-Centres) and the Foundation for Finnish

Inventions. Finpro is an organisation whose sphere of tasks is broadly defined: to speed up the internationalisation of Finnish companies while minimising the risks involved, using the resources of its own organisation and co-operating with other service organisations working for the same goals.

Recently, support of innovation has emerged as a new theme in Finpro's mission. In practice Finpro aims to offer a new kind of contribution to the other innovation supporting organisations. Finpro offers its partners expert services needed in their own development and research programmes, either through specific projects or through consulting assignments. In addition, Finpro's public funding will increasingly be based on its mission as an innovation supporting organisation and on projects financed through the new partners.

Regional employment and economic development centres (TE-Centres) were established in the mid-1990s. The centres were composed of regional offices of three different ministries — the Ministry of Trade and Industry, the Ministry of Agriculture and Forestry, and the Ministry of Labour. Nowadays also experts of regional networks of Tekes and the Foundation for Finnish Inventions can be found under the same roof of the TE-centre.

Fifteen centres countrywide provide a wide range of advisory and development services for businesses, entrepreneurs and other clients. The centres support and advise small and medium-sized enterprises at the various stages of their life cycles. Tasks also include a number of other activities, such as promotion of technological development in enterprises, assisting companies in matters associated with export activities and internationalisation, implementation of regional labour policies and participation in regional development. For instance, the TE-Centres have a significant role in implementation and administration of EU structural funds in areas eligible for EU funding.

7.2.3 Monitoring and Evaluation

Monitoring has been established from the beginning for the additional funds and for FII. Currently a large part of the public research, technology development and innovation system is under the evaluation. The Science and Technology Policy

Council of Finland decided in the autumn 2003 that the structures of the Finnish research system will be evaluated by the end of 2004. The evaluation focuses both on research system as a whole and actors at different levels: decision-making- and steering organisations, research institutes and mediator organisations (e.g. regional TE-Centres, technology centres and Centres of Expertise). Public funding agencies (the Academy of Finland, Tekes, Sitra) are not assessed in this process because they have been evaluated separately at an earlier stage.

Additional Funds

Each organization in charge of the additional funds was responsible for assessing the individual projects and research groups. It was decided that this would be complemented by an overall assessment in order to obtain a general picture of whether the additional funds were appropriately allocated and to receive answers to questions on their impact on the economy and society in general. The basic data were collected in research projects and interviews, an internet application helped to manage the information and serves until today as database for evaluations of research programmes.

In 1996 the Finnish government decided on the "Additional Appropriation for Research". Between 1997 and 1999 Finland invested FIM 3 billion into the national innovations system. The money was distributed mainly through the traditional channels, i.e. Tekes and Academy of Finland. Targeted research funding for the Technical Research Centre (VTT) and to universities was also to be stepped up. Moreover, additional funding was to be granted to R&D projects that aim to foster the development of the country's industrial clusters. These projects were implemented in collaboration between the sectoral ministries, the science and technology administration and individual business enterprises. Overall the additional fund were allocated to the following institutions and programmes:

Table 12: Structure of the Finnish Additional Appropriation for Research

Institutions	**Share of funds in %**	**Programme**
Tekes	54	Cluster programmes and impact assessments
Universities	20	Equipment and other research conditions and facilities
		Expanding existing and establishing new graduate schools
		Expansion in training

		Data transfer, information services and cooperation with industry
		Bioteknia II
Academy of Finland	20	Centres of Excellence
		Research programmes
		Doctor-researchers
		Internationalisation
Sectoral ministries	4	Cluster programmes
VTT and Ministry of Trade and Industry	2	Cluster programmes and impact assessments

Source: SITRA 2000

For the overall evaluation of the efficiency of the FIM 3 billion additional funds distributed from 1997 to 1999, the Ministry of Trade and Industry and the Ministry of Education established an international expert group. Concerning the efficiency of the FIM 3 billion additional funds distributed from 1997 to 1999, the results of the evaluation were:

- The additional public appropriation for research seems to have had a positive impact on private research investments.
- Increased research input has led to the growth of company profitability, a rise in the know-how level of personnel and a larger number of product innovations.
- Besides research investments, productivity has been improved by personnel training, renewal of organisational structures, more effective management culture and companies' improved capacity to take a new information.
- The effects of research input on employment have been clearly positive, but of a dual character: demand for highly educated personnel has increased rapidly, but no job opportunities have emerged for employees with lower educational level.
- Integration of the new and old economy is considered very important. Encouraging small and medium-sized enterprises to take up new technology calls for new measures.
- Additional funding has positive effects on regional development, but only in the regions where research investments have been focused.
- Quantity and quality of Finnish basic research was developing very positive and rapid.
- The cluster programmes have made in possible to initiate a fruitful co-operation between various sectors and to provide a valuable link between technology and public services.

- The development of TEKES has been rapid and in many ways successful, but new strategic assessment should be carried out.

In 2003, an “Evaluation of the Finish Innovation Support System” was done on behalf of the Ministry of Trade and Industry. An international team with researchers from Great Britain, the Netherlands and Finland came to the following conclusion:

“The general findings of the report regarding the conditions for industrial innovation created and maintained by the public sector in Finland show that the conditions are favourable. The public sector has a distinctive task in the *national innovation system*, which covers areas that cannot be covered by the open sector alone in a way that is optimal for the national economy. The Finnish innovation support system as a whole is functioning well and the different public organisations have each a clear task in it. However, in the future, the support organisations must be able to meet the challenges of, e.g. internationalisation, and also more closely analyse the balance and overlaps of public and private activities in each area. Also the development of the Finnish financial market, the significance of education and basic research, and the connections between different policy sectors must be acknowledged.“ (cf. Evaluation of the Finnish Innovation Support System, 2003, p. 3)

Finnish Industry Investment Ltd

The FII was evaluated in 2003. The main findings were:

- The effectiveness of FII in resolving market failures is fundamentally weakened by two constraints on its operations. First, the imposition by the government of a minimum annual profitability requirement virtually removes the ability of FII to undertake significant investments in the earliest and most risky investment stages. Secondly, FII’s operating principle of investing with private investors further undermines the purpose and effectiveness of FII.
- The performance of FII in fulfilling the State’s policy goals should be measured more precisely. In addition to fund categorisation, FII should measure the actual investment allocation made by the funds in which it invests.
- If the financial performance of FII continues to be a key objective of the organisation, it should be measured over a sufficiently long period of time in order to allow FII the opportunity to meet both its financial and policy goals. This means that FII has to be given the managerial freedom to take risks and to invest counter-cyclically.

- In terms of stimulating the supply of seed-stage venture capital, FII should take a more proactive role. Early stage market failure cannot be solved passively without the active involvement of the State as a co-investor and risk taker.

Finnvera

International evaluation of Finnvera plc was published in February, 2004. The evaluation aimed at examining the cornerstones on which the future activities of the company would be based, taking into account the development of the market, the impacts of the European Union and other international legal framework and the availability of public funding. In the case of domestic financing, the evaluators recommend a stronger emphasis on guarantees and risk-sharing with banks. They further propose that the State's credit loss compensations should be highlighted instead of interest subsidies. In addition, the evaluation contains proposals for restructuring the company's domestic financing activities. As far as the company structure is concerned, the evaluators recommend adoption of a holding company structure. Furthermore, the evaluators regard Finnvera plc's tax liability and inability to set aside provisions as unnecessary limitations.

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www.research.fi
www.sitra.fi

7.3 ICELAND

7.3.1 Programmes and Institutions

In recent years the size and composition of R&D expenditures in Iceland have undergone significant changes. Starting from a relatively low level, and with a predominant part financed by the public sector, the latest figures show that not only is the total R&D in per cent of GDP is among the highest in Europe (3%) but nearly two-thirds come from the private sector. The increase in private financing brings Iceland in line with the general European trend. However, there is a reason for concern because more than half of the private R&D comes from one single company. Therefore a strengthening in public funding of R&D is still considered as very important.

To increase co-ordination within research, technology and innovation policy and to make more efficient use of public R&D appropriations, new legislation on the organisation of science and technology policy and the funding of research and technology development has been enacted in 2003. The legislation composed of three separate Acts, replacing the Act of the Icelandic Research Council of 1994 and introducing new structures and organization.

- **The Science and Technology Policy Council** (STPC)
  The legislation established the STPC as a ministerial-level co-ordinating body headed by the Prime Minister. The Council, formally replaces the Icelandic Research Council, provides for the permanent seat of three other ministers

namely Minister of Education, Science and Culture and Minister of Industry and Commerce. The council comprises 14 other members with scientific, technical and other relevant qualifications appointed from higher education institutions, labour market organisations and ministries.

- **Research Fund** and **Technology Development Fund**
  The new legislation also set up a two-stringed public funding structure to support scientific research and technology development and innovation. Each Fund (the Research Fund and the Technology Development Fund) will be governed by a Board appointed from among the non-ministerial members of STPC by the Minister of Education, Science, and Culture and the Minister of Industry and Commerce, respectively. The Research Fund was created through the merger of the Science Fund and the Technology Fund.
- **Icelandic Centre for Research (Rannis)**
  At the end of 2003, a new administrative "framework" for the whole science and technology policy in Iceland was introduced by act of parliament. Rannis operates under the auspices of the Council for Science and Technology Policy headed by the Prime Minister and including the Minister of Education, Science and Culture, the Minister for Trade and Industry, the Minister for Finance and two other government ministers as occasional members. Its mission is to give administrative and operational support to the boards and funding bodies, to manage the international connections, monitor the effects and impacts of policies and to provide intelligence and informed advice to the Science and Technology Policy Council and its boards and sub-committees.

  Rannís operates on an annual budget of about 130 million Icelandic krónur (ISK), of which about half comes from the direct budget and the rest from service fees and contracts.

  The grants funds operated by Rannís have the following annual budgets for 2003:
  - Research Fund: 412 million ISK. The target is to raise the available resources of the Fund to ISK 600 million at the end of the current Government term of office.

  - Instruments fund: 90 million ISK
  - Technology Development Fund: The available resources of this Fund are to be ISK 200 million in 2004, rising to ISK 500 million towards the end of present Government term.
  - Graduate Education Fund: 40 million ISK. In 2005, the resources of the Fund will be increased by 25%, then amounting to ISK 50 million.
  - Information Technology and Environmental Research Program: 95 million ISK

Rannís thus handles a total turnover of around 770 million ISK a year.

- **Universities**

  A government decision was taken in 2001 to award additional 100 million IKR per annum for the next three years to strengthen research in the university sector. A pilot framework agreement between the University of Iceland and the Ministry of Education on performance-based support to research was signed at the end of 2001 and is to be implemented during this three-year period. Performance is i.e. to be measured through publication output, research training output and performance in attracting competitive research funding from other sources.

  In the light of the contract between the University of Iceland and the Ministry of Culture and Education, signed in December 2001, it is stated that the University of Iceland will increase its R&D co-operation with other higher education institutions, public research institutions and companies. In the light of this contract an additional support for R&D will be granted. The total amount is 240 million ISK, to be paid in three years. An amount of 80 million ISK are allocated in 2001, 55 million ISK in 2002 and 105 million ISK in 2003.

7.3.2 Monitoring and Evaluation

As the re-organization of the Icelandic R&D-infrastructure has taken place only four months ago, there are now no evaluations available. This resolution on policy in scientific and technological matters ("Science and Technology Plan") was the first step in the task of the Science and Technology Policy Council. An action programme for 2004-2007 should be presented at the spring meeting of the Council in April 2004.

7.3.3 Sources of Research

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7.4 THE NETHERLANDS

7.4.1 Characterisation of R&D Performance

Over the past decade The Netherlands exhibits a constant rate of GERD/GDP at an international comparative level of about 2%, though the recent growth rates on expenditures in real terms have fallen short. The Netherlands is far from reaching the Barcelona targets of investing 3% of GDP in R&D. In fact, according to data of the Trend Chart 2003 Innovation Scoreboard of the European Commission The Netherlands is losing momentum, as almost all innovation indicators show negative trends. Regarding the sources of funding R&D expenditures by business enterprises account for 50.1%, government expenditures for 35.9% and foreign investment in R&D for 11.4%. The remainder of 2.6% is financed by other national sources (OECD 2003).

As far as public R&D expenditures are concerned, The Netherlands experienced a steady decrease in relation to the GDP over the last decade from 0.96% in 1991 to 0.68% in 2001. With a ratio of 1.08% of BERD/GDP the R&D intensity of the business sector is below the European Union average. Overall growth rates of GERD/GDP are lagging behind.

One reason for this might be found in the composition of the Dutch business sector, which is characterised by a relative small manufacturing industry (26% of GDP), of which only a small part of enterprises is active in the R&D intensive High-Tech and Medium High-Tech industrial sectors. In contrast the service sector is relative large (71%of GDP), but again characterised by a lower R&D intensity than in reference countries (NOWT 2003). Table A.2 points out that the make-up of the manufacturing industry varies considerable between the countries of the European Union.

Table A.2: Structure of the manufacturing economy

	Percent of total manufacturing value-added in each sector				
	HT	**MHT**	**MLT**	**LT**	
Austria	11.3	27.4	27.8	33.5	100%
Belgium	12.4	31.2	27.3	29.1	100%
Germany	11.4	42.5	23.5	22.5	100%
Denmark	14.3	24.0	21.3	40.5	100%
Spain	6.2	14.4	33.1	46.3	100%
Finland	23.7	18.7	19.9	37.7	100%
France	17.8	27.5	24.9	29.7	100%
Greece	6.2	14.4	33.1	46.3	100%
Ireland	*30.2*	*34.5*	*6.0*	*29.4*	100%
Italy	9.8	27.1	28.8	34.3	100%
Luxembourg	3.1	14.7	54.1	28.1	100%
Netherlands	11.9	26.3	24.7	37.1	100%
Portugal	6.3	18.6	25.7	49.4	100%
Sweden	16.0	33.0	19.6	31.4	100%
United-Kingdom	17.9	24.0	21.9	36.2	100%
EU15 MEAN	**13.7**	**30.9**	**24.4**	**31.0**	**100%**

HT: High-Tech; MHT: Medium High-Tech; MLT: Medium Low-Tech; LT: Low Tech

Source: Innovation Scoreboard 2003

In The Netherlands, the business sector covers 58% of Dutch R&D performance, of which the manufacturing spends more than 75%. However, the service sector is somewhat catching-up: R&D expenditures have grown 15% per year between 1995 and 2001, whereas the average growth rate in the manufacturing was only 6% per year.

Another peculiarity of the Dutch R&D structure is that a major part (ca. 80%) of total business expenditures on R&D are spent by the so called „Big Seven“ of the Dutch industry (Philips, Unilever, Akzo Nobel, Shell, ASML and Océ) which rather tend to increase expenditures on R&D in foreign countries whereas the R&D spending in the Netherlands is stagnant (cf. NOWT 2003). Therefore, the main impulses for a future increase in business expenditures on R&D have to stem from the Small and Medium Enterprises in the manufacturing sector and companies in the service sector.

The Dutch university sector accounts for about 27% of R&D performance and is hence of higher importance than in reference countries of the EU (e.g. Germany, France, Finland, Denmark)[22]). Another outstanding fact concerning the University system is that the rate of external funding from the private sector is traditionally high and even increased significantly from a 20% share in the early 1990s to 27% in 2000 (NOWT 2003). Overall University-Industry links are better developed than in the average EU country.

7.4.2 Output and Quality of Research

The Netherlands can be qualified as a high-level performer as well as quantity of scientific output and quality of scientific output is concerned. The volume of scientific output represents 2.1% of worldwide scientific publications, which ranks the Netherlands twelfth. One way to measure the relevance/impact of scientific output is the "relative citation impact", which is the relative quantity of citations these publications receive from subsequent publications in scientific journals. In terms of its relative citation impact the Netherlands worldwide rank is number 3, behind Switzerland and the United States.

With respect to the type of research conducted, the Netherlands spends relatively more money on basic research (37%) compared to an international level. This applies not only to the public sector R&D but also to R&D activities in firms and is reflected in a high industry share in publication output, which amounts 4.2% of total scientific publication output of which one third is solely written by private industry researchers. The Netherlands is thus one of the leading countries worldwide in terms of private basic research. About 75% of all scientific publications originate from the Universities and 20% from semi-public organisations and centres of expertise.

However, the high share of basic research raises concern that the transfer of knowledge into new competitive products runs into mischief as too little is spent on applied research and product development.

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[22]) In the Southern European Countries, which show low overall R&D intensity, universities account for even a bigger share of R&D spending.

7.4.3 Innovation Policy - Recent Developments

Measures within the regular Budget

In the last 2 years The Netherlands have undergone a period of political instability accompanied by a severe depression. In May 2003 the Government Balkenende II announced intense cuts in public spending for all policy domains except from „the knowledge economy“ that would even receive more funding – taking the increasing public pressure to invest in science and technology seriously (cf. European Commission 2003). The stated ambition of the government is to become “one of the best knowledge economies of the world”.

For the planning period 2004-2007 the government announced an additional 800 million Euros in the regular budget for „education and knowledge“, of which 515 million Euros are going to be invested in the higher education sector. The remainder of 285 million Euros is devoted to innovation policy of which

- The Research and Development Promotion Act (WBSO) accounts for 100 Million Euros and
- 185 million Euros for knowledge and innovation mainly at disposal for the ministry of economic affairs, which is responsible for innovation policy.

The Research and Development Promotion Act is a fiscal facility for companies, knowledge centres and self-employed persons who perform R&D. The R&D promotion act reduces the wage costs of employees directly involved in R&D via a reduction of payroll tax and social security contributions or tax deductions for self-employed persons. The WBSO is still the most important fiscal measure in order to promote R&D: The maximum WBSO payments are 403 million Euros in 2004 and 453 million Euros from 2006 onwards.

The 185 million Euros reserved for knowledge and innovation in the coalition agreement will contribute to government priority themes such as: human resources (knowledge-workers), start-ups in the high tech sector and research collaboration between research centres and firms, though one has to remark that not the complete amount will contribute to R&D expenditures (e.g. it’s yet not obvious how far the measure “techno-starters” contributes to R&D).

Besides the financial measures mentioned following aspects are of certain interest for Innovation Policy (cf. European Commission 2003):

- For the Ministry of Economic Affairs (EZ) the three policy priorities are 1) the knowledge economy and innovation, 2) competition and dynamism and 3) room for entrepreneurship
- EZ will make better choices for strategic research areas and R&D co-operation with countries with market opportunities. There will be a cut in the budgets (20%) for space research
- There will be more focus on the international dimension of R&D and innovation
- The high-tech starters policy will particularly address the lack of risk capital
- Other priorities will be transparent and accessible policy instruments, better exploitation of public knowledge, more synergy between innovation policy and export policy.

The Innovation Policy paper “In action for Innovation” published by the Ministry of Economic Affairs in October 2003 outlines the agenda for innovation policy measures in order to promote the innovation capacity in Dutch industry. In three sections the paper tries to 1) present the new policy strategy with related solution lines, 2) give an analysis and outline the foundation of the strategy and 3) give the line of reasoning behind the actions and the status of actions (for a more detailed information see: European Trend Chart on Innovation - Country Report: The Netherlands).

Table A.3 provides an overview about the total government expenditures on R&D as assigned by the governmental departments. If one compares the total appropriations for research in the year 2004 with the two subsequent years one can see, that the additional regular budget attributed to the knowledge economy does not lead to an intensification of public spending on R&D, even a nominal reduction on R&D expenditures of about 66 million Euros occurs.

This cutback is mainly due to the reduction in R&D expenditures in 7 out of twelve departments, with major cutbacks taking place in the Department of Economic affairs. To a minor part the reduction in R&D appropriations is also the consequence of a narrower counting definition of R&D expenditures and non-R&D expenditures.

However, the table does not include the WBSO funds, as those funds contribute to indirect fiscal measures in order to promote R&D. In addition to the WBSO funds, the table does not include the additional funding outside of the regular budget of the ministries, the so-called "ICES/KIS-3" measure, which provides an additional fund on R&D from the funds to reinforce the economic structure (Fonds Economische Structuurversterking – FES). These additional funds, which do not contribute to the regular budget are thus analysed in more detail.

Table A.3: Total expenditures on R&D (TOF) by governmental Departments (in mio Euros)

Department	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***
General Affairs (Dept. of Prime Minister)	1.5	2,6	2,6	2,6	2,6	2,6	2,6
Foreign Affairs/Development Work	78.0	72.5	68.1	65.9	70.8	81.6	81.6
Justice	12.3	14.4	17.6	17.6	17.6	17.5	17.5
Interior and Kingdom Relations	0.9	2.0	1.8	1.8	1.8	1.1	1.1
Education, Culture and Science	2235.9	2218.1	2310.9	2335.6	2366.6	2394.7	2420.3
Defense	74.6	72.9	73.4	73.0	72.8	72.5	72.5
Spatial Planning, Housing, the Environment	48.0	46.1	43.3	43.3	45.6	43.5	40.9
Transport, Public Works, Water Management	181.0	171.8	165.2	137.9	138.2	138.0	137.5
Economic Affairs	495.7	486.3	450.5	390.0	354.1	382.7	339.5
Agriculture, Nature and Food Quality	209.9	210.0	194.2	189.1	186.4	186.8	186.8
Social Affairs and Employment	9.9	11.9	8.4	8.3	8.2	8.1	8.1
Health, Welfare en Sport	82.0	98.4	88.5	79.0	79.2	78.9	78.9
+ Intensification via Government Agreement			*10*	*23*	*42*	*100*	*100*
Research Financing Total	**3429.7**	**3404.4**	**3431.9**	**3364.5**	**3383.3**	**3505.4**	**3484.7**

Source: Ministerie van Onderwijs, Cultuur en Wetenschap (2004)

7.4.4 Additional Funds - The ICES/KIS Initiatives

So far, all additional funding measures in The Netherlands gearing towards innovation and R&D stem from the ICES/KIS Initiatives. Since 1994 the ICES/KIS initiative launched 3 investment rounds in order to strengthen the structure of the knowledge intensive economy.

In 1994 the Cabinet decided to invest 113 million Euros in projects for the planning period 1994-1998(ICES/KIS-1). The second investment round in 1998 (ICES/KIS-2) accounted for 211 million Euros.

In 2002 the Dutch government launched a third round of calls for proposals with an associated value of 800 million Euros for the period 2004-2010. The third generation of this programme is implemented by the Dutch innovation agency Senter. To this end, a new rule has been developed, which is known as the 'Besluit Subsidies Investeringen Kennisinfrastructuur' (BSIK) – in English: Decision for Subsidies for Investment in the Knowledge Infrastructure (Cf. European Commission, 2003). The third round of the additional funds initiative is thus as well known as ICES/KIS-3 and BSIK.

7.4.5 Organisational Structure – Responsibility

The Ministries – EZ & OCenW

In The Netherlands there has always been a strong division of labour between science on the one hand and technology and innovation on the other hand: The Ministry of Economic Affairs is responsible for Innovation Policy whereas the Ministry of Education, Culture and Science is in charge of Science Policy. At different levels of the Innovation and Science Policy system the two spheres are moving towards each other, in the Innovation Policy White paper EZ and OCenW have collaborated intensely. (cf. European Commission 2003)

ICES

The interdepartmental Commission to foster the Economic Structure (ICES) is an advisory board for financial and economic tasks in charge of the intensification of the economic structure. The working group consists of members of 9 ministries:

- The Department of the Prime Minister (AZ)
- The Department of Economic Affairs (EZ)
- The Department of Education, Culture and Science (OCenW)
- The Department of Housing, Spatial Planning and Environment (VROM)

- The Department of Agriculture, Nature and Fisheries (LNV)
- The Department of Social Affairs and Employment (SZW),
- The Department of Foreign Affairs (BZK),
- The Department of Transport ad Water Management (V&W) and
- The Department of Public Finance.

The ICES is also responsible for the distribution of funds from the Economic Structure Fonds (FES), which was set up in 1995 retroactive since 1993.

Fonds Economische Structuurversterking – The Economic Structure Funds (FES)

The FES is an important source for investments in the economic infrastructure. The main aim of the funds is the funding of investment projects in the economic structure of the Netherlands. The ministry of economic affairs and the ministry of public finance administer the fund. The accountants-service of the ministry of economic affairs is responsible for the internal control of the fund. The Netherlands Court of Audit (Algemene Rekenkamer) controls the management and spending of the fund.

The financial sources from the funds mainly stem from the revenue of the state owned gas-enterprises and from proceeds of a sale of state-owned enterprises. In 2002 the expenditures of the funds accounted for 2.4 billion Euros, the revenues accounted for 2.0 billion Euros. At the close of 2002 the Saldo of the FES was about 1.7 billion Euros (Source: Algemene Rekenkamer 2003)

ICES-KIS

As knowledge and innovation are deemed to be key elements for sustainable economic growth and development ICES set up a working group dealing exclusively with investments in the knowledge infrastructure in 1994. The ICES/KIS working group consists of members of 6 ministries: EZ, OCenW, LNV, V&W, VROM and the Ministry of Public Finance. EZ and OCenW together form the secretariat of the ICES/KIS working group. The ICES/KIS working group launched the special funds initiatives. The ICES/KIS-3 initiative is going to be implemented by Senter.

Senter

Senter is an agency on behalf of the Ministry for Economic Affairs. Senter is responsible for the implementation of subsidies, credits, fiscal rules and programmes in the field of technology, energy, environment, export and international co-operations.

Research centres and firms are the main target groups of Senter: Senter provides assistance for application of subsidies for innovation projects and serves as a facilitator for national and international co-operation partners.

7.4.6 Motivation-Objectives

The ICES/KIS-3 tries to tackle some of the bottlenecks or shortcomings of the Dutch innovation system:

- Research is by far not always gearing towards innovation or on the social and corporate needs on knowledge;
- Research is fragmented and -
- The supply of knowledge does not sufficiently correspond to the demand.

The aim of the ICES/KIS-3 initiative is to stimulate the basic-strategic and the industrial-applied research in a manner, which contributes to the development of high-quality networks. The objective is to promote a more dynamic innovation system for a better use of future chances and developments. Therefore the knowledge, which will be developed in the ICES/KIS-3 projects, has to form a long-lasting effect on the existing knowledge infrastructure. Furthermore it has to be assured that others can apply the new knowledge in a useful way (cf. OCenW, 2003).

Public-Private-Partnerships are a major term in the third investment impulse. The issues are:

- To create collaboration between knowledge users and knowledge producers;
- To combine public and private sources of funding;
- To bundle knowledge, expertise and innovative capacity in flexible networks of the supply-side and the demand-side.

7.4.7 Timetable of the Decision Process

According to the OCenW (2003) the program-planners tried to incorporate all concerned parties of the investment-program from the beginning, as this was deemed to be an important factor for the success of the program. Thus ideas and needs from companies, research centres etc. were taken into account for the whole process, which should be marked by transparency and predictability of legal decisions. The planning period consisted of three stages:

1. 2000-2001

In the first stage supplier and customers of knowledge put forth ideas for research areas in which future investments were considered to be important. Those ideas were bundled into eight fields of knowledge. External working groups further developed the areas of special interest.

2. 2001-2002

In May 2001 knowledge producers and knowledge-users were invited to submit investment packages (investeringspaketten), which demonstrated the usefulness and the necessity of investment via a call for expressions of interest. 130 investment packages were submitted. The Central Planning Bureau was giving advice on the importance of the themes. The second phase closed with the selection of 5 themes (see Themes and Projects).

3. 2002-2003

In the third stage large-scaled knowledge consortia were able to develop and submit R&D plans according to the five central themes. A call for proposals was launched. 67 proposals were submitted. Several committees assessed the proposals and a "Commissie van Wijzen" advised the Cabinet upon the allocation of subsidies. On this account the Royal Netherlands Academy of Sciences (KNAW), the planning offices and Senter provided background analysis. In November 2003 the Cabinet decided to allocate the funds on 34 projects and 3 projects, which are still to be developed. The subsidy covers 50% of total project costs; research centres and companies have to make an allowance of the same amount. Senter will implement the programme.

7.4.8 Themes and Projects

The 800 million Euros for the investment period 2004-2010 are allocated along 5 themes of priority:

- ICT,
- Spatial Use,
- Sustainable System Innovations,
- Micro-Systems and Nano-Technology and
- Health, Food and Life Sciences.

Within the themes focal points have been made up.

ICT

The focal points for the ICT theme are: Broadband-Technology, Informatics and Software, Embedded and distributed systems, multimedia, ICT-networks and “grids”. The following projects are going to be subsidized by the ICES/KIS-3 initiative:

- Gigaport Network (40 million euros)
- VL-E Science (20 million euros)
- Freeband (30 million euros)
- Smart Surroundings (6,5 million euros)
- Multimedian (16 million euros)
- BRICKS (12 million euros)
- Embedded Systems I. (25 million euros)
- Thales/ICIS (13,7 million euros)
- Lofar (52 million euros)

Spatial Use

The Netherlands exhibits scarcity of land. Efficient spatial use is therefore central. The focal points of spatial use are: system innovation and spatial use, water and space, climate and space, geo-information, sustainable use of resources and networks. The following projects are going to be subsidized by the ICES/KIS-3 initiative:

- Klimaat voor Ruimte (40 million euros)
- Leven met Water (22 million euros)
- GEO-informatie (20 million euros)
- Delft Cluster (22 million euros)

Sustainable System Innovations

The concrete topics of the theme are: knowledge and competences for sustainable system innovations, system innovation in construction processes; transition to sustainable mobility, sustainable farming and sustainable use of energy, sustainable chemistry and resources. The following projects are going to be subsidized by the ICES/KIS-3 initiative:

- CATO (12,7 million euros)
- PSIBouw (15,4 million euros)
- Large-scale wind power (13 million euros)
- Chemistry and Energy/B-Basic (25 million euros)
- Next Generation Infrastructures (20 million euros)

Micro-systems and Nano-Technology

In the field of Micro-Systems and Nano-Technology three projects are subsidized by the ICES/KIS-3 measure:

- BioMade (7 million Euros)
- NanoNed (95 million Euros)
- MicroNed (28 million Euros)

Health, Food, and Life Sciences

The focal points in the field are genomics; food and food-quality (?) and biomedical technology. The following projects are going to be subsidized by the ICES/KIS-3 initiative:

- Ecogenomics (11 million euros)
- Virgo Consortium (10,8 million euros)
- Coeliac Disease Consortium (7,7 million euros)
- Biorange (21,9 million euros)
- Molecular Imaging Ischemic Heart Disease (11,2 million euros)
- Stems cells in development (8,8 million euros)
- Mouse Phenomics (13,1 million euros)
- Nutrigenomics (10 million euros)
- Neth. Proteomics Centre (24,7 million euros)
- TREND (11,7 million euros)
- Weefsel op maat (25 million euros)
- Cyttron (8,8 million euros)

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7.5 Hungary

7.5.1 The transmission of the RTD system and its performance

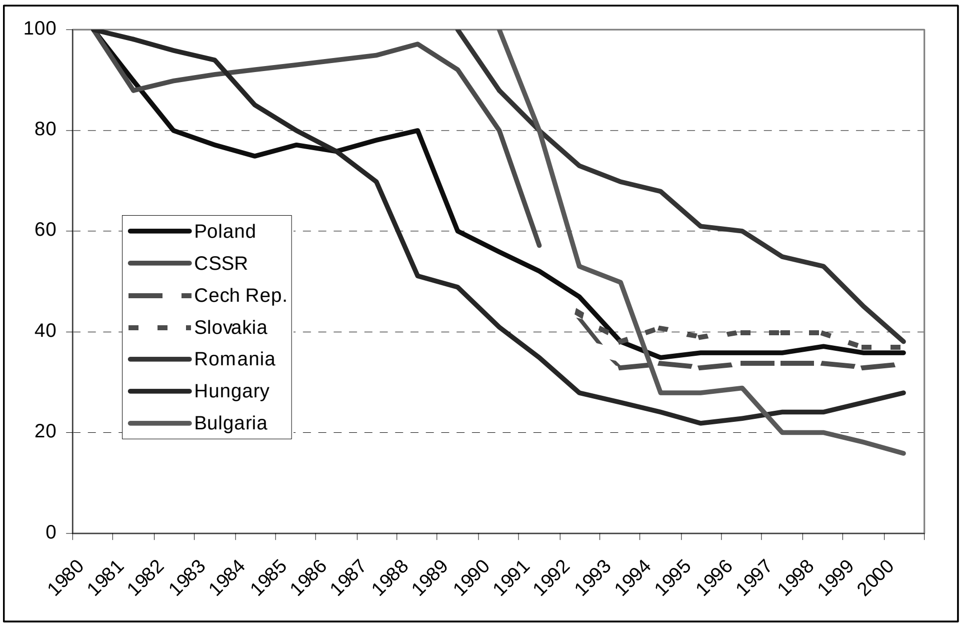
As in all other so-called transition countries the Hungarian techno-economic system has been experiencing a major, rather dramatic structural change. The nature of this profound structural transformation process may be characterized as an idealized „3-phase-model“ characterized as following:

- Phase 1: Abandoning/De-scaling of the former centrally-planned institutions of research and technological development and a de-coupling of the R&D system from the economic system associated with a sharp decline in indicators measuring the quantity of inputs (R&D expenditures, R&D employment, both public as well as business R&D).

