ResIST

Researching Inequality through Science and Technology (ResIST)

Work Package 2
Supporting sustainable scientific mobility

Contributions by

Fraunhofer Institut System- und Innovationsforschung ISI

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crest Centre for Research on Science and Technology

Contents

GENERAL INTRODUCTION

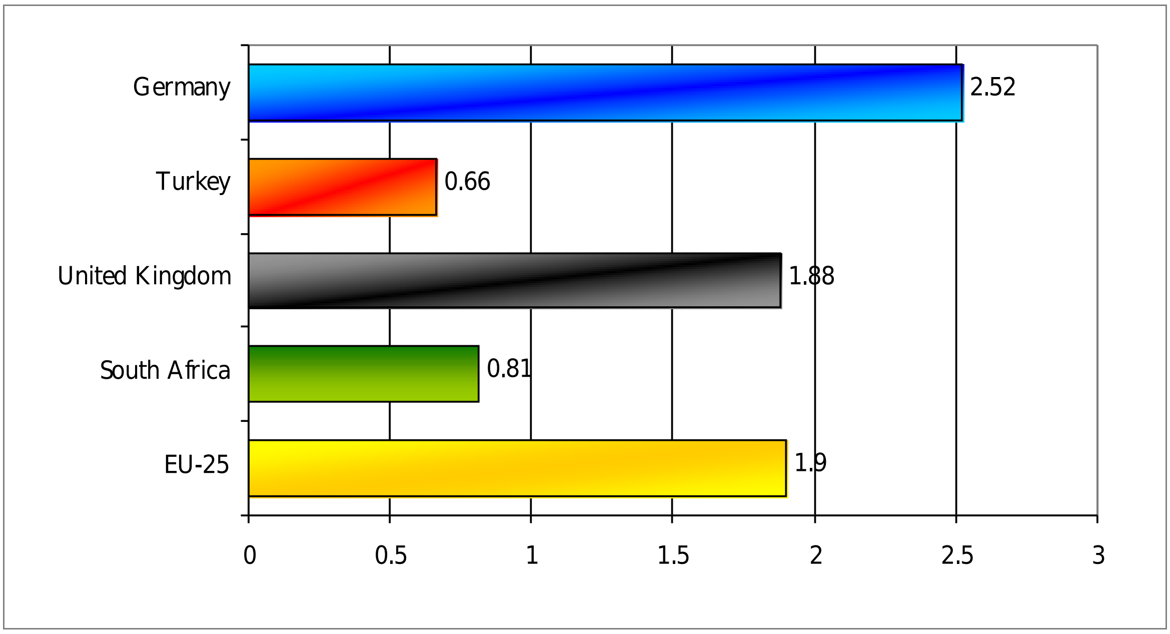
The WP2 team has compiled four country reports on Turkey, Germany, South Africa and the United Kingdom as essential background documents to the empirical surveys and fieldwork that will study flows of scientific mobility in certain fields between Turkey and Germany respectively and South Africa and the United Kingdom respectively. The aim with these country reports is to provide basic information on the S&T systems in these countries including key R&D indicators, to provide both quantitative and qualitative information on scientific mobility as well as highlight policy and programmatic initiatives that pertain to scientific mobility.

Each country team was requested to address these topics following a template that was jointly developed. This does not mean that individual differences and context-specific information would not be included. However, it explains the similarities in topics and issues covered. In addition, we have also compiled in this General Introduction a set of comparative S&T indicators (including the EU average where available) for these four countries in order to provide a more comprehensive and comparable basis for understanding the country reports.

The following comparative S&T indicators have been compiled for this introduction:

- R&D intensity
- R&D expenditure per million of population
- Share of public sector in total R&D expenditure
- Researchers per 1000 of total labour force
- Share of researchers by sector
- Women researchers as % of total researchers
- PhD's per million of population
- PhD's by broad scientific field
- ISI publications
- Patents granted

R&D intensity (GERD as % of GDP), 2003



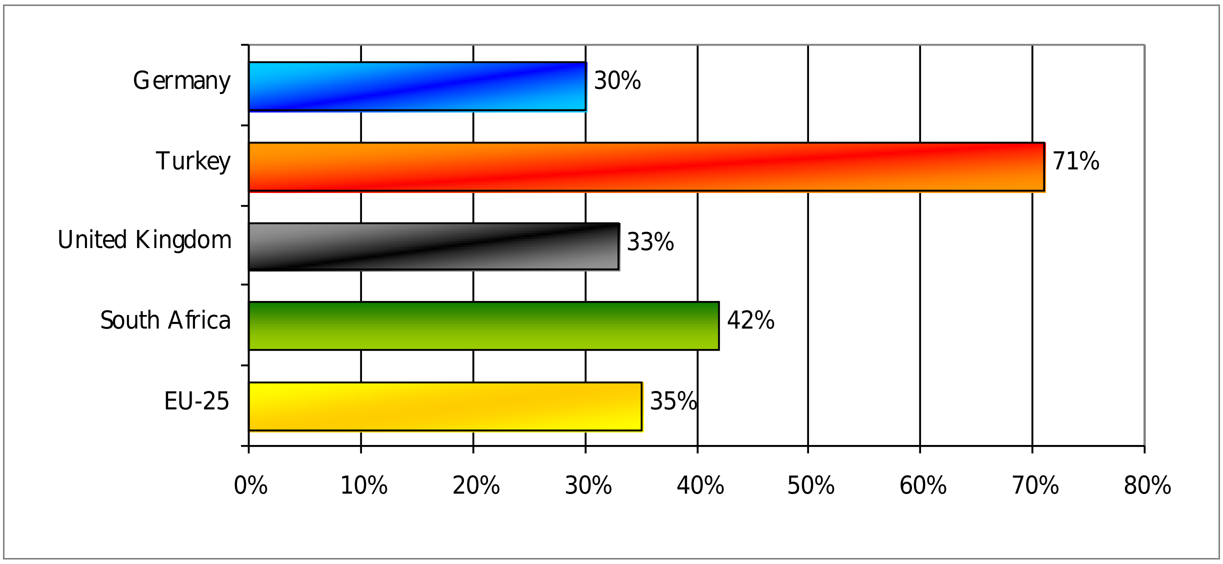
Data sources:
Eurostat (2007c): Germany, Turkey, United Kingdom & EU-25
DST (2005): South Africa
Note:
Exception to the reference period: Turkey = 2002

R&D expenditure per million of the population, 2003

Country	R&D expenditure in EUR million	Population (in million)	R&D expenditure per million population
Germany	54 538	83	657.1
Turkey	1 280	70	18.3
United Kingdom	30 089	60	501.5
South Africa	1 198	46	26.0
EU-25	188 481	308	612.0

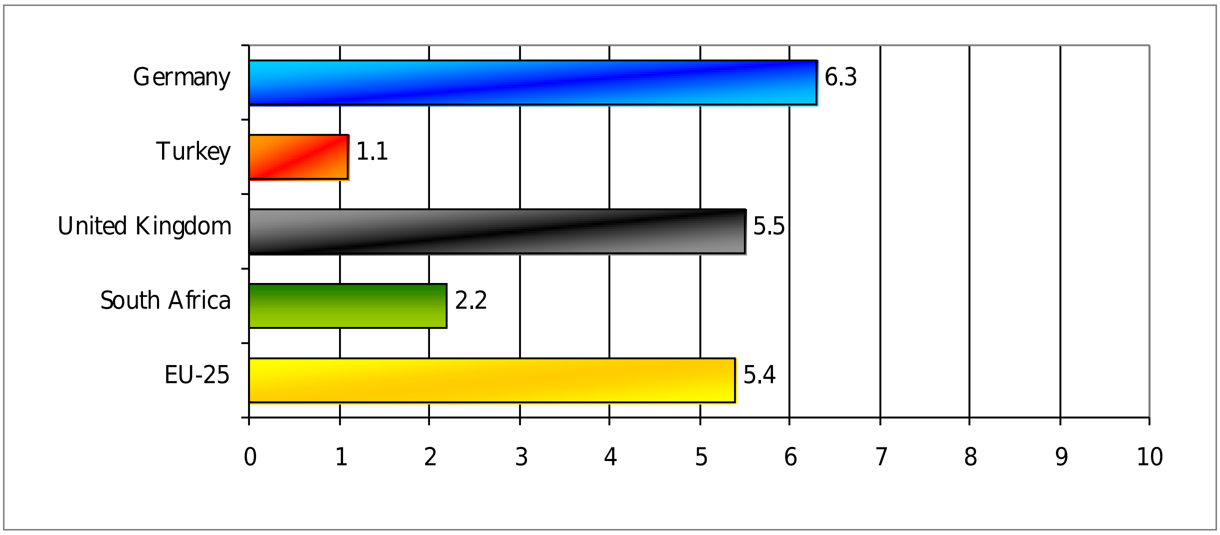
Data sources:
Eurostat (2007c): Germany, Turkey, United Kingdom & EU-25
DST (2005): South Africa
http://web.worldbank.org: Population figures
Notes:
Exception to the reference period: Turkey = 2002
Monetary value for South Africa was converted as follows: R10 082.6 million @ 0.119 Euro per R1, as at 31 Dec 2003.

Share of public sector in total R&D expenditure, 2003



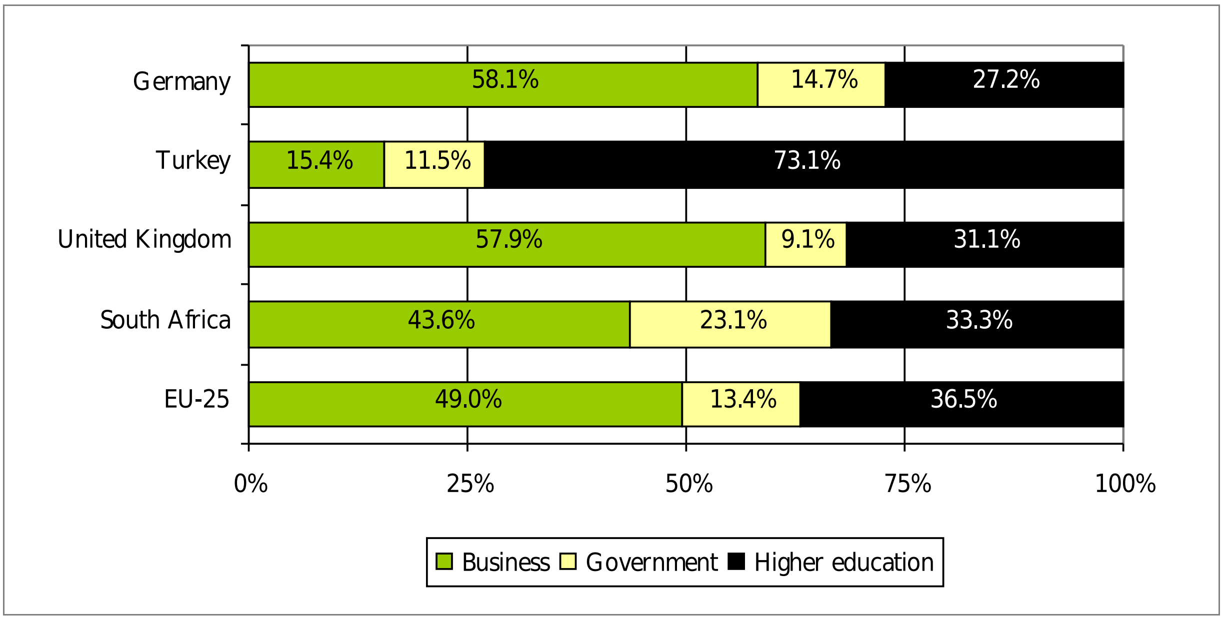
Data sources:
Eurostat (2007b): Germany, Turkey, United Kingdom & EU-25
DST (2005): South Africa
Notes:
Exception to the reference period: Turkey = 2002
Public sector for South Africa includes the higher education, government sectors and science council sectors

Researchers (FTE) per 1 000 of the labour force, 2003



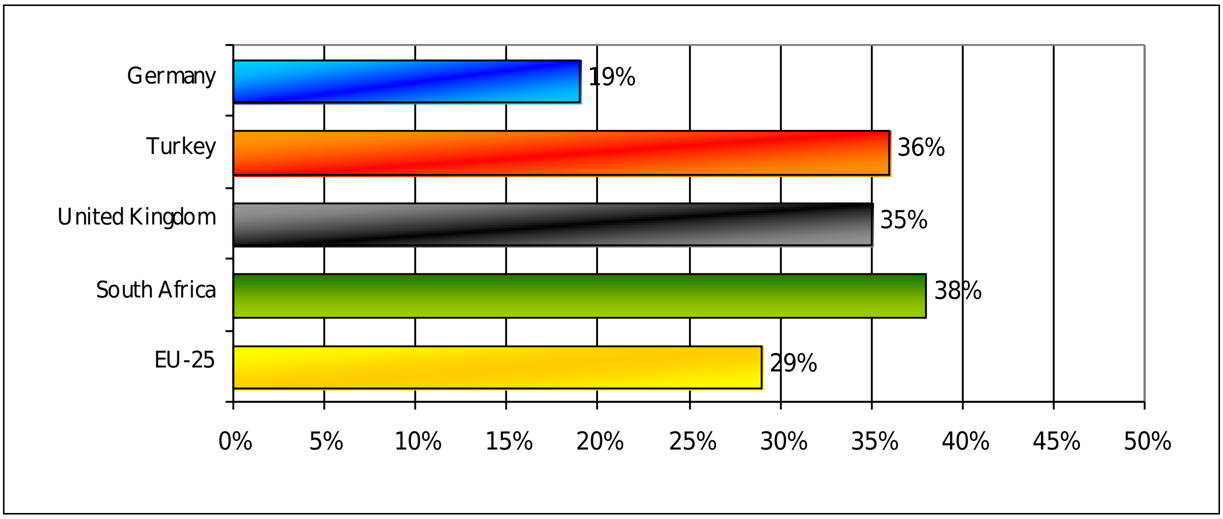
Sources:
EC (2005): Germany, United Kingdom & EU-25
DST (2005): South Africa
Eurostat (2005): FTE researchers for Turkey (= 23 955 in 2002)
http://www.die.gov.tr/english/SONIST/ISGUCU/070303BI.gif: Labour force for Turkey (= 23 995 thousand in 2002)
Note:
Exceptions to the reference period: Turkey = 2002; United Kingdom = 1998

Share of researchers (FTE) by sector, 2003



Sources:
EC (2005): Germany, United Kingdom & EU-25
Eurostat (2005): Turkey
CeSTII (2005): South Africa
Note:
Exceptions to the reference period: Turkey = 2002; United Kingdom = 1998

Women researchers as % of total researchers, 2003



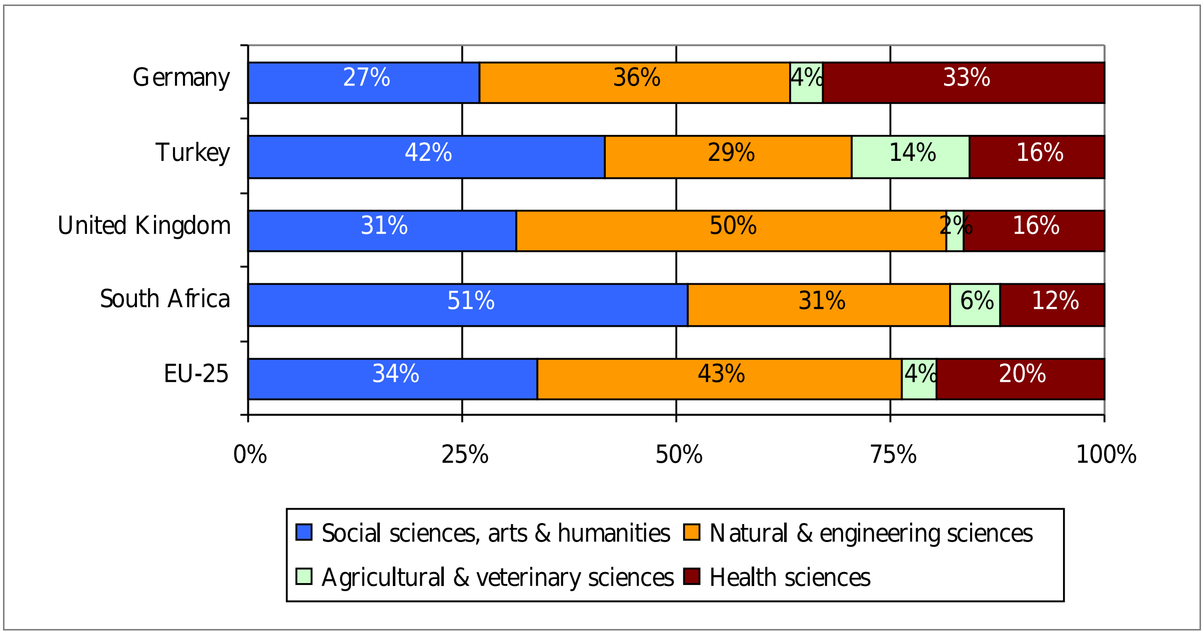
Sources:
EC (2006): Germany, Turkey & EU-25
EC (2003): United Kingdom
DST (2005): South Africa
Note:
Exceptions to the reference period: Turkey = 2002; United Kingdom = 2000

ISCED6 graduates (PhD/doctoral or equivalent) per million of the population, 2003

Country	Number of ISCED6 graduates	Population (in million)	Number of ISCED6 graduates per million population
Germany	23 043	83	278
Turkey	2 815	71	40
United Kingdom	14 935	60	249
South Africa	1 024	46	22
EU-25	88 115	308	286

Sources:
EC (2006): Germany, Turkey, United Kingdom & EU-25
HEMIS: South Africa (HEMIS = Higher Education Management & Information System, National Department of Education)
http://web.worldbank.org: Population figures

ISCED6 graduates (PhD/doctoral or equivalent) by broad scientific field, 2003



Sources:
EC (2006): Germany, Turkey, United Kingdom & EU-25
HEMIS: South Africa (HEMIS = Higher Education Management & Information System, National Department of Education)

ISI publications per million of the population and per FTE researcher, 2003

Country	Number of ISI publications	ISI publications per million population	ISI publications per FTE researcher
Germany	72 318	871	0.27
Turkey	11 183	158	0.49
United Kingdom	68 986	1 150	0.43
South Africa	4 233	92	0.49

Sources:
ISI Web of Knowledge by Thomson Scientific (number of ISI publications)
Eurostat (2003): FTE researchers for the United Kingdom (159 000)
Eurostat (2005): FTE researchers for Germany (264 386) & Turkey (22 702)
DST (2004): FTE researchers for South Africa (8 661)
http://web.worldbank.org: Population figures
Note:
Publications include articles, letters, notes and reviews in the ISI Web of Knowledge by Thomson Scientific
Reference years for FTE researchers are as follows: Germany, Turkey & South Africa (2001) and the United Kingdom (1998)

Patents granted by the USPTO (2000) and EPO (2003), per million of the population

Country	USPTO, 2000 Number of patents	USPTO, 2000 Patents per million population	EPO, 2003 Number patents	EPO, 2003 Patents per million population
Germany	10 509	128	13 429	162
Turkey	12	0.2	8	0.1
United Kingdom	3 050	51	2 679	45
South Africa	111	3	54	1

Sources:
Eurostat (2007a): USPTO patents for Germany, Turkey & United Kingdom
Pouris (2006): USPTO patents for South Africa
http://annual-report.european-patent-office.org/2003: EPO patents for the four countries
http://web.worldbank.org: Population figures for 2000 & 2003

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Eurostat (2007a). *National patent statistics*. Publication 9/2007, compiled by Bernard Félix.
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Pouris, A. (2006). *Quantitative assessment of South Africa's inventive outputs: International patent analysis*. Institute for Technological Innovation, University of Pretoria, South Africa.

RESEARCHING INEQUALITY THROUGH SCIENCE AND TECHNOLOGY (RESIST)

Work Package 2
Supporting sustainable scientific mobility

COUNTRY REPORT ON TURKEY

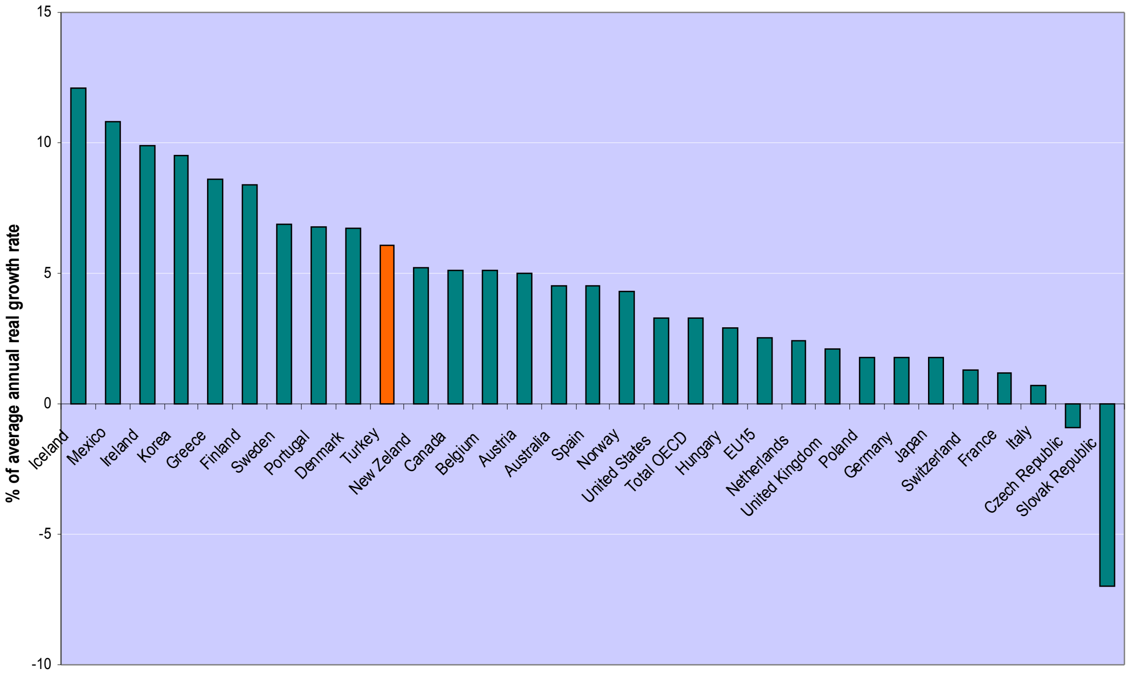
Sirin Elci

1. R&D Country Profile[1]

1.1 Policy Framework

Turkish research policy, which dates back to early sixties, forms an integral part of its national development plans. There is also a well-developed institutional framework, and the policy measures are in place mainly for funding R&D activities. Turkey's R&D intensity increased with an average growth rate of 6.1 percent per annum in real terms between 1991 and 2000 Figure 1). On the other hand, R&D expenditure as percentage of Gross Domestic Products (GDP) remains at a low level (0.67 percent in 2004).

Figure 1: Average annual real growth rate of GERD in OECD countries (1992-2002)

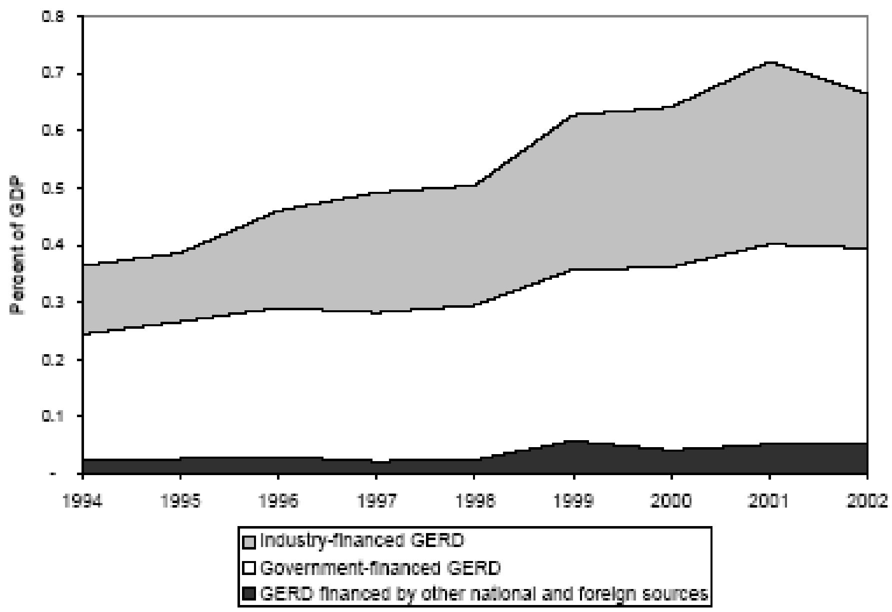


Source: Based on OECD data, MSTI Database

Unlike the most OECD countries, the higher education sector performs a significant proportion of total R&D, and the business sector accounts only for 24 percent of total R&D spending (Figures 2 and 3).

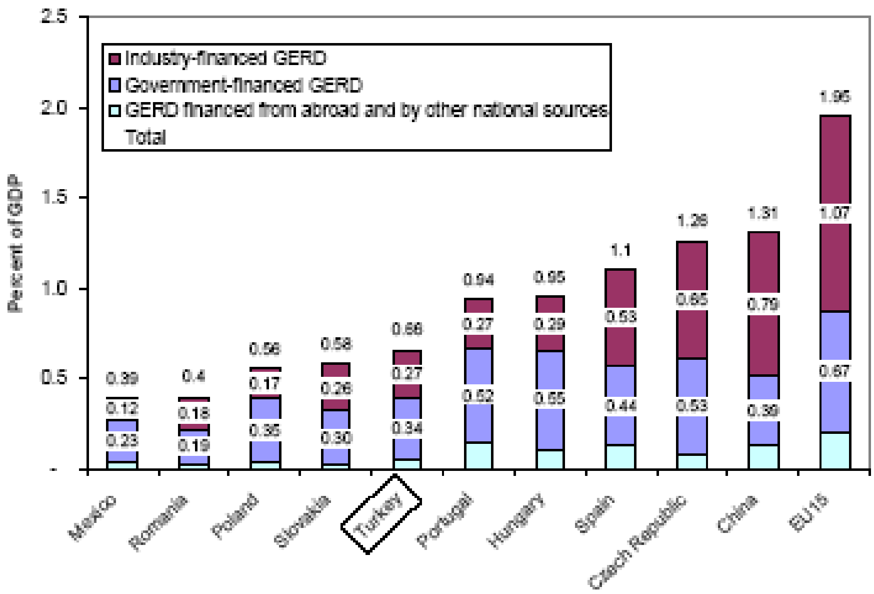
1 This section draws on (a) Elci S. ERAWATCH Research Inventory, Country Profile: Turkey, European Commission, 2006-2007, (b) Elci S. "Turkish S&T Policy between Focus on Research and Innovation" International Conference and High-Level Round Table entitled 'Why Invest in Science in South Eastern Europe?", UNESCO 2006, (c) Elci S, "Annual Innovation Policy Trends and Appraisal Report: Turkey" European Commission, 2006

Figure 2: Gross Expenditures on R&D, trends and composition



Source: OECD

Figure 3: Gross Expenditures on R&D-international comparison



Source: World Bank, OECD

In order to change this scene, the Turkish Government recently committed to increase the R&D investments as important drivers for the creation of a strong economy and improved quality of life. The main objectives of the recent science and technology strategy of Turkey are to increase

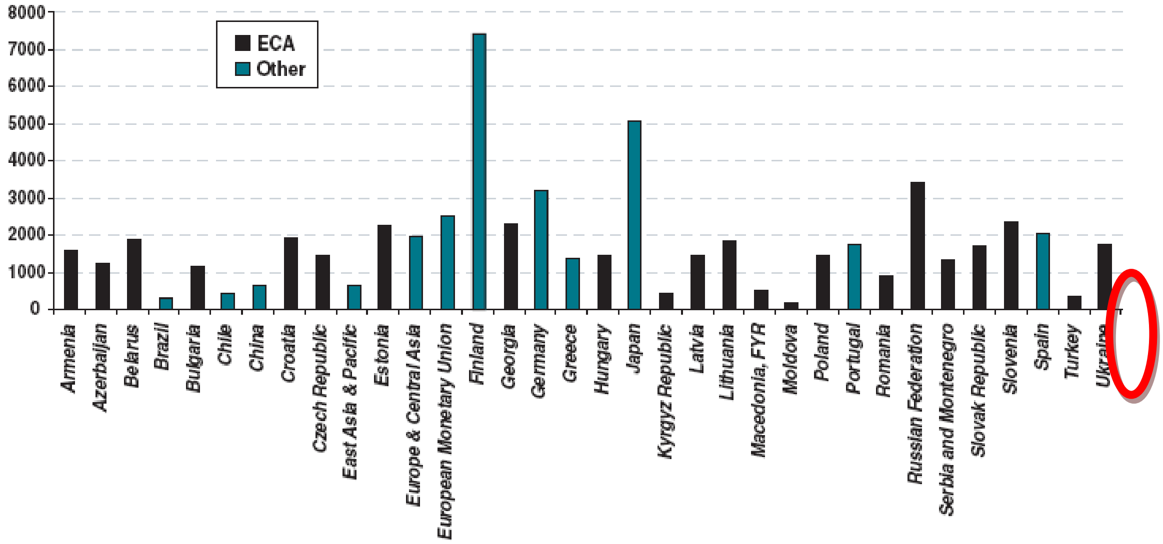
- the demand for R&D,
- the number and quality of scientists, and vocational and technical staff,
- the Gross Domestic Expenditures in R&D (GERD) as a percentage of GDP.

As set by the Government in 2004, the 2010 goal of Turkey in research and development (R&D) is to achieve an R&D intensity (R&D expenditure as percentage of the Gross Domestic Products-GDP) of 2 percent, with half of it financed by the private sector. According to the 2004 figures, Turkey's R&D spending is 0.67 percent of GDP and 37.9 percent of it is financed by the business enterprises. In order to reach the 2 percent target, the Government gradually increases public funds allocated for

R&D activities of the public and private sectors. In line with these developments, the total amount of funds put aside for new and ongoing R&D programmes for the last two years is €1.5 billion while it was €1 billion during the period of 2000-2004.

In 2004, the Government also established the target of increasing the number full-time equivalent researchers to 40,000 by 2010 from 23,995 in 2002. It is expected that the target will be well exceeded since the R&D survey results announced in August 2006 revealed that there were 39,960 full-time equivalent researchers in 2004 due to the change of the definitions for researchers in the OECD Frascati Manual.

Figure 4: Researchers per million of the population, 2002



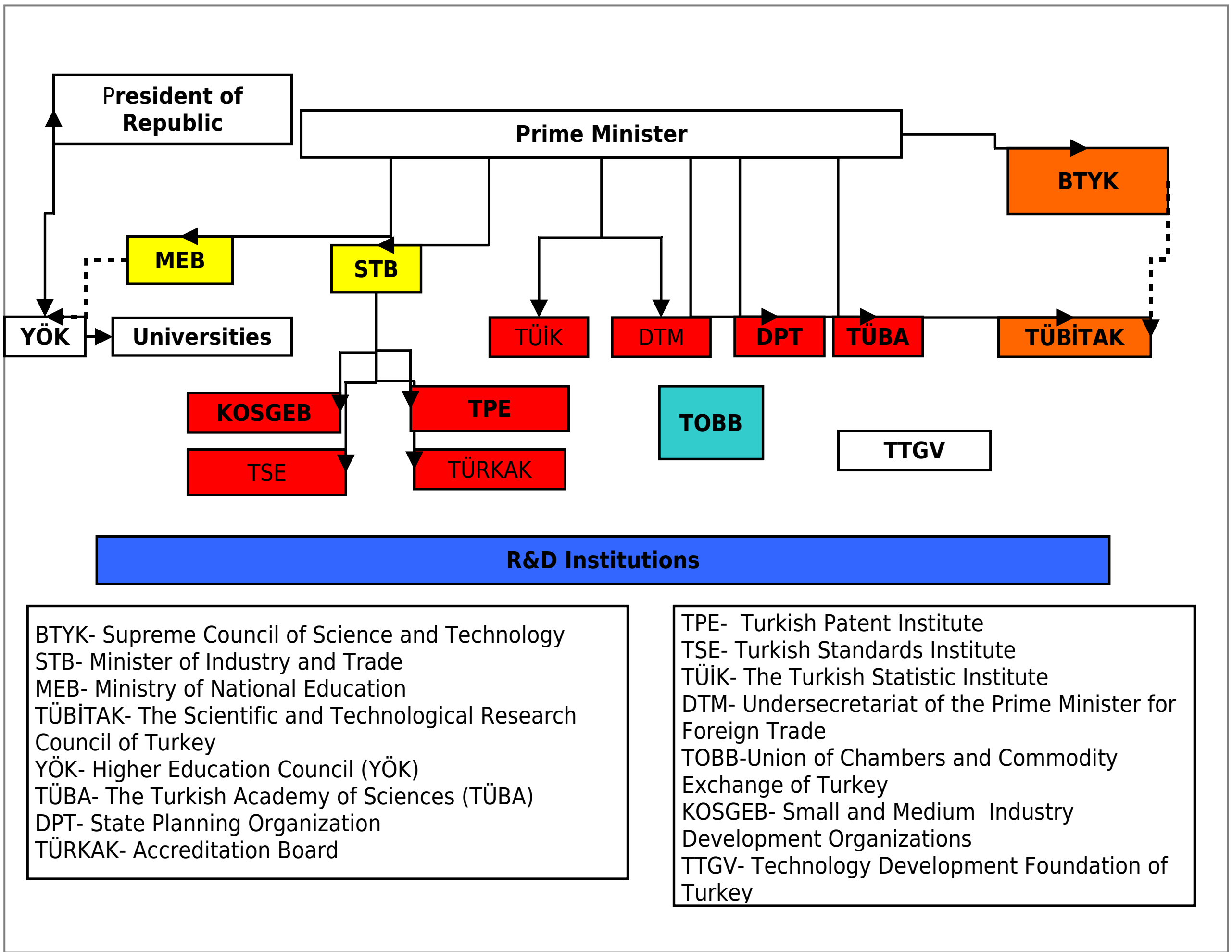
Source: World Development Indicators

Universities are the most important research performers in Turkey. 67.9 percent of the country's R&D spending is performed and 61.9 percent of researchers are employed by universities. There are nearly

100 public research institutes which employ approximately 2000 researchers and account for some 8 percent of total R&D spending. Majority of these institutes work on traditional sectors, such as agriculture (there are 64 R&D centres operating under the Ministry of Agriculture and Rural Affairs) and forestry. The research institutes of the Scientific and Technological Research Council of Turkey (TUBITAK) are among the most active research organisations which work on a variety of technology areas such as information and communication technologies, genetic engineering and biotechnology. The Marmara Research Centre of TUBITAK is the largest research organisation which operates five institutes and hosts a technology park.

From the perspective of governance system, Turkey has long tradition of science and technology policy making (dating back to 1960s) and the well-developed institutional framework at national level (TrendChart report, 'Annual Innovation Policy Trends and Appraisal Report, Turkey, 2004-2005'). The Supreme Council of Science and Technology (BTYK) is the highest level policy co-ordination body for research and innovation. The BTYK is chaired by the Prime Minister and is composed of the related ministers, high level representatives of the government bodies, universities and non-governmental organisations (NGOs). TUBITAK, which is affiliated to the Prime Minister and the secretary to the BTYK, is the institution responsible for designing research and innovation policies as well as developing and managing main research programmes. The State Planning Organisation, Turkish Academy of Sciences, Ministry of Finance, Ministry of National Education and the Council of Higher Education are, inter alia, the main actors of the system (Figure 5).

Figure 5: Organisational chart of the research system[2]



In the design of the research policies a participatory approach has been followed since mid-nineties. A large group of stakeholders from the private and public sectors and NGOs involve in the policy-making process. Current research policies was determined as a result of the Vision 2023 Project carried out between 2002 and 2004 to formulate science and technology strategies of Turkey for the next two decades by achieving the widest participation possible with increased commitment around a shared vision. The backbone of the project was a technology foresight study. In light of the results of the Vision 2023 Project, the BYTK defined the “Turkish Research Area” (TARAL) in 2004 as a platform for the private and public sectors and NGOs to strategically focus and collaborate for R&D (Figure 6). The responsibilities for effective functioning of TARAL and its integration with the European Research Area (ERA) are assigned to TUBITAK by the BTYK.

