



UNLEASHING THE POTENTIAL

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Women in Scientific Careers

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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Foreword

On 16-17 November 2005 the OECD, in partnership with the French Research Ministry's "Mission for Gender Parity", organised a workshop on "*Women in Scientific Careers: Unleashing the Potential*" under the auspices of the OECD Committee for Scientific and Technological Policy (CSTP) *ad hoc* Working Group on the Steering and Funding of Research Institutions (SFRI), and with the active support of the Finnish Ministry of Education. This workshop was a response to a request from science ministers at the January 2004 CSTP Ministerial meeting for the OECD to determine the reasons for the gap between growing participation of women in higher education and the low share of women in the research workforce, and to identify good policy practices for attracting, recruiting and retaining women in scientific careers.

The major aim of the workshop was to take stock of the situation as regards women in science, to identify the causes behind the low participation of women in scientific careers -- especially in certain fields and at senior levels -- and to share experiences among countries and existing solutions. The workshop was attended by nearly 100 representatives from government, academia, public sector research, and the business community to draw lessons and recommendations for all stakeholders.

This publication presents the proceedings of the workshop. The workshop itself was co-organised by the OECD Secretariat, namely by Mario Cervantes and Gudrun Maass, together with Dr. Michèle Baron of the French Research Ministry. Heidi Küssi at the Finnish Ministry of Education provided critical input into the selection of workshop themes. Delphine Küss at the French Research Ministry, and Philippe Marson and Marion Barberis at the OECD provided organisational and logistical support. Sandrine Kergroach provided statistical support and Nathalie Callewaere assisted in compiling the manuscript. The Secretariat would also like to thank all the national experts and delegates from OECD member and non-member countries that participated, and without whose support the workshop would not have been possible.

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Part 1

INTRODUCTION

WORKSHOP SUMMARY

The policy context

Why should the OECD governments be concerned with women in scientific careers? According to OECD Deputy Secretary-General Berglind Ásgeirsdóttir, who opened the workshop, the available data show that the number of female students enrolled in science courses is much higher than the number of women actually employed in research occupations. There is thus a risk that much of the social and individual investment in human capital is lost if a large part of that investment does not find itself participating in economic activities. Another reason for concern about women in science has to do with achieving equality between men and women in all walks of life, a societal goal with a long historical process in OECD countries. Arguably, women bring in different perspectives and research interests and as such can contribute to improving the quality of research. Furthermore, scientific integrity itself depends on non-discrimination.

For former French Research Minister Claudie Haigneré, OECD countries cannot remain inactive with regard to the need to build human potential in the field of science and technology, and the insufficient participation of women. While women have made progress in participating in the research workforce, progress has been uneven across scientific and technical fields as well as in terms of women's access to senior positions. This point was reinforced by the current French Research Minister, François Goulard, who noted that policy makers would be short-sighted to believe that just because there are now more women with higher education, and in the labour force, the issue of equality would take care of itself. Instead, he added, "policy action" was needed to address the issue of women's participation in scientific careers. For this reason, it is important to continue work to standardise and monitor statistics as well as to study the barriers that cause so few women to go into scientific careers, and to devise appropriate policies. In this respect, an exchange between OECD member countries is timely and can help countries learn from each other's experience and identify good policy practices that have emerged as well as the issues that need further research and policy attention.

Taking stock

The first session of the workshop explored the state of affairs with regard to what statistics can tell us about the participation of women in S&T education and careers. The OECD and Eurostat, the European Commission's statistical office, have worked closely to improve the collection of gender-disaggregated statistics in this area. From the background paper and the expert presentations in the session, it is evident that the share of women in S&T education has increased overall. The data also show that female participation in the labour market varies considerably between countries, age groups, areas of work and educational background. Participation rates seem to be higher in Nordic countries, North America and a few Western European countries, but lower in Asian OECD countries. In the OECD area, the population of female researchers has increased; women account for 25% to 35% of researchers in most OECD countries, with the exception of Japan and Korea (12% each).

However, women tend to be concentrated in fields and industries such as biology, health, agriculture and pharmaceuticals, with low representation in physics, computing and engineering. Women also tend to be concentrated in lower-level positions; just over one-third of US university faculty are women and this figure is even lower in EU countries, Australia, and Korea (only 14.5%). In the EU, women make up less than 20% of senior academic staff in the majority of countries. Despite the importance of such data in assessing the situation, a key message that emerged is that simple statistics on the share of women in certain fields or at the top of the career ladder are not sufficient for policy makers to devise solutions or remedies to the problems. Consequently, there is a greater focus on extending the collection of data, both quantitative and qualitative, to understand the working conditions of women S&T graduates (*e.g.* conditions of recruitment, salaries, mobility) as well as their productivity (*e.g.* publications, teaching, patenting activity) and career paths. In particular, there are important gaps in the data on the participation of women in business sector research and in the creation of science-based start-ups.

Horizontal segregation

The second session of the workshop explored the issue of “horizontal segregation” or the concentration of women in certain fields of scientific research (*e.g.* life sciences as opposed to engineering) and certain sectors of employment (pharmaceutical versus information technologies). This is a concern from a policy perspective as policies to increase the participation of women in science in general may inadvertently contribute to aggravating existing biases in scientific education and employment if the latter are not taken into consideration. In some countries, the share of women in science is increasing more in fields where women have already achieved equality in participation or even in some cases, account for the majority. Experts and participants identified several factors as contributing to horizontal segregation. Among these are:

- *Individual factors.* Women may make a personal and individual choice to pursue a career in a certain field, which may be driven by gender-specific motives and preferences. Gender stereotypes (*e.g.* engineering as being male-oriented and therefore not attractive to women) can also affect the direction of such choices.
- *Ability in mathematics.* One of the most polemical factors considered in explaining the causes behind horizontal segregation is whether differences in math ability between boys and girls plays a role in the participation of girls in scientific education and later on in careers. The presentation by Prof. Xie of the United States, for example, showed that the gender gap in average mathematics achievement is small and has been declining. Gender differences neither in average nor in high achievement in mathematics explain gender differences in the likelihood of majoring in science and engineering fields.
- *Interpersonal factors.* The type of networks that women may be involved in or a lack of networking can influence their choice to seek careers in certain scientific fields. The lack of role models among teachers early on as well as persons actually in the labour force is another factor that can impact on the career choices of women. Research has shown that youth make occupational choices on the basis of adult workers’ experience. Insofar as the choice of role models is gender-linked, the issue of role models becomes extremely important in influencing change.

- *Organisational structures.* The organisational structure of the workplace (e.g. hierarchical) as well as recruitment and promotion practices, the selection and allocation of research funding, and the workplace culture (e.g. male-centred engineering culture) are some of the other variables that affect the career paths of women.
- *Societal attitudes.* A society's broad-based attitudes towards gender equality as well as the prevalence of gender stereotypes also affect the conditions in which girls and women are more or less encouraged to choose and continue to pursue scientific careers.
- *Sex discrimination.* From a policy perspective, there is a need to distinguish between discrimination that has a material impact (such as denial of job or tenure) versus covert or perceived discrimination that discourages women. The former is often addressed in the context of equal employment laws but the latter is more difficult to pin down and often involves a complex interaction of different underlying biases.

The *interplay* of these factors in the decision-making process makes it extremely difficult to address the problems. For example, increasing the number of role models among teachers or among senior researchers can help but it may not be sufficient if changes in the other areas, such as the participation of women in academic selection committees or among research funding agencies, do not evolve in the same direction.

Vertical segregation

The third session addressed the issue of vertical segregation, which refers to the low share of women among senior research staff and faculty in many countries. OECD data show that female scientists and engineers are less successful than their male counterparts in moving along the academic career path. In Europe, for example, the percentage of women in the top grades of academia rarely exceeds 20%, and men are three times more likely than women to obtain professorships or their equivalent. The factors which may contribute to the less rapid advance of women in their scientific careers are multiple and well established by academic research: the difficulty to reconcile professional careers and child-rearing responsibilities; the use of research evaluation methods which may be gender-biased (e.g. a focus on research activity rather than on teaching); research agendas that may not be attractive to women's research interests or within their areas of specialisation; and a work environment that excessively favours competition over co-operation. Another factor identified by Prof. Pigeyre was the career structures in academia which are characterised by few positions at the top and specialised institutional profiles that determine recruitment strategies (e.g. a preference for external versus internal candidates). One implication is that funding special research posts, in partnership with industry, such as Canada's NSERC Chairs for Women in Science and Engineering, could be a way to bypass institutional constraints and open up career paths for women. Other factors identified by experts and participants alike include:

- *Employment conditions gap.* Women may enter research careers at a later stage; women are also more likely to work on temporary work contracts and on a part-time basis.
- *Career management gaps.* Senior recruitment committees may not include women. There may also be organisational attitudes towards family/work balance issues (*e.g.* taking parental leave or working part-time being seen as a disadvantage in promotion possibilities); a lack of leadership role models and mentors in the workplace that could encourage women.
- *Scientific excellence gap.* There is some research that suggests that there are dysfunctions or gender bias in the system for the evaluation of scientific excellence which may impact on the possibilities for career advancement.
- *Research productivity gap.* Lower research productivity may explain differences in promotion between men and women, but productivity is also affected by access to team leader positions, where women are under-represented. The implication here is that without access to team leader positions early on, the incentives and opportunities for the promotion of women may be reduced.

Instruments for change: existing policy and programmes

With regard to women in S&T most OECD countries have policies and programmes in place to increase the participation of women in science and engineering. These policies and programmes include a large variety of measures ranging from grants to support senior positions for women at universities to preferential recruitment policies towards equally qualified women candidates. On the employment side, equal opportunity policies, flexible working hours and parental leave are also important for encouraging women to pursue research careers in the public and private sectors. Experts presented a range of programmes and strategies to promote women in scientific careers.

- Gender mainstreaming research programmes (*e.g.* in Austria)
- Coaching and mentoring (*e.g.* in Germany)
- Partnerships with employers (*e.g.* United Kingdom, Canada)
- Work and family balance initiatives – flexible hours, part-time for senior staff
- Support for returnees to the S&T labour force (*e.g.* in United Kingdom, new programmes in Japan)
- Specially funded chairs for women faculty (*e.g.* in Canada)
- Targeted awards/fellowships (*e.g.* United States, Norway, France)
- Awareness-raising measures at research institutions (*e.g.* in the United States)
- Data collection efforts and programme evaluations (*e.g.* in Austria, United States, Netherlands)
- Comprehensive policy strategies, from initiatives at schools to S&T careers (*e.g.* Norway, Finland, France)

Conclusions

Short of endorsing specific “action” measures, experts and participants agreed that without a voluntary and active policy towards the recruitment of women among senior research faculty and management at universities, public research labs and in technology-based companies, the participation of women in the scientific labour force would not improve fast enough to meet the growing demand for S&T workers. It was also agreed that more had to be done to address the underlying causes behind the low number of women in top science positions, including the difficulties for women to reconcile professional careers and child rearing; the demands for mobility early in research careers; the system for evaluating researchers which often favours research outputs over teaching; a lack of participation by women in the setting of research agendas and hence the predominance of male-gendered research agendas and more importantly, the scarcity of female role models among senior researchers and faculty. In terms of solutions, the participants pointed to the following issues as important steps forward:

- Encourage the nomination of women to top senior positions so as to increase the number of role models for younger women.
- Foster the development of formal and informal networks of women researchers, including partnerships between researchers in firms and in universities.
- Ensure that gender-mainstreaming initiatives at research institutions and in firms are result-oriented and are supported at the highest levels of the research institution/firm.
- Use scholarships and research grants to encourage young women researchers to pursue careers in fields of science and technology where women are under-represented.
- Link initiatives to promote women’s entrepreneurship with those targeted to women in science so as to promote alternative career opportunities for women S&T graduates.
- Evaluate public programmes and initiatives to promote women in science so that results feed back into policy and programme design.
- Disseminate “good practices” for attracting and retaining women in science careers among and within public research institutions and firms.
- Improve the collection of sex-disaggregated data on the careers of researchers, especially through longitudinal studies.

Participants also urged the OECD to continue work in this area, especially with regard to the evaluation and effectiveness of policy measures and initiatives. Participants also noted the need for further disaggregating statistics (aggregation masks important differences) but noted that this can be costly and that the OECD should strengthen its co-operation with the European Commission in this area. In general, delegates felt the OECD should now move beyond documenting the problems of vertical and horizontal segregation and focus on practical solutions as well as understanding the career paths of women researchers in the business sector. To address these issues, a follow-up OECD conference, hosted by Canada with support from the Austrian authorities, is planned on 28-29 September 2006 in Ottawa, Canada.

OPENING REMARKS

Welcome speech by Ms. Élisabeth Giacobino, Director for Research, French Ministry for Higher Education and Research

I am pleased to welcome you today to this workshop organised by the OECD and France on the subject of women in scientific careers. I salute the presence of Ms. Claudie Haigneré, France's Minister for Research from 2002 to 2004, who in 2004 was behind the initiative for France to propose work on this issue within the OECD. I would also like to salute the presence of Ms. Berglind Asgeirsdottir, Deputy Secretary-General of the OECD. I want to welcome all the delegates here today. I would also like to thank Finland, which helped to organise this event.

The career of women in research is an important subject, for we will need their talent in the years to come if we are to successfully develop a knowledge-based economy and society. We need women who have successful careers who can act as models for young generations. We are currently witnessing in France and Europe a declining interest among young people, and among young women in particular, in the “hard” sciences, such as physics, mathematics, information and communication sciences, and technologies and engineering. We must also enable young women to pursue careers in industry. It is the example of dynamic scientists and attractive careers that will draw young people to the sciences.

Consequently, it is important to understand why, after being trained in the sciences, many women do not go on to pursue a scientific career. We must enable more women to rise to posts of responsibility and to sit on appointment and promotion committees. There are many women whose talent is not sufficiently recognised.

Aware of these difficulties, the Ministry responsible for higher education and research is working to improve the situation of women in research, technology and higher education. In 2001, for example, it set up the Mission for Gender Parity in Research and Higher Education.¹ Every year it prepares a plan of specific initiatives aimed at meeting the objectives sought: to encourage girls to study the sciences, to promote gender balance in scientific careers and to ensure that the gender dimension is taken into account in research institutions, programmes and policies in France.

The Mission also provides analyses and quantitative indicators. In this regard it co-operates with the other ministries involved in this field, as well as with associations of women scientists, networks of “parity” correspondents and representatives of EU member states. It published a report on “The Situation of Women in Research in France” in 2002 and the “White Paper on Women in Private Research” in 2004, and it organises yearly the Irène Joliot-Curie Prize, which rewards initiatives aimed at promoting the situation of girls and women in higher education and research.

1. For more information, see www.recherche.gouv.fr/parite (in French).

Much still remains to be done and I am particularly interested in learning about the systems that exist in the different countries and in working with you to find the best solutions for attracting young women to the sciences by offering them attractive research careers.

I thank you for your attention and I hope that your exchanges will be fruitful.

Opening remarks by Ms. Berglind Ásgeirsdóttir, OECD Deputy Secretary-General

Good morning, Ministers, ladies and gentlemen.

It gives me great pleasure to take part in this workshop on Women in Scientific Careers. This is not the first time the OECD has tackled the issue of “Women in Science”. A similar event was organised more than 10 years ago, in 1992. However, the fact that we are here today reminds us that, although women have made progress entering higher education and the labour market, including the scientific workforce – only around 30% of university degrees in science and engineering are awarded to women and around 25 to 35% of researchers in OECD countries are women – much more remains to be done, especially with regard to improving the participation of women at the senior and decision making levels.

Why should the OECD care about women’s participation in science careers?

But first, I should like to take a step back and ask the question, why should the OECD care about women in science education and scientific careers? As many of you know, the OECD’s mission is to help countries achieve sustainable economic growth. As our economies have become more knowledge-driven, they have become more dependent on science and innovation for growth. The contribution of science to innovation is both old and new. It was not until the Enlightenment, however, that we came to acknowledge that science has a more or less direct impact on the development of our societies, both economically and socially. At the beginning of the 21st century, we are experiencing a third industrial revolution, one where innovations – especially in information and communication technologies and biotechnologies, and also in nanotechnologies and new materials – are rooted more in scientific knowledge than in the past. Thus, achieving sustainable growth in modern economies requires investment not only in research and innovation but also in human capital. People with science and technology skills play an important role in channelling investments in knowledge into productivity and growth.

Women are half of the population. As humans, men and women are part of the natural world. Human understanding of the natural world therefore cannot be complete without the full participation of women. This increases the diversity and richness of human knowledge and understanding. In innovation, women also have much to contribute as inventors, technologists, managers as well as entrepreneurs. The OECD has taken a lead on the issue of women and entrepreneurship but we have not thus far explored entrepreneurship for women with scientific training as an alternative to careers where the glass ceiling remains. In addition, meeting the challenge of ageing populations and declining birth rates in OECD countries will require that we make fuller use of the social and economic contributions of women.

Addressing the broader issues of education of women and girls

While female participation in higher education increasingly exceeds that of males, women remain an untapped resource for science and innovation. This brings us also to consider earlier stages of education, that is, education of girls.

The OECD's Programme for International Student Assessment (PISA), which gathers information about student learning and attitudes at age 15, shows some gender differences. In PISA 2000, when reading was the main domain of assessment, girls outperformed boys in reading in all participating countries by a significant margin. In PISA 2003, when mathematics was the main domain of assessment, it was found that boys outscored girls in mathematics in nearly all countries, but the differences were much less than those for reading. PISA also shows that girls aged 15 have a much more negative attitude to mathematics than boys, and feel more anxious about their performance in mathematics classes. A relatively small positive shift in girls' attitudes to mathematics could, perhaps, result in performances on a par with those of boys. PISA 2003 showed that in problem-solving skills – general competencies to solve life's challenges – gender differences were minor. (Girls outperformed boys in five countries while boys outperformed girls in one country.)

PISA also assessed scientific literacy in 2000 and 2003 and will make it the main domain of assessment in 2006. In 2003, boys performed significantly better than girls in science in 11 OECD countries and girls significantly better than boys in two (Iceland and Finland) at age 15. This means that there were no significant gender differences in science in 17 OECD countries, and that represents an encouraging development which may ultimately translate into a better gender balance in higher education enrolments in science. It will be important to see what the fuller picture in science achievement in PISA 2006 shows and what light it sheds on student attitudes.

Addressing the broader issue of reconciling work and family life

The problems which women face in their scientific careers are of course just one manifestation of the problems they face in the labour market more generally. Women are still generally expected to be the primary care-givers in our societies. The result is that women have greater pressures on their time on average than men. If governments do not provide appropriate policies to help them combine work and family life, the result will damage women's career prospects. Similarly, if employers do not structure their business practices to recognise that work is not the only goal in most people's lives, then women will on average find it hard to compete with their male colleagues.

The OECD has recently reviewed national policies for reconciling work and family life in its series *Babies and Bosses*. These found that childcare is more readily available today in many countries than it was, although its price can still discourage women from working. The tax and benefit system still discriminates against women in some countries, but the penalty on married women who work is less than it was. Part-time work for men and women is, at least in some countries, an effective way of reconciling earning and caring. Some employers now make great efforts to help retain their skilled employees. But overall working life is still experienced very differently by men and women. Even in the Nordic countries, which have gone the farthest in publicly subsidising parents who wish to work, the result is that female employment rates are high, but women work in the public sector, predominantly in non-managerial posts. What policies could help eliminate the existing penalty against women in the labour market? One example would be to encourage men to take leave to look after young children, rather than only mothers having

to spend extended periods out of work. Equal and non-transferable rights to maternity and paternity leaves already exist in some OECD countries.

Importance of international co-operation for data collection and analysis

The OECD has a long experience in collecting and standardising social and economic data. This is important for benchmarking country performance in order to better inform policy making and design best practice policies. It is my sincere hope that this workshop will not be a one-off event, but that it will be the beginning of a longer-term partnership between countries and the OECD Secretariat to improve data collection on a gender-ed basis. For instance, we have little data on women science graduates working outside academia. We know little of their contribution to the commercialisation of research or the development of new spin-off companies from universities. These help foster clusters of new industries and act as magnets for attracting highly qualified human capital. We also do not know enough about what government can do, including in partnerships with industry, to remove barriers to the full participation of women in science and technology.

The tasks ahead

The main task before us today is to assess the slow growth in the female scientific workforce, especially in senior positions, and what can be done about it. Women researchers are often concentrated in the public research sector in many OECD countries, and I look forward to learning from experts and industry representatives about what can be done to encourage women to pursue careers in industry as well as in alternative careers outside the traditional bench and corporate lab work. Women are also concentrated in certain academic fields and occupations, but we don't know to what extent this is the result of personal choice or direct and indirect barriers to women's participation. Women are also moving up the corporate and academic ladders but here as well barriers remain. In academia, women make up less than 20% of senior faculty in European OECD countries. What is holding them back? What can help them? These are some of the questions to which we will have to find answers.

Concluding remarks

Before closing, I would like to express my sincere gratitude to Minister François Goulard for the invitation to speak today, as well as to Mme Claudie Haigneré, who as Research Minister of France in 2004, launched this initiative at the OECD Committee for Science and Technology Policy Ministerial Meeting. I would also like to acknowledge the contribution by the Finnish government to this event.

The importance that OECD countries as well as non-member countries attach to this workshop is clear from the presence of participants from throughout the OECD area and beyond. This conference must address some very difficult but critical issues. If we are successful, it is my belief that the scientific community and societies at large will benefit greatly.

Thank you.