- Phase 2: Consolidation and founding of new (often scattered) institutions. The R&D system in this stage is characterized as very uneven with the potential danger to degenerate into a somewhat "divided" economic system as a whole: Some (mainly foreign-owned) modern business sectors (based upon inflow of FDI) but with very weak linkages to the regional environment (weak embededness) are confronted with a huge bulk of local indigenous industries with no or low R&D activities and hence low absorptive technological capabilities.
- Phase 3: Re-Integration of institutions into new national innovation system paralleled with a (Re-)Internationalisation under different premises and – eventually - technological catching-up.

Although Hungary in general fits into this idealized model there are some peculiarities mainly caused to the fact, that the political-economic transformation in Hungary had begun much earlier and in a more gradual form than in other central-eastern European countries. Especially the decline in R&D personnel began much earlier in Hungary than in other CEEC countries as it is shown in Figure A.1.

Figure A.1: Development of R&D personnel in selected CEEC countries



Source: Meske, 2004

Using R&D employment figures as a rough indicator for the adjustment process of the overall R&D system it can be obtained that the major bulk of the down-scaling process (associated with phase 1 in the above mentioned idealized model) in Hungary took place already in the 80ies whereas throughout the 90ies consolidation took place. Essentially, the trough with respect of R&D personnel is to be found in the mid 90ies, since then employment figures have been increasing steadily, albeit at a very modest pace. However, the down-scaling was quite significant in quantitative terms. The R&D personnel in the year 2000 reaches only about 30% of the 1980 figure.

Currently, the national innovation system of Hungary may be described as being in a crucial stage of phase 3, meaning that major consolidation and re-integration processes have been completed and the principal seedbeds for technology-driven growth and catching-up processes might have been laid down. The key characteristics of the current Hungarian innovation system can be described as following:

- Concerning the quantitative inputs (i.e R&D employment and expenditures) into the knowledge-generating process the trough clearly had been crossed during the mid-nineties. After a prolonged decline beginning as early as about 1980 input figures (i.e. R&D expenditures, R&D personnel have been growing fairly steadily since about 1995 leading to an **increase of the ratio of GERD to GDP from about 0.7% (1998) to 1.0% in 2002**, which is about 50% of the EU average. This in increase in the GERD/GDP ration comes mainly from a significant rise of public expenditures on R&D, which rose from about slightly under 0.4% of GDP (mid-to-late 90ies) to 0.57% (2002), whereas business R&D expenditures rose only moderately from 0.25 to 0.38% of GDP. The somewhat **lacking contribution of the private business sector to the funding of R&D** (as typical in transition countries) is clearly demonstrated in an international comparison. With 0.57% Hungary is almost near the EU average (0.69) concerning public R&D expenditures and is similar to countries as diverse as Belgium (0.57), Italy (0.54) or Portugal (0.57)[23]. However, concerning the contribution of the private business sector to R&D a significant gap still exists: With 0.38% the contribution of the Hungarian private business sectors is far below the EU average of 1.30 and Hungary is near the bottom place within the ranking of EU member states (Spain 0.50, Portugal 0.27, Greece 0.19, Slovakia 0.45, Poland 0.24).

[23]) As comparison the ratio for Austria is 0,65, the leading countries are Finnland and Sweden with 1.02 and 0.96 respectively.

- The low profile of Hungary concerning knowledge-generation in the private business sector is also reflected in relatively **low international patent activities**. With only 19 patent applications at the European Patent Office per 1 mio. population Hungary is far below the activities of the "old" EU member states (EU-15 average 161.1 patent applications, Spain 24,1, Greece 7.7, Portugal 5.5).[24]
- Given the evidently low R&D intensity of the Hungarian private business sector, one might argue, that this situation may be caused by the industrial structure of Hungarian industry. However, within the past decade the **industrial structure of Hungary changed significantly** and cannot be described as characterized by a dominance of traditional, low-tech-sectors anymore. This change is marked profoundly by the shift of the structure of Hungarian industrial exports. Still in 1990, meat products accounted for about 10% of total industrial exports (and semi-finished chemical and steel products took the second and third position with respect to export shares). This pattern has changed dramatically throughout the 90ies. Currently telecommunications equipment (12.6%) and electric machinery and components (11.9%) are the two dominant product categories with respect to export shares (followed by energy generation machinery and vehicles wit 10.7% and 8.9% respectively). Thus, exports are dominated by somewhat technology-intensive products, but, obviously, the knowledge, necessary to be internationally competitive in these products, stems mainly from abroad and is not generated within Hungary, at least to a certain degree.
- The change of the export structure is mainly caused by the **massive inflow of foreign direct investments (FDI)** and reflect the business strategies of major foreign-controlled companies and not by a successful re-orientation towards high-tech of the indigenous enterprise sector. Indeed, Hungary was able to attract huge bulks of FDI (Hungary has been traditionally the leading country within the CEEC concerning attracting FDI) and its industrial economy is now characterized by a high share of foreign controlled firms. In 2000 foreign firms accounted for almost 50% (growing from 37% in 1995) of private sector employees and their share in turnover was 74%(growing from 57%). Thus, Hungary has become a very internationalised country with respect to foreign investment inflows. The main investment motives have been market-oriented (initial to get a foothold in a "new" market with great growth potential as well as export-oriented given the abundance of relatively cheap but skilled labour. R&D related motives (i.e. home-base augmenting or home-base exploiting strategies) clearly played close to no role (at least in the initial stages of the foreign

[24]) For comparison Austria 174.2. The top EU countries are Sweden with 366.6, Finland (337.8) and Germany (309.9).

investment processes). This is reflected in the share of R&D by foreign firms. In 1995 foreign firms accounted for only 21.8% R&D expenditures (although their share in employment and turnover was significantly higher). However, this pattern is changing recently. In 1998 foreign firms already accounted for 78.5%, indicating that foreign production in Hungary is shifting more and more towards knowledge-intensive production which needs in-situ R&D capabilities. This shift is also supported by anecdotic evidence of the establishment of R&D labs/facilities by a number of renowned multinational firms in Hungary[25]. In addition, the official statistics shows, that there is a growing funding for private business sector R&D from abroad (1997: < 5%, 2002: almost 25%). However, inherently with this process is a potential **danger of a divided economy**: the modern foreign-controlled economic sector (albeit still based upon imported technologies and knowledge) may be contrasted by a traditional (often small-scale) indigenous economic sector with low absorption capacities and limited innovative potential and with weak backward and forward linkages between these two distinct sectors.

- Within Hungary a distinct regional economic pattern has been establishing during the past two decades. The central region (Budapest and surrounding areas) as well as the western regions have been attracting the major bulk of FDI, therefore modernizing their industrial & economic basis at a rapid pace, whereas the eastern and south-eastern areas are lacking, although they are locations of significant and out-standing public research institutions. This has led to a distinct regional divine of supply of supply of technological knowledge (public research institutions) and potential demand (private businesses). This **regional discrepancy** may further hinder the integration of supply and demand elements within the national innovation system.

7.5.2 The current Hungarian RTD policy system

Given the profound changes which are associated with the transformation process of the techno-economic system during the past two decades, the institutional system and setting have been under constant pressure and in constant flux as well. It is not the aim of this project to depict the nature of this development process in detail, nor is there the place for such a detailed “historical” description. Thus, the following

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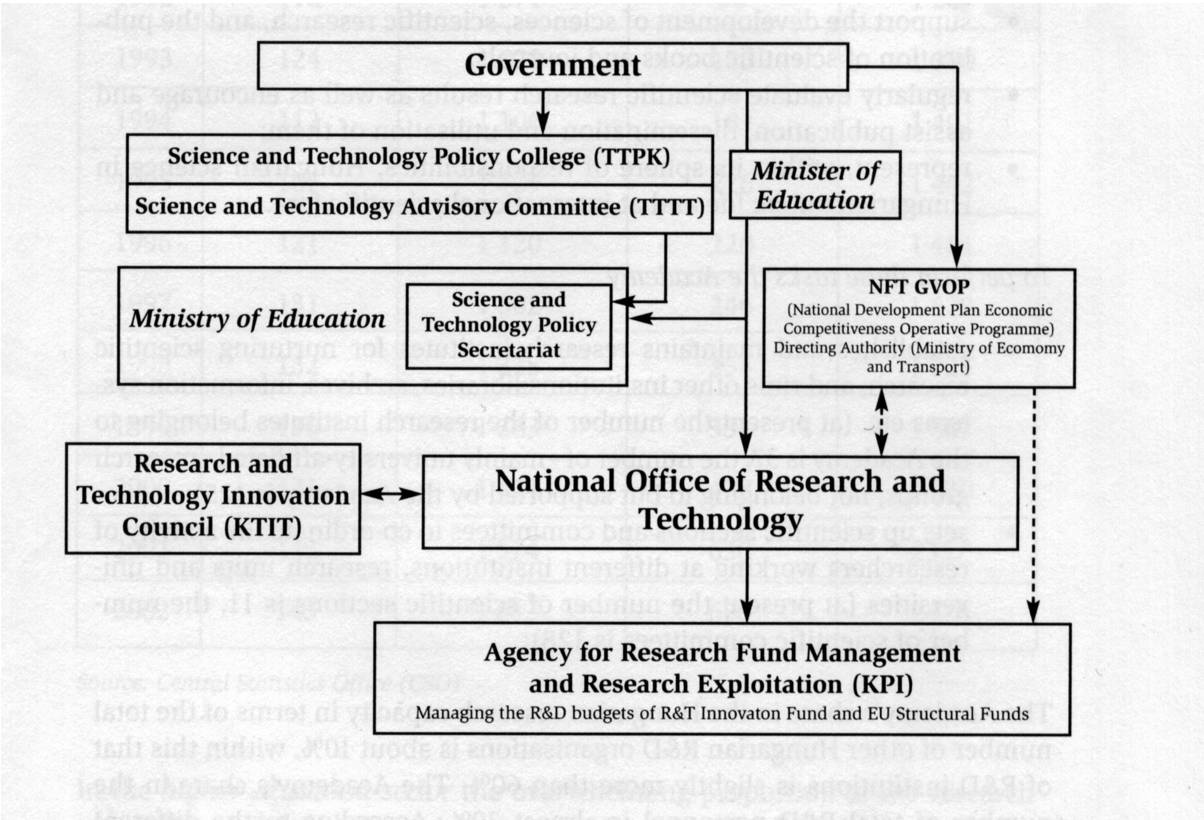
[25]) The most prominent examples of R&D units set up by multinational companies are GE-Tungsram, GE-Medicor, Sanofi-Chinoin, Astra, Teva-Biogal, Akzo Nobel/Organon, Ericsson, IBM, Compaq, Nokia, Siemens, Motorola, Tata Consultancy, T-Systemy/Matáv, Audi, Volkswagen, TEMIC, Michelin, Knorr-Bremse, Mannesmann-Rexroth, Flextronics, Novartis/Sandoz Seeds, Unilever, ZOLTEK, Furukava)

description of the institutional system and framework of the Hungarian innovation system is restricted strictly to the system in place, as of the time of the writing (i.e. spring/summer 2004). Figure A.2 illustrates the current institutional setting of the RTD policy system.

Figure A.2: The institutional setting of the Hungarian RTD system



Source: Inzelt, 2004

At the ministerial level the main player is the ministry of education, which is responsible not only for education, but also for science and technology policy. Beside the ministry there are consulting and advisory boards which are reporting directly to the government, as is shown in Figure A.2. The so called *Science and Technology Policy College* (TTPK) is the highest government level consulting body of science and technology policy. Adjacent to the TTPK is the *Science and Technology Advisory Committee* (TTTT). The TTTT acts as the advisory body of the TTPK is composed of eleven highly distinguished representatives of the national scientific community and industry.

On 1st January 2004 *the National Office of Research and Technology* (NKTH) has been founded as the legal successor of the former R*&D Division of the Ministry of Education*[26] complemented by the *Research and Technology Innovation Council* (KTIT).

The NKTH acts as a government office and has the following responsibilities and missions:

- Elaborating the government strategy in the field of innovation,
- Forming the means and tools for the R&D and innovation policy at government level,
- Preparing background reports concerning the national science and technology policy, technology foresight programmes, generally serving the government's science and technology strategy in co-operation with social partners, NGOs, industrial and professional associations,
- Representing the government in the international arena, in intergovernmental S&T organisations and programmes, organising and co-ordinating the Hungarian participation in such programmes. In this capacity, it is also in charge of the multilateral S&T co-operation and participates in the EU accession process,
- Co-ordinating the activity of the new *Research and Technology Innovation Fund* (RTIF) see section 3), and the National R&D Programmes
- supervising the *Agency for Research Fund Management and Research Exploitation* that was set up on the 1 of August 2003. This Agency is responsible for managing different R&D support programmes financed from the new *Research and Technology Innovation Fund* (RTIF).
- Raising the awareness for technology and innovation in the society.

7.5.3 New funding measures

Economic Competitiveness Operational Programme (EPOC)

Hungary's recent accession to the European Union (May, 1st, 2004) has led to some necessary adaptations of the supporting infrastructure/framework. Thus, the specific

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[26]) The R&D division of the Ministry of Education was created in January 2000, replacing the old OMFB (*National Committee for Technology and Development*).

EU regulatory framework for subsidies have to be applied in Hungary. To avoid redundancy, this framework strictly forbids a “doubling” of measures: a given objective/ activity can only be supported by one scheme, either by a purely national one, or by jointly (by EU and Hungarian funds) financed one. Hence, the measures of the programmes funded by the European Regional Development Fund (ERDF) have to be separated from schemes funded by purely Hungarian funds.

Thus, with respect to technology policy instruments some major adjustments had to be undertaken. A large number of the former OMFB schemes are now part of the Community Support Framework, under the heading of the Economic Competitiveness Operational Programme (ECOP), Priority 3, Research, Development and Innovation. The budget of this priority is 35 billion HUF for the period of 2004-2006. 25 billion (71%) will be financed by the ERDF where-as the rest is to be co-financed by Hungarian national sources. These schemes have been devised by the Office of Research and Technology, but their so-called Managing Authority is the Ministry of Economic Affairs and Transport. Table A.4 summarizes the various schemes, their objectives and their eligible activities of the ECOP.

Table A.4: Technology and innovation policy schemes in the ECOP, launched in January 2004

Scheme	Objectives of scheme	Eligible activities/ cost elements/ conditions
Application-oriented research and technology development (AKF) (basic research elements are eligible up to 30%)	Fostering the development of new products, services, materials and processes	Fields of research: material sciences, nanotechnology and manufacturing technologies biotechnology electronics, measurement, control technologies energy technologies information and communication technologies environmental technologies transport technologies, logistics Form of assistance: non-refundable subsidy
Upgrading the physical infrastructure of publicly financed and non-profit R&D institutes (KMA)	Modernisation of equipment so as to improve efficiency of R&D activities	Purchasing new R&D instruments and equipment, upgrading existing ones Accreditation of measurement activities Form of assistance: non-refundable subsidy
Co-operative Research Centres (KKK)	Integration of higher education, R&D, knowledge and technology transfer	Multi- and trans-disciplinary, oriented basic and applied research projects, aimed at problem-solving

	activities by establishing CRCs, jointly set up by higher education institutes, R&D institutes and businesses at least for 3 years, preferably 6-9 years	Scientific training of students, lecturers and researchers Adaptation, improving upon R&D results Feasibility studies for innovation projects Purchasing R&D services Obtaining licences, know-how Patent and trademark application fees Purchasing legal, IPR, financial, management consultancy services Form of assistance: non-refundable subsidy At least 5 business partners, and 10 PhD students or young researchers are required
Technology- and knowledge intensive start-up micro firms and spin-off companies	Commercialisation of innovative ideas and R&D results by supporting start-up and spin-off firms	R&D projects Adaptation, improving upon R&D results Feasibility studies for innovation projects Purchasing R&D services Obtaining licences, know-how Patent and trademark application fees Purchasing legal, IPR, financial, management consultancy services Form of assistance: non-refundable subsidy
Development of the physical infrastructure of business R&D units	Creating new R&D jobs, improving working conditions for researchers, and thus enhancing competitiveness	Purchasing R&D instruments and equipment, hardware, software for newly created jobs At least 3 jobs per projects, Form of assistance: non-refundable subsidy Newly created R&D jobs to be kept for at least 5 years
Promotion of innovation at SMEs	Developing innovation capabilities of SMEs, fostering academia-industry co-operation aimed at introducing new or improved products, services, processes	Obtaining exploitation rights of R&D results Commissioning applied R&D activities Own R&D projects Improving upon existing technologies, products, services Feasibility studies for innovation projects Form of assistance: non-refundable subsidy

Source: Havaz (2004) based upon a compilation from official documents launching the various ECOP schemes

The new Research and Technology Innovation fund (RTIF)

In parallel with the re-organisation of the government body responsible for RTD policies, on 10 November 2003 a new legislation was passed on a new fund to finance RTD activities, called Research and Technological Innovation Fund (RTIF, Law XC 20003). In practice it is replacing the former Central Technological Development

Fund, which used to be financed directly from the state budget since the early 1990s.

The RTIF is financed mainly from two sources:

- Companies have to pay a levy based on their net value added (so-called innovation contribution). – The amount of the levy depends on company size. Micro firms (less than 10 employees) are exempt from any contribution, small firms (10 to less than 50 employees) have to pay a smaller amount per cent as large firms. R&D expenditures (both intramural as well as extramural) can be deducted from the payments. Thus the levy may be characterized as having an re-distribution effect with non R&D firms as payers and R&D firms as possible receivers (via the activities of the fund itself). Currently (2004) the levy is 0.05% for small firms and 0.2% for large firms. It is to be raised continuously during the next years. For the fiscal year 2007 the levy is planned to be 0.2% for small and 0.3% for large firms.
- this income generated by the levy is then (at least) doubled with public money from the central budget[27].

Due to this specific setting of the Fund's financing, the RTIF is independent from the annual budget cycle which enhances the predictability and sustainability of its actions. The size of the Funds (in terms of money to be distributed) is quite significant and it is estimated that the fund accounts for about 30 – 40% of the size of the total R&D fiscal year 2004 budget.

Concerning the funding principles following premises have to be fulfilled:

- Financial resources of the Fund shall benefit RTD activities undertaken directly or indirectly by private companies.
- 95% of the financial resources of the Fund shall be spent through competitive calls, thus a lean management of the Fund shall be realized (operational costs are estimated at about 2% of total resources, 3% are commitments under separate legislation).
- At least 25% of the resources shall be used for regional innovation purposes (addressing the regional disparity problem mentioned in section 1.1)

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[27]) In addition to these two major sources the fund shall receive voluntary donations as well as income through left-overs and refunds. However the share of these additional funding will remain tiny.

The priorities of the RTIF for 2004 are as follows:

- enhancing the competitiveness of the Hungarian economy by direct and indirect support to innovation at firm level, as well as by boosting demand for innovation
- promoting industry-academia co-operation (since extra-mural R&D can be deducted from the mandatory levy there is an implicit incentive for industry-academia co-operation by the very financing setting of the RTIF itself).
- contributing to costs of commercialization/exploitation of R&D
- supporting RTD services, innovation bridging and networking activities
- developing RTD infrastructures
- fostering regional innovation directly addressing the problem of regional discrepancy in chapter X.1.1
- orchestration with the schemes financed by the Community Support Framework (ECOP)
- harmonisation with EU RTD FP6 programmes, especially calls for Networks of Excellence and Integrated Projects
- building intense, wide-ranging science – society relationships, popularisation of science and technology.

Offset-funding based on (large) public procurements

Currently, the possibilities of using offsets of large public procurement purchases (e.g. the purchase of new fighter-planes) for funding of RTD related projects. In principle, for each large public procurement purchase a multiplier would be defined which has to be invested in Hungary by the vendor as an offset. However, this discussion is up to now at a strategic level and there are no final decisions made yet. Hence, detailed information is still confidential and not for public use.

7.6 IRELAND

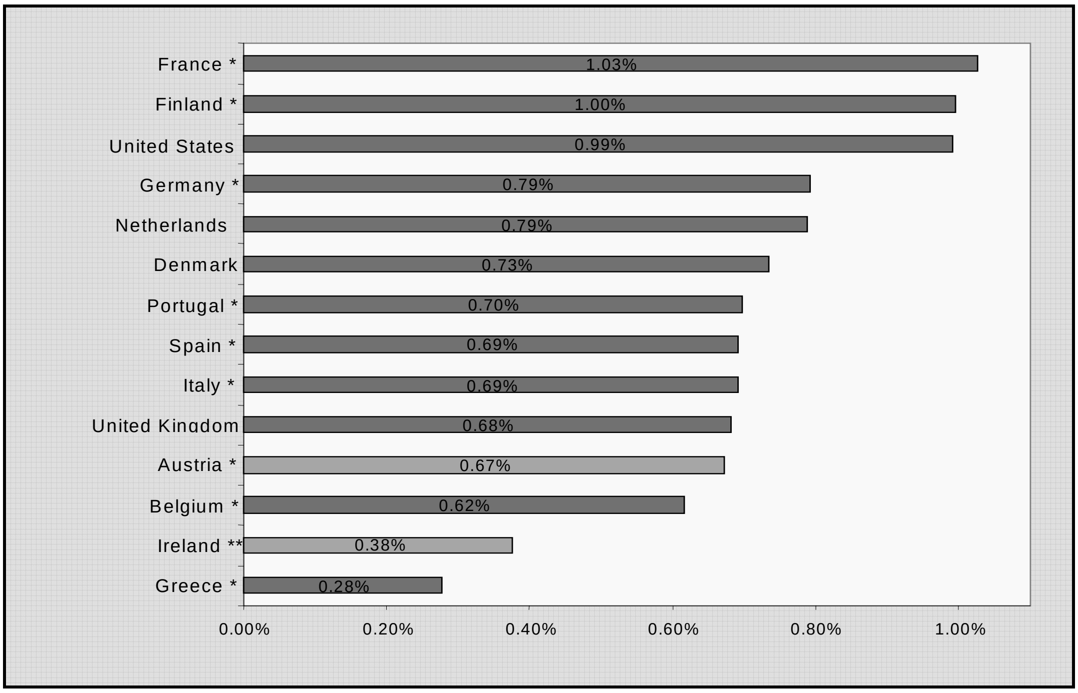
7.6.1 Characterisation of the Irish National Innovation System and R&D Performance

Ireland is an interesting example for comparative policy learning, both because of the characteristics of its National Innovation System as well as because of its recent initiatives in Science, Technology and Innovation Policy.

Ireland has seen its levels of GDP per capita rise from levels well below to those above the European average. It has for a long period experienced sustained high rates of growth in GDP/GNP and productivity. The background for these developments was a strong performance of the manufacturing sector, mainly due to the substantial investment of foreign multinationals in past decades. As the main thrust of the investment went into the ICT sector, Ireland was also able to 'ride the new economy wave' in the 1990ies of the previous century. This specialisation pattern heavily geared to the ICT sector can be depicted both in the share in production and in exports. On the other hand, the high share of high- to medium-high-tech industries was not matched by a correspondingly high R&D intensity.

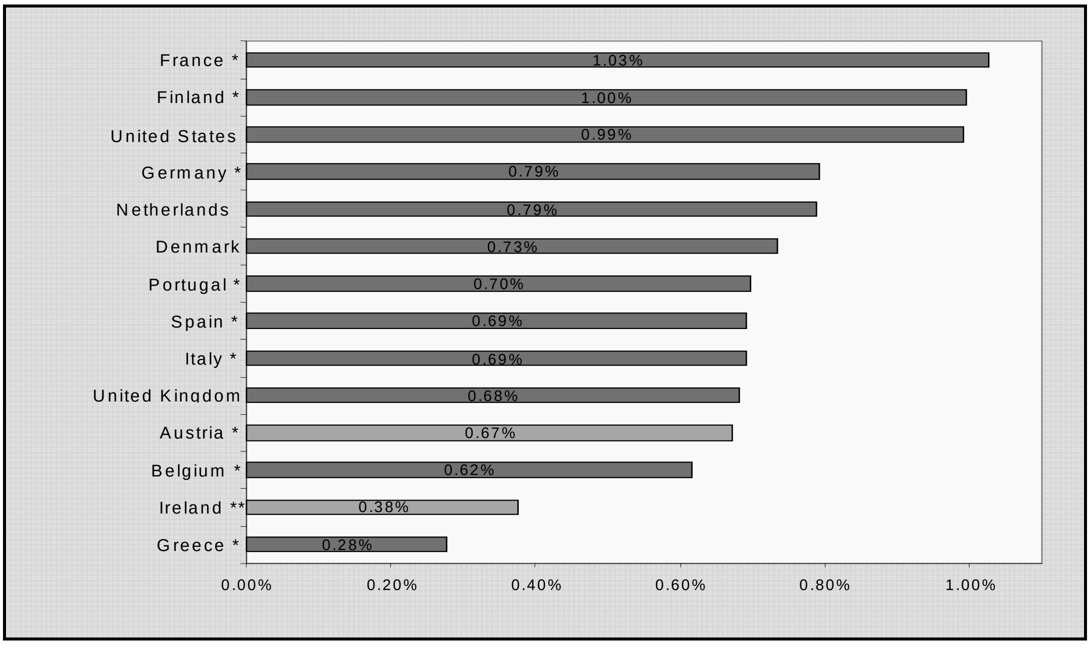
Starting from a low level, Ireland has substantially increased its R&D spending in recent years: the level of business R&D expenditures have already been on the rise throughout the 1990ies (at growth rates of approximately 12 per cent between 1995 and 2002; see Figure A.3), but as GDP and GNP also experienced very rapid growth in this period, R&D intensity grew very little if at all. Recently (2001 figures), R&D intensity was 1.4%, still well below the EU average of 1.9%. Business expenditures on R&D accounted for some 0.9% of GNP (EU average: 1.25%), while R&D spent in higher education and public research sector equalled 0.4% of GNP (EU average: 0.66%) (FORFAS and OST, 2004; see Figure A.4).

Figure A.3: Government R&D budget average annual growth (%),1995 - 2002 (or latest year available)



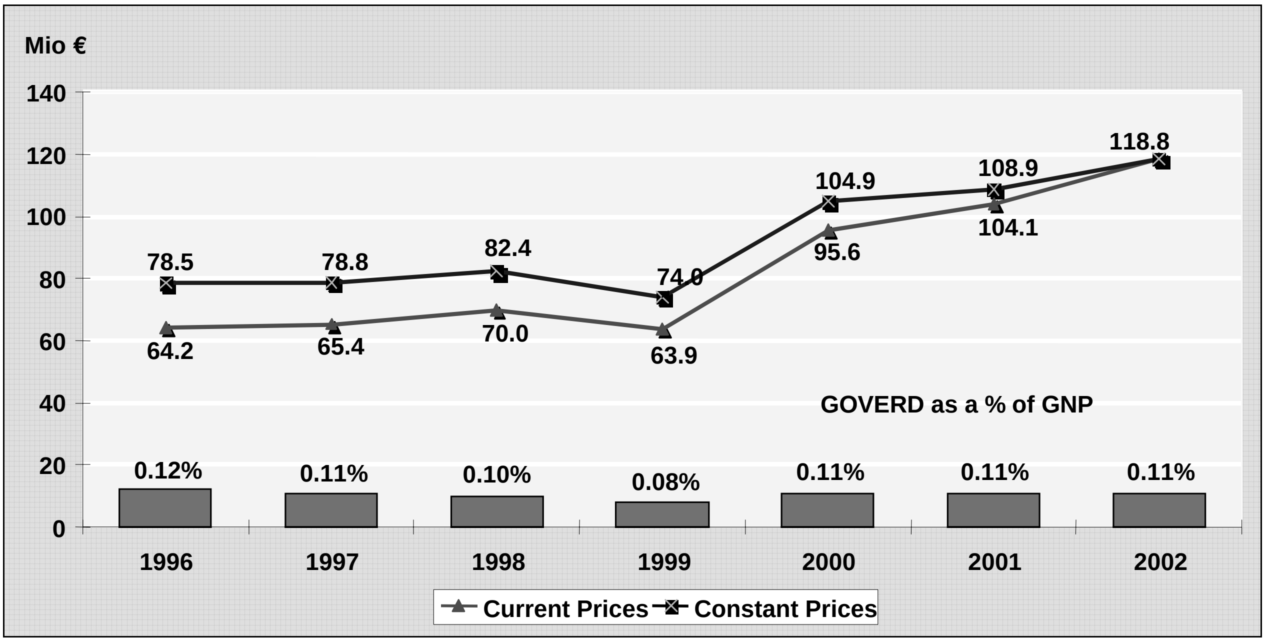
** as Percent of GNP. Source Forfas 2004

Figure A.4: Government Budget allocated to R&D as % of GNP 2002 (or latest year available)



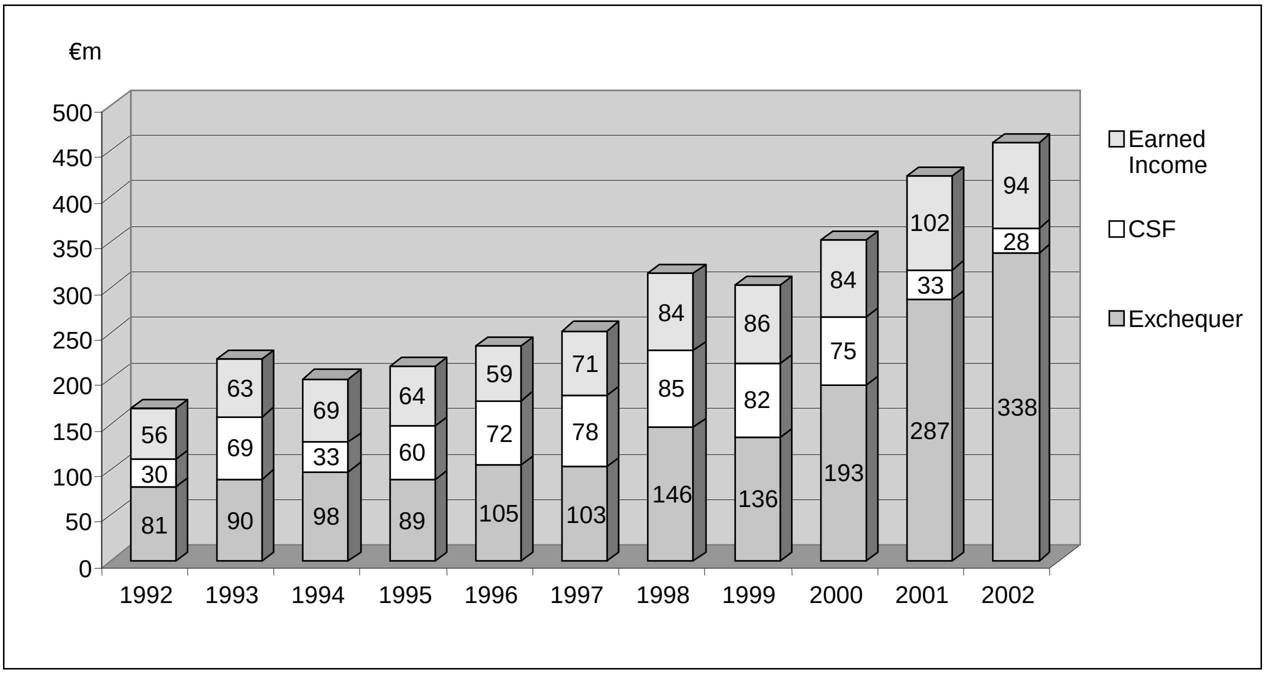
** as Percent of GNP. Source Forfas 2004

Figure A.5: Government Expenditure in % of GNP (Current and Constant Prises)



Source: FORFAS 2004, OECD

Figure A.6: Sources of Total R&D Funding 1992-2002 (2002 prices, Mio €)



Source: FORFAS 2004

Also the peculiarities of the Irish National Innovation System make for an interesting example for policy learning: the strong role of multinational corporations, the low level of R&D spending of indigenous corporations, a relatively high importance of the EU's Framework Programme and – until recently - the very low level of domestic public R&D expenditure.