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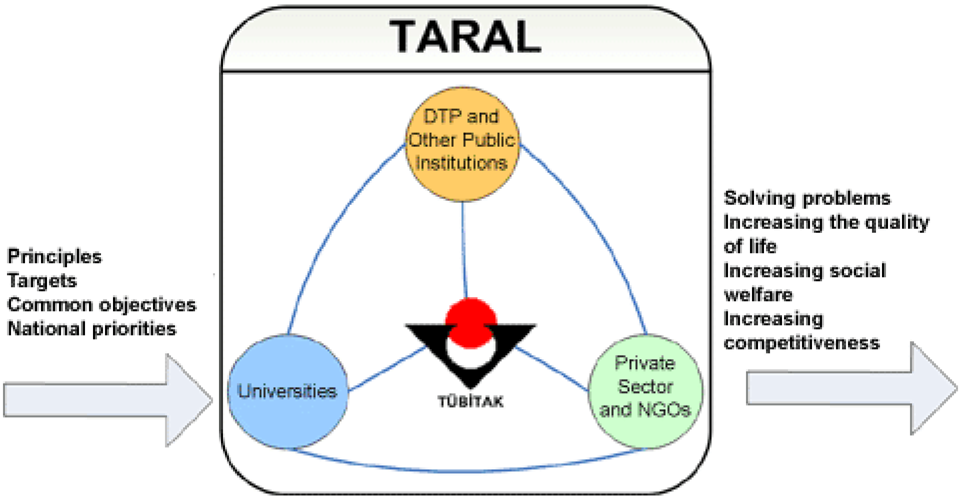
2 Elci S, ERAWATCH Baseload Inventory, European Commission (2006)

Figure 6: TARAL as defined by the BTYK



1.1.1 The Challenges

While above developments are very important and promising for Turkey, investing in research alone is not sufficient when it comes to the solving major and urgent issues facing the country. The most important challenge is unemployment, which stands at around 11 percent. Although the average growth rate over the last four years was the second highest since 1950 (~8 percent), economic growth did not reduce unemployment. What is particularly worrisome is that unemployment rates among young people with higher education degrees are high: More than 38 percent of university graduates between 20 and 24 years of age are unemployed.

The main challenges for Turkey listed in the EC report "Annual Innovation Policy Trends and Appraisal Report: Turkey" are identified on the basis of the fact that the country needs to focus on input innovation drivers and knowledge creation to be able to increase the innovation performance of the private sector.

Increasing investments in human resources for innovation: Turkey needs a further increase in the quantity and quality of tertiary level education to develop human resources for innovation. In spite of the increase in tertiary education enrolment rates in recent years (from 13 percent in 1990-91 to 25 percent in 2002-03) Turkey still ranks last out of the 33 countries covered by the EIS. In addition, according to the World Bank Country Economic Memorandum[3], while the enrolment ratio in science and engineering schools is high in Turkey (and above its main competitors), Turkish business executives and entrepreneurs consider the quality of science and engineering schools as rather low.

Recognising this challenge, the government has taken steps to improve the education system (for example, by integrating innovation in the national curricula for compulsory school education (requiring each pupil to attend school for at least eight years) and by designing a new measure to support masters and doctorate theses prepared by university students in line with the needs of the industry). Further steps are needed, particularly at the tertiary level to increase the number of universities and the number of students and to upgrade the curricula according to the needs of the business community.

Enhancing university-industry co-operation: Establishing strong linkages between the private sector and the research community is critical for Turkey as most R&D is performed by universities (universities account for 58.9 percent of the country's R&D expenditure, employ 73.2 percent of researchers and produce a high level of scientific output which is not transformed into innovation).

3 World Bank, Turkey: Country Economic Memorandum (2006) Promoting Sustained Growth and Convergence with the European Union

The government addresses this challenge with the following measures:

- Establishment of Technology Development Centres (TEKMERs) in order to create favourable environments for the start-up of innovation companies within universities
- University-Industry Joint Research Programme (USAMP) to facilitate the university -industry collaboration for research and innovation,
- Support for the establishment of technology parks (the Law on Technology Development Zones) to provide incentives for R&D activities of companies located in techno-parks within universities and research institutes.

Although these measures have been useful in addressing the challenge, much remains to be done in this area. It is crucial to increase the number and quality of intermediaries to improve communication and co-operation between the private sector and academia; to revise university regulations and legislation to encourage collaboration; and to provide incentives to raise the demand from industry. In addition, initiatives are needed for cluster development and networking among firms, and between firms and the research community.

Increasing innovation activities of the private sector: The levels of investment in innovation and R&D by the private sector are very low in Turkey, thus making it difficult for Turkey to create and maintain a competitive advantage. The government has financed R&D and innovation since the beginning of the 1990s through various schemes such as the Technology Research and Development Support programme and New Entrepreneur Support initiative, implemented by the Small and Medium Industry Development Organisation (KOSGEB). The State Support for R&D programme (providing grants via the Technology and Innovation Support Programmes Directorate of the Scientific and Technological Research Council of Turkey (TUBITAK-TEYDEB)), and loans by the Technology Development Foundation of Turkey (TTGV) are also relevant measures. There are also indirect schemes such as the R&D Tax Exemption by the Ministry of Finance and tax incentives provided for by the Law on Technology Development Zones).

Private finance for innovation is also very limited: there are only three venture capital companies two of which were established by major banks (Vakif Girisim, Is Girisim and KOBI Girisim) and no business angels networks.

Although above measures have been instrumental in stimulating investment in R&D and innovation, they are far from meeting the demand or even from having a substantial effect. Responding this challenge requires a wide variety of actions, ranging from awareness raising in the private sector to other forms of innovation support. In addition, the results of many evaluations show that there is a need for reviewing and revising existing innovation policy measures in order to better respond to the needs of the private sector and to make them more user-friendly.

National Science and Technology Performance and Targets for 2010:

Indicator	Present performance*	Target for 2010
Gross domestic expenditure of R&D (GERD) as a percentage of GDP (%)	0.67	2
GERD per capita (US$, PPS)	51.4	124
Number of total researchers (fulltime equivalent)	33,876	40,000
Number of researchers per thousand employed	1.6	2.3
Business expenditure on R&D (BERD) as a percentage of GERD (%)	24.2	50
Public expenditure on R&D as a percentage of GERD (%)	8	12
Higher education expenditure on R&D as a percentage of GERD (%)	67.9	38
Number of Triadic Patents	7	100
Number of scientific publication per million population	200	400
Number of science citation per million population	60	150
SMEs innovating in-house (% of all SMEs)	24.6	40
SMEs involved in innovation co-operation (% of all SMEs)	18	20
Sales of ‘new to market’ products (% of total turnover)	9.4	10
Share of manufacturing value-added in high-tech sectors	6.6	10
Tertiary-type A education graduates participating in workforce (men) (%)	83	90
Tertiary-type A education graduates participating in workforce (women) (%)	65	80
Competitiveness ranking	48	35
Global competitiveness index raking: infrastructure	51	45
Competitiveness ranking: Legal environment influencing scientific research	41	35

Universities as Research Performers[4]:
Universities are the largest research and development (R&D) performers in Turkey (64.3 percent of total R&D expenditures in 2002). The amount of funds allocated between 2000 and 2006 for university research is about €795 million (personnel costs of research are not included in this amount because of the funding mechanisms). There is a remarkable increase in the amounts allocated from €34 million in 2000 to €221 million in 2006.

Important activities of higher education institutions (i.e., planning, organization, governance, instruction and research) are steered by the Council of Higher Education (YOK) which is a constitutional body reporting to the President of the Republic. The Inter-universities Council is responsible for the coordination and evaluation of the research activities of universities and advising to YOK on the subject.

Public Research Organisations:
In Turkey, there are more than 100 public research institutions with around 2000 researchers. Most of them work on agriculture and forestry and are distributed all around the country. The share of public research in total R&D expenditures is 8 percent.

The most active public research institutes are those established by the Scientific and Technological Research Council of Turkey (TUBITAK): Marmara Research Centre (MAM), Space Technologies Research

[4] Elci S. ERAWATCH Research Inventory, Country Profile: Turkey, European Commission, 2006-2007

Institute (UZAY), Defence Industries Research and Development Institute (SAGE), National Electronics and Cryptology Research Institute (UEKAE), Basic Sciences Research Institute (TBAE), Genetic Engineering & Biotechnology Research Institute (GMBAE), and Advanced Agricultural Technologies Research and Development Institute (CITTAGE).

TUBITAK-MAM is the largest public research centre. There are six institutes in the centre, namely Information Technologies Research Institute, Energy Systems & Environmental Research Institute, Materials Institute, Chemistry and Environment Institute, Food Science & Technology Research Institute and Earth & Marine Sciences Research Institute. MAM also runs a technopark.

The General Directorate for Agricultural Research (TAGEM), which is affiliated to the Ministry of Agriculture and Rural Affairs, is also one of the biggest public research organisations having seven central and nine regional research institutes, and 34 thematic research institutes.

Another important public organisation related with research is the Atomic Energy Council of Turkey (TAEK). Research activities of TAEK are carried out in Saraykoy Nuclear Research and Training Centre (SANAEM) and Cekmece Nuclear Research Centre (CNAEM).

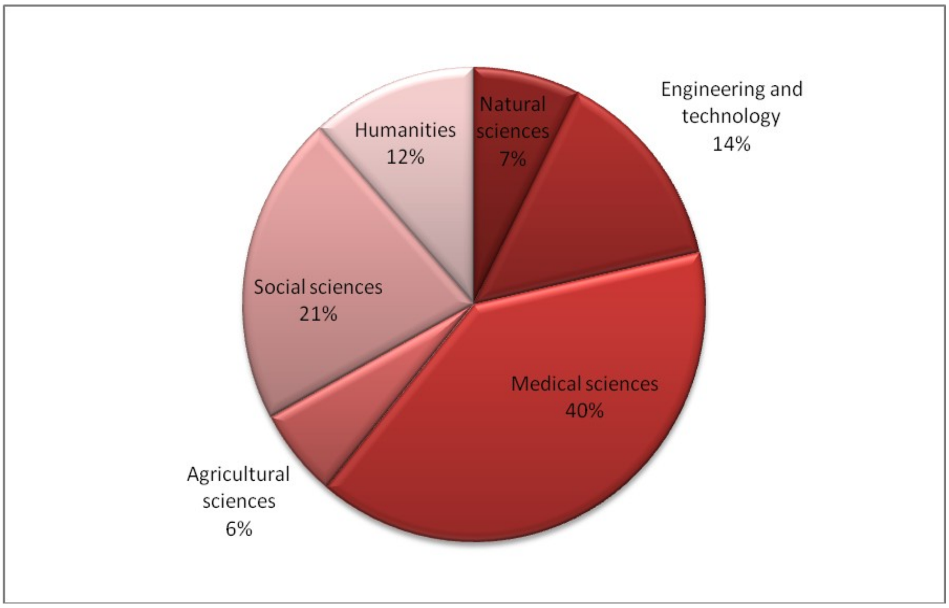
Private Research Performers:
According to the results of the 2004 R&D survey, the private sector employs 8,836 full-time equivalent R&D personnel (24 percent female) with 5,372 classified as researchers, 2,434 as technicians and 1,029 as support personnel. 21 percent of the R&D personnel have graduate degrees and 46 percent have undergraduate degrees. The manufacturing industry employs 79 percent of the private R&D personnel in the country.

2. Field Overview

Since the research being conducted by the Turkish team is not field specific, this section provides information on all fields.

There is not any data available on R&D expenditures in science and engineering fields for all sectors in Turkey. The following chart provides the breakdown of higher education expenditure on R&D by scientific fields.

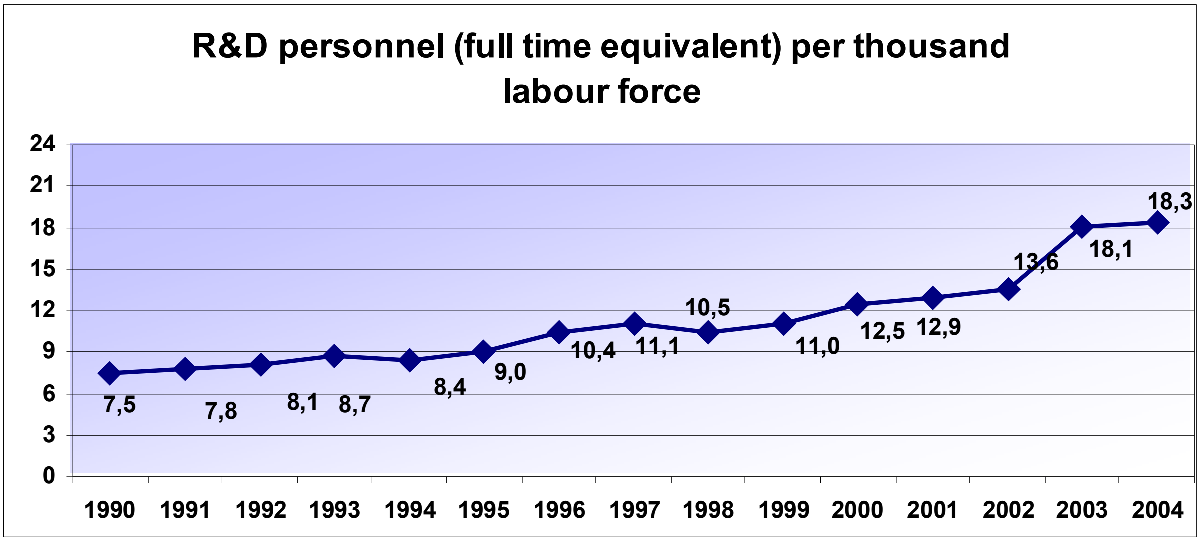
Figure 6: Higher education expenditure on R&D by field of science



Source: TURKSTAT, 2006

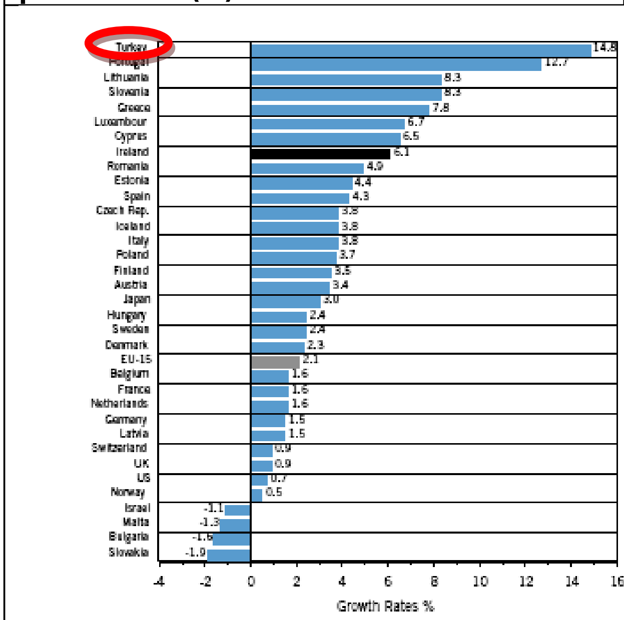
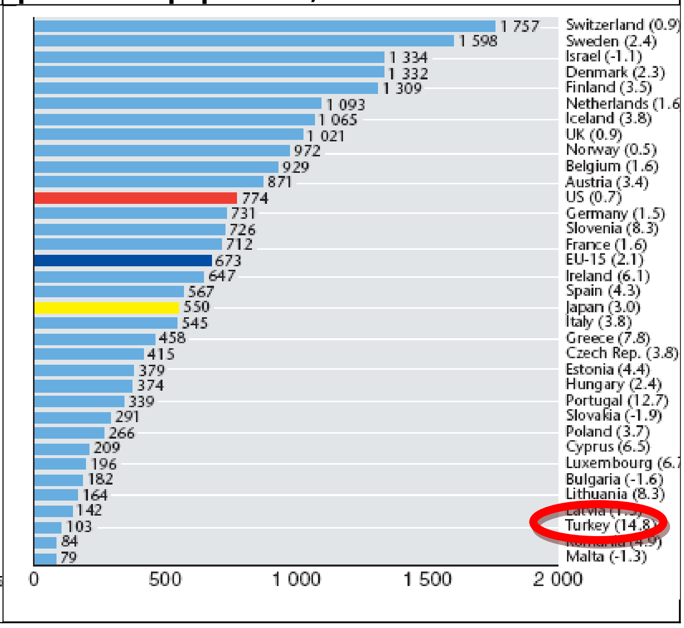
There is a gradual increase in the R&D personnel (full time equivalent) per thousand labour force since 1990 as seen below.

Figure 7: R&D personnel per 1000 labour force



Source: TURKSTAT, 2006

Since the number of scientific publications is the main criterion for the promotion of an academic, the scientific output by Turkish researchers significantly increased since mid 90ies (Figures 8 and 9). The number of publications by scientists in Turkey increased from 2,333 in 1995 to 17,717 in 2005 and Turkey's world ranking accordingly improved from 34th to 19th.

Figure 8. Growth rates of scientific publications (%) 1995-2002	**Figure 9. The number of scientific publications per million population, 2002**
	

The following table shows relative specialisation of Turkey and other countries in six main science and technology fields. As indicated in the table Turkey is active in engineering. It is argued that one reason
for the rather strong activity in engineering might be the fact that Turkey is a preferred co-publication partner of US scientists.[5] The five main co-publication partners of Turkish researchers are the UK, US, Israel, Japan
and Germany.

[5] European Commission, "Towards a European Research Area Science, Technology and Innovation", 2003

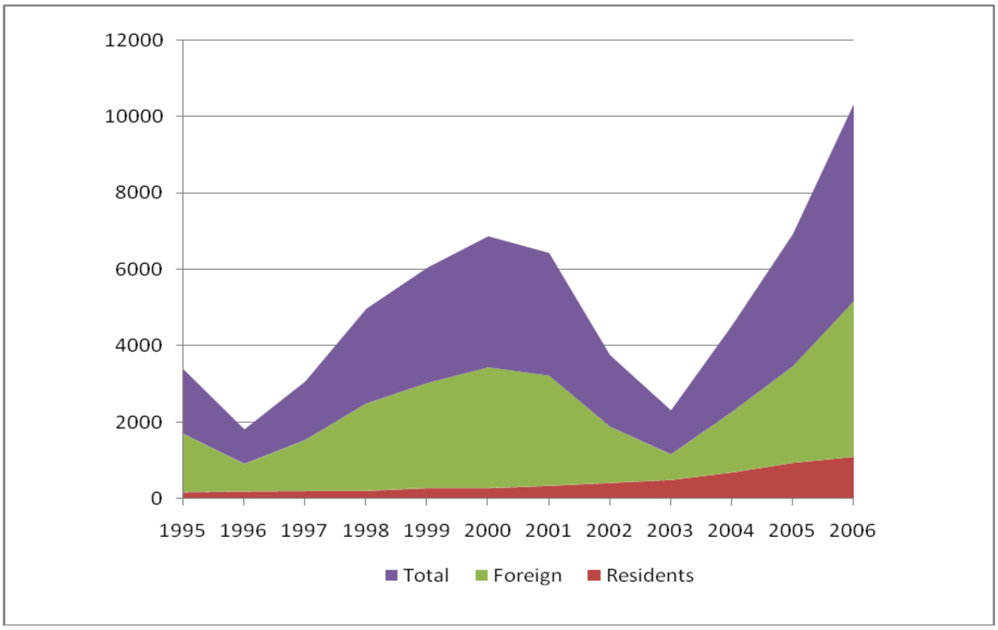
Figure 10: Relative Activity Index (RAI) (1996-1999)

	Engine-eering	Physics, Astrophysics & Astronomy	Mathe-matics, Statistics& Computer Sciences	Chemistry	Earth & Environm. Sciences	Life Sciences
Greece	+		+		+	
Poland		+		+		
Bulgaria		+		+		
Latvia		+		+		
Italy		+				
Slovenia	+			+		
Cyprus						
Turkey	+					
Germany		+		+		
Russia		+		+		
Estonia		+			+	
Slovakia				+		
Spain				+		
Czech Republic				+		
France						
Japan			+			
Israel						
UK						
US						
Austria						
Switzerland						
Denmark					+	
Belgium						
Norway					+	+
Ireland						
Iceland					+	+
Finland						+
Sweden						+

Source: EC

The number of patent applications by residents is quite low (figure 11) and there is a slight increase in the number of patent registration by residents from 58 in 1995 to 95 in 2005.

Figure 11: Number of Patent Applications by Year, 1995-2006



Source: Turkish Patent Institute

Turkish researchers are producing low number of patents in relation to the size of its population at both European and US patent offices (Figure 12 and 13).

Figure 12. Patent applications at the EPO per million population, 2000-in brackets: growth (%) 1995-2000

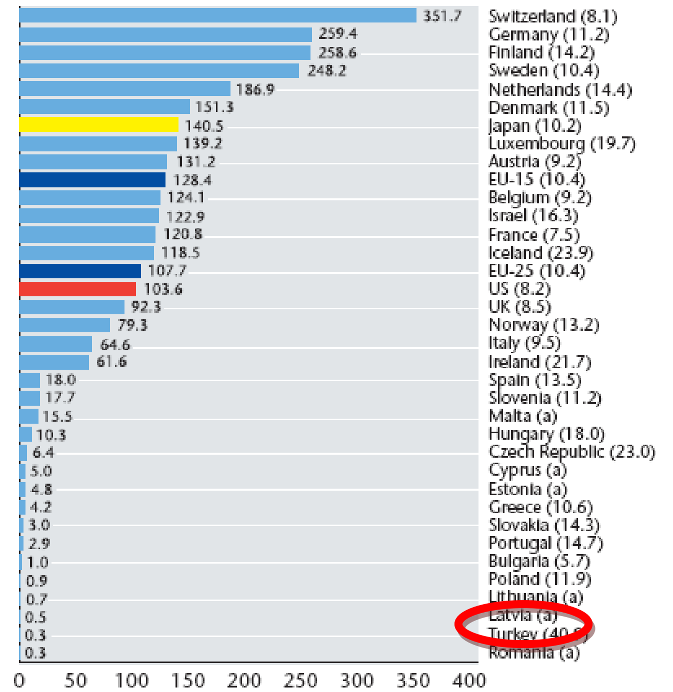
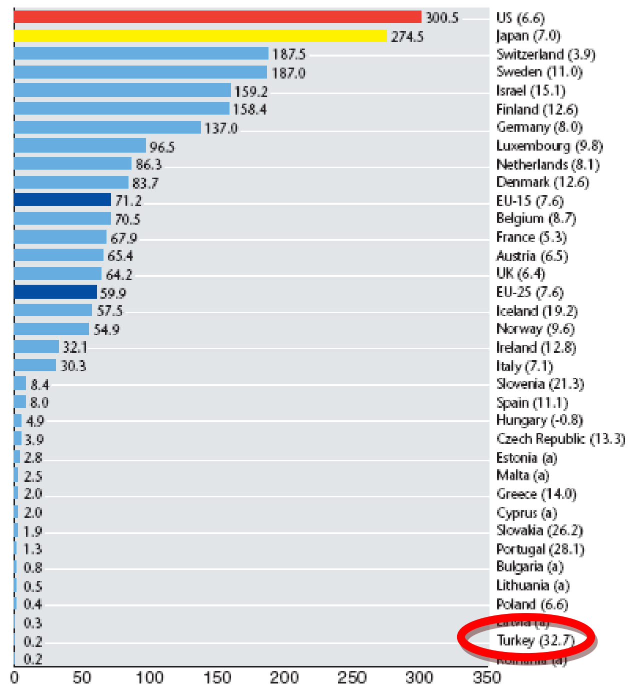


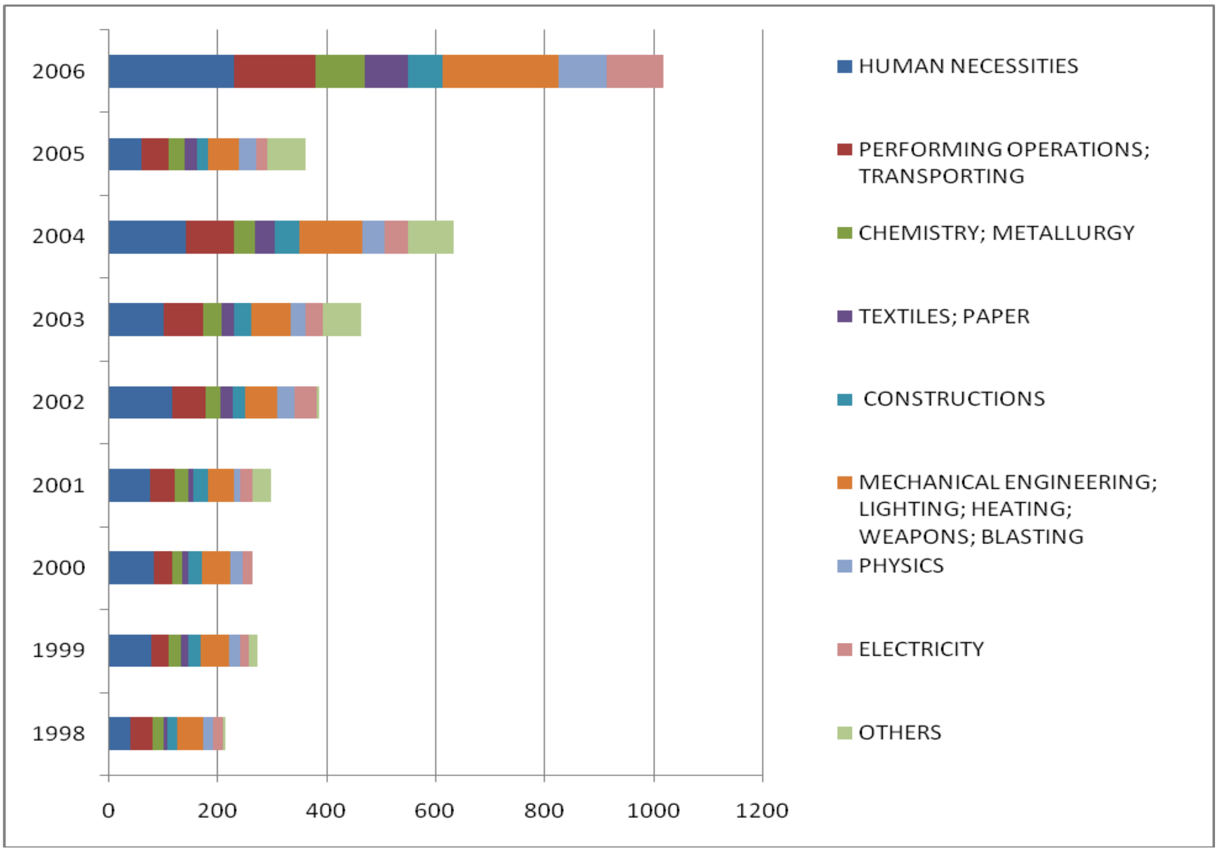
Figure 13. Patents granted at the US Patent Office -per million population, 2002-in brackets: growth (%) 1995-2002



Source: EC

The breakdown of resident patent applications by international patent classification verifies the specialisation of Turkey in engineering fields.

Figure 14: Breakdown of resident patent applications by IPC, 1998-2006



2.1 Training and Supply

There were 83 universities in Turkey 25 of which are non-profit private and 58 state universities. A bill accepted by the Parliament has paved the way for 32 new state universities to become effective soon.

In the academic year 2005- 2006, universities had a total of 2,309,918 students studying at different levels. The table below gives a breakdown of students according to the educational level.

Student Breakdown According to Educational Level-Academic year 2005 – 2006

Levels	Total	Women	Men
Undergraduate	1 306 459	571 258	735 201
Graduate	144 317	59 642	84 675
Masters	111 814	46 835	64 979
Doctorates	32 503	12 807	19 626
Medical Interns	10 431	4 547	5 884

Source: www.osym.gov.tr

It must, however, be pointed out that out of 1,306,459 undergraduates 573,319 students are "open university" students which have to be treated in a different category.

In depicting training and supply of brain-pool which at the same time can be regarded as research-pool the number of teaching staff at the universities are also crucial in getting the full picture.

University Staff in 2005 – 2006 Academic Year

Titles	Total	Women	Men
Professor	11 668	3 1741	5 527
Assoc. Prof.	5 556	1 806	3750
Assistant Prof.	14 871	4 838	10 033
Instructor	12 927	5 271	7 656
Research Assistant	28 749	12 916	15 839
Specialist	2 373	1 075	1 298

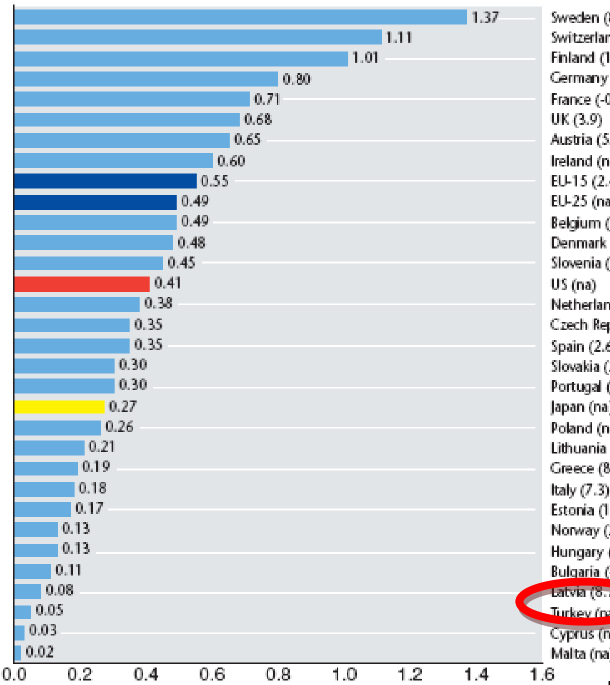
Source: www.osym.gov.tr

There are some encouraging developments with regards to graduate students and research assistants. In both, the gender differences are diminishing sharply as more women enter into the supply market and secondly, demand for both masters and doctorates is on the rising.

With respect to the field specialization, Turkey has a relatively large share of engineering graduates (17%) and one quarter graduated in science and engineering fields of study according to the International Standard Classification of Education (first stage of tertiary education –not leading to an advanced research qualification- and second stage of tertiary education-leading to an advanced research qualification). With regard to the new PhDs in science and engineering fields of study per 1000 population, which provides insight into the production of the human resources qualified for occupation as researchers, Turkey lags behind most of the European countries.

Figure 15. University graduates (ISCED 5 and 6) (2001)	**Figure 16. New PhDs in S&E fields of study per thousand population aged 25-34, 2001**

	Graduates by field of study in %				Number of graduates		
	Science	Engine-ering	Health and food	Soc/ hum/ educ	All fields of study	In S&E fields of study	Tota grow rates i 1998-20
Belgium	8	11	16	57	70 202	13 239	:
Denmark	8	14	13	47	39 017	8 456	40
Germany	9	17	24	40	296 640	76 617	-17
Spain	11	16	13	54	277 853	74 312	41
France	15	15	7	57	508 189	154 756	4
Ireland	19	12	8	49	45 818	14 038	8
Italy	8	15	19	57	202 309	46 590	7
Luxembourg	11	4	:	79	680	99	27
Netherlands	5	10	16	58	81 603	12 664	-7
Austria	7	21	12	56	27 099	7 423	-16
Portugal	5	12	17	60	61 136	10 257	:
Finland	8	20	21	41	36 141	10 104	-1
Sweden	10	22	19	43	42 741	13 702	51
UK	17	11	17	52	551 665	150 865	24
EU-15 (³)	12	14	15	52	2 241 093	593 122	14
Cyprus	6	6	11	56	2 813	336	:
Czech Rep.	10	11	13	51	43 629	9 586	28
Estonia	6	12	9	64	7 600	1 379	123
Hungary	2	10	9	73	57 882	5 820	-28
Lithuania	5	21	11	57	27 471	7 025	49
Latvia	5	7	2	82	20 308	2 473	22
Malta	4	5	14	75	2 003	186	:
Poland	3	7	3	56	431 104	44 842	80
Slovenia	4	17	12	61	11 991	2 432	5
Slovakia	9	17	13	49	26 272	6 733	83
EU-25 (³)	11	13	13	54	2 872 166	675 313	18
Bulgaria	4	15	8	66	47 504	9 117	36
Romania	6	18	11	59	76 230	18 365	13
Turkey	8	17	10	46	241 464	61 467	:
Iceland	14	5	11	69	2 066	393	39
Norway	8	8	20	53	32 092	5 161	9
US	9	8	13	53	2 150 954	369 391	6
Japan	3	19	12	49	1 067 878	233 386	-1

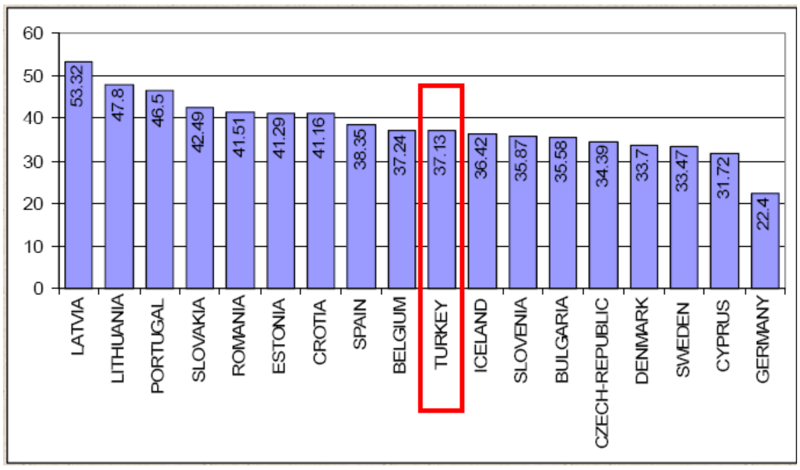


Source: EC

As also noted above, women have a high representation in higher education sector in Turkey. The share of women researchers is 37.13 percent higher than the European average which is around 30 percent.

The share increased on an average between 1998 and 2001 by 2.3 percent similar to the EU average and the US.

Figure 17. Percentage of women researchers in higher education

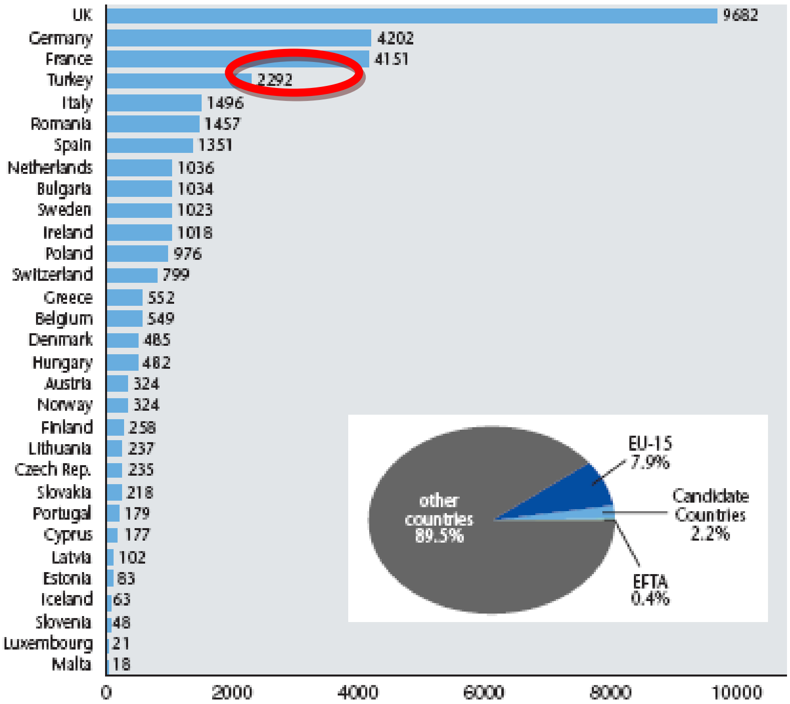


Source: www.abgs.gov.tr

There is limited information on the foreign students in Turkey. The number of foreign students was 16,656 in 2001. The top countries or regions with highest number of students in Turkey were Asia, Azerbaijan, Turkmenistan, Kazakhstan, Russia, Kyrgyzstan, Bulgaria and Albania.

Turkish researchers mainly migrate to the US which is also the main destination of PhD students, followed by the UK and Germany (figure 19). As shown in below figure 18, the H-1B visa beneficiaries (a non-immigrant classification, which permits US employers to bring in foreign skilled workers on a temporary basis (maximum 6 years)) are high in Turkey.