Opening remarks by Ms. Claudie Haigneré, Former French Minister for Research (2002-2004)

Minister, Deputy Secretary-General of the OECD, Director, ladies and gentlemen, I am very pleased to have been invited to open this international workshop, organised jointly by the OECD and the French government, to discuss the situation of women in scientific careers. In 2004, as French Minister for Research, I had the good fortune to participate in the meeting of OECD research ministers and among the topics that we discussed, I highlighted the fact that we could not remain inactive with regard to the gap between the need to build human potential in the field of science and technology and the insufficient participation of women in this process that will enrich our knowledge-based societies in the future. One of the objectives of this workshop is to share our experiences and define collective forms of action and I would like to thank you for attending in such large numbers and for the commitment you have shown.

In France, the number of women in research has doubled since 1992. In 2003, there were 66 713 women researchers, but they only accounted for 27.6% of all researchers in the public sector and industry.

The figures show that there are far more women in public research than in the private sector. France is in line with the European average, with women accounting for 33.41% of researchers in public research and 20.31% in companies. Our country does not rank too badly in comparison with European averages, since in the EU women account for 34% of researchers in universities, 31% of researchers in government bodies and 15% in the corporate sector.

However, it must be emphasised that the number of women researchers varies greatly across disciplines and disparities abound. There is a much lower proportion of women in materials sciences. Barely 20% of the researchers in this field are women and their share falls to 15% in aeronautics sectors.

With regard to posts of responsibility, the figures still show that the number of women in the highest posts is decreasing. Only 16% of full professors in universities and 22.6% of research directors are women.

Only 23% of the staff participating in decision making, policy setting and evaluation bodies were women in 2001, and their share dwindles the higher we move up the hierarchy. On the whole, the most recent indicators show that the gender mix has been evolving too slowly.

In universities, men are 1.9 times more likely to be promoted than women. This likelihood is 2.9 times greater in chemistry, 3.8 times greater in biology and biochemistry and 1.6 times greater for the CNRS as a whole.

Although the proportion of women in higher education has risen significantly, women's enrolments in scientific curricula and programmes remain low in upper secondary schools, universities and engineering schools. In 2003-2004, women accounted for 56.4% of university enrolments, but only a small proportion of them were enrolled in scientifically oriented programmes. Women accounted for 27.9% of enrolments in fundamental and applied sciences, 31% in the sciences and techniques of physical and sports activities and 38.9% in multi-sciences.

The share of women students enrolled in doctoral programmes across all disciplines is rising, with women now accounting for 51% of enrolments and 42% of dissertations, although these figures must always be qualified in the light of the situation in individual disciplines. For example, the proportion of women in all engineering schools was 25% in 2003-2004 and their enrolments remained low in scientific preparatory schools, where they only accounted for two out of every five students (28.5%) in 2003.

Consequently, it would appear that certain careers are not sufficiently attractive to women. Are women overly wary of career difficulties in the future and the difficulty of being a working mother? Is it a question of culture? Are women not sufficiently familiar with these occupations?

There are still problems with what is known as the glass ceiling (women's difficulty in rising to the top) and the scissor effect (the loss of women who are trained in scientific fields but do not go on to have scientific careers).

Special attention must be focused on women's careers and how women are treated in the workplace.

A great deal of work has been done to gather data and establish indicators, both by the OECD and the EU, which has set up a statistics group, and the EU member states. Work to standardise and monitor these statistics is under way, and it is important that it be continued and made systematic.

We must also study the barriers that cause so few women to go into scientific careers. We must look at how the need to balance work and family life is taken into consideration, how the different stages of motherhood are dealt with during careers and whether there are adequate arrangements to help women return to research that has been temporarily interrupted. We must also examine whether appropriate criteria are used with regard to access to competitive examinations and to the various appointment and evaluation boards.

It is for these reasons that the exchange between different countries made possible by this workshop on the career of women scientists seems to be coming at the right time. I hope that it will make it possible to identify the most suitable arrangements and best practices, to identify the studies that must still be conducted and to promote an exchange of views. I also hope that it will mark the beginning of joint work and a new stage in useful international work in this field. There can be no doubt that we will need to use all the talent available in the years to come and that this must include the talent of women trained in scientific fields.

Remarks by Mr. Johannes Klumpers Directorate General Research, European Commission

Since 1999, the European Commission has been pursuing a specific gender equality policy within research. Its establishment was one step in the implementation of the general equal opportunities and gender mainstreaming policy of the European Commission. Indeed, the European Treaty contains a number of references to gender equality. It mentions in article 2:

“The Community shall have as its task, ... to promote throughout the Community equality between men and women...”

In article 3, it continues:

1. *For the purposes set out in Article 2, the activities of the Community shall include, ... the strengthening of the competitiveness of Community industry and the promotion of research and technological development;*
2. *In all the activities referred to in this Article, the Community shall aim to eliminate inequalities, and to promote equality, between men and women.*

Article 13 refers to combating discrimination based on sex, whereas article 137 deals with the labour market:

... the Community shall support and complement the activities of the Member States in the following fields:... equality between men and women with regard to labour market opportunities and treatment at work;

and Article 141 with equal pay:

Each Member State shall ensure that the principle of equal pay for male and female workers for equal work or work of equal value is applied.

The treaty gives a clear mandate to the Women and Science Unit, which has addressed all the issues covered by the treaty except pay gap, always focusing specifically on scientific research and researchers. While the treaty addresses human rights, anti-discrimination and equal treatment in general, the Women and Science Unit also addresses issues such as the functioning of the science system and the issue of scientific quality or scientific excellence. Can Europe maximize scientific excellence without achieving a balanced participation of women and men, and without properly taking into account the gender dimension of research?

We know that in 1999, 52% of students in basic higher education studies were women. In 2003, 59% of those who graduated with a degree qualifying for Ph. D. studies were women. Women are thus more successful in their studies, which is in stark contrast to the number of women who become full professors. In 2003, only 15% in Europe were women. These sorts of statistics raise serious doubts as to whether Europe is succeeding in optimally deploying all its talents.

What are we doing about it? Most importantly, a good knowledge base is needed to implement measures or make proposals. We know that a multitude of factors are put forward to explain the low number of women in decision-making positions in research or the low number of women taking up certain science or engineering disciplines. What we do not know is what the relative importance is that can be attributed to each of the factors under discussion. We also have insufficient information on how -- in quantitative terms -- major societal trends influence the career perspectives of today's students.

This is why in March 2005 the Commission put forward a staff working document on “Women and Science: Excellence and Innovation -- Gender Equality in Science” (COM [2005]370) which described seven priorities for the years to come, among which “strengthening gender research” in the field of scientific careers. The development of gender research was then also put forward in the Commission proposal for the 7th Framework Programme. This type of research will also include the development of scenarios to demonstrate the consequences – for European research – of achieving or not achieving gender equality.

The subject of women and science is part of a larger community programme called “Science in Society” where other issues such as ethics in science, governance of science, communication of science and science education are also dealt with. This reflects the Commissions’ opinion that the under-representation of women in research cannot be treated solely as a problem of availability of human resources – the lack of women also has impacts on priority setting, how research is carried out and how decisions are taken. It is a problem of fair participation in research, as a researcher and/or as a decision maker.

This is why the Commission will not limit its activities to only improving the knowledge base. The Commission will continue to try to put gender mainstreaming research and research policy into practice.

Chapter 1

OECD BACKGROUND PAPER

Mario Cervantes

Science and Technology Policy Division

OECD Directorate for Science, Technology and Industry

This background paper has been prepared by the OECD Secretariat for the Joint OECD-French government workshop on “Women in Scientific Careers: Unleashing the Potential” to be held at the French Research Ministry in Paris on 16-17 November 2005. The workshop will take place in context of the SFRI’s activities on human resources in science and technology. The following key messages and facts serve as a point of departure for the discussions at the workshop.

- Against a background of growing demand for human resources in S&T, policy makers have paid greater attention to encouraging women to pursue careers in S&T.
- Beyond the important contribution of women to increasing the supply of human resources in science, the participation of women in research helps to extend the frontiers of human knowledge and discovery.
- Women have made significant gains in labour force participation as well as in higher education. The share of women aged 15-64 years who participate in the OECD-wide labour force increased from 56.6% in 1990 to 60.1% in 2004. Nevertheless, the patterns of employment of men and women differ greatly between countries, economic sectors and fields of study.
- Women account for only 30% of science and engineering graduates in OECD countries, but this figure hides important discrepancies by field: women account for more than 60% of life science graduates in a number of OECD countries, but account for less than 30% of graduates in computing and 40% of graduates in the physical sciences.
- The population of female researchers has increased and women account for 25% to 35% of researchers in most OECD countries, with the exception of Japan and Korea (12% each). While nearly two-thirds of women researchers in the United States work in industry/business, the figures are 17.5% for the EU and 6% for Japan. This contrasts with the general trend in which most OECD researchers overall, primarily men, work in the business sector.
- When women do research, they tend to be concentrated in fields and industries such as biology, health, agriculture and pharmaceuticals, with low representation in physics, computing, and engineering.

- Just over one-third of US university faculty are women but this figure is much lower in EU countries and in Australia as well as Korea (14.5%). Women also make up less than 20% of senior academic staff in the majority of EU countries.
- OECD countries are addressing the issue of women's participation in science to a varying degree. However, few OECD countries appear to have a comprehensive approach to promoting the participation of women in research careers. Moreover, the evaluation of such programmes is lacking.

Introduction

At the meeting of the Committee for Scientific and Technological Policy (CSTP) held at Ministerial level in January 2004, much discussion was devoted to the issue of human resources in science and technology (HRST). Ministers expressed concerns over declines in enrolments and the slow growth in the number of science and engineering graduates. In this context, ministers highlighted the particular importance of increasing the participation of women in science and technology studies and careers, and asked the OECD to examine the situation prevailing in OECD member countries, to identify the barriers to the participation of women in academic and non-academic research careers, and also to describe programmes and good practice in place to overcome such barriers.

The Working Group on the Steering and Funding of Research Institutions, under its revised mandate, has responded to the ministers' request and has included an activity on "women and scientific careers" in its work programme. This paper, which serves as background for the conference on "Women in Scientific Careers: Unleashing the Potential", reviews the current trends with regard to the participation of women in the S&T labour force, based on available statistics. It also discusses some of the reasons behind the gap between the increasing participation of women in science and engineering education on the one hand, and the low share of women in the research workforce. It presents some examples of policies being put into place by OECD countries to attract and retain women in research careers.

Why should we care?

The rationale and context for promoting women in S&T careers

OECD countries have long sought to increase the participation of women in science and engineering education and careers not only to improve social equity in higher education and the workplace, but also to increase the overall supply of scientific and technical personnel. Indeed, against a background of growing demand for S&T workers, combined with concerns about declining interest in science among youth and an ageing research workforce, policy makers are increasingly keen on tapping the other half of the human talent pool. Another driver behind the recent attention focused on women in S&T careers relates to some OECD governments' targets to raise the level of R&D spending as a share of GDP (*e.g.* the EU target of 3% of GDP, but also targets in Canada). Part of the supply of new researchers needed to carry out R&D will have to come from greater participation by women.

However, increasing the supply of researchers or technologists is neither the only nor the most important reason for encouraging women to participate in scientific and technical careers. As humans, men and women are part of the natural world. Human understanding of the natural world therefore can only benefit from the greater participation of

women. Women, arguably, may also have different interests or seek answers to questions left aside by men (Tilghman, 2004). This increases the diversity and richness of human knowledge and understanding. In engineering too, the contributions of women – both as engineers but also as users – are essential and are slowly changing the way we approach everything from infrastructure to the design of automobiles and robots.

There are also larger societal and economic developments in OECD countries that have raised the importance of gender on the policy agenda. For one, demographic trends such as ageing populations and declining birth rates in many OECD countries have resulted in policy actions to encourage women to remain in the workforce by creating incentives for balancing work and family life. In the business and political spheres there is also a focus on improving the participation of women. While OECD countries have long-standing laws to promote gender equality and abolish sex discrimination in the workplace, namely through equal opportunity laws, several have gone a step further and enacted “gender mainstreaming” laws whose goals are to achieve equality between women and men in all areas of decision making in the public and private sectors. France recently enacted a gender parity law to promote greater participation of women in the political sphere. In Denmark, since 2000, the Danish Equal Status Laws require public authorities to “work for equal status [between men and women] in all planning and administration”. In Norway, just this year, the government passed legislation requiring the governing boards of private companies to have a minimum of 40% representation by each gender. The EU has set itself a target of increasing the share of women in leading positions in the public research sector to 25%.

What do we know about women and the labour force?

Data is all important in understanding the situation of women in the workplace in general and in the S&T workforce in particular. Most countries have gender mainstreamed the collection of labour force data. From this data we know that the participation of women aged 15-64 years old in the labour market increased from 56.6% in the OECD area in 1990 to 60.1% in 2004. Iceland has the highest share of women participating in the labour force (82%) while Turkey (27%) has the lowest. Among the bigger economies, the labour force participation rate for women in Japan is 60% compared to 69% in the United States and 62.8% in the EU-15.

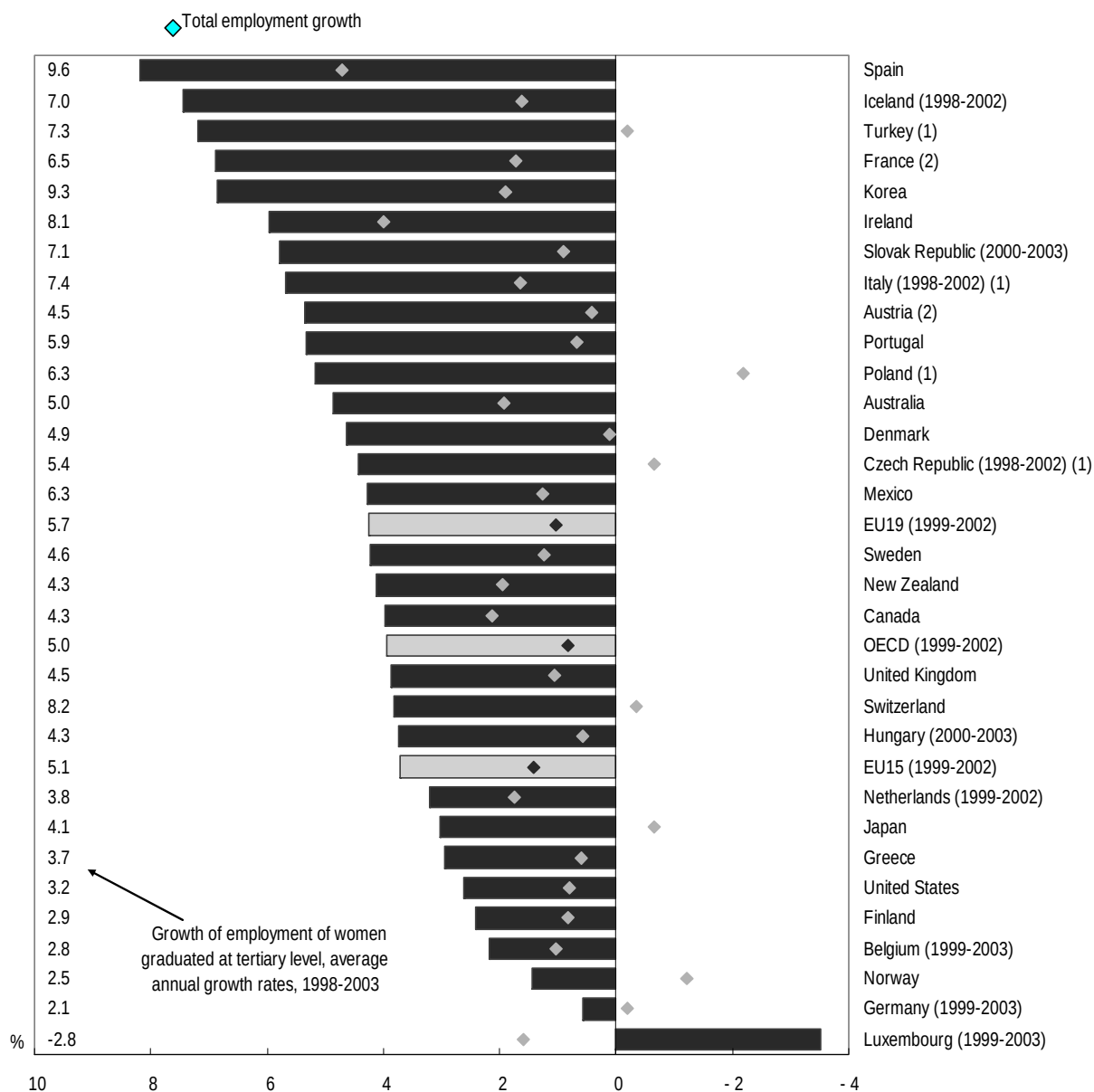
Data also tell us that participation of women in the labour market varies considerably between age groups, sectors of employment and education background. Women between 25 and 54 years of age – which represents the main pool of women who can take part in the S&T workforce – have the highest rates of employment in Sweden, Norway and Denmark; 80% or more of women in that age group and in those countries were working in 2004. Countries with the smallest shares of working women as a share of the population in that age group include Turkey (28%), Mexico (48.3%), Italy (57.8%) and Korea (58%).

Employment of women university graduates

Across the OECD, more men than women with university degrees and aged between 25-64 years were working in 2003; 88.4% of male tertiary graduates were working compared to 74.9% of women tertiary graduates. Again, differences by country are significant; some 78.2% of Australian women and 80.6% of Polish women with tertiary degrees were working while only 56% of Korean women and 64.3% of Japanese women with university degrees were working in 2003. While women university graduates have lower rates of employment in many OECD countries, this rate has been increasing. In all

countries in Figure 1, the rate of employment grew faster for women except for Austria and Iceland. In Switzerland, the growth rate of women tertiary graduates entering employment was over 8% per annum compared to 2.09% for men (Figure 1.1).

Figure 1.1. Employment growth of tertiary-level graduates, 1998-2003



1. Do not include graduates at ISCED 5B level.

2. Do not include graduates at ISCED 6 level.

Source: OECD Science, Technology and Industry Scoreboard, 2005.

Women have thus made significant progress in increasing their participation in the labour force and women university graduates have made even greater strides in entering employment in most OECD countries. As women continue to increase their participation in higher education, they will account for more of the employment growth in knowledge-based economies. However, insofar as women obtain more than half of all university degrees in many countries but only around 30% of the university degrees awarded in science and technology, OECD countries face a paradoxical situation: a feminisation of the workforce in general and of university-trained graduates in particular, but continued under-representation of women in the research workforce.

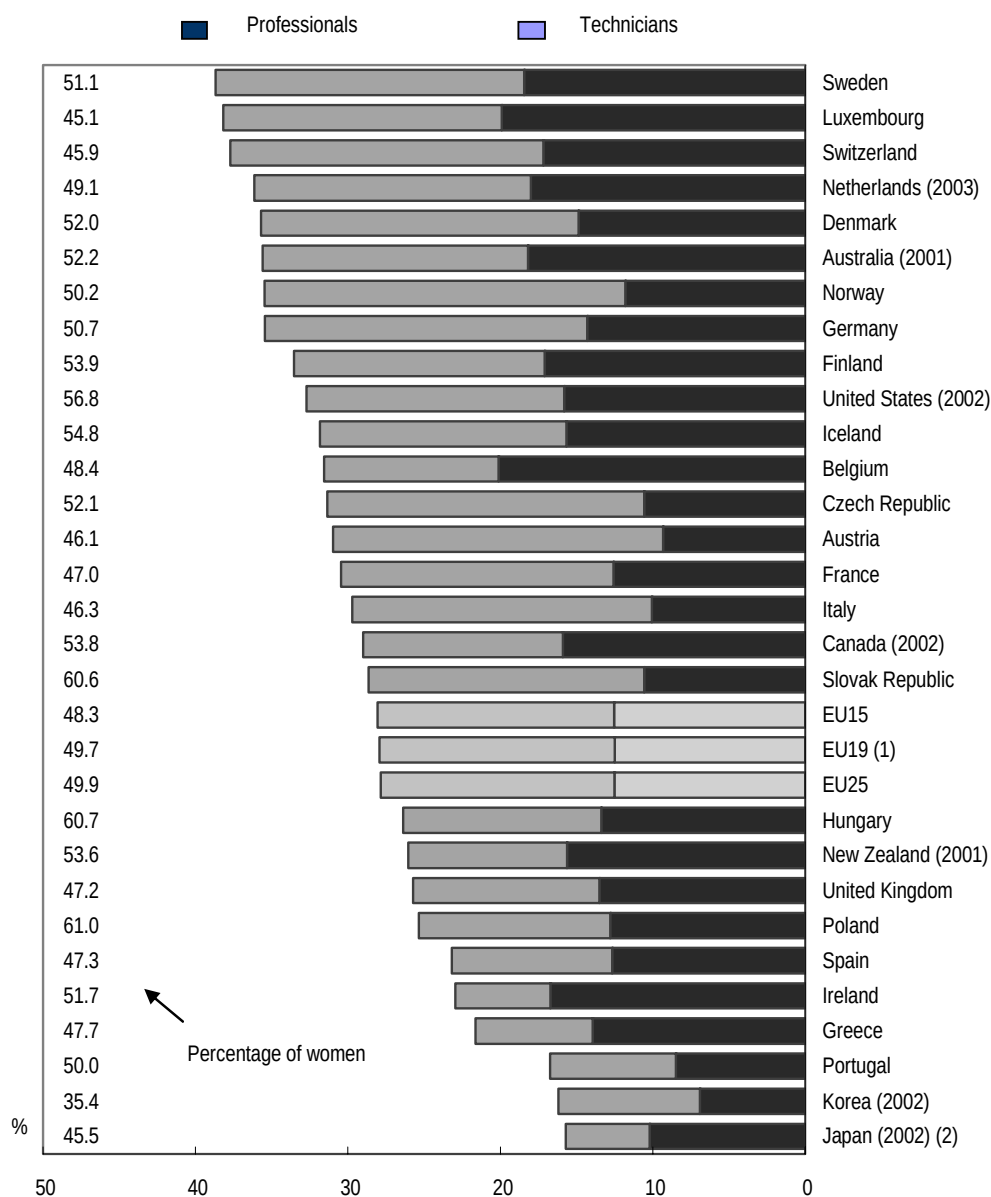
A look at OECD data on the population of human resources in science and technology (HRST), defined as individuals who have successfully either completed education at the third level in an S&T field of study or are employed in an S&T occupation for which such qualifications are normally required, shows that women represent nearly half of the HRST workforce broadly defined in the EU25 (49.9%), but up to 56.8% of HRST occupations in the United States are filled by women. At the other extreme, only 35% of HRST occupations in Korea are held by women, according to this broad measure of HRST. Furthermore, the growth rates of women working in HRST occupations have increased faster than total employment, and in some cases, than employment growth of HRST occupations (Figure 1.2). The relatively strong performance of women using these aggregate measures may nevertheless include some biases since the occupational categories used in the HRST definition may include jobs in which women tend to predominate, such as teaching, and in medicine and nursing. A more detailed disaggregation of occupational data by gender would be needed to better assess the underlying trends behind the apparent strong representation of women in HRST occupations.