While the enterprise sector spends two-thirds of all R&D expenditures, multinational corporations account for two-thirds of all business R&D, of which again two-thirds stem from just 19 firms. Of indigenous firms, only a small number has significant R&D expenditures. Public R&D expenditures have been low from the outset and have been rising at a much slower speed than business R&D in the 1990ies, but experienced a major push at the turn of the century, when expenditures roughly doubled between 1999 and 2001. Conversely, the importance of funding from the Framework Programme declined (but still amounts to some 12 per cent of all funding in the HEI).

In terms of output, the Irish business sector has very high shares of high-tech and high-medium tech production and exports. Here, Ireland ranks among the top countries in the EU. These high shares have preceded the rise in enterprise R&D, pointing to the fact that they are mainly due to the strong manufacturing base of the multinational corporations. Output indicators for the public research sector show that the current output of graduates compares very favourably with other EU countries (especially in terms of S&E graduates and female participation), but the share of researchers in the total work force is still low (5,1 compared to an OECD average of 6,5). With respect to scientific output, the Irish authorities recognise, that "[t]hroughout the 1980s and 1990s, there was little scope to carry out high quality research in universities in Ireland due to a lack of research infrastructure and a lack of funding to support researchers" (Inter departmental Committee 2004, 13).

Thus, with respect to S&T expenditures, Ireland can be seen as a country which strives to rapidly catching up, with a strong increase in business expenditure on R&D upfront, which is now thought to be matched by an equally string rise in public R&D. As the latter is happening at a much higher speed, the strain on the Irish system of S&T policy formulation and delivery is considerable. Such a rapid increase in public

R&D spending needs a well laid out strategy and institutions well in place to be absorbed in a sensible way.

7.6.2 Science, Technology and Innovation Policy

Additional Funding for STI

Against the above described background, Irish STI policy reacted in the following way: A strategic decision was taken to heavily invest into ‘building Ireland’s knowledge economy’ (Inter Departmental Committee, 2004), epitomized in the National Development Plan (NDP)[28] for the period 2000-2006, which sets the target to increase Government spending on R&D from 0.5 bn € over the previous period (1994-1999) to more than 2.5 bn €. (ICSTI, 1999).

[28] The national devlopment plan sets out development targets for all areas of economic policy, including R&D.

Table A.5: National Development Plan 2000-2006: Envisaged Spending on Research, Technological Development and Innovation (RTDI), Mio €

Policy Area	Irish expenditure	EU co-financing	Total
Education	706	104	810
Industry	1667	763	2431
Agriculture	62	0	62
Food	77	0	77
Marine	53	0	53
Forestry	17	0	17
Environment	45	0	45
Total	2627	868	3495

*including other sources. Source: INDECON 2003

In this plan, as well as in a number of other policy documents (see e.g. DETE, 2002 Inter Departmental Committee, 2004), R&D and innovation was given highest priority for future development in Ireland. This went along with a general re-orientation of state-aid, which saw a significant re-orientation from sect oral to horizontal objectives, among which R&D figures prominently.

The National Development Plan 2000-2006 is an investment plan designed to underpin the development of Ireland as a dynamic, competitive economy. The Plan provides for a total investment of €51.5 billion, in 1999 prices, of which some €2.5 billion is allocated to science, technology and innovation (RTDI). The scale of this allocation represents a major upward step-change in the funding available to implement science and technology policy in Ireland, and for the first time, it foresaw indigenous monies to outgrow European monies for RTDI.

The Plan has the general objective to foster the research, technological development and innovation base of the country especially by strengthening the research capability in the third-level education and State research institutes to meet RTDI and skills' needs of the economy; thus, the plan addresses the following sub-goals:

- Strengthening supports to researchers and research students;
- Increasing RTDI linkages between institutions and companies;
- Helping companies to develop innovative products, services and processes;

- Increasing the number of companies performing effective R&D;
- Increasing the scale of RTDI investment by companies in Ireland
- Promoting research and development (R&D) and technology transfer;
- Embedding the culture of R&D in small and medium sized enterprises;
- Providing substantial public investment in niche technologies; and
- Promoting balanced regional development.

The additional monies foreseen by the NDP are to be allocated via the budget (no specific fund was created), but – as will be described below – a number of new institutions and programmes were put in place or substantially transformed to serve as channels for these monies.

7.6.3 Institutional Framework for Decisions on the STI Budget

Ireland has a rather complex institutional framework for STI policy, the outlines of which were developed in the ‚White paper on Science, Technology and Innovation policy' from 1996. Its main characteristics can be summarized as follows:

- While the respective Ministries are supposed to play a larger role in STI policy than in many European countries (Ireland resembling more the ‚R&D by department' organisation of the US), the Inter-departmental Committee on S&T is expected to coordinate between the Departments. In fact, it has only met occasionally and has no strong coordinative powers.
- The overall S&T budget is little more than a compilation on the budget plans of the respective departments.
- The departments with the strongest role in STI policy are the Departments of Education and Science (EDS), of Enterprise, Trade and Employment (ETE), and of Agriculture and Food (AGF) respectively
- Since the elections 2002, the Tánaiste (Deputy prime minister) and Minister for ETE is responsible for the science and technology portfolio. She is aided in this task by the Office of Science and Technology of the Dpt. of ETE, which is responsible for the development and co-ordination of national S&T policy, the S&T budget and the international S&T co-operations (FP, ERA)
- For the period from 1997 till 2002, when the Department of Education was renamed Education and Science, a special Minister for Science and Technology was appointed to the Dpt. of EDS and the Dpt. of DETE.

- Forfas, is the national board responsible for providing strategic policy advice to the government on STI issues. In addition, it is also the organisation responsible for the promotion of FDI and STI in Ireland. This role can be fulfilled either directly or through other operative units under Forfas.
- For the purpose of providing policy advice, the Irish Council for Science, Technology and Innovation (ICSTI) was established as an independent body, appointed by the Minister for Science and Technology and Forfas.
- For the promotion of industry and technology, Forfas delegates responsibilities to associated agencies: Enterprise Ireland (indigenous industry), IDA Ireland (FDI), and Science Foundation Ireland (SFI) (funding basic research).
- Most of the institutions have only been established recently and the institutional landscape still seems to be in flux, with responsibilities not quite clear and existing structures often not well incorporated when new ones are created. Therefore, a forthcoming plan for reform – based on the recommendations of a report produced under the aegis of ICSTI (Wilson commission) is waging again institutional changes for better policy coordination.

7.6.4 Implementation of the increased funding – new institutions and instruments

To put these monies into policy action, new institutions and instruments have been proliferating in recent years. In fact, most of the institutions currently in place in Ireland, have only been put in place very recently or have seen their roles changed considerably in recent years. This can be exemplified by listing the most important organisations / agencies and instruments foreseen to channel these funds:

In the realm of support to scientific research,

- *Science Foundation Ireland* (SFI) was established in 2001, became independent in 2003 and funds 'excellent' research, mainly in ICT and Biotech. In these areas, SFI has created centers for Science, Technology and Industry to foster scientific excellence and industry science-cooperation. In addition, two research councils were created - one for Humanities and Social Sciences (in 2000) and one for Sciences, Engineering and Technology (in 2001). Financing for SFI, which already accounted for the mayor part of previous increases[29], again rose by 62 per cent in 2004, totalling 113,4 Mio €.

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[29] E.g. in 2002 total government expenditure increased by €59.5m over the 2001 outturn. The major increases in allocations relate to additional allocations by Forfás/ Science Foundation Ireland - €32.7m

- In 2000 and 2001 the Minister for Education and Science created the Research Council for the Humanities and Social Sciences (IRCHSS) and the Research Council for Science. The latter was established to fund the development of local research capabilities and skills and the Irish Research Council for Science, Engineering and Technology (IRCSET), to promote excellence in research in the wide areas of sciences, engineering and technology. Since 2001, IRCSET launched the 'Embark Initiative', to support students and researchers to pursue their vocation via Basic Research Grants (since mid-2003, this was transferred under the responsibility of SFI), Post-Doctoral Research and Post-Doctoral Fellowship.

Both Science Foundation Ireland as well as the two Research Councils are financed through the NDP. SFI administers a 646 million Euro fund over the period 2001-2006. Spending accelerated as the institutional construction of SFI consolidated. Between 2000 and 2002, total expenditure equalled 46.4 million Euro, or 20.5% of the initial forecast (Indecon, 2003). In 2004, the financing for SFI increased by 62% compared to 2003, to 113.4 million Euro. The Basic Research Support sub-measure in the RTDI Education Priority used 13.4 million Euro by year-end 2002, slightly below the initial forecast. The Basic Research Support sub-measure in the RTDI Education Priority used 13.4 million Euro by year-end 2002, slightly below the initial forecast.

- The Programme for Research in Third Level Institutions (PRTLI), launched in 1998, received additional funding from the NDP. It main tasks is the strategic development of institutional research capabilities in scientific institutions. Funding covers also the design of strategies in TLIs in response to their need for profiling and specialisation.

Measures targeted towards industrial R&D recently implemented are the following measures:

- A considerable number of programmes are addressing enterprise R&D under the heading of the 'Productive Sector Operational Plan 2000-2006', e.g. the

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(for research in biotechnology & information & communications technologies), the Department of Education and HEA – 8.6m and 7m for research in third level institutions, the Department of Agriculture & Rural Development via Teagasc - €8.5m (for research in the fields of agricultural production and food processing) Department of Health & Children via the Health Research Board - €5.4m (for research units and HRB laboratories).

Competitive Research, Technology Development and Innovation (RTDI) scheme, the R&D capability scheme, or the RTDI for collaboration scheme. Under these schemes, several sub-programmes were created or merged with existing initiatives – e.g. the Programmes in Advanced Technology (PATs). While according to the NDP, these initiatives should have also seen a steep rising in funding, pick-up was slowest here, partly because of administrative and institutional reasons, partly because of the limited adoption capabilities of firms.

- The Competitive Research, Technology Development and Innovation (RTDI) Scheme supports R&D undertaken by manufacturing or internationally traded firms in Ireland. Also since 2000 the R&D Capability Scheme supports the building-up of a company's R&D infrastructure provided a company developing plan is presented. Since 2001, Enterprise Ireland administers a scheme for funding so-called 'significant R&D initiatives', including high potential start ups, significant expansions of current R&D efforts, and large individual projects in excess of 3 Mio €, with maximum grant rates of up to 45%.
- Under the RTDI Competitive Scheme, expenditures totalled 70.75 million Euro over the period 2000-2002 (Indecon, 2003), which represented only 21.6% of the initial forecast. Under the R&D Capability Initiative, expenditures totalled 55.4 million Euro in 2001-2002 (Indecon, 2003), which represented only 25.6% of the initial forecast. In 2003, spending summed up to 33.5 million Euro under the RTDI scheme, and to 22.4 million Euro under the R&D Capability scheme, 63% of the latter being equity-based (DETE Report). Between 2001 and 2003, Enterprise Ireland provided 38 million Euro for R&D initiatives.

Table A.6: Meeting the targets (1)? - Results from 2002 mid-term assessment of the RTDI Competitive Scheme

	2000	2001	2002	Total 2000-2002	Mid term target (end 2003)	Final target (2000-2006)	End 2002 in % of mid-term target
Number of companies benefitting from the scheme	58	199	219	476	650	1250	
Additional R&D spending by companies, Mio €	54	161	134	350	300	600	
New R&D performers	40	111	106	257	250	500	

Source: INDECON 2003

Table A.7: Meeting the targets (2)? - Results from 2002 mid-term assessment of the R&D Capabilities Scheme

	2000	2001	2002	Total 2000-2002	Mid term target (end 2003)	Final target (2000-2006)
Number of projects supported	16	47	74	137	140	220
Total business investment in R&D facilities	32	100	120	252	234	364
Number of new R&D staff employed	162	528	532	1222	500	800
New R&D performers	12	29	21	62	60	100

Source: INDECON 2003

- An indirect form of financial support especially for local SMEs is the Business Expansion Scheme (BES). It provides income tax based incentives for private investors to invest in long-term equity in R&D active companies that operate in certain sectors of the economy. The scheme was operational since 2001 and has been recently prolonged until the end of 2006.
- In 2004 The Department of Finance introduced a 20% tax credit for companies for incremental R&D expenditures. Expenditure on plant and machinery and revenue items will qualify for this measure over a specified base, while the full cost of buildings used for R&D purposes will qualify. The application of this tax credit is nevertheless subject to the approval of the European Commission’s state aid procedures (Forfas Report). This measure was initiated by The Irish Council for Science, Technology and innovation (ICSTI), especially aiming at large national and multinational corporations in high-tech sectors. In its recent statement on priorities, ICSTI has proposed an extension of this measure to cover SMEs specifically (ICSTI 2004). The budgetary effects of the tax measures remain to be determined.
- Since 2004, transfers of intellectual property such as copyrights, patents and trademarks are exempted from stamp duty.

With respect to science-industry interaction,

- apart from the major RTDI for collaboration programme mentioned already above, under Enterprise Ireland’s (EI) Innovation Partnerships, companies are encouraged to undertake research projects with Irish universities and institutes of technology. Grants cover between 35% and 75% of eligible costs.
- Other programmes in this vein are Research Innovation Funds, Regional Business Incubation Space, Third Level Incubation Space, also run by EI.

- From another angle, SFI has established the Centers for Science, Technology and Engineering to promote academic-industry cooperation in the fields of ICT and biotechnology.

Alongside these measures, a number of others have sprung up recently (on SMEs on public awareness of RTDI etc.), contributing to an increasing number of support programmes for R&D. No overview of such programmes is available at the moment. As has been stated above, also to oversee the budgetary RTDI spending is not easy (reflected in the fact that compilations of RTDI budgets are published with a delay of some 2 years later than the respective budget year (see for the latest publication FORFAS 2004a and 2004b)

7.6.5 Assessing the effects of increased spending

A few evaluations are available which shed some light on whether the targets of the NDP are met and the implementation is functioning smoothly. The whole of the implementation of the NDP has been subject to a mid-term evaluation (see Indecon 2003), while some of the specific programmes (e.g. PRTLI and the RTDI for collaboration Programme – see HEA 2004 and Technopolis 2004 respectively) also have been evaluated. By and large, these evaluations only allow for a first tentative assessment of the implementation and the effects of the increased RTDI spending.

The main results from the overall evaluation are:

- That, overall, the NDP had a slow start due to administrative problems and the need to obtain approval from the EU. Thus, only parts of the monies that should have been spent on RTDI in the first 3 years of the plan were really made available. Spending in the education sector was much closer to the target than spending in industry, probably pointing to the fact that public research institutions are more easy to identify and address than clients for support measures.
- That, despite the slow start, the NDP had positive effects on GDP, employment and labour migration, but negative effects on inflation, the level of debt and the balance of payments (Indecon 2003).
- That, although measures like the Competitive RTDI scheme and the R&D capability scheme seem to have met their interim targets, and measures like the PRTLI have also been evaluated quite favourably (see HEA 2004) and is suggested to be continued and increased.

Judging also from assessments in the administration, it seems that the rapid increase of public R&D spending has put the Irish 'system of policy delivery' under stress. Indicators for this stress are slower than anticipated uptake of spending and the proliferation of institutions and support measures can be seen as an indication for this stress. It also appears that not all measures have been designed according to 'good/best' international practice. Further evaluations will have to look into the effectiveness not only of the single measures, but also on their portfolio. As they have not been designed in a coherent way (i.e. on the basis of a 'concerted political action' by the stakeholders), but rather by the individual players, it might turn out that this portfolio needs to be streamlined in the future.

After the launch of the NDP, economic conditions deteriorated (e.g. growth has slowed, unemployment rose slightly and the budgetary position worsened; see Table A.9) and spending targets will be hard to meet. In order to keep the pace of spending and to signal the sustained nature of the RTDI spending, the new 'action plan on innovation' (Interdepartmental Committee 2004) sets the targets for RTDI spending even more ambitious:

- "Business investment in R&D should increase from €917 million in 2001 (0.9% GNP) to €2.5 billion in 2010 or 1.7% GNP;
- the number of indigenous companies with minimum scale R&D activity (in excess of €100,000) should double, from 525 in 2001 to 1,050 in 2010;
- the number of indigenous enterprises performing significant R&D (in excess of €2 million) should increase from 26, currently, to 100 by 2010;
- the number of foreign affiliates companies with minimum scale R&D activity (in excess of €100,000) should double, from 239 in 2001 to at least 520 in 2010;
- the number of foreign affiliates performing significant levels of R&D (in excess of €2 million) should increase from 47 in 2001 to 150 by 2010;
- R&D performance in the higher education and public sectors should increase from €422 million in 2001 (0.4% GNP) to €1.1 billion in 2010 or 0.8% GNP;
- The combined increases in performance in business, higher education and public sector R&D should result in gross expenditure on R&D increasing to 2.5% of GNP by 2010;

- Consequently, the number of researchers should reach 9.3 per 1,000 of total employment by 2010, from approximately 5.1 per 1,000 in 2001."

(Interdepartmental Committee 2004, p 2-3)

7.6.6 Conclusions and policy lessons from the Irish case

Irish S&T policy has to respond to the challenge of increased competitive pressures in the manufacturing industries pushing towards increased knowledge intensity. Irish policy accepted that challenge and made S&T a cornerstone of its development strategy (see Inter Departmental Committee, 2004 and ICSTI 1999). Ireland had to start from a low level of R&D intensity in international comparison. Irish enterprises have responded by substantial increases in enterprise R&D in the 1990s, though mainly confined to multinational firms. Thus, main tasks for policy were (a) to improve the indigenous knowledge base and supply of highly-skilled personnel by expanding the public research base and the higher education sector, (b) to trigger R&D efforts by indigenous enterprises (mainly SMEs) and (c) to increase the interaction between enterprises and the public sector. To this avail, a large number of programmes and initiatives have been created. The effect of most of these programmes cannot be properly assessed at this time. Nevertheless, some first indications point to difficulties of the Irish system of policy implementation and delivery: the increase in public spending (though remarkable in international comparison) stayed behind the ambitious targets – due to difficulties of the existing institutions to administer such a rapid increase (see Indecon, 2003). Also, institutional changes and the establishment of new programmes at the beginning of the phase did not make the task easier. Some of the programmes do not seem to be designed in line with 'best practice' in other countries. E.g. main parts of the RTDI for Collaboration Programme follow the now out-dated 'linear model' by conceiving technology transfer as a simple one-way street of ready made knowledge in public research to be transferred to enterprises, while truly co-operative elements remain rare in the programme (see Technopolis 2004). Also, there is a proliferation of programmes which is hard to keep track of, some of which potentially could overlap. Partly, this finds an explanation in the fact that – though each public institutions regularly issues 'strategy statements' (see e.g. DETE 2002, SFI 2002) - these statements might not add up to a coherent overarching strategy. Irish S&T policy currently tries to respond to these difficulties by setting up a Cabinet Committee on S&T supported by an Inter Departmental Committee and a Chief Science Advisor.

Apart from the adjustments of the policy system, ICSTI (2005) has pointed the need to sustain the expenditures to meet the Lisbon targets.

Thus, several tentative lessons could be drawn from the Irish developments in RTDI policy:

- S&T policy can be put on top of the political agenda even in times of deteriorating economic situations, Even very substantial increases of public spending on R&D can be agreed upon.
- In the Irish case, the additional funding was conceptualized in a specific policy document (the National Development Plan), which provided a frame for multi-annual perspectives. It was channelled via (and not outside) the budget, but a lot of institutions were created or had to adapt substantially (e.g. with the introduction of new instruments), to funnel these additional monies. As there is – as of yet – no framework for the formulation of a coherent budgetary policy for RTDI (rather this process happens in a department-by-department manner), it seemed to have caused some problems to implement the monies in a coherent fashion. One lesson for policy could be that strategies of individual institutions should be brought more in line.
- Before injecting an large increase of public R&D expenditure into the system, one has to get the system ready to digest these monies, both in terms of having the institutions in place to implement the policies and instruments as well as being conceptually prepared to employ the instruments in a ‘best practice’ manner. In both cases Ireland seems to have had some difficulties.
- In terms of institutional capabilities instead of such a ‘sprint’, a more continuous rise of R&D expenditure is preferable.

Table A.8: Current RTDI Spending versus National Development Plan (Mio €)

	Spending in 2000-2002	Forecast according NDP	Spending in % of Forecast
Total spending on RTDI	498	1304	38
of which…			
Industry	263	966	27
Education&Universities	152	238	64

Source: Indecon (2003)

Table A.9: Ireland – Key Economic Indicators

	2000	2001	2002	2003
Real GDP, % change	10,1	6,2	6,9	1,4
Real GNP, % change	10,2	3,8	0,1	3,3
Government Balance, in % of GDP	4,3	1,1	-0,2	0,2
Current account, in % of GDP	-0,4	-0,7	-0,7	-0,2
Unemployment rate	4,3	3,9	4,4	5,1

Source: OECD

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FORFAS - Industrial Policy, Enterprise Development, Irish Trade , Ireland Enterprise – www.forfas.ie

ICSTI, The International Council for Scientific and Technical Information - www.icsti.org/

7.7 Zwischenbericht: F&E-Ausgaben im internationalen Vergleich unter spezieller Berücksichtigung von Sondermitteln

7.7.1 Einleitung

Das hier vorliegende Länder-Screening analysiert die Struktur und die Entwicklung der F&E-Ausgaben für eine Vielzahl von OECD-Mitglieds sowie affiliierten Ländern .

Den Resultaten des Länder-Screenings vorangestellt ist eine Empfehlung für eine Detailanalyse jener Länder, die in den vergangenen Jahren „F&E-Offensiven" vergleichbar mit den Sondermitteln des Offensivprogramms I gesetzt haben.

Das anschließend dokumentierte Länder-Screening erfolgte anhand der Entwicklung folgender Kennzahlen zur Forschung- und Entwicklung über den Zeitraum 1995-2002:

- GERD/GDP... Gesamtausgaben für F&E in Prozent des BIP
- BERD... Gesamtausgaben der Unternehmen für F&E in Prozent des BIP
- GERD & BERD Anteile nach Finanzierungsquellen sowie GERD Anteile nach Durchführung
- Anteil der Ausgaben des GBAORD (Government Budget Appropriations and Outlays for R&D) für militärische Zwecke sowie nach sonstigen Verwendungszwecken

Im Anschluss daran wird eine kurze Beschreibung der Zielsetzungen der nationalen F&E Politiken gegeben und die Maßnahmen zur Erreichung sowie die Finanzierung der öffentlichen F&E Ausgaben einer kurzen Analyse unterzogen.

7.7.2 Vorschlag für eine Länderauswahl

Auf Basis der Ergebnisse des Länder-Screenings liegt nunmehr ein Vorschlag von Ländern vor, die für eine detaillierte Analyse der Struktur und Entwicklung des FTE-Finanzierungssystems als besonders interessant eingeschätzt werden (siehe für einen Überblick die Maßnahmenmatrix weiter unten) Hintergrund war dabei die Überlegung, dass die Auswahl keinen echten „repräsentativen" Querschnitt darstellen kann, sondern markante Beispiele von Ländern inkludiert, die

- entweder besonders auffällige Entwicklungstendenzen aufweisen (z.B. stark oder nachhaltig ansteigende F&E-Aufwendungen oder entsprechende Zielsetzungen [z.B. Umsetzung der Barcelona-Ziele]) und/oder
- starke Veränderungen in der Struktur der F&E-Ausgaben erkennen lassen (z.B. zwischen öffentlichen und privaten, zwischen heimischen und internationalen, zwischen verschiedenen Zwecken der F&E-Ausgaben [z.B. militärisch-zivil]),
- strukturelle Reformen ihres Finanzierungssystems durchlaufen (z.B. Reorganisation der Förderungslandschaft, Zuwachs der verfügbaren Mittel etc.) bzw. ‚Sondermittel[30]' eingesetzt haben oder aktuell einsetzen.

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[30] Als 'Sondermittel' wurden hier im engeren Sinne zusätzliche öffentliche Mittel für F&E verstanden, die in einem zeitlich begrenzten Zeitraum zur Verfügung stehen und meist ausserhalb der ‚Regelbudgets' bereitgestellt wurden. In einem weiteren Sinn könnte man von ‚Sondermitteln auch dann sprechen, wenn einmalige starke Zuwächse der Regelbudgets zu verzeichnen sind und diese aus bloss temporär anfallenden Einnahmequellen (z.B. Privatisierungen, UMTS-Versteigerungen etc.). Auch auf solche Fälle wurde im Länder-Screening hingewiesen.

Maßnahmenmatrix-Übersicht

Land	Quant. Zielsetzung	Sondermittel	GERD/GDP gewachsen	Exp. Maßnahmen über best. Zeitraum
Australien				✓
Belgien	✓		✓	
China	k.I.	k.I.	✓	k.I.
Dänemark	✓		✓	
Deutschland	✓		✓	
Finnland	✓	✓	✓	✓
Frankreich	✓			
Griechenland	✓		✓	
Großbritannien		✓		
Irland	✓	✓		✓
Island		✓?	✓	✓
Israel	k.I.	k.I.	k.I.	k.I
Italien	✓	✓?		✓
Japan			✓	
Kanada	✓	✓	✓	✓
Korea	✓		✓	✓
Neuseeland	✓		✓	
Niederlande	✓	✓		✓
Norwegen	✓	✓		
Portugal	✓		✓	✓
Schweden	✓		✓	
Schweiz				✓
Slowenien	✓		✓	
Spanien	✓		✓	✓
Taiwan	k.I	k.I	✓	k.I.
Tschechische Republik	✓		✓	
Ungarn	✓	✓	✓	✓
USA		✓	✓	

Auf der Basis dieser Resultate ergeben sich drei Gruppen von Ländern, wobei die erste Gruppe vom Projektteam als „Fixstarter“ für die Detailanalyse eingeschätzt wird, da die Länder dieser Gruppe die oben genannten Kriterien in besonderem Ausmaß erfüllen. Dies trifft - mit jeweils leichten Einschränkungen - ebenso auf die Länder der zweiten Gruppe zu, wobei diesbezüglich jedoch von Seiten des Projektteams ex ante keine Priorisierung eines Landes vorgenommen wurde. Die dritte Gruppe von potentiell zur Auswahl stehenden Ländern erfüllt die oben angeführten Bedingungen teilweise und kann daher von dem RFTE ebenfalls als in Betracht zu ziehen empfohlen werden, sollte es von Seiten des RFTE aufgrund anderer Gesichtspunkte bestimmte länderspezifische Prioritäten geben (z.B. strategisches Interesse an dem gewünschten Vergleichland etc.).