Figure 18: H-1B visa beneficiaries by country of birth, 2001



Source: EC

Figure 19: Turkish Graduate Students Studying Abroad-Distribution of PhD Students (by country)

Years	1987	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	TOTAL
USA	67	138	55	68	67	60	745	64	169	85	40	56	50	47	32	53	41	1835
UNITED KINGDOM	38	208	112	127	110	74	446	52	93	57	17	21	8	9	10	11	8	1401
GERMANY	7	17	4	13	13	13	44	2	11	5	5	1	7	2			1	145
FRANCE	5	12	7	4	8	3	13	5	9	2	3	9	8	2	1	4	9	104
CANADA	24	17	3	3		2	6	1		4	1	3	3	1	3	1	1	73
AUSTRIA	2	2	1	3	3	2	3		1	1	1	1	1			1		22
AUSTRALIA						1	14	1		1	1							18
SWITZERLAND	6	1	2	3	1	1	2								2			18
NETHERLAND		1		2	1		3	1	1	1			1	1	1	2	1	16
JAPAN				2	1		1	3	1		1	1						10
RUSSIA					3		2			2				1	1		1	10
OTHERS (18 Countries)	0	3	3	3	1	3	3	2	0	4	7	5	2	0	3	1	2	42
TOTAL	149	389	187	226	208	159	1282	131	285	162	76	97	80	63	53	73	64	3694

Source: www.abgs.gov.tr

2.2 Labour Market

The rising trend both for masters and doctorates could be taken as an indication of the fierce competition in the labour market for high- skilled high-waged jobs. Steady growth of economy in the last five years has, no doubt, opened new employment possibilities, but not large enough to accommodate the rising supply. Consequently, Turkey faces loss of high quality brain-force (undergraduates, graduates and senior researchers) due to lack of sound home-generated demand both public and private. This emanates from two sources: i) lack of enough resources for R&D in general and ii) low wages due to large pool of brain-supply. Low wages seem to be one of the most serious push factors in driving young researchers abroad.

Following a major economic crises real earnings fell sharply between 1994 and 2002. From 1994 to 2002 mean monthly earnings fell by 12.2 percent for university graduates[6]. Although the first jobs found abroad may not offer impressively high wages, it is expected that they will pave the way towards it. In seeking more promising jobs abroad the US and EU countries take the top priority. Here “English” becomes to be the determining element in choosing the place of destination. In the last decade, however, EU R&D institutions have been rather flexible languagewise and managed to attract a good number of young researchers.

The basic characteristics of the Turkish labour market can be summarised as supply dramatically outgrowing demand. Indeed from 1980 to 2004 the working age population grew by 23 million as opposed to growth in employment by only 6 million. This in effect means that the employment rate, which was 43.7 percent in 2004, is one of the lowest in the world (the EU-15 average for the same year being 65 percent)[6].

The case for educated young people is even more serious. As shown in the table below the young graduates face a grave situation when they enter into the market. Although there seems to be a sharp fall for the age group 25-29, 14.8 percent unemployment rate is still very high. This along with other factors analysed above, have contributed towards the brain-drain of the young Turkish graduates. New employment generating policies have to be developed if the trend is to be reversed.

Unemployment Rates According to the Education Level

Age group	Illiterates	No diploma	Primary	Secondary	Tertiary
15-19	18.0	27.7	13.7	29.5	0.0
20-24	17.0	37.5	16.1	23.4	38.5
25-29	16.3	14.8	12.2	12.2	14.8
30-34	13.3	16.7	10.3	7.1	5.3
35-39	11.4	16.7	8.1	5.4	4.1
40-49	7.5	9.5	7.8	4.6	2.5
50-59	5.0	4.9	5.9	5.7	2.2
60+	1.6	1.5	1.4	4.0	0.0

Source: TURKSTAT, 2006

The issue at stake here is how to enlarge the demand side of the market. As it is the largest demand is provided by the higher education institutions and will remain so. With 32 new universities in the pipeline it is expected that demand for academic researchers will expand in great numbers.

While there are not up to date data on the sectoral supply and demand for skilled human resources, the following table provides information on skills shortages and surpluses.

6 World Bank, 2006, Labour Market Study

Supply and demand projections for skilled human resources in key sectors

Sector	Supply in 2000	Demand in 2000	Supply in 2005	Demand in 2005
Architecture	28,800	25,100	33,100	32,400
Civil Engineers	43,900	37,100	50,200	45,900
Mechanical Engineers	44,300	44,700	52,100	56,300
Industrial Engineers	12,400	12,400	17,600	18,800
Electr.&electronics Eng.	32,400	30,900	39,700	43,000
Computer Engineers	6,800	9,200	12,500	16,600
Chemical Engineers	19,100	17,400	20,500	21,500
Mining and Petr. Eng.	8,700	7,400	10,600	9,800
Metallurgy Eng.	4,600	2,900	5,900	3,800
Geology and geophy. Eng.	14,000	10,000	17,500	13,000
Geodesy Engineers	6,700	6,200	8,300	8,400
Environmental Eng.	5,500	5,500	9,100	9,500
Agricult.&forestry Eng.	62,200	38,100	73,000	49,100

Source: State Planning Organisation, 2000

2.2.1 Human resource strategies to address shortages

Turkey ranks the 24th among 32 countries with the highest share of brain drain. It is estimated that there are more than 50,000 undergraduate and graduate Turkish students studying abroad. The majority of Turkish students study in Germany and the USA (24,000 and 15,000, respectively). 59 percent of those studying abroad do not return to the country[7].

There are not any direct measures to encourage return of skilled researchers. The Supreme Council of Science and Technology (BTYK) discussed, for the first time, at its meeting on 7 March 2007 the need for developing measures to reverse brain drain. In the analysis provided in the BTYK Decisions, the following programmes are listed as those help to prevent and reverse brain drain:

- The employment priority given to researchers with a PhD degree by TUBITAK head office and its institutes. Encouragement of existing staff to attend masters and PhD programmes.
- 100 percent grant support for the wages of project staff with PhD degrees provided to the companies with projects supported by the TUBITAK's Technology and Innovation Support Programmes Directorate.
- Support provided to the young entrepreneurs to start up their technology and innovation-based companies.
- "Evrana" programme to recruit foreign experts for research projects funded by TUBITAK through the national resources.
- "Visiting Scientist Support Programme" to encourage universities, public and private organisations to hire foreign scientists.
- "Career Programme" to support the research projects of young scientists who have just earned their PhD degrees.
- Scientist exchange support through bilateral agreements with many countries including the US, Japan and Europe.
- Support to scientists who work for the research institutes in the countries outside the European Union and initiates research projects with Turkish institutes.
- Scholarship and support provided to foreign scientists to conduct research in Turkey both during their PhD studies and after PhD.
- Scholarship given to the highly successful students, who are attending the last semester of their BS programme, for their MS and PhD studies at a local university.
- Scholarship given to students who rank in the top 5000 at the university entry exams for their entire undergraduate and graduate life.
- Support to scientists, who earned their PhD degree abroad, to carry out research activities in Turkish universities.

7 ATO (Ankara Chamber of Commerce) (2004) 'Türk Beyin Gurbetçileri' (Turkish Brain Migration)

Above measures are implemented by the Scientist Development Directorate of TUBITAK. With the increased level of public funds for R&D, the number of scientists supported was increased remarkably as shown in below figures.

Figure 20. The number of scientist supported through public funds

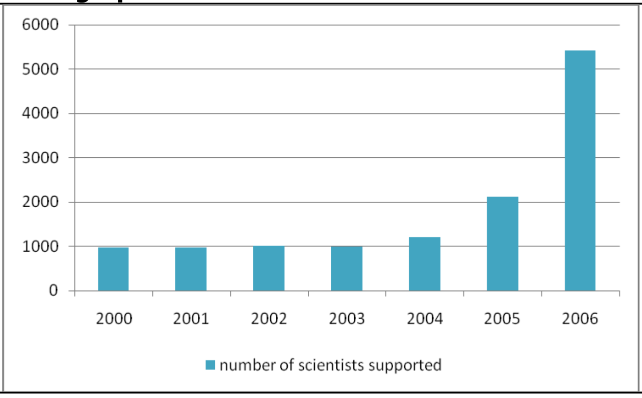
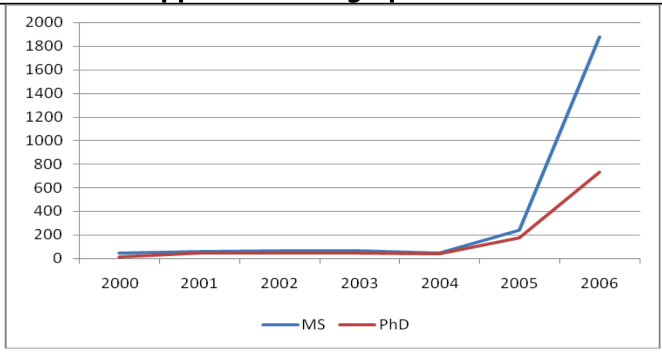


Figure 21. The number of masters and doctorate students supported through public funds



Source: TUBITAK, 2007

The following actions were proposed to be taken at the above-mentioned BTYK meeting:

- Increasing the wages of scientists to a satisfactory level for returned scientists.
- Employing scientists, who earned their PhD degrees abroad, by local universities and research institutes.
- Continuing to increase the investments in R&D and to encourage the university-industry collaboration for technology development.
- Removing red tape in the employment of foreign researchers.
- Encouraging the staff exchange between the local and international universities and research centres.

Apart from the measures implemented by TUBITAK[8],

- Article 34 of Higher Education Law sets the provision to invite international visiting faculty/researchers with the objectives of meeting the demand for international experts in the emerging fields and promoting the dissemination of knowledge and creating synergy. However, there are certain constraints and obstacles limiting the mobility.
- Sabbatical leaves abroad are regulated by the Article 39 of Higher Education Law to allow academic staff to spend one year abroad on leave with payment from their university after the completion of 6 years of service. After the completion of sabbatical leave, an additional year of absence without pay can be taken.
- Since the establishment of the Republic of Turkey, researchers have been granted with scholarships to participate in research activities abroad. Major funding organisations include the Ministries, Higher Education Council, TUBITAK, NGOs and international organisations. The objectives are to provide further education for young academicians/researchers at the universities, and to help development of human resources for industry and public sector.

- Starting from MEDCAMPUS projects (1990's) mobility and interaction between Turkish and European researchers have tremendously increased. Turkey participates in various mobility programmes of the EU.
- Inspired by the European Research Area (ERA), 14 universities from 6 countries agreed upon a protocol to institutionalise the Eurasian Research Area (EaRA) in September 2003. Objectives are to integrate the individual research efforts in the region in order to create synergy (Integrated Eurasian Projects), and to contribute to the Human Resource Development of the universities in the region (Eurasian Faculty Development Programme).

[8] Screening Chapter 25 Science and Research-Agenda Item 4: Specific Research Actions-Mobility (2005)

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3. Conclusions

Supporting researchers is a priority of the Turkish Government. In fact, “increasing the number and quality of scientists” is one of the three main objectives set in 2004 by the Supreme Council of Science and Technology, the highest level policy making and co-ordination body headed by the Prime Minister.

International mobility has been encouraged by various institutions in Turkey since 1920ies. Main organisations providing scholarships for this purpose include the Ministries, Higher Education Council, TUBITAK, NGOs and international organisations. On the other hand 59 percent of scientist studying abroad does not return to the country. While the programmes implemented by TUBITAK aim to help prevent or reverse brain drain, there are not any direct measures to encourage return of skilled researchers. The Supreme Council of Science and Technology (BTYK) discussed, for the first time, at its meeting on 7 March 2007 the need for developing measures to reverse brain drain.

Previous studies on brain drain indicate that the following factors have been the driving forces for mobility of Turkish researchers:

- For young university graduates, the economic crisis in 2001 in Turkey has been the main reason for studying and/or starting their careers abroad.
- “The prestige, better quality education and advantages associated with study abroad” is another reason for studying abroad.
- One important reason for doctoral students and postdoctoral scholars is the “lack of facilities, resources and necessary equipment to carry out research in Turkey in their field of specialisation”.
- Compulsory military service is an important reason for male students/researcher studying abroad.
- The reasons for student non-return include political instability, lower salaries and lack of employment opportunities in Turkey when studies are completed, and a preference to live abroad.
- The most important reason for returning is “reaching academic and work experience goals”.

There is an emerging need to develop new employment generating policies, and to design and implement actions to reverse brain drain while at the same time to attract Turkish Diaspora to Turkey and to establish international networks to transfer knowledge to Turkey.

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RESEARCHING INEQUALITY THROUGH SCIENCE AND TECHNOLOGY (RESIST)

Work Package 2
Supporting sustainable scientific mobility

COUNTRY REPORT ON GERMANY

Compiled by:

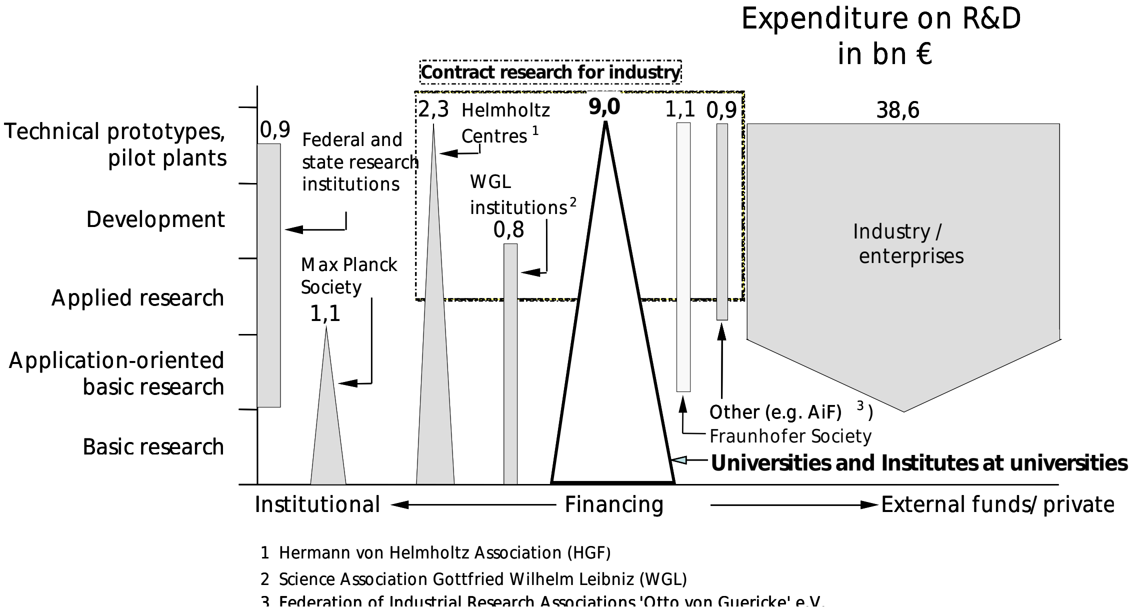
ISI
Fraunhofer Institut
System- und
Innovationsforschung

1. R&D Country Profile

Types of Research and Development (R&D) Institutions

The German R&D landscape is characterised by a great variety of research organisations (Figure 1). All public non-university organisations taken together represent about 80% of the university research. Thus, there is also explicit competition within the public research sector between universities and non-university institutions. The large share of non-university institutions is based on the division of labour between central government and the federal states. On the one hand, the federal states are responsible for the basic funding of universities; the central government strives for a high relevance in research by supporting non-university institutions. In consequence, the non-university institutions are primarily financed by the central government.

Figure 1: Depiction of the German research landscape, 2004



Source: Fraunhofer ISI, BMBF (2006)

In detail, the German higher education sector consists of 100 full universities (Table 1) and the non-university institutes are made up of a variety of institutions with different missions. The major organisations within the non-university sector are the Max Planck Society with a clear orientation towards basic research, the Fraunhofer Society with a focus on applied research, and the Helmholtz Association which runs large research facilities.

Table 1: Number of different types of high-level education institutions in Germany

Institution	Number	
Universities	100	
thereof		
with clinics		35
with engineering dpts.		17
Pedagogical schools	6	
Theological schools	16	
Art schools	52	
Polytechnical schools	168	
Administration schools	29	
Total	**371**	

Source: Hochschulrektorenkonferenz (HRK)

As to their general orientation, the Max Planck institutes are engaged in excellent basic research and primarily rely on institutional funding.[9] The main areas covered by Max Planck institutes are physics, biology, and chemistry, but their share in the humanities and social sciences is also relevant. In general, the mission of Max Planck institutes is to conduct leading-edge research in important or strategic fields of science with an adequate concentration of personnel and equipment, to quickly enter newly developing fields, especially those outside the mainstream, or fields that cannot be covered sufficiently at the universities, and to conduct research requiring special or large equipment, or research that is so costly that it cannot be undertaken at universities. Some of the leading researchers of Max Planck also teach part-time at universities, but the general focus of Max Planck institutes is on research. Due to this general orientation, the Max Planck institutes are able to perform better than universities, for instance, in terms of publications per researcher. An indicator for the excellent performance of these institutes is that most German Nobel Prize winners are from Max Planck institutes.

The Fraunhofer Society has a distinct orientation towards applied research and is primarily financed by external funds, in particular from industrial enterprises. The Fraunhofer Society was founded in 1949, but it was not until 1973 that it obtained its present role. The decision to strengthen the Fraunhofer Society must be seen in the context of the intensive discussions taking place at that time about the technological gap between Europe and the United States, and the more active technology policy being implemented by the then German federal government (Schimank 1990). Nearly all of the 58 Fraunhofer institutes have a specific technical focus covering the areas of information and communication technology, life sciences, microelectronics, surface technology and photonics, production, and materials. The major transfer mechanism of Fraunhofer research results to industry is contract research, which represents about 40% of Fraunhofer's activities. However, the "Fraunhofer model" could not exist in isolation; the research activities are closely related to those of other research institutions, in particular universities. The main element of such relationships is the (joint) appointment of a tenured university professor as director of a Fraunhofer institute and to a university chair. At the university, the Fraunhofer director can carry out basic research funded by institutional funds of the university, and he is in close contact with other academic researchers. At the same time, the university becomes acquainted with the needs of applied research, as the Fraunhofer director is a faculty member and can directly influence its research policy. A further important element of this close relationship to universities is the direct access of Fraunhofer institutes to qualified students.

The first Helmholtz centres were founded in the late 1950s, when the allied forces gave Germany permission to perform nuclear research; at that time, they were called large research centres (*Grossforschungseinrichtungen*). Following the pattern of US and British national laboratories, all Helmholtz centres initially worked in various areas of civil nuclear research. Since the late 1960s, other areas of research have been added, such as aeronautics, computer science, and biotechnology. It is not possible to describe the research orientation of Helmholtz in terms of simple categories like basic or applied. Their activities include

- basic research requiring large research facilities
- large projects and programmes of public interest, necessitating extraordinary financial, technical and interdisciplinary scientific resources and management capacities and
- long-term technology development, including pre-industrial fabrication.

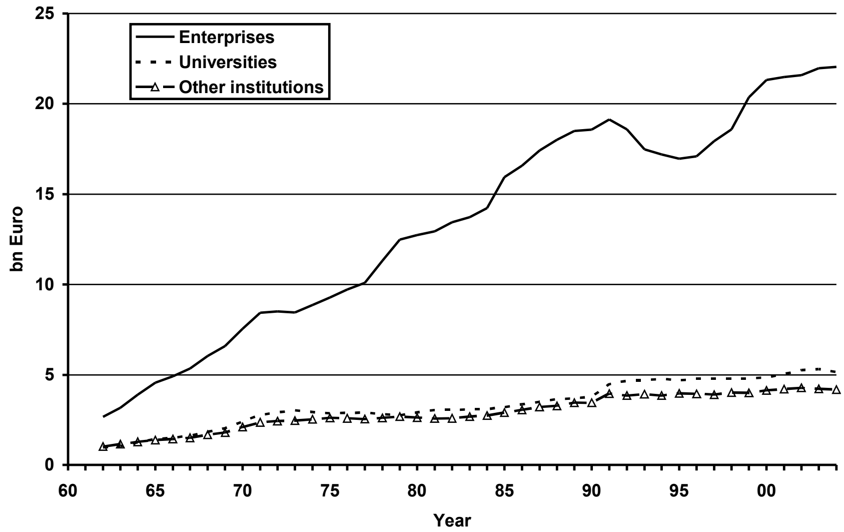
In the 1980s, the focus on civil nuclear research was abandoned, so that at present only a limited share of the Helmholtz activities are still linked to that field. Therefore the mission of the Helmholtz Association is less clear than that of the Max Planck Society and the Fraunhofer Society. In recent years, a move towards a stronger focus on basic research can be observed, but the debate on the role of the Helmholtz centres within the German research landscape has not been concluded.

[9] The following description of German non-university institutions is largely based on Encarnação/Schmoch (1997: 302 ff).

R&D expenditures

The situation in Germany has been characterised by economic growth since the 1960s, and in parallel, a tremendous increase of the R&D budgets of enterprises, universities and other research institutes can be observed as well (Figure 2).

Figure 2: R&D expenditures of major organisational sectors in Germany (in real terms)



Source: BMBF (2006), BMBF (2004), BMBF (2000), BMFT (1993), own computation

In particular, the enormous growth of firms' R&D activities is striking, but a large share of their activities refers to experimental development. Nevertheless, firms represent the largest organisational sector in research. Between 1970 and 2004, industrial R&D expenditures increased by the factor 2.9 (in real terms), in universities by the factor 2.1, and in the non-university institutes by 2.0. A similar trend can be observed in many advanced industrialised countries, reflecting the growing knowledge-intensity of technology. With the growing relevance of knowledge-based technologies, German firms substantially engaged in knowledge production and developed a considerable absorptive capacity, thus becoming appropriate partners for universities and other R&D institutions. Public research is being increasingly urged to contribute knowledge useful for technology development (compare, for instance, Krücken et al. 2007).

Overall, around one third of the overall R&D budget of the higher education institutions (HEIs) stems from third parties, showing a slight decrease during the past three years.

Table 2: R&D Expenditures of HEIs 2002-2004

Year	Total R&D Expenditure in € bn	Thereof Third Party Funds
2002	9.1	3.3
2003	9.3	3.5
2004	9.1	3.5

Source: Bundesforschungsbericht

Number of scientists and technologists working in the country

In the public sector, R&D staff comprises about 77,000 people in non-university institutes (government) and 98,000 people in universities, so that all in all, 472,000 people are working in research and development, 271,000 of whom are researchers (Table 3). Compared to most other advanced countries, the non-university sector is quite large.

Table 3: R&D staff in Germany by institutional sector, 2004

Sector	R&D staff (in thousands)	Share (in per cent)
Industry	298	63
Government	76,8	16
Universities	97,6	21
Total	472,5	100

Source: Statistisches Bundesamt

Women in Research and Development

The share of women in R&D personnel is characterised by a steady decline according to the hierarchical level: whereas about half of all first-year students are women, only ca. 9% hold a C4 professorship, the highest position available in the German university sector (see Table 4).

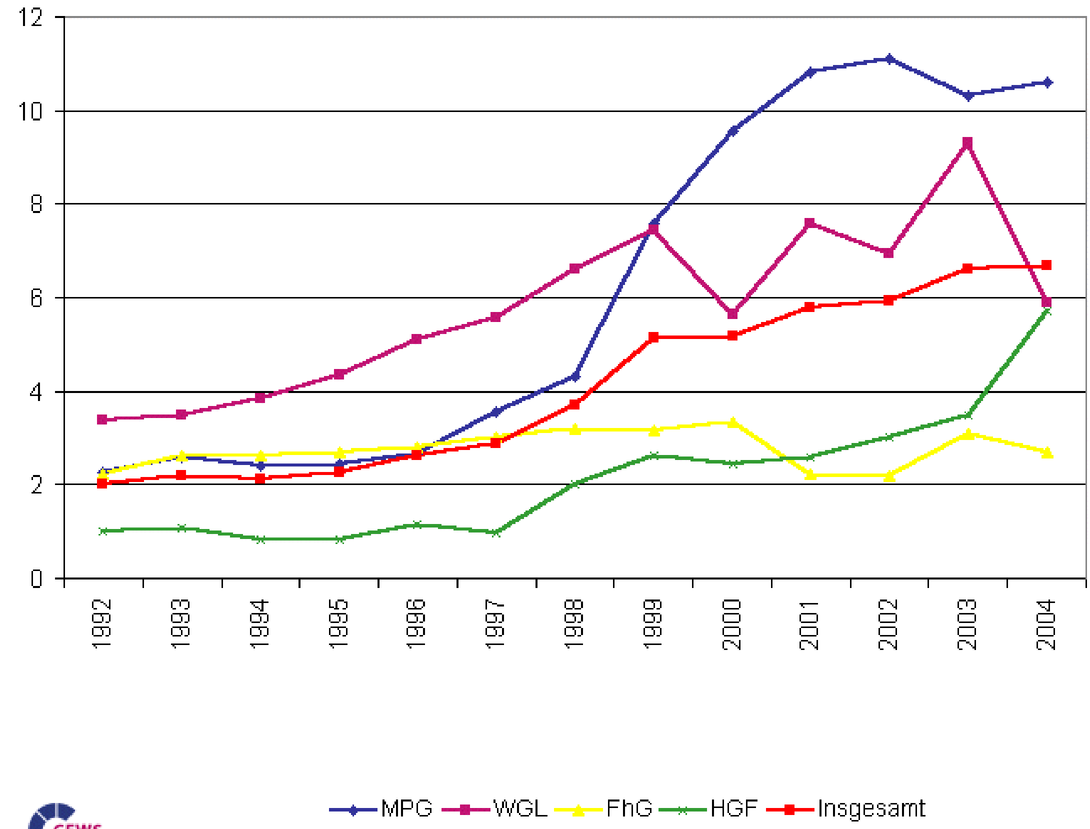
Table 4: Share of women at different hierarchical levels

	Share of women in %		
	2001	2002	2003
First-year students	49.4	50.6	48.2
Students	46.7	47.4	47.4
Alumni	46.0	47.0	48.4
Graduates	35.3	36.4	37.9
State doctorates	17.2	21.6	22.0
Higher education personnel	51.2	51.2	51.3
Personnel in arts and science (regular occupation)	27.0	27.7	28.6
Personnel in arts and science	31.9	32.7	33.5
Professors	11.2	11.9	12.8
C4 Professors	7.7	8.0	8.6
Population in total	51.2	51.1	51.1

Source: http://www.cews.org/statistik/hochschulen.php?aid=49&cid=18

Figure 3 shows the share of women in leading positions in the different R&D institutions in Germany (head of department or institute). All research institutes increased the share of women. The large increase of the Max Planck Society results from a special programme to establish C3 professorships.

Figure 3: Share of women in research institutes (senior positions 1992-2004)



MPG= Max Planck Society
FhG= Fraunhofer Society
WGL= Scientific Association Gottfried Wilhelm Leibniz
HGF = Hermann von Helmholtz Society
Source: http://www.cews.org/statistik/forschungseinrichtungen.php?aid=54&cid=7

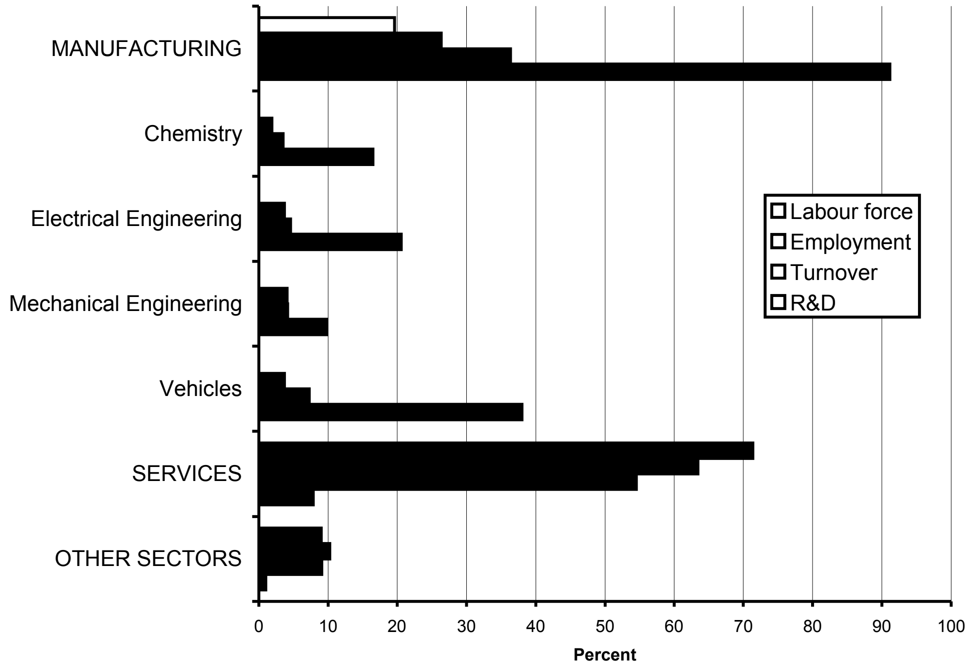
2. Field Overview

The German economy is characterised by a strong orientation towards manufacturing. Within manufacturing, the primary sectors are chemistry, electrical engineering, mechanical engineering and vehicles (Figure 4).

Within this general pattern, chemistry steadily decreased in the last decades, whereas vehicles showed an enormous growth. These four sectors cover half of the employment in manufacturing, 55 percent of the turnover, and 93 percent of the expenditures on research and development (R&D). To conclude, these four sectors dominate German R&D activities, but they represent high-level leading-edge technology rather than leading-edge technology.[10]

[10] High-level technology is defined by an R&D share of 3.5 to 8.5 percent of the turnover, leading-edge technology by a level of more than 8.5 percent. For a more detailed explanation, see Legler et al. (2006: 7).

Figure 4: Labour force, employment, turnover and R&D in shares of the German totals for selected sectors, 2004



Source: Statistisches Bundesamt

Within manufacturing, the highest activities in R&D take place in vehicles, with 38% of all industrial R&D activities. Within electrical engineering, the contribution of the sub-sector data processing is quite modest, at about 1% of the total industrial R&D. All in all, the increase of data processing and of information technology in general is quite dynamic, but the volume in comparison to other industrial sectors is quite small.

Number of scientists and technologists working in the country

In 2004, the total German labour force encompassed 38.8 million people, whereof 20% worked in manufacturing and 71% in services (Figure 4). The share of 20% of labour force in manufacturing, even 26% in terms of employment, is quite high in comparison to other countries. As to the expenditures on R&D, the share of manufacturing is even 91%, whereas the contribution of services amounts to 8%. To summarise, the contribution of services to the German labour force is considerable, but to R&D modest. In terms of personnel, 160,000 people work as researchers in the business sector, 141,000 thereof in manufacturing. The focus is on vehicles with 57,000 researchers followed by electrical engineering with 44,000 researchers.

The highest number of R&D staff can be found in medicine, followed by natural sciences and engineering technology. Not many changes have occurred during the past years concerning the number of R&D staff.
Overall, we observe a steady decrease of the number of R&D personnel.

Table 5: Total staff at HEI according to disciplines, 2002-2004

Year	Total Staff (scientific and artistic personnel)	Natural Sciences	Engineering Technology	Medicine
2002	156,003	33,392	25,997	39,237
2003	153,334	33,143	24,822	40,139
2004	150,593	33,631	24,151	38,000

Source: Bundesforschungsbericht

In the public sector, 34% of the researchers are active in the natural sciences, 19% in engineering, and 15% in medicine, so that almost three quarters of the R&D staff have an orientation towards technology-linked activities (year 2004).

In the comparison of universities and non-university institutes, the share of medicine in universities is distinctly higher (29% in universities, 7% in non-university institutes), whereas the natural sciences have a distinctly higher weight in non-university institutes (42% in non-university institutes, 28% in universities).

Table 6: Number of researchers at HEI according to disciplines, 2002-2004

Year	Researchers	Natural Sciences	Engineering Technology	Medicine
2002	71,292	22,175	14,370	10,214
2003	68,243	21,458	13,458	10,654
2004	66,314	21,518	12,884	9,789

The total expenditures of the German higher education institutions are shown in the following table. It can be seen that the medical faculties have very high R&D expenditures compared to polytechnical institutions and to the total expenditures. The expenditures for engineering sciences vary: they are quite low for universities, but quite high for polytechnical institutes.

Table 7: Total expenditures according to type of HEI, 2002-2004

Type of HEI	Year	Total Expenditure	Natural Sciences	Engineering Technology	Medicine
Universities, polytechnics (excluding medicine)	**2002**	13035,0	3017,0	1824,8	/
	2003	13060,3	3243,2	1858,9	/
	2004	12861,9	3193,8	1803,1	/
Medical facilities	**2002**	5110,4	/	/	5110,4
	2003	5293,1	/	/	5293,1
	2004	4989,6	/	/	4989,6
	2002	2916,3	157,7	830,8	/
Universities of applied science	**2003**	2921,1	173,4	807,9	/
	2004	2894,6	178,8	843,1	5
	2002	21062,5	3264,7	2655,7	5110,4
Total universities	**2003**	21274,5	3416,6	2688,8	5293,1
	2004	20746,4	3372,6	2646,2	4994,6
	2002	9080,4	2647	1843,9	2291,7
R&D Expenditure	**2003**	9202,1	2645,2	1908,6	2386,5
	2004	9103	2657,5	1854,3	2328

Source: Bundesforschungsbericht

3. Training and Supply in the Field

3.1 Tertiary level students

Due to German immigration history, an important distinction is made between students who passed their school leaving certificate in Germany, but do not possess German citizenship (*Bildungsinländer*) and those who passed the school leaving certificate in their country of origin (*Bildungsausländer*)[11]. In 2005 the share of *Bildungsausländer* compared to all foreign students is around 75%, the share of foreign first-year students from abroad even 83%. The share of Turkish first-year students (*Bildungsausländer*) of all first-year students in 2004 is 2.9%. (Migrationsbericht 2005, 97 ff).

[11] In 2004, there were ca. 1.8 m Turkish inhabitants in Germany (Migrationsbericht 2005, p. 119).

Table 8: First-year students in selected fields (2005), total and foreigners

Disciplines	Students	Foreign Students	%
Natural Sciences, Mathematics	**67,095**	**9,023**	13.5
Natural Sciences, Mathematics. General	443	74	16.7
Mathematics	11,714	1,478	12.6
Computer Science	23,078	2,871	12.4
Physics, Astronomy	6,340	1,014	15.9
Chemistry	8,533	1,579	18.5
Pharmacy	2,188	292	13.3
Biology	8,393	1,082	12.9
Geoscience	2,364	290	12.3
Geography	4,039	343	8.5
Medicine, Health Care	**11,450**	**1,997**	17.4
Health Care General		43	
Human Medicine		1719	
Dentistry		235	
Veterinary Medicine	999	106	10.6
Engineering Technology	**69,510**	**7,501**	10.8
Engineering Technology General	3,791	291	7.7
Mining, Metallurgy	361	153	42.4
Engineering, Chemical Engineering	30,329	2,836	9.4
Electrotechnology	15,755	2,127	13.5
Traffic Engineering, Nautics	3,295	145	4.4
Architecture	7101	802	11.3
Regional Planning	1,175	301	25.6
Construction Engineering	6,588	782	11.9
Surveying	1,115	64	5.7

Overall, there is a very high number of first-year students in the field of engineering technologies, particularly engineering, chemical engineering. The share of foreign first-year students in 2005 is highest in mining, metallurgy, regional planning (both belonging to engineering technologies), chemistry (19%), medicine (17%), natural sciences, mathematics general (17%) and physics, astronomy (16%).

On a aggregate level and referred to the overall number of students, the general picture for students in
2005 is that most of them can be found in natural sciences/ mathematics, followed by engineering technologies and medicine. In Table 9 we can also see that the largest share of foreign students in 2005 is in natural
sciences / mathematics, followed by medicine and in last place engineering technologies (for more details, see chapter 3.2).

Table 9: Students in selected fields (2005)

Discipline	Students General		Foreign Students 2005	
	2004/25	**2005/2006**	**Number**	**%**
	1,348,829	1,362,370		
Natural Sciences, Mathematics	350,584	357,555	36,071	10.2
Medicine, Health Care	108,510	109,666	10,848	9.9
Veterinary Medicine	7,769	7,785	444	5.7
Engineering, Technology	318,781	326,491	27,796	8.6

Source: Statistisches Bundesamt, www.wissenschaft-weltoffen.de, own computation

Share of Foreign Students

In 2005 some 246,300 foreign students were enrolled at German higher education institutions, which is about 41% more than in 2000. This figure includes around 186,000 so-called "*Bildungsausländer*", who are of foreign nationality and gained their qualifications for admission to university or similar education institutions abroad (unlike "*Bildungsinländer*" who got their qualification in Germany). This is 65% more than in 2000. In 2005, in total 13% of all students were foreigners.

There was a remarkable increase of 58% of "*Bildungsausländer*" studying at universities and 108% at universities of applied science (FH) in 2005 compared to 2000.

Regarding the various nations enrolling at German higher education institutions, the number of Asian students saw an above-average increase of 117% in the same period.