Supply of women researchers

Across the OECD demand for researchers is rising. The researcher population in the OECD area as a whole increased sharply in the 1990s from 2.5 million to 3.4 million researchers in 2002. The OECD countries with the largest proportion of researchers (men and women) in the labour force are Finland, Sweden, Japan, and the United States followed by Denmark and Norway. Although women account for close to half of the HRST population (Figure 1.1) in most countries for which data are available, the share of women researchers is quite low, representing between 25% and 35% of the researcher population. Korea and Japan are outliers with 12% shares each. Data from the US show that women account for around one out of four researchers (scientists and engineers) in 1999 (NSF, 2004a). While nearly two-thirds of them work in industry/business, the figures are only 17.5% for women researchers in the EU and 6% for women researchers in Japan.

Figure 1.2. HRST occupations and women, 2004

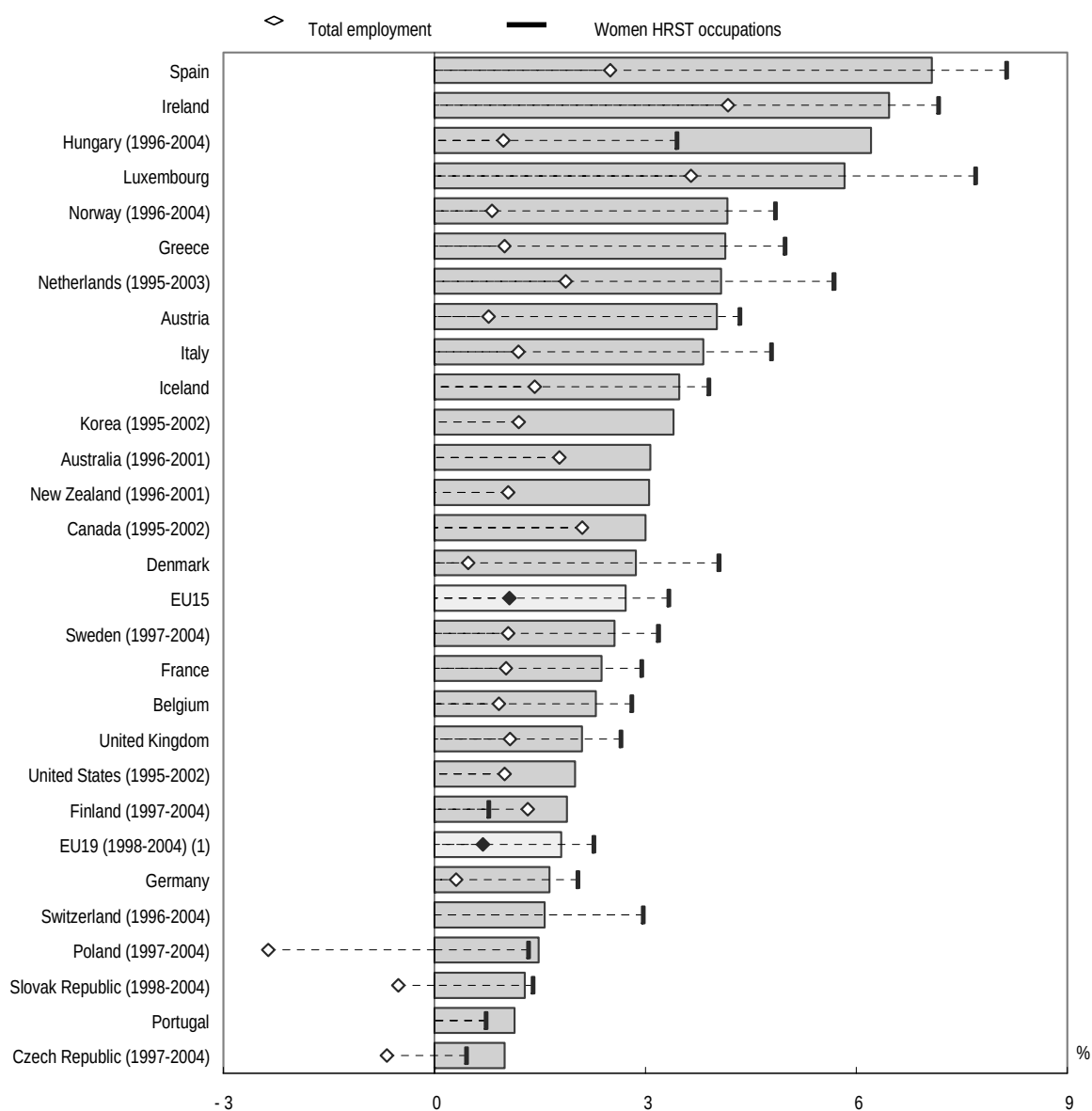
As a percentage of total employment



1. OECD estimates.

2. National estimates.

Source: OECD Science, Technology and Industry Scoreboard, 2005.

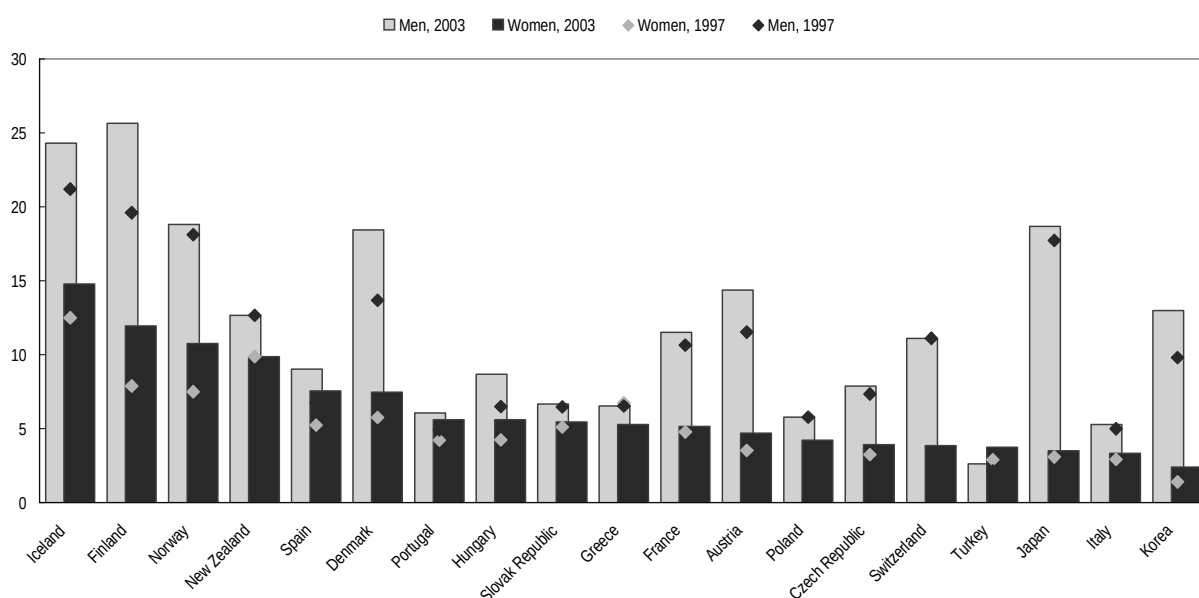
Figure 1.3. Women in HRST occupations, average annual growth rate, 1995-2004

1. OECD estimates.

Source: OECD Science, Technology and Industry Scoreboard, 2005.

A look at the relative intensity of the production of both men and women researchers (on a head-count basis and relative to the size of their respective labour forces) shows that the gap between men and women is greatest in Japan, Korea and Austria, and also considerable in Switzerland and Denmark (Figure 1.4). The gap between men and women researchers per thousand labour force is smaller in countries such as the Slovak Republic, Greece, Portugal, Spain and New Zealand. Between 1997 and 2003, the gap between male and female researchers closed the most in Finland, Norway and Spain. The gap between men and women researchers increased the most in Korea, Austria, Hungary and to a lesser extent Japan. The gap was pretty much stable in France. While some countries, such as Portugal, the Slovak Republic, New Zealand and Spain demonstrate a relatively high number of women researchers compared to other OECD countries, these countries are also characterised by low overall R&D spending as a share of GDP with a concentration of research in the public sector and low business R&D spending.

Figure 1.4. Women and men researchers per thousand women and men labour force, 1997 and 2003¹



1. Head counts.

Source: OECD Main Science and Technology Indicators (MSTI), 2005.

Using data from the European Commission, which has limited cross-country comparability as it includes both head counts and full-time equivalent, nevertheless shows some interesting patterns (Table 1.1). In Portugal, for example, the share of women is relatively higher in the government (56.1%) and higher education sectors (45%) than in the business sector (27.7%). In the business sector overall, Japan and Germany have one of the lowest shares of women in research, 6% and 11.7%, respectively. This uneven distribution of women in research results from a combination of factors. In some cases, the career choices of women are influenced by gender-specific variables (*e.g.* choice of field of study at secondary and tertiary levels, which preconditions career options) but also by external factors such as lower relative pay which may push men out of some fields/sectors or gender-biased recruitment, funding, evaluation and promotion processes

that discourage or even prevent women from entering certain sectors. Some studies argue that women are squeezed out of competitive, high-expenditure R&D systems with a high reputation into low-expenditure systems with less reputation. This seemed to be, for example, a problem in Central and East European countries where women moved into positions in public research institutions and universities which had been vacated by men having moved to better paid positions in the private sector. There is also some evidence in the United States and the United Kingdom that the share of women in public sector research has increased due to the fact that men have shifted to the private sector (Huyer, 2004).

Table 1.1. Women researchers, as a share of all researchers, by sector of employment, 2002

	Business enterprise	Government	Higher education
Belgium	18.1	29.9	37.2
Czech Republic	19.7	32.9	34.9
Germany	11.7	23.7	22.4
Denmark	21.3	33.8	32.0
Estonia	23.4	60.0	43.4
Greece	23.9	38.5	38.1
Spain	24.8	42.4	37.0
France	20.9	31.9	33.0
Ireland	20.4	32.1	-
Italy	19.0	38.4	29.8
Cyprus	24.1	32.9	30.5
Latvia	48.2	54.8	52.2
Lithuania	32.7	49.2	48.0
Luxembourg	-	33.5	20.4
Hungary	23.7	38.2	35.3
Malta	-	51.5	-
Netherlands	9.3	-	27.3
Austria	-	-	-
Poland	28.2	42.9	38.9
Portugal	27.7	56.1	45.1
Slovenia	28.7	43.3	34.3
Slovak Republic	29.9	44.1	40.8
Finland	18.4	40.7	44.2
Sweden	25.1	-	39.9
United Kingdom	-	31.8	36.6
EU25	17.5	34.8	34.9
United States	-	-	-
Japan	6.0	11.5	20.0

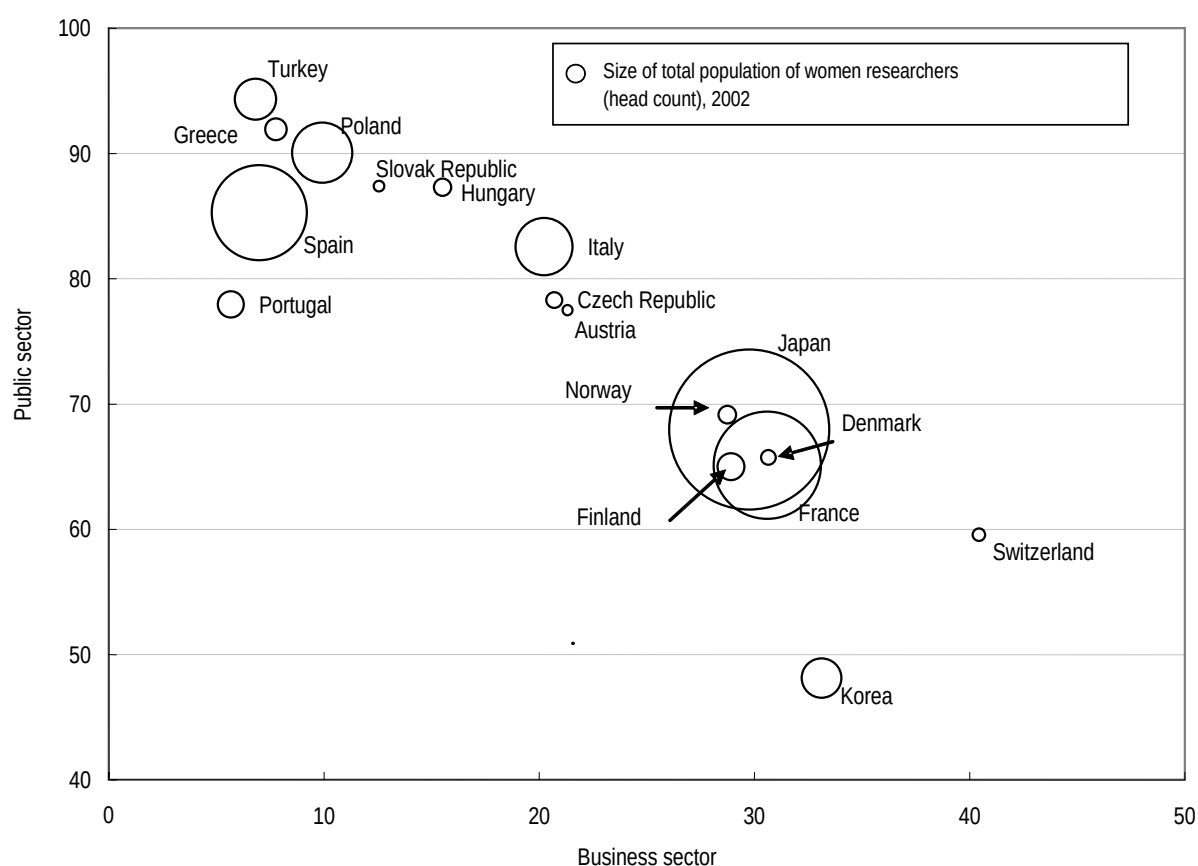
Notes:

1. FTE instead of HC: Belgium (government, higher education); Germany (all sectors); Ireland (government).
2. Business enterprise: Poland (2000); Belgium, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Sweden (2001). Government: Belgium, Greece, Portugal (2001).
3. The values for EU25 were calculated by DG Research.

Source: Eurostat, DG Research, WIS database, 2003.

An examination of the distribution of women researchers (on a head-count basis) between the public and business research sectors relative to the size of the total population of women researchers shows that some countries have a high share of women researchers despite relatively low numbers. For example, while nearly 80% of Portugal's women researchers are concentrated in the public research sector (the government and higher education sectors), their total numbers are relatively small – 15 000 women are researchers in Portugal – compared to Japan which, despite its low share of women researchers, has around 88 000. In France, there are around 60 000 women researchers, almost twice as many as in Poland (33 000) and Italy (32 000).

Figure 1.5. Share of women researchers employed in the business and public sector, 1997-2002 or nearest years available



Source: OECD Main Science and Technology Indicators (MSTI), 2005.

In which fields of science and technology do women researchers work?

To some extent, the distribution of researchers in one field or another reflects the specialisation of a country's academic research system and its technological/industrial specialisation. There are, however, differences in fields of research employment between men and women that do not always reflect a country's technological or academic specialisation, but instead gender-dependent variables.

The data from the European Commission's *She Figures 2003* report show that there are large differences between countries in terms of the share of women researchers working in the higher education sector. In engineering, there are twice as many men as women performing research. This is not surprising given the relatively small share of women who study engineering at university level. Most women scientists tend to work in “soft” sciences (biology, health, agriculture), with low representation in the “hard” sciences (physics, engineering).

In contrast, while women account for more than 60% of life science graduates in a number of OECD countries, they account for a smaller share of researchers in medical sciences. Women account for 50% or more of medical researchers in the higher education sector in Finland, Sweden, and the United Kingdom. In these same countries they account for 70%, 64%, and 63%, respectively, of all university graduates in the life sciences. In Italy, Belgium, Germany and Austria, where the shares of women researchers in the medical sciences are all under 30%, women nevertheless account for more than 50% of life science graduates. In contrast, a look at researchers in engineering in the higher education sectors and women engineering graduates shows that women make up less than 20% of researchers working in related fields in academia, which is closer to the share of women among engineering graduates in OECD countries (25%).

Table 1.2. Share of women researchers in the Higher education sector in EU member states, by field of study, head count, 1999¹

% 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	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	28.7	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

Notes:

1. Exceptions to the reference year: Denmark, Germany, France, United Kingdom (2000); Austria (1998).

2. Data not official. Belgian estimates made from Flanders for 2001 and Wallonia for 2000.

3. Social sciences include humanities.

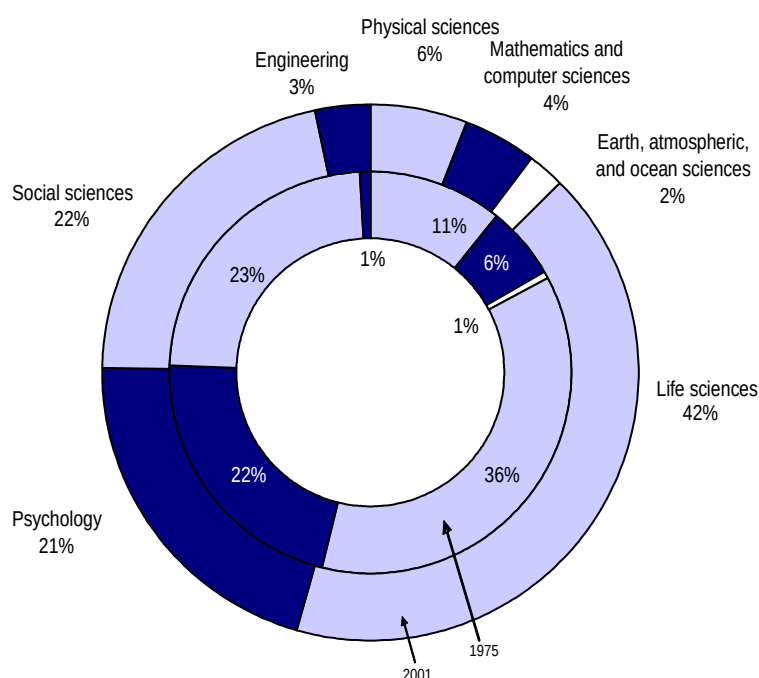
4. FTE exception to head count.

Source: Eurostat, S&T Statistics, DG Research, WIS database.

The discrepancy between the share of women graduates in the life sciences and those working as researchers in medical scientists may be due to a variety of factors. For one, it may be that recent graduate trends point to an increase in the supply of future women medical researchers that has yet to be realised. It may also be that women life science graduates are going to other sectors such as the business and the government sector, and it may be that they are not doing research at all but are exercising other occupations. This in itself may not be problematic if women science graduates are nevertheless capitalising on their training to contribute to the economy. It may, however, be a problem for society if women science graduates are not going into employment at all or are going into areas where their science training, especially if it is at an advanced level, is under-utilised or not relevant.

In the United States a similar picture emerges. National Science Foundation data show that in 2001, most women PhD holders working in academia had backgrounds in the life sciences. In fact, this share of women in this field has increased from 36% in 1975 to 42% in 2001. In the physical sciences, however, the opposite is true. The share of women in academia in this field fell from 11% in 1975 to 5% in 2001. The share of women PhDs working in academia in the social sciences and psychology has remained broadly stable over the past 25 years.

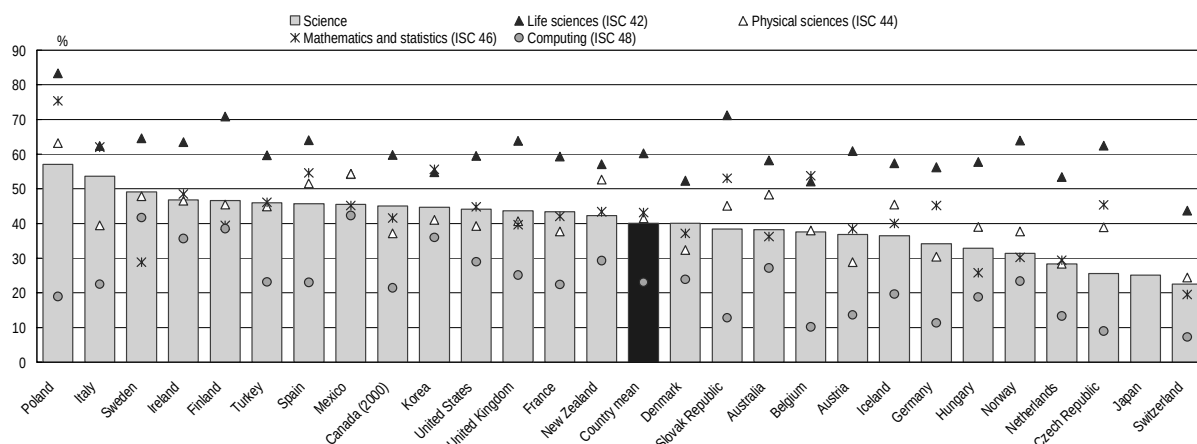
Figure 1.6. Women S&E doctorate holders employed in US academia, by field of study, 1975 and 2001



Source: NSF, *S&E Indicators 2004*.