7.7.3 Länderauswahl

Gruppe 1: Erfüllt die oben genannten Anforderungen in besonderem Ausmaß:

- Finnland
- Niederlande
- Irland
- Ungarn

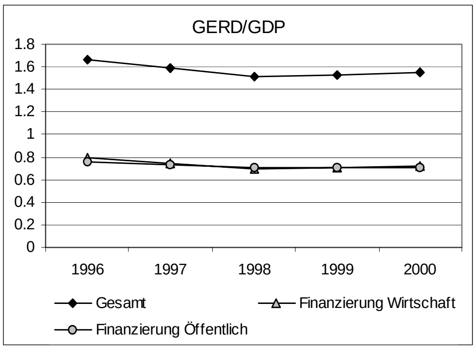
Gruppe 2: Erfüllt die genannten Anforderungen:

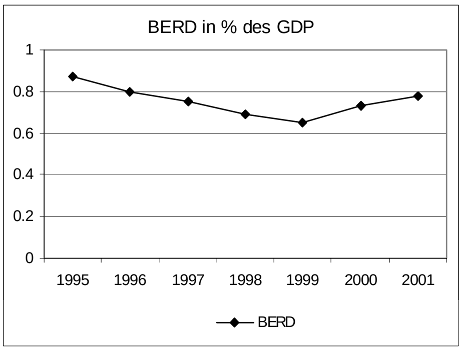
- Kanada
- Neuseeland
- Island
- Großbritannien

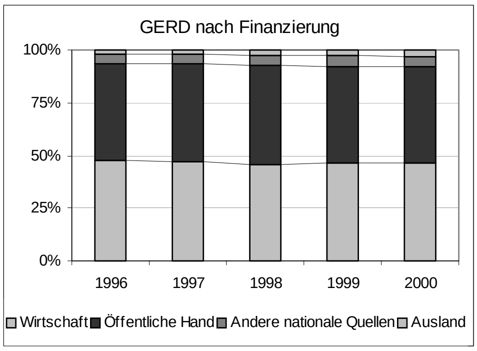
Gruppe 3: Erfüllt die genannten Anforderungen teilweise:

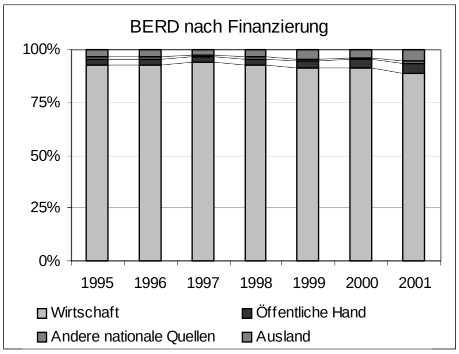
- Italien
- Korea
- Norwegen
- Dänemark

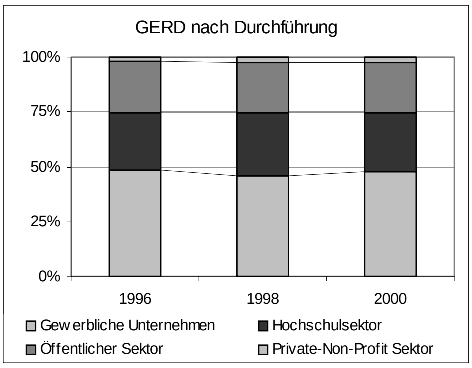
Australien

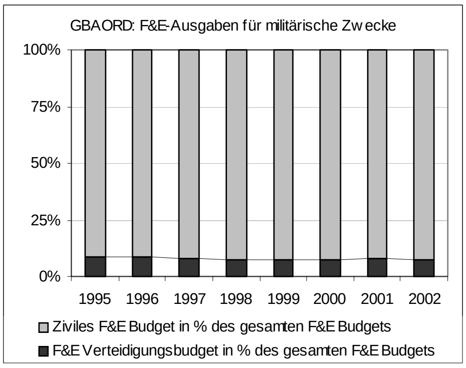


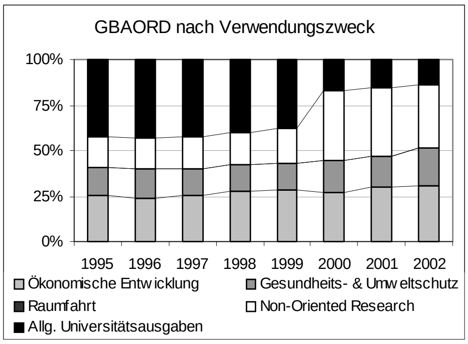












Quelle: OECD

Stylized Facts - Australien:

GERD/GDP

- GERD/GDP von 1996-1998 leicht fallend, dann wieder leicht wachsend.
- BERD/GDP sinkt bis 1999, tritt dann in Erholungsphase

FINANZIERUNG von GERD und BERD

- GERD zu knapp 50% durch Wirtschaft, wobei eine Abnahme seit 1997 erfolgt ist
- BERD zu knapp 90% durch Wirtschaft finanziert

DURCHFÜHRUNG von F&E

- Ca. 50% Unternehmen, Spiegelbild zur Finanzierung
- Öffentlicher Bereich zu gleichen Teilen Forschungseinrichtungen und der Hochschulsektor (je 25%)

F&E BUDGET

- Ausgaben für militärische Forschung immer zwischen 7-9%
- Zivile Zwecke: Strukturbruch im Jahr 2000 was die allgemeinen Ausgaben für Universitäten betrifft. Hinweis auf mehr projektbezogene Finanzierung.

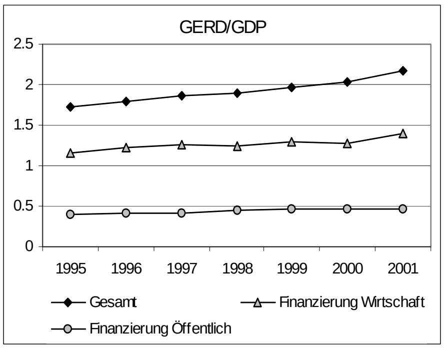
Zielsetzungen

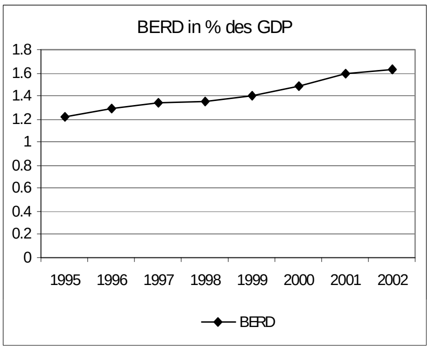
- Schwerpunktsetzung erfolgte im Februar 2000 ⇨ Maßnahmen durch „The Prime Minister's Science, Engineering and Innovation Council" gesetzt
- Strategie umfasst alle Bereiche der FTI-Politik, allerdings keine quantifizierbare Zielsetzung vorhanden ⇨ „Backing Australia's Ability" Initiative

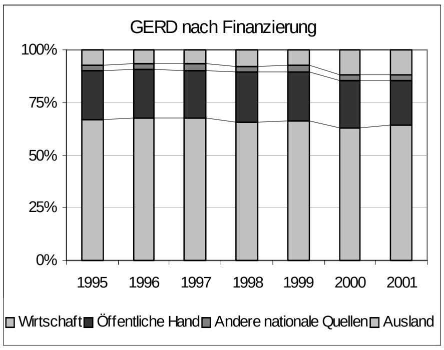
Massnahmen & Sondermittel

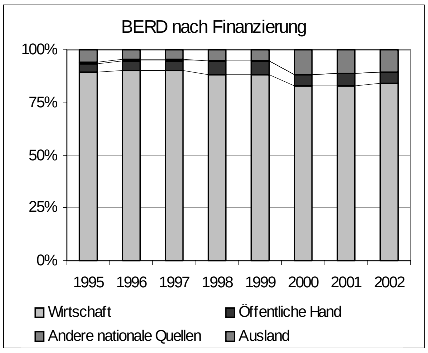
- Verdoppelung der Fördermittel des „Australian Research Council" für die Jahre 2001-2006
- Infrastrukturinvestitionen für Universitäten
- Gründung sog. Centres of Excellence im Bereich IKT und Biotechnologie

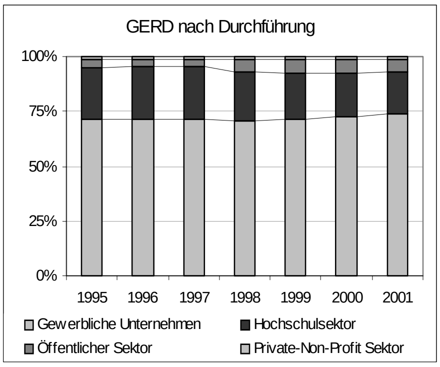
Belgien

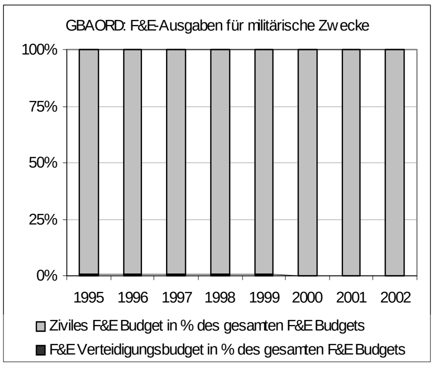


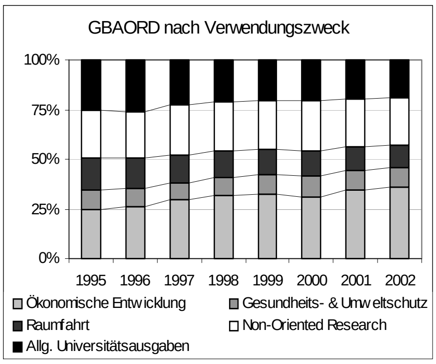












Quelle: OECD

Stylized Facts - Belgien:

GERD/GDP

- Konstant wachsend - Durchschnittliches Wachstum um 3.4% p.A.
- Finanzierung durch öffentliche Hand relativ konstant
- Wachstum großteils durch Wirtschaft getragen ⇨ Konstanter Anstieg der BERD.

FINANZIERUNG von GERD und BERD

- Verdoppelung des Auslandsanteils von 5% auf 10% seit 1999 ⇨ Steigende Internationalisierung

DURCHFÜHRUNG von F&E

- Ca. 75% Unternehmen, Tendenz steigend
- Ca. 25% Staatlicher Bereich, Tendenz leicht fallend. Leichte Verlagerung von den Hochschulen zu öffentlichen Forschungseinrichtungen.

F&E BUDGET

- Ausgaben für militärische Forschung: Kaum 0.5% der gesamten staatlichen Ausgaben
- Zivile Zwecke: Vermehrt ökonomische Entwicklung, Ausgaben für Universitäten sinken, stärkere Fokussierung auf „Call for Offers“ für Universitäten⇨ mehr Programmorientierung. Nicht-Programmorientierte Forschung ca. 25%.

Zielsetzungen & Massnahmen

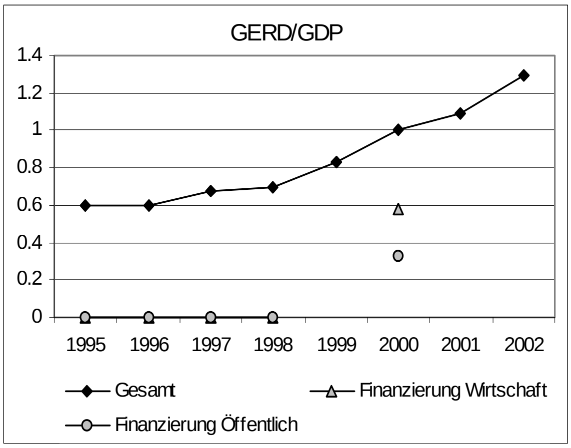
- GERD/GDP 3% bis 2010
- Wachsende Regionalisierung von F&E seit den 90ern ⇨ Ausgaben in 2000 nach Regionen: 42% Flandern, Wallonien & Französische Gemeinschaft 24%, Bundesstaat 33% ⇨ Konzentration auf Flandern
- 1999: „Flemish Innovation Decree“ ⇨
    - Erweiterung der traditionellen Aufgaben mit Schwerpunkten in „wissenschaftliche Forschung“ und „technologische Entwicklung“ um den Bereich Innovation, Berücksichtigung von Marktorientierung, IPR, Management, Training etc. im Innovationsprozess
    - Bildung transparenterer Rahmenbedingungen zur Finanzierung von unterstützenden Einrichtungen
    - **IWT** (gegr. 1991, www.iwt.be) in Rolle des „One Stop Shop“ für Technologiepolitik in Flandern. Aufgabe ⇨ Finanzielle Mittel für

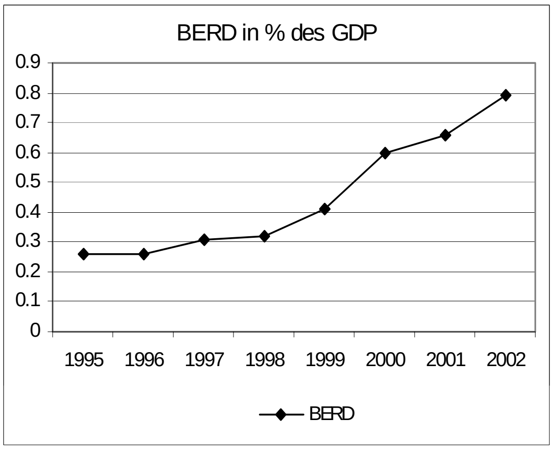
Forschung mit wirtschaftlichem Schwerpunkt ⇨ finanzielle Unterstützung für Forschung auf Universitäten mit angewandtem Fokus ⇨ Budget: 190 Millionen Euro p.A. zur Projektvergabe im „Bottom Up- Approach“

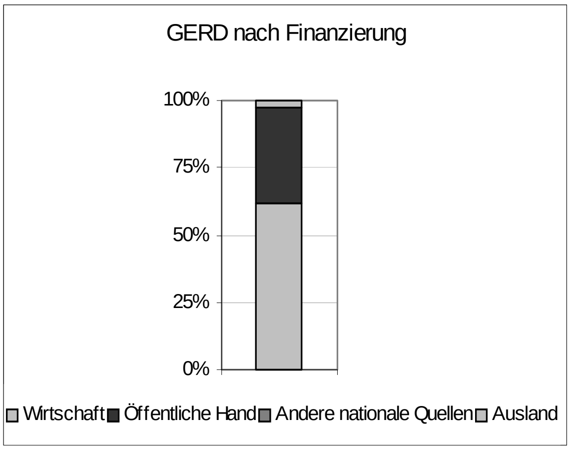
Sondermittel

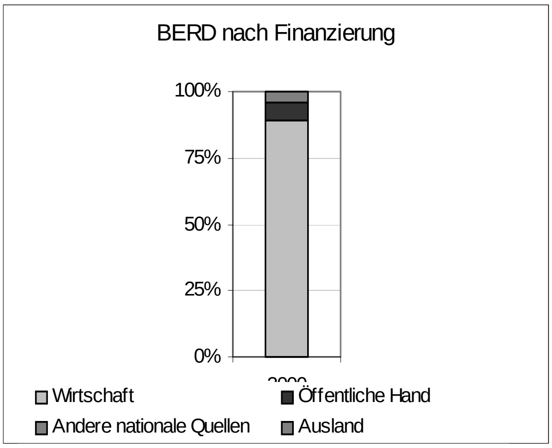
- Einsatz von Sondermittel aus bisherigen Informationen nicht ersichtlich

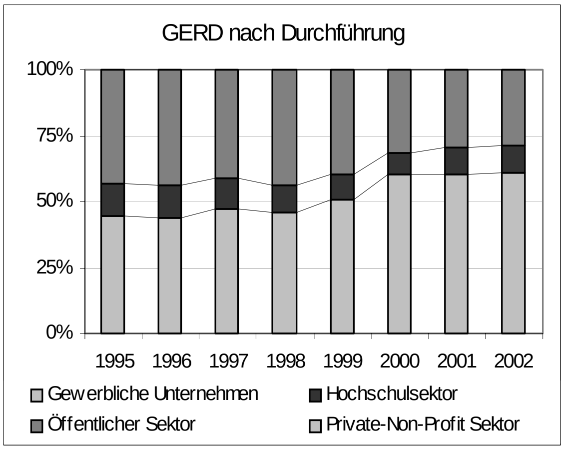
CHINA











Quelle: OECD

Stylized Facts - CHINA

GERD/GDP

- Deutlicher Anstieg der GERD/GDP (Verdoppelung zw. 1995 und 2002 !)
- Rasanter Anstieg der BERD/GDP (Verdreifachung zw. 1995 und 2002 !)

Finanzierung von GERD und BERD

- Finanzierung der GERD ca. 60% Wirtschaft, Rest öffentliche Hand
- Ca. 85% der BERD durch Wirtschaft finanziert

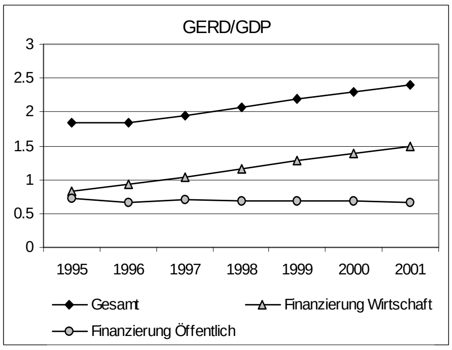
DURCHFÜHRUNG von F&E

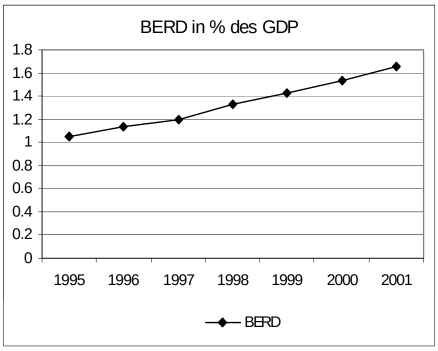
- Ca. 60% von Unternehmen durchgeführt (deutlich gestiegen)
- Anteil des Hochschulsektors nur ca. 10%
- Anteil des öffentlichen Sektors von 45% (1995) auf knapp über 25% (2002) gesunken

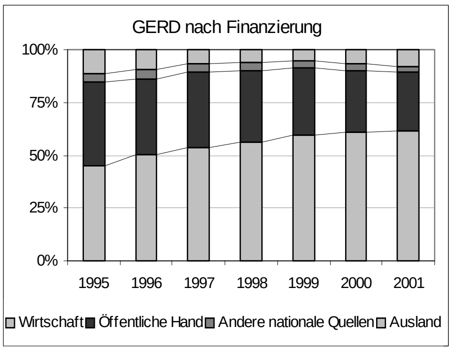
F&E Budget

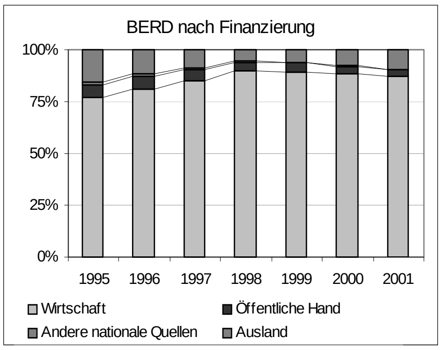
- Keine Informationen verfügbar

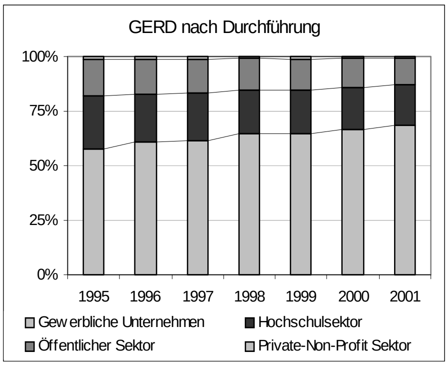
Dänemark

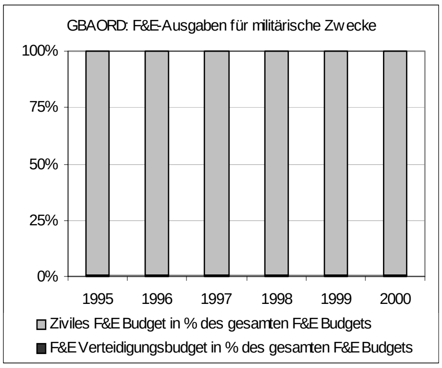


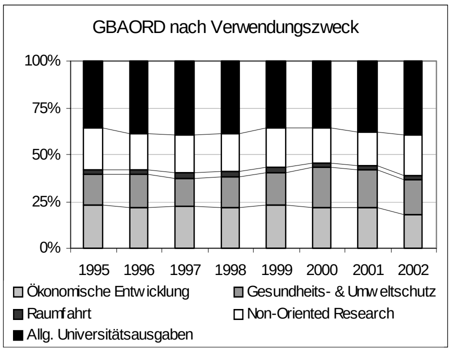












Quelle: OECD

Stylized Facts - Dänemark

GERD/GDP

- Konstanter Anstieg des GERD/GDP
- Dieser Anstieg ausschließlich getragen durch starke Zunahme des BERD

Finanzierung von GERD und BERD

- Starke Zunahme des Finanzierungsanteils der Wirtschaft (von unter 50% auf über 60%)
- Deutlicher Rückgang des Finanzierungsanteils der öffentlichen Hand (von über 30% auf ca. 25%)
- Auslandsanteil etwas unter 10%
- BERD zu fast 90% von Wirtschaft getragen, schrumpfender Anteil der öffentlichen Hand, ab 1998 Anstieg des Auslandsanteils (nach vorangegangen starkem Rückgang)

DURCHFÜHRUNG von F&E

- Konstant steigender Anteil des Unternehmenssektors (von ca. 65% auf ca. 70%)
- Rückgang bei Hochschulsektor (auf ca. 20%) und beim öffentlichen Sektor (ca. 10%)

F&E Budget

- Anteil des Verteidigungssektors an der F&E an der Wahrnehmungsgrenze
- Anteil allgemeiner Univ.Ausgaben dominierend und leicht steigend (ca. 40%)
- Die Bereiche Ökonomische Entwicklung, Gesundheits- u. Umweltschutz sowie Nicht-orientierte Forschung umfassen jeweils ca. 20%

Zielsetzungen

- GERD/GDP 3% bis 2010 und BERD/GDP 2% bis 2010

Organisation & Umsetzung

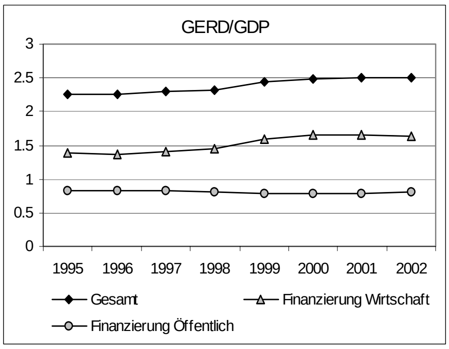
- Schwerpunktsetzung durch Ministry of Science, Technology & Innovation mit Unterstützung durch „Public Research Commission“
- Umstrukturierungsprozess im Gange. Seit 2002 ⇨ Reform des Forschungssektors

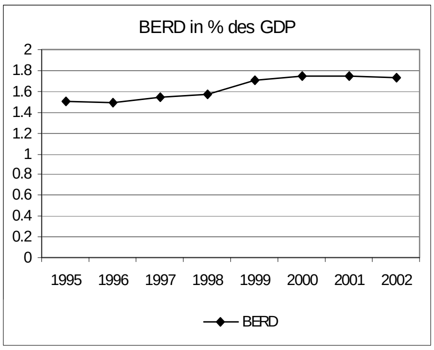
- Festgelegt in ⇨ The Danish Knowledge Strategy /Danish Strategy for Public-Private Partnership/ The Danish Growth Strategy

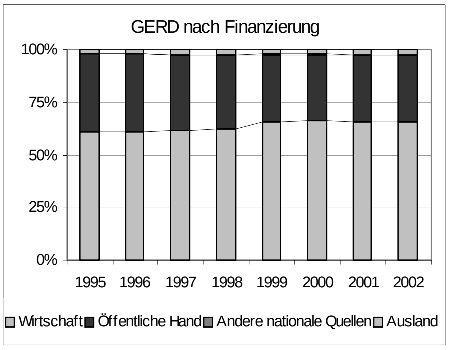
Sondermittel

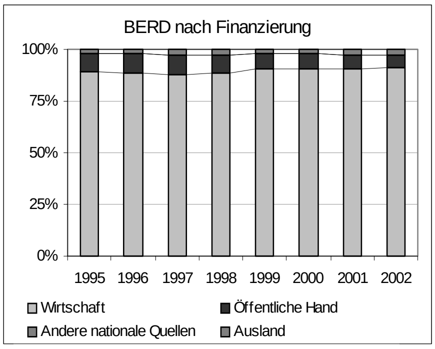
- Keine Sondermittelfinanzierung ersichtlich

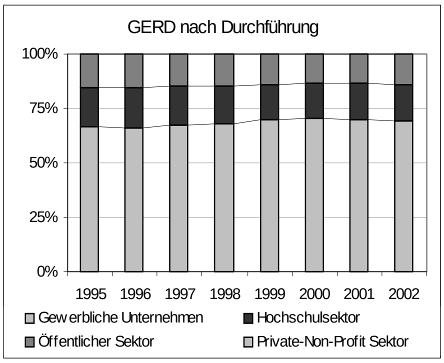
Deutschland

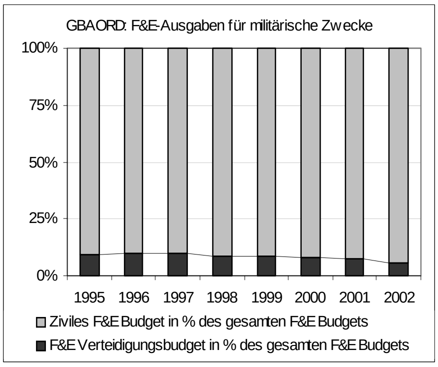


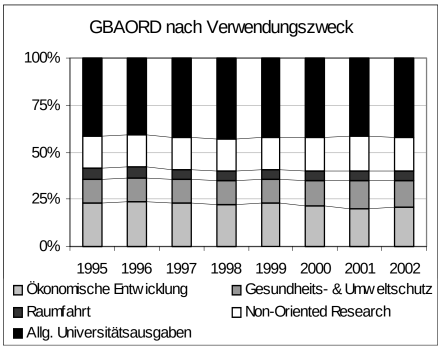












Quelle: OECD

Stylized Facts – Deutschland

GERD/GDP

- Konstant leicht ansteigende Forschungsintensität, im Durchschnitt 1.9% p.A. Mit knapp 2.5% des GERD/GDP im oberen Drittel der Industrienationen
- BERD Triebfeder des Wachstums

FINANZIERUNG von GERD und BERD

- GERD: Zu 65% privat, zu 32% staatlich, 2% Ausland
- BERD: mit 90% ist die Selbstfinanzierung der Unternehmen sehr hoch (zB mit Frankreich verglichen), und ähnlich der Struktur in Finnland und Belgien

DURCHFÜHRUNG von F&E

- Sehr konstant über den Beobachtungszeitraum ⇨Private Unternehmen sind bei weitem der wichtigste Innovationsakteur mit ca. 70% der Durchführung
- Universitäten – ca. 17%
- Andere öffentliche Einrichtungen – ca. 13%

F&E BUDGET

- Ausgaben für militärische Forschung reduziert von ca. 10% auf 5% reduziert
- Zivile Zwecke: konstant über die Jahre – ca. 40% Universitäten, knapp 25% ökonomische Entwicklung, 18% ohne programmatische Richtung

Zielsetzungen & Charakteristika

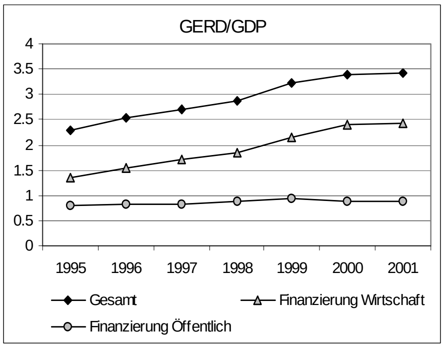
- GERD/GDP 3% bis 2010 und BERD/GDP 2% bis 2010
- Voraussetzungen für Innovationen und technischen Fortschritt nachhaltig zu verbessern
- Förderung der Innovationsfähigkeit vor allem der mittelständischen Wirtschaft
- Geregelt durch: Bundesministeriums für Wirtschaft und Arbeit (BMWA) ⇨ für eine zukunftsgerichtete Technologie- und Innovationspolitik; http://www.bmwi.de

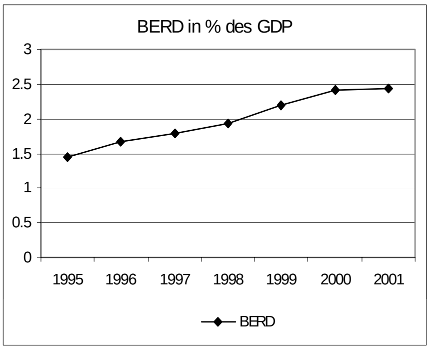
Massnahmen & Sondermittel

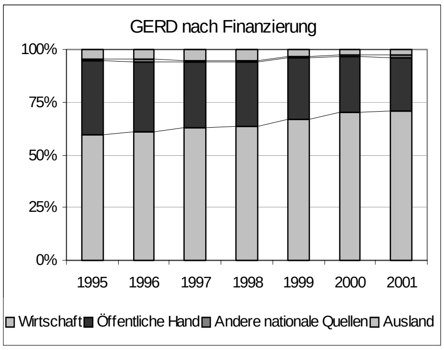
- „Förderlinien”: Innovation – Forschungskooperation – Technologische Beratung

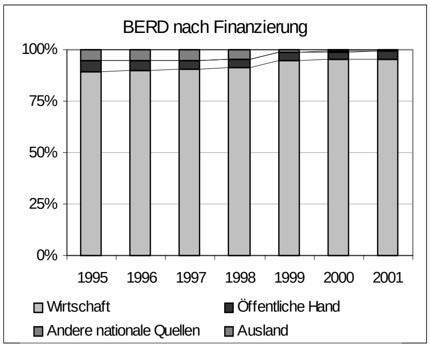
  - Innovation: Finanzierungsmöglichkeiten für die Entwicklung und Markteinführung von neuen Produkten, Verfahren und Dienstleistungen ⇨ langfristige Darlehen und Zuschüsse
  - Kooperation: Austausch von Wissen und Personal zwischen Unternehmen und Forschungs- und Entwicklungseinrichtungen ⇨ Förderung mittels Zuschüsse
  - Technologische Beratung: Stärkung der Kompetenz des Mittelstandes bei Nutzung modernster Techniken ⇨ Aufbau überbetriebliche Berufsbildungs- und Technologietransferzentren bundesweit.
- Spezielle Forschungsgebiete: Energieforschung & Luftfahrtforschung
- Kein Einsatz von Sondermitteln ersichtlich

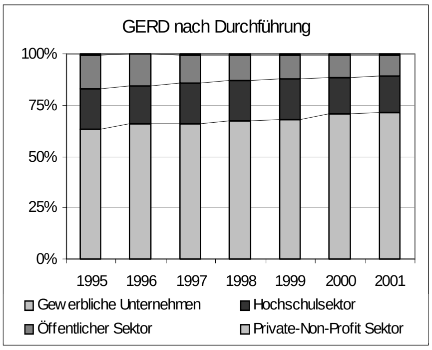
Finnland

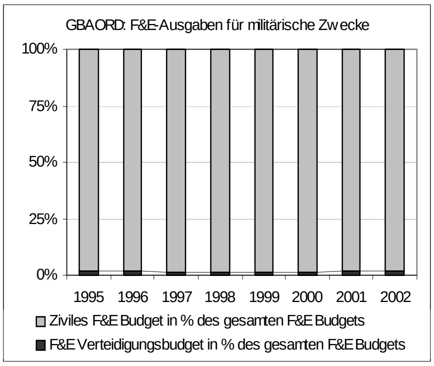


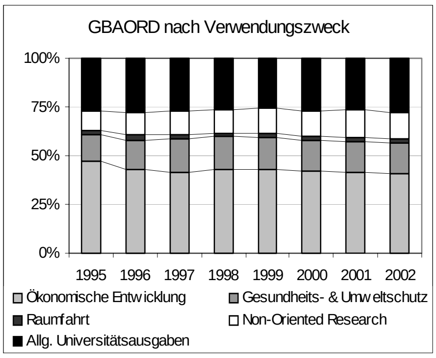












Quelle: OECD

Stylized Facts – Finnland:

GERD/GDP

- Heftiger Anstieg von GERD und BERD
- Wachstum Großteils durch Wirtschaft getragen, obwohl stattliche Mittel um 25% zwischen 1997 und 1999 erhöht wurden

FINANZIERUNG von GERD und BERD

- Finanzierung durch Wirtschaft gewinnt an Bedeutung ⇨ Öffentliche Hand nimmt in eben diesem Ausmaß ab. Auslandsanteil gering.