As far as Turkish students are concerned, in 2004 there were 24,448 studying in Germany, which is the second most important group behind the Chinese. For the quantitatively most important countries of origin of "*Bildungsausländer*", the highest growth rates were for students from China, Bulgaria und the Ukraine.

Table 10: Foreign students at German higher education institutions in 2004

Rank	Countries of origin	foreign students 2004
1	China	25.284
2	Turkey	24.448
3	Poland	14.350
4	Bulgaria	12.048
5	Russian Federation	10.814
6	Marocco	8.097
7	Ukraina	7.238
8	Italy	7.183
9	Greece	7.043
10	France	6.431
11	Austria	6.373
12	Spain	5.739
13	Korea,Republic	5.361
14	Cameroon	5.332
15	Iran	5.090
16	Croatia	4.795
17	India	4.112
18	Romania	3.977
19	United States	3.324
20	Yugoslavia	3.252

Source: http://www.wissenschaft-weltoffen.de

The following table shows the number of students and their countries of origin for the 10 most important fields of study. In total numbers, business sciences (703), informatics (574), engineering/ technology (479) and electrical engineering (383) are the most important fields for the Turkish students. However, looking at the rank Turkish students have compared to other foreign students, the most important disciplines are informatics and electrical engineering at rank 5 and engineering/ technology as well as industrial engineering at rank 4.

In 2004 19,590 foreigners successfully completed their studies at a higher education institution in Germany, of which more than 14,450 were "*Bildungsausländer*" (Wissenschaft weltoffen 2006, p. 6).

Table 11: Number of foreign students and their country of origin in 2004

1.Business Sciences:		
Rank	**State**	**Number**
1	China	4163
2	Bulgaria	2778
3	Poland	1805
4	Russian Federation	1573
5	Ukraina	1090
6	France	962
7	Turkey	703
8	Austria	556
9	Marocco	522
10	Romania	422

2.Informatics:		
Rank	**State**	**Number**
1	China	2822
2	Bulgaria	1197
3	Marocco	906
4	Cameroon	833
5	Turkey	574
6	Russian Federatio	456
7	Ukraina	448
8	Poland	411
9	Tunisia	351
10	Austria	332

3.German Language:		
Rank	**State**	**Number**
1	Poland	1492
2	Russian Federation	929
3	Georgia	731
4	Ukraina	623
5	Bulgaria	595
6	China	592
7	United States	543
8	Italy	356
9	France	339
10	Turkey	271

4.Electrotechnology:		
Rank	**State**	**Number**
1	China	2741
2	Marocco	2004
3	Cameroon	1104
4	Tunisia	487
5	Turkey	383
6	Bulgaria	379
7	India	262
8	Lebanon	190
9	Spain	176
10	Indonesia	157

5.Engineering,Technology:		
Rank	**State**	**Number**
1	China	2312
2	Marocco	681
3	Cameroon	553
4	Turkey	497
5	Bulgaria	440
6	France	409
7	Indonesia	370
8	India	296
9	Austria	291
10	Tunisia	270

6.Human Medicine:		
Rank	**State**	**Number**
1	Bulgaria	376
2	Israel	326
3	Cameroon	280
4	Norway	242
5	Syria	223
6	Greece	212
7	China	209
8	Iran	199
9	Poland	190
10	Russian Federation	164

7.Degree in law.:		
Rank	**State**	**Number**
1	Poland	628
2	Bulgaria	419
3	France	289
4	Russian Federation	253
5	Ukraina	172
6	China	160
7	Greece	141
8	Turkey	137
9	Georgia	108
10	Hungary	80

8.Anglistics,American studies:		
Rank	**State**	**Number**
1	Ukraina	301
2	Russian Federatio	290
3	China	288
4	Poland	248
5	Bulgaria	238
6	United States	120
7	Romania	119
8	France	87
9	GB,Nordireland	87
10	Spain	80

9.Mathematics:		
Rank	**State**	**Number**
1	China	743
2	Bulgaria	319
3	Russian Federation	151
4	Cameroon	127
5	Poland	122
6	Ukraina	118
7	Turkey	110
8	Marocco	98
9	Georgia	97
10	Romania	74

10.Industrial Engineering:		
Rank	**State**	**Number**
1	China	984
2	Austria	412
3	Marocco	145
4	Turkey	136
5	Cameroon	126
6	POland	101
7	Bulgaria	90
8	Russian Federation	66
9	Ukraina	45
10	Vietnam	41

Source: http://www.wissenschaft-weltoffen.de/

A more detailed picture is given in the following table: a share of more then 5% foreign students is found in computer sciences (7.7%) and chemical engineering (5.2%) in 2005. Further important disciplines are human medicine (4.9%), mathematics (2.8%), chemistry (2.8%) and biology (2.3%).

Table 12: Foreign students in selected disciplines (details)

Disciplines	Foreign Students 2005	Share
	Number	%
Natural Sciences, Mathematics	**36071**	**196**
Natural Sciences, Mathematics. General.	248	0.1
Mathematics	**5,186**	**2.8**
Computer Science	**14,239**	**7.7**
Physics, Astronomy	3,211	1.7
Chemistry	**5,193**	**2.8**
Pharmacy	1,264	0.7
Biology	**4,265**	**2.3**
Geoscience	1,071	0.6
Geography	1,394	0.8
Medicine, Health Care	**10,848**	**5.9**
Health Care General	346	0.2
Human Medicine	**8,953**	**4.9**
Dentistry	1,549	0.8
Veterinary Medicine	444	0.2
Engineering Technology	**27,796**	**15.1**
Engineering Technology General	847	0.5
Mining,Metallurgy	505	0.3
Engineering, Chemical Engineering	**9,603**	**5.2**
Electrotechnology	9,269	5
Traffic Engineering, Nautics	524	0.3
Architecture	2,592	1.4
Physical Planing	999	0.5
Construction Engineering	3,215	1.7
Surveying	242	0.1

Source: Bundesforschungsbericht

4. Field Labour Market (Demand)

General R&D labour market

As already mentioned above, in the public sector, 34% of the R&D staff is active in the natural sciences, 19% in engineering, and 20% in medicine, so that almost three quarters of R&D staff have an orientation towards technology-linked activities. In the comparison of universities and non-university institutes, the share of medicine in universities is distinctly higher (29% in universities, 7% in non-university institutes), whereas the natural sciences have a distinctly higher weight in non-university institutes (42% in non-university institutes, 28% in universities).

There is a certain regional concentration of R&D personnel in the federal states: Baden-Württemberg and Bavaria, two states in south Germany, show the largest share of R&D staff.

Table 13: Distribution of R&D personnel across in the federal states, 2003-2004

Federal State	2003		2004	
	Number	%	Number	%
Baden-Württemberg	15,954	15.9	16,997	17.4
Bavaria	13,674	13.6	13,210	13.5
Berlin	7,541	7.5	7,850	8
Brandenburg	1,543	1.5	1,532	1.6
Bremen	1,922	1.9	1,744	1.8
Hamburg	3,032	3.0	2,866	2.9
Hessen	6,693	6.7	6,302	6.5
Mecklenburg-Vorpommern	1,873	1.9	1,814	1.9
Lower Saxony	8,770	8.7	7,746	7.9
North Rhine –Westpfalia	21,117	21	20,047	20.5
Rheinland-Palatinate	3,270	3.3	3,247	3.3
Saarland	1,277	1.3	1,244	1.3
Saxony	6,202	6.2	5,871	6
Saxony-Anhalt	2,714	2.7	2,682	2.7
Schleswig-Holstein	2,380	2.4	2,037	2.1
Thuringia	2,629	2.6	2,452	2.5
Total	100,594	100	97,641	100

Source: Bundesforschungsbericht

Table 14 shows employment data in the field of engineering sciences. Overall, it can be stated that the unemployment rate decreased since the middle of the 1990s, starting at 11% and now at around 6%. Accordingly, the share of foreign engineers increased from 3% to 4%.

Table 14: Employment data in the field of engineering sciences

Year	Employees subject to social insurance contributions	Rate of total unemployment (in %)	Foreigner Occupation Group	Share of foreigners (%)
1996	636,572	10.9	21,746	3.4
1997	632,598	12.2	20,929	3.3
1998	623,660	10.8	20,465	3.3
1999	637,935	10.7	19,057	3.0
2000	648,077	9.5	20,318	3.1
2001	657,491	8.9	23,469	3.6
2002	655,876	9.0	24,795	3.8
2003	647,051	9.7	25,538	3.9
2004	640,371	9.1	25,220	3.9
2005	639,119	8.6	25,878	4.1
2006	642,201	5.6	26,989	4.2

Source: VDI-Homepage, own computation

Generally it is very difficult to get any reliable figures about employed academics in the industrial sector. The "Bundesagentur für Arbeit" (Federal Employment Agency) supplied us with data for Turkish employees according to their educational qualifications. There are around 5,900 "academic" Turks for sure, i.e. they have completed studies at university or universities of applied science (FH). Still, there are 121,700 Turkish employees for whom no data is available about their education level.

Table 15: Employees paying social insurance contributions in Germany, March 2006

Education		Total 1	thereof Turkish 2
Primary, secondary modern school without vocational training	1	3,583,343	192,684
Primary, secondary modern school with vocational training	2	14,493,436	121,002
Abitur (A levels) without vocational training	3	481	4,845
Abitur (A levels) with vocational training	4	1,190,479	3,960
Senior technical college diploma	5	944	2,262
University degree	6	1,603,403	3,655
Education unknown	7	3,640,365	121,736
No classification possible	X	2	26
Total		**25,937,677**	**450,170**

Source: Bundesagentur für Arbeit

Foreign Scientists in Germany

The following figures make clear that the Russian Federation (736), India (637) and China (626) had the largest number of postgraduate students at German higher education institutions in 2004, whereas Turkey ranks in 9th position (236 postgraduates), similar to Kenya with 243 postgraduates. There are almost no Turkish scientists engaged in post-doc studies.

Table 16: Postgraduates by countries of origin in 2004

Rank	Countries of origin	Postgraduates 2004
1	Russian Federation	736
2	India	637
3	China	626
4	United States	386
5	Poland	324
6	Brazil	310
7	Mexico	278
8	Romania	250
9	Turkey	236
10	Kenya	234
11	Vietnam	213
12	Ukraina	212
13	Indonesia	211
14	Italy	198
15	France	196
16	Spain	162
17	Ethiopia	161
18	Sudan	151
19	Japan	143
20	Chile	134

Source: http://www.wissenschaft-weltoffen.de/

Table 17: Post-Docs by countries of origin in 2004

Rank	Countries of origin	Post-Docs 2004
1	China	319
2	Russian Federation	202
3	India	172
4	United States	166
5	Japan	89
6	Poland	51
7	Italy	48
8	Spain	48
9	Australia	48
10	France	47
11	GB,Nordireland	33
12	Canada	32
13	Ukraina	30
14	Romania	29
15	Israel	24
16	Holland	23
17	Austria	20
18	Bulgaria	16
19	Czech Republic	15
20	Slovakia	14

Source: http://www.wissenschaft-weltoffen.de/

As far as being employed as a scientist or professor at German higher education institutions is concerned, the Russian Federation, China and India take the upper places in 2004, together with the United States. There were 942 scientists/ professors originating from the Russian Federation, 475 from the United States, 309 from China and 215 from India. Turkey ranked only in 10th position with 74 scientists/professors.

Table 18: Foreign scientists and professors by countries of origin in 2004

Rank	Countries of origin	Scientists/Professors 2004
1	Russian Federation	942
2	United States	475
3	China	309
4	India	215
5	Ukraina	123
6	Bulgaria	118
7	Italy	104
8	Poland	94
9	GB,Nordireland	90
10	Egypt	90
11	Romania	74
12	Turkey	74
13	Japan	74
14	France	69
15	Spain	69
16	Hungary	68
17	Brazil	67
18	Israel	66
19	Australia	66
20	South Korea	65

Source: http://www.wissenschaft-weltoffen.de/

Foreign scientists are often funded by host organisations. The most important of these are the Deutscher Akademischer Austauschdienst (DAAD), Max-Planck-Gesellschaft, Deutsche Forschungsgemeinschaft, Hermann von Helmholtz Association and Akademischer Ausländerdienst. Whereas postgraduate scientists are mainly funded by the DAAD (54.5%), post-doc scientists will be funded by the Max Planck Society (63.4%). Altogether around 21,000 scientists are funded.

The following tables show the overall distribution of foreign scientists in Germany according to different disciplines. We can see that particularly the post-docs and academics are mainly concentrated in natural sciences and mathematics whereas engineering technology and medicine is much less important.

Table 19: Foreign scientists in Germany in 2004

Disciplines	Postgraduate 2004		Post-docs 2004		Academics 2004	
	Number	%	Number	%	Number	%
Natural Sciences, Mathematics	4,115	32.70%	1,558	62.50%	2926	61.30%
Medicine, Health Care	944	8.50%	471	18.90%	350	7.30%
Engineering, Technology	1355	12.30%	54	2.20%	329	6.90%

Source: Bundesforschungsbericht

The postgraduates are concentrated in biology – 912 out of the total of 11,380 postgraduates can be found in this field. Further important natural science fields are chemistry and medicine, but with much lower numbers. In engineering sciences, 262 postgraduates from abroad were found in 2004. However, the most important area of research for postgraduates is economics; and German language follows just after biology in rank 3. The situation is a different one for the foreign post-docs in Germany: the first 5 ranks are dominated by natural sciences and mathematics. Engineering follows in rank 6, particularly chemical engineering. Finally, looking at the total number of foreign scientists, we find that physics and astronomy occupy rank 1, followed by chemistry and economics. Engineering follows only at rank 9.

Table 20: Foreign postgraduates and post-docs in Germany – detailed overview*

Rank	Area of Research	Postgraduate 2004	Rank	Area of Research	Post-docs 2004
1	**Economics**	924	**1**	**Physics, Astronomy**	72
2	**Biology**	912	**2**	**Biology**	68
3	**German Language**	583	**3**	**Chemistry**	64
4	**Chemistry**	355	**4**	**Mathematics**	22
5	**Law**	324	**5**	**Human Medicine**	20
6	**Human Medicine**	323	**6**	**Chemical Engineering, Engineering**	17
7	**Engineering General**	262	**7**	**Economics**	16
8	**Agronomy**	257	**8**	**History**	15
9	**Chemical Engineering, Engineering**	233	**9**	**Law**	13
10	**History**	226	**10**	**Geoscience**	13

Source: Bundesforschungsbericht
* including all scientists where the discipline was not known

Table 21: Foreign scientists in Germany – detailed overview

Rank	Area of Research	Scientists 2004
1	**Physics, Astronomy**	211
2	**Chemistry**	147
3	**Economics**	139
4	**German Language**	137
5	**Biology**	125
6	**Law**	100
7	**History**	94
8	**Human Medicine**	83
9	**Engineering**	82
10	**Mathematics**	81
		4941 total

Source: Bundesforschungsbericht

If we now consider the three most important disciplines for our study – mathematics and natural sciences, medicine and engineering, we do not find Turkish scientists in the top places: in medicine at rank 18, in mathematics and natural sciences at rank 14 and in engineering at rank 11.

Table 22: **Foreign scientists in Germany – medicine, mathematics and natural sciences**

Medicine			Mathematics and Natural Sciences		
Rank	**Country of Origin**	**Number**	**Rank**	**Country of Origin**	**Number**
1	**India**	155	1	**Russ. Federation**	1,540
2	**China**	140	2	**China**	733
3	**USA**	116	3	**India**	626
4	**Russ. Fed.**	106	4	**Poland**	464
5	**Asia**	72	5	**USA**	439
6	**Egypt**	35	6	**Italy**	283
7	**Japan**	31	7	**Ukraine**	258
8	**Bulgaria**	28	8	**France**	251
9	**Canada**	26	9	**Romania**	206
10	**Australia**	25	10	**Spain**	206
18	**Turkey**	**11**	**14**	**Turkey**	**134**

Source: Bundesforschungsbericht

One can find funded Turkish scientists/professors mainly in subjects from the field of mathematics and natural sciences (134), but also in the fields of languages/cultural sciences and sports (72), law/ economics & business administration/ social sciences (42), engineering (36), agriculture, forestry and nutrition sciences (19) and human medicine (11) (source: http://www.wissenschaft-weltoffen.de/)

Table 23: **Foreign scientists in Germany – engineering**

Engineering		
Rank	**Country of Origin**	**Number**
1	**Russ. Federation**	118
2	**China**	99
3	**India**	86
4	**Poland**	57
5	**Mexico**	57
6	**Indonesia**	56
7	**USA**	42
8	**Romania**	40
9	**Egypt**	38
10	**Brasil**	37
11	**Turkey**	36

Source: Bundesforschungsbericht

5. Human Resource Strategies

5.1 German scientists in foreign countries

Generally speaking, there is a growing tendency for German academics to leave their home country and start working abroad. However, one recent study (Diehl/Dixon 2005) revealed that the number of academic emigrants from Germany is not as high as expected, as the total numbers are (still) rather low. The federal government estimates that the number of German scientists in the USA is 20,000 persons maximum. The "current population survey" of the U.S. Bureau of the Census records a maximum number of 15,000 up to 20,000 Germans with a scientific degree working within the HEI or similar sectors. Within this population there are about 4,640 "German scholars", that is, young graduate German scientists who work as post-docs, guest professors or scientific staff at HEIs in the USA. The number of highly qualified Germans who possess a permanent residence permit was around 3,800 persons in 2001. This number, however, includes family members therefore the real number of German highly-skilled workers abroad is much lower. To conclude: the number of Germans studying, researching or generally gathering experience within the USA is increasing, but the largest share returns home or at least signalises a readiness to do so (Deutsche Forschungsgemeinschaft 2004) (Migrationsbericht 2005, p. 114 ff.).

If we look at German scientists in foreign countries who have been promoted by selected agencies, it becomes clear that the USA is the most important target county – in all selected disciplines. In the field of mathematics / natural sciences as well as in the field of engineering technology, Great Britain and Ireland also attract large numbers. Japan is an important target country in medicine.

Table 24: German scientists in foreign countries – 10 most important countries

Rank	Target Country	Total	Mathematics & Natural Science	Engineering, Technology	Medicine
1	USA	883	288	98	26
2	GB, Ireland	416	115	51	5
3	France	209	72	25	2
4	Switzerland	152	90	11	3
5	Japan	166	62	20	14
6	Italy	130	40	17	1
7	China	124	66	11	6
8	Russian Fed.	106	53	12	9
9	Australia	78	38	5	/
10	Canada	52	24	7	2

Source: Bundesforschungsbericht

A more detailed picture is given in Table 25, where the 10 most important target countries for German scientists are shown for the three selected areas: This additional overview shows the Netherlands as an important target country in the engineering sciences and Poland for mathematics / natural sciences
and medicine.

Table 25: German scientists in foreign countries – 10 most important countries according to discipline

Mathematics/ Natural Sciences			Medicine			Engineering Scienes		
Rank	**Target Country**	**Number**	**Rank**	**Target Country**	**Number**	**Rank**	**Target Country**	**Number**
1	USA	288	**1**	USA	16	**1**	USA	98
2	GB	115	**2**	Japan	14	**2**	GB	51
3	Switzerland	90	**3**	Poland	10	**3**	France	25
4	France	72	**4**	Russ. Fed.	9	**4**	Netherlands	20
5	China	66	**5**	Bulgaria	7	**5**	Japan	20
6	Japan	62	**6**	China	6	**6**	Italy	17
7	Russ. Fed.	53	**7**	Netherlands	5	**7**	Spain	13
8	Italy	40	**8**	GB	5	**8**	Russ. Fed.	12
9	Australia	38	**9**	Chile	5	**9**	Switzerland	11
10	Poland	26	**10**	Israel	5	**10**	China	11

Source: Bundesforschungsbericht

5.2 Recruitment Schemes

There is a wide range of immigrant types to Germany, for example: EU citizens, asylum seekers, refugees, immigrants as family member or spouses, but also particular groups of employees, like IT specialists, foreign students and scientists. The different exceptions permitted to the general recruitment stop regulation (ASAV – *Anwerbestoppausnahmeverordnung*) for employees are defined in the new residence law and the employment regulation (*Beschäftigungsverordnung* BeschV) of 1 January 2005 (Migrationsbericht 2005, 75 ff.).

In the course of the boom in information and communication technology around the year 2000, the German federal government enacted regulations concerning work and resident permits for highly qualified foreign specialists in the IT sector from abroad. This regulation which came into force on 1 August 2000 was referred to as the "Green Card Programme". According to these regulations up to 20,000 foreign IT specialists can be granted a work or residence permit, limited to a maximum of five years. The precondition for the specialist is that they have a degree from a university or polytechnic college with the main emphasis on the field of information and communication technology, or that their qualification in this field is proven by means of an agreement with the employer regarding an annual salary of at least € 51,000.

From August 2000 - the time when the green card regulations were introduced - until the end of December 2002, a total of 13,373 green card work permits were issued by the employment service in Germany. Almost 60% of the work permits issued went to people who were to work in firms with no more than 100 employees.
The share of green card immigrants from Turkey was 3.8%; most IT specialists stemmed from India (2,008), followed by Romania (771), the Russian Federation (695), Poland (572), Slovakia (400) and China (398).

Table 26: Green card immigrants

Rank	Nationality	Total	of which from Germany	Rates in %
1	**India**	2,008	67	20.9%
2	**Romania**	771	30	8%
3	**Russian Federation**	695	50	7.20%
4	**Poland**	572	26	5.90%
5	**Slovakia**	400	8	4.20%
6	**China**	398	129	4.10%
7	**Hungary**	377	11	3.90%
8	**Turkey**	367	28	3.80%
9	**Ukraine**	363	21	3.80%
10	**Czech Republic**	305	6	3.20%

Source: Schreyer 2003, p. 5

On 1 January 2005 the new law, the so-called "Immigration Act" went into effect before the first green card expired. With the Immigration Act now in effect, residence permits granted to IT specialists remain valid until the original expiration date. The work permit remains in effect with no expiration date for the designated employment, ensuring that holders may continue to work at the same job even after the five years have elapsed.

With the new Immigration Law, Germany is making a great attempt to encourage highly skilled workers to move to Germany. Instead of five types of residence permits, the residence title for exceptional circumstances, the residence title for a specific purpose, the temporary residence permit, the permanent residence permit and the right of unlimited residence as previously, the new law reduces the number of residence titles to two, the temporary residence permit and the permanent settlement permit.

The new residence legislation is no longer based on residence titles, but on purpose of residence (education, gainful employment, subsequent immigration of dependents, humanitarian grounds). Instead of having to go through two separate application processes, one for residence permits and another for work permits as previously, foreigners now only need to submit their residence permit applications to the responsible foreigners authority.

The admission of foreign employees is be geared to the requirements of the German economy, according due consideration to the situation in the labour market.

Citizens of the new EU member states are permitted to work in certain jobs, as long as no German or other equally entitled candidate is available to fill the position. Furthermore, citizens of the new EU member states have priority over citizens of non-EU countries.

Visiting researchers and academics will generally receive a residence permit, which allows them to take up gainful employment. Through the Immigration Act the residence status for highly skilled workers improved significantly. Highly skilled workers in accordance to the law are:

- scientists with special technical knowledge
- teaching personnel in prominent positions or scientific personnel in prominent position, or
- specialists and executive personnel with special professional experience who receive a salary corresponding to at least twice the earnings ceiling of the statutory health insurance scheme.

Highly skilled workers who are offered a position in Germany may receive permission to work without having to get approval from the Federal Employment Agency and without having to determine whether German candidates are available for the position. They may be granted a settlement permit from the state. Family members accompanying them to Germany or entering later are entitled to take up paid employment or self-employment.

Self–employed persons are eligible for a residence permit if exceptional economic interests or special needs exist, if the planned business would have a positive economic effect, and if it has secure financing. Entrepreneurs planning to invest at least € 1 million and create 10 jobs also fulfil the conditions for a residence permit. A residence permit may also be granted if international law provides for special privileges on the basis of reciprocity. Self-employed persons are eligible for a settlement permit after three years if their business is successful and their livelihood is assured.

6. Conclusions

The German R&D landscape is characterised by a great variety of research organisations. Since the 1960s a tremendous increase of the R&D budgets of enterprises, universities and other research institutes can be observed. Firms represent the largest organisational sector in research. Between 1970 and 2004, industrial R&D expenditures increased by the factor 2.9 (in real terms), in universities by the factor 2.1, and in the non-university institutes by 2.0.

In the public sector, R&D staff comprises about 77,000 people in non-university institutes (government) and 98,000 people in universities, so that all in all, 472,000 people are working in research and development, 271,000 of whom are researchers. As in many EU countries, the share of women in R&D personnel is characterised by a steady decline according to the hierarchical level.

The German economy is characterised by a strong orientation towards manufacturing. Within manufacturing, the primary sectors are chemistry, electrical engineering, mechanical engineering and vehicles.
Overall, there is a very high number of first-year students in the field of engineering technologies, particularly engineering, chemical engineering. The share of foreign first-year students in 2005 is quite high in parts of engineering technologies and chemistry. The general picture for students in 2005 in Germany is that most of them can be found in natural sciences/ mathematics, followed by engineering technologies and medicine. The largest share of foreign students in 2005 is in natural sciences/ mathematics, followed by medicine and in last place engineering technologies.

With regard to Turkish students, business sciences, informatics, engineering/ technology and electrical engineering are the most important fields, but looking at the rank Turkish students have compared to other foreign students, the most important disciplines are informatics and electrical engineering, engineering/ technology as well as industrial engineering.

With regard to foreign scientists in Germany it becomes clear that the Russian Federation, India and China had the largest number of postgraduate students at German higher education institutions in 2004, whereas Turkey ranks in 9th position (236 postgraduates). One can find funded Turkish scientists/professors mainly in subjects from the field of mathematics and natural sciences (134), but also in the fields of languages/cultural sciences and sports (72), law/ economics & business administration/ social sciences (42), engineering (36), agriculture, forestry and nutrition sciences (19) and human medicine (11) (source: http://www.wissenschaft-weltoffen.de/).

This picture converges with the results of a bibliometric analysis of co-publications between Germany and Turkey conducted by Fraunhofer ISI: Between 1990 and 2005, the number of SCI publications of Turkish origin substantially increased from 1,060 to 14,800. This level is comparable to that of Belgium (13,400) or Poland (14,700), so the scientific activities in Turkey are substantial.

Looking at the share of co-publications with international partners, the level is quite moderate with a share of 15% in 2005. Thus 2,150 SCI publications were published in cooperation with international partners.

Scientific research in Turkey is distinctly focused on domestic needs. There is a quite strong orientation of Turkish publications to medical fields. Within the field classification of the Science Citation Index with 170 items, most Turkish publications refer to surgery. In the top list, further medical fields such as paediatrics, neurology, cardiac and cardiovascular systems, radiology, oncology or gynaecology appear. In particular, the activities linked to information technology are still quite modest. So the field electrical and electronic engineering appears at rank 24, theory and methods of computer science at rank 50, and computer science and artificial intelligence at rank 65.

The United States are the most important cooperation partner of Turkey in the scientific field, with about 47% of all international co-publications. The top field of cooperation is electrical and electronic engineering, followed by some medical fields and then theory and methods of computer science at rank 7. The quite strong focus on medical fields in the cooperations is closely linked to a similar focus of the United States on medical fields. In the second and third position of Turkey's international co-publication partners we find the UK with 14% and Germany 13%, equivalent to 286 joint SCI publications in 2005. The cooperation between Turkey and Germany is focused on different fields of materials science, chemistry and physics. So the picture is quite different to that of the cooperation between Turkey and the United States. In the case of Germany, the field theory and methods of computer science is at rank 38 with only four joint publications. So in the scientific cooperation between Germany and Turkey, computer science is not relevant.

Of course, the number of international co-publications is no unequivocal indicator for Turkish academics working in Germany. The SCI does not record the nationality of the authors, but the nationality of the institution. In the case of the Turkish researcher working in a German institution, his or her publication would appear as a German one. However, international co-publications are based on the personal knowledge of the co-operating researchers, and this knowledge is often based on the former migration of one of the partners.

To conclude, we can expect quite a high level of cooperation between Turkey and Germany in the fields of materials sciences, chemistry and physics based on different mechanisms of exchange, whereof temporary work of Turkish researchers in German institutions may be a relevant one.

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RESEARCHING INEQUALITY THROUGH SCIENCE AND TECHNOLOGY (RESIST)

Work Package 2
Supporting sustainable scientific mobility

COUNTRY REPORT ON SOUTH AFRICA

Compiled by:

Johann Mouton and Nelius Boshoff

(Assisted by Lynn Lorenzen, Cornelia Jacobs, Annemarie Louw, Charline Mouton and Astrid Valentine)

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Section 1: R&D country profile

1.1 Overview

The reference source of this section is the National Research and Experimental Development Surveys, conducted by the Human Sciences Research Council on behalf the National Department of Science and Technology. Table 1 shows the key R&D figures from the surveys.

Table 1: Key R&D figures

Indicator			
GERD as a percentage of GDP	0.76	0.81	0.87
Total R&D personnel (FTE)	21 195	25 185	29 696
Total researchers (FTE)[a]	14 182	14 129	17 915
Total researchers per 1000 total employment (FTE)	3.1	1.2	1.6
Total R&D personnel per 1000 total employment (FTE)	4.6	2.2	2.6
Civil GERD as a percentage of GDP	0.71	0.72	0.80
Total researchers (headcount)	26 913	30 703	37 001
Women researchers as a percentage of total researchers	36.0	38.0	38.3

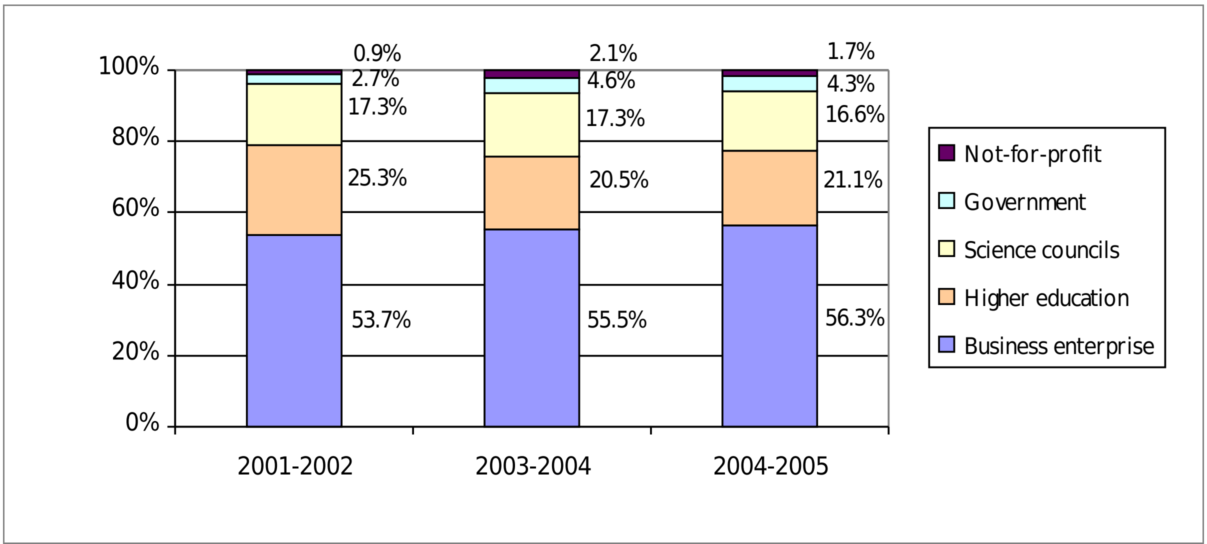
[a] Following OECD practice doctoral students have been included as researchers since 2003/04

Since 2001, R&D expenditure has grown in both nominal and real terms. This increase is partly due to improved survey coverage, particularly of the business and higher education sectors as well as increased funding from government sources. The growth of the South African economy since 2002 also appears to be stimulating an increase in R&D activities.

1.2 R&D expenditure by sector

The business sector accounted for 56.3% of R&D performance in South Africa in 2004/05, followed by the higher education sector (21.1%). The government sector (incl. science councils[12]) accounted for 20.9% of total R&D expenditure and the not-for-profit sector contributed 1.7% (Figure 1). The increase in the percentage of R&D performed by the business and higher education sectors since 2003 mostly arouse from a combination of better coverage and increased R&D activities within these sectors.

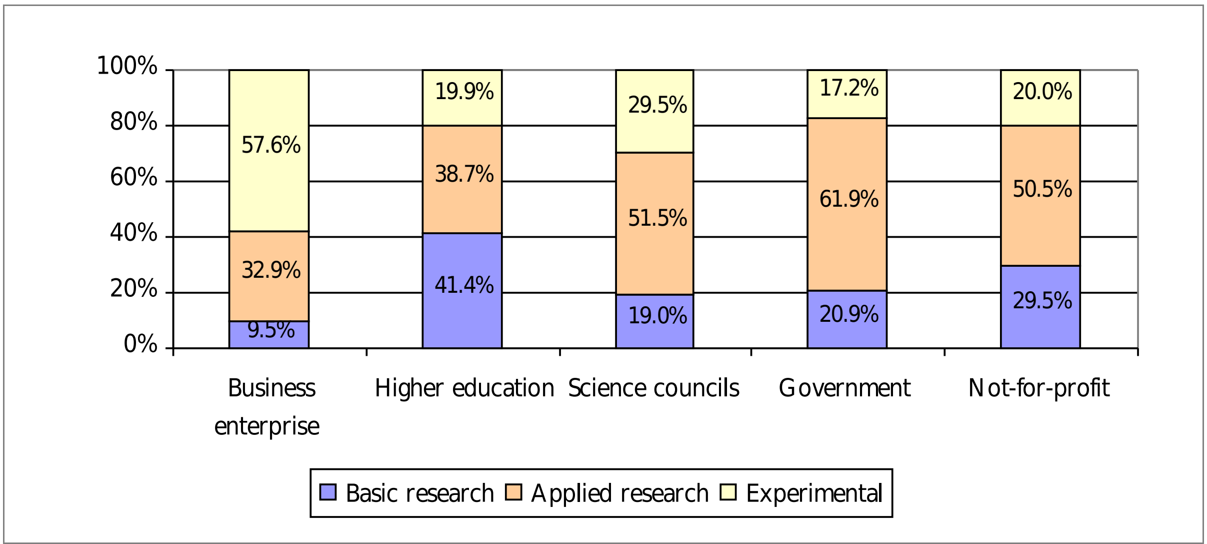
Figure 1: Total in-house R&D expenditure by sector (2001/02, 2003/04 & 2004/05)



[12] The statutory science councils are a key part of South Africa's national system of innovation. Through them, government is able to directly commission research in the interest of the country and support technology development in its pre-competitive phase. There are 9 such councils.

As expected, basic research activities – measured in terms of expenditure – are largely concentrated within the higher education sector (41% – Figure 2). Applied research activities occur mostly within the science councils and government and not-for-profit sectors (51%-62%). In the business sector, largely experimental work is at the order of the day (58%).

Figure 2: Total in-house R&D expenditure by sector (2004/05)



1.3 R&D personnel by sector

Table 2 summarises the number of R&D personnel per occupational category (researchers, technicians and R&D support staff) in terms of both headcounts and full-time equivalents.