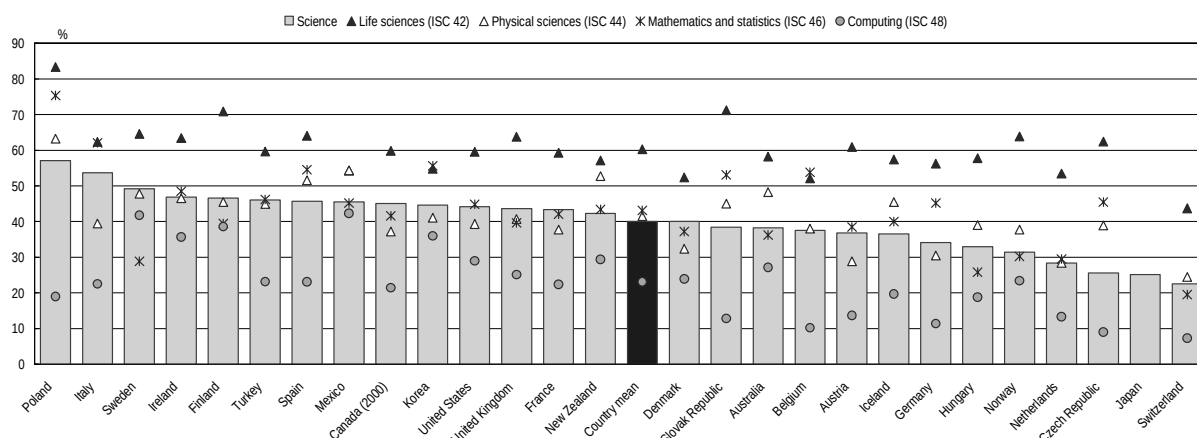
Data on the employment of women researchers by sector and field provide an indication of the different distributions of men and women in employment. Such data, however, do not tell us what causes such different distributions. The literature on women in science has highlighted several factors that influence this distribution, including early education choices and outcomes. In addition to this, however, perceptions of, or the incidence of discrimination, and a lack of mentors and networks for women in certain fields may deter younger women from going into such fields.

Figure 1.7. Distribution of women science graduates by field of study, 2002



Source: OECD Education database, 2005.

Figure 1.8. Distribution of women engineering graduates, by field, 2002

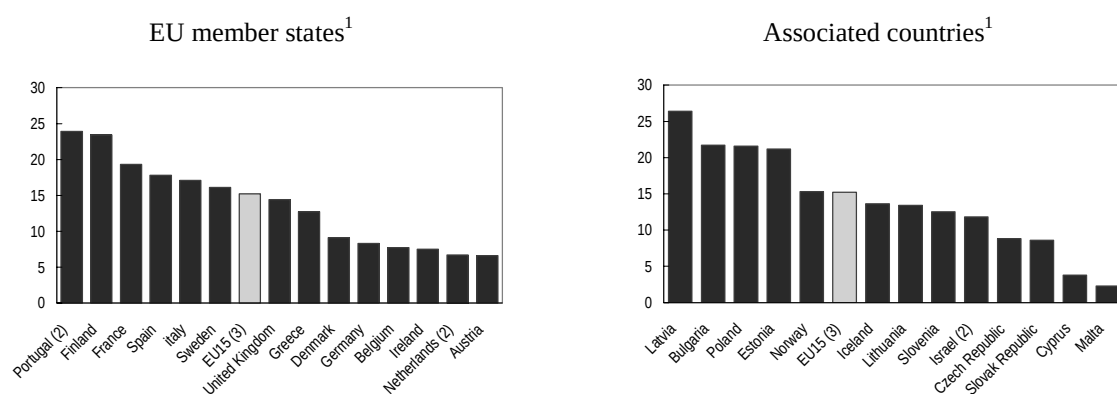


Source: OECD Education database, 2005.

Women in business sector research

OECD data on women researchers in the business sector tell us that women are under-represented in this sector, but not in which industries they are working. The only data on field of employment in the business sector comes from the European Commission's *She Figures* report (Figure 1.9). In most of the countries for which there is coverage, there are higher proportions of women researchers in companies whose main economic activity is manufacturing and business activities. Within manufacturing, the underlying data reveal that the main sector of employment for women researchers is in pharmaceuticals. This is consistent with the high share of women graduates in life sciences in many countries.

Figure 1.9. Feminisation rates among senior academic staff (grade A) in the EU, 2000



Notes:

Data are not yet comparable between countries due to differences in coverage and definitions.

1. Exceptions to the reference year: Germany, Italy, Sweden (2001); Belgium, Spain, Portugal (1999); Austria (1998).
2. FTE as exception to HC.
3. EU15: estimate excludes Luxembourg. Above exceptions to reference year apply.

Notes:

Data are not yet comparable between countries due to differences in coverage and definitions.

1. Exceptions to the reference year: Cyprus (2000); Malta (1999).
2. FTE as exception to HC.
3. EU15: estimate excludes Luxembourg. Above exceptions to reference year apply.

Source: European Commission, *She Figures 2003*, Eurostat, DG Research, WIS database.

Women faculty at universities

OECD data on women researchers in the higher education sector are not equivalent to data on women in faculty at universities since researchers are not always part of the established faculty nor do all faculty carry out research. An attempt to collect data on women in faculties was made by the SFRI group based on a questionnaire. The results are shown in Table 1.3. In Australia, women account for around 35% of faculty in universities. In Switzerland, women represent 26.6% while in the United States and the United Kingdom, just over one-third of faculty positions are occupied by women. National data from Canada, Denmark and New Zealand suggest that the proportion of women is increasing at all levels of the academic system; however, there are considerable differences. Between 2002 and 2004, the percentage of chairs awarded to women in Canada rose on average 13 to 18%, depending on the type of chair.

Table 1.3. Share of women researchers in the business sector in EU member states, by sector of activity, headcount, 1999¹

	Manufacturing	Real estate rental and business activities	Others
Belgium	-	-	-
Denmark	21.9	16.8	20.3
Germany ²	9	14.8	13.6
Greece	21.4	22.5	30.8
Spain	17.7	22.2	28.5
France	21	17.9	21.4
Ireland	-	-	-
Italy	15.3	26.7	23.1
Luxembourg	-	-	-
Netherlands	-	-	-
Austria	7.8	13.3	8.7
Portugal	20.8	27.1	28.5
Finland	21.8	20.8	20.4
Sweden	-	-	-
United Kingdom	-	-	-

Notes:

1. Exceptions to the reference year: France, Italy, Finland (2000); Austria (1998).

2. FTE as exception to HC.

Source: European Commission, *She Figures*, 2003. Eurostat, DG Research, WiS database.

Table 1.4. Share of women faculty in universities, 2002 or latest available year

Country	Percentage
Australia	0.351
Austria (2002)	0.252
Czech Republic	0.329
Denmark	0.24
Finland (2002)	21.7% to 78.5%, depending on the level
France	16% to 63.8% depending on the level
Germany	0.286
Hungary	56.6% (academic and non-academic)
Italy (1999)	0.275
Korea	0.145
Netherlands	8.5 % to 35.3%, depending on the level
New Zealand	0.158
Switzerland (2002)	0.266
United Kingdom (2002)	0.35
United States (2000/2001)	0.384

Source: National data submitted to the Secretariat.

In Denmark, the average growth of the proportion of women at professorship level equaled approximately half a percentage point per year in the period 1993-2000. The slow growth rate was due to the fact that for a majority of the professorships there were only male candidates. When exclusively considering the professorships for which there were both qualified male and qualified female candidates, the female candidates have been more successful than the male candidates in the period 1998-2000. In New Zealand there was almost a 140% increase in representation of women in senior academic positions between 1997 and 2003.

Breaking the glass ceiling: women among senior academic staff

In addition to the horizontal segregation – employment segregation by discipline and by sector – women also face vertical segregation, which relates to issues of career advancement. Available data on the existence and scale of vertical segregation – whereby women are less represented in senior and decision making positions – confirm that women scientists and engineers are less successful than their male counterparts in traveling along the academic career path. In the United States, among S&E doctorate holders who hold academic faculty positions at four-year colleges and universities, women are less likely than men to be found in the highest faculty ranks. Women are also less likely than men to be full professors and are more likely to be assistant professors (NSF, 2004b). In most European countries, the percentage of women in the top grades of academia is below 20%. Women make up less than 10% of senior faculty in Denmark, Germany, Belgium, Ireland, the Netherlands and Austria. Research also shows that men are three times more likely than women to obtain professorships or their equivalent (European Commission, 2003).

The low share of women among senior academic staff raises the question of what role gender plays in women's ability to climb the academic ladder. The literature on women in science has identified several direct and indirect forms of gender bias in the process of researcher selection, evaluation and advancement (EC, 2004). It is generally assumed that research systems are meritocratic in nature. Indeed, the focus on excellence and productivity through the peer review process and publications is seen as the basis for career advancement. Research shows that women tend to publish less than men but that each paper is more substantive insofar as papers published by women are, on average, cited more frequently than papers by more productive men (EC, 2004b). Still, there is some research that suggests that women may be inherently disadvantaged by some elements of the evaluation systems in research. The reliance on publications and citations as a measure of productivity/quality between men and women researchers may result in non-gender neutral outcomes. For one, it has been observed that the value of the citation index may be limited due to bias in language (*i.e.* English) and the fact that the journals that are covered are limited, which could reduce the impact or visibility of the work of women in the social sciences and humanities (for a more detailed discussion see EC, 2004b).

What can be done to close the gender gap?

Legal frameworks

OECD countries have enacted a variety of laws to promote gender equality in general, from equal opportunity laws to affirmative action laws that allow positive discrimination to encourage the hiring of women (based on the assumption that qualifications are equal). Such positive discrimination laws exist in Austria, Finland, Germany, the Netherlands and Switzerland, though to differing degrees. In the United Kingdom and Italy, however, such positive discrimination is illegal.

Many OECD countries have also passed “gender mainstreaming” laws and integrated these in administrative regulations and procedures (*e.g.* Germany). No such concept, however, has been adopted in the Czech Republic, Hungary or Korea; in New Zealand the concept has not been adopted, but incentives are given to create an environment that makes it attractive for women to choose a scientific career. Many countries (Australia, France, Italy, the Netherlands, Switzerland and the United Kingdom) have adopted measures that are not expressly called “gender mainstreaming” but which do aim to facilitate the participation of women in research and science. Other countries (Austria, Canada, Finland and Germany) have established a specific framework for “gender mainstreaming”. However, so far few evaluation results about the gender mainstreaming concept are available.

Direct support measures

Most OECD countries also have specific programmes in place which aim to achieve a better gender balance in science education and research (*e.g.* improved childcare, measures to balance work and family responsibilities, mentoring programmes). Such programmes are very important at the level of individual institutions. Most of these instruments and measures are geared to the universities and public sector research. The picture is quite different when it comes to promoting women’s recruitment in business R&D. In general, governments, with the exception of affirmative action laws, have not adopted any specific laws or regulations to increase the proportion of women in the business research sector. However, some have programmes to encourage industry to recruit women (Austria, Finland, and France); others rely on voluntary agreements with industry (Germany). The United Kingdom has a comprehensive programme to foster women’s entrepreneurship, including in R&D.

More specific measures range from grants to support positions for women at universities to preferential policies towards equally qualified women candidates. Recent research suggests that efforts to close the gender gap in science must begin at the earliest levels of schooling. On the employment side, equal opportunity policies, flexible working hours and parental leave are also important for encouraging women to pursue research careers in the public and private sectors.

Box 1.1. Examples of gender mainstreaming in government

Austria

In 2002 the Austrian federal government confirmed that gender mainstreaming is a strategic instrument for achieving equal treatment of men and women. An inter-ministry working group on gender mainstreaming was set up, and in all Austrian ministries there are programmes on the subject. In the fields of education, science and research, a comprehensive gender mainstreaming action plan was implemented by 2003. The plan includes guidelines and measures for the incorporation of gender mainstreaming into the mission statement of the Ministry of Education, Science and Culture as well as its management tools, education of civil servants, and directives for research programmes and advisory boards, publications, data collection and evaluation. The plan also includes gender budgeting. Experts oversee the gender mainstreaming process within the ministry. An interim report was published in December 2005.

Finland

Finland is committed to gender mainstreaming. A cluster of pilot projects carried out by six ministries was evaluated in 2001. Positive outcomes included a basic equality structure in each ministry, and development of gender mainstreaming methods at local and regional level. Some shortcomings were also noted and have been taken into consideration, *e.g.* inadequate anchoring of the project, lack of resources and lack of familiarity about gender issues. Several recommendations were made for improvement, including a better definition of objectives and gender training.

The Government Equality Programme includes a gender mainstreaming plan within the state administration. The plan includes gender mainstreaming education for civil servants and producing guidebooks on gender mainstreaming. To aid the process, a database on gender equality was set up in December 2004. The plan also includes a gender impact assessment of legislation and budgeting. All ministries will strengthen their activities in this field and a network of equality contact persons in the ministries has been formed. Gender mainstreaming has also been expanded into ministerial agencies and other institutions. A national equality barometer is published every three years (the third dates from November 2004). Through men and women's attitudes, personal experiences and estimates, the barometer seeks to analyse the division of labour and power between men and women and how acceptable the division is in various societal situations. Comparisons can then be made with earlier barometers.

Gender impact assessment is also a key gender mainstreaming method within universities. Questions such as student selection, development of curricula and degree requirements are all relevant issues from the standpoint of gender equality.

Gender mainstreaming requires continuous efforts. In renewing equality legislation, Finland is making the gender impact assessment of mainstreaming a pervasive issue at all levels of government.

Table 1.5. Problems and policy solutions

Problems to be addressed	Possible policy measures and programmes	
	<i>Informal</i>	<i>Rules and regulations</i>
Gender differences between disciplines	Measures to raise awareness and attractiveness	Preferential policies for women
Gender differences between sectors	Information programmes	Preferential policies for women, financial incentives
Life-work balance	Child care facilities	Laws on parental leave
Career advancement	Coaching, mentoring, role models	Preferential policies, financial incentives
Decision-making positions		Quota

As to programmes aiming to increase the *participation* of women in research and science, most countries – with a few exceptions (Czech Republic¹, Hungary, Korea) – have adopted such programmes or measures. In a number of countries these are very comprehensive and complex (e.g. Australia, Austria, Canada, Denmark, Finland, Germany, Switzerland, United Kingdom); in others they are very decentralised and established or implemented mostly or only at the institutional or grass-root level (Italy, New Zealand). Some countries do not have specific regulations, but rather work through incentives (e.g. France). Generally, it can be said that all measures and programmes in place very much depend on their implementation by individual research institutions or companies.

Australia has had special programmes since 1991 when female enrolment in non-traditional areas such as engineering, management and commerce, science and architecture was identified as being too low. Targets were set for female access and participation rates in non-traditional fields for sciences, agriculture, architecture and commerce at 40% and 15% for engineering, where participation was particularly low at 11% in 1991. To date, the targets set have been met in all broad fields of study except in architecture, although current enrolments are close to the target. Therefore targets are no longer used to monitor enrolments in these disciplines. A recent initiative has been directed at encouraging girls in secondary schools. Other funding and networking initiatives, directed at women from undergraduate level to senior staff levels, have been put in place by some Australian state governments, individual universities, professional and other groups.

Many countries have very comprehensive programmes in this field (Austria, Canada, Denmark, Finland, Germany, Switzerland and the United Kingdom). Such programmes comprise initiatives targeting girls in secondary schools, students in colleges and universities and university graduates. They also vary from informal measures aimed at breaking up stereotypes and creating role models, to formally funded government programmes for the recruitment, retention, returning and progression of girls and women in science, engineering and technology, in academia as well as in business R&D units.

Germany has programmes like the ones described above at all levels – undergraduate, graduate and post-graduate. Many of them are information measures or mentoring schemes; however, there also are funding instruments such as grants and posts particularly open and accessible for women. Finland's programmes put the major emphasis on interesting girls from the early stages of education (in science and engineering). Austria has a strong programme – partly financed by the European Commission – with initiatives and activities designed to strengthen the role of women in science and technology. The United Kingdom has established a Resource Centre for Women in SET (science, engineering and technology) which is designed to help female SET undergraduates make the transition to the SET workplace, and includes measures such as mentoring, work experience and placements. Switzerland has promotion programmes such as the Federal Gender Equality Programme for Universities or the Federal Programme for Equal Opportunities at Universities of Applied Science (*Fachhochschulen*) including such elements as financial support for hiring female professors, mentoring programmes and the improvement of childcare at each university.

1. The Czech Republic, however, has collected extensive data on women in science.

Canada has as one of its objectives to attract and retain more women into careers in science and engineering at all levels of higher education. To this effect it has established a number of measures and programmes. Outstanding among those is the “Chairs for Women in Science and Engineering” programme (see Box 1.2).

Box 1.2. Chairs for Women in Science and Engineering in Canada

The goal of this chair programme is to increase the participation of women in science and engineering and to provide role models for women active in and considering careers in these fields. The programme has been in place since 1996.

Through this programme, NSERC will match private-sector cash contributions of up to CAD 70 000 per year for each of five years towards the creation of a chair in each of five regions of the country. Chairs are tenable at any Canadian university within a designated region, and are renewable for an additional three years if progress is satisfactory and private-sector support continues.

Chair holders are expected to contribute at least 50% of their time to the activities of the chair, and the remaining time to their professor/researcher activities at the university. The contributions from NSERC and the corporate sponsor(s) can be used to cover part of the chair holder’s salary plus the cost of activities associated with the chair.

Each chair holder must develop, implement, and communicate strategies to raise the level of participation of women in science and engineering as students and as professionals, specifically to:

- Encourage female students in elementary and secondary schools to consider careers in science and engineering.
- Increase the enrolment of women in undergraduate and graduate programmes in science and engineering in all Canadian universities and colleges.
- Increase the profile and retention rate of women in science and engineering positions.
- Eliminate barriers for women who wish to pursue careers in science and engineering; and promote the integration of female students and professionals both within and outside academia.

The chair holders also provide female role models who are accomplished, successful, and recognised researchers in science and engineering.

Coaching and mentoring

With regard to programmes and measures to retain women in scientific careers, a few countries have extensive programmes which focus on coaching, mentoring and other instruments to encourage women to take research positions (see examples from Germany in Box 1.3). Many such programmes are established and implemented at the decentralised level of individual institutions.

Many countries give attention to raising the share of women in senior positions of the research system. Main programmes in this area aim at increasing the quota of women on research boards. The United Kingdom has set a target stating that by 2008 40% of the representation on SET boards should be women.

Box 1.3. Coaching and mentoring programmes in Germany

On the national level, two coaching and mentoring programmes for women scientists have been established:

To promote career strategies for women in German academia in 2001, the Centre of Excellence for Women and Science (CEWS) started the programme “*Anstoß zum Aufstieg*” (Encouragement to Advance), supported by the Federal Ministry of Education and Research and sponsored via a public-private partnership by the L’Oréal Group, Germany. The programme dealt with the specific aspects of the working situation of women scientists at universities, the aim being to optimise their career planning, their networking and their individual strategies in the application procedure and appointment negotiations. When the programme ended in spring 2004, more than 700 highly qualified women scientists had participated in three-day training seminars led by professional coaching teams.

In 2004 the Federal Ministry of Education and Research started a peer-mentoring programme for female post-doc scientists in public research institutions. The two-year programme supports the co-operation and networking of peer-mentoring groups with the aim of enabling female scientists to become increasingly involved in the scientific community.

Some federal states (*Länder*) organise mentoring and coaching programmes for women scientists to promote their professorial qualifications (*e.g.* Baden-Württemberg: mentoring and training; North Rhine-Westphalia: coaching and training for women scientists with a habilitation grant; in 2004 the three universities in Berlin started a mentoring and training programme for female post-doc scientists).

In addition, many universities, research institutions and business firms have established mentoring and training programmes for women scientists since the end of the 1990s. Some of the programmes offered by universities are financed by the Academic Science Programme.

Specific funding schemes

According to countries’ responses there is no evidence that new funding instruments influence the participation of women in research. However, some data show that a shift in funding priorities – such as less physics more biotechnology – clearly increases the participation of women.

Some countries have special funding schemes addressed to women researchers. These can be programmes at decentralised level (Germany), scholarship programmes (Austria), return-to-work programmes after a family care break (Switzerland, United Kingdom) or more comprehensive schemes (Canada, Netherlands).

In addition to its women chairs programme (see Box 1.2), Canada has a range of funding schemes for women, in particular a specific Women Faculty Awards programme aimed at encouraging greater numbers of highly qualified women to continue their graduate studies and enter academic careers at the doctoral level in science and engineering, particularly mathematical/physical sciences and engineering; encouraging universities to appoint increased numbers of women to tenure-track positions in scientific and engineering disciplines; assisting in maintaining or increasing the level of university research and development in Canada; and addressing the anticipated requirement for promising and highly qualified researchers in Canada in the 1990s and into the 21st century.

Since women are prominently under-represented in high positions in universities in the Netherlands, the Dutch Ministry of Education, Culture and Science, the Dutch Research Council (NWO) and the universities decided to design a national programme to help women into senior university positions (see Box 1.4).

Box 1.4. The Dutch Aspasia Programme

The Aspasia programme, which aims to promote women assistant professors to the position of associate professors, was started in 1999. The Ministry, NWO and the universities contribute to funding. The subsidy relates to either a four-year PhD project or a two-year post-doctoral project and all associated research costs up to a maximum of EUR 11 000 per annum. This means that the Aspasia laureates will be given the opportunity to become acquainted with research management and the coaching of other researchers. The universities pay for the difference in salary between an assistant and an associate professor. If the evaluation after the (five-year) project is positive, the candidate will remain an associate professor (this implies a long-term commitment by the universities).