DURCHFÜHRUNG von F&E

- Unternehmen – stetiger Anstieg von 60% auf 70%
- Universitäten – bleiben gleich
- Staatliche Forschungseinrichtungen – Tendenz fallend

F&E BUDGET

- Ausgaben für militärische Forschung : Mit 1.6% gering
- Zivile Zwecke: Hoher Anteil für ökonomische Entwicklung

Zielsetzungen

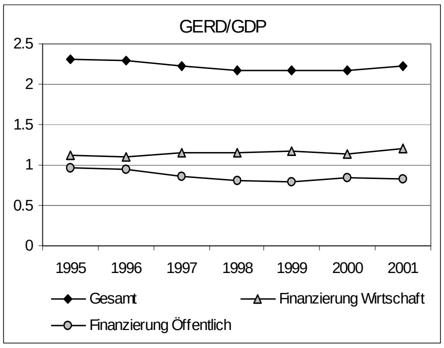
- 1996: Steigerung von GERD/GDP auf 2.9% bis 1999 – Ziel übertroffen
- GERD/GDP auf 3.5% ab 2002, Wachstum der öffentlichen F&E Ausgaben
- Verstärkung von Forschung und Innovation für 2003-2007 – Beibehaltung der staatlichen F&E Finanzierung auf bisherigem Niveau

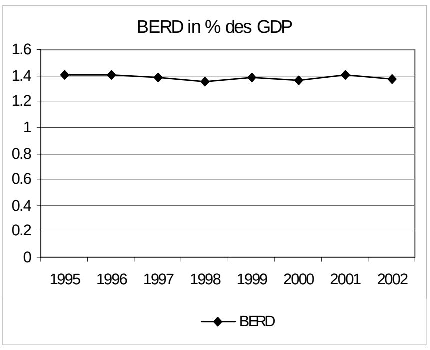
Massnahmen & Sondermittel

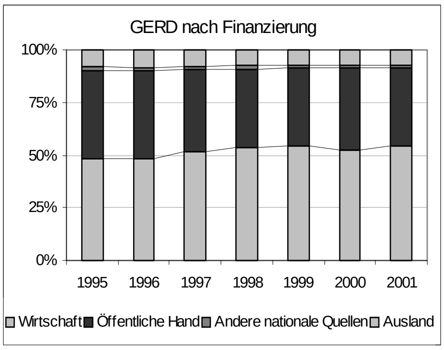
- „Additional Appropriations for R&D – 1997-1999" ⇨ Regierung beauftragte den Rat für Forschung & Technologie (gegr. 1987) Pläne zur Allokation zusätzlicher Mittel zu erstellen. Ministerium für Handel und Industrie ⇨ http://www.ktm.fi
- Problem: Steigerung der staatlichen F&E Ausgaben bei gleichzeitiger Einhaltung der Konvergenzkriterien
- Speisung der Fonds durch Erlöse aus Verkauf staatlicher Industrie

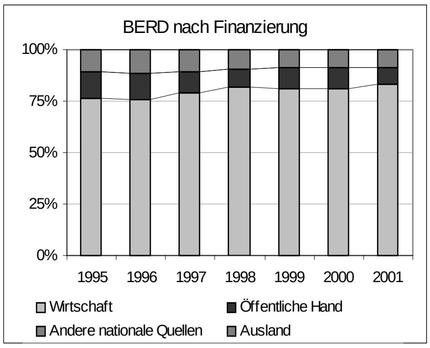
- Operationalisierung der staatlichen Fördermittel großteils durch TEKES, die Agentur für Technologische Entwicklung ⇨ www.tekes.fi
    - Mittelvergabe durch TEKES: Subvention oder niedrig verzinste Kredite auf Projektbasis. Für Grundlagenforschung zuständig ⇨ „The Academy of Finland“
- Key-Player von rein wirtschaftlicher Perspektive:
    - SITRA (Nationaler Fond fur F&E – Venture Capital)
    - FINNVERA (Exportkreditagentur)
    - FINPRO (Association for internationalisation) und Invest in Finland
- Impakt-Analyse des F&E Programmes 97-99, sowie laufende Evaluierungen der beteiligten Organisationen sind vorhanden bzw. laufen.

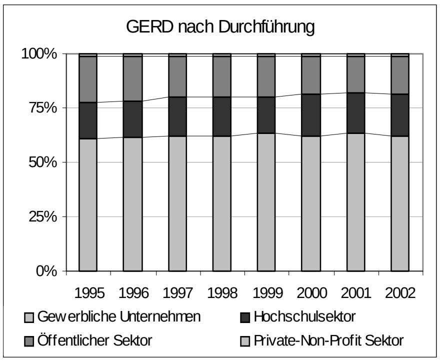
Frankreich

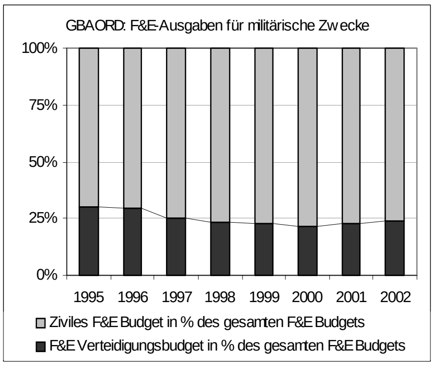


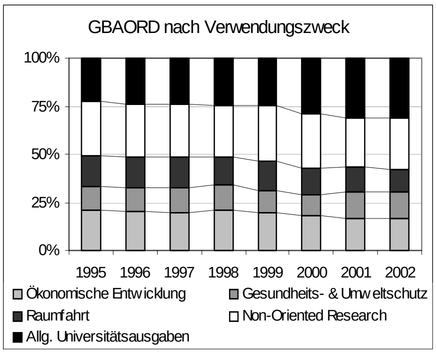












Quelle: OECD

Stylized Facts – Frankreich:

GERD/GDP

- Leicht fallendes GERD und BERD – Im Durchschnitt minus 1.1% p.A.

FINANZIERUNG von GERD und BERD

- GERD: Verteilung von 1995-2001 bleibt beinahe konstant ⇨ ca. 50% privat, 40% öffentlich, 10% Ausland.
- BERD: Die Unternehmen legen zu, der Staat reduziert

DURCHFÜHRUNG von F&E

- Sehr konstant über den Beobachtungszeitraum ⇨ 62% Unternehmen, 18-20% Hochschulen, 18% übrige öffentliche Sektor, 1.5% Private Non-Profit

F&E BUDGET

- Ausgaben für militärische Forschung : Sehr hoch – Meist knapp über oder unter 25%
- Zivile Zwecke: 25% Universitäten, 25% ohne programmatische Bindung, Raumfahrt von 15% auf 11% im Beobachtungszeitraum gesunken.

Zielsetzungen

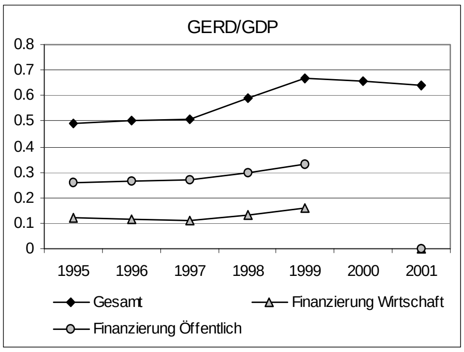
- 1999: Neues Schema der Forschungsförderung – Gründung des FNS „Fonds Nacional de la Science“ um Unterstützung für Forschungsprojekte die inter-institutionelle & interdisziplinäre Forschung beinhalten zu gewähren; Unterstützung von in Entstehung begriffenen akad. Karrieren.
- GERD/GDP: 3% bis 2010 und BERD/GDP 2% bis 2010

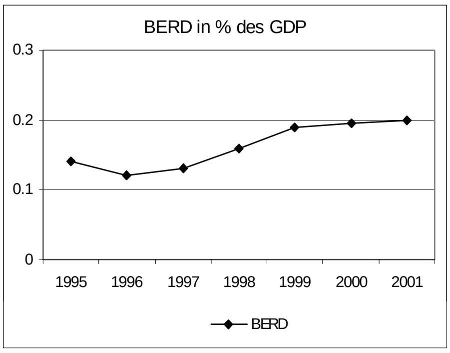
Massnahmen & Sondermittel

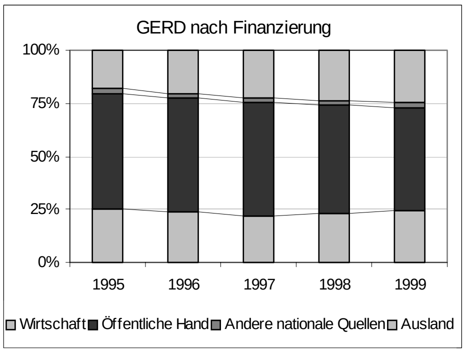
- „FNS” – Allokation der Ressourcen auf der Basis von Peer-Review für einen Zeitraum von vier Jahren
- Projekte müssen sich auf ein von der Regierung vorgegebenes Prioritäten Feld beziehen ⇨ 2000/2001, Genom-Forschung, Mikrobiologie aber auch Sozial- und Geisteswissenschaften, Ko-Finanzierung von regionalen Forschungsinitiativen

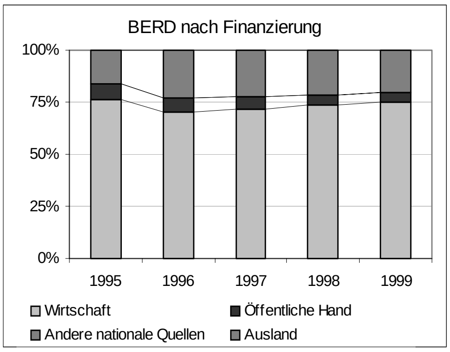
- Zur Unterstützung von Public Private Partnerships ⇨ „Fonds de la Recherche Technologique“: Unterstützt pre-kompetitive Technologieentwicklung und Innovation in Prioritätsbereichen.
- Kein Einsatz von Sondermitteln zu erkennen

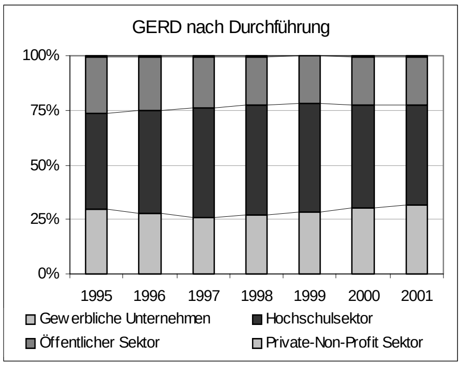
Griechenland

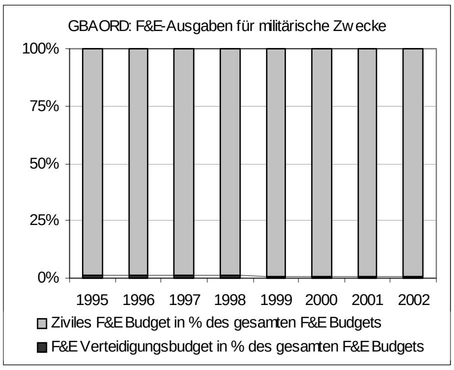


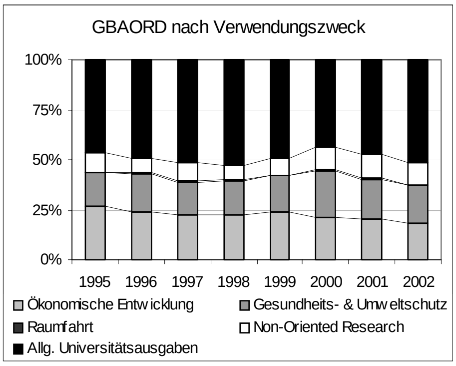












Quelle: OECD

Stylized Facts – Griechenland

GERD/GDP

- Geringe Forschungsintensität ⇨ 0.6% des GDP ⇨ im Wachstum begriffen, allerdings abgeflaut.

FINANZIERUNG von GERD und BERD

- Große Bedeutung des Auslandes als Finanzierungsquelle für GERD und BERD
- GERD: 50% Anteil der öffentlichenHand
- BERD: Anteil der Wirtschaft bei knapp 75%

DURCHFÜHRUNG von F&E

- Im Gegensatz zu anderen Ländern sind vor allem die Universitäten & der öffentliche Sektor für die Durchführung von F&E verantwortlich ⇨ 75% Anteil

F&E BUDGET

- Ausgaben für militärische Forschung : unter 1%
- Zivile Zwecke: Spiegeln Durchführung von F&E wieder ⇨ 50% Anteil für Universitäten

Zielsetzungen

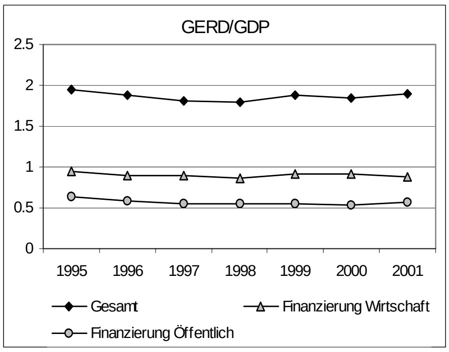
- Erhöhung von GERD/GDP auf 1.5% bis 2010 und BERD/GDP 0.6% bis 2010
- Erhöhung des Wirtschaftsanteils für Finanzierung von GERD von 25% auf 40% bis 2010
- Thematische Prioritäten:
    - Nachfragesteigerung nach neuem Wissen und Forschungsergebnissen ⇨ Steigerung wissenschaftlichen Personals in Unternehmen, Förderung von Public Private Partnerships
    - Re-Organisation des Forschungssystems: Reorientierung der Forschungsorganisationen unter der Führung des „General Secretariat for Research and Technology“ ⇨ siehe http://www.gsrt.gr
    - „Freeing-Up“ des Forschungssystems in Richtung mehr Internationalisierung

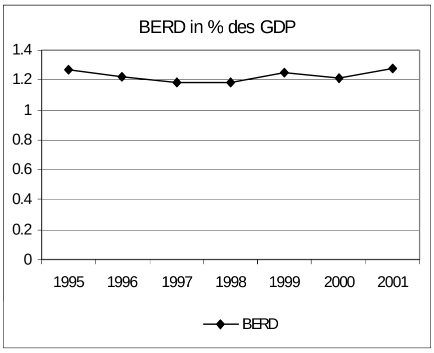
- Entwicklung und Technologische Infrastruktur ⇨ Verbesserung der materiellen Infrastruktur & Aufbau von Datenbanken etc.
- Sektorale Prioritäten ⇨ Erneuerbare Energien; Nahrung und Hydrokulturen; Wissensintensive Kulturaktivitäten und Tourismus, Sport; Seefahrt, Gesundheit (diagnostische und therapeutische Methoden), Erdbeben-Sicherung, e-learning; e-business – anhand des 3rd Community Support Framework

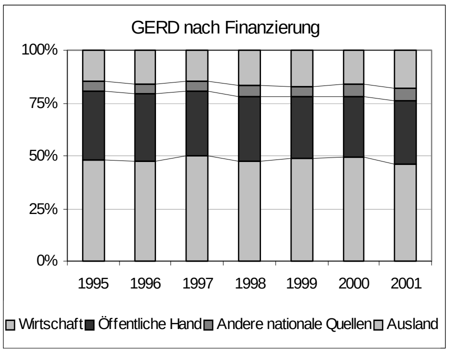
Sondermittel

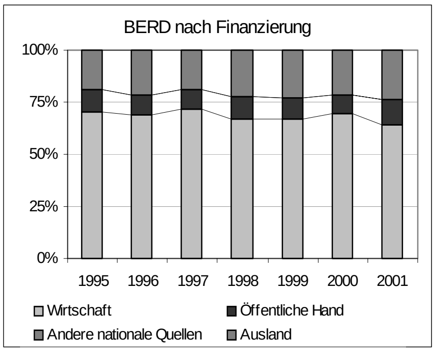
- Keine Sondermittelfinanzierung ersichtlich

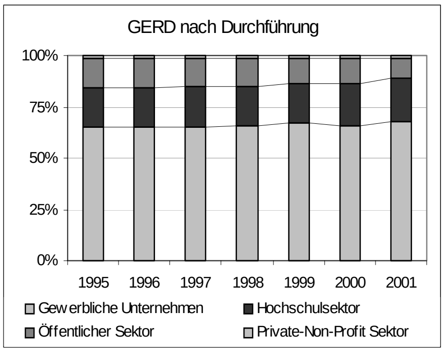
GROSSBRITANNIEN

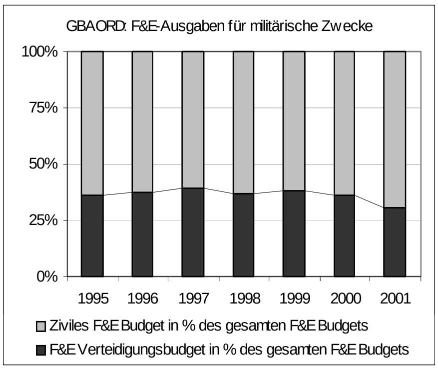


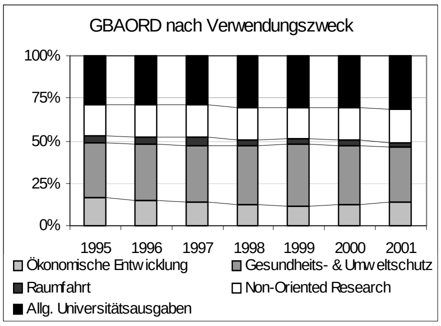












Quelle: OECD

Stylized Facts - Großbritannien

GERD/GDP

- GERD/GDP bei relativ konstant knapp unter 2%
- BERD/GDP schwankt erratisch zw. 1.2 und 1.3%

Finanzierung von GERD und BERD

- Relativ konstante Anteile: knapp 50% Wirtschaft, 30% öffentliche Hand, Rest v.a. Ausland
- Anteil der Wirtschaft an BERD-Finanzierung zw. 65 und 70%, Ausland zweitwichtigste Finanzierungsquelle (wichtiger als öffentliche Hand !) und erreicht 2001 beinah die 25%-Marke

DURCHFÜHRUNG von F&E

- Anteil der Wirtschaft um die 65%, relativ konstant
- Anteil des Hochschulsektors etwas über 20%
- Öffentlicher Sektor abnehmend

F&E Budget

- Hoher Anteil der Militärforschung (jüngst abnehmend), bis zu 35%
- Keine signifikanten Anteilsverschiebungen: Ökonomische Entwicklung und Allgem. Univ.Ausgaben jeweils um 30%, nicht-orientierte Forschung um 20%, Gesundheits- und Umweltschutz um 15%

Ziele:

- Keine Zielsetzung hinsichtlich des Barcelona Ziels

Organisation

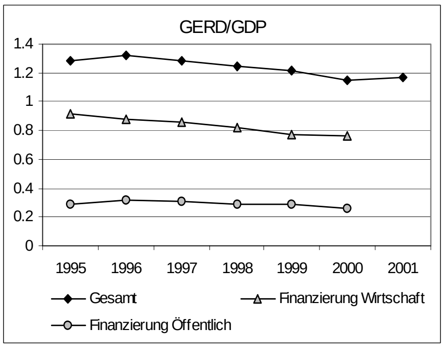
- Science and Innovation White Paper (Juli, 2000): http://www.dti.gov.uk/ost/whatsnew und Foresight Programme als strategische Plattform
    - Schwerpunkte: Genomforschung, e-science, basic technologies (??)

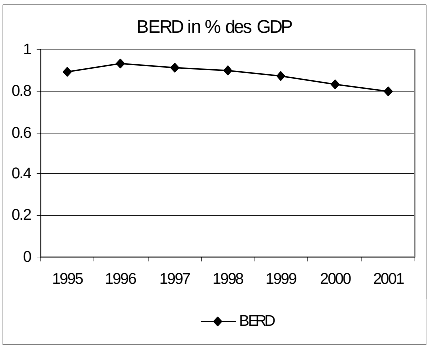
- Die Forschungsförderung der Grundlagenforschung (an HEIs) erfolgt auf Basis von sechs wissenschaftsspezifischen Research Councils (Biotechnology/Biological Sciences; Engineering/Physical S.; Economic & Social Res. C.; Medical Research Council, Natural Environment Research Council; Particle Physics & Astronomiy Research Council).

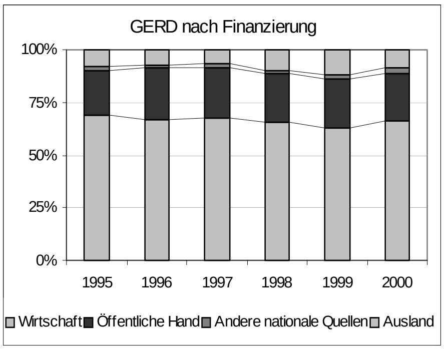
Sondermittel:

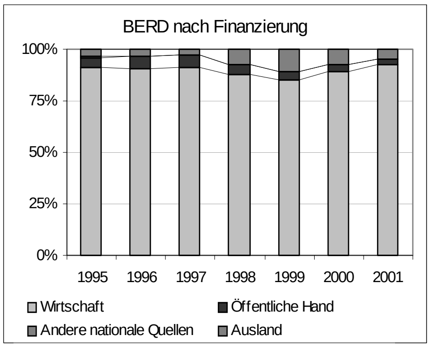
- 1 Mrd. Pfund für die Erneuerung der Forschungsinfrastruktur (an HEIs) 2002-2004: Science Research Investment Fund (SRIF, Partnerschaft zw. OST, HEFCE, and the Wellcome Trust)

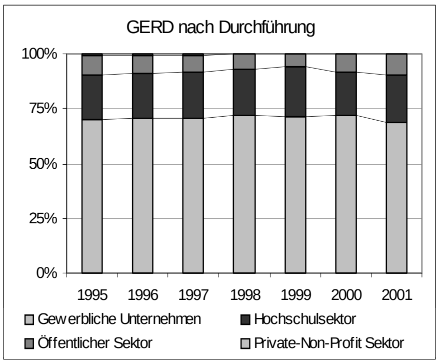
Irland

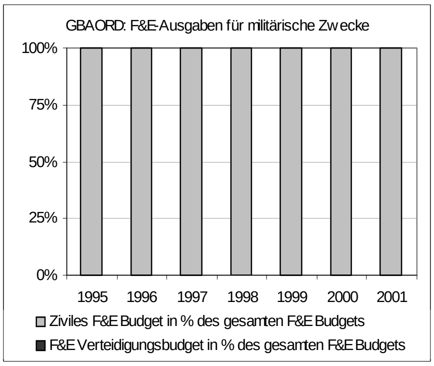


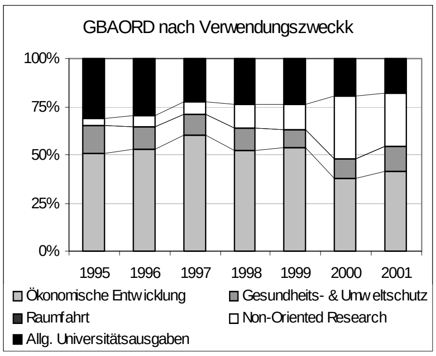












Quelle: OECD

Stylized Facts – Irland

GERD/GDP

- Sinkendes GERD und BERD im Beobachtungszeitraum – allerdings relativiert zu sehen aufgrund des extremen Wirtschaftswachstums

FINANZIERUNG von GERD und BERD

- GERD: Relativ konstant zwischen Unternehmen (66%), öffentlicher Hand (23%) und Ausland (11%) ⇨ Leichte Verschiebung zugunsten der öffentlichen Hand und Ausland.
- BERD: zu über 90% von Unternehmen finanziert, Rückgang der öffentlichen Finanzierung und nach einem Aufschwung seit 1999 auch der Finanzierung aus dem Ausland.

DURCHFÜHRUNG von F&E

- Sehr konstant im Verhältnis 70:20:10 (Unternehmen/Universitäten/öffentliche Forschung). Leichter Rückgang des Unternehmensbereiches seit 1999

F&E BUDGET

- Keine Rüstungsausgaben
- Enormer Ausbau der Nicht-Programmorientierten Forschungsförderung bei Rücknahme der allgemeinen Universitätsausgaben seit 2000

Zielsetzungen

- GERD/GDP auf 2.8% bis 2006 und BERD/GDP auf 2% bis 2006
- Stärkung von F&E durch nationalen Entwicklungsplan 2000-2006

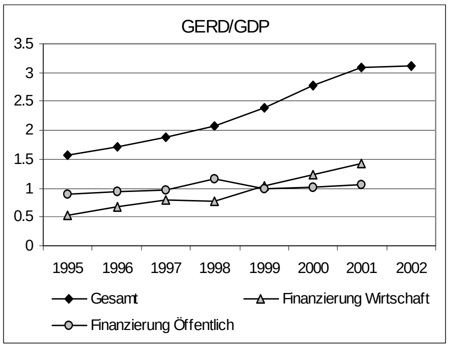
Massnahmen & Sondermittel

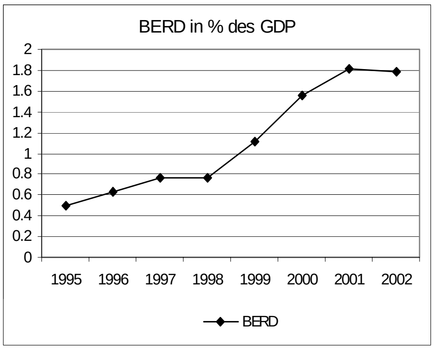
- Nationaler Entwicklungsplan: 2.5 Mrd. Euro im Zeitraum 2000-2006 für Forschung, technologische Entwicklung und Innovation, wovon 1.5 Mrd. Euro für Entwicklung von industriellen Aktivitäten vorgesehen sind.
- Hauptakteuere sind:
    - FORFÁS ⇨ nationales Gremium für Unternehmen, Handel, Wissenschaften und Technologie

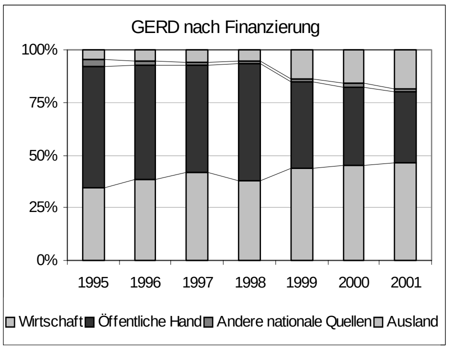
  - IDA Ireland und Enterprise Ireland ⇨ die Unternehmensagenturen Irlands
  - HEA ⇨ Higher Education Authority, für Planung und Entwicklung der akad. Ausbildung: Förderung von hervorragenden individuellen jungen Forschern und Teams etc. im Ausmaß von 650 Million Euro (seit Gründung 1999 bis 2006)
  - Science Foundation Ireland ⇨ Nationale Stiftung für Exzellenz in der wissenschaftlichen Forschung: 646 Mill. Euro zwischen 2000-2006 für akademische Forschung in den Bereichen Biotech und IKT.

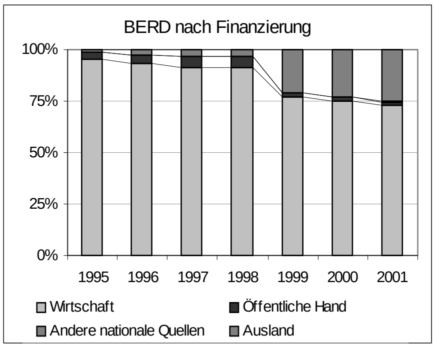
- Mittelvergabe erfolgt autonom durch Fonds, Mittel wurden von Regierung an Fonds für Zeitraum 2000-2006 vergeben
- Unklar ob Finanzierung durch F&E Budget oder außerbudgetäre Mittel

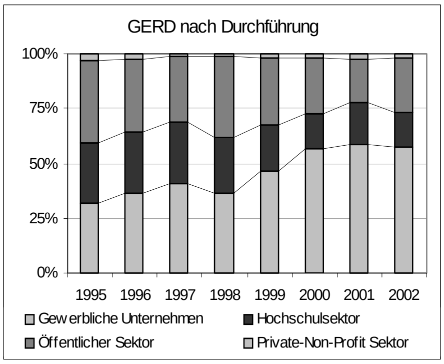
Island

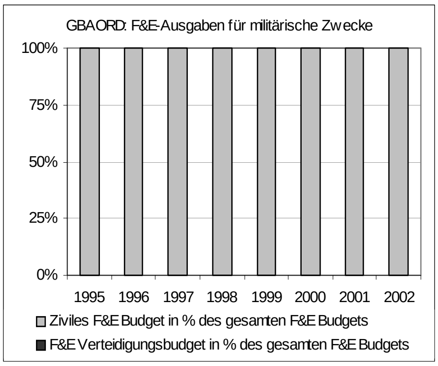


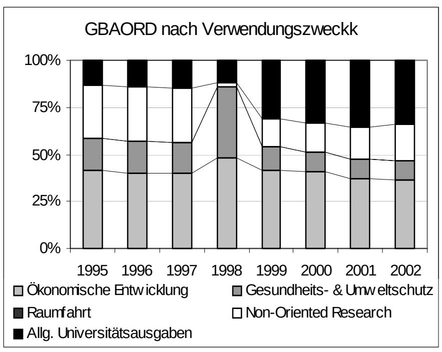












Quelle: OECD

Stylized Facts – Island

GERD/GDP

- Verdoppelung der Forschungsintensität im Beobachtungszeitraum auf über 3% ⇨ Triebfeder Unternehmensseite.
- Vervierfachung des BERD im Beobachtungszeitraum

FINANZIERUNG von GERD und BERD

- GERD: Verschiebung von öffentlicher Finanzierung hin zu Unternehmen und Ausland ⇨ Ausland seit 1999 dramatisch gestiegen
- BERD: Auslandsanteil dramatisch gestiegen ⇨ bereits 25% Anteil

DURCHFÜHRUNG von F&E

- Gewerbliche Unternehmen ⇨ Beinahe Verdoppelung von F&E auf knapp 60%
- Anteil des staatlichen Bereiches konstant gefallen ⇨ nun ca. 15% Universitäten, ca. 25% öffentliche Forschungseinrichtungen

F&E BUDGET

- Keine Rüstungsausgaben
- Mit 1999 eintretende Erhöhung der Universitätsausgaben von 10-15% auf ca. 35%
- 1998 Ausreißer – Ausgaben für Umwelt&Gesundheitsforschung zu Lasten von Nicht-Programmorientierten Programmen, in der Folge 15-20% Nicht-Programmorientierte Forschung

Zielsetzungen

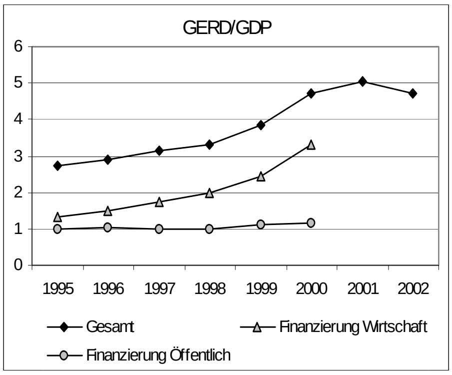
- Anerkennung der Rolle von Wissenschaft- und Technologie im nationalen Haushaltsplan 2002 ⇨ Stärkung der Universitäten

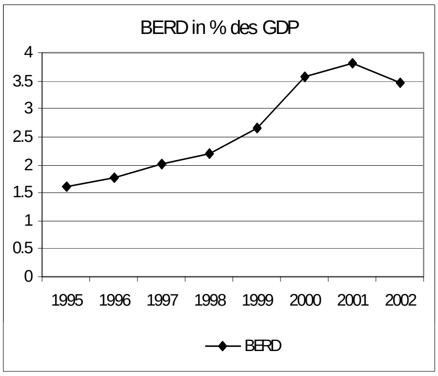
Massnahmen & Sondermittel

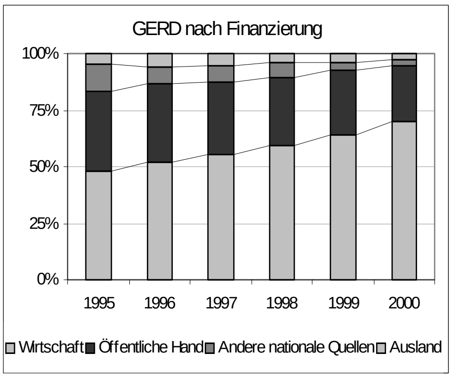
- Installation eines Rates für Forschungs- und Technologiepolitik auf Ministerialebene mit Vorsitz des Premierministers. Des weiteren die Minister für Unterricht, Wissenschaft und Kultur, Industrie und Handel sowie 14 RepräsentantInnen der „Scientific Community“.