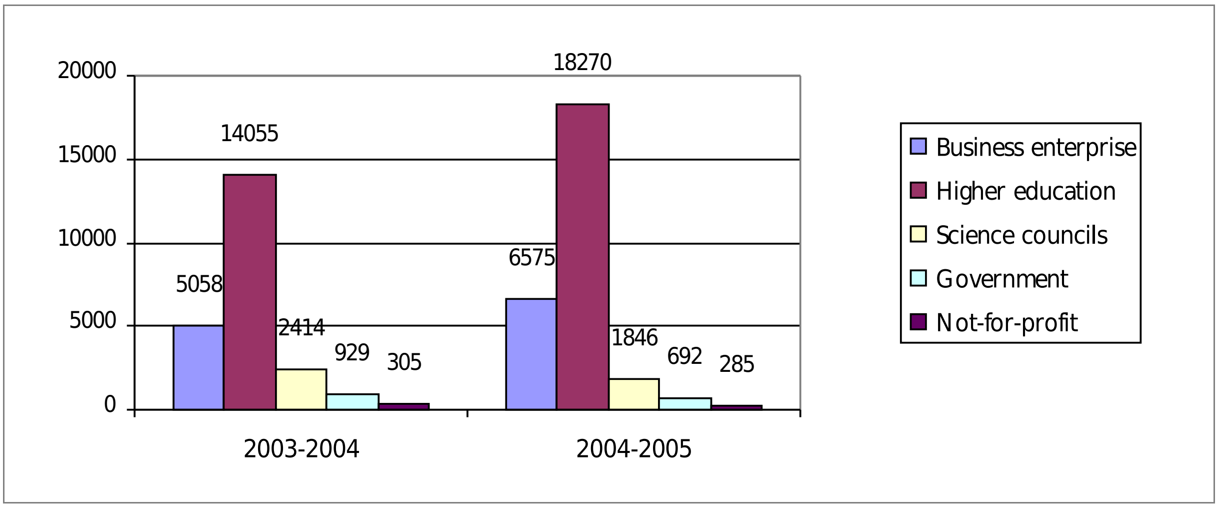
Table 2: R&D personnel by sector (2004/05)

Sector	**Researchers**		**Technicians directly supporting R&D**		**Other personnel directly supporting R&D**		**Total R&D personnel**	
Headcount								
Business enterprise	6575	17.8%	3724	43.1%	4038	37.4%	14337	25.4%
Higher education	27603	74.6%	2801	32.4%	2722	25.2%	33126	58.7%
Science councils	1846	5.0%	1582	18.3%	2742	25.4%	6170	10.9%
Government	692	1.9%	494	5.7%	1125	10.4%	2311	4.1%
Not-for-profit	285	0.8%	40	0.5%	184	1.7%	509	0.9%
Total	*37001*	*100.0%*	*8641*	*100.0%*	*10811*	*100.0%*	*56453*	*100.0%*
Full-time equivalent (FTE)								
Business enterprise	5300.7	29.6%	2856.5	55.2%	3138.8	47.5%	11296.0	38.0%
Higher education	10339.8	57.7%	568.1	11.0%	473.0	7.2%	11380.9	38.3%
Science councils	1548.8	8.6%	1344.1	26.0%	2096.6	31.7%	4989.6	16.8%
Government	491.1	2.7%	376.3	7.3%	800.0	12.1%	1667.3	5.6%
Not-for-profit	234.2	1.3%	30.7	0.6%	97.8	1.5%	362.7	1.2%
Total	*17915.0*	*100.0%*	*5175.7*	*100.0%*	*6606.3*	*100.0%*	*29696.0*	*100.0%*
FTE as % of headcount								
Business enterprise	80.6%		76.7%		77.7%		78.8%	
Higher education	37.5%		20.3%		17.4%		34.4%	
Science councils	83.9%		85.0%		76.5%		80.9%	
Government	71.0%		76.2%		71.1%		72.1%	
Not-for-profit	82.2%		76.8%		53.2%		71.3%	
Total	*48.4%*		*59.9%*		*61.1%*		*52.6%*	

Figures for higher education include doctoral students
As can be seen in Table 2, the deployment of researchers varies considerably by sector. The higher education sector has significantly more researchers (including doctoral students) compared to the business sector in terms of both headcounts and FTE's. If one compares the FTE's for each sector directly to the headcounts for that sector, one could derive an indication of approximately how much time the researchers spend on R&D activities. In all sectors, except for the higher education sector, significant proportions (71%-84%) of the researchers' time are devoted to R&D. However, in the higher education sector (where academics are mostly lecturers), the corresponding figure is only 37%. Based on this one could conclude that, on average, roughly 37% of academics' time is spent on R&D activities.

Figure 3 shows that between 2003 and 2004 the number of researchers in the higher education sector has increased by more than 4 000, even if doctoral students and post-doctoral fellows are excluded as researchers.

Figure 3: Headcount of researchers by sector (2003/04 & 2004/05)

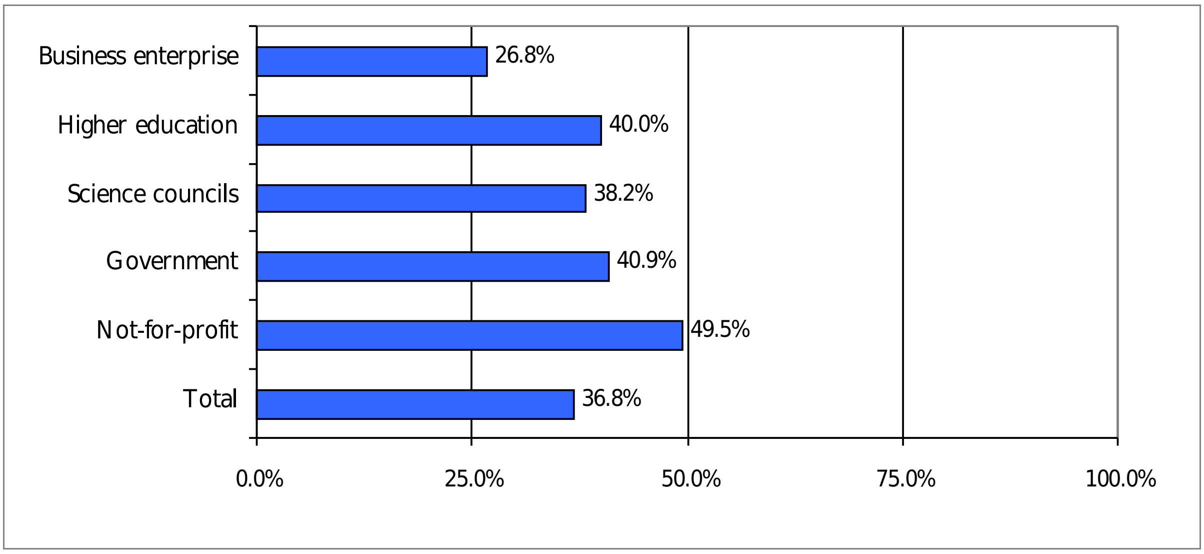


The 2004/05 figures exclude the 8 851 doctoral students and 482 post-doctoral fellows in the higher education sector.

1.4 Gender profile of researchers

Figure 4 shows the percentage of female researchers in the five R&D performing sectors. The smallest of the sectors (not-for-profit) has the highest share of female researchers (50%). The share of female researchers is lowest in the business sector (27%) and about 40% in each of the three remaining sectors.

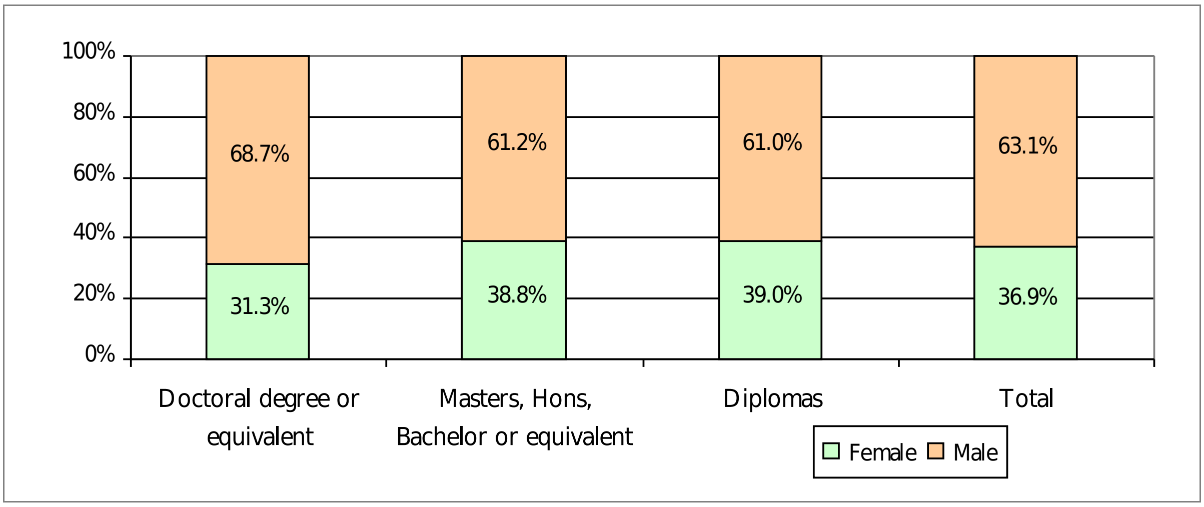
Figure 4: % Female researchers by sector (2004/05)



Figures exclude the 8 851 doctoral students and 482 post-doctoral fellows in the higher education sector

According to Figure 5, researchers in possession of a doctoral degree or equivalent qualification are largely male (69%).

Figure 5: % Female researchers by qualification level (2004/05)



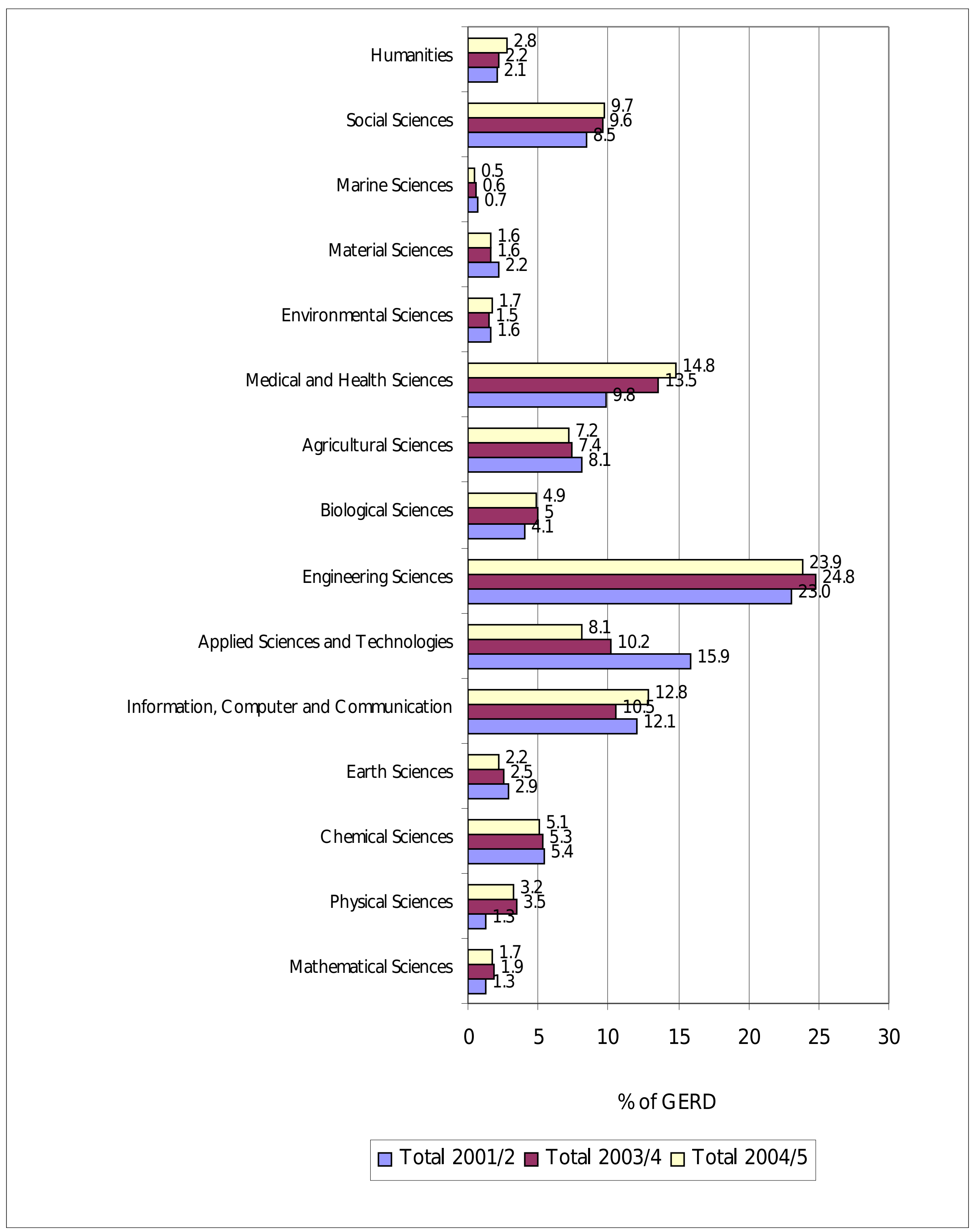
Figures exclude the 8 851 doctoral students and 482 post-doctoral fellows in the higher education sector

Section 2: Field overview

2.1 R&D expenditure in health sciences

In 2004 the field of medical and health sciences accounted for almost 15% of total R&D expenditure in South Africa (Figure 6). This represents the second largest proportion of R&D expenditure per field in the country. The largest proportion is associated with the field of engineering sciences, namely 24% in 2004. Moreover, the medical and health sciences experienced a steady increase in R&D expenditure between 2001 and 2004 (from 9.8% to 14.8%).

Figure 6: R&D expenditure by major research field as % of GERD

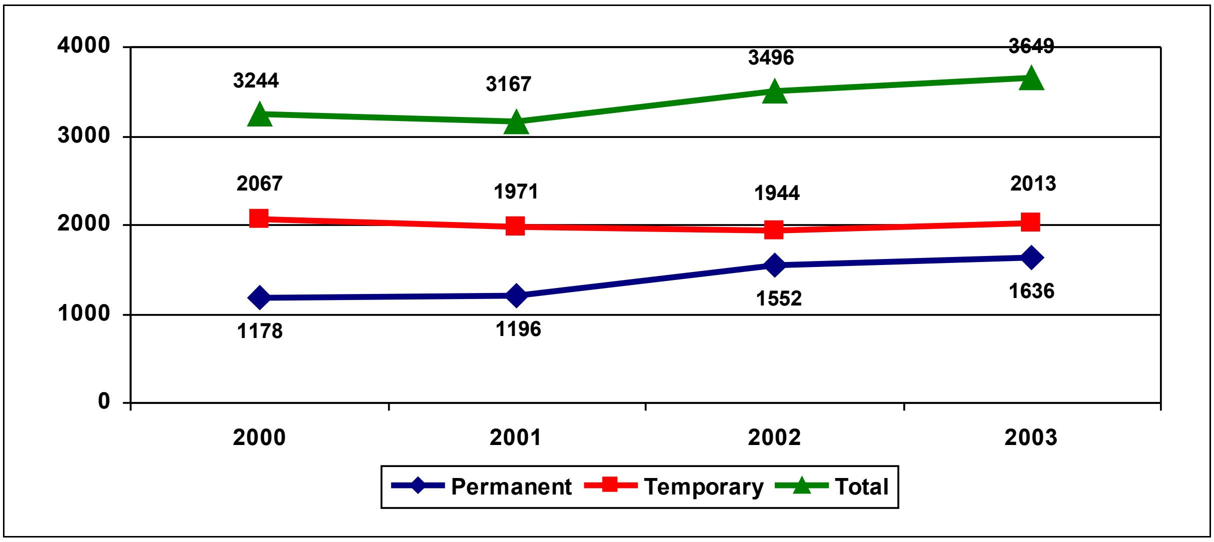


Source: South African R&D Survey, CeSTII (www.hsrc.ac.za/CCUP-RnD-7.phtml)

2.2 Researchers in health sciences

In 2000, there were altogether 3 244 academics (researchers and/or instructional staff) in the field of health and this figure has slightly increased to 3 649 in 2003 (see Figure 7).[13] The increase is largely due to the employment of more permanent[14] academic staff in health in 2002 and 2003. Although an increase in both the total number of health academics and in the number of permanently appointed health academics can be observed, these do not represent big shifts. Given the short time frame, large shifts would of course not necessarily be expected.

Figure 7: Headcount of academic staff in health, by permanent/temporary appointment, 2000 to 2003



Source: Boshoff, N. & Mouton, J. (2006). *A profile of researchers and research production in health research in South Africa*. Centre for Research on Science and Technology (CREST), Stellenbosch University, South Africa.

Outside the university sector the two biggest research organisations in health are the Medical Research Council (MRC) and the National Health Laboratory Services (NHLS). The total number of researchers in these two organisations is approximately 700.

2.3 Student enrolments and graduates in health sciences

In Table 3 we show the number of student enrolments and graduates in health for three degree types, namely professional first bachelors degree[15], master degree and doctoral degree. The table also expresses health student enrolments and graduates, respectively, as a percentage of total student enrolments and graduates in all fields.

As can be seen, the share of students who graduated in 2004 with a first professional degree in health (26.7%) is somewhat lower than that of the previous years (27.4%-29.9% in 1999-2003). Still, in terms of headcounts there has been an increase in student graduates for this degree in 2004 (3 518 versus 2 944-3 266 of the preceding years).

The headcounts of students who graduated in 2004 with a masters or doctoral degree in health have also shown positive improvements since 1999.

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13 Figure 7 is based on data from the Higher Education Management and Information System (HEMIS) of the South African Department of Education. The following 10 sub-fields in HEMIS were used to construct the broad field of health sciences: (1) basic health care sciences, (2) clinical health sciences, (3) rehabilitation and therapy, (4) pharmaceutical science, (5) emergency services, (6) hospital and health care administration, (7) public health, (8) general perspectives on health care and health sciences, (9) other health care and health sciences, and (10) kinesiology.

14 HEMIS considers a university employee as a permanent staff member if he/she contributes to an approved retirement fund of the employing organisation.

15 HEMIS defines a professional first bachelors degree as follows: A qualification which has a minimum duration of 4 or more years and which has a grade 12 pass with matriculation exemption as a minimum entry requirement.

Table 3: Headcount of student enrolments and graduates in health for three degree types, 1999 to 2004

Degree	Year	Enrolments			Graduates			
		Health sciences	All fields	Health as % of all fields	Health sciences	All fields	Health as % of all fields	% Women in health
Professional first bachelors degree	1999	14117	68206	20.7%	2944	10729	27.4%	--
	2000	16934	75199	22.5%	3241	11584	28.0%	--
	2001	16901	72682	23.3%	2951	10515	28.1%	--
	2002	17171	83200	20.6%	3016	10709	28.2%	67.4%
	2003	18485	90526	20.4%	3266	10922	29.9%	68.6%
	2004	19068	105624	18.1%	3518	13186	26.7%	69.0%
Masters degree	1999	4148	25320	16.4%	493	4728	10.4%	--
	2000	4987	29711	16.8%	578	5704	10.1%	--
	2001	6718	31924	21.0%	988	6055	16.3%	--
	2002	5677	36282	15.6%	651	6667	9.8%	56.5%
	2003	6014	39839	15.1%	730	7182	10.2%	59.9%
	2004	6509	40842	15.9%	770	7552	10.2%	60.3%
Doctoral degree	1999	552	5400	10.2%	77	713	10.8%	--
	2000	631	5842	10.8%	92	821	11.2%	--
	2001	978	6238	15.7%	127	784	16.2%	--
	2002	700	7455	9.4%	90	963	9.3%	55.6%
	2003	801	8112	9.9%	123	1024	12.0%	58.5%
	2004	801	8757	9.1%	118	1071	11.0%	58.5%

Source: Own calculations from HEMIS datasets (www.education.gov.za/dynamic/dynamic.aspx?pageid=326&dirid=14)

2.4 Publications and patents in health sciences

About 20% of peer-reviewed article output in South Africa can be accounted for by the health sciences

(Table 4). Moreover, 16 069 of the 21 015 articles that were published between 1990 and 2004 in the field of health can be found in journals that are indexed by the ISI Web of Knowledge, produced by Thomson Scientific. Lastly, 26% of all the ISI journal articles published by South Africans during this 15-year period occurred in the field of health.

Table 4: South African article output in health sciences, 1990-2004 (3-year periods)

	1990-1992	1993-1995	1996-1998	1999-2001	2002-2004	Total period
All journals						
Article output in health	3674	3722	4061	5048	4510	21015
Total article output in all fields	20282	21091	21258	22704	22065	107400
Article output in health as % of total article output in all fields	18.1%	17.6%	19.1%	22.2%	20.4%	19.6%
South African journals						
Article output in health	1619	1441	1573	1850	1345	7828
Total article output in all fields	12305	12357	12247	12374	11242	60525
Article output in health as % of total article output in all fields	13.2%	11.7%	12.8%	15.0%	12.0%	12.9%
ISI-indexed journals						
Article output in health	2717	2948	3103	3822	3479	16069
Total article output in all	10719	11610	11999	13409	13151	60888

fields						
Article output in health as % of total article output in all fields	25.3%	25.4%	25.9%	28.5%	26.5%	26.4%

Source: SA Knowledgebase, CREST, Stellenbosch University

As far as patents is concerned, between 100-120 USPTO patents per year are granted to South African inventors. Of these, about 8.3% patents have a patent class that can be regarded as 'health-related' (Table 5). "Drug, bio-affecting and body treating compositions" is the technology class that produced the largest number of patents in the health-related field.

Table 5: USPTO patents (health-related) granted to South African inventors by technology class

Class	Class title	2000	2001	2002	2003	2004	Total period
424	Drug, Bio-affecting and body treating compositions (includes class 514)	5	4	5	7	1	22
604	Surgery (medicators and receptors)	4	0	2	1	1	8
623	Prosthesis (i.e. artificial body members), parts thereof or aids and accessories therefor	0	2	0	2	2	6
128	Surgery (includes class 600)	1	0	1	1	1	4
606	Surgery (instruments)	3	1	0	0	0	4
602	Surgery: splint, brace or bandage	0	0	0	1	1	2
Total health-related patents		13	7	8	12	6	46
Total patents in all classes		111	120	113	112	100	556
Health-related as % of total		11.7%	5.8%	7.1%	10.7%	6.0%	8.3%

Source: Pouris, A. (2006). *Quantitative assessment of South Africa's inventive outputs: International patent analysis*. Institute for Technological Innovation, University of Pretoria, South Africa.

Section 3: Training and supply in health sciences

3.1 Tertiary level students in health sciences

In this section we present and discuss statistics on:

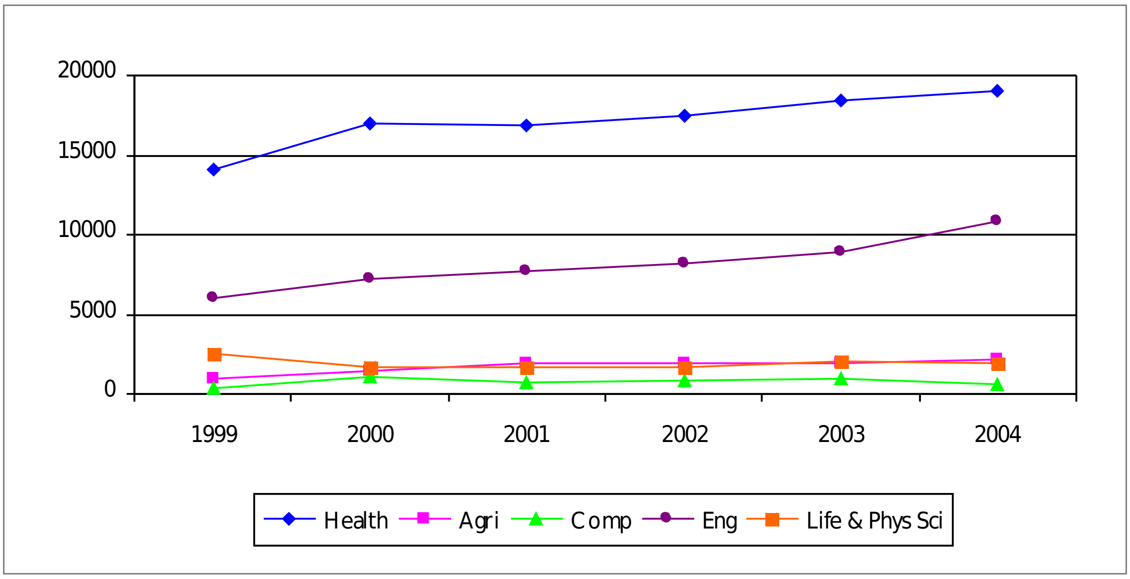
- Student enrolments in health sciences compared to student enrolments in other fields (1999-2004)
- Student graduations in health sciences compared to student enrolments in other fields (1999- 2004)

All these statistics are based on data derived from the HEMIS datasets available on the internet (www.education.gov.za/dynamic/dynamic.aspx?pageid=326&dirid=14). The same 10 sub-fields as mentioned in Footnote 2 were used to construct the broad field of health sciences.

3.1.1 Student enrolments at tertiary level

Figures 8 to 10 present the total headcount of student enrolment in five fields, namely (1) health sciences,
(2) agriculture and renewable resources, (3) computer science and data processing, (4) engineering and engineering technology and (5) life and physical sciences, and across three degrees, namely, first professional degree, masters degree and doctoral degree.

Figure 8: Headcount of student enrolments for the 1st professional degree, 1999-2004

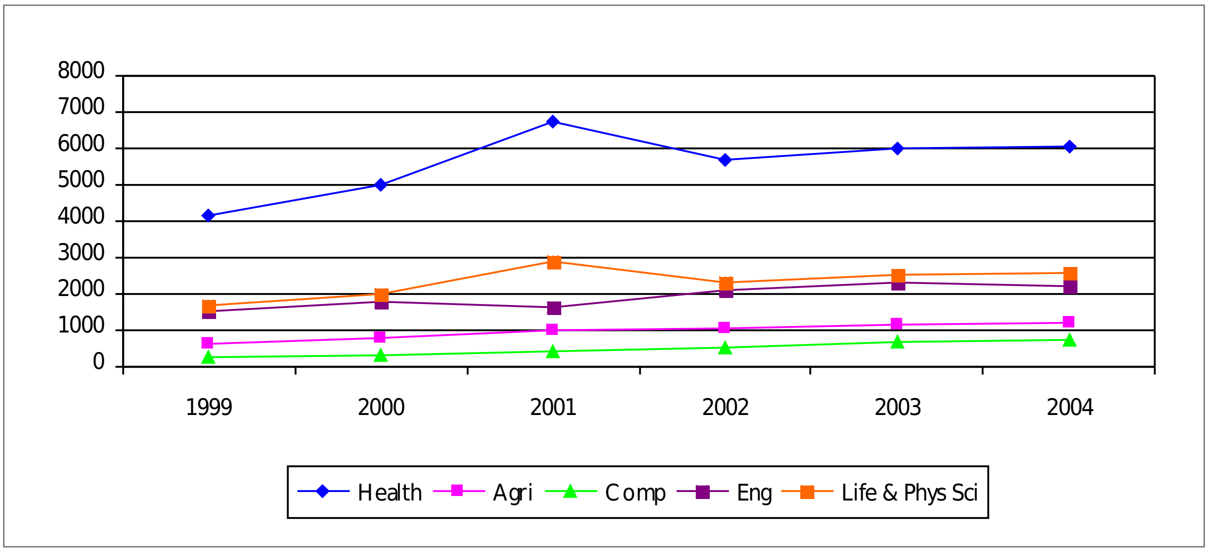


In the case of the first professional degree (Figure 8), both the health and engineering fields showed a steady increase in enrolments between 1999 and 2004, although the health field significantly exceeded the engineering field in terms of the number of enrolments. Other fields, while showing increases over the period, average only around 2 000 enrolments.

What should be kept in mind, though, is that the 1st professional degree in health has a longer duration (about 6 years) than that of 1st professional degrees in the other fields (about 4 years). This could explain why the total enrolment in health is so much higher than the enrolment in the other fields. Ideally Table 8 should have included only first year enrolments. However, the source dataset (HEMIS) still requires additional cleaning and manipulation in order for us to produce such a finer analysis.

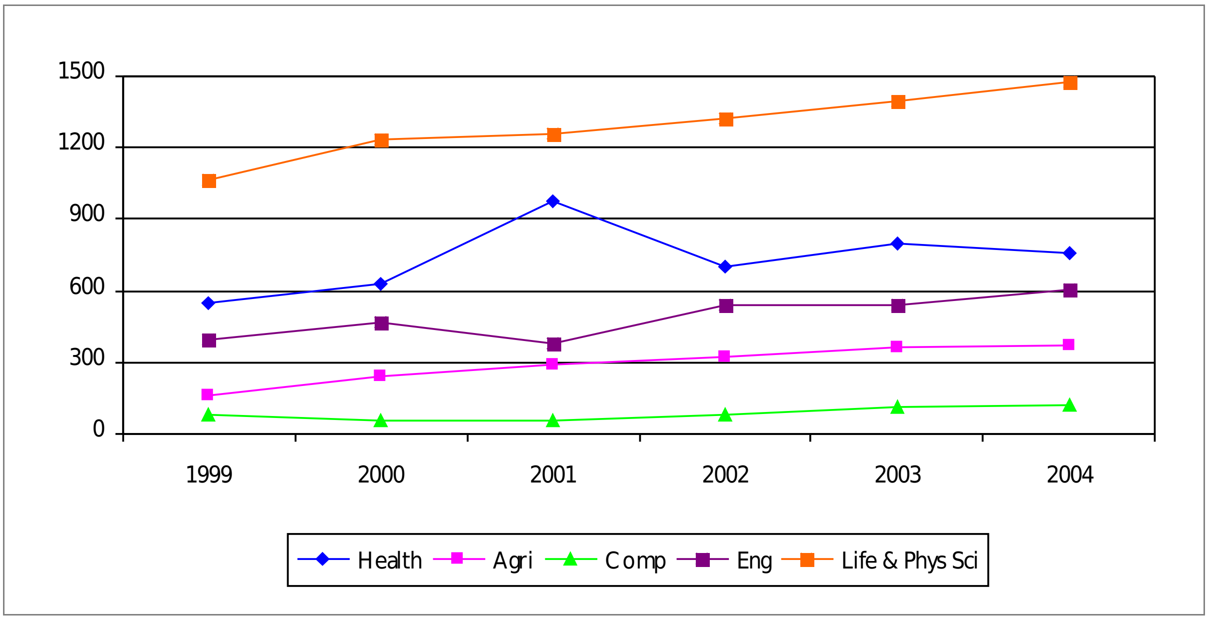
In Figure 9, which pertains to student enrolments for the masters degree, values for 2001 show an outlier and in all probability is due to an error in the HEMIS data set. If we ignore these values, a steady increase can be accounted for in all fields. The field of health sciences, however, still seems to have more enrolments than any other field.

Figure 9: Headcount of student enrolments for the masters degree, 1999-2004



In the case of the doctoral degree enrolments (Figure 10), there seems to be a similar error in the values for the year 2001 as was noted in the previous figure (Figure 9). If we ignore this once again, an increase can be seen across all fields. The interesting point here though, is that the life and physical sciences fields show greater numbers than the health sciences field.

Figure 10: Headcount of student enrolments for the doctoral degree, 1999-2004

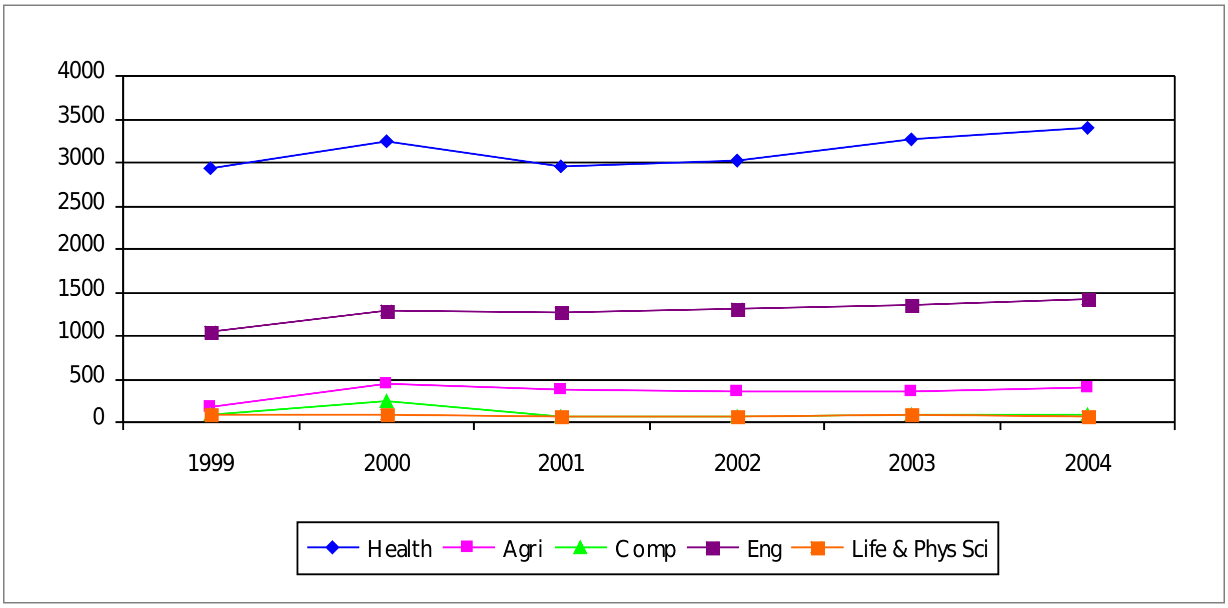


3.1.2 Student graduates at tertiary level

Figures 11 to 13 present the total headcount of student graduates in the same five fields, and for the same three degrees as in the previous section.

Figure 11 indicates that, as far as a first professional university degree is concerned, more students graduate in the health sciences field compared to other fields. While health sciences tend to average around 3 300 graduates, other fields don't exceed 500 graduates – except for engineering, which still falls well short of the average health sciences graduate in any given year.

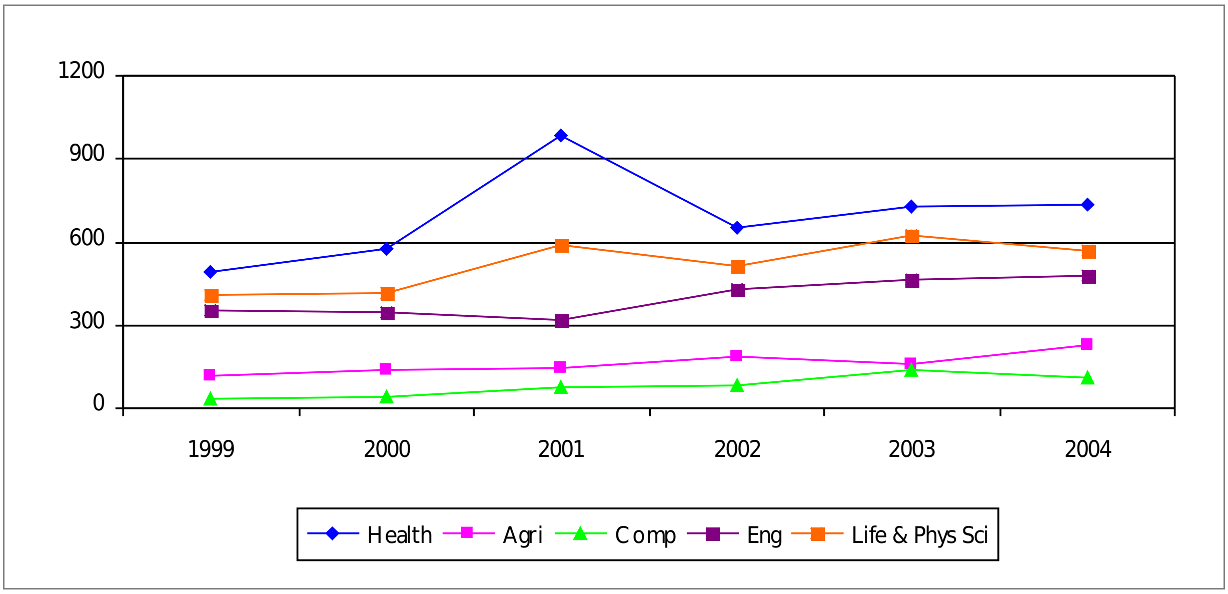
Figure 11: Headcount of student graduates for the 1st professional degree, 1999-2004



In Figure 12, which captures masters degrees, there again appears to be an error in the data set for the year 2001. If we ignore this, we can see an increase in masters graduates across all fields up until

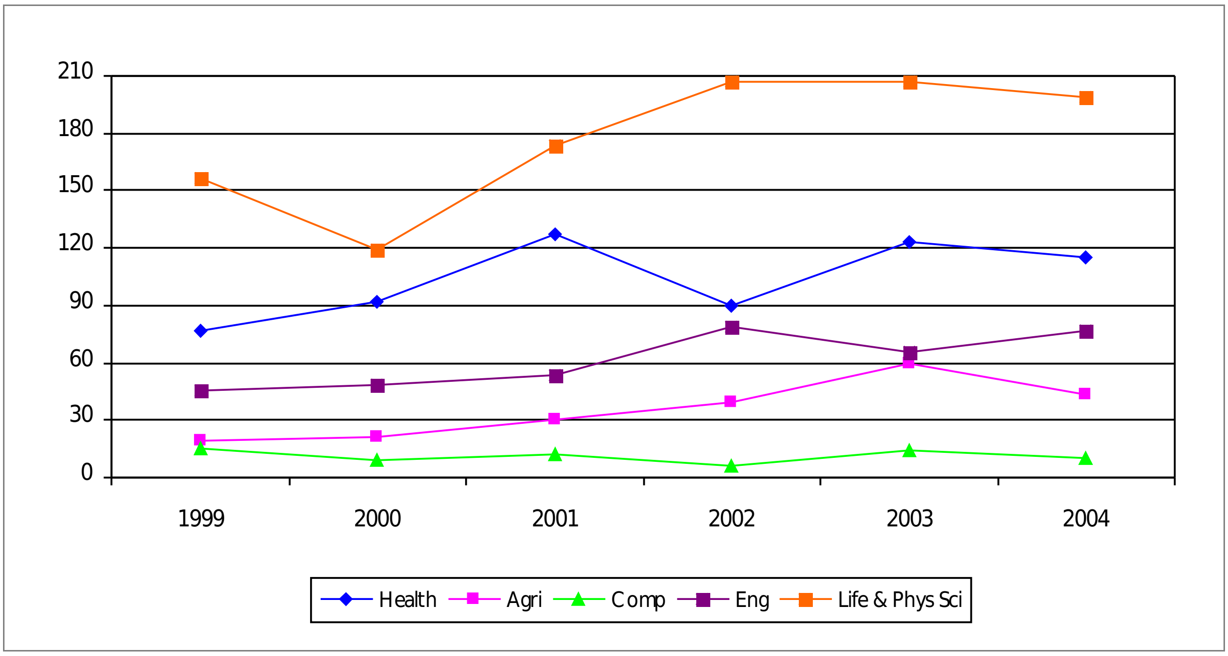
2002. In 2003, while other fields experienced an increase in students graduating from 2002, agriculture had a slight decline. In 2004 the number of masters graduates in life sciences and computer sciences decreased slightly while other fields increased. Health sciences once again dominate but the gap between this field and the other fields is much smaller than was the case in the professional first degree (Figure 11).