The existing literature mentions a number of factors which might influence the fact that women do not advance in their scientific careers: the difficulty to reconcile professional and family care requirements, less mobility compared to their male colleagues (a very important issue relating to globalisation), evaluation methods which are not adapted to female choices (women often prefer teaching over publishing), research agendas which are not particularly attractive to women, and a work environment which is too competitive.

Family/work life issues

Results from the OECD project on work and family life balance show that high female employment rate are not incompatible with fertility rates close to replacement level (OECD, 2005b). Framework policies such as fiscal and social policy also influence the choice of women with children with regard to the decision to seek certain types of employment or even to continue working at all. That said, the situation may be somewhat more complex when it comes to balancing the demanding careers of research and family life. Research has shown there is a family effect on productivity for both men and women with men having a greater productivity in their early career years (EC, 2004). All OECD countries have a scheme of maternal leave; however, many countries go beyond this in order to facilitate the balance between work and family responsibilities (*e.g.* lifting age limits for women with children to apply for grants and posts).

Issues relating to mobility and evaluation

In many OECD countries national and international mobility is either a formal or at least tacit requirement for advancing in a scientific career. This may be a disadvantage for female researchers with families. However, very few countries address this issue in particular with measures or programmes, although some countries have increased grants for researchers taking up temporary positions abroad and wishing to take along their family (*e.g.* Finland).

As to the criteria for measuring scientific excellence, research has shown barriers to career advancement for women are linked to gender bias in the indicators used to evaluate performance (such as publications). In nearly all countries publications and peer reviews are still the main criteria for advancement. Teaching is only a secondary criterion (equality between publications and teaching only in Denmark), in some countries teaching is not taken into account at all (Czech Republic and France). This situation is generally seen as

being a disadvantage for the advancement of women since they tend to focus on teaching rather than on publications – though no quantitative evidence is available. Eliminating such barriers is important to attracting and retaining women in research.

Conclusions

This document has provided a short review of the trends in the participation of women in science, and has highlighted some of the barriers to increasing the participation of women in research and some of the measures that governments take in response. It is clear from the available data that women are making progress in terms of their participation in the science workforce as well as in science education, but more needs to be done. Insofar as women obtain more than half of all university degrees in many countries but only around 30% of the university degrees awarded in science and technology, OECD countries face a paradoxical situation: a feminisation of the workforce in general and of university-trained graduates in particular, but continued under-representation of women in the research workforce. Furthermore, in terms of horizontal and vertical segregation, the available data tend to reinforce results from the academic literature that show women remain unevenly distributed in research occupations and under-represented in senior positions.

The scarcity of women in senior scientific positions inevitably means that their individual and collective opinions are less likely to be voiced in policy and decision-making processes. This in turn means disempowerment in terms of the general planning of research agendas and the allocation of public funding for projects and managing resources. It also means that women are contributing less than men to shaping the major scientific questions of the moment, many of which impact directly on the lives of women (European Commission, 2003).

Many of the available studies argue that not only has gender equity to be achieved as far as numbers are concerned, but that an increased participation of women in S&T must also lead to qualitative changes in research. Such qualitative changes, it is argued, should lead to an improvement in research, and even to an increase in scientific excellence.

Most OECD countries are addressing the issue of women's participation in science to varying degrees. Some have very extensive and comprehensive programmes, others take minor measures, and some countries do not appear to address the issue directly. Not enough is known about the selection or prioritisation of policy measures. Moreover, few countries appear to have a comprehensive approach to promoting the participation of women in scientific education and research careers.

The joint OECD-French government workshop on “Women in Scientific Careers: Unleashing the Potential” (16-17 November 2005), should help clarify some of these issues and provide new insights as well as lessons from member countries.

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Part 2

**BARRIERS FACED BY WOMEN RESEARCHERS:
SEGREGATION BY FIELD OF WORK**

Chapter 2

STATISTICS ON WOMEN IN SCIENCE: EXAMPLES FROM THE EUROPEAN UNION

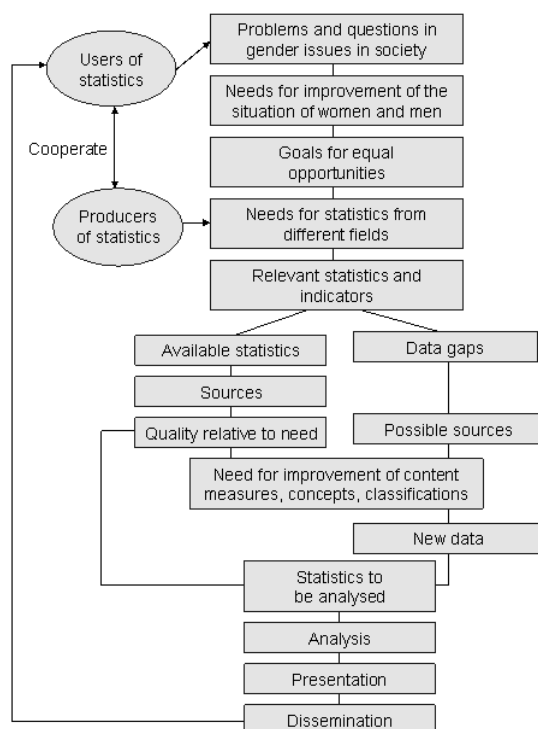
Camilla Gidlöf Regnier

Women in Science Unit, Directorate General Research, European Commission

Gender statistics

During the last three decades much has been done to improve the production and dissemination of statistics that reflect the actual situation of women and men in society. Gender statistics describe social progress from the perspective of gender equality. In order to accomplish this, all statistics on individuals must be available by sex and reflect society's gender equality issues. Today most national statistical offices have a policy that all data on individuals should be disaggregated by sex. Gender statistics is a relatively new field that cuts across all traditional statistical fields.

Figure 2.1. Production process for gender statistics



Source: "Engendering Statistics: A Tool for Change", Statistics Sweden, 1996.

However, in some areas such as research and development, some measurement problems remain and data are often inadequate. While UNESCO, with a mandate for S&T statistics worldwide, recommended breakdown by sex as early as 1978, there has been a vicious circle: lack of statistics => lack of awareness => lack of policy priority, causing the lack of statistics. Because of these data gaps, the Women and Science Unit of the European Commission started a data collection in 2001 through the Statistical Correspondents, a sub-group to the Helsinki Group of Women and Science. In the last few years, data availability has much improved and gender-sensitive indicators have been developed. Eurostat, as well as the OECD, have started collecting data by sex in many R&D areas and the 2002 edition of the OECD *Frascati Manual*¹ clearly recommends sex-breakdown. The Women and Science Unit now co-operates with Eurostat and OECD to introduce sex-breakdown into official R&D statistics wherever possible.

Researchers

Data availability

Following the increased demand for data on women and science, Eurostat incorporated into the R&D survey and its NewCronos database (EU-25 and 13 other countries) a quite complete set of sex-disaggregated indicators. This database includes data on 'R&D personnel by occupation and sector' (both in HC and FTE²); 'total R&D personnel' and 'researchers by field of science and sector' (both in HC and FTE); 'total R&D personnel', 'researchers by qualification and sector' (both in HC and FTE); 'researchers by age and sector' (in HC); and 'researchers by citizenship and sector' (in HC). Because of the special attention given to business sector research in EU, additional indicators related to this area are also broken down by sex, such as 'business enterprise sector R&D personnel by occupation and economic activity' (both in HC and FTE) and 'researchers by size class' (according to number of employees) in the business enterprise sector.

While 80% of the countries covered in the database present data on female researchers by sector and 56% on female business enterprise researchers by economic activity, less than 50% of the countries provide data for the rest of the featured indicators (Table 2.1). Although the collection of researchers by citizenship and sex is still at a preliminary stage, the availability of data is still considered satisfactory in EU member states. However, sex-disaggregated data on researchers by qualification, field of science and age are still scarcely available even in EU countries.

Despite the improvements made so far, a significant effort is still needed in data collection at national level to provide the comprehensive information requested. In other regions of the world there are even more data gaps, as shown in Table 2.2.

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1. OECD (2002), *Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development*.
 2. HC = head count. FTE = full-time equivalent.

Table 2.1. Availability of sex-disaggregated data on researchers in the Eurostat NewCronos database

Indicator: Researchers by...	Availability of data for sex- total disaggregated number of data for researchers researchers		Rate of relative availability of sex- disaggregated data	Availability of data for sex- total disaggregate number of d data for researchers researchers		Rate of relative availability of sex- disaggregated data
	in HC			in FTE		
Sector (in general)	84.0%	80.0%	0.95	100%	76.0%	0.76
- Business enterprise	84.0%	76.0%	0.91	100%	60.0%	0.60
- Government	84.0%	80.0%	0.95	100%	76.0%	0.76
- Higher education	80.0%	72.0%	0.90	96.0%	60.0%	0.63
- Private non-profit	64.0%	56.0%	0.88	80.0%	48.0%	0.60
Qualification	36.0%	24.0%	0.67	20.0%	0.0%	0.0
Field of Science	32.0%	28.0%	0.88	40.0%	32.0%	0.80
Age	20.0%	20.0%	1.00	-	-	-
Economic activity (in Business enterprise sector)	64.0%	56.0%	0.88	72.0%	48.0%	0.67
Size class in Business enterprise	-	-	-	64.0%	48.0%	0.75
Citizenship	52.0%	44.0%	0.85	-	-	-

Source: Eurostat NewCronos database, 2005.

Table 2.2. Availability of sex-disaggregated data on researchers (FTE) in the UIS database

Region/Group (countries and territories)	Availability of data for total number of researchers	Availability of sex- disaggregated data for researchers	Rate of relative availability of sex-disaggregated data
	A	B	B/A
World (223)	44.8%	30.5%	0.68
Developed countries	77.8%	57.4%	0.74
Developing countries	34.3%	21.9%	0.64
Africa	26.8%	14.3%	0.53
Americas (51)	45.1%	23.5%	0.52
Asia	50.0%	40.0%	0.80
Europe	75.6%	62.2%	0.82
Oceania	14.3%	0.0%	0.00
OECD	100%	66.7%	0.67
EU-25	96.0%	76.0%	0.79

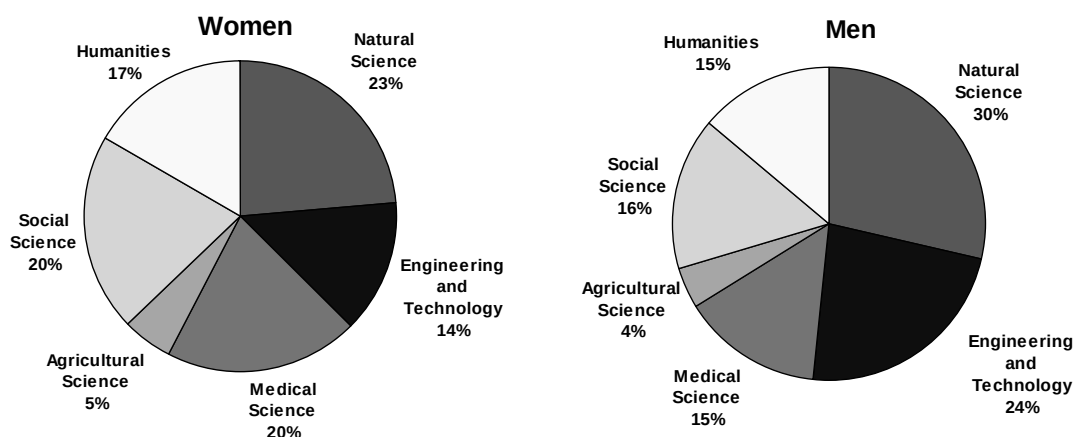
Source: UNESCO Institute for Statistics S&T database, 2004.

Some results

Women researchers are still a minority in the government and higher education sectors, with both sectors having an EU average of 35% women. In all countries these sectors nevertheless have higher proportions of women researchers than the business enterprise sector with an EU average of 18% women according to latest data, but there are large cross-country variations. The countries with the fewest women in business research are Germany (11.8%), Austria (10.4%) and Netherlands (8.7%) whereas Latvia, Bulgaria and Romania all have over 40% women. The situation is improving very slowly. Women researchers only have higher growth rates than men in less than half of the countries, and for a few countries the percentage of women researchers has decreased.

The distribution of researchers by main fields of science shows different patterns for men and women. Among male researchers in the higher education sector, 54% work in natural science and engineering compared to 37% among women researchers. This distribution of researchers across the broad field of science of course reflects study choices made by men and women in higher education.

Figure 2.2. Distribution of researchers across main field of science by sex
EU-25, HES, 2003,
FTE



Source: Eurostat NewCronos database.

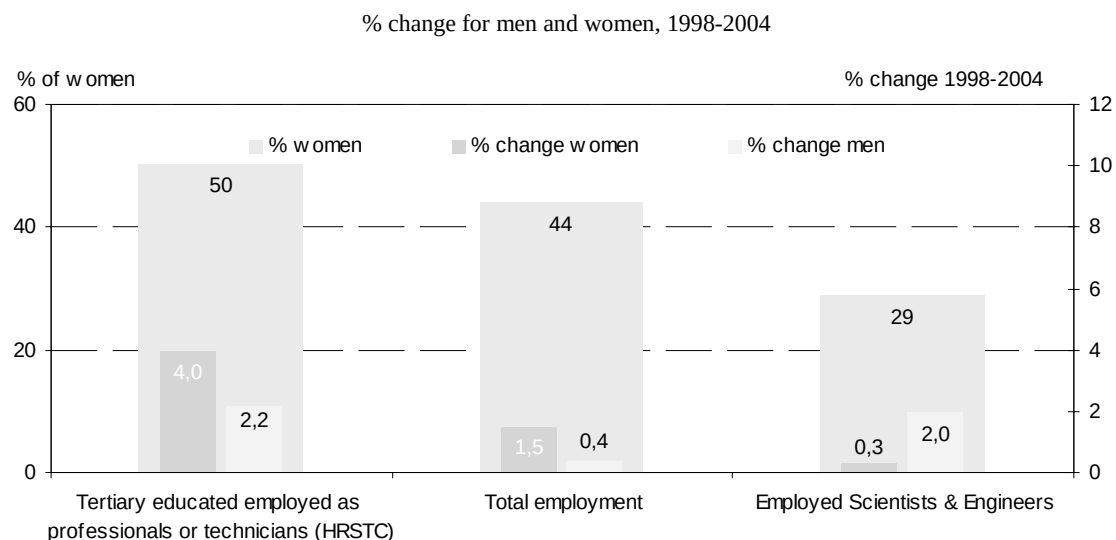
Human resources in science and technology

In addition to R&D data, Eurostat and OECD also collect data on employment in science and engineering, human resources in science and technology (HRST). This category is broader in the sense that it includes not only researchers but also other science and technology occupations.

For the category called HRSTC (human resources in science and technology core³) the proportion of women is 50% and this is higher than for total employment regardless of educational attainment or occupation. For both these groups, the growth rates for women in the period 1998-2004 were higher than for men. For the category S&E (employed scientists and engineers⁴), however, the growth rate in the period was higher for men than for women. As a result, the proportion of women decreased from 32% to 29% between 1999 and 2004 in the EU as a whole. These EU averages hide large differences between countries, and at national level there are trends in both directions.

3. Human resources in science and technology core (HRSTC): individuals who have successfully completed tertiary education in an S&T field of study (ISCED '97 levels 5a, 5b or 6) and are employed in an S&T occupation (ISCO '88 COM codes 2 or 3).
4. Scientists and engineers (S&E): physical, mathematical and engineering occupations (ISCO '88 COM code 21); life science and health occupations (ISCO '88 COM code 22).

Figure 2.3. Proportion of women in the EU-25 for total employment, HRSTC and scientists & engineers in 2004



Source: Eurostat NewCronos database.

Seniority

The existence of a “glass ceiling” or “sticky floor” for women trying to progress to senior positions is well documented and affects all occupational sectors, even those which are dominated by women. The absence of women in leadership positions is more acute in science and technology occupations than in other fields. Vertical segregation, *i.e.* that women tend to work in lower hierarchical positions than men despite equal qualifications, is one of the focus areas of the Women in Science Unit. Data on this topic is therefore collected annually from the statistical correspondents.

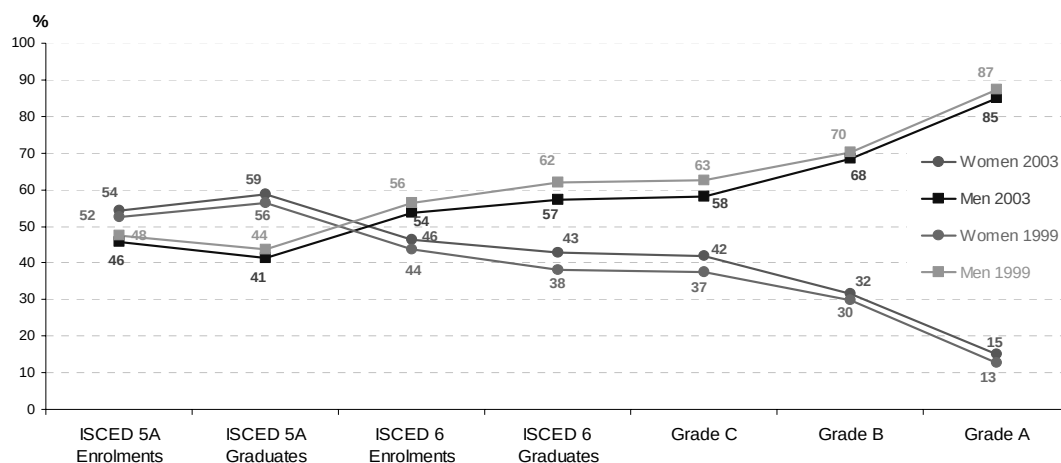
The data collection on seniority of researchers started with the higher education sector, and has also been piloted for the government sector; however, very few countries could provide data for the government sector. Academia seems to have quite similar hierarchical structures across countries, but this is not the case for government research institutions that have more heterogeneous personnel structures. No attempts have been made so far to collect seniority data for the business enterprise sector since not all countries have even the total number of researchers by sex for business research. To monitor progress in this area on a cross-country basis, a four-tier system of seniority or ‘academic grades’ has been developed.⁵

5. Women and science questionnaire, definitions of seniority grades:

- A: The single highest grade/post at which research is normally conducted.
- B: Researchers working in positions which are not as senior as the top position (A) but definitely more senior than the newly qualified PhD holders (C); *i.e.*: below A and above C.
- C: The first grade/post into which a newly qualified PhD (ISCED 6) graduate would normally be recruited.
- D: Either postgraduate students not yet holding a PhD (ISCED 6) degree who are engaged as researchers, or researchers working in posts that do not normally require a PhD.

The scissors diagram below shows the gender gap in a typical academic career. At the highest positions in academia women now make up 15% (2003) of full professors and equivalent and this is an increase of two percentage points compared to four years earlier.

Figure 2.4. Relative share of women and men in a typical academic career EU-25, HC, 1999 and 2003



Source: Eurostat NewCronos database and WiS database.

Gender equity in setting the scientific agenda

The Women and Science Unit also collects additional data from the statistical correspondents on members of scientific boards and applicants and beneficiaries of research funds by sex. These data are available for most European countries but must be interpreted within different national contexts due to varying data sources. Cross-country comparability has not yet been assured since there is uncertainty whether existing data have complete national coverage. Data on the share of women on scientific boards show large difference between countries. The Nordic countries show levels close to 50%, but in a majority of countries parity has not been reached and the percentage is below 10% for several of the new member states. Data on funding success rates show that in a majority of countries men have higher success rates, but the differences between men and women are quite small and not statistically significant.

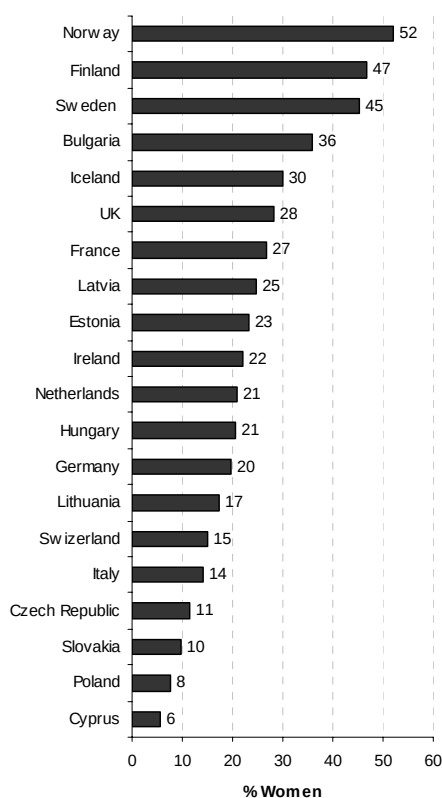
Further data needs

There is still much room for further advancement in the collection of sex-disaggregated data. Firstly, much improvement is needed in the availability of sex-disaggregated data on researchers, especially for breakdowns like researchers by qualification, field of science or age, where data are missing for many countries. The data and measurement of vertical segregation, research funding and scientific boards can be further improved and eventually incorporated into official statistics. In addition, we also have knowledge gaps for graduates in scientific detailed disciplines⁶, where currently no data are collected internationally. Other missing areas are pay gap, S&T performance

6. 3-digit detailed fields of study according to ISCED97.