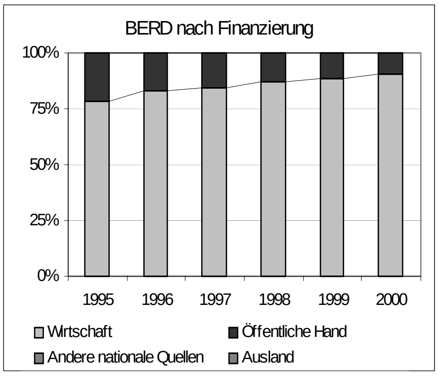
- Merger der existierenden „Science Fund“ und „Technology Fund“ in einen einzigen „Research Fund“, operationalisiert durch ein autonomes Gewährungs-Gremium
- Gründung eines neuen „Technology Development Fund“
- Zusätzliche Mittel: 2001 ⇨ 100 MIKR p.A. über die nächsten 3 Jahre zur Stärkung des Universitätssystems bei gleichzeitiger Installation eines Pilotprojektes zur leistungsbezogenen Unterstützung von Universitäten anhand von Publikationsoutput, Training, Fähigkeit fremde Ressourcen an Land zu bringen etc.

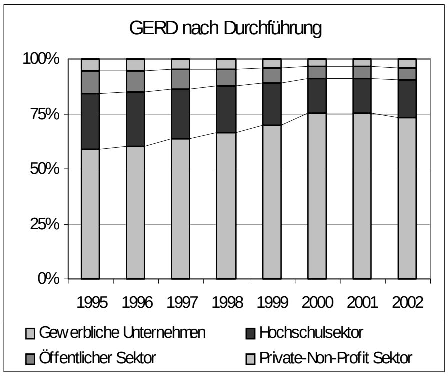
ISRAEL











Quelle: OECD

Stylized Facts - Israel

GERD/GDP

- Deutlicher Anstieg der GERD/GDP (auf bereits sehr hohem Niveau), ausgelöst durch drastische Zunahme der Finanzierung durch die Wirtschaft, leichter Rückgang im Jahr 2002
- Starker Anstieg der BERD/GDP

Finanzierung von GERD und BERD

- Zunahme des Finanzierungsanteil der GERD durch die Wirtschaft von 50% auf 70%
- Ca. 85% der BERD von Wirtschaft finanziert, Rest öffentliche Hand (sinkender Anteil)

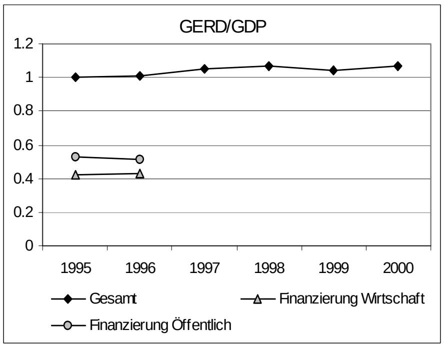
DURCHFÜHRUNG von F&E

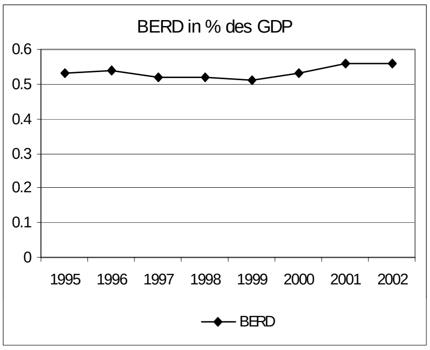
- Anteil der Unternehmen 75% (steigend)
- Hochschulsektor 20% (sinkend)

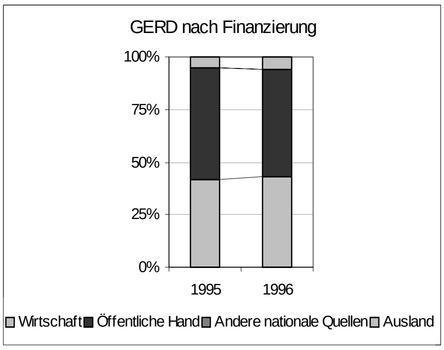
F&E Budget

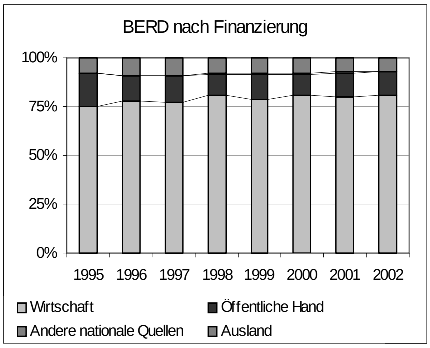
- Keine Informationen verfügbar

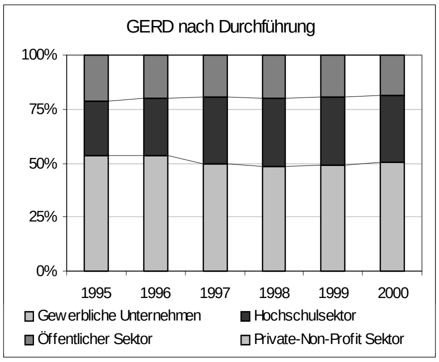
Italien

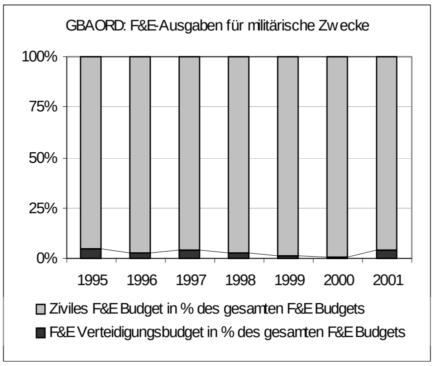


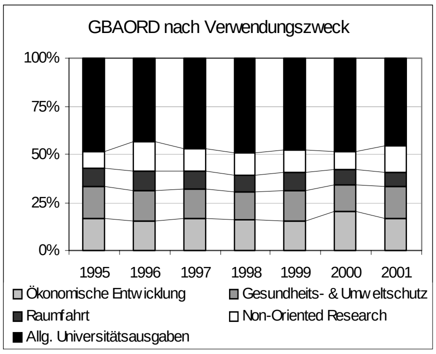












Quelle: OECD

Stylized Facts – Italien

GERD/GDP

- Minimale Auf- und Abwärtsbewegungen um ein Niveau von ca. 1% für GERD. Selbes für BERD auf einem Niveau von ca. 0.55%.

FINANZIERUNG von GERD und BERD

- GERD: Wenig Daten vorhanden, hoher Anteil der öffentlichen Hand von über 50%
- BERD: Wirtschaftsanteil bei ca. 75%, Tendenz leicht steigend.

DURCHFÜHRUNG von F&E

- Unternehmen ⇨ ca. 50% Anteil sinkt tendenziell
- Universitäten ⇨ ca. 30% Anteil ausgebaut
- Öffentliche Forschungseinrichtungen ⇨ ca. 20% Anteil leicht sinkend

F&E BUDGET

- Rüstungsausgaben: 2001 bei 4%
- Ca. 50% allgemeine Universitätsausgaben, Anteil schwankt etwas. 16% des Budgets für Gesundheit und Umweltschutz, 7-10% für die Raumfahrt.

Zielsetzungen

- GERD/GDP auf 1.75% bis 2006 und BERD/GDP auf 0.75% bis 2006
- Nationaler Forschungsplan: 2001-2003 anhand von expliziten Bereichen:
    - „Quality of Life“ – Post Genomic, Medizinische Forschung, Neuro-Wissenschaften
    - „Competitive Sustainable Growth“⇨ IKT, Nanotechnologie
    - „Environment and Energy“
    - „Mediterranean Civilizations in the Global System“

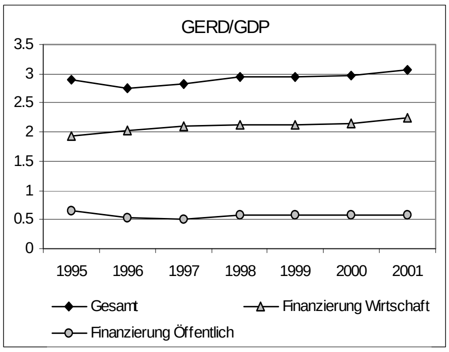
Massnahmen & Sondermittel

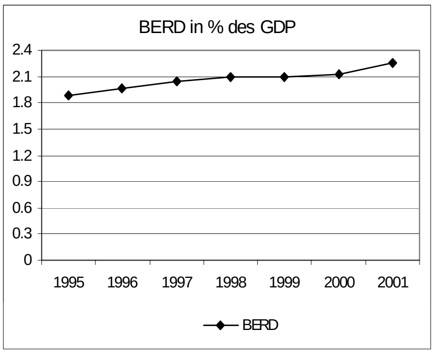
- Nationaler Forschungsplan 2001-2003 ⇨ Einsetzung von 3 Fonds zur Neuordnung und Vereinheitlichung der Forschungsförderung

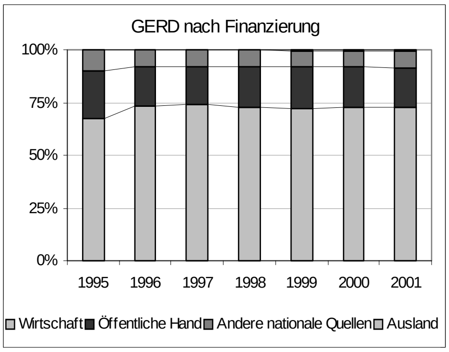
- o FAR: „Fondo per le Agevolazione alla Ricerca“ ⇨ Kurzfristig - Forschungsaktivitäten in industriellen Bereichen wie Herstellung, Nahrungsmittel, Umweltschutz und Aktivitäten wie Training für Forscher, öffentliche Spin-Offs, Anstellung von Forschern; Mittelvergabe: 2001 650 Mio Euro, 2002 400 Mio Euro
- o FIRB: Langfristige Grundlagenforschung, Strategische Projekte, Grundlagenforschung; Dotierung: 2001: 390 Mio, 2002 14 Mio Euro und zusätlich Förderung nach Spezialthemen. Budget: ca. 150 Mio Euro für 2002.
- o FISR: „Fondo Integrativo Speciale per la Ricerca“ Forschung in Spezialgebieten wie Nano-Tech, Mikrotechnologie (60 Mio. Euro 01/02)

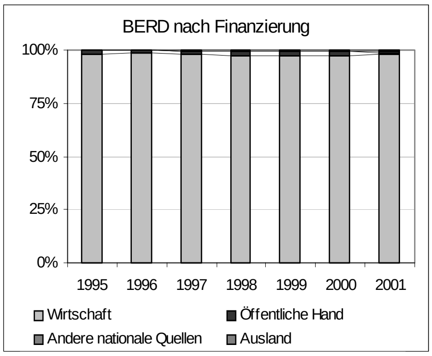
- Mittelvergabe erfolgt durch das Ministerium für Unterricht, Universitäten und Forschung – MIUR, zum Teil durch andere Ministerien.

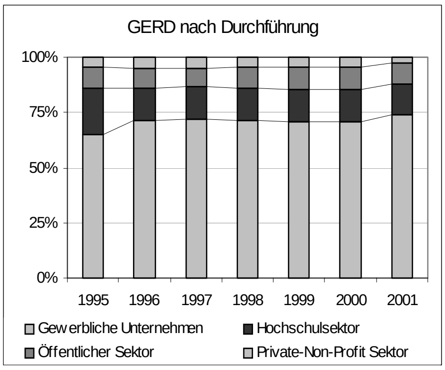
Japan

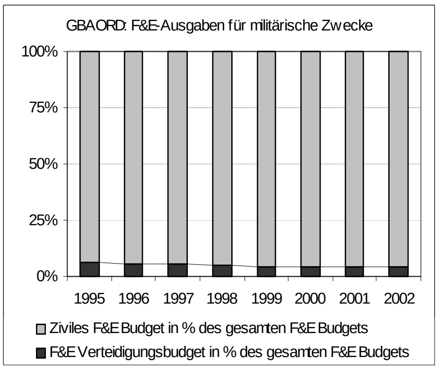


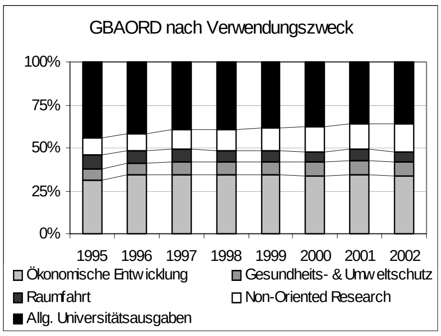












Source: OECD

Stylized Facts – Japan

GERD/GDP

- GERD von 1995 auf 1996 gefallen, seither langsamer Anstieg auf Level über 3%
- BERD ist im Beobachtungszeitraum konstant gestiegen

FINANZIERUNG von GERD und BERD

- GERD: Unternehmensanteil auf ca. 75% gestiegen. Leichter Rückgang der öffentlichen Hand.
- BERD: Beinahe ausschließliche Finanzierung durch Wirtschaft

DURCHFÜHRUNG von F&E

- Ident zur Finanzierung ⇨ Unternehmensanteil auf 75% gestiegen

F&E BUDGET

- Rüstungsausgaben: Konstante 4%
- Leichter Rückgang der allgemeinen Universitätsausgaben zugunsten von Programmen zur ökonomischen Entwicklung sowie Nicht-Programmorientierter Forschung

Zielsetzungen

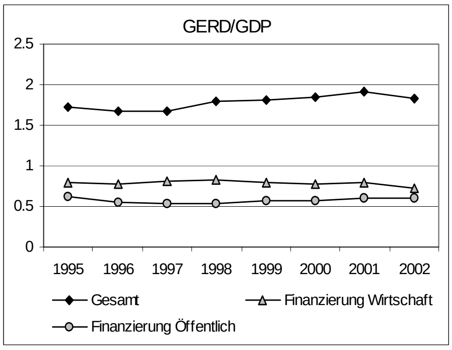
- Strategische Prioritätensetzung in F&E
- Reform des Wissenschafts- und Technologiesystems um Exzellenz zu erreichen
- Globalisierung von Wissenschaft- und Technologie- Aktivitäten

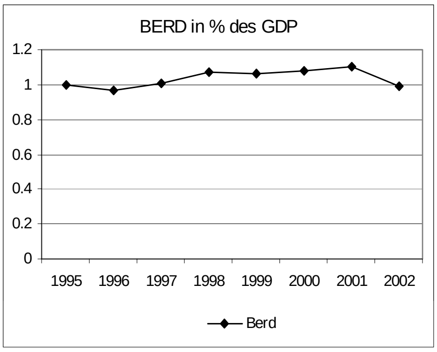
Massnahmen & Sondermittel

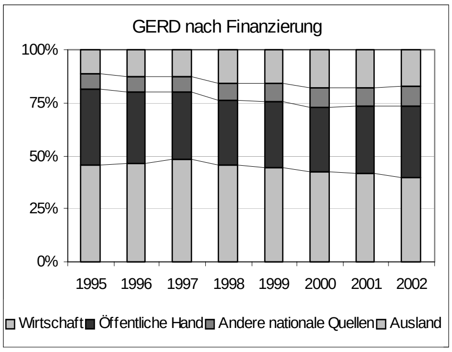
- Science & Technology Basic Law ⇨ Grundlage 1996 1. Plan, 2001 2. Plan
- Merger von 3 Ministerien um Forschung unter 1 Dach zu bringen
- Etablierung eins Rates für Forschungs- und Technologiepolitik zur Entwicklung von nationalen Maßnahmen
- Prioritätensetzung in ⇨
    - Life-Sciences
    - IKT

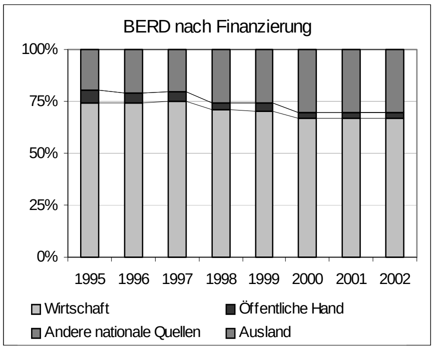
  - Umweltwissenschaften
  - Nanotechnologie und Materialien
- Steueranreize für private F&E
- Verdoppelung von Forschungs-Fonds
- Spezielle Verwendung von Sondermitteln nicht ersichtlich

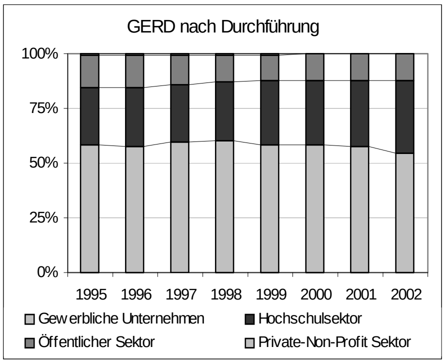
Kanada

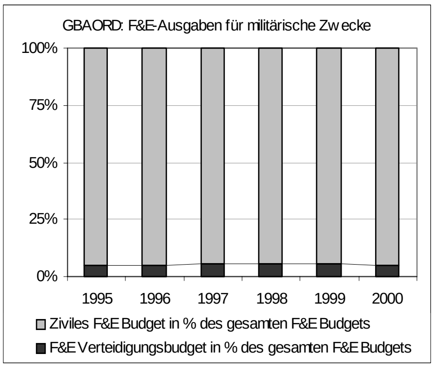


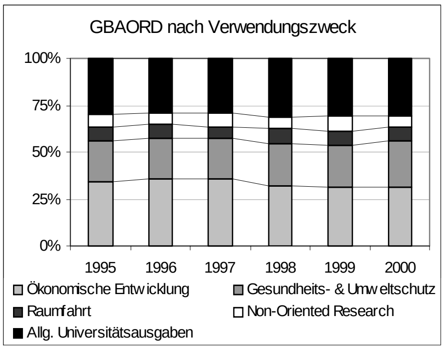












Quelle: OECD

Stylized Facts - Kanada:

GERD/GDP

- Leichter Anstieg von 97-2000, Einbruch 2001 ⇨ auf BERD zurückzuführen. Immer unter 2% des GDP

FINANZIERUNG von GERD und BERD

- Finanzierung durch Wirtschaft sowohl für beide Kennzahlen seit 1997 rückläufig. (GERD: von 48% auf 40%, BERD: von 75% auf 67%)
- Leichte Erhöhung des öffentlichen Anteils
- Tendenzielle Erhöhung des Auslandsanteils für beide Indikatoren

DURCHFÜHRUNG von F&E

- Ca. 55% Unternehmen, Tendenz leicht fallend
- Ca. 33% Universitäten, Tendenz leicht steigend
- Ca. 12% andere Forschungseinrichtungen der öffentlichen Hand

F&E BUDGET

- Ausgaben für militärische Forschung: Relativ hoch mit ca. 5% der gesamten staatlichen Ausgaben
- Zivile Zwecke: Ausgaben für Universitäten relativ konstant bei 30%. Forschungsförderung für Gesundheit und Umweltschutz konstant über 20%. Geringer Anteil an Nicht-Programmorientierter Forschung.

Zielsetzungen

- 2001: Eines der Top 5 Länder für F&E bis 2010 gemessen an GERD/GDP
- Verdoppelung der staatlichen Ausgaben für F&E bis 2010
- Unterstützung spezieller Wirtschaftsbereiche, z.B. Mikroelektronik & Computer-dienstleistungen durch Reduktion von Körperschaftssteuern etc.

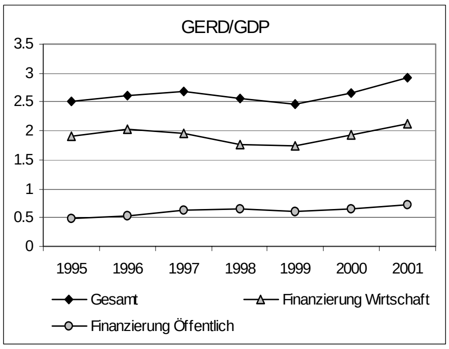
Massnahmen & Sondermittel

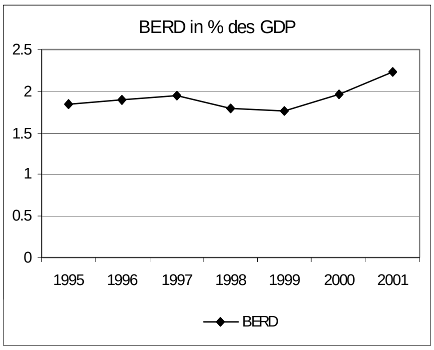
- Gründung des „**Atlantic Innovation Fund**“ (Juni, 2000) ⇨ 300 Mill. $ für Innovationsinfrastruktur der Atlantic Region von Universitäten und

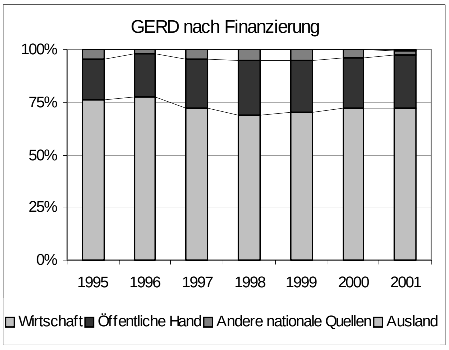
Forschungseinrichtungen zur Entwicklung und Kommerzialisierung von neuen Technologien

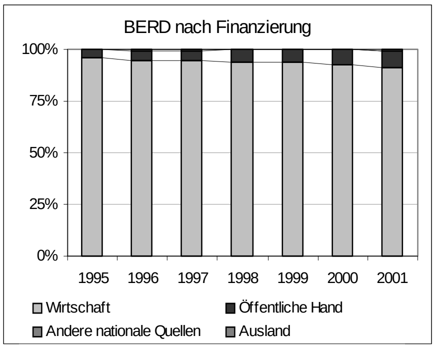
- Mittelvergabe stark gebunden an nationale Förderungs-Räte ⇨
- Budgetsteigerung der 3 nationalen Förderungs-Räte als auch des nationalen Forschungsrates- NRC ⇨
    - CIHR: Canadian Institutes of Health Research – Beinahe Verdoppelung der Investitionen für Forschung im Gesundheitsbereich auf letztlich 552 Mill. $
    - NSERC: Natural Science & Engineering Research Council (www.nserc.ca) - Stellt 1/6 aller Mittel für Universitäre Forschung in den Natur- und Ingenieurswissenschaften bereit.
    - SSHRC: Social Sciences and Humanities Research Council (www.sshrc.ca)
- **CFI** ⇨ Canada Foundation for Innovation, gegr. 1997 durch Regierung. (www.innovation.ca) Unabhängige Organisation, ursprünglich mit 5-Jahresmandat und 800 Mill. $ ausgestattet um Beiträge für Forschungsinfrastruktur zu leisten. ⇨ Verlängerung des Programms bis 2010 und Aufstockung der Mittel auf 3.18 Mrd. $.
- Investitionen in F&E in Kanada sind mEa keine Sondermittel in dem Sinn, dass sie außerhalb des Budgets stehen.

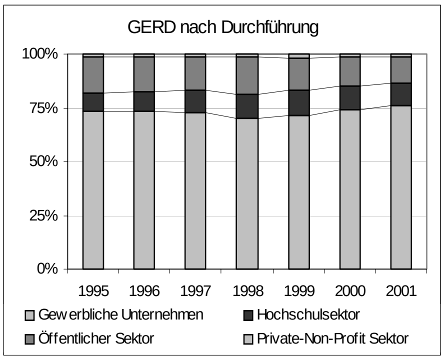
KOREA

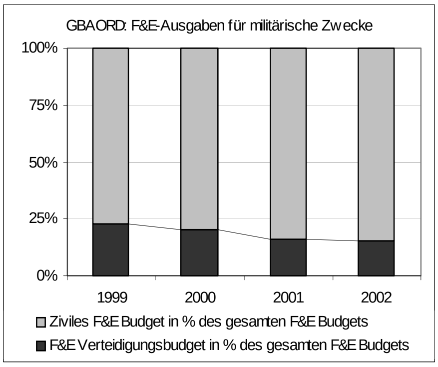


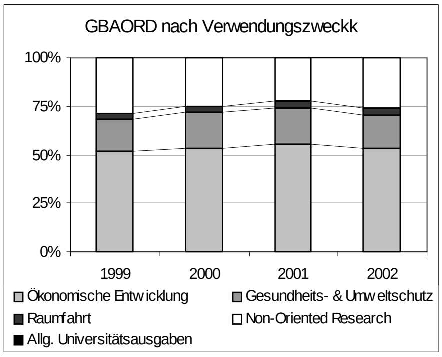












Quelle: OECD

Stylized Facts - Korea

GERD/GDP

- Nach vorübergehenden Rückgang (Asienkrise) gegen Ende der 90er Jahre wieder deutlich wachsend
- Wachstum getragen von Wirtschaft und öffentlicher Hand
- Wirtschaftssektor hat jedoch deutlich größeres Wachstum, starker Anstieg des BERD/GDP zu Ende der 90er Jahre/Beginn 2000

Finanzierung von GERD und BERD

- Anteil der Wirtschaftsfinanzierung am GERD ca. 75% (leichter Rückgang während der Asienkrise)
- Auslandsanteil sehr gering
- Finanzierungsanteil der öffentlichen Hand am BERD deutlich steigend (von 5% auf über 10%)

DURCHFÜHRUNG von F&E

- Ca. 75% Unternehmen (leichter Anstieg nach geringem Rückgang zu Zeit der Asienkrise)
- Sehr geringer Anteil des Hochschulsektors (ca. 10%)
- Rückgang des öffentlichen Sektors (von über 20% auf über 10%)

F&E Budget

- Rückgang des (hohen) Rüstungsanteils (von knapp 25% auf unter 20% zw. 1999 und 2002)
- Zivile Zwecke: Ökonomische Entwicklung mit 50 % dominierend, gefolgt von nicht-orientierter Forschung mit 25%. Allgemeine Universitätsausgaben mit unter 5% sehr gering.

Ziele

- 5-Jahres-Plan (1997-2002) in Verbindung mit Long-Term-Vision (Vision 2025): (i) öffentliche F&E-Ausgaben auf 5% der gesamten öffentlichen Ausgaben im Jahr 2002 zu erhöhen, (ii) Erhöhung des Grundlagenforschungsanteils auf 20% (von 16%), (iii) 40 FTE-Personal/10.000 EW. im Jahr 2002

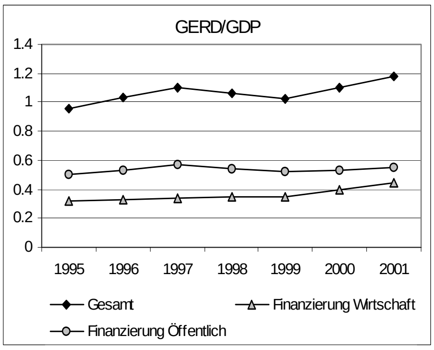
Schwerpunkte

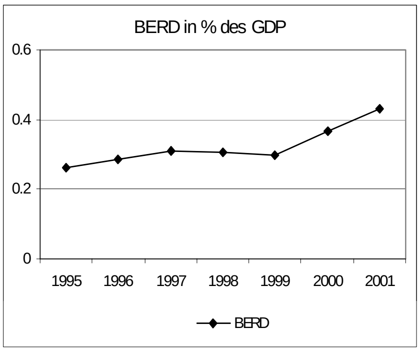
- Im Rahmen des 21st Frontier Program wurden Schwerpunktprogramme in folgenden Bereichen eingesetzt: Life Sciences, Biotechnologie, Nanotechnologie, Neue Materialien und Umwelttechnologien

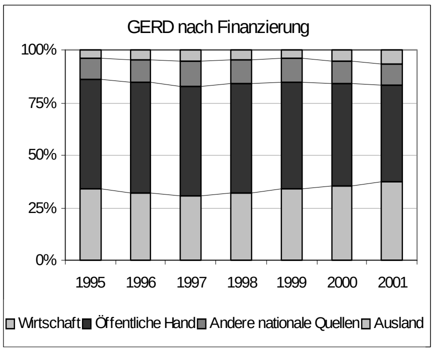
Organisation

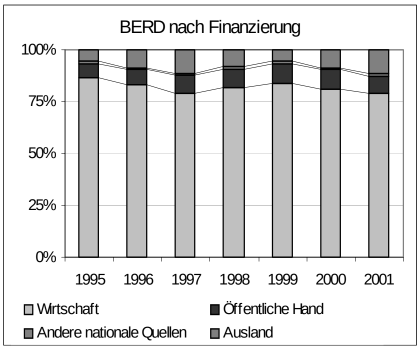
- National Science and Technology Council (NSTC) setzt Prioritäten für FTE-Politik und FTE-Investitionen und weist technologiespezifische Subkomitees auf (Subkomitee für FTE allgemein, Biotechnologie, Nanotechnologie)

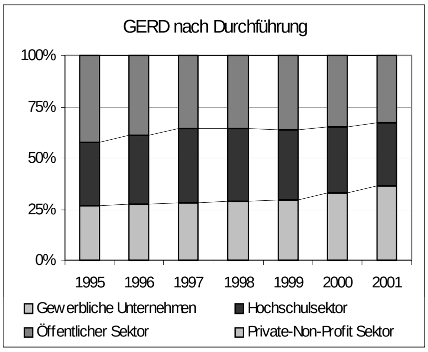
NEUSEELAND

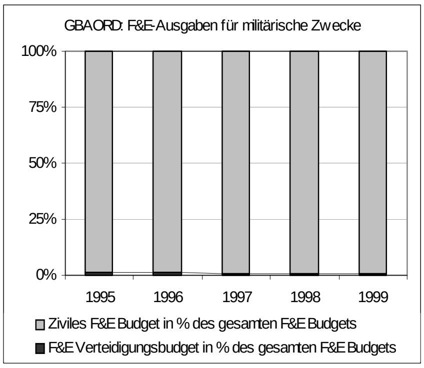


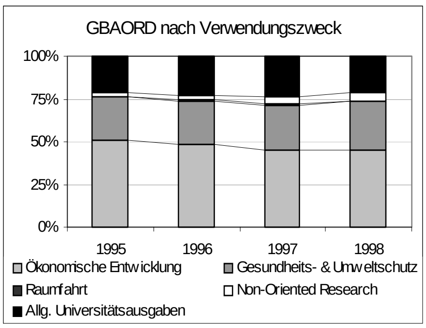












Quelle: OECD

Stylized Facts - Neuseeland

GERD/GDP

- Leichte Zunahme gegen Ende der 90er, getragen de facto vollständig von der Wirtschafts
- Deutlicher Anstieg des BERD/GDP ab 1999

Finanzierung von GERD und BERD

- Hoher Anteil des öffentlichen Sektors (knapp 50%), aber sinkend
- Geringer Anteil der Wirtschaft (unter 40%), aber steigend
- Geringer (unter 10%), aber steigender Auslandsanteil
- Vergleichsweise hoher Anteil sonstiger nationaler Quellen (ca. 10%)
- Anteil der Wirtschaftsfinanzierung am BERD auf etwas über 75% sinkend (deutlich steigender Auslandsanteil seit 1999)

DURCHFÜHRUNG von F&E

- Geringer, aber steigender Anteil von Unternehmen (unter 40%)
- Anteil des Hochschulsektors um 30%, sinkende Tendenz
- Hoher Anteil des öffentlichen Sektors (über 30%, aber sinkend)

F&E Budget

- Militärischer Anteil am F&E-Budget an der Wahrnehmungsgrenze
- Sinkender Anteil des Bereichs Ökonomische Entwicklung (auf knapp unter 50%)
- Allgemeine Universitätsausgaben leicht sinkend (knapp unter 25%)
- Steigender Anteil für Gesundheits- und Umweltschutz (auf über 30%)

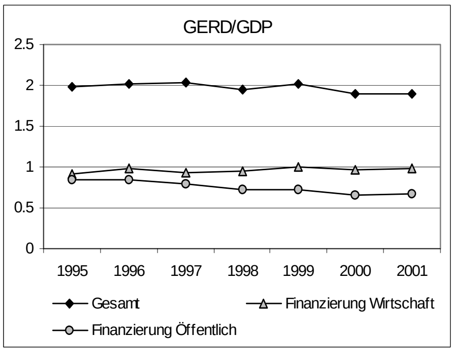
Ziele

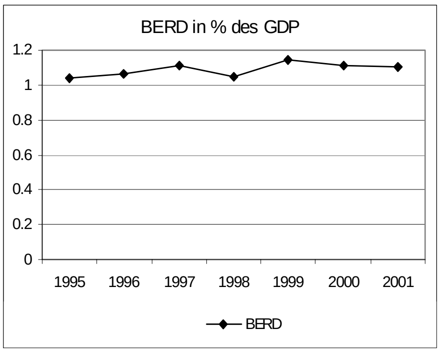
- GAINZ (Growing an Innovative New Zealand Strategy): umfasst allgemeine und technologiespezifische Komponenten (Technologien: Biotech, IKT, Creative industries)
- Erhöhung der öffentlichen Aufwendungen für F&E in Prozent des BIP auf 0.8% im Jahr 2010 (derzeit: 0.6%).