Figure 12: Headcount of student graduates for the masters degree, 1999-2004



As we have noted before, there is more than likely an error in the data source for the values in 2001 for doctoral degrees (Figure 13), which we once again will ignore. While health sciences was generally the field with the most graduates in the first professional and masters degree (Figures 11 and 12), the life and physical sciences field now assumes this position in the doctoral degree. All fields show some degree of fluctuation over the 6-year period.

Figure 13: Headcount of student graduates for the doctoral degree, 1999-2004



Salient points:

- If we compare the health sciences to other fields, the health sciences have larger numbers of students enrolling and graduating in both the first professional degree and the masters degree than any other field.
- Life and physical sciences, however, are greater in number for enrolments and graduates for the doctoral degree.

3.2 Share of foreign student enrolments and graduates in health sciences

The share of foreign students enrolled for a masters and doctoral degree in health sciences remained more or less constant at 13%-14% per year during the period 2001 to 2004. With regard to graduation figures (masters and doctoral) larger fluctuations can be observed. For instance, in 2004, foreigners comprised about 21% of masters degree awardees in health, compared to 13% in 2003.

Table 6: Share of foreign students in health enrolling for and graduating with masters and doctoral degrees, 2000 to 2004

Degree	Year	Enrolments			Graduates		
		% South African	% Foreign	% Unknown	% South African	% Foreign	% Unknown
Masters degree	2000	83.8%	14.1%	2.1%	86.9%	9.7%	3.4%
	2001	84.6%	13.4%	2.0%	83.6%	12.6%	3.8%
	2002	85.7%	13.3%	1.0%	81.0%	18.0%	0.9%
	2003	84.9%	13.9%	1.2%	86.4%	12.6%	0.9%
	2004	84.0%	14.8%	1.2%	79.0%	20.6%	0.4%
Doctoral degree	2000	84.8%	11.2%	4.0%	80.7%	11.0%	8.3%
	2001	86.4%	10.5%	3.0%	84.4%	7.8%	7.8%
	2002	84.4%	14.9%	0.7%	89.9%	9.0%	1.1%
	2003	84.9%	14.4%	0.6%	85.2%	14.8%	0.0%
	2004	84.8%	14.7%	0.5%	89.0%	11.0%	0.0%

Source: Own calculations from a special HEMIS dataset.

Respectively about 77% and 59% of students who graduated with a masters or doctoral degree between 2000 and 2004 were from African countries (Table 7). Doctoral graduates, relative to masters graduates, have the larger share of students from European countries over this period (26% versus 9%).

Table 7: Country affiliation of foreign students who graduated with masters and doctoral degrees in health during 2000-2004

Masters graduates		Doctoral graduates	
Country	**%**	**Country**	**%**
African countries		**African countries**	
Botswana	5.5%	Botswana	5.2%
Democratic Republic of Congo	0.8%	Lesotho	8.6%
Lesotho	4.1%	Malawi	5.2%
Malawi	3.5%	Mozambique	1.7%
Mauritius	0.4%	Namibia	3.4%
Mozambique	0.6%	Swaziland	6.9%
Namibia	4.3%	Tanzania	1.7%
Swaziland	3.5%	Zambia	1.7%
Tanzania	2.0%	Zimbabwe	5.2%
Zambia	5.5%	Other African countries	19.0%
Zimbabwe	5.9%	**Rest of world**	
Other African countries	40.9%	Asian countries	5.2%
Rest of world		Australia and Oceania countries	3.4%
Asian countries	11.6%	European countries	25.9%
Australia and Oceania countries	0.4%	North American countries	5.2%
European countries	8.7%	South American countries	1.7%
North American countries	2.0%		
South American countries	0.2%		

Source: Own calculations from a special HEMIS dataset.

Section 4: Labour market in health

4.1 Introduction

The available statistics on the labour market in health reveal an uneven distribution of health workers between the private and public sectors, and between the urban and rural sectors. When reflecting upon the “anomalies” in the sectoral data, notwithstanding the causes, the explanation in most instances relates to migration patterns:

- *External migration of health workers i.e. out of South Africa*
  A 2006 OECD study reveals that a total of 37% South African doctors are working in the following eight countries: Australia, Canada, Finland, France, Germany, Portugal, UK and the USA. This makes South Africa the largest Sub-Saharan African “supplier” of medical doctors to the developed world (World Health Report, 2006).
- *Internal migration of health workers i.e. within South Africa*
  The internal brain drain caused by an influx of health professionals from rural to urban areas and from the public to private sector can be attributed to an array of aspects, also referred to as “push factors”. Poor work climate, heavy workloads, limited career opportunities, unattractive remuneration, inadequate resources and management structures in the rural areas are just some of the contributing factors (Gilson & Erasmus, 2005).

4.2 Urban versus rural areas

In this section we use “province” as a proxy for the urban/rural comparison. Gauteng and Western Cape are characterised as the two most “urbanised” provinces while the Eastern Cape, Kwazulu-Natal and Limpopo Provinces are classified as predominantly rural provinces. Hence, our comparison largely focuses on these five provinces in order to illustrate the uneven distribution of health-related professional occupations between the urban and rural sectors in South Africa.

In a study undertaken by the HSRC in 2004 on the professional labour market for medical doctors in South Africa, Gauteng reported the highest incidence of doctors (36%), followed by the Western Cape (22%). Kwazulu-Natal, one of the most populous provinces, housed only 16% of doctors in the country (Breier & Wildschut, 2006*)*.

Table 8, which is based on data provided by the Health System Trust, presents data on the ratio of medical professionals per 100 000 of the population for a variety of occupations per province (2000

and 2006). The figures only apply to the public sector. Only the grey columns will be considered as it highlights the
uneven distribution of human resources between the “urbanised” and “rural” provinces. The following

patterns emerge:

- When considering the 2006 data, most occupations have a significantly higher ratio of medical personnel to population in the urban provinces compared to the rural provinces. The exception is enrolled nurses and pharmacists, for whom higher ratios are reported in the rural provinces (Kwazulu-Natal and Limpopo) than in the urban provinces (Gauteng and Western Cape).
- However, except for the nursing personnel (enrolled nurses and professional) the ratio of medical personnel to population in the rural provinces has increased between 2000 and 2006, whereas the ratio of medical personnel to population in the urban areas has slightly decreased (except for pharmacists and physiotherapists in the Western Cape).

Table 8: Provincial occupational ratios for 2000 and 2006

Medical practitioners per 100 000 population in public sector										
Province	**EC**	**FS**	**GP**	**KZN**	**LP**	**MP**	**NC**	**NW**	**WC**	***Total***
2000	12.3	24.3	36.6	24.0	12.5	16.4	28.9	11.9	39.7	*21.9*
2006	16.1	21.4	29.7	27.5	14.8	22.0	34.7	14.8	38.8	*23.7*
Dental practitioners per 100 000 population in public sector										
Province	**EC**	**FS**	**GP**	**KZN**	**LP**	**MP**	**NC**	**NW**	**WC**	***Total***
2000	0.80	1.10	4.90	0.80	0.60	1.80	1.60	1.40	3.80	*1.70*
2006	0.99	2.12	3.16	0.73	1.15	2.51	2.94	1.35	3.48	*1.78*
Enrolled nurses per 100 000 population in public sector										
Province	**EC**	**FS**	**GP**	**KZN**	**LP**	**MP**	**NC**	**NW**	**WC**	***Total***
2000	59.2	36.1	46.6	85.0	63.6	42.7	44.0	46.1	60.0	*59.7*
2006	34.5	16.0	45.1	94.1	49.7	43.3	31.2	30.3	50.5	*51.7*
Occupational therapists per 100 000 population in public sector										
Province	**EC**	**FS**	**GP**	**KZN**	**LP**	**MP**	**NC**	**NW**	**WC**	***Total***
2000	0.2	1.4	2.5	0.9	1.1	0.8	0.7	0.6	2.9	*1.2*
2006	0.6	2.5	2.1	1.2	1.9	2.3	2.3	1.1	2.9	*1.7*
Pharmacists per 100 000 population in public sector										
Province	**EC**	**FS**	**GP**	**KZN**	**LP**	**MP**	**NC**	**NW**	**WC**	***Total***
2000	2.3	2.3	5.1	3.3	2.0	2.3	2.3	1.6	6.1	*3.1*
2006	3.0	3.9	4.1	4.7	3.3	4.8	6.9	3.3	8.1	*4.3*
Physiotherapists per 100 000 population in public sector										
Province	**EC**	**FS**	**GP**	**KZN**	**LP**	**MP**	**NC**	**NW**	**WC**	***Total***
2000	0.60	1.20	2.60	1.50	0.90	0.50	0.60	0.40	2.90	*1.30*
2006	0.96	2.32	2.28	2.22	1.23	2.30	4.22	1.09	3.30	*1.94*
Professional nurses per 100 000 population in public sector										
Province	**EC**	**FS**	**GP**	**KZN**	**LP**	**MP**	**NC**	**NW**	**WC**	**Total**
2000	106.1	128.9	172.5	119.8	104.6	90.5	122.3	94.3	139.9	*120.3*
2006	102.3	139.4	113.1	111.4	110.3	96.4	126.9	88.9	114.7	*109.5*
Radiographers per 100 000 population in public sector										
Province	**EC**	**FS**	**GP**	**KZN**	**LP**	**MP**	**NC**	**NW**	**WC**	**Total**
2000	3.9	8.5	13.7	4.7	1.7	1.7	3.1	2.1	16.3	*6.1*
2006	*4.1*	*6.7*	*7.8*	*4.7*	*2.4*	*3.1*	*6.1*	*2.3*	*11.3*	5.2

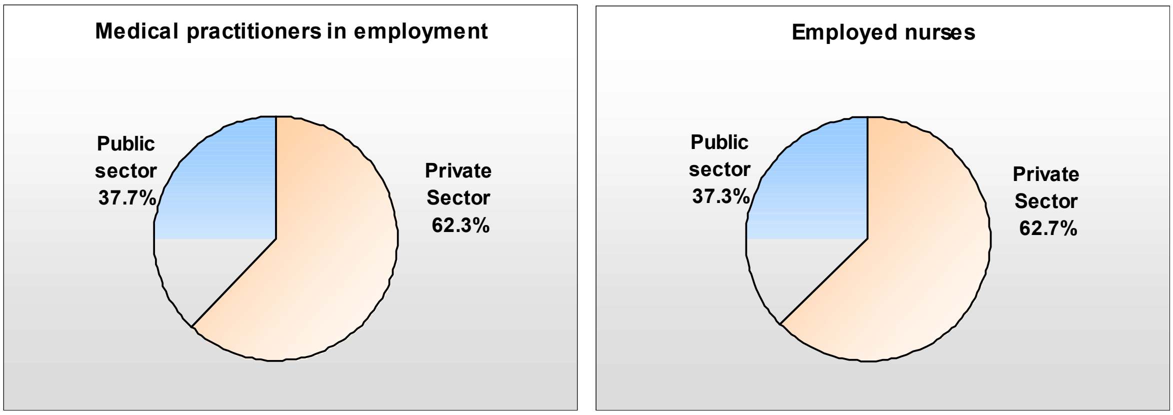
(Source: Health Systems Trust, available: http://www.hst.org.za/healthstats/index.php)
EC=Eastern Cape, FS=Free State, GP=Gauteng Province, KZN=Kwa-Zulu Natal, LP=Limpopo Province, MP=Mpumulanga, NC=Northern Cape, NW=North West, WC=Western Cape

The contributing factors in the increase of rural ratios are difficult to accurately establish. Possibilities include that local retention strategies are starting to pay off, specifically those aimed at the rural areas (discussed in Section 5.2.2). Another explanation for the increase in rural ratios may relate to the “assignment” of foreign professionals to designated rural areas (see Section 5.2.3). Declines in urban provinces do also not necessarily indicate migration to rural areas but could very well be due to international migration, which will be looked at in Section 5.1 of this document.

4.3 Private versus public sector

Doherty et al. (2002, as cited in Gilson & Erasmus 2005) report that nearly 60% of health expenditure is spent in the private sector, while this sector services less than 20% of the total population. Recent statistics on the split between public and private health *professionals* are however difficult to obtain. For this reason we report on the results of a study conducted by Hall and Erasmus (2003), which contains figures for 2001. The private/ public sector split for medical practitioners and nurses are displayed in Figure 14.

Figure 14: Private vs. public sector split for medical practitioners and nurses



It is evident that these two pie charts are almost exact replicas of one another, which shows that the majority of doctors and nurses (about 63%) are located in the private sector.

4.4 Job market for doctors and nurses

The HRD review (Hall & Erasmus, 2003) calculated the job opportunities for nurses and doctors using a methodological process of combining demand and supply to arrive at the projected gaps in the market. The number of medical practitioners and nursing staff that will be needed for the period 2001 to 2011 was projected to be as follows:

- *Medical practitioners*: All three scenarios investigated under the medical practitioner section revealed the possibility of an oversupply of physicians by the year 2011 when aiming to retain a 65:100 000 medical practitioner: patient ratio[16]. The authors nevertheless reason that this is highly unlikely as a lack on information on emigration, skewed proportion in the distribution of physicians and the impact of HIV/AIDS will strongly influence future human resource needs.
- *Nurses*: A different scenario for nurses is revealed. Table 9 is a combination of tables from the Hall and Erasmus study and show the projected gaps in the supply of nurses between 2001 and 2011

[16] In 2003 when the report by Hall and Erasmus (2003) was written the ratio of physicians per 100 000 population was 65. As this figures compares favourably to similar practitioner/ratios established by WHO the 65:100 000 ratio was used as benchmark throughout the report when determining demand.

Table 9: Estimated gap in supply of nurses

Year	Projected Population	Nurses needed *	Replacement demand **	Estimated supply **	Estimated Gap
2001	45 349 800	155 484			
2002	45 969 270	157 429	6 599	5 837	762
2003	46 558 520	159 447	6 769	5 837	932
2004	47 112 480	161 344	6 842	5 837	1 005
2005	47 629 350	163 114	7 918	5 837	2 081
2006	48 101 620	164 732	8 618	5 837	2 781
2007	48 528 670	166 194	7 688	5 837	1 851
2008	48 913 280	167 511	8 264	5 837	2 427
2009	49 252 100	168 672	8 881	5 837	3 044
2010	49 554 890	169 709	7 843	5 837	2 006
2011	49 823 220	170 627	7 706	5 837	1 869
Total demand			77128	58370	18 758

(Hall & Erasmus, 2003)
*Nurses needed to maintain the 2001 ratio of 343:100 000 population.
**Indicate the amount of nurses needed (new and replacement positions) in order to maintain the 343:100 000 ratio. Factors such as population growth, changing health needs, death, retirement and emigration are also included in the calculation
***Average total of nursing graduates from different tertiary institutions between 2001 and 2011.

The estimated shortage of 18 758 nurses by 2011 should be "interpreted with caution". A lack of data on nursing staff in the private health sector, the unknown number of inactive nurses, lack of migration statistics as well as the unknown impact of HIV/AIDS cumulatively impact on the validity of the statistics provided above (Hall & Erasmus, 2003). The statistics provided in the discussion of the urban and rural distribution of resources (Table 8 in Section 4.2) also showed that the nursing profession has experienced a loss in health professionals in the public sector between 2000 and 2006.

Much has been done to improve the regulation and training of the nursing profession through the introduction of two regulatory bodies namely SANC and the Democratic Nursing Organization of South Africa (DENOSA). The 2006 National Human Resources Plan for health also prioritises nursing professions and stipulates a range of matters that are being attended to in an effort to improve the "impending crisis" (Chapter of National Human Resources Plan for Health Final Draft 2006).

As far as initiatives pertaining to the other health-related professional occupations are concerned, the Human Resource Plan circulated in 2006 dedicates an entire section to the current vacancies in the public sector. The targets for each profession were developed by using the current vacancies in the public health sector and comparing it with the current and potential output of education institutions. A study is in the pipeline in order to determine whether or not education institutions would be able to increase the number of professional to the proposed benchmarks. The five medical occupations with the greatest shortage, together with their respective targets, are listed below:

- Emergency Medical Service Practitioners (need 1000 by 2009)
- Medical Practitioners (need 2400 by 2014)
- Professional nurses (need 3000 by 2011)
- Nursing assistants (need 10 000 by 2008)
- Pharmacy Assistants (need 900 by 2008)

As far as broader skills shortages in the health sector are concerned, these will be discussed in the next section (Section 4.5) of the report.

4.5 Skills needs and surpluses in health

A variety of sources were utilised to determine where the scarce skills in the health sector are located. The Revised Draft Health Charter, the health disciplines covered by the Skills Development Fund and the health occupations qualifying for the Scarce Skills Allowance all provide a list of critical areas in the health sector.

The Revised Draft Health Charter of 2005 lists the following shortages in the health care sector: specialised nursing, general medical practice, specialised medical practice, clinical technology, pharmacy, radiology and pathology.

When reviewing the focus areas of the Skills Development Fund (NDoH, 2006a), the following designated sub fields are listed:

- Mid-level workers
- Physiotherapy
- Nursing
- Occupational Therapy
- Pharmacy
- Radiography

When comparing the above to the critical areas eligible for the Scarce Skills Allowance, as set out in the Public Health & Welfare Sectoral Bargaining Council Agreement no 1 of 2004, much of the same fields emerge (PHWSBC, 2004). Table 10 provides a breakdown of the qualifying occupational areas together with the corresponding scarce skills allowance percentage.

Table 10: Professions qualifying for scarce skills allowance

Profession (registered health professionals)	Percentage (%)
Medical and dental specialists Dentist Medical doctor Pharmacist Pharmacologist	15%
Dental technician Psychologist Dietician and nutritionist Occupational therapist Physiotherapist Radiographer Speech therapist	10%
Professionals nurses - Operating theatre technique - Critical care - Oncology	10%

Source: PHWSBC, 2004

What has been done to address the skills needs/shortages in the field? The next section (Section 5) will focus on policy initiatives to regulate recruitment of skilled professionals from abroad as well as changes within the tertiary medical education system to address the local skills shortages.

We will first provide an overview of migration trends in the professional category, and specifically in the field of health.

Section 5: Human resource strategies to reverse the brain drain

5.1 Migration trends

5.1.1 Scope of emigration

Figures 15 to 17 give an indication of the scope of emigration in the professional, semi-professional and technical occupations, and express the figures for medical, dental and related health services occupations as a proportion of total professional emigration. The figures were obtained from Statistics South Africa (www.statssa.gov.za/publications/Report-03-51-03/Report-03-51-032003.pdf, accessed 16 January 2007).

Figure 15: **Total professional, semi-professional and technical occupation emigrants from South Africa, as published by StatsSA**

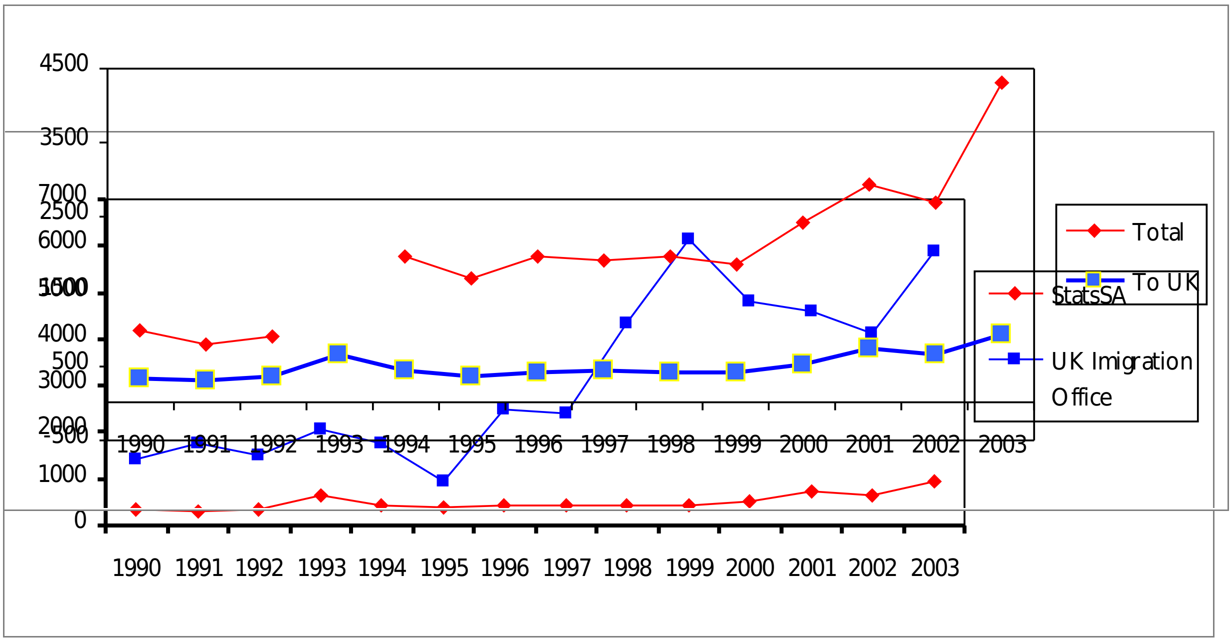
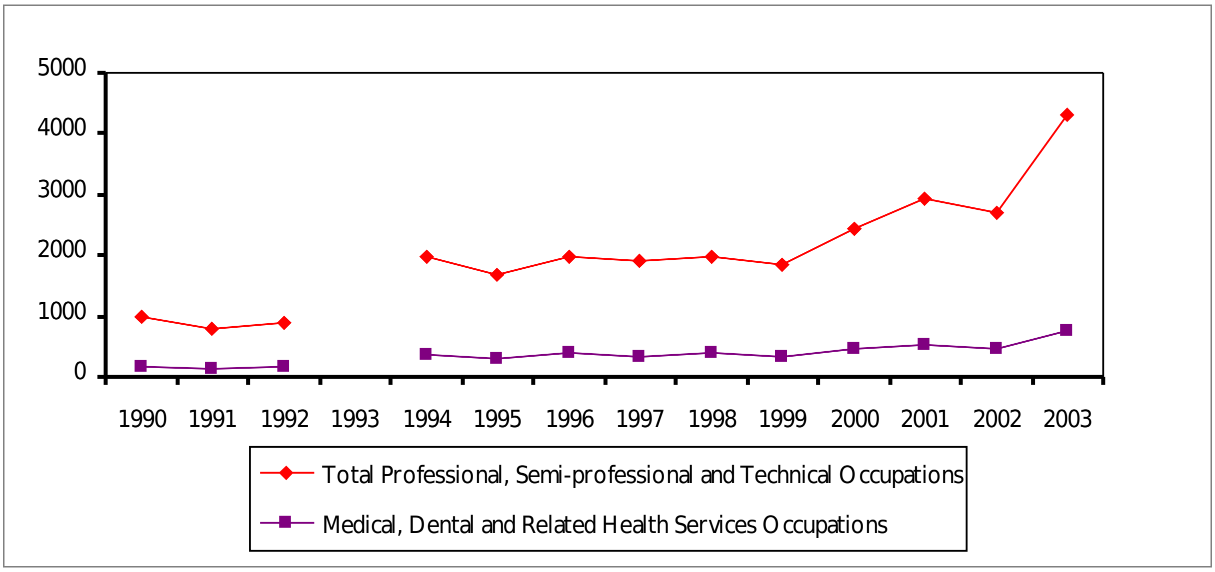


Figure 16: **Total professional, semi-professional and technical occupation emigrants from South Africa to the United Kingdom: A comparison of the figures of StatsSA and the UK Immigration Authorities**

Figure 17: Medical, dental and related health service emigrants as a proportion of the total number of professional emigrants



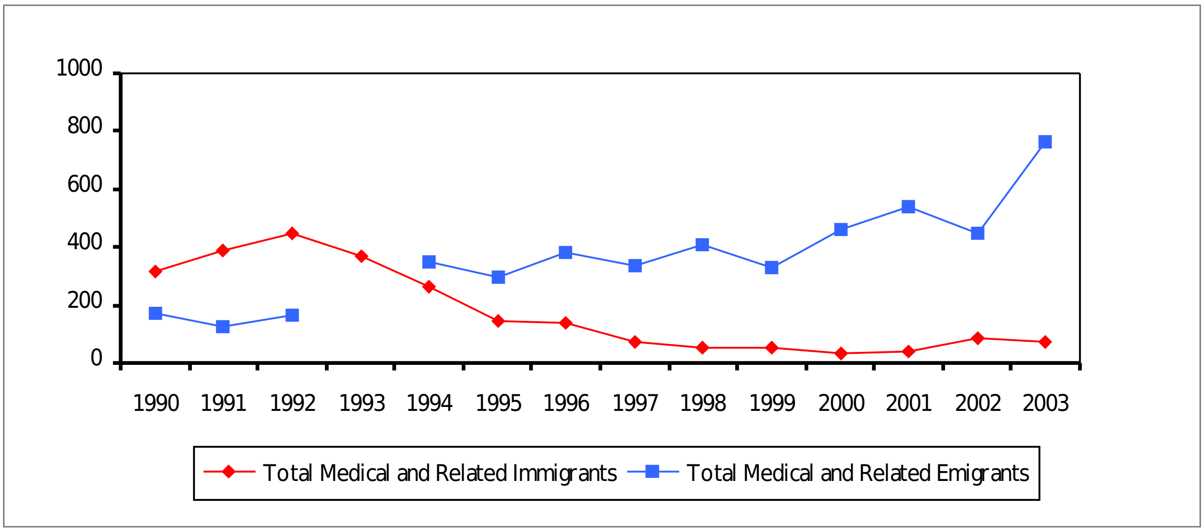
The figures for the Medical etc occupations, include emigrants from the Veterinary Sciences (2001=12; 2002:=8; 2003=29).

The following three conclusions can be drawn from the data in Figures 15 to 17:

- For the period 1990 to 2003 between one third and one quarter of professionals leaving the country moved to the United Kingdom. A positive trend is the decline in this proportion from around 34% in 1990 to 22% in 2003.
- The UK Immigration Authorities' figures indicate that the official South African statistics reflect an under-reported figure that ranges from 76% in 1990 to 84% on 2003.
- Of the total Professionals Category of Emigrants, 18% are in medical and related fields – a figure which has remained constant since 1990.

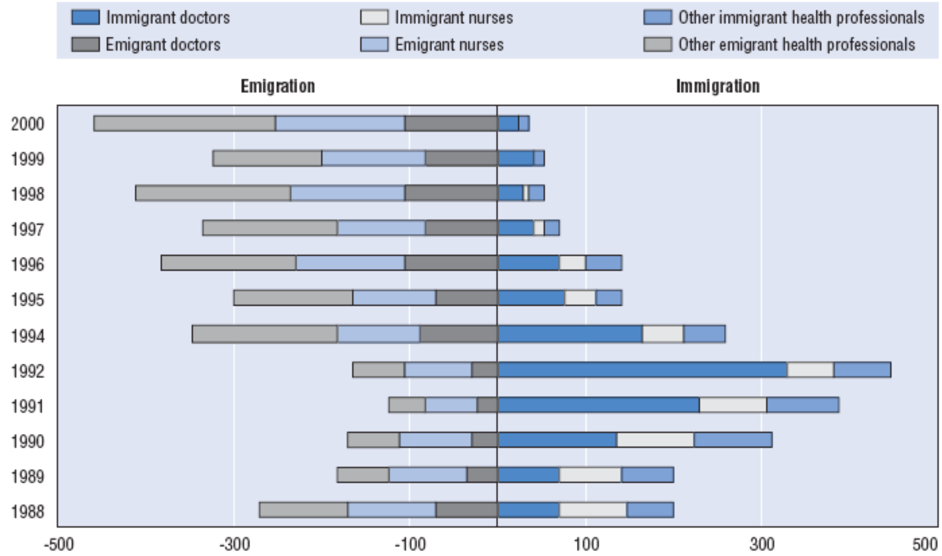
The migration flows of South African health professionals, for the period 1990-2003, are shown in Figure 18.

Figure 18: Migration flows of health professionals in South Africa, 1990-2003 (official data)



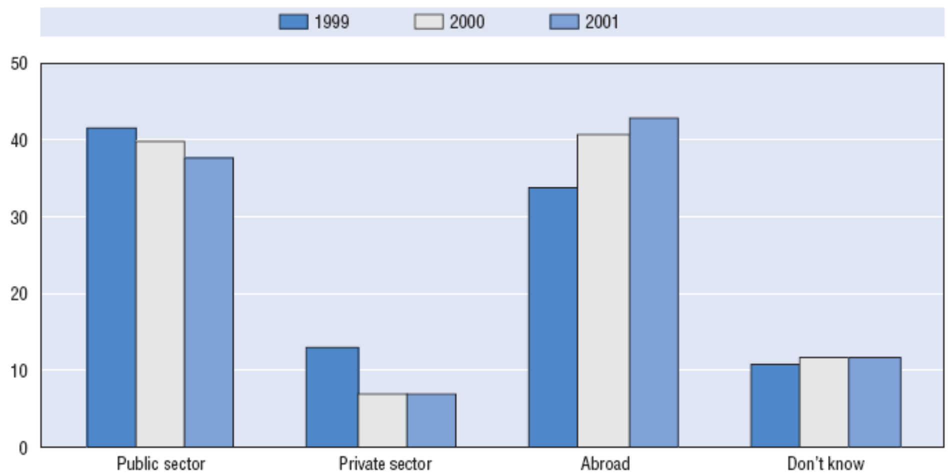
The following charts (Figures 19 & 20), from the OECD publication, *Trends in International Migration* (2004), confirm the increasing trend in emigration of health professionals as well as their intentions for emigration.

Figure 19: **Migration flows of health professionals in South Africa by categories, 1988-2000 (official data)**



Source: Doherty and Joffe, 2003.

Figure 20: **Intentions declared by young South African doctors for assignment at the end of community service, 1999-2001**



Source: Reid (2002).

According to S. Reid of the Centre for Rural Health of the University of Natal, in his article *Community Service for Health Professionals*, this pattern of emigration had been stable for some years, but the reported plans to work overseas were mostly short-term: 70% reported an intention to return to South Africa.

In a study by the WHO (*Migration of Health Professionals in Six Countries: A Synthesis Report* by M. Awases, A. Gbary, J. Nyoni and R. Chatora, WHO Regional Office for Africa, 2004), more than half (58.3%) of the health professionals interviewed for the study in 2002, indicated that they considered leaving the country. Of these, 52% indicated that they considered the UK as a destination. The next biggest intended destination for these respondents was Australia, with 10%.

5.1.2 Demographics of emigration

The emigrants, as documented by StatsSA, display the following demographics in terms of age and gender:

Table 11: Age and gender demographics of professional and medical emigrants, 2003

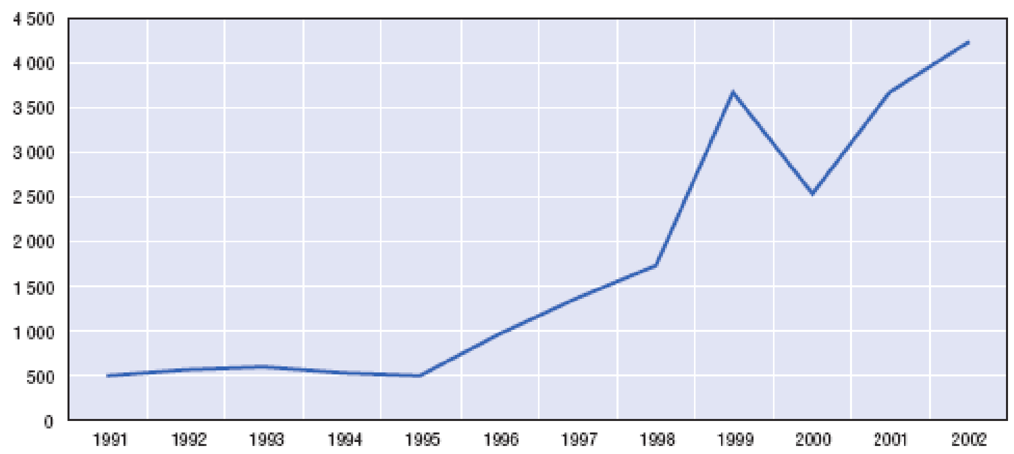
Occupation	Gender	Total	<20	20-24	25-29	30-34	35-44	45-54	55-64	65+
Total professional, semi-professional and technical occupations	Total	4 316	11	176	890	1 003	1 247	671	252	66
	Male	2 254	5	68	402	497	694	390	158	40
	Female	2 025	5	107	483	500	545	270	90	25
	Unknown	37	1	1	5	6	8	11	4	1
Medical, dental and related health services occupations	Total	766	1	23	128	190	221	138	53	12
	Male	243	0	2	31	50	74	56	24	6
	Female	520	1	21	96	140	147	82	28	5
	Unknown	3	0	0	1	0	0	0	1	1

The figures in Table 11 indicate that the majority of medical emigrants are women (68%) and that 78% of female medical emigrants are under 44 years of age, where male emigrants of the same professional classification, tend to be older (65% are under 44 years of age).

5.1.3 Emigration of nursing professionals as a subgroup

Applications for Skills Certificates, a document required by most foreign nursing employers, give an approximation of the numbers of nurses intending to emigrate. This number had increased dramatically towards 2002, after which it is reported to have stabilised (Figure 21).

Figure 21: quests for certificates of qualification by South African nurses, 1991-2002



Source: South African Nursing Council.

The number of South African health professionals registering with UK professional bodies, serves as another indicator of migration. The statistics in Table 12 were obtained from the Nursing and Midwifery Council of the UK (Statistical analysis of the register; 1 April 2004 to 31 March 2005, published August 2005 – website: www.nmc-uk.org, accessed 16 January 2007).

Table 12: South African trained nurses and midwives registering with the UKCC, per year

Year	South African trained nurses and midwives registering with the UKCC, per year
1998/99	599
1999/00	1460
2000/01	1086
2001/02	2114
2002/03	1368
2003/04	1689
2004/05	933

The number of nurses emigrating had increased dramatically until 2002, after which it became more stable and even decreased. This is also echoed by sources in private healthcare in South Africa (Health Systems Trust News, Subashini Naidoo, 2006-07-31) – they concur that they are experiencing fewer resignations from nursing staff intending to work abroad.

5.2 Recruitment initiatives in health sciences

5.2.1 Initiatives to address the skills shortage in the health sector

The revised draft health charter of 2005 recommend that: "*A comprehensive analysis, involving tertiary institutions, must be undertaken to identify gaps in all the areas that relate to healthcare supply and service delivery, and that skills development and human resources targets in the health scorecard are set commensurately.*"

The health charter further recognises that the health challenge can only be addressed if the higher education institutions are on board. Shortages in the health sector can only be addressed effectively if higher education institutions' strategies and programmes are aligned with market needs.

A further challenge is the representation of black people on senior management level. It is also important that transformation takes place over the total value chain i.e. senior management, middle management, junior management and professional and skilled workers. (NDoH, 2005).