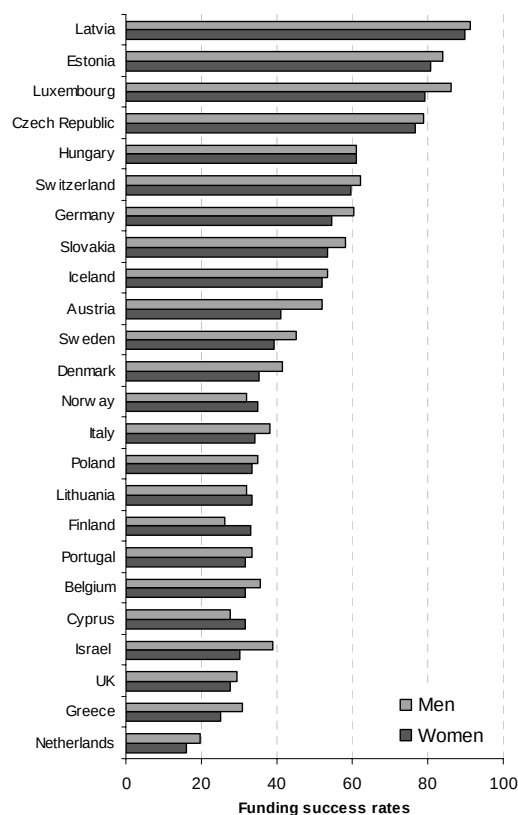
(patents, publications, etc.) and the financial weight of positions held by women and men in general. The conclusions from the EU Competitiveness Council in April 2005 also proposed the production of yearly recruitment statistics, which is an entirely new area that needs to be developed.

Figure 2.5.
Percentage of women on scientific boards, 2003



Source: European Commission, WiS database.⁷

Figure 2.6.
Funding success rates by sex, 2003



Source: European Commission, WiS database.⁸

7. Exceptions to the reference year: Austria, Sweden (1999); Israel (2000); Greece, Portugal, Lithuania, Latvia, Netherlands, Luxembourg (2002).
Belgium: Flemish-speaking community only.

8. Exceptions to the reference year: Norway, France, Poland, Sweden (2002).

Chapter 3

THE GENDER GAP IN THE PUBLIC RESEARCH SECTOR: THE CASE OF DENMARK

Kamma Langberg

Senior Researcher, Danish Centre for Studies in Research and Research Policy¹

Introduction

Gender equality, the gender gap and other similar questions have been widely discussed among politicians, administrators and researchers in Denmark as well as in other countries.

This paper begins with a broad presentation of the international discussion on the gender gap and the “pipeline” metaphor. A study of Danish universities is presented in the third section together with other figures from the Danish research sector.

In the fourth section, the “leaking pipeline” metaphor related to promotions is discussed and compared with actual findings from Danish universities, with a focus on promotions from assistant to associate professorships.

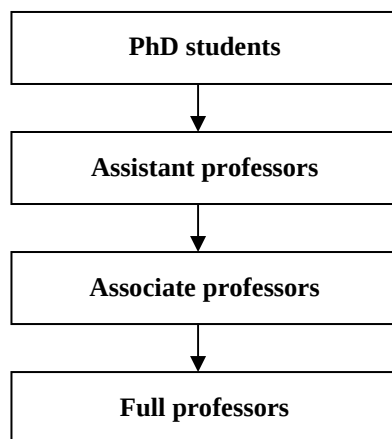
The main conclusions and perspectives based on the findings are found in the final section.

The gender gap in the research sector: some international results and perspectives

Most papers on the gender gap within research focus implicitly on a specific country and a specific system. They therefore reflect the historical gender gap (*e.g.* gender differences in education 20 years ago), current gender differences, and changes that have occurred in specific areas. When gender gaps in one system are compared with another, these temporal and systemic differences must be taken into account.

The international trend in discussing gender gap and hierarchy at research institutions points to a “pipeline” structure from PhD student to professor (Saunders, 2002; Kulis *et al.*, 2002). Most researchers start as PhD students, proceed as post-docs, researchers or assistant professors, and are then promoted to associate professor with some ultimately becoming full professors, as seen in Figure 3.1. If the share of women differs from one level to the next, it is assumed that the pipeline “leaks”, *i.e.* female researchers leave the pipeline because they are not promoted.

1. www.cfa.au.dk

Figure 3.1. The “position pipeline”

The pipeline can be drawn for a single university, for a country or other geographic area, or for specific scientific areas. The focus can also be on whether the person is employed at a “research university” or a “college” (Saunders, 2002). The distinction between research universities, colleges and other higher education institutions differs all over Europe and, consequently, the working condition for university researchers/teachers differs; in Denmark all universities are research universities, while in Norway and Sweden a number of “university colleges” (*højskoler*) are regarded as part of the university system.

Hierarchies differ from place to place. In the United States, Canada and some European countries the focus is on “tenure”² vs. “non-tenure”, but there is no formal tenure track system in Denmark and a number of other European countries. Often the issue of part-time vs. full-time positions (Neale and White, 2004) is connected to gender, as are childcare and maternity leave policies. In Denmark, all research positions are full-time (research combined with teaching and/or other responsibilities). They can be converted to part-time positions for short periods in special circumstances, but this occurs so rarely that no statistics are available. However, a large number of part-time professors are found at universities, but they normally have another job, *e.g.* as researchers in a private company, lawyers, etc., and they are seldom regarded as part of university staff.

In Denmark, 85% of children aged one to three years are in pre-school or some other form of public day care, and maternity leave (six months to one year) will normally extend a temporary research contract (for a PhD student or assistant professor) by at least six months; mothers can therefore work full time.

In some countries researchers at research institutions (such as national laboratories) hold positions similar to the university researchers. This is the case in Denmark, as seen in Table 3.1, which illustrates the hierarchy of researchers at Danish universities and government research institutes (GRIs).

2. A tenure track position implies that after a period of satisfactory performance, an assistant professor will be promoted to associate professor.

Table 3.1. Position structure and requirements at Danish universities and GRIs in 2004

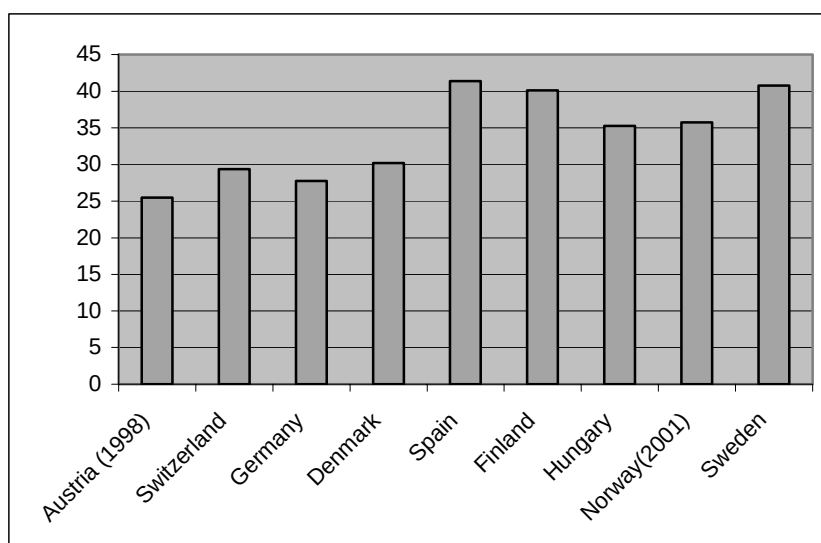
Requirements	Positions at universities	Positions at government research institutes
MA or MSc. ISCED 5a (Grade D***)	Research assistant* PhD student*	Research assistant* PhD student*
PhD ISCED 6 or equivalent** (Grade C***)	Assistant professor* Researcher* (Post doc)	Researcher * (Post doc)
PhD or equivalent Plus a number of scientific publications or equivalent qualifications** (Grade B***)	Associate professor (Temporary associate professor*, associate research professor*)	Senior researcher (Temporary senior researcher*)
PhD or equivalent Plus a number of scientific publications or Doctor-degree (like the German <i>Habile</i>) or equivalent qualifications** (Grade A***)	Full professor (Temporary professor*, research professor*) The highest research position in the university system	Research professor* The highest research position at the GRIs

*All contracts are fixed-period (temporary).

** It was not until the early 1990s that formal PhD studies were started in all subjects; some associate professors and professors therefore might not have a PhD (or other doctoral) degree but “equivalent qualifications”.

*** Grade A-D according to Women and Science Unit grade system.

The European Commission’s Women and Science (W&S) Unit³ has devised a four-grade system to make figures on academic researchers from all over Europe comparable. Consequently, it is now possible to compare the actual gender gap among academic researchers across Europe, as seen in Figures 3.2 and 3.3, which provide figures from a selection of European countries.⁴ Figure 3.2 shows the overall percentages of female researchers at higher education institutions. The percentage is above 25% in all the countries, with three countries (Spain, Finland and Sweden) over 40%.

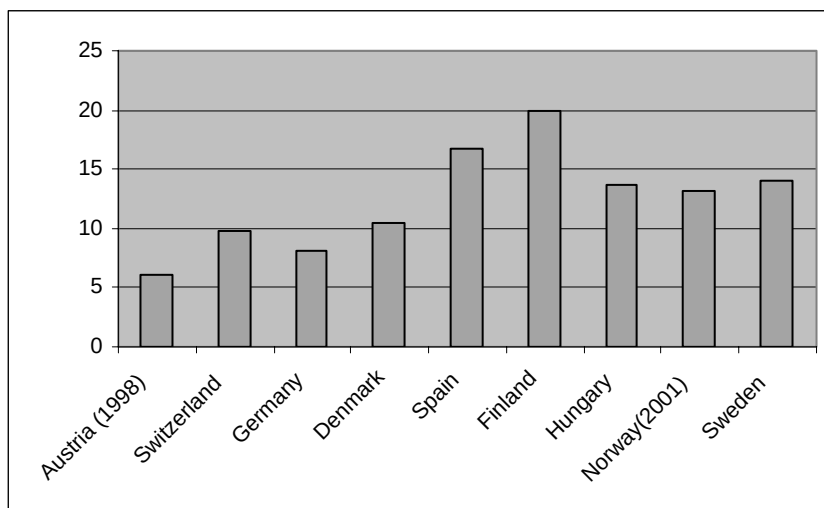
Figure 3.2. Percentage of female researchers at higher education institutions in selected European countries 2002 (W&S)

3. Directorate-General for Research, Science and Society.

4. Some larger European countries are not presented due to problems with the grades: the United Kingdom has a fifth grade, a group called “others”, and France has reported a three-grade system.

As seen in Figure 3.3, the pattern is not the same when the percentage of female full professors is compared. Finland clearly has the highest percentage of female full professors (20%). At the other end of the scale, Austria is found with 6%.

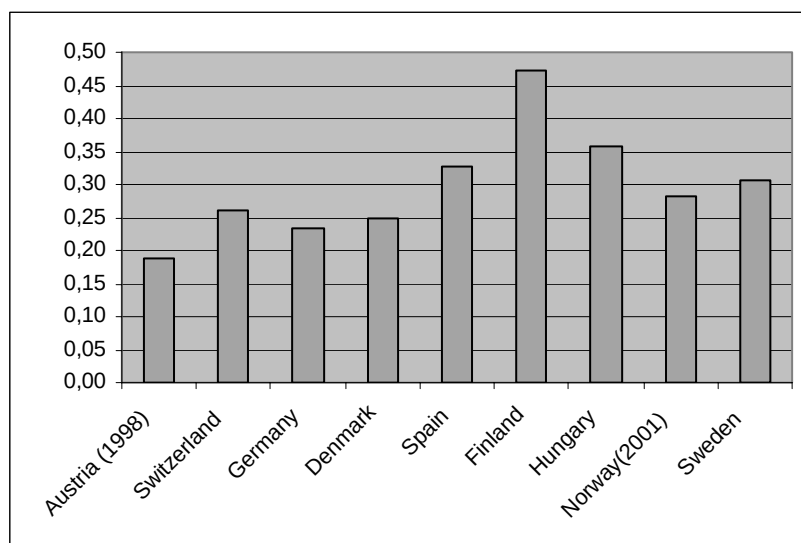
Figure 3.3. Percentage of women among full professors at higher education institutions in selected European countries, 2002 (W&S)



The gender gap among full professors might reflect two differences at the same time: the gap among researchers in the higher education sector as such, and the differences in promotion of men and women. One way to compare the two differences is to calculate an index for “equal differences”, *i.e.* compare the percentages as seen in Figure 3.4. If the index is 1, the gender gap is the same regardless of position (percentage of female full professors is the same as the percentage of female researchers at the universities), a low index reflects that the promotion tends to be more discriminative in that area than a high index value, *i.e.* a low index value points to a “leaking pipeline”. The index alone cannot prove discrimination within the promotion structure, because a low index might be due to “historical” reasons: if the university sector in a specific area has had a large influx of younger researchers within the last ten years, and the relative number of female applicants has been significantly larger than 30 years ago, this alone could result in a low index. The gender gap analysis must therefore include investigations of the promotions.

Internationally, a number of qualitative studies have been carried out on the issue of promotion, *e.g.* Neale and White have studied senior academic women in Australia and New Zealand (2004), and large Danish project (*Kønsbarrier-projektet*) studied different parts of the Danish system (Højgaard and Søndergaard, 2002).

Figure 3.4. Gender gap index (percentage of female full professors/percentage of female researchers) in selected European countries, 2002

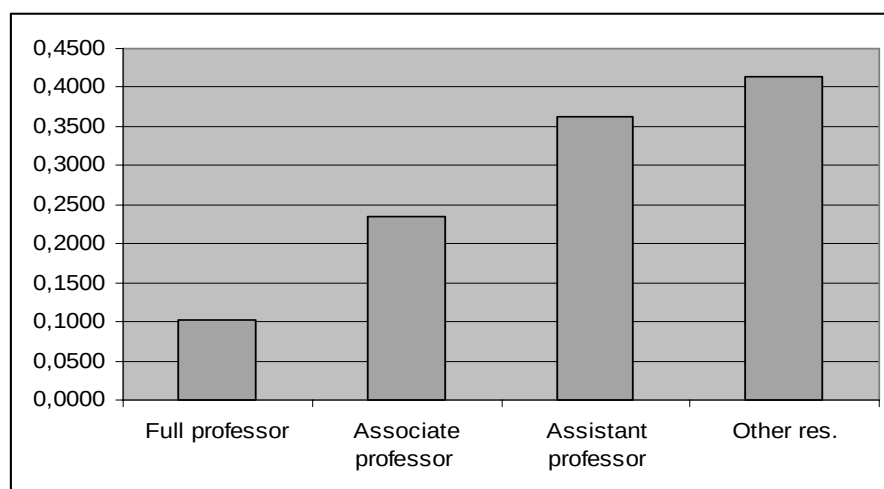


Gender ratios in the Danish research sector

Gender ratios in the public research sector

In Denmark, as in other countries, the public research sector is divided between universities and other government research institutions (GRIs)⁵. In both, there is a correlation between the share of women in positions and the job level, *i.e.* there is a greater percentage of women in the lower categories. In the university sector, the percentage of women among full professors was 10% in 2003, as seen in Figure 3.5. The percentage of women among associate professors was 23%, and 36% among assistant professors.

Figure 3.5. Percentage of female researchers at Danish universities, by category. 2003

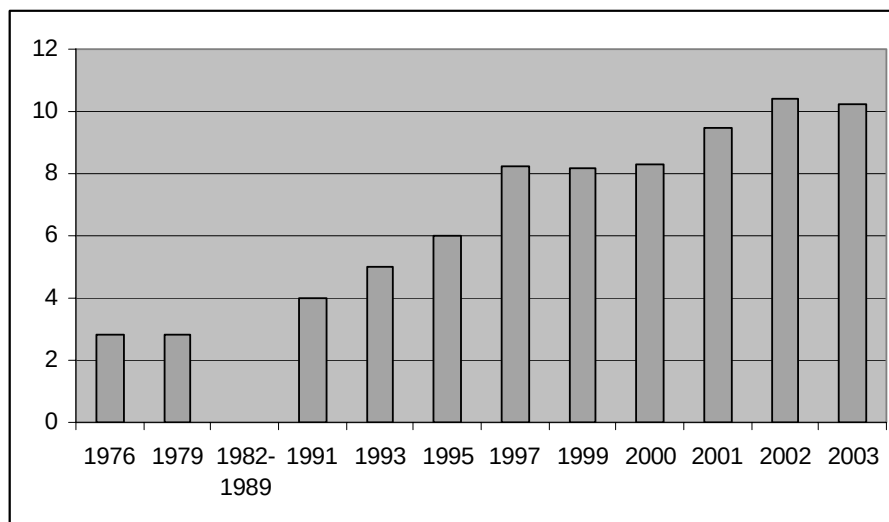


Source: Danish R&D statistics.

5. Called *sektorforskningsinstitutter* in Denmark.

This picture has only slowly changed since the 1970s, as seen in Figure 3.6, where the percentage of female full professors is shown over a longer period. Since 1976, the total number of full professors has grown from 625 to 1 179, reflecting the overall growth in the total number of researchers in the public sector. Figures are missing for the period 1982-1989 because whereas the data in the 1970s were based on individual observation (including age and gender), the data in the 1980s did not include gender, and earlier data only exists as tables in publications (Siune and Jensen, 2000). In any case, the percentage of women among full professors has more than doubled since 1991.

Figure 3.6. Percentage of women among full professors at Danish universities, 1976-2003



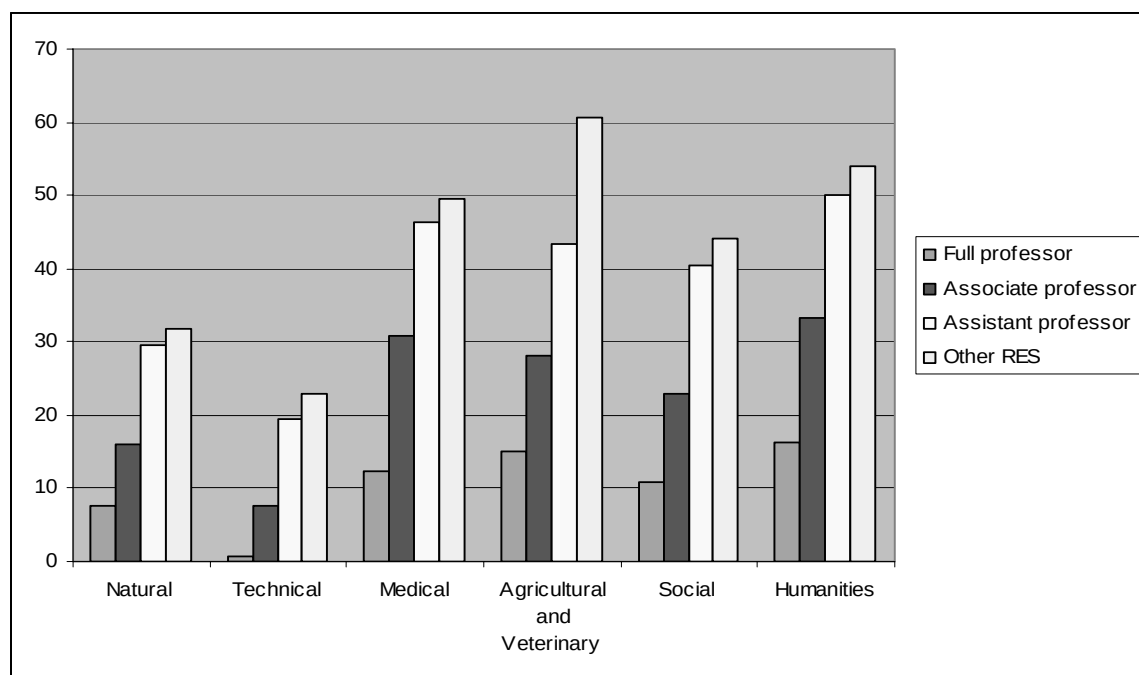
Note: No gender data available on full professors for 1982-1989.

Source: Danish R&D statistics.

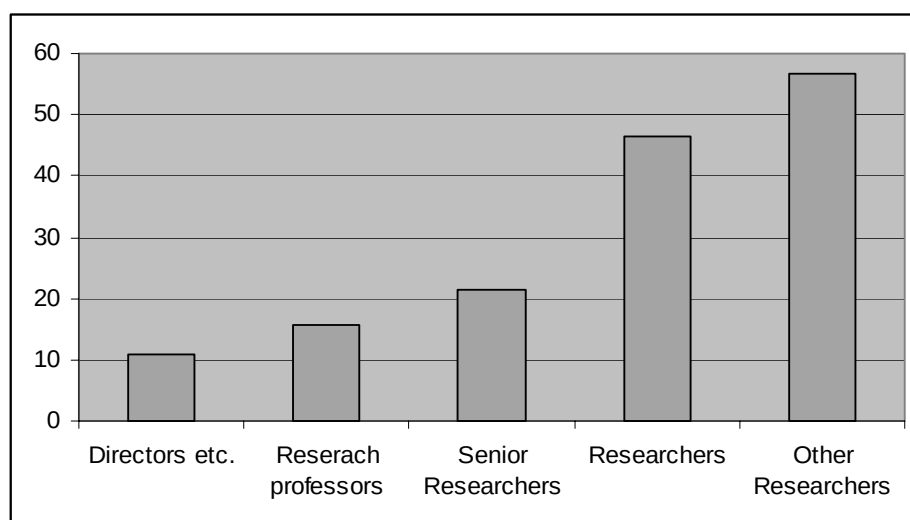
The share of women differs in the main scientific areas, as seen in Figure 3.7. The overall picture is that the largest percentage of women is found in agricultural and veterinary science, medical science, and the humanities.

Figure 3.8 illustrates the percentage of women in research positions at GRIs. The percentages are lower in the higher positions.

The low percentage of women among researchers in higher job positions has been a cause for discussion among researchers, research managers and policy makers in Denmark over the last decade, but no strategic political decisions to change the situation have been made. However, the Minister for Gender Equality and the Minister for Science, Technology and Innovation convened a public meeting to discuss the matter in May 2004, and this initiative was followed up by the creation in autumn 2004 of a think tank on women and science, which released a final report in the summer of 2005.