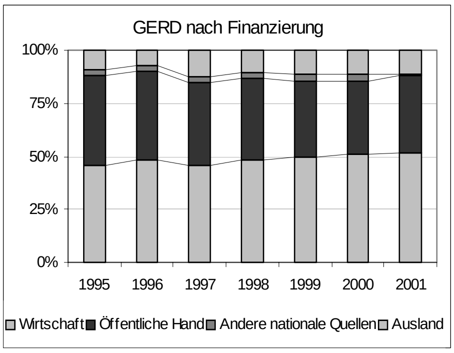
Organisation

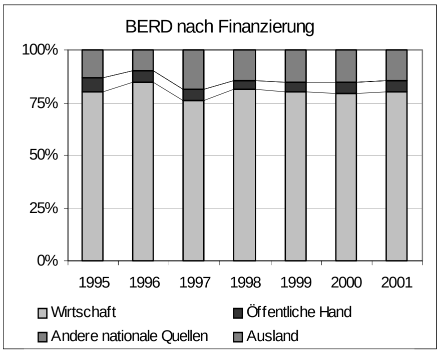
- Science and Innovation Advisory Council (SIAC, Gründungsjahr 2000) als unabhängiges Beratungsgremium direkt an die Regierungsspitze (Prime Minister)
- Public Good Science Fund (PGSF) wurde in fünf fokussierte Fonds aufgespalten
- New Economy Research Fund (NERF): Orientierung/Förderung von wissenschaftlicher Forschung mit Potential für ökonomische spin-offs. 33.6 Mio. USD (?) wurden vom PGSF zum NERF umgeschichtet.

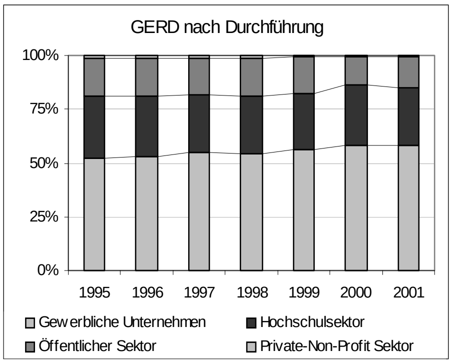
Niederlande

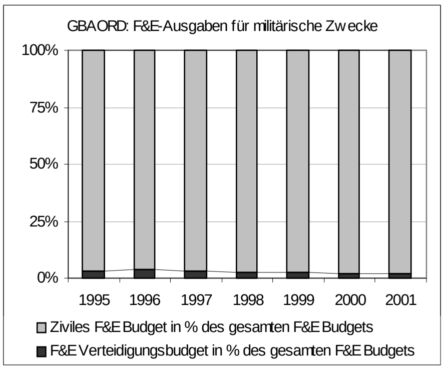


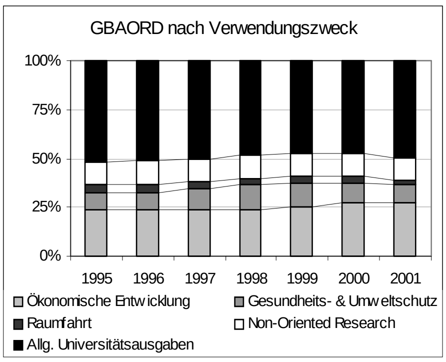












Quelle: OECD

Stylized Facts – Die Niederlande:

GERD/GDP

- Konstant um 2%, seit 1999 leicht gesunken

FINANZIERUNG von GERD und BERD

- GERD Finanzierung knapp über 50% durch Wirtschaft, Tendenz leicht steigend
- BERD Finanzierung etwa 80% durch Wirtschaft, Auslandsanteil bei ca.15%, die öffentliche Hand bei etwa 5%

DURCHFÜHRUNG von F&E

- Unternehmen – Anteil weist Richtung 60%
- Universitäten & staatliche Forschungseinrichtungen leicht rückläufig

F&E BUDGET

- Ausgaben für militärische Forschung : Knapp 2%, rückläufig
- Zivile Zwecke: Beinahe 50% der Ausgaben gehen direkt an Universitäten

Zielsetzungen

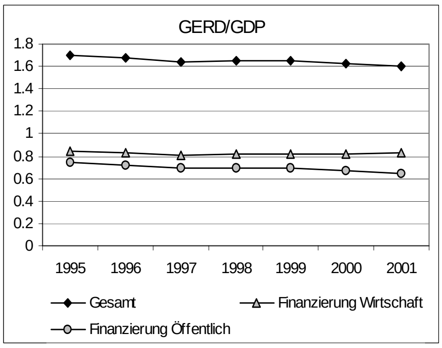
- Unter den führenden EU Ländern bis 2010 und BERD/GDP höher als EU Durchschnitt bis 2005
- Im Wissenschaftsbudget 2000 ⇨
    - Raum für Eigenverantwortung
    - Forschung als Karriereoption
    - Investitionen in Wissen für die Zukunft
    - Soziale Verantwortlichkeit
    - Neue Formen von Kooperationen

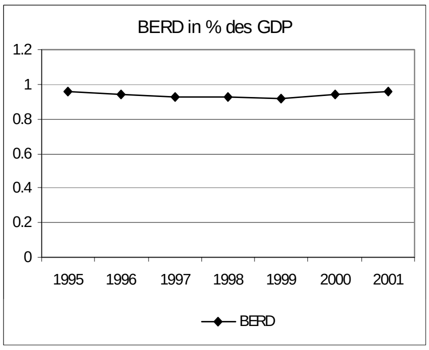
Massnahmen & Sondermittel

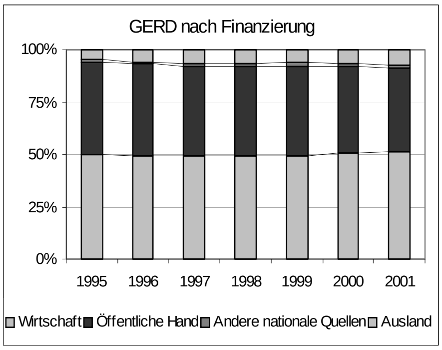
- „Progress Report Science Policy“ ⇨ http://www.minocw.nl/wetenschapsbudget/
- Kurz & Langfristige Sondermittel für den Zeitraum 2000-2005 im Ausmaß von 575 Mill. Euro – 93 Mill. Euro pro Jahr + 109 Millionen Startfinanzierung

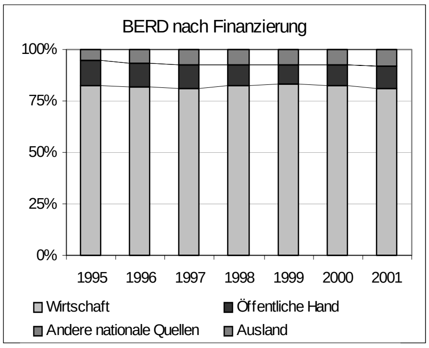
- Extra Mittel für die Universitätslehre im Ausmaß von 418 Mill. Euro ⇨ 45 Mill. Euro für Initiierung des Bachelor-Master Systems, und eine strukturelle Erhöhung auf insg. 103 Mill. Euro pro Jahr in 2005
- Spezieller Fokus – GENOMICS: 189 Mill. Euro für 2001-2006
- Kein spezieller Vermerk auf „Barcelona-Ziele“ eher allgemein – Forschung für die Zukunft fit machen
- Art der Mittelvergabe bedarf genauerer Untersuchung, die nur per Internet-Recherche nicht möglich ist
- Finanzierungsursprung unklar

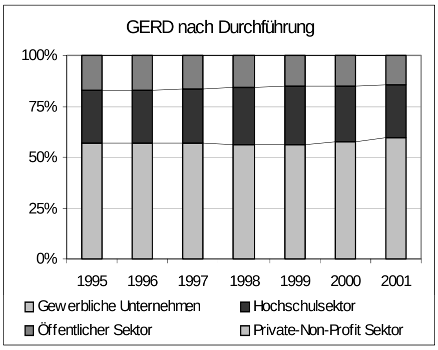
NORWEGEN

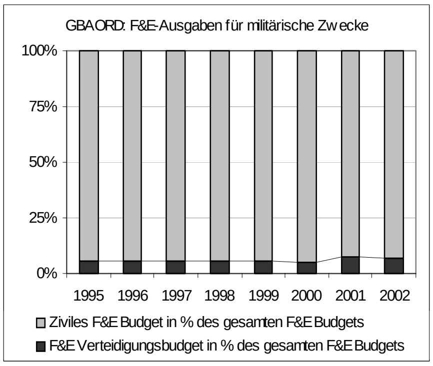


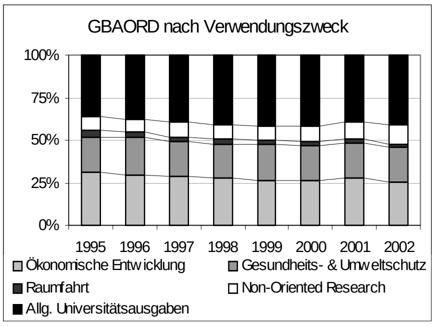












Quelle: OECD

Stylized Facts - Norwegen

GERD/GDP

- Leicht sinkend (von 1.7% auf 1.6%) aufgrund leicht sinkender öffentlicher Finanzierung

Finanzierung von GERD und BERD

- Anteil der Wirtschaft bei ziemlich konstant 50%
- Sinkender Anteil der öffentlichen Hand
- Steigender Auslandsanteil (aber noch immer unter 10%)
- Finanzierungsanteil der Wirtschaft am BERD ca. 80% (relativ konstant), Rest: über 10% öffentliche Hand, unter 10% Auslandsanteil

DURCHFÜHRUNG von F&E

- Anteil der Wirtschaft über 60% und leicht steigend
- Hochschulsektor um 20%, leicht sinkend
- Öffentlicher Sektor um 10%, sinkend

F&E Budget

- Militärischer Anteil um 7%, leicht steigend
- Allgem. Univ.ausgaben haben größten Anteil mit knapp mehr als 40% (steigend)
- Ökonomische Entwicklung 25% (sinkend)
- Gesundheits- und Umweltschutz etwas unter 25% (relativ konstant)
- Nicht-orientierte Forschung unter 10%, aber leicht steigend

Ziele:

- Forschungsquote soll im Jahr 2005 zumindest OECD-Durchschnitt erreichen
- Zuwachs der öffentlichen F&E-Aufwendungen soll v.a. fokussiert werden langfristige Grundlagenforschung sowie auf FTE in vier Bereiche: (i) Meeresforschung, (ii) IKT, (iii) Medizin- und Gesundheitsforschung, (iv) Energie- und Umweltforschung

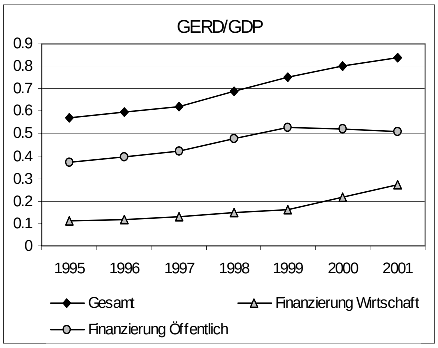
Organisation

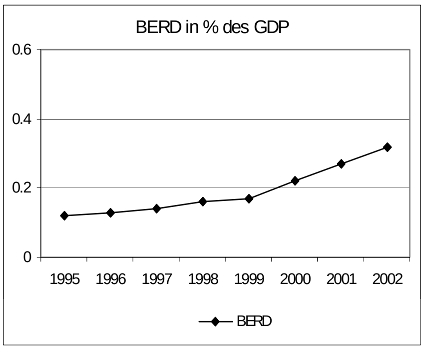
- 40% des Zuwachses in den F&E-Aufwendungen sollen aufgrund der Erhöhung der öffentlichen FTE-Finanzierung erbracht werden, Teile dieser zusätzlichen Mittel werden durch die Erträge aus den Fund for Research and Innovation aufgestellt
- Das Kapital dieses Fonds wurde in den letzten Jahren aufgestockt, was dazu führt, dass die laufenden Fondserträge deutlich steigen (z.B. von 204 MOK i.J. 2001 auf 525 MOK i.J. 2002)

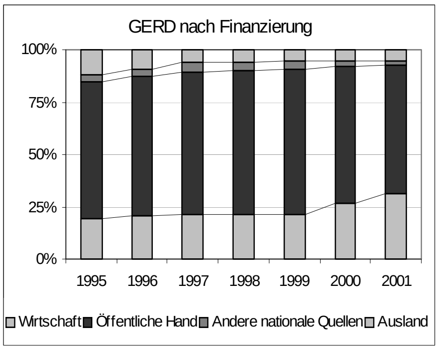
Sondermittel

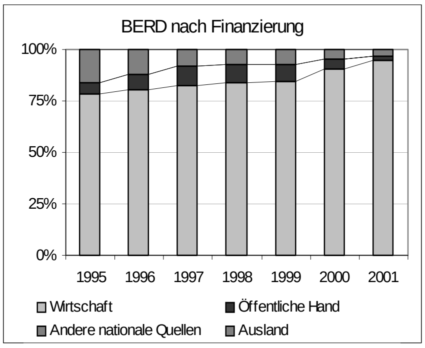
- Aufstockung des Fund for Research and Innovation, Im Jahr 2002 betrug das Fondskapital 13 Mrd. NOK.

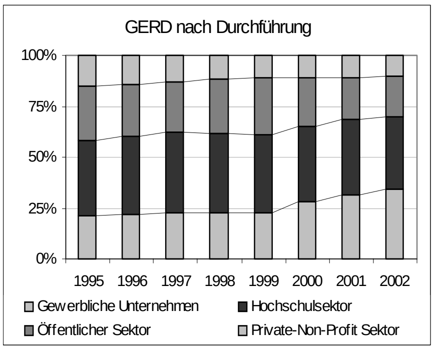
PORTUGAL

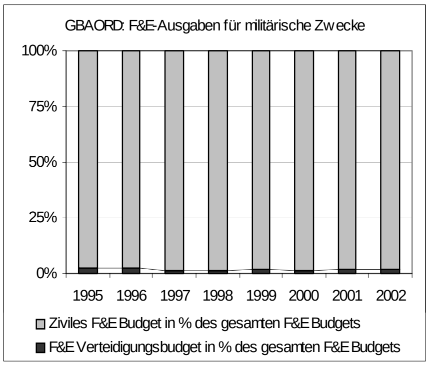


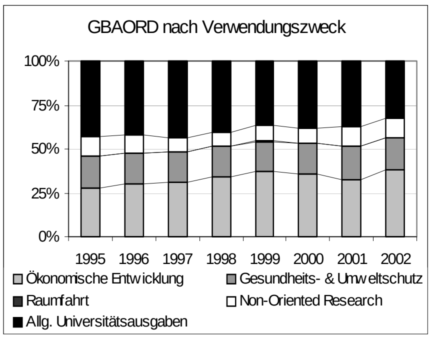












Quelle: OECD

Stylized Facts - Portugal

GERD/GDP

- Deutlich steigendes GERD/GDP von niedrigem Niveau ausgehend (von unter 0.6% im Jahr 1995 auf 0.8% im Jahr 2001)
- Geprägt durch starke Zunahme des Wirtschaftssektors, besonders deutlich ab 1999 (Verdreifachung des BERD/GDP zwischen 1995 und 2002 !)

Finanzierung von GERD und BERD

- Extrem hoher Anteil der öffentlichen Hand (über 60%), aber sinkend
- Anteil der Wirtschaft an der Finanzierung vom BERD auf deutlich über 90% steigend

DURCHFÜHRUNG von F&E

- Hochschulsektor und Unternehmenssektor mit jeweils ca. 30% mittlerweile annähernd gleich bedeutend (noch 1995 lag der Anteil des Unternehmenssektors unter 25%)
- Öffentlicher Sektor auf ca. 20% sinkend

F&E Budget

- Militärischer Anteil konstant sehr niedrig
- Anteil der Allgem. Universitätsausgaben von über 45% auf etwas über 30% sinkend
- Anteil von Ökonomischer Entwicklung von ca. 25% auf über 30% steigend
- Gesundheits- und Umweltschutz sowie Nicht-orientierte Forschung in etwa bei15%, respektive 10%

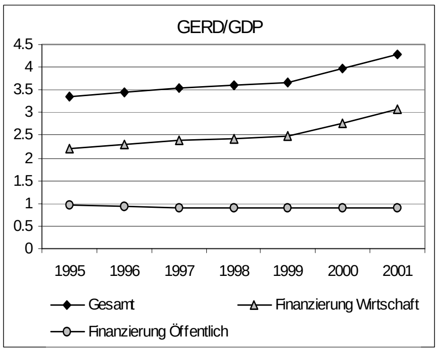
Ziele

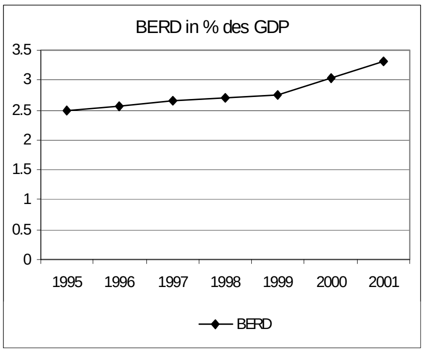
- GERD/GDP 1% bis 2003
- Ankurbelung des Aufholprozesses im Bereich wissenschaftlicher Forschung und Erhöhung des Absorptionspotentials der Wirtschaft für FTE

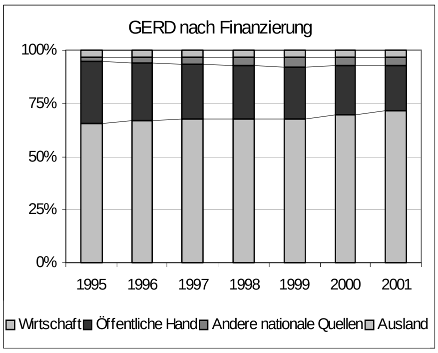
Organisation

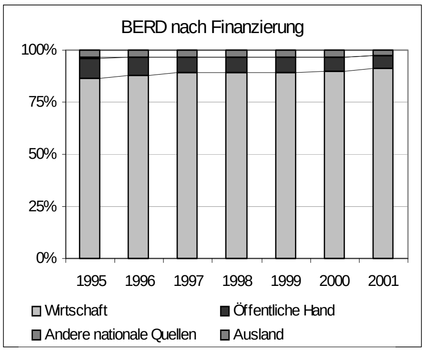
- Foundation for Science and Technology (FCT) als Förderungs- und Finanzierungsinstitution
- Strategic Areas for Development (OperationalPlan for the Economy:POE – Axis 2): folgende Schlüsselbereiche: e-commerce &digital economy, IKT, Multimedia, Biotechnologie ,Energie- und Umwelttechnik, zusätzlich auch Innovationsprojekte in traditionellen Sektoren, die jedoch im Zusammenhang mit IKT, neuen Materialien, Biotechnologie, erneuerbare Energien bzw. Umweltschutz stehen

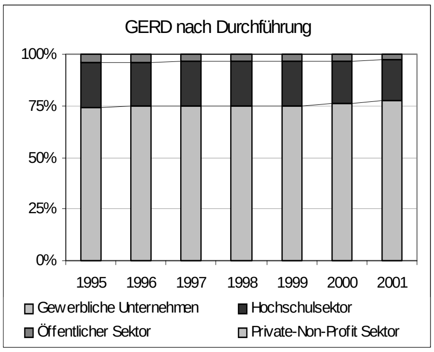
SCHWEDEN

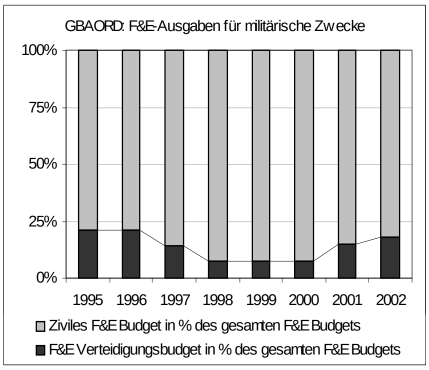


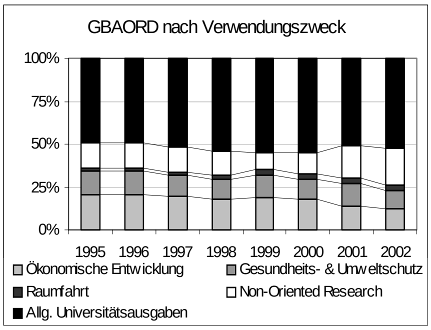












Quelle: OECD

Stylized Facts - Schweden

GERD/GDP

- Laufender Anstieg des GERD/GDP, der ab 1999 noch besonders deutlich ausfällt
- Anstieg getragen durch Wirtschaft -> Erhöhung des BERD/GDP, besonders stark ab 1999

Finanzierung von GERD und BERD

- Mehr als 70% der GERD von Wirtschaft finanziert (und kontinuierliche Zunahme dieses Anteils)
- Anteil der öffentlichen Hand an der Finanzierung der GERD beträgt nur noch ca. 25%
- Anteil der Wirtschaft an der Finanzierung der BERD ca. 90%

DURCHFÜHRUNG von F&E

- Anteil der Wirtschaft an GERD bei über 75%, Rest entfällt fast zur Gänze auf Hochschulsektor

F&E Budget

- Zunächst deutlicher Rückgang der Militärforschung (von fast 25% auf unter 10%, ab 2000 wieder Anstieg auf ca. 20% im Jahr 2002)
- Allgemeine Universitätsausgaben machen etwas mehr als 50 % aus, gefolgt von nicht-orientierter Forschung (20%, steigend) sowie ökonomische Entwicklung und Gesundheits- und Umweltschutz (jeweils ca. 10%)

Ziele

- Beibehaltung des hohen Levels von GERD/GDP

Organisation

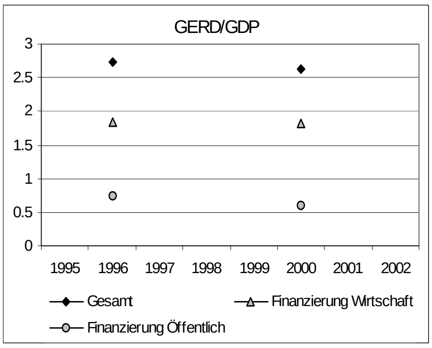
- Institutionelle Re-Organisation mit 1. 1. 2001 mit dem Ziel der Fokussierung und Bündelung der verschiedenen Institutionen. Als FTE-relevante Finanzierungsinstitutionen sind nunmehr folgende von besonderer Bedeutung:
- Swedish Research Council als (nunmehr) zentrale Finanzierungsinstitution für (Grundlagen-)Forschung, Budget für 2001 v. 200 MEUR
- VINNOVA (Swedish Agency for Innovation Systems), 120 MEUR f. 2001

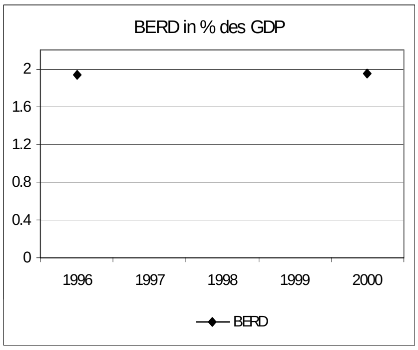
- FOI (Swedish Defence Research Agency, entstanden aus Fusion der FOA (Militär) und FFA (Weltraum))

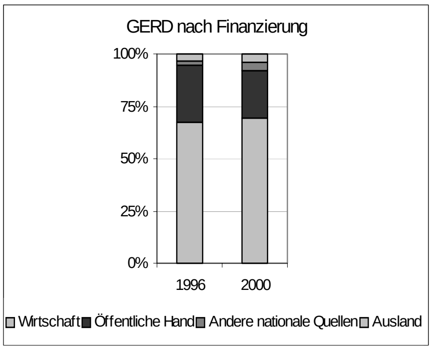
Sondermittel

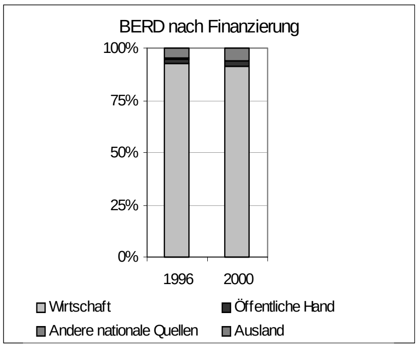
- Keine Verwendung von Sondermittel ersichtlich

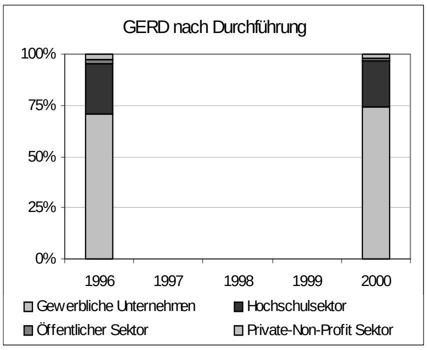
SCHWEIZ

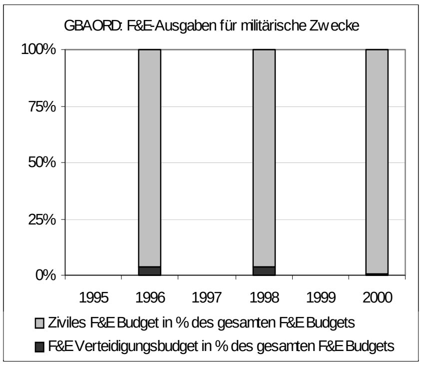


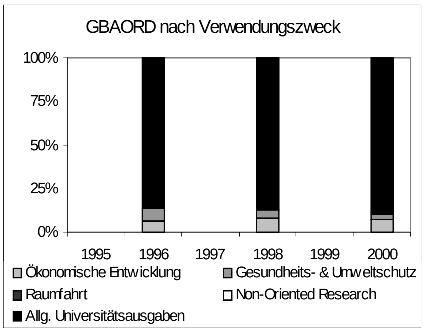












Quelle: OECD

Stylized Facts - Schweiz

GERD/GDP

- GERD/GDP 1996 wie auch 2000 auf ca. 2.7% des GDP (Stagniert seit mehr als 15 Jahren auf diesem Niveau)
- BERD/GDP 1996 wie auch 2000 auf knapp 2% des GDP

Finanzierung von GERD und BERD

- Zu ca. 70% durch Wirtschaft bei GERD, zu über 90% bei BERD ⇨ überwiegend von den Unternehmen selbst finanziert

DURCHFÜHRUNG von F&E

- Ebenso wie die Finanzierungslage

F&E Budget

- Militärische F&E knapp an der Wahrnehmungsgrenze
- Großteil der Ausgaben für allgemeine Universitätsausgaben

Ziele

- 2002 ⇨ 9 Punkte Programm zur Förderung von Wissenschaft und Technologie
- Durchschnittliches jährliches Wachstum der Wachstum der Gesamtressourcen für Bildung, Forschung und Technologie um 6% (Vergleichsbasis: Finanzplan 2003) für Periode 2004-2007.