A range of policies signifies government's commitment to the improvement in the quality of education and addressing skills shortages in the health sector:

- The National Health Bill of 2004 paved the way for a National Health Council which had to set guidelines and policies pertaining to adequate distribution of human resources, provision of appropriately trained staff at all levels of the national health system and effective utilisation, functioning and management of human resources within the national health system. (Paradath et al. 2004)
- The White Paper for Public Service Training and Education (WPPSTE, 1998) states the intention to invest in training and development in order to improve service delivery (NDoH, 2006d)
- The higher education institutions in health are primarily accountable to the National Department of Education (also in respect of human resource development). Efforts are made to align policy between Department of Education, Health and Labour in order to ensure that skills development in the health sector is properly managed. (NDoH, 2006d)
- The Policy on Internship paves the way for supervised training of newly qualified health professionals before entering independent practice. (NDoH, 2006d)
- The Policy on Continuing Professional Development (established by the Statutory Health Councils in 1999), provides for the continuation of skills development on an ongoing basis. (NDoH, 2006d)
- The National Skills Development Act of 1999 promotes skills development through the provision of learnerships. (NDoH, 2006d)
- The Medical Education for South African Blacks (MESAB) celebrated its 20th anniversary in 2005. Since its inception in 1985 the number of black doctors, working in both the private and public sector, has increased from 500 to 6800. The minister of Health has appealed to MESAB and mind-liked organisations to align skill strategies with that of the Human Resource Plan for Health as presented in 2006. (NDoH Speeches, 2005)

- The Scarce Skills Allowance as mentioned in section 4.5 remunerates health professionals who are active in the identified scarce skills professions.

More recent developments are as follows:

- The introduction of the Mid-Level worker[17] (MLW) cadre and community health workers is another effort by government to free health professionals from routine tasks which could easily be performed by a lower level worker. The first discipline to introduce the mid-level worker has been pharmacy with active steps been taken in the medical field (medical assistant). The other scarce skills areas such as physiotherapy, occupational therapy and nutrition have been discussing the possibility of MLW's but nothing have been finalised (NDoH, 2006d)
- The Community Health Workers Programme was launched in 2004 and since then four community worker qualifications have been registered on the NQF (NDoH, 2006a). The role the community health worker plays in primary health care could be around issues such as waste disposal, safe playgrounds and parks, sanitation and other community developmental issues. The introduction of the new health professional cadres will be monitored closely to ensure that a "healthy balance is maintained" and that the skills gap are being addressed purposefully. For this reason close collaboration between the Department of Health and the Department of Education is central. (NDoH, 2006d)
- In terms of skills enhancement the NDoH has agreed to support a resolution by the Health Profession Council SA to increase doctor's internship period from 1 year to 2 years. This necessitates a curriculum reform as the traditional six-year training programme now needs to be reduced to 5 years. Three medical faculties have already switched over to the 5 year curriculum programme. Those are the Walter Sisulu University of Technology (UNITRA), the medical faculty at the University of Free State and the Nelson Mandela School of Medicine in UKZN. The reasoning behind the change is that a 1 year internship does not provide sufficient time to gain competency in all the domains that needs to be covered. The further inclusions of the anaesthetics, psychiatry and other fields as exit level competencies also demanded an increase in the internship period. (NDoH Media Room, 2005d)
- The Health Professions Training and Development Grant is a mechanism for financing health science education and training. The scope and application of this grant is vague and confusion exists as to who takes responsibility for the grant. The Human Resource plan of 2006 makes recommendations with regards to the management and range of the grant, making it ready for full implementation by 2007. (NDoH, 2006d).
- The implementation of the Scarce Skills Allowance has fuelled unhappiness with the general remuneration of health workers. The minister of health has communicated at a recent health forum that a new financial package are currently under review and will most likely inform the budget process for 2007/08. (NDoH Speeches, 2006).

Moreover, a major effort by the NDoH has been deployed in an attempt to "turn the tide" in rural areas as well as in the public sector. These include reviving or promoting the health system in the rural areas, and the recruitment of medical professionals from abroad. Each will be discussed below.

5.2.2 Reviving the health system in the rural areas

A number of initiatives have been introduced in South Africa to counteract migration from rural to urban. The initiatives can be divided into three types:

- "Renovation" of the rural work environment
- Rural area and public health sector retention policies/regulations
- Other recent developments

"Renovation" of the rural work environment

Initiatives to transform the rural work environment for health workers aim to improve the diminishing work morale. Strategies include management development, improved remuneration packages, fair workloads and the hospital revitalisation programme. (Section 2b Human Resources for Health, 2001*).* In some instances these strategies are linked to formal legislation, which will be discussed next. For example: the rural allowance policy puts in place financial incentives to retain health workers in the rural areas.

[17] A Mid-level worker is a non-professional who undertakes 2 years of training after school. The mid-level worker works under the supervision of a health professional.

The hospital revitalisation plan addresses the poor physical infrastructure and inadequate equipment in rural and under-served areas of the health sector. In 2004, 27 hospitals were "revitalised" with a budget of R717 million. The budget in 2006 were projected to have been more than R1 billion. (NDoH Media Room, 2004)

Rural area and public health sector retention policies/regulations

A range of policy documents exist on "preserving" health workers in the rural areas and public health sector. Policy revolves around tactics such as extending community service to most medical professions, introducing financial incentives for rural health professionals as well as broadening the health professional base by governing traditional healers. Some of these policies, with a short description are listed below:

- The Pharmacy Amendment Act of 1997 ruled that people other than pharmacists were allowed to own pharmacies ensuring sufficient supply in rural areas (Breier & Wildschut, 2006).
- In 1996, the Policy on Community Service by Health Professionals initiated the compulsory one year community service for medical professionals (NDoH, 2006d).
- The community service was extended to dentists and pharmacists and in 2003 extended to include the following disciplines: radiography, speech and hearing therapy, occupational therapy, environmental health, dietetics, psychology and physiotherapy (Paradath et al. 2004). The 2006/07-2008/09 strategic plan has indicated the implementation of community services for nurses by 2007 as a priority area (NDoH, 2006c).
- The Policy on commuted overtime for medical and dental practitioners provide for the compensation of public sector medical and dental practitioners for overtime that is required outside their standard working hours. (NDoH, 2006d)
- The National Health Act of 2003, circulated in 2004, stipulated that all practitioners acquire a "certificate of need" to practice in a certain area. Renewal or issue of such a certificate will take into account reasonable distribution of health services as well as the suitable mix between public and private health service. (Paradath et al. 2004)
- The Traditional Health Practitioners Act of 2004, circulated in 2005, endorsed the commencement of the Interim Traditional Health Practitioners Council. Padarath et al. (2003, as cited in Breier & Wildschut, 2006) claim that there are 200 000 traditional healers practising in South Africa and that 80% of the population consult them before consulting biomedical health practitioners. The act formalises the registration, training and practice of traditional medicine.
- The Rural and Scarce Skills Allowance, backdated to July 2003, attempt to lure health professional to the rural areas, specifically in the public sector. The estimated budget for 2006 is anticipated to have been more than R1 billion (Paradath et al. 2004). In 2004 it was estimated that more than 33 000 full-time health professionals qualified for the rural allowance, whereas the scarce skills allowance applied to more than 60 000 full time health professionals across the health sector (Pauw et al., 2006).

Other recent developments

- Sessional work in the public sector is part of the Department of Health's strategic plan to strengthen human resources. Private partnerships will be established with GP's and specialists in the private sector to do sessional work in the public sector. The intended date for the commencement is the beginning of 2007. (NDoH, 2006c).
- The establishment of RUDASA (Rural Doctor Association of Southern Africa) is worth mentioning. As part of its endeavours a recruitment project, in collaboration with the Rural Health Initiative has been initiated focusing on the recruitment of health professionals in the rural areas. Funded by CIDA (Canadian International Development Agency) RUDASA acknowledges the need for attracting foreign doctors to under-serviced areas. RUDASA has been lobbying for the improvement of conditions surrounding the employment of foreigners. Recent developments in this area include the Health Profession Council agreeing to register foreign doctors without necessarily requiring examination and also the Department of Home Affairs issuing work visas for 3 year periods. (RUDASA).
- The Rural Health Initiative (RHI) also states one of its programme priorities as the following: "The return of South African–qualified health professionals after a year or more of working overseas". Research has shown that South African health workers are not adverse to the idea of working in the public sector, but usually receive no information or offers after completing their community service. For this purpose the RHI's plan of action include advertising local positions overseas, including UK, Canada and the USA and supplying updated information on job opportunities in the health sector. (Rural Health Initiative)

5.2.3 Recruitment of medical professionals from abroad
Currently medical officers' vacancies in some rural hospitals are estimated at 80% to 90% (Keeton, 2007). The loss in skilled medical professionals to the developed world has to be compensated for in one way or another. Although internal measures are taken to retain staff within the public sector and rural areas this is not adequate to fulfil the health needs of the country.

It is extremely difficult to compete with developed countries in retaining health professionals for South Africa's health system. The recruitment of medical professionals from other countries means walking the proverbial "fine line" as to ensure that local demand and supply does not negatively impact on the "donor" or source country. The NDoH attempts to regulate the movement of health professionals in and out of South Africa in various ways.

We will regard the following when dissecting the "internationalisation" of health professionals in the South African health context:

- How international is the health sector?
- Where do international recruits come from?
- To what extent are the international recruitment processes regulated by government and what have been the latest developments in this area?

How international is the health sector?
It is estimated that more than 2 000 foreign doctors are currently employed in the public sector (Keeton, 2007). A 1998 study by Makan (1998) found that even though the number of foreign doctors in Northern Province and North West were small compared to Gauteng and Kwa-Zulu Natal, they still comprised about 40% of all doctors in those two provinces. Unfortunately more recent figures on provincial splits between foreign and local health professionals are not available.

Where do international recruits come from?
The big influx of health professionals from SADC countries to South Africa in the 1990's, prompted policy to limit the recruitment of health professionals. Paradath et al. (2004) state that approximately 200 doctors left Zimbabwe and Botswana for SA in the early 1990's. The potential inflow from African countries was effectively blocked with the moratorium the Health Professional Council placed on the registration of all foreign doctors from African countries (Paradath et al., 2003).

Recent international recruitment activities have been from four countries, namely Cuba, Tunisia, Iran and Russia.

Iranian doctors for SA

Twenty-seven Iranian doctors have been offered jobs in South Africa as part of an agreement signed by the two countries yesterday.

According to a joint communique signed in Pretoria by Foreign Affairs Minister Nkosazana Dlamini-Zuma and her Iranian counterpart Manouchehr Mottaki, the first group of Iranian doctors have already arrived in South Africa.

"The parties agreed to accelerate the process of recruitment of the next group of Iranian doctors as a second phase for implementing the protocol on Recruitment of Health Professionals," it said. – **Sapa**

Cuba: The agreement between Cuba and South Africa constitutes an exchange program. A media extract (NDoH Media Room, 2006) reports that more than 400 previously historically disadvantaged students were sent to study medicine in Cuba since the start of the programme. Students were typically recruited from the more rural provinces such as the Eastern Cape, Kwazulu-Natal, Mpumalanga and North-West.

Hereby students, who would not have been able to gain access to the local tertiary health system - due to high selection criteria and financial constraints - were given the opportunity to enter the medical arena by studying in Cuba. The public sector will benefit their return as they are required to work in the community sector the same amount of time they spent studying in Cuba.

In return, Cuban doctors have been "imported" to address the current shortage in the rural areas. These doctors are governed by strict regulations to ensure that under serviced areas of the health sector are targeted. (NDoH Media Room, 2002; NDoH Speeches, 2003; NDoH Media Room, 2006)

Source:
www.hpcsa.co.za/hpcsa/UserFiles/File/Current%20News/iranian%20doctors%20for%20sa.pdf

Iran: The 2006 Annual Report of the NDoH lists a range of international Health Liaison activities. According to this report 24 contracts for the recruitment of Iranian doctors were finalised. The newspaper clipping on the left confirms this.

Tunisia: A recruitment agreement between the health ministers of South Africa and Tunisia has been signed in 2004. This agreement lays down a commitment by the two countries to strengthen the ophthalmology programme (specifically pediatric ophthalmology) as well as the exchange of experts and healthcare professionals to counteract the current migration of health professionals. In September 2005 Dr Manto Tshabalala-Msimang again visited Tunisia to further discuss the under representation in the rural and under-served areas of South Africa. (NDoH Media Room, 2005a)

Russia: Discussion with the Russians regarding the recruitment of Russian health professionals for work in South Africa is in its planning stages. (NDoH Media Room, 2005b)

To what extent are the international recruitment processes regulated by government and what have been the latest developments in this area?
Some of the ways to control the movement of health professionals into South Africa and attempts to preserve skills for the local health arena are as follows:

- A Memorandum of Understanding, signed in 2003, exists between the UK Department of Health and the South African National Department of Health. Following a survey conducted in many countries (including South Africa) it was found that the main reason for migration was the opportunity to gain international exposure. This has lead to an agreement whereby South African health professionals will be able to work in the UK for up to two years and then return to South Africa to apply that knowledge locally. Opportunities are also created whereby British health professionals can work in rural and underserved areas in South Africa. (NDoH Speeches, 2004)
- A meeting was arranged in August 2004 between Health Minister Manto Tshabalala-Msimang and her British counterpart, John Hutton in order to "tighten the screws" on the recruitment of health professionals from South Africa. Hutton announced that the code would also be extended to the recruitment of all health workers not only full-time employees. Current loopholes include temporary health workers and agencies recruiting for the private health sector in the UK. (SA, UK tighten recruitment rules, 2004)
- The development of the policy document "Recruitment and Employment of Foreign Health Professionals in the Republic of South Africa" emanated from the Ministers of Health in the SADC region. It aims to regulate the "recruitment, employment, migration and support towards the residency status of foreign health professionals in South Africa" (NDoH, 2006b). Amongst other things the policy clearly stipulates that foreign health professionals will be recruited to address the health needs in under-serviced areas in the South Africa. Full-time employment for foreign health professionals will only be considered if no qualified South African is available for the same position. Foreign doctors are also required to register with the Health Professions Council of South Africa (Paradath et al. 2004). The recruitment of health professionals from any developing country will not be supported.
- The Association of South African Nurses in the UK (ASANUK) has agreed to "mobilise South African nurses in the UK to engage in issues relating to health service provision and development in South Africa". The body also enables them to share specific knowledge, information and advice with colleagues in South Africa. A meeting requested by ASANUK, was held in September 2005 between the Minister of Health SA and approximately 200 nurses working in the UK. At this meeting the NDoH encouraged nurses to return home and used the opportunity to enlighten UK nursing professionals of contemporary strategies that were implemented to improve working conditions in the public sector. (NDoH Media Room, 2005c)

5.3 Ethical guidelines for recruitment

South Africa is a signatory to the Commonwealth Code of Practice for the International Recruitment of Health Workers. The guidelines provided takes into account demand of health professionals in a manner that is cohesive to both source and recipient countries. The principles listed by the Commonwealth code of practice include:

- Transparency: the agreement should be clear on the type of skills, expertise and numbers of health care workers recruited.
- Fairness: a range of factors come into play when considering fairness. Recruiters should not engage with health workers who have an outstanding obligation to their own country. Fairness also requires that recruiters provide accurate information on selection procedures, nature and requirements of the jobs they are expected to do. Employment regulations such as remuneration, professional development also come into play when considering fairness as a principle.
- Mutuality of benefits: recruiters should consider ways in which they could provide support to source countries for example technical assistance. (Commonwealth Code of Practice)

The Commonwealth Code of Practice is not a legal document but rather provides a framework within which international recruitment should take place. The Memorandum of Agreement signed in 2003 between the
UK Department of Health and South African Department of Health is an outflow of the Commonwealth Code of Practice.

In 2005, a resolution on health recruitment and migration drafted by South Africa, was handed over to the World Health Assembly (WHA). The resolution called for an increase in financing and resources of the World Health Organisation's Human Resource for Health Division to enable them to adequately address previous matters on recruitment and health brain drain (NDoH Media Room, 2005e). This shows that African ministers of health are uniting against the brain drain and the continued "luring" of health professionals from developing countries to the developed world.

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Further possible data sources:

- National Human Resource Databank – National Department of Health
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- National Department of Education – Higher Education and Further Education & Training
- Department of Labour – Employment Statistics
- Census Records - Statistics South Africa
- Fiscal Review Reports – National Treasury
- Documents of World Health Organisation considered for HRH Planning

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Researching Inequality through Science and Technology (ResIST)

Work Package 2
Supporting sustainable scientific mobility

COUNTRY REPORT ON THE UNITED KINGDOM

Compiled by:

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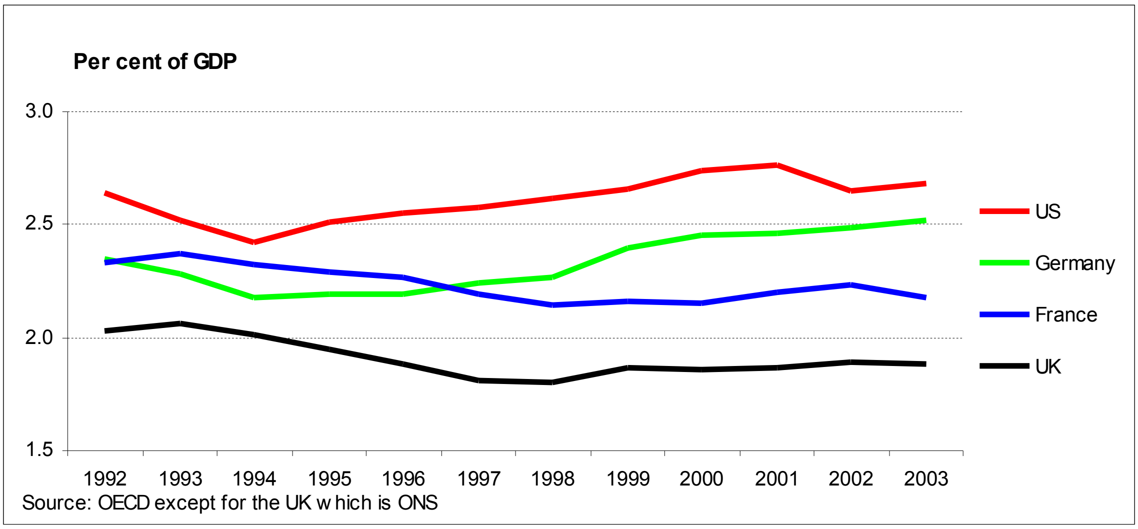
Section 1: R&D country profile

1.1 GDP expenditure on R&D

The UK still lags behind European neighbours such as Germany and France in expenditure on R&D as a percentage of GDP (Figure 1). The UK Government has not yet committed to the three per cent target as set in the Lisbon agenda, but has set a target of 2.5 per cent by 2014. A major part of this strategy is to increase investment in R&D by the private sector and charities (*Science and Innovation Investment Framework 2004-2014).*

Figure 1: Gross Domestic expenditure on R&D, UK and selected countries, 1992-2003



(Source**: http://www.dtistats.net/competitiveness5/spreadsheets/xl/W.all260606.xls)**

The UK performs over three-fifths of its R&D in business enterprise but, of the G7 countries, only Italy displays a proportionally lower percentage of funding from business (Table 1). The UK does attract significantly more R&D funding from overseas than countries like Germany and Japan.

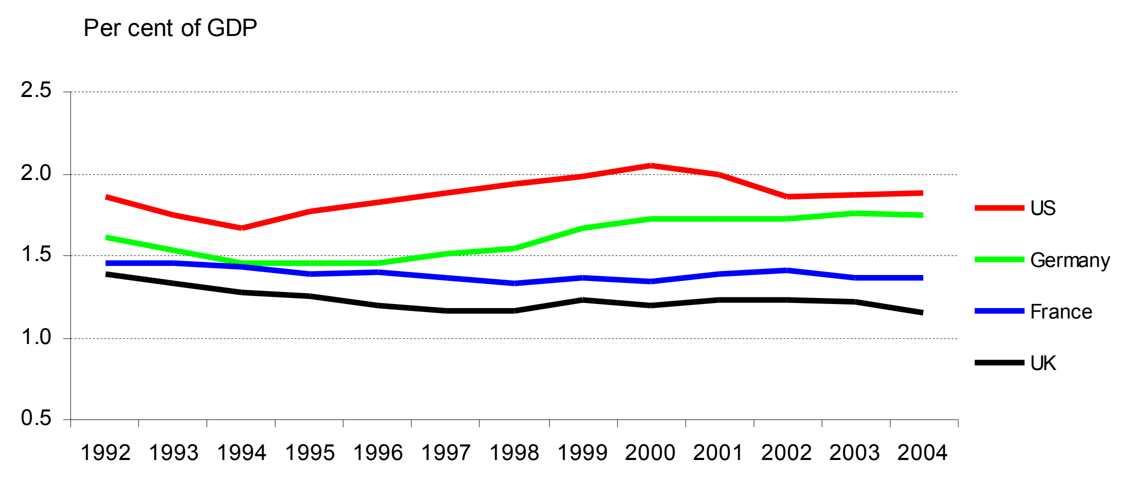
Table 1: Comparison of gross expenditure on R&D in G7 countries by sector of performance and source of funding, 2004

Per cent	UK	Germany	France	Italy	Japan	Canada	USA
Percentage by sector of performance							
Government	10.6	13.6	17.1	17.9	9.5	9.3	12.2
Business enterprise	62.8	69.9	62.5	47.8	75.2	55.5	70.1
Higher education	24.5	16.5	19.2	32.8	13.4	34.8	13.6
Private Non-Profit	2.0	..	1.3	1.5	1.9	0.5	4.1
TOTAL	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Percentage by source of funds							
Government	32.9	30.4	37.6	50.8	18.1	32.0	31.0
Business enterprise	44.1	66.8	51.7	43.0	74.8	49.0	63.7
Abroad	17.2	2.5	8.8	6.2	0.3	9.0	..
Other	5.8	0.4	1.9	..	6.8	10.0	5.4
TOTAL	**100**	**100**	**100**	**100**	**100**	**100**	**100**

(Source: OECD Databank (May 2006) via ONS in http://www.dti.gov.uk/science/science-funding/set-stats/index.html)

The UK consistently reports a lower proportion of BERD than the EU average and other EU countries such as Germany and France (Figure 2), although it had increased by 20 per cent in real terms (HMSO, 2006: 8)

Figure 2: Business Enterprise expenditure on R&D, UK and selected countries, 1992-2004



Source: OECD except for the UK w hich is ONS. Break in series for France 1996/7 and 2000/1. US data excludes most or all capital expenditure.

(Source: www.dtistats.net/competitiveness5/spreadsheets/xl/W.all260606.xls)

1.2 Science Funding

Total funding for R&D performed in the Science and Engineering Base in 2003-2004 was £5,486 million of which:

- 72% came from Government
- 14% from charities
- 8% from overseas (including 4% from the EU)
- 5% from UK industry

(http://www.dti.gov.uk/science/science-funding/set-stats/sci-eng-base/index.html)

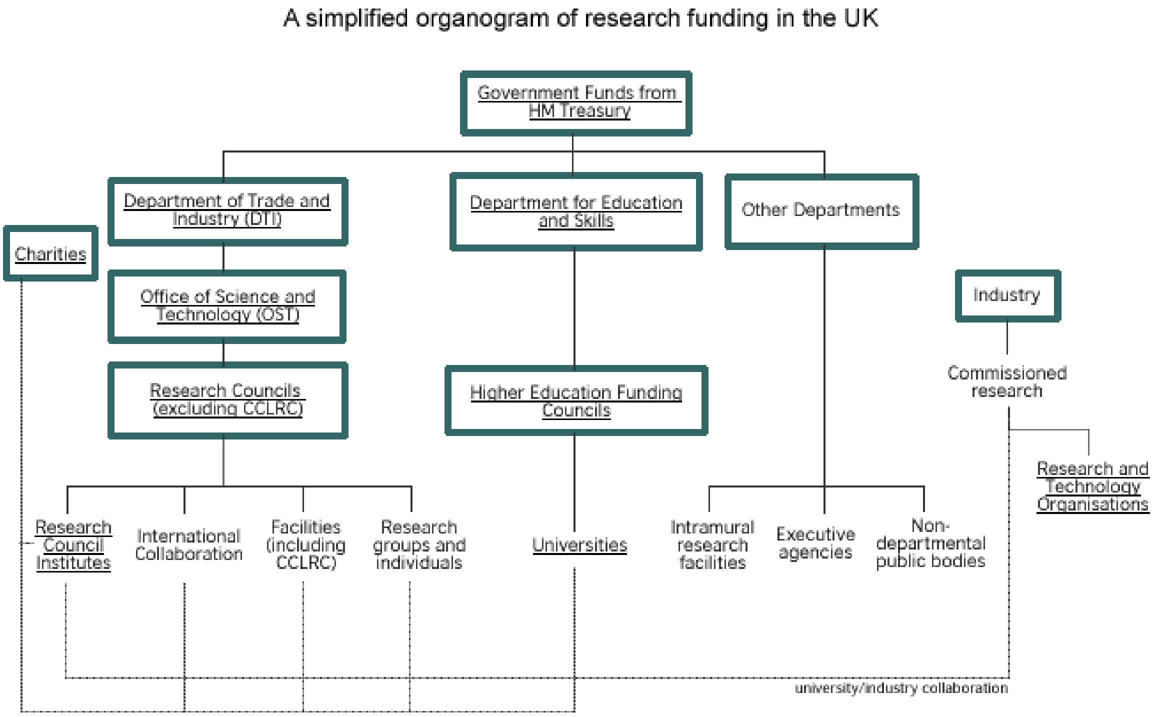
Public expenditure on science declined in the UK in the 1980's and early 1990's but has experienced growth in the past decade. The (OST) Science Budget is £3.4 billion in 2007-08, more than double the level of 1997; and total spending on science through the Department of Trade and Industry (DTI) and Department for Education and Skills (DfES) will reach £5.4 billion (€7.9billion) by 2007-08 (HMSO, 2006: 6).

Funding to support research in the UK comes through three major sources – the science budget (set by the Office of Science and Technology), higher education funding, and from other funders (Charities, other Government Departments, Business, and International – Figure 3). The Office for Science and Technology has overall responsibility to maintain the health of the UK research base.

Academic research is funded through the dual support system –the Higher Education Funding Councils distribute core grants, and project grants[18] are usually competitively bid for, and awarded by the Research Councils. There are seven different research councils in the UK (spanning different disciplinary areas (cf. Table 6) some funding opportunities are available through joint funding initiatives.

[18] Also awarded by Industry, Charitable Foundations and Regional/ International funding bodies

Figure 3: Organogram UK research funding



(Source: British Council, www.britishcouncil.org/gost/organ.htm)

1.3 R&D personnel by sector

There has been a decline in the total number of people engaged in R&D in the UK (not including in HEI's) between the late 1980's and 2004-05 (Table 2). An exception to this general trend occurred in business enterprise where there was considerable growth in the number of research personnel.

Table 2: R&D personnel by sector, 1998-89 -2004-05

Full time equivalents, 000s	1988-89	1992-93	1995-96	1998-99	2001-02	2004-05
All personnel engaged on R&D*						
Business Enterprise	181	152	145	148	152	163
Research Councils	13	13	12	11	12	11
Government Departments	24	25	17	18	12	9
Private Non-profit	6	6	5	5	6	8
Researchers						
Business Enterprise	88	80	82	91	93	103
Research Councils	6	6	6	5	5	5
Government Departments	9	9	8	9	5	4
Private Non-profit	3	3	3	3	4	4
Technicians						
Business Enterprise	46	37	33	32	28	25
Research Councils	2	2	2	3	3	2
Government Departments	4	4	4	4	3	2
Private Non-profit	1	1	1	1	1	1
Administration & other staff						
Business Enterprise	47	35	29	24	31	34
Research Councils	5	5	4	3	4	4
Government Departments	11	11	5	5	4	3

	Private Non-profit	2	2	2	1	1	2

* not including personnel in UK HEI's (see table x)

(Source: ONS Government R&D Survey in http://www.dti.gov.uk/science/science-funding/set-stats/index.html)

A total of 163,692 staff were employed in UK Higher Education Institutions' in 2004-05 comprising, lecturers (34%), researchers (21%), other grades (19%), senior lecturers and researchers (17%) and professors (9%).Table 3 shows the representation of staff in UK universities by nationality group where high levels of internationalisation is apparent, just over a third of the staff categorized as 'researchers' come from abroad: [19]

Table 3: Staff in UK HEIs' by Grade and Nationality Group (%)

	Nationality group				**Total**
Grade	**UK**	**EU**	**non-EU**	**unknown**	
Professors	86.8	5.1	6.4	1.6	100.0
Senior Lecturers and Researchers	84.8	6.1	6.8	2.3	100.0
Lecturers	77.5	7.7	7.7	7.1	100.0
Researchers	**61.4**	**15.8**	**18.6**	**4.3**	100.0
Other grades	71.3	8.0	7.4	13.3	100.0
Total	75.0	8.9	9.6	6.4	100.0

(Source: HESA Staff record 2004-5)

1.4 Gender profile of researchers

In the last decade the number of women academics in the UK has been growing sharply - increasing by 43 per cent between 1995–96 and 2002–03, from 39,625 to 56,480 (compared to four per cent growth for males in the same period) (AUT, 2004: 6). Women are concentrated in research and lectureships accounting for only 15 per cent of professors in 2002-03 (Table 4).

Table 4: Percentage of staff in employment grades by gender in English HEIs', 2002-03

Grade	**% women in grade**	**Female**	**Male**	**Total**
Researchers	45%	11,562	14,243	25805
Other	45%	16,244	21,064	10943
Lecturers	44%	5423	13,530	37308
Senior Lecturers and Researchers	29%	1520	8881	18953
Professors	15%	4906	6037	10401
Total	38%	39,655	63,755	103410

(Source: Ackers and Gill, 2005:284)

SECTION 2: Field overview

2.1 R&D expenditure in health sciences

Table 5 shows that funding for research in the medical sciences has been steadily increasing year on year in
the UK.

Table 5: `Higher Education Funding Councils R&D and SET expenditure by subject area

£ million	1995-96	1997-98	1999-00	2001-02	2003-04

[19] This raises complex definitional questions which demand a detailed knowledge of career structures in UK universities. In the UK, doctoral candidates hold the status of students and not staff as they do in many other EU Member States (including Germany). According to HESA data, the category of 'researchers' include all research grades that are not included as professors, senior lecturers & researchers, or lecturers. Although these groups of permanent academic staff also undertake research as part of their employment, in the UK the 'researcher' category generally includes those staff, mainly in early career (post-doc or contract research) positions who hold research-only contracts, usually on a fixed-term basis.

Natural science	286	289	323	407	447
Medical science	199	207	253	331	389
Engineering	182	189	211	261	283
Social science	200	189	202	255	281
Arts & Humanities	151	159	169	220	265
TOTAL SUBJECT AREAS	1,018	1,033	1,157	1,474	1,665

(Source: www.dti.gov.uk/files/file22178.xls)

In 2007/08 the Medical Research Council was awarded 20 per cent of the total science budget distributed between the research councils in the UK, topped only by the Engineering and Physical Sciences Council who were allocated 26 per cent (Table 6). While funding to the Engineering and Physical Sciences had risen by 44 per cent between 2004 and 2007, funding to the Medical Research Council had only risen by 20 per cent in the same period.

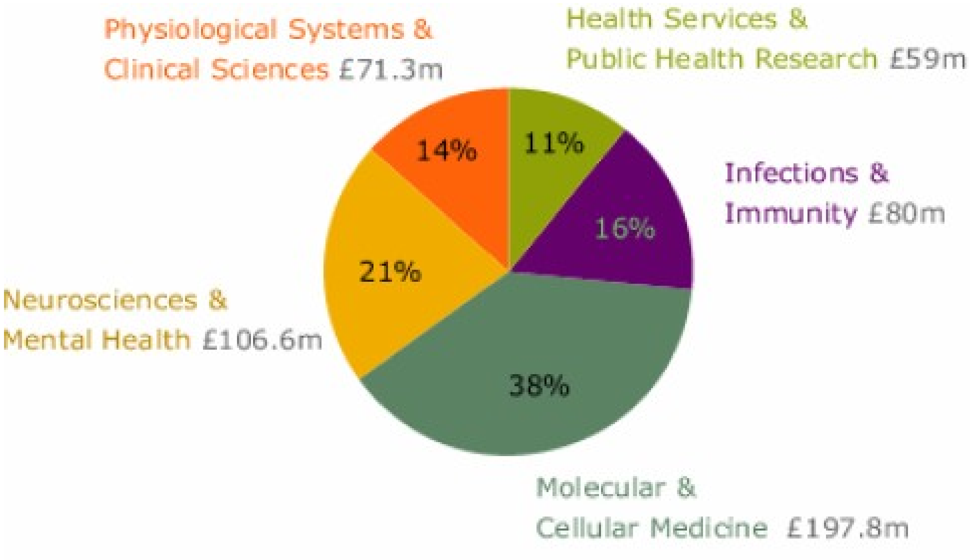
Table 6: Science Budget allocation to Research Councils UK (total 2,791,943)

£000's	07/08 allocation	% increase in 2007/08 compared to 2004/05
of which		
Arts and Humanities Research Council	97,092	43%
Biotechnology and Biological Sciences Research Council	381,829	33%
Council for the Central Laboratory of the Research Councils	212,507	66%
Engineering and Physical Sciences Research Council	721,172	44%
Economic and Social Research Council	150,336	43%
Medical Research Council	546,514	20%
Natural Environment Research Council	367,248	18%
Particle Physics and Astronomy Research Council	315,245	15%

(DTI, 2005:6)

The MRC funds training and research in Universities and teaching hospitals and its own funded centres (three research institutes, 27 research units in the UK and two in Africa) Figure 4 provides a breakdown of the areas of research funded by the MRC – with 38 per cent of funding concentrated in molecular and cellular medicine.

Figure 4: Medical Research Council Estimated spend 2005/06 by research area



(Source : http://www.mrc.ac.uk/OurResearch/Overview-FactsandFigures/index.htm)

Priorities for investment by the Medical Research Council 2005-98

- The MRC and Health Departments will build on their existing partnerships to further accelerate the translation of research results into improved human health. MRC will also give priority to other areas, including infections and vaccine development, global health, and biomarkers.
- The MRC's research training and career development programmes will continue to respond to critical capacity shortages such as integrative physiology and pharmacology, where a partnership is being forged with industry. The MRC will use the additional £7.9M provided for implementing the recommendations of the Roberts' Review on recruitment and retention of young scientists. MRC and Health Departments will build on their existing partnerships to further accelerate the translation of research results into improved human health.
- The MRC will also give priority to other areas, including infections and vaccine development, global health, and biomarkers.
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- During the SR2004 period, MRC Technology will build on the MRC's already strong position in exploiting the Council's IPR. MRC Technology will establish a new Drug Discovery Group to better position MRC intellectual property for translation into commercial exploitation.
- The MRC will work closely with OST and other RCs on the delivery of science and society work.

(Source: DTI, 2005:30-31 Abridged version)

2.2 Researchers in health sciences

Health research in the UK is carried out in Universities, the health service, and charitable research centres (with research frequently bridging these sectors, for example, in university teaching hospitals). Research is carried out throughout the UK, but there are concentrations of research funding and associated staff, most notably in the Golden triangle of Oxford, Cambridge and London.

Table 7 shows the proportion of female researchers in different fields working in EU countries, the general trend being that engineering and technologies have the least women. Medical sciences were the most feminised field in the UK, where 48 per cent of higher education researchers were women.