Figure 3.7. Percentage of women at Danish universities by category and main scientific area, 2003

Source: Danish R&D statistics.

Figure 3.8. Percentage of women at Danish government research institutes, by category, 2003

A small number of 'senior advisors' is included in the figure for 'senior researchers'.

Source: The Danish R&D statistics.

Gender ratios in the private sector

Whereas public research positions are well defined and contingent on university degree level, this is not the case in the Danish private sector. In some industrial R&D departments it has become the norm to have researchers with a PhD degree (*e.g.* in the pharmaceutical industry) while not in others. In Danish R&D statistics, firms are asked to count personnel working with R&D and then divide between researchers, technicians and others.

Women account for 24% of private sector researchers in Denmark.

The private research sector in Denmark is larger than the public research sector. The private sector's expenditure for firms' own research and development was 1.75% of GDP in 2002, whereas public sector expenditure was 0.77% of GDP. Consequently, the number of researchers in the private sector in Denmark is greater than in the public sector.

The empirical “pipeline” from assistant to associate professor at Danish universities

Until 2003 investigations of the “pipeline hypothesis” in Denmark were based on:

- Data from one university or department
- Data on applications for specific positions
- Or data from Danish R&D statistics, based on tables with information on a number of “units” such as university departments, centres, etc., and not based on information on individuals.

In 2003 the Ministry of Science, Technology and Innovation, together with the Academic Union (The Danish Confederation of Professional Associations, AC) and the universities (The Danish Rectors' Conference), agreed on a project investigating the career steps for researchers at universities, with a focus on the assistant professors (Langberg and Lauridsen, 2004).

The first study was based on university payroll information that was provided to CFA (Danish Centre for Studies in Research and Research Policy). The payroll information included personal ID numbers (a unique number that all Danish citizens and all foreigners with a permanent address in Denmark hold), a position code, and the university department. A part of the Danish ID number indicates sex. As part of the study an internal database, where information from all Danish universities was merged, was set up at CFA. This database can be used to perform a “pipeline” analysis that follows individuals over a three-year period.

As seen in Table 3.2, some discrepancies were found between the payroll information and information from the R&D statistics. The biggest differences were found at the assistant professor and full professor levels and can be explained by two factors: some researchers at universities are not on the university payroll because they are fully paid by external funds, whereas others may be counted twice, as they can work part-time at one university on a specific research project and part-time at the university that actually pays their full salary. They are therefore counted as separate individuals at both places in the R&D statistics although their research time is split between two universities.

Table 3.2. Number of assistant professors, associate professors and full professors in 2002, by gender

Level	Gender	R&D statistics 31 December 2002	Payroll data November 2002*
Assistant professor	Women	504	449
	Men	901	730
	Total	1 405	1 179
Associate professor	Women	939	946
	Men	3 185	3 234
	Total	4 124	4 180
Full professor	Women	123	102
	Men	1 056	1 004
	Total	1 179	1 106

*Internal CFA database based on university payrolls.

During the period studied the numbers of full professors and assistant professors increased, while the numbers of associate professors were relatively constant as seen in Table 3.3 (a similar trend is found in the R&D statistics).

Table 3.3. Number of assistant professors, associate professors and full professors from April 2000 to November 2002, according to university payrolls*

	Assistant professor	Associate professor	Full professor	Total
April 2000	1 091	4 193	962	6 246
November 2000	1 092	4 208	992	6 292
April 2001	1 102	4 181	1 014	6 297
November 2001	1 122	4 186	1 045	6 353
April 2002	1 135	4 217	1 082	6 434
November 2002	1 179	4 180	1 106	6 465

*Internal CFA database based on university payrolls.

The next step was to investigate promotions from assistant professor to associate professor by looking at individual mobility. From a theoretical point of view, an assistant professor could leave the university, leave the research track, remain an assistant professor, or be promoted to associate professor. Surprisingly, as seen in Table 3.4, the investigation showed that the share of assistant professors that left the university or the research track (labelled O in Table 3.4) was larger than the share that were promoted (labelled P in Table 3.4).

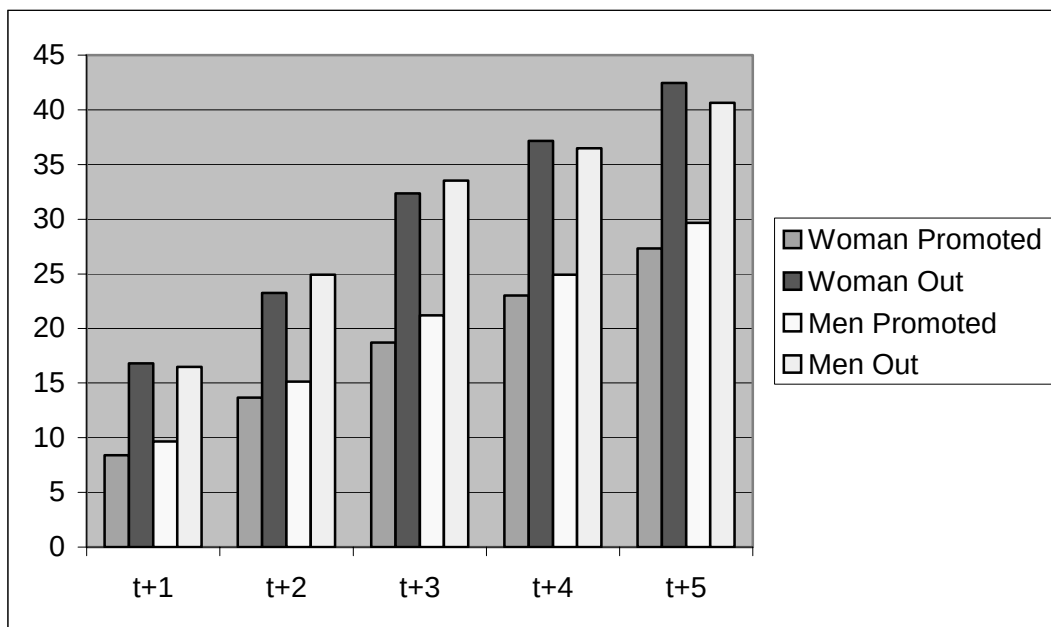
Table 3.4. Assistant professors and their mobility from April 2000 to November 2002, according to university payrolls*

Time (t)	Assistant professors _t	Mobile** assistant professors _t	Mobile assistant professors who are assistant professors (A), have been promoted to associate professor or full professor (P) or have left the research track (O)				
			A _{t+1} / P _{t+1} / O _{t+1}	A _{t+2} / P _{t+2} / O _{t+2}	A _{t+3} / P _{t+3} / O _{t+3}	A _{t+4} / P _{t+4} / O _{t+4}	A _{t+5} / P _{t+5} / O _{t+5}
April 2000	1091	871	593/97/181	447/159/265	289/221/361	206/264/401	106/314/451
Nov. 2000	1092	872	660/58/154	464/123/285	357/170/345	244/220/408	-
April 2001	1102	882	628/58/154	489/111/282	358/167/357	-	-
Nov. 2001	1122	902	710/58/134	548/114/240	-	-	-
April 2002	1135	915	686/59/170	-	-	-	-
Nov. 2002	1179	-	-	-	-	-	-

*Internal CFA database based on university payrolls.

**Assistant professors who either have changed department or position in the period studied.

Similar tables for women and men showed that the pattern was not gender-specific. In Figure 3.9, assistant professors in April 2000 are taken as an example. The differences in promotion percentages between women and men are, as seen, much smaller than the difference between the those that are promoted and those who leave the system.

Figure 3.9. Share of assistant professors at Danish universities in April 2000 (t), that were promoted to associate professor (P) or left the research track (O), November 2000 (t+1), April 2001 (t+2), November 2001 (t+3), April 2002 (t+4) and November 2002 (t+5), by gender

The results in Table 3.4 did not fit with information on the change in numbers of associate professors in the R&D statistics or in the internal database. It was known that some associate professors were foreign, *i.e.* educated in other countries before becoming associate professors in Denmark, and that some Danish-educated researchers had left Danish universities for a period; but both ‘outside’ groups were assumed to be rather small. So the focus moved to the newly appointed associate professors. The result was, as

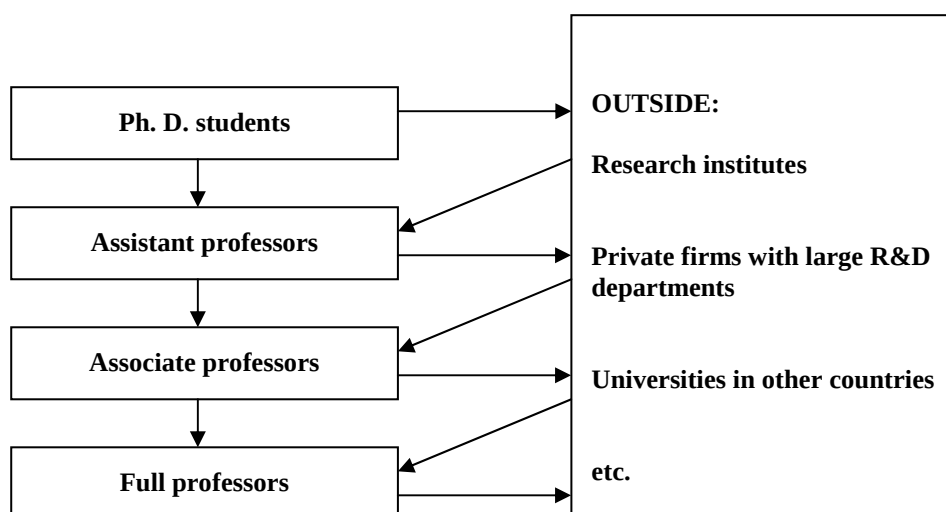
seen in Table 3.5, that the number of newly appointed associate professors who did not come from the Danish university system (either a change in department or position) were double the amount that were former assistant professors in Denmark. It was also found that the “outside” group had a considerably different gender ratio than the group of former assistant professors: 35% of the former assistant professors who were promoted were women, whereas women accounted for 27% of the “outside” group.

Table 3.5. Associate professors in November 2002, by gender and former positions at Danish universities

Former position	Associate professors in November 2002		
	Women	Men	Total
Assistant professor in April 2002	20	39	59
Associate professor in April 2002	877	3 059	3 933
Full professor in April 2002	1	1	2
Not on payroll in April 2002	48	140	188
On payroll as assistant professor before April 2002	7	12	19
On payroll as associate professor or professor before 2002	11	40	51
Not on payroll 2000-2002	37	100	137
Total	946	3 236	4 182

The result shows that the system is both leaking and absorbing at the same time, so the pipeline metaphor might not fit the Danish situation. Mobility in Danish universities is illustrated in Figure 3.10. The “outsiders” might come from universities in other countries, research institutes (*e.g.* Danish GRIs), or from the private sector.

Figure 3.10. Mobility in Danish universities



The Ministry of Science, Technology and Innovation then asked CFA to do a survey of former assistant professors in order to investigate their mobility pattern. The survey focused on assistant professors that were employed at Danish universities in 2000 and 2001, assuming that they had finished their assistant professorship in 2004 (the normal assistant professor contract is for three years). The former assistant professors home addresses as well as their citizenship were then retrieved from the Danish Central Person Register. 26% of the former assistant professors did not have Danish citizenship and 19% of the former assistant professors had left Denmark in 2004.

The results of the survey (Langberg and Christensen, 2004) were the same as for the payroll investigation: a large number of the assistant professors did leave the universities, and most of them responded that they were pushed out: among the respondents, 77% wanted to stay but only 32% had been promoted to associate professor, and 9% were promoted to temporary associate professor positions. Surprisingly, 27% were still assistant professors in 2004; this figure can be explained by their wish to stay at the universities for temporary research contracts. The flow between the private sector and the GRI sector was not as great as the international flow: only 7% of the former assistant professors were researchers in the private sector and 3% were researchers at the GRIs.

Few had jobs that did not match their qualifications and some were out of work, but the unemployment rate among the former assistant professors was much lower than the unemployment rate among other academics.

This general trend highlighted problems for younger researchers – regardless of gender. However, the picture was different when the focus was changed to scientific fields: gender did matter in some areas, as shown by a simultaneous model involving a number of factors (Langberg (ed.), 2005): in the social sciences, the probability of being promoted was greater for women than for men, and vice-versa in the humanities.

The model implied that the probability for being promoted depends on:

- Scientific field.
- University.
- Age (age group).
- Gender.
- Type of contract (assistant professor with an ordinary three-year contract, shorter period post doc., etc.).
- Nationality (Danish/non-Danish).
- Gender.

With a “non-pipeline” system the focus might therefore be different: universities are workplaces with power structures like other organisations, researchers might leave because they are forced to or because they want to, and researchers are mobile.

Conclusions and perspectives

The gender gap in the Danish university sector is substantial: 30% of researchers are female and women only represent 10% of full professors. This points to a “leaking pipeline”, *i.e.* a system where women have career problems with regard to promotions.

But an investigation based on individual information showed that the idea of a “pipeline” is misleading: among the persons that started as associate professors in Denmark, only one-third came from positions as assistant professors at Danish universities -- the rest came from positions outside the Danish university sector. Among the findings is the fact that a large group were internationally mobile: 26% were not Danish citizens and 19% had left Denmark after their period as assistant professor/post doc. This investigation was followed by a survey that showed that less than 60% of the assistant professors stayed in the Danish university sector – among these 27% were still assistant professors.

Policies based on the “pipeline” metaphor in a system like Denmark’s might therefore not work or even work in the wrong direction.

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Chapter 4

WOMEN'S RESEARCH CAREERS AND SCIENTIFIC PRODUCTIVITY IN PUBLIC RESEARCH

María Bordons and Elba Mauleón

Centro de Información y Documentación Científica (CINDOC)

Spanish Research Council (CSIC)

The Spanish Research Council (CSIC) is the main institution devoted to research in Spain. It has over 2 300 scientists (31% of whom are women) distributed across eight scientific areas and it is responsible for 20% of the Spanish publications in the international Web of Science database. The multidisciplinary nature of CSIC enables us to analyse inter-gender differences in the distribution of scientists by fields (horizontal segregation), whilst the analysis of the distribution of scientists by professional categories may shed some light on possible inter-gender differences in the promotion of scientists (vertical segregation).

The percentage of female scientists at CSIC varies by area, ranging from 20% in physics to 40% in food science and technology (Figure 4.1). The percentage of women decreases as the professional category rises: 38% of tenured scientists are women as opposed to only 13% of professors. This is shown in Figure 4.2, the so-called “scissors diagram” that has been observed for many institutions, disciplines and countries (ETAN, 2000).

Since scientific publications are the main output of research in many areas, comparisons of scientific performance of men and women can be made through publication-based indicators. In this paper, the following questions are addressed: Could the low presence of women in the top academic ranks be explained by their less successful performance in research? Are they less productive than men? Do they publish in lower-quality journals?

Figure 4.1. Distribution of scientists by gender

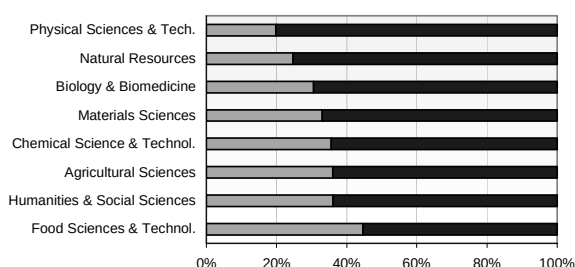
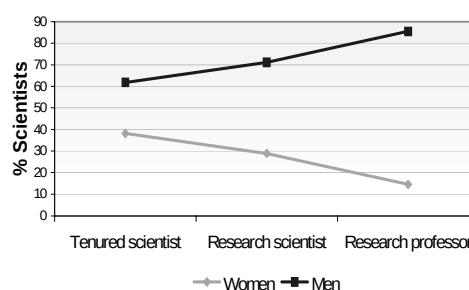


Figure 4.2. Percentage of scientists by gender and professional category



Data shown here are from a research project conducted at CSIC with the aim of improving the knowledge about the situation of the female researchers in Spain through bibliometric indicators. Some results have been previously published elsewhere (Bordons *et al.*, 2003; Mauleón and Bordons, 2006). This line of research follows European recommendations that indicate the need to review the position of women in science and technology as a first step in identifying possible situations of gender inequality, with the final aim of facilitating the integration of women in science (Dewandre, 2002; ETAN, 2000; Helsinki Group, 2002; Third European Report, 2003).

Bibliometric studies by gender: methodological issues

Bibliometric studies on scientific publications have emerged as an important tool for the evaluation of scientists' research performance. However, there are few studies dealing with bibliometric studies by gender due to the fact that gender is not included in bibliographic databases. Authors' names are not complete in most databases, and even in most journals as, often, only first name initials are included, so it is usually not possible to infer the sex from the bibliographic records (Naldi *et al.*, 2004). Only in a few countries can the sex of the authors be deduced from their surnames (Lewison *et al.*, 2001). Searching for publications from a specific population of scientists whose full name and sex are already known is the best option to tackle this type of study, and this is the one followed in this study.

In this paper, scientific publications of CSIC scientists from 1996 to 2000 were downloaded from the international Science Citation Index (SCI), produced by Thomson-ISI, and the Spanish databases ICYT (Spanish journals in Science and Technology) and ISOC (Spanish journals in Social Sciences and Humanities) produced by CINDOC-CSIC. Scientists' personal data (name, sex, professional category and number of years working at the institution) were obtained from the internal CSIC database on human resources. CSIC scientists are distributed among three different professional categories: tenured scientists, research scientists and research professors. Personal data were matched to publication data for every author with the aim of studying the influence of gender, professional category and years at CSIC on their scientific production. Institutional and author names were normalised. Data were analysed within the eight scientific areas in which CSIC operates (see Figure 4.1).

The activity of female and male scientists was compared in the following respects:

- Quantity: measured by the number of publications per scientist.
- Quality or visibility of the research: analysed by means of the average impact factor of publication in journals and the percentage of documents in top journals.
- Collaboration habits: analysed by using the number of authors and centres per document and the percentage of documents performed in collaboration.
- Signing habits: the position in which men and women sign the publications was studied.

Productivity of scientists

Scientists' productivity varies according to the area, but the percentage of CSIC scientists without publications in the period 1996-2000 is very low in all cases. Approximately 95% of male and female scientists have at least one publication in ISI or ICYT during the period under study. Although previous studies have reported that women predominate among non-publishing scientists (Long, 1992), this is not the case at CSIC. The percentage of non-publishing authors was higher in social sciences and humanities than in the remaining areas (15%) due a trend in these areas whereby scientists publish other types of documents, *e.g.* books, which are not covered by Thomson-ISI databases. However, inter-gender differences were not found in these areas either.

Although some studies have suggested that women are more locally oriented than men (Lemoine, 1992; Webster, 2001), our results do not support this hypothesis. The tendency to publish in national or international journals depends on the area, with biology, physics and chemistry being among the most international ones, while social sciences and humanities are the most nationally oriented. In all areas except the latter, both men and women show a high international orientation, and there were no differences by gender within each area.

Wide differences between fields were found in the productivity of scientists. The average number of documents per scientist during the period studied ranges from three documents in social sciences and humanities to 17 in chemistry. Previous studies have shown higher productivity for men as compared with women (Long, 1992). At CSIC, productivity of women, measured through the number of ISI publications per scientist, is slightly lower than that of men in most areas, but only in two of them are the differences statistically significant (agriculture and materials science). On the other hand, productivity of women is higher than for men in one area (food, science and technology).

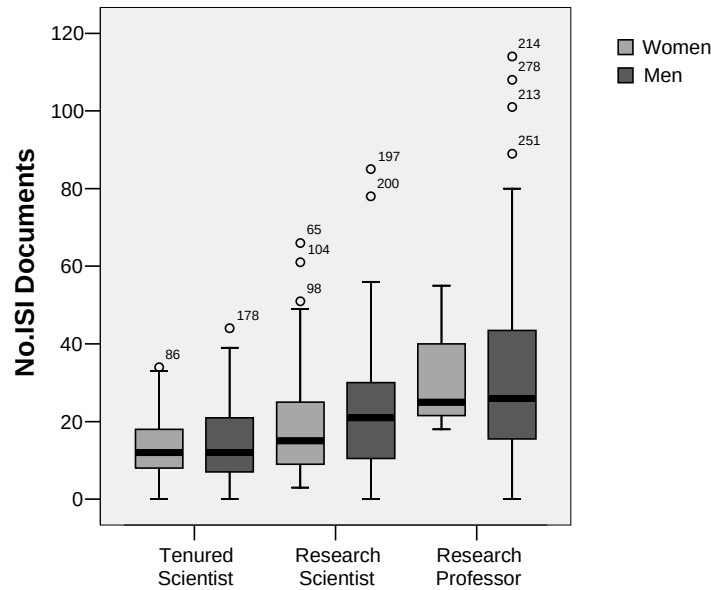
In any case, it is interesting to note that productivity increases with professional category for both sexes. This indicates that scientific promotion relies heavily on scientific publications for both men and women, that is, scientific productivity is determinant in the career development of scientists. Within each category, in most areas there are no differences in productivity of men and women. As an example, data corresponding to the area of materials science is shown in Figure 4.3. We think that the lower productivity found for women in some areas -- when the category is not considered -- could be explained by the lower female presence in the highest and most productive categories.

Impact of publications

The impact factor of publication in journals is one of the indicators more frequently used as a proxy for the quality of documents, since within each discipline journals with the highest impact factor are the most prestigious ones.