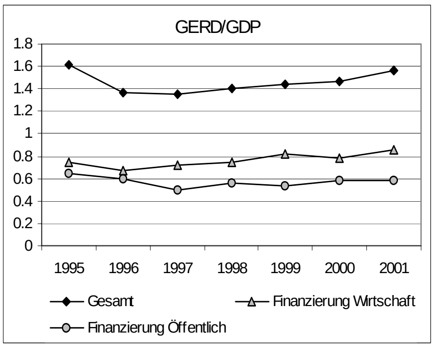
Organisation

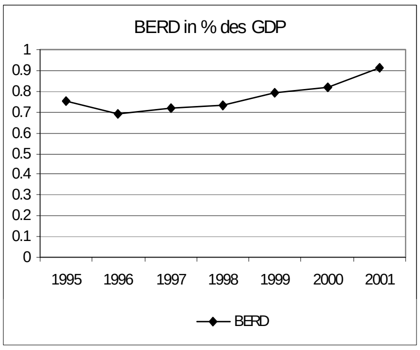
- Schweizer Wissenschafts- und Technologierat (SWTR) ⇨ Konsultativorgan des Bundesrates für alle Fragen der F&E Politik
- KTI ⇨ Agentur für anwendungsorientierte Forschung (weniger „Bottom-Up“ Förderung, sondern Entwicklungsprojekte für KMU in Zusammenarbeit mit Hochschulen und FH, bis zu 50% Finanzierung durch Industriepartner)
- SNF ⇨ Schweizerische Nationalfonds zur Förderung der wissenschaftlichen Forschung

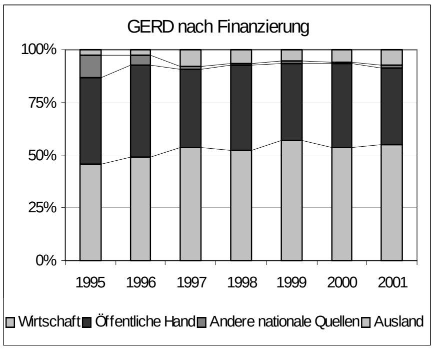
Sondermittel

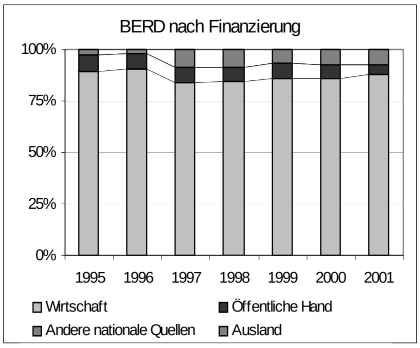
- Erhöhung der Mittel innerhalb des nationalen Budgets
- Keine zusätzlichen Institutionen, welche neue Programme oder Initiativen startet

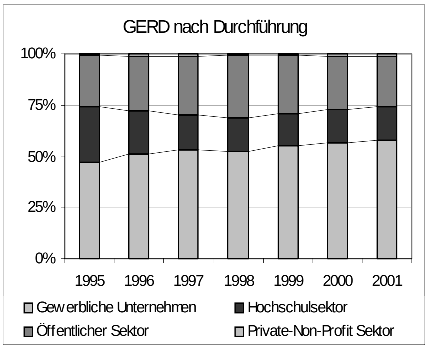
SLOWENIEN

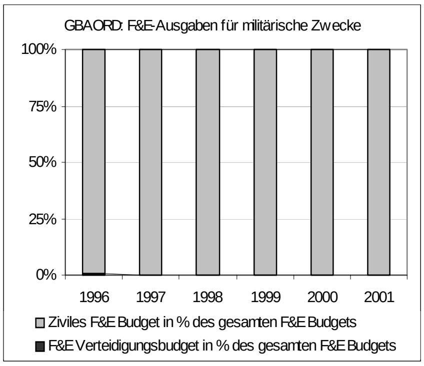


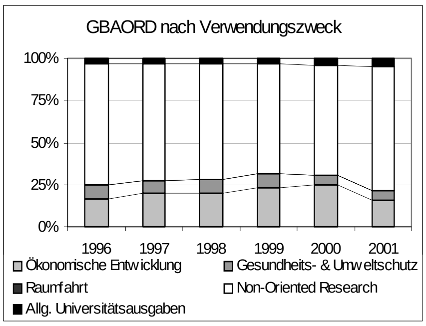












Quelle: OECD

Stylized Facts - Slowenien

GERD/GDP

- GERD und BERD leicht steigend (BERD etwas stärker)

Finanzierung von GERD und BERD

- Anteil der Wirtschaft etwas über 50% (leicht steigend)
- Anteil öffentliche Hand 35-40% (sinkend)
- Auslandsanteil bei 10% (leicht steigend)
- Anteil Wirtschaft am BERD ca. 85%
- Auslandsfinanzierung am BERD größer als Finanzierungsanteil durch öffentliche Hand

DURCHFÜHRUNG von F&E

- Unternehmenssektor auf knapp unter 60% steigend
- Hochschulsektor auf 20% fallend
- Öffentlicher Sektor ca. 25% (sinkend)

F&E Budget

- Militäranteil an Wahrnehmungsgrenze
- 75% Anteil nicht-orientierter Forschung
- Allgemeine Universitätsausgaben auf 5% steigend
- 15% für ökonomische Entwicklung (nach 25% in den Jahren 1999/2000)

Zielsetzungen

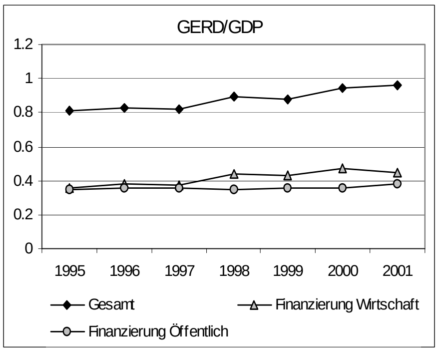
- GERD/GDP auf 3% bis 2010

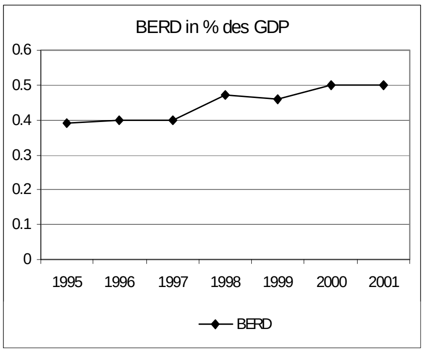
Massnahmen

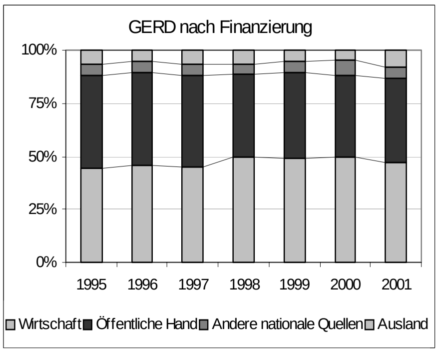
- Nationaler Aktionsplan zur Erreichung des 3% Zieles
    - Unterstützung für industrielle F&E
    - Entwicklung von steuerlichen Anreizen und fiskalen Maßnahmen
    - Unterstützung des Wissenstransfers von öffentlichen Forschungseinrichtungen

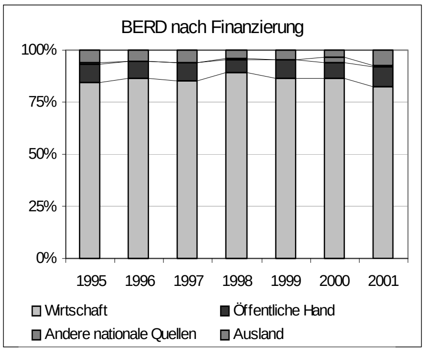
- Unterstützung beim Aufbau von S&T Parks
- Aufbau von Technologienetzwerken und Cluster-Initiativen

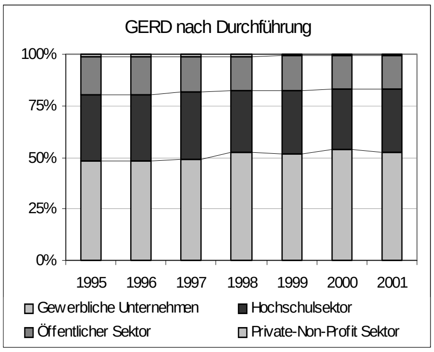
SPANIEN

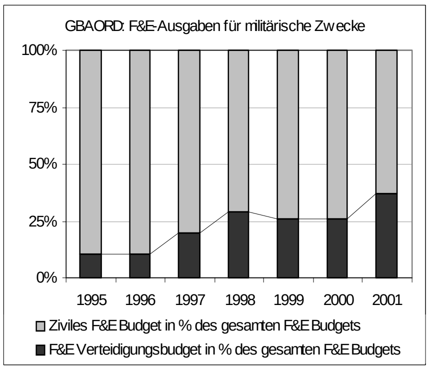


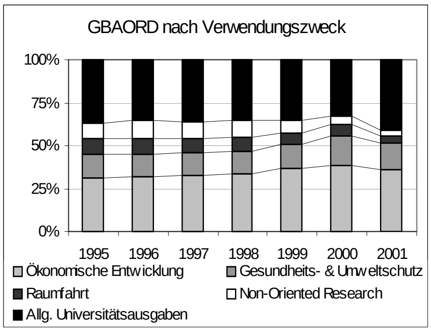












Quelle: OECD

Stylized Facts - Spanien

GERD/GDP

- GERD/GDP leicht steigend (von 0.8 auf knapp unter 1%)
- Zunahme des Finanzierungsanteils der Wirtschaft v.a. Mitte der 90er Jahre (-> Steigerung des BERD/GDP in diesem Zeitraum und 0.1 Prozentpunkt)

Finanzierung von GERD und BERD

- Anteil der Wirtschaft um/knapp unter 50%
- Anteil der öffentlichen Hand knapp unter 40%
- Ca. 80% des BERD von Wirtschaft finanziert

DURCHFÜHRUNG von F&E

- Relativ konstanter Anteil des Unternehmenssektors von etwa 50% (leicht steigende Tendenz)
- Hochschulsektor relativ konstanter Anteil von ca. 30%
- Öffentlicher Sektor etwas über 20% (leicht fallende Tendenz)

F&E Budget

- Hoher und stark ansteigender (auf über 30%) Anteil der Miltitärforschung
- Anteil d. allgem. Universitätsausgaben etwas über 40% (zuletzt deutlich steigend), gefolgt von ökonomischer Entwicklung (etwas über 30%) und Gesundheits- und Umweltschutz (15%)

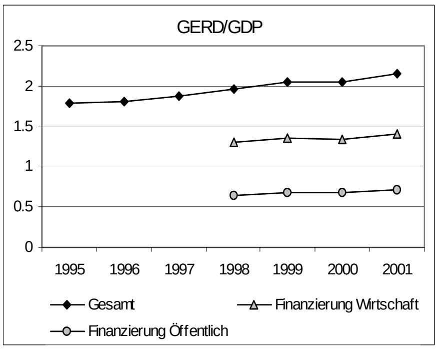
Ziele

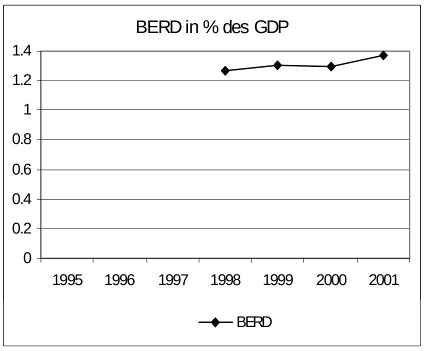
- GERD/GDP auf 1.4-1.5% bis 2007 und BERD/GDP auf 0.8% bis 0.9% bis 2007

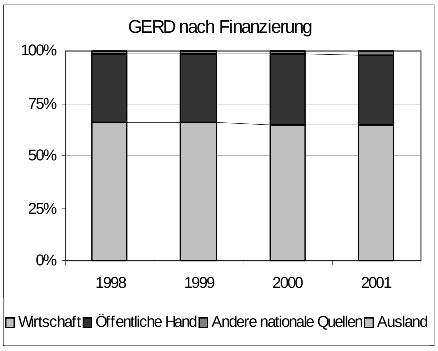
Massnahmen

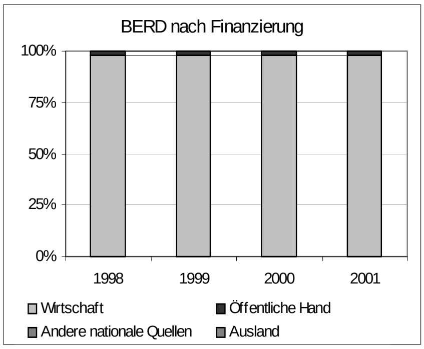
- Nationaler Plan für Forschung, Entwicklung und technologische Innovation 2004-2007
- Anhebung der öfffentlichen F&E Ausgaben
- Bessere Rahmenbedingungen für private Investitionen in F&E

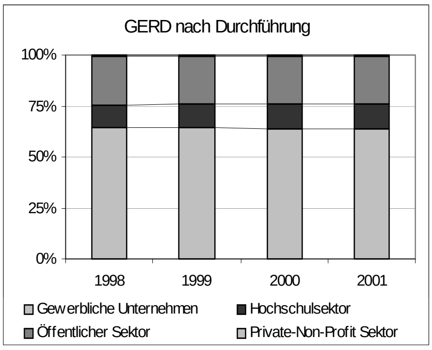
TAIWAN

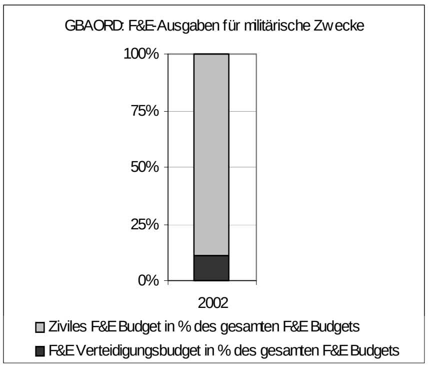


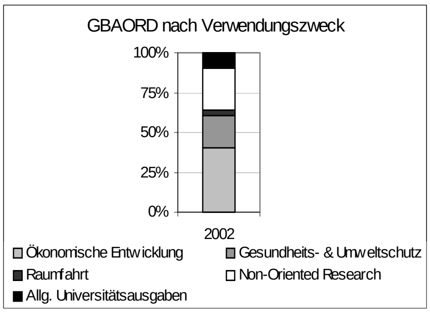












Quelle: OECD

Stylized Facts - Taiwan

GERD/GDP

- Leichter, aber kontinuierlicher Anstieg der GERD/GDP (sowohl Wirtschaft als auch öffentliche Finanzierung)

Finanzierung von GERD und BERD

- Anteil Wirtschaft an GERD-Finanzierung ca. 65%, Rest fast vollständig öffentliche Hand
- Anteil Wirtschaft an BERD bei 98% ! (Rest: öffentliche Hand)

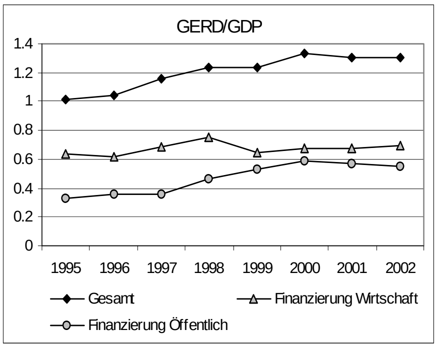
DURCHFÜHRUNG von F&E

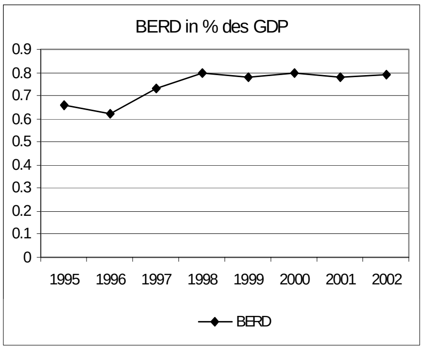
- Anteil Unternehmen 65%
- Anteil Hochschulsektor über 10% (leicht steigend)
- Anteil öffentlicher Sektor knapp unter 25%

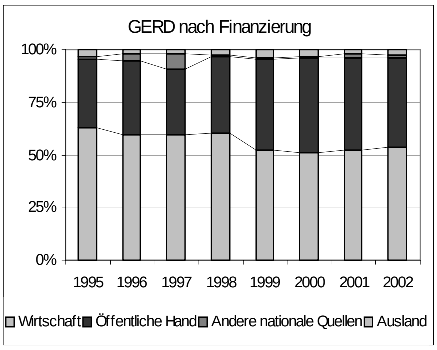
F&E Budget

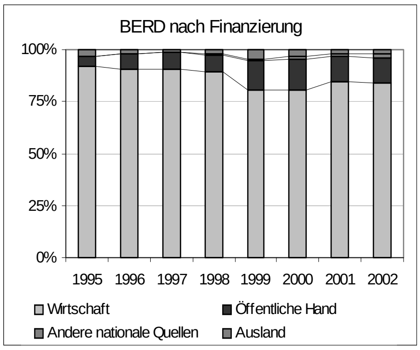
- Militäranteil knapp über 11%
- Anteil ökonomischer Entwicklung von 40%, gefolgt von nicht-orientierter Forschung 25%, Gesundheits- und Umweltschutz 20% und allg. Universitätsausgaben v. 10%

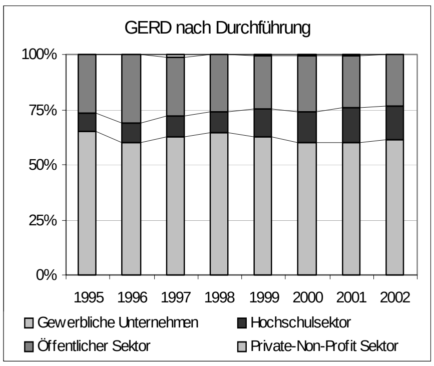
Tschechische Republik

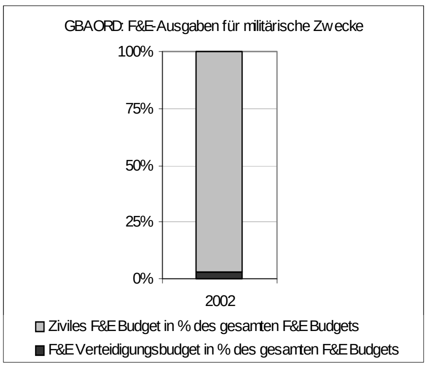


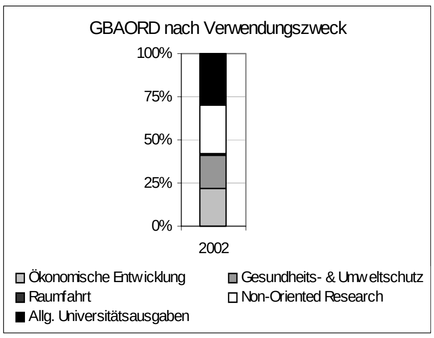












Quelle: OECD

Stylized Facts – Tschechische Republik:

GERD/GDP

- Anstieg bis 2000 auf 1.3% des GDP. Seither konstant
- BERD seit 1998 konstant auf 0.8% des GDP

FINANZIERUNG von GERD und BERD

- Bedeutung des öffentlichen Haushaltes nimmt für beide Indikatoren zu ⇨ Wirtschaftsanteil nimmt von 63% auf 53% ab, der Staatsanteil steigt von 32% auf 42% bei GERD
- Auslandsanteil spielt sehr geringe Rolle (ca. 2%)

DURCHFÜHRUNG von F&E

- Unternehmen – Anteil pendelt zw. 60-65%
- Universitäten – 15% in 2002 mit steigender Tendenz
- Forschungseinrichtungen der öffentlichen Hand – noch 23%, Tendenz fallend

F&E BUDGET

- Nur Daten für 2002 verfügbar
- Ausgaben für militärische Forschung: 3% der gesamten staatlichen Ausgaben in 2002
- Zivile Zwecke: Relativ gleich verteilt auf einzelne Bereiche

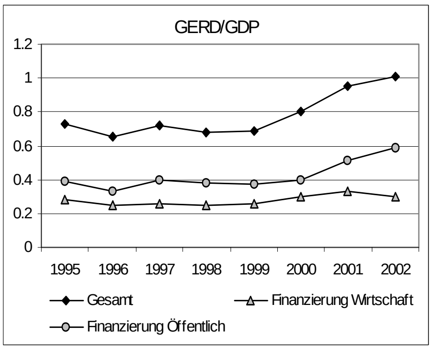
Zielsetzungen

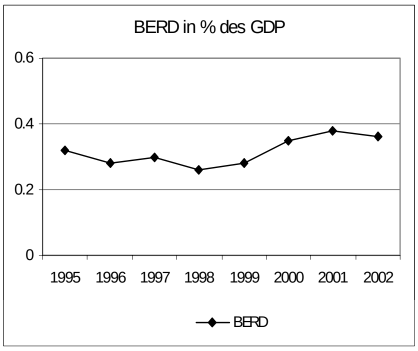
- GERD/GDP auf 2% bis 2010 und BERD/GDP auf 1% bis 2010
- Priorität auf industrielle F&E die vor allem den Güterexport unterstützen soll, Augenmerk auf langfristige ökonomische Entwicklung
- Finanzielle Unterstützung für F&E die internationalen Standards gerecht wird, meist an Universitäten
- Unterstützung des Wissenstransfers
- Harmonisierung von Förderungssystem Gesetzen ⇨ 2001: Neuer F&E Akt.

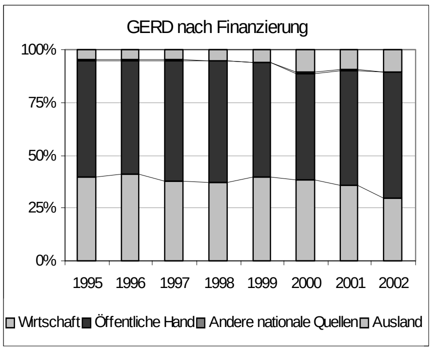
Massnahmen & Sondermittel

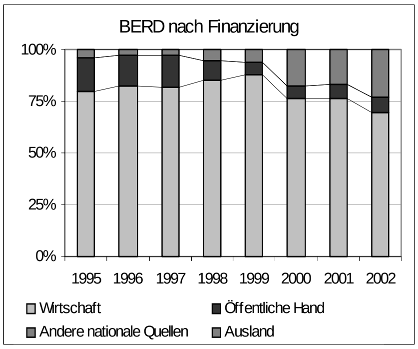
- Mittelvergabe geregelt in “On the State Support of Research and Development“ – regelt auch Status und Aufgaben des Rates der tschechischen Republik für Forschung und Entwicklung ⇨ http://www.msmt.cz/
- Kein Einsatz von Sondermitteln

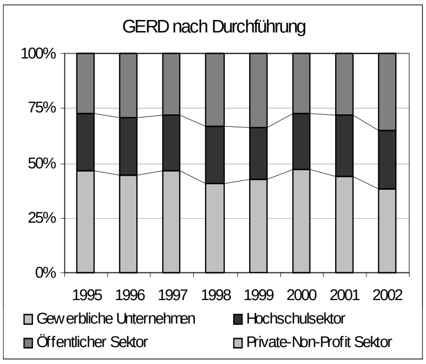
Ungarn











Quelle: OECD

Stylized Facts – Ungarn

GERD/GDP

- Ankurbelung der Forschungsintensität seit 1999 ⇨ bisweilen 1% GERD/GDP
- Prozeß durch öffentliche Finanzierung in Gang gesetzt

FINANZIERUNG von GERD und BERD

- Finanzierung der öffentlichen Hand seit 1999 auf 60% ausgedehnt
- Auslandsanteil beachtliche 10% bei GERD und 25% bei BERD ⇨ Strukturbruch fand statt

DURCHFÜHRUNG von F&E

- Unternehmensanteil hat abgenommen, die öffentliche Hand zugelegt

Zielsetzungen

- GERD/GDP auf 1.5% bis 2006 und BERD/GDP auf 0.6% bis 2006
- Dargelegt in „Széchenyi Plan“ – Nationaler Entwicklungsplan von 1999, mittelfristig angelegt, mit Fülle an Zielen:
    - Erhöhung von GERD/GDP
    - Erneuerung des staatlichen F&E Systems
    - Stärkung bestehender Forschung
    - Erstellung eines nationalen F&E Registers
    - Steigerung der F&E Ausgaben der öffentlichen Hand
    - Steigerung der Durchführung von F&E im privatwirtschaftlichen Sektor
    - Erweiterung der Humanressourcen
    - Verstärkte Internationale Wissenschafts- und Technologiekooperation

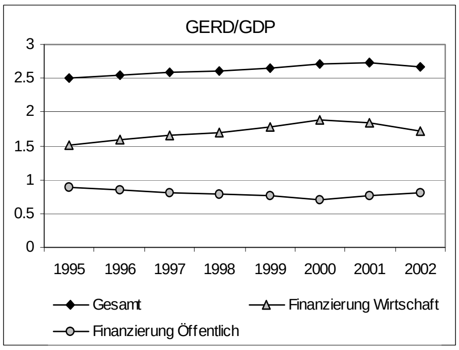
Massnahmen & Sondermittel

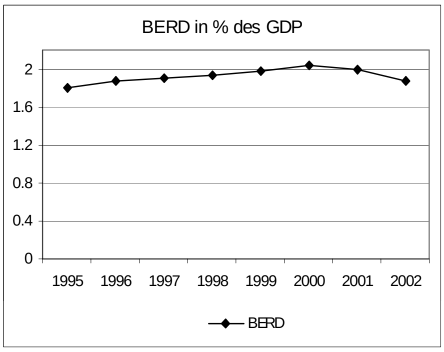
- „The Science and Technology Policy 2000“⇨ langfristiges Entwicklungsprogramm für das ungarische Forschungs- und Innovationssystem
- Gründung eines Rates für Forschung und Technologiepolitik 1999 und eines mit Beratungs- Evaluierungs und Koordinierungskompetenzen ausgestatteten

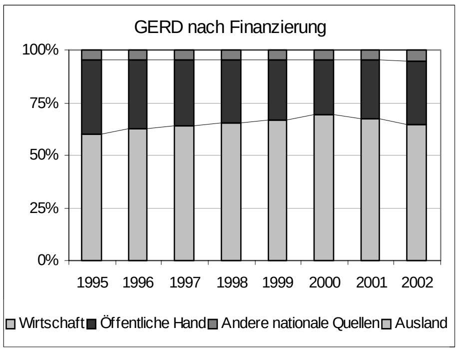
„Science Advisory Board": Aufgabe des Rates ⇨ Ausarbeitung der grundlegenden Struktur des ungarischen Innovationssystems

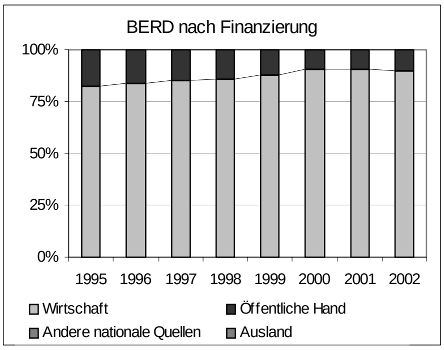
- Erstellung und Ausbau von Fonds zur Unterstützung von F&E:
    - NRDP ⇨ „National R&D Programmes" nach thematischen Schwerpunkten
    - NSRF ⇨ „National Scientific Research Fund" seit 1986 – unabhängig, zur Unterstützung der Grundlagenforschung
    - NTDF ⇨„National Technology Development Fund" seit 1996 – technologische Innovation, Bildung von F&E Infrastruktur, ökonomische Verwertung von F&E Resultaten
- Geplant für 2004: Erstellung eines Fonds für „Science, Technology and Innovation" finanziert durch anteilsmäßige Abgaben/Steuern durch Wirtschaft, und Verdoppelung der Einlagen durch den Staat.

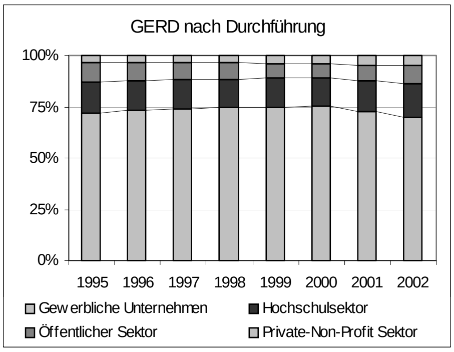
USA

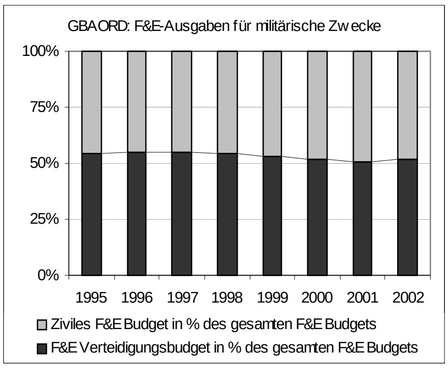


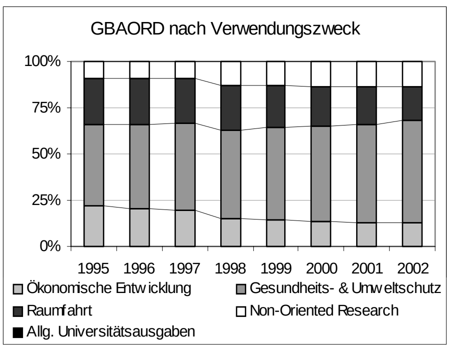












Quelle: OECD

Stylized Facts - USA

GERD/GDP

- Leichter Anstieg der GERD/GDP, ab 2000 Stagnation/Rückgang (aufgrund Abnahme der Wirtschaft -→ deutlicher Rückgang der BERD/GDP ab 2000)

Finanzierung von GERD und BERD

- Finanzierungsanteil der Wirtschaft erreicht Maximum von ca. 70% im Jahr 2000, danach Rückgang dieses Anteils auf ca. 65% im Jahr 2002
- Anteil der öffentlichen Hand zwischen 25% (2000) und 30% (2002)
- Anteil der von der Wirtschaft finanzierten BERD ca. 85%

DURCHFÜHRUNG von F&E

- Anteil der Wirtschaft 75%, ab 2000 sinkend
- Hochschulsektor 15%, öffentlicher Sektor 10%

F&E Budget

- Anteil der Militärforschung 50% (!)
- Anteil für ökonomische Entwicklung ca. 50-55%
- Anteil für allgemeine Univ.Ausgaben ca. 20-25%
- Rest zu etwa gleichen Anteilen für Gesundheits- und Umweltschutz sowie nicht-orientierte Forschung

Organisation:

- Public Sector R&D nach ministeriellen Zuständigkeiten gegliedert (z.B. Department of Agriculture; Department of Defense; Department of Health, Department of Energy etc.)
- Academic Research wird über die National Science Foundation (NSI) auf der Basis kompetitiv vergebener Förderungen finanziert. 2002 wurde vorgeschlagen die staatliche Förderung der Grundlagenforschung unter dem Dach der NSI zu zentralisieren (d.h. einige der spezifischen ministeriellen F&E-Programme werden zur NSI transferiert)
- Zentralstaatliche Unterstützung für private FTE existiert zwar im Bereich des Technologietransfers von öffentlicher Forschung in den privaten Sektor,

Kooperative Projekte zw. Unternehmen und öffentlichen FTE-Einrichtungen etc., deren Größe ist jedoch sehr limitiert (relativ zur Gesamt-FTE des privaten Sektors).

- Zentralstaatliche FTE-Initiativen (die auch private-public partnerships und Zusammenarbeit zw. Unternehmen und öffentlichen Einrichtungen ansprechen) findet sich high-priority Feldern, wie z.B: clean coal research, Nanotechnologie, Brennstoffzellen-Technologie.
- Sondermittel: Zusätzliche Mittel wurden – im Anschluss an September 2001 – für Forschung im Bereich Terrorismusbekämpfung bewilligt (Department of Defense, Department of Energy, Department of Health & Human Services)