Table 7: Percentage of researchers who are women, by field of science, in Higher Education Sector, EU, 1999

Percentage Women	NATURAL SCIENCES	ENGINEERING AND TECHNOLOGIES	MEDICAL SCIENCES	AGRICULTURAL SCIENCES	SOCIAL SCIENCES	HUMANITIES
Belgium[2]	29,5	20,0	30,1	25,1	32,4	35,9
Denmark[5]	22,9	12,2	35,6	44,7	26,8	37,1
Germany	18,1	11,3	34,1	31,5	23,5	35,2
Greece	:	:	:	:	:	:
Spain	:	:	:	:	:	:
France[3]	29,4	15,2	32,4	:	39,8	X
Ireland	:	:	:	:	:	:
Italy	31,0	13,4	22,9	24,3	26,7	41,5
Luxembourg	50,0	-	50,0	-	37,5	66,7
Netherlands[4]	19,7	13,7	37,0	25,7	29,2	31,2
Austria	18,2	8,9	31,9	30,6	29,9	37,2
Portugal[3]	48,6	28,7	49,7	44,0	48,7	X
Finland	34,4	22,4	52,0	36,2	47,0	50,6
Sweden	30,5	19,0	51,2	40,9	43,3	43,7
United Kingdom	30,6	13,2	48,1	35,5	42,8	40,3

Source: Eurostat, S&T statistics; DG Research, WiS database
Notes: [1]Exceptions to the reference year: DK, DE, FR, UK: 2000; AT: 1998
[2]Data not official. Estimates made from BE-FL for 2001 and BE-FR for 2000
[3]SS includes H
[4]FTE as exception to HC
[5]Definition of HES coverage differs slightly from Annex Table 1.2.a

NB/ No figures on gender breakdown for the UK are provided in the Government or Business sectors in SHE figures

(Source: EC, SHE Figures 2003: 46)

A more detailed breakdown of staff by field is provided in Table 8 and shows that nursing, health and community studies had the highest concentrations of female staff in 2002-03 – at 73 per cent and 63 per cent respectively. In the same year, nearly half of all staff working in the cost centre of clinical medicine were women. In the UK, engineering, mathematics and physics consistently had the lowest proportion of women working in the field comparing 1995-96 and 2002-03. The following section shows a similar pattern in relation to female graduates in these fields.

Table 8: Academic cost centre and gender in UK HEI's

	1995–96 Female	*1995–96 Male*	*2002–03 Female*	*2002–03 Male*
Nursing and Paramedical Studies	72.6%	27.4%	73.0%	27.0%
Health and Community Studies	59.8%	40.2%	63.1%	36.9%
Other modern languages	N/a	N/a	55.5%	44.5%
French, Spanish & German modern languages	N/a	N/a	55.1%	44.9%
Continuing Education	49.2%	50.8%	54.7%	45.3%
Education	44.9%	55.1%	54.4%	45.6%
Psychology and Behavioural Sciences	43.5%	56.5%	52.4%	47.6%
Clinical Medicine	41.2%	58.8%	48.1%	51.9%
Catering and Hospitality Management	42.1%	57.9%	46.5%	53.5%
Language Based Studies	44.0%	56.0%	46.1%	53.9%
Veterinary Science	36.5%	63.5%	43.2%	56.8%
Design and Creative Arts	34.0%	66.0%	40.4%	59.6%
Social Studies	34.8%	65.2%	40.2%	59.8%
Anatomy and Physiology	34.1%	65.9%	40.1%	59.9%
Librarianship, Communication and Media Studies	36.3%	63.7%	39.4%	60.6%
Biosciences	32.1%	67.9%	39.2%	60.8%
Clinical Dentistry	31.3%	68.7%	38.1%	61.9%
Archaeology	N/a	N/a	37.3%	62.7%
Pharmacology	32.6%	67.4%	37.0%	63.0%
Pharmacy	28.6%	71.4%	35.8%	64.2%
Sports science & leisure studies	N/a	N/a	35.8%	64.2%
Humanities	28.8%	71.2%	34.7%	65.3%
Business and Management Studies	29.8%	70.2%	34.3%	65.7%
Agriculture and Forestry	23.6%	76.4%	33.9%	66.1%
Geography	25.5%	74.5%	30.1%	69.9%
General Sciences	26.2%	73.8%	29.0%	71.0%
Information Technology and Systems Sciences	19.7%	80.3%	28.7%	71.3%
Earth, Marine and Environmental Sciences	19.8%	80.2%	26.8%	73.2%
Architecture, Built Environment and Planning	20.5%	79.5%	26.7%	73.3%
Mineral, Metallurgy and Materials Engineering	14.6%	85.4%	23.1%	76.9%
Computer software engineering	N/a	N/a	21.9%	78.1%
Chemistry	15.4%	84.6%	21.3%	78.7%
Other Technologies	24.0%	76.0%	20.3%	79.7%
Chemical Engineering	15.4%	84.6%	19.7%	80.3%
General Engineering	10.8%	89.2%	16.6%	83.4%
Mathematics	14.6%	85.4%	16.3%	83.7%
Civil Engineering	9.5%	90.5%	14.7%	85.3%
Physics	9.6%	90.4%	12.6%	87.4%
Mechanical, Aero and Production Engineering	8.4%	91.6%	12.5%	87.5%
Electrical, Electronic and Computer Engineering	7.2%	92.8%	11.4%	88.6%
Grand Total	*31.7%*	*68.3%*	*38.8%*	*61.2%*

Note: Cost centres represent administrative units in higher education institutions for accounting purposes; they do not necessarily have a direct correspondence with academic departments. N/a means no data available for 1995–96

(Source: AUT, 2004: 13)

2.3 Student enrolments and graduates in health sciences

Education, health and social services and the humanities were the most feminised disciplines in 2001 for graduates across the EU (Table 9). The same pattern was evident in the UK, where over half of all graduates in health and social sciences were women in 2001. Engineering, manufacturing and construction is the discipline with the least female graduates, followed by science, mathematics and computing. Further detail is provided in Section 3.

Table 9: % of ISCED 6 graduates in EU who are women by broad field of study, 2001

Percentage Women	EDUCATION	HUMANITIES AND ARTS	SCIENCE, MATHEMATICS AND COMPUTING	AGRICULTURE & VETERINARY	HEALTH AND SOCIAL SERVICES	ENGINEERING, MANUFACTURING & CONSTRUCTION	SOCIAL SCIENCES, BUSINESS AND LAW
Belgium	54,5	31,1	33,6	31,2	39,6	15,4	35,0
Denmark[2]	X	50,6	32,6	46,6	47,5	23,7	41,7
Germany	41,7	45,2	26,8	52,5	45,5	11,8	32,1
Greece	:	:	:	:	:	:	:
Spain	54,3	45,4	44,6	33,3	48,7	23,2	44,0
France	50,0	56,5	39,3	56,5	57,0	26,8	42,4
Ireland	50,0	54,3	42,7	36,8	60,3	22,2	49,1
Italy	:	57,9	47,7	56,0	66,3	34,4	46,0
Luxembourg	-	-	-	-	-	-	-
Netherlands	:	31,5	25,5	32,8	41,8	13,8	37,2
Austria	62,1	51,4	35,6	51,1	71,9	13,0	39,4
Portugal	66,4	64,2	49,8	56,1	64,9	39,1	46,1
Finland	72,2	45,6	37,4	39,2	62,9	21,2	50,9
Sweden	65,6	44,0	33,0	48,4	52,7	24,1	41,1
United Kingdom	55,2	46,4	38,9	39,6	51,6	18,8	40,2
EU-15[3]	55,4	48,9	35,7	46,5	49,0	20,6	39,3

Source: Eurostat, Education
Notes: [1]Exceptions to the reference year: DK, FR, IT, FI: 2000
[2]Humanities and arts includes education
[3]EU-15: estimate excludes EL, LU. Above exceptions to reference year apply

(Source: EC, SHE Figures 2003: 43)

2.4 Publications in health sciences

Between 1995-2004 there were 179,247 articles produced in the UK on clinical medicine – of these, 21per cent had not been cited (Table 10).

Table 10 Research impact profiles - UK at the level of Thomson journal categories disciplines

	Total output 1995-2004	Percentage of output				% > World Average	RBI Average 2000-04	RBI Median 1995-04
		Uncited	RBI < 1	RBI 1-4	RBI > 4			
Plant & Animal Science	38582	19.9	39.4	33.4	7.3	40.7	1.51	0.73
Chemistry	60022	19	44.6	31	5.4	36.5	1.23	0.63
Ecology/ Environment	16884	20.9	42.8	30.5	5.8	36.4	1.4	0.64
Geosciences	22939	21.4	42.2	30.8	5.6	36.4	1.33	0.65
Mathematics	9596	35.7	29.6	28.3	6.4	34.7	1.29	0.52
Molecular Biology & Genetics	23805	10	55.7	28.5	5.8	34.3	1.27	0.61
Physics	61205	23.2	42.6	27.5	6.7	34.2	1.42	0.54
UK total & average	750376	21.8	44.6	27.9	5.7	33.6	1.28	
Engineering	55236	35.4	31.6	25.5	7.4	32.9	1.08	0.39
Clinical Medicine	179247	20.8	48.3	25	6	30.9	1.21	0.45
Social Sciences, general	36108	35.6	34.1	24.7	5.5	30.2	1.05	0.37
Economics & Business	15236	36.9	37.2	21.4	4.5	25.9	0.93	0.31

(Source: Adams, 2006: 10)

Section 3: Training and supply in the health field

3.1 Tertiary level students in health sciences

Engineering was the largest field of enrollment for science subjects in UK HEIs between 1997-2002 (Table 11). During this period there was rapid expansion in computer science, gradual growth in biological sciences and a decline in physics and chemistry.

Table 11: UK HE enrollment in science disciplines, 1997-2002

Year	Biolog.Sc	Phys. Sc.	Maths	Computer	Engineering	Chemistry	Physics
1997	81 750	74 496	19 908	73 612	134 041	22 679	14 366
1998	87 987	72 285	20 481	77 987	130 926	22 010	13 982
1999	89 338	71 356	20 198	85 102	128 713	21 905	13 675
2000	90 740	69 540	20 310	91 540	123 910	20 910	13 150
2001	93 730	69 285	20 520	110 400	129 925	19 660	12 905
2002	94 560	66 845	21 800	118 345	132 580	19 085	12 310

(Source:EC 2004:41)

Over the last decade students in health related studies are making up a larger proportion of the total enrollments of students in UK HEIs' (table 12).

Table 12: All HE students by level of study, mode of study and subject of study, 2005/06

	1996/97	1999/2000	2002/2003	2005/2006
Medicine & dentistry	40476	43100	48915	59585
Subjects allied to medicine	153105	193810	266415	309405
Biological sciences	81750	90740	125860	155220
Total HE students (undergraduate and postgraduate)	1756179	1856330	2175115	2336110
% fields above represent of total	16%	18%	20%	22%

(Source: Students in Higher Education Institutions 2005/06
www.hesa.ac.uk/holisdocs/pubinfo/student/subject0506.htm)

Table 13 shows the composition of the student body in UK HEIs' in 2005/2006 by subject of study and whether they are registered as a full-time or part-time student. Business and administrative studies and subjects allied to medicine each accounted for 13 per cent of full-time undergraduate students, followed by creative arts and design (10 per cent).A further 9 per cent were registered in the biological sciences and three per cent were studying clinical medicine or dentistry fulltime. Nineteen per cent of part-time undergraduates were studying subjects allied to medicine.

Business, education and social studies had the most full-time postgraduates students registered in 2005/06 – with only three per cent in medicine and dentistry, four per cent in subjects allied to medicine and six per cent in biological sciences.

Table 13: All HE students by level of study, mode of study and subject of study, 2005/06

	Total HE students	Full-time undergraduate	Full-time postgraduate	Part-time undergraduate	Part-time postgraduate
Medicine & dentistry	59585	41035	6780	155	11615
Subjects allied to medicine	309405	151665	9205	111050	37485
Biological sciences	155220	104580	14920	21610	14115
Veterinary science	4465	3570	520	30	345
Agriculture & related subjects	17275	10040	1580	4265	1390
Physical sciences	82740	49820	13210	12605	7100
Mathematical sciences	32425	20765	3285	5730	2640
Computer science	120150	65465	12800	31445	10440
Engineering & technology	136695	75905	21735	21810	17245
Architecture, building & planning	56445	27560	5725	13740	9420
Social studies	201075	106325	22900	49645	22205
Law	89580	52350	13370	13295	10570
Business & administrative studies	304405	152165	39950	48485	63805
Mass communications & documentation	47805	34410	5455	3260	4675
Languages	139190	75890	9625	45560	8110
Historical & philosophical studies	101445	51945	7525	30935	11045
Creative arts & design	156180	123260	9210	16750	6960
Education	207705	44385	36155	57225	69940
Combined	114315	7680	260	104325	2045
Total - All subject areas	2336110	1198820	234220	591925	311150

(Source: HESA, Students in Higher Education Institutions 2005/06 www.hesa.ac.uk/holisdocs/pubinfo/student/subject0506.htm)

3.2 Share of foreign student enrolments and graduates in health sciences

The UK and Germany host over half of all reported tertiary level foreign students in the EU (Wilen, 2005). European Commission statistics on undergraduate mobility present a similar picture, once again identifying the UK and Germany as key receiving countries (Table 14). The combined figures for undergraduate mobility within the UK, Germany and France exceed the proportion of foreign students in the US.

Table 14: Tertiary level foreign students by country/region of citizenship and top supplying countries, 2001

Country or region of citizenship, 2001						
Host country/ Region	Total	1st rank	2nd rank	3rd rank	4th rank	5th rank
EU-15	795,436	Greece	France	Germany	Italy	Poland
US	542,996	India	China	Korea	Japan	Taiwan
UK	225,722	Asia	Greece	US	Africa	Germany
Germany[20]	199,132	Asia	Turkey	Africa	Poland	China

Source: EC Key Figures 2003-4: 52

Subjects allied to medicine had the largest number of students registered in 2005/06 (as a total of undergraduate and postgraduate, full and part time) – but only six per cent of students had been domiciled outside the UK before starting their studies (Table 15). A comparable number of students are registered in Business studies but there international recruitment of students is far more evident

[20] The figures for Germany presented here do not accord with DAAD figures for 2004/5 which show Bulgaria to be the second largest supply country, followed by Poland (Suter, 2006).

-28 per cent of students had been domiciled overseas before the course began. A higher proportion of medicine and dentistry students had been domiciled abroad before starting, four per cent in another EU country and ten per cent from elsewhere internationally.

Table 15: All HE students in UK HEIs' by subject of study and percentage domicile 2005/2006

Grade	% UK	% Other EU	% Non-EU	Total
Veterinary science	87	4	9	4465
Agriculture & related subjects	88	5	7	17275
Mathematical sciences	83	5	13	32425
Mass communications & documentation	86	6	9	47805
Architecture, building & planning	85	6	10	56445
Medicine & dentistry	86	4	10	59585
Physical sciences	88	5	7	82740
Law	82	5	13	89580
Historical & philosophical studies	92	3	5	101445
Combined	96	1	3	114315
Computer science	82	4	14	120150
Engineering & technology	70	9	21	136695
Languages	85	6	9	139190
Biological sciences	91	4	5	155220
Creative arts & design	89	5	6	156180
Social studies	85	5	10	201075
Education	94	2	4	207705
Business & administrative studies	72	7	21	304405
Subjects allied to medicine	94	2	4	309405
Total	**86**	**5**	**10**	**2336110**

(Source: Students in Higher Education Institutions 2005/06
http://www.hesa.ac.uk/holisdocs/pubinfo/student/subject0506.htm)

There were 55,960 full time and part-time undergraduate and postgraduate students studying Medicine & Dentistry in 2004-05, of these eighty six per cent were domiciled in the UK prior to starting their studies, four per cent were domiciled in the EU and the remaining ten per cent had come from outside the EU (see appendix 1 for further details)
Of the 149,520 undergraduate and postgraduate students in the biological sciences in 2004-05 ninety-one per-cent were ordinarily domiciled in the UK prior to starting their studies, four per cent had been previously living in the EU and five per cent had lived elsewhere internationally.

In the UK in the academic year 2003/2004 15,255 PhDs were awarded, the majority of which (11,680) were for full-time study.[21] Biological and physical sciences together accounted for just under a third of all registrations (HESA, 2005). 59% of total doctorates awarded to full-time students in 2003/4 were to students who were domiciled in the UK prior to their PhD and 41% came from abroad.[22] Thus a larger proportion of higher degrees in the health sciences are being undertaken by migrants

Section 4: Labour market in health

4.1 Skills shortages

The UK Government's 'Roberts Review' was set up in 2002 in response to *'serious problems in the supply of people with requisite high quality skills …which could undermine the Government's attempts to improve the UK's productivity and competitiveness'*. The causes of skills shortages in the UK are highly complex but include a level of losses due to out-migration (mainly to the US)[23], the progressive expansion of higher education coupled with the demographic ageing of the scientific

21 A total of 43,255 students were registered on a full-time basis in the same time period.

22 13% were domiciled elsewhere in the EU prior to their PhD and 28% in third countries. The figures for the UK include candidates who did their first degree in the UK irrespective of their nationality

23 A report by the UK Campaign for Science and Engineering (CaSE) gives evidence to suggest that 'many of the rising stars of British science have emigrated to the world's leading scientific nation [the US]' (CaSE, 2002).

workforce and declining rates of transition from compulsory schooling into undergraduate science courses and subsequently into doctoral research and research careers (HEFCE, 2006).[24] The Fifth Annual Survey of Recruitment and Retention of Staff in Higher Education (Thewlis, 2003) found that almost 30% of universities reported difficulties *recruiting* younger academic staff and almost 25% in *retaining* them. This concern is reflected in the White Paper on the 'Future of Higher Education' which concluded that, *'We need to consider how to attract and retain the best researchers internationally, and how to maintain a steady flow of the brightest and best young people into research*.' (DfES 2003:14)

Identifying growing concerns around the ability to generate home-grown supply, the Roberts Review acknowledged the contribution of international migration as a partial solution to skills shortages emphasising the importance of *'being able to access scientific expertise from abroad*.' (2002:17). Whilst it concludes that the
UK *'appears to be a net beneficiary of the increasing migration of science and engineering talent – enjoying a 'brain gain' rather than 'brain drain'* (ibid:185) The UK Government recognises the relationship here with economic growth, a recent report states that, '*Like most developed countries, the UK needs migration for economic reasons. There are gaps in our labour market that cannot be filled by the domestic workforce. Skilled migrants, students and visitors bring major economic benefits, with net inward migration contributing 10-15% of forecast UK trend economic growth.'* (Home Office, 2005:11)However, the Roberts review goes on to caution about the degree of 'risk' in over-reliance on these sources of supply referring to the 'elasticity of flows' of science migrants which are highly sensitive to changes in demand and conditions in the home and receiving countries and the broader European/global context.

Likewise, there are ongoing concerns regarding shortages of healthcare workers in the UK. Pond and McPake (2006) suggest some contributory factors necessitating growth in the health workforces in developed countries, namely, ageing populations and growing incomes, an ageing and increasingly feminised workforce and a greater focus on work-life balance. Studies also suggest that only a minority of medical staff who leave the UK return (ibid: 1449). International recruitment, therefore, plays an increasingly important role in policies to address skills shortages in health.

4.2 Demand for Healthcare workers

High proportions of doctors, nurses and healthcare workers in the UK are migrants. An OECD study in 2000 found that in France and Germany four to five per cent of doctors were trained overseas compared with between twenty-five and thirty per cent in the UK, Canada and the US (reported in Martin, 2003) A survey of medical staff working in hospitals and community health services in September 2005 found that from the total 86,660 staff, sixty two per cent had qualified in the UK, six per cent had qualified elsewhere in the EEA, and thirty two per cent had qualified elsewhere internationally (NHS, 2006, Table 5). With a third of medical staff trained outside the UK, there is evidence that migrant workers are making a significant contribution to the delivery of health care in the UK.

The most recent figures for doctors show that this trend continues. In 2005 there were 232,380 doctors registered in the UK by the General Medical Council. Of these, 69 per cent had received their primary medical qualification in the UK, a further nine per cent in India, 3 per cent in South Africa[25] and Ireland respectively and two per cent in Pakistan. By 2007 the number of doctors had increased to 239,845 but the proportion of doctors who were awarded their primary qualification in the UK had decreased to 62.5%, with 12 per cent trained in India and the second largest group having trained in South Africa (Table 16).

[24] These are complex issues which are discussed in more detail in Ackers and Gill (2005)

[25] The number of doctors educated in South Africa and registered by the GMC fluctuates - in 2005 there were 6327, decreasing to 6088 in 2006 and increasing to 8444 in 2007 (Source: GMC data, 2007)

Table 16: Register Count by country of qualification as of 1 March 2007

Country of qualification	Number of doctors registered	%
Spain	1078	0.4%
Hong Kong	1331	0.6%
Italy	1602	0.7%
Greece	1834	0.8%
Poland	1957	0.8%
Iraq	1980	0.8%
Sri Lanka	2296	1.0%
Nigeria	2583	1.1%
Egypt	2585	1.1%
Australia	3123	1.3%
Germany	4222	1.8%
Republic of Ireland	5506	2.3%
Pakistan	6593	2.7%
South Africa	8444	3.5%
Other	16993	7.1%
India	27738	11.6%
United Kingdom	149980	62.5%
Total	**239845**	**100.0%**

Source: GMC (2007)

Recent statistics for work permits issued show that the main occupations recruited to in 2004 and 2005 were nurses (15.1%), other management related occupations (8.6%), musicians (7.5%), other health/medical occupations (excluding doctors and nurses) (6.8%), other IT related occupations (excluding software engineer, analyst programmer, system analyst) (5.9%). 'Researcher' was the eleventh most common profession and accounted for 8,504 approvals or 2.5% of the total in 2004 and 2005 (combined). In total 341,396 work permits were issued in 2004 and 2005 combined (180,740 in 2004 and 160,656 in 2005) (Home Office 2006). (according to Home Office, these figures do not include HSMP).

According to Loizillon (2004) in the OECD report, all types of healthcare professionals are included in the shortage occupation (See http://www.workpermits.gov.uk/default.asp?pageid=2594). The UK Home Office regularly consult advisory panels about skills needs for the labour market and subsequently produce a list of skills shortage occupations that are given priority for work permits (without employers having to prove they could not appoint a domestic / EEA worker). The latest list was released in December 2006. The main areas where the UK has acute shortages and accepts direct recruitment of non-EEA workers are in engineering, health and teaching and veterinary surgeons - shortages in health professions dominate the list of occupations(Table 17).

Table 17: Work Permits (UK) Shortage Occupation List, December 2006

Doctors:	
Salaried GPs	
Dentists:	
Salaried General Dental Practitioners	Salaried Assistant Dentists
Salaried Vocational Dental Practitioner	Consultants in Dental Specialities
Consultant posts in the following specialist areas:	
Accident & Emergency	Additional Dental Specialities
Anaesthetics	Cardiology
Cardiothoracic Surgery	Chemical Pathology
Child and Adolescent Psychiatry	Clinical Neurophysiology
Clinical Oncology	Clinical Radiology
Dermatology	Endocrinology & Diabetes Mellitus
Endodentics	Forensic Psychiatry
Gastroenterology	General Adult Psychiatry
General Internal Medicine	General Surgery
Genito-urinary Medicine	Geriatric Medicine
Haematology	Histopathology
Immunology	Infectious Diseases
Intensive Care Medicine	Medical Microbiology & Virology
Medical Oncology	Neurology
Neurosurgery	Nuclear Medicine
Obstetrics & Gynaecology	Occupational Health
Old Age Psychiatry	Opthalmology
Oral & Maxillo-facial Surgery	Orthodontics
Otolaryngology	Paediatric Cardiology
Paediatrics	Palliative Medicine
Plastic Surgery	Psychotherapy
Public Health Medicine	Rehabilitation Medicine
Renal Medicine	Respiratory Medicine
Rheumatology	Trauma & Orthopaedic Surgery
Urology	
General:	
Audiologist	Audiological Scientist
Clinical Psychologist	Dietician
Occupational Therapist	Pharmacists
Pharmacy Technician	Pre-Registration Cytogeneticists
Senior Physiotherapist	Speech & Language Therapist
Social Worker	State Registered Scientists in Cytogenetics
Biomedical Scientist / Medical Laboratory Scientific Officer (MLSO)	Qualified HPC Registered Diagnostic & Therapeutic Radiographers, including
Ultrasonographers	
Nurses:	
Midwives	Registered Nurse employed or engaged at Band 7 or Band 8 of Agenda for Change or their
Independent sector equivalents	
Registered Nurse employed or engaged in the following specialities:	
• Audiology	• Sleep/Respiratory Physiology
• Neurophysiology	• Cardiac Physiology
• Operating Theatre Nurse	• Clinical Radiology
• Pathology	• Critical Care (nurses working in wards with a Level 2 or Level 3 classification)

From August 2006 band 5 and 6 nurses were removed from the shortage list, meaning positions will have to be advertised and only if they are unfilled can they be offered to an nurse who is a third country national. The reason for this change is to support retention and progression of nurses within the UK, ‘to ensure that UK resident nurses are given every opportunity to continue their career in the UK and to secure an NHS workforce that reflects the communities it serves**.’** (http://www.nhscareers.nhs.uk/shortageOccInfo.shtml)

As the figures above suggest there are increasing proportions of non-UK doctors working in the UK, often filling ‘unpopular’ roles. Recent changes to out-of-hours services mean that doctors can opt out of weekend working. Recruitment agencies have therefore looked elsewhere in the EU to fill these positions and media reports indicate that the number of German doctors is particularly high, ‘At times a third of the GPs doing out-of-hours work in one region alone, Northumberland and Tyneside, are from Germany. In parts of the country they can earn as much as £2,000 for a weekend's work.’ (Harding et al. 2005, The Guardian, 2005)

In order to attract health workers to the NHS a global advertising campaign was launched in 2001. Of the additional physicians, trained overseas, that were recruited in 2002 and 2003 twenty-four per cent were from sub-Saharan Africa (Pond and McPake, 2006: 1450). However, the UK government is keen not to extensively recruit from developing regions and have produced some guidelines to this effect.

Section 5: Strategies to address shortages

5.1 Opening access to the UK

Citizens from the European Union have the right to be treated equally to UK nationals in access to employment. Citizens from outside Europe (Third country nationals) can only be employed in the absence of an appointable UK/EU candidate. Most non EEA nationals would need a work permit to enter the UK. A South African would need a visa to enter. The work permit is only for one specific job with one employer. If they move jobs or even move between posts in the university, they would normally need to make a new application (Leeds University Human Resources, Home Office helpline). Work permits are usually granted for a maximum period of five years. After four (now five according to recent changes) years in continuous employment, overseas nationals are eligible to apply for removal of restrictions - indefinite leave to remain in the UK (Leeds University Human Resources website). Spouses have the right to accompany highly skilled migrants, as do partners providing they can supply evidence that they have been living together for two years previously.

The UK is in the process of overhauling access for migrants (*‘A Points-Based System: Making Migration Work for Britain’(March 2006)*. Citizens from outside the UK can seek entry on five schemes (Tier 1-Highly Skilled Migrants, Tier 2 – Skilled workers, Tier Three – Low Skilled Migration, Tier Four – Students, Tier Five – Youth Mobility and temporary workers). Health researchers from third countries are most likely to enter the UK as highly skilled migrants or as students.

The UK and Denmark are the only two EU member states *not* introducing the "scientific visa" package, (Directive 2005/71/EC ‘a specific procedure for admitting third-country nationals for the purposes of scientific research’) which aims to streamline the process of entry for international staff. The remainder of EU countries are due to transpose this directive into their national legislation by 12th, October 2007.

Example: Flows of South African academic staff in UK HEI’s

There were 264 South African staff working in UK Higher Education Institutions in 2004/05. The majority of South African staff were either researchers (30%) or lecturers (37%). Of the seventy-eight South African research only staff ninety-four per cent were on fixed term contracts (in part explained by the way these positions are funded in the UK).

<u>Concentration in the health sciences</u>
Nineteen per cent of all South African staff were working in clinical medicine, nine per cent were in Nursing and paramedical studies, seven per cent worked in bio-sciences, and a further three per cent were in anatomy and physiology. This provides evidence that South African researchers moving to the UK are most often working in the broad field of physical health, the largest other group (11%) worked in the social sciences.
There is also a bias towards younger South African migrants – looking at the bio-science and clinical medicine staff alone, two thirds were aged 35 or less. Turning attention to the whereabouts of these staff, they were distributed between twenty institutions in the UK. There are significant clusters of South African scientists in these fields in London institutions – thirty-five out of the total sixty-eight.
(Source: HESA staff record 2004_05)

5.2 Recruitment Schemes

International Medical Graduates

Despite the fact that doctors are in short supply the UK government has recently introduced more stringent requirements on the international recruitment of junior doctors. From 3rd April, 2006 IMGs' wishing to work or train in the UK need a work permit. The General Medical Council, responsible for the registration of doctors within the UK have commented that, 'We anticipate (IMGs') employment prospects will significantly worsen following the Department of Health announcement on 7 March 2006. This is in addition to the on-going difficulties IMGs have reported in seeking employment' (http://www.gmc-uk.org/doctors/work_permits/index.asp). Depending on where doctors have trained and their nationality they may also have to undertake a series of tests for the Professional and Linguistics Board. A recent survey on behalf of the GMC (IPSOS-MORI, 2006) found that the number of graduates who had passed the PLAB test but who were still without a position after a year was rising – and had reached forty-one per cent for the cohort who passed between March and May 2005. Doctors that had passed the PLAB tests in this period and who had found a position were mostly on short-term contracts, with sixty-eight per cent leaving after six months (IPSOS-MORI, 2006).

A number of Department of Health Initiatives have taken place to recruit health care workers (Rollason 2004). These include the following:

- *The Global Scheme*
  Aims to attract doctors at consultant level to the NHS. It was launched in 2001 and advertised in the press in North America, Europe and Australia. The NHS contracted TMP Worldwide, a private recruitment agency to deal with response under the campaign. The Department compiles a database of doctors on the specialist register, which is then matched to NHS vacancies (Rollason 2004).
- *Managed Placement Scheme*
  This is an NHS scheme whereby doctors work in the UK for a trial period of 6 months as consultants.
- *NHS International Fellowship Scheme*
  This scheme was launched in February 2002 to attract surgeons and physicians from outside the UK for two-year fellowships working in the NHS as consultants. Recruitment is to focus on North America, the Middle East (expatriates), Australia and New Zealand.
- *Postgraduate Doctors/Dentists*
  There is a scheme for postgraduate doctors and dentists to complete training in the UK, but they intend to leave after the end of their training. They can only stay in the UK if they switch to one of these categories:
  - A work permit holder
  - A highly skilled migrant
  - A business person
  - An innovator

  (See http://www.workingintheuk.gov.uk/)
  This scheme is to be modified with the introduction of the pointed based system. There will still be a category called postgraduate doctors and dentists, but it will only provide for *'those doctors and dentists who have completed their medical / dental studies in the UK to take their Foundation Programme here'*. This will mean that these doctors and dentists will now be considered as in employment rather than in training and will now need to meet the work permits requirements of an employment category (Department of Health 2006).
- *Bilateral schemes/initiatives*
  The Department of Health has established a number of nursing recruitment initiatives with the Spanish Ministry of Health, and agreements have been signed with the Philippines and India, which provide for individual nurses to come the UK (Department of Health website). But according to Rollason, they are informal arrangements and not bilateral treaties. The Department of Health has also established schemes in other European countries which have involved recruitment fairs and seminars.
  (Rollason 2004).
  (See http://www.doh.gov.uk/international-recrutiment/)

5.3 Ethical recruitment

Concerns about poaching healthcare workers from developing countries, and depleting their healthcare resources, has meant that recent recruitment drives have been restricted to developed countries. Guidelines on international recruitment were issued in 1999 (Guidance on International Nursing Recruitment). They followed a review of nursing strategy in 1999 (Department of Health 1999). These guidelines were then replaced by a code of practice in 2001 (Department of Health 2001), which has, in turn, been superseded by a new Code of Practice published in 2004. The Code requires NHS employers *not* to actively recruit from a list of developing countries (which includes South Africa) unless there was government to government agreement.

Despite the existence of the Code, it does not cover the independent sector, which continues to recruit from countries on the proscribed list (DFID 2004). A Report for DFID (2004) points to significant increases the inflows of doctors and nurses. In 2002 nearly half of the 10,000 new full registrations on the GMC register (registration is compulsory for doctors) were from non-EU overseas countries. According to Rollason (2004) all private recruitment agencies must abide by the NHS code of practice, and the Department of Health publishes a list of agencies operating within the code of practice (therefore the implication is that there are others who do not abide by the Code of Practice). Similarly, the number of overseas nurses also continues to grow. According to the report, one in four new overseas nurse registrations were from the DoH proscribed list of developing countries. This does not however show that the code has been broken, because they can come through other channels. The most significant source countries in recent years have been The Philippines, South Africa, Australia and India. According to the Report, recruitment channels have become more systematic. This includes the introduction of an NHS recruitment website for nurses and the development of regional recruitment co-ordinated through the NHS Workforce Development Confederations.

Tackling the African health staff crisis
'The UK will help partners to solve their staffing crises by:
- Training professional workers such as doctors, nurses, managers, pharmacists and other support staff – this includes support to higher education.
- Creating incentives for staff to work in under-served areas – for example through hardship allowances or better housing.
- Increasing support for community health workers – people who can help treat many simple illnesses and are more likely to live in the communities they serve.
- Expanding links between the UK National Health Service and poor countries.
- Exploring opportunities for health workers to return from the UK to their own countries, for extended periods, to help improve health services**.'**

Department for International Development (2006) Eliminating World Poverty, Making Governance Work for the Poor, White Paper, UK, p.79

Section 6: Conclusions

The number of students in health disciplines in the UK is steadily growing over time. The proportion of foreign students in health disciplines is comparatively low compared to other shortage areas (e.g. engineering). Only fourteen per cent of current registered medical and dentistry students were domiciled outside the UK
before they started their studies, yet thirty-seven and a half per cent of doctors registered with the GMC received their qualification overseas. Despite concerns about ethical recruitment there are a number of employment drives to encourage researchers and healthcare workers to work in the UK particularly to fill areas of high demand.

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Appendix 1: HE students by level of study, mode of study, subject of study, domicile and gender 2004/05

						United Kingdom			Other European Union			Non-European-Union		
	Total HE students	FT UGs	FT PGs	PT UGs	PT PGs	Total	Female	Male	Total	Female	Male	Total	Female	Male
Medicine & dentistry	55960	38395	6160	180	11220	48325	28165	20160	2070	1250	820	5565	2820	2745
Broadly-based programmes within medicine & dentistry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pre-clinical medicine	14490	13810	245	30	410	13065	7845	5220	375	235	140	1050	620	435
Pre-clinical dentistry	1190	1110	25	20	35	1090	645	445	30	25	5	70	30	40
Clinical medicine	34340	19705	5160	85	9390	29025	16835	12190	1450	875	580	3865	1885	1980
Clinical dentistry	5250	3680	520	10	1040	4570	2490	2080	180	100	80	500	260	240
Others in medicine & dentistry	690	90	210	40	345	575	345	230	35	20	15	75	30	45
Subjects allied to medicine	300140	146290	8385	110355	35115	282705	236295	46415	6515	4900	1615	10920	7130	3795
Broadly-based programmes within subjects allied to medicine	1165	705	0	460	0	1085	715	370	25	10	20	50	25	25
Anatomy, physiology & pathology	16325	11945	1610	1385	1385	14945	10480	4465	760	515	245	620	325	300
Pharmacology, toxicology & pharmacy	17840	10945	1480	750	4665	14445	9325	5120	1110	710	405	2285	1255	1025
Complementary medicine	5685	3435	105	845	1300	5345	3855	1490	215	125	90	120	90	30
Nutrition	4580	2610	520	875	580	3830	3365	465	355	310	40	395	295	100
Ophthalmics	3900	2320	105	550	925	3585	2325	1260	155	100	50	155	100	60
Aural & oral sciences	3360	2210	490	230	430	3135	2880	255	145	130	15	80	65	15
Nursing	191425	90950	1245	90680	8550	184995	164235	20755	1920	1685	235	4510	3515	995
Medical technology	8540	5110	355	710	2365	7805	5680	2125	305	205	95	435	215	220
Others in subjects allied to medicine	47325	16060	2475	13880	14910	43535	33435	10100	1520	1110	415	2270	1245	1025
Biological sciences	149520	100050	14275	21115	14080	135985	87605	48380	6155	4045	2105	7385	4250	3135
Broadly-based programmes within biological sciences	825	800	10	10	0	740	350	385	30	10	20	60	30	30
Biology	26290	17380	2895	3815	2200	23550	14480	9075	1210	745	465	1525	770	755
Botany	845	205	330	205	110	625	340	280	50	30	20	175	75	100
Zoology	3800	3145	340	200	115	3510	2240	1270	150	100	50	145	90	55
Genetics	2550	1635	505	90	315	1905	1065	840	180	110	75	465	260	205
Microbiology	4470	2375	1090	175	830	3385	1940	1440	315	180	135	770	375	400
Sports science	25505	22135	870	1525	970	24445	9125	15320	690	270	415	370	140	230

Molecular biology, biophysics & biochemistry	9600	6595	1685	340	980	7725	4225	3500	655	385	270	1215	650	570
Psychology	68265	41175	5470	14125	7500	63580	50485	13095	2560	2035	525	2130	1625	505
Others in biological sciences	7370	4600	1080	635	1055	6525	3355	3170	315	175	140	530	245	285

http://www.hesa.ac.uk/holisdocs/pubinfo/student/subject0405.htm