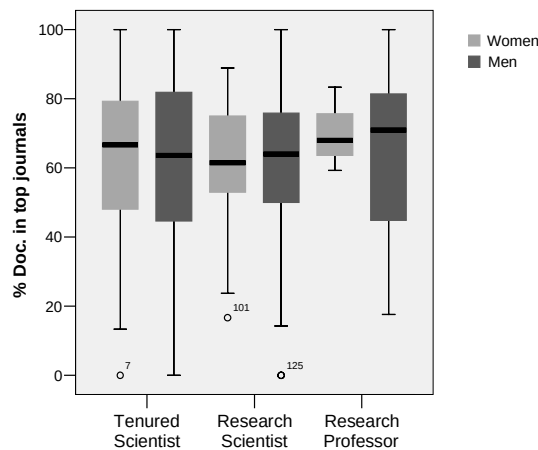
In most areas, the average impact factor of scientists' publications does not increase with a higher professional category, that is, research professors do not publish more on average in higher impact factor journals than scientists in the lowest category. This holds true for both men and women. Moreover, neither do we find inter-gender differences within each category. This finding was also reported in other studies (see, for example, Lewison, 2001). It seems that the higher productivity of research professors is obtained by publishing in journals of very different prestige.

Figure 4.3. ISI productivity by gender and professional category: materials science



The trend of publishing in the “best journals” can be analysed through the percentage of documents published by every scientist in the journals with the highest impact factor (25% of journals with the highest impact factor within each category). This percentage ranges from 15% in social sciences and humanities to 71% in biology-biomedicine. Inter-gender differences in the percentage of documents published in the best journals are not found within each area. Moreover, the trend of publishing in high impact factor journals does not rise as the category increases and inter-gender differences within each category are not found.

Figure 4.4. Average percentage of documents in top journals by scientist: materials science



Signing habits

The name order of co-authors in a publication by-line follows different conventions depending on the field (Harsanyi, 1993; Einsenhofer, 2003). In a few fields, alphabetical order is the norm, while in others name order indicates the amount or importance of each collaborator's contribution. In many fields the experimental work is performed by the first-named co-author, supervised by the last-named co-author, and with the assistance of those between. Results in our study support this policy, since scientists in the upper category sign mostly as last authors, while those in the lowest one tend to sign as first author of publications. This holds true for both men and women, but women sign less often than men as last or unique author, and more often as first author in chemistry, agriculture and food, and science and technology.

Since the signing position is associated with the role of the scientists in the research, the more eminent scientists being more likely to be last authors, the lower presence of women in this position might indicate their lower prestige and lower position in the social structure of science.

Collaboration

One of the features of current science is the increasing importance of collaboration in the development of research. The growing cost of scientific instrumentation leads to shared acquisitions between different scientists and teams, and favours co-operation. The easier communication between scientists (cheaper trips, e-mail) and the need for joint work between scientists from different disciplines are other reasons that motivate collaboration. Collaboration ensures a more effective use of skills and techniques and may lead to more innovative and higher quality research results (Narin *et al.*, 1991).

The trend of collaborating can be measured through the percentage of documents with two or more signing research teams in the output of each scientist. Inter-field differences are found due to differences in the type of research, amount of experimental work and importance of research teams in conducting research. At CSIC, each scientist publishes on average 14% of his/her documents in collaboration with two or more centres in social sciences and humanities, while this percentage rises to 40% in food and science and technology and to 67% in natural resources or chemistry. But within each area, inter-gender differences were not found: both men and women show the same tendency to collaborate with scientists from other centres.

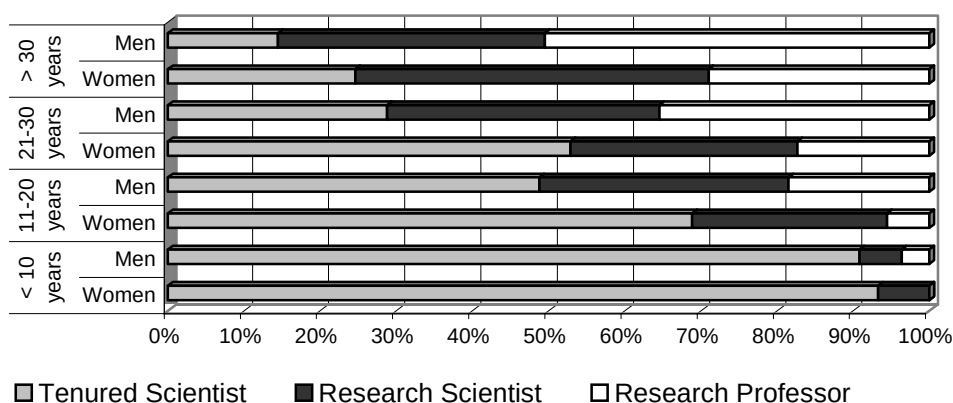
Scientific promotion

The later incorporation of women into science has frequently been put forward as an explanation for the low presence of women in the upper categories. According to this hypothesis, it is just a question of time before women arrive at the upper positions. However, different authors reject this explanation (Palomba and Menniti, 2001), and our data suggest that the later entrance of women in science only partly explains the present situation.

If the lower presence of women in the upper categories is due to their later arrival into science, and both men and women were promoted at the same rate, we would expect to find a similar distribution of male and female scientists by professional category when controlling for length of working life. However, our data at CSIC show that a different distribution is found for men and women.

Figure 4.5 presents the distribution of scientists according to the length of their professional career at CSIC (all areas combined). We can see that 90% of scientists who have been working at CSIC for fewer than ten years belong to the lowest professional category (tenured scientist). Among scientists with 11-20 years of career, almost 70% of women belong in the lowest category, while less than 50% of men are in this category. With 21-30 years of career, 50% of women are still in the lowest category as opposed to 30% of men.

Figure 4.5. Distribution of male and female scientists by professional category and years at CSIC



As scientists advance in their professional career, they are more likely to be promoted to the higher categories. The more years spent CSIC, the higher the probability of being promoted. However, promotion seems to be slower for women than for men. Inter-gender differences are statistically significant for all areas combined, and also in six out of the eight areas considered separately.

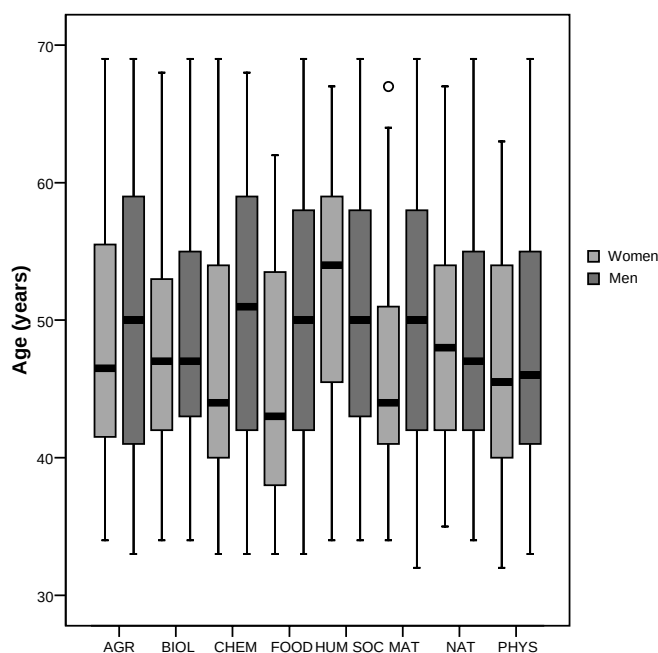
Are there inter-gender differences in productivity or in scientists' impact, after controlling for number of years at CSIC, which could explain the different promotion of men and women? The answer is affirmative in three areas (physics, biology and materials science), in which productivity of women is lower than that of men in some age brackets, although inter-gender differences in quality of journals were not found. So in these three areas the lower promotion rate of women could be partially explained by their lower productivity.

Any change in the future?

The analysis of the average age of scientists in the different areas provides indirect information about time trends in the recruitment of scientists. Figure 4.6 shows the age of scientists by gender in each of the areas. It is interesting to note that women are younger than men in three areas: food, science and technology, chemistry, and materials science. This lower age is due to a high relative percentage of women entering CSIC over the last 20 years, as compared to men. So in these areas, if there were no differences in research performance of men and women and no discrimination in the promotion system, we would expect women to arrive at the upper positions in the near future.

Curiously, social sciences and humanities is the only area in which men are younger than women. In this area 40% of women have been at CSIC for more than 20 years, vs. 26% of men. It could probably be explained by the fact that SSH studies have had a longer tradition among women over many years, but in the last 20 years women have increased their incorporation into other areas at the expense of social sciences and humanities.

Figure 4.6. Average age of female and male scientists by area



Conclusions

The later entrance of women into science cannot by itself explain the low presence of women in the upper categories at CSIC, since for a similar length of scientific career, women show slower promotion than men. Our data suggest that differences in productivity might contribute to explaining the lower promotion of women in some areas (materials science, biology/biomedicine, physics), but this is not the case in others. Differences in personal characteristics, social factors and access to resources have been arguments to explain differences in productivity and gender inequality in science (Cole, 1998; Xie and Shauman, 1999; Kyvik and Teigen, 1996; Etzkowitz *et al.*, 2000; Webster, 2001; Prpic, 2002). In our study we have not analysed this type of factor, but the lower proportion of women signing as last author suggests their lower prestige and eminence and points out the importance of social factors.

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Chapter 5

WOMEN'S CAREERS IN SCIENCE AND TECHNOLOGY IN JAPAN

Mariko Ogawa
Mie University, Japan

Just two weeks before this workshop, a new ministerial position was created in Japan: Minister of Gender Equality. This post is held by Ms. Inokuchi, who is an established professor of international politics, especially of peace studies. I look forward to seeing the treatment of female Japanese scientists and engineers change dramatically.

Current situation and problems

First, I will explain the present situation as well as problems faced by women in science and technology (S&T) in Japan. I will then, with reference to three specific factors, elucidate the reasons why Japan has relatively few female researchers. I will also provide a historical and social analysis. Thirdly, I will describe some recent strategies for increasing the proportion of female researchers in S&T.

The number of female researchers in Japan, as well as the percentage they represent, has gradually been increasing. However small these increases have been, they are positive signs. However, we need to look at the current situation of female researchers in Japan from an international viewpoint. From the perspective of other countries, we can see how Japanese policy for woman scientists and engineers is lagging. The percentage of female researchers in Japan is 11.6%. This is the lowest among OECD member countries and as a result has aroused considerable discussion, especially in light of the fact that Japan is such an industrialised country, with about 3% of its GDP devoted to research and development (R&D).

In Japan, there is a conspicuous horizontal segregation among female students. This horizontal segregation should be considered at two levels -- among female students as a whole and among female students in S&T. The first level raises the question of why so few students major in S&T, and the second level raises the question of why so few students major in hard sciences. However, I must explain why there are so few female researchers in S&T in Japan before further discussing the horizontal segregation.

The following survey results provide insight into why Japan has relatively few female researchers. Figure 5.1 shows that three major factors seem to underlie the current poor numbers of female researchers. The first part shows that many people mention family responsibilities. Women have a lot of difficulties in continuing their research because of childbirth, childcare, or nursing the elderly. Male respondents feel there has been an improvement in this situation but female respondents do not. The next factor is fewer job opportunities for female researchers. Female respondents feel there has been an improvement, but male respondents do not. The third factor is the small number of female students majoring in the natural sciences. The responses to this survey question show a particularly

marked contrast between male and female respondents, and there are big differences between male and female recognition of these factors. Male respondents do not grasp the seriousness of female researchers' burdens and they make much of differences in talent between the sexes. Even the results of these questionnaires provide evidence of the difficulties faced by female researchers; moreover, the male respondents' lack of awareness of female researchers' burdens aggravates matters.

Figure 5.1. Survey results: reasons for the low numbers of female science researchers in Japan (percentage)

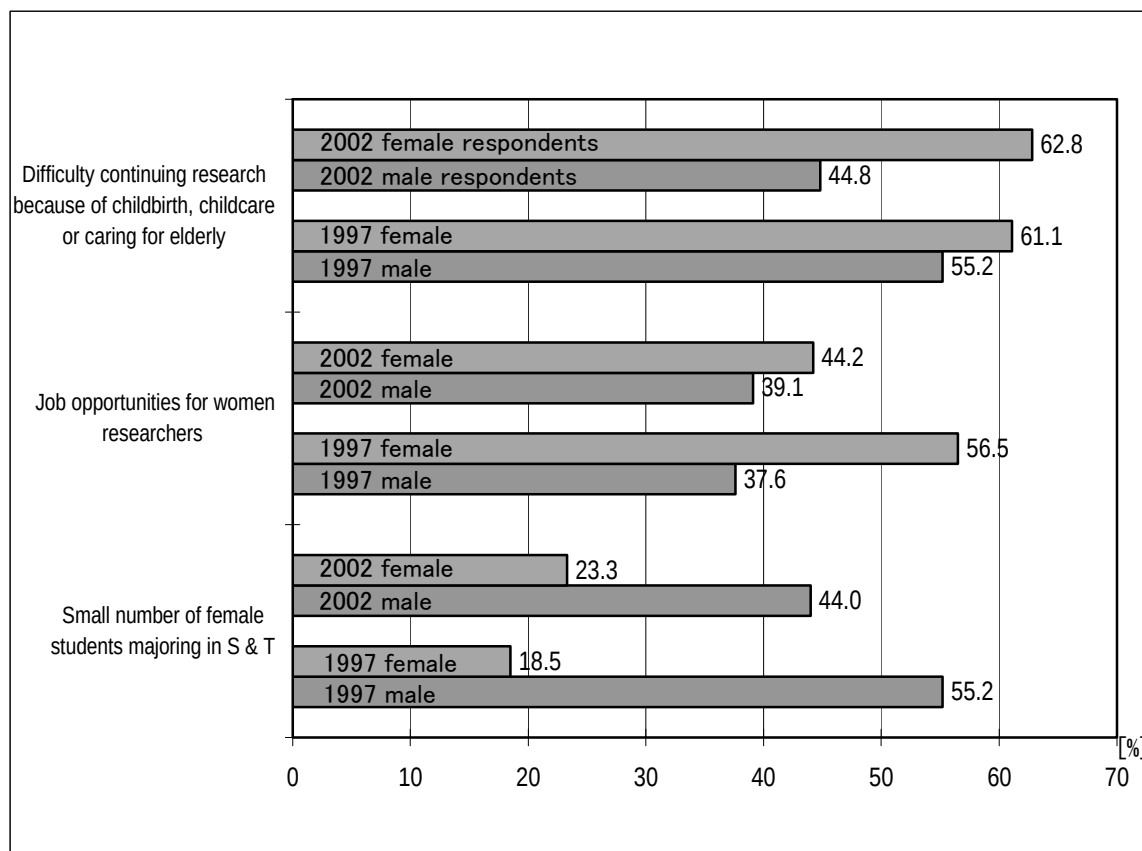


Figure 5.2 shows how many hours researchers spend on household matters, childcare or caring for the elderly. A total of 40% of researchers who are mothers spend three to five hours a day on the household, childcare or nursing care, while almost 20% spend more than five hours for such matters. On the other hand, nearly 60% of researchers who are fathers spend less than one hour a day on the household, childcare or nursing care. They even enjoy more freedom than female researchers without children. It seems that even if married men cannot rely on their wives' support, they can concentrate on jobs almost as well as single males. In Japan, married female researchers' responsibilities for the household, childcare or nursing care are extremely heavy. This is the main reason why there are so few female researchers in Japan.

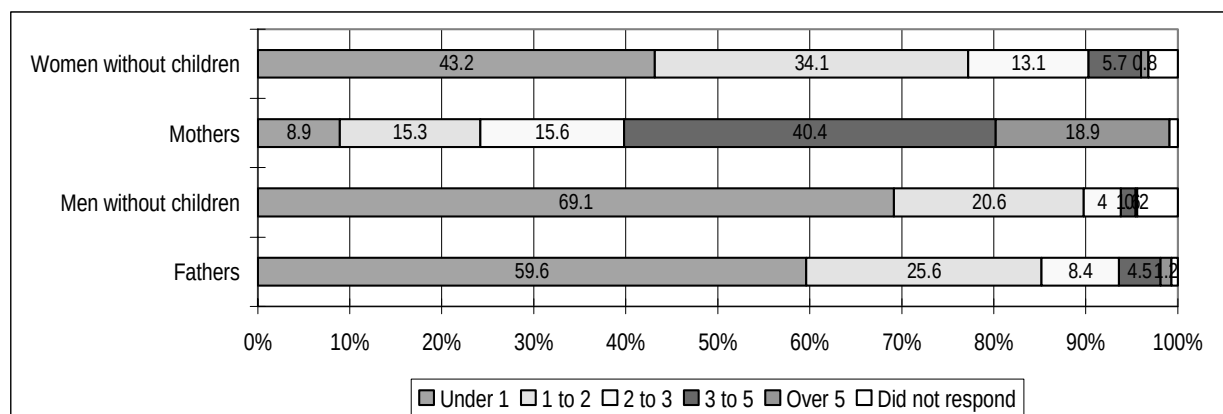
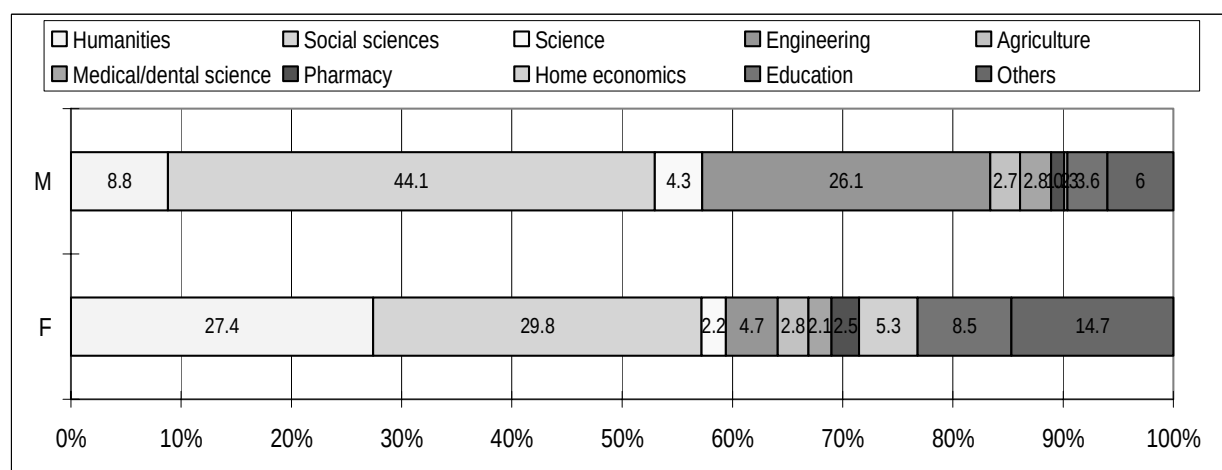
Figure 5.2. Hours per day spent by researchers on household matters, childcare or care for elderly

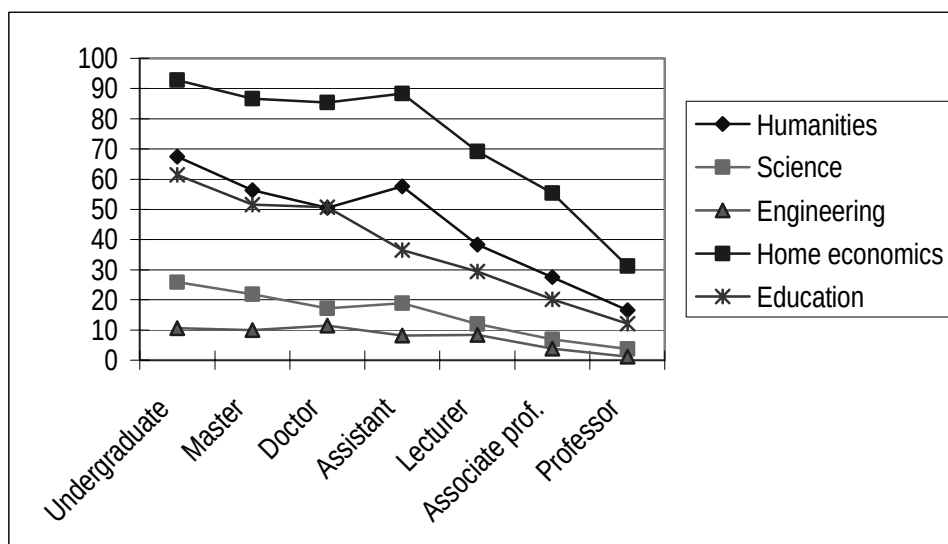
Figure 5.3 gives some explanations for the conspicuous horizontal segregation existing in Japan. It compares the share of enrollment in undergraduate majors by sex. First of all, it is a Japanese-specific characteristic that engineering is several times more popular than science. Male engineering students account for 70% of male students in the whole of S&T (including agriculture, medical/dental science, and pharmacy). This makes it less likely that women will major in the natural sciences. Male students in S&T account for 37.1% of all male students. Female students in S&T account for 14.3% of all female students. Note that there are more female students of pharmacy than of science.

Figure 5.3. Percentages of undergraduate majors

The proportion of Japanese GDP spent on R&D currently stands at 3.35%. This is the third highest in the world. However, 70% of R&D funding is in the private sector, *i.e.* the industrial sector. It is a very difficult and competitive area even for male researchers, and gender mainstreaming in the private sector lags even in comparison with the public sector. If we hope to increase the number of female researchers, we should change our way of working in the private sector.

The three biggest areas in terms of high rates of female students are home economics (92.8%), humanities (67.5%) and education (61.4%). Figure 5.4 shows the percentage of women in home economics, humanities, education, science, and engineering by academic rank. Even in the three biggest areas, the percentage of women in higher career positions is very low. To increase the number of female students in science and engineering is one thing, but to maintain human resources and push them up the career ladder is another. The biggest reason for the scarcity of women majoring in science and engineering is the current scarcity of professionals. Young women cannot imagine themselves as researchers because of the paucity of role models.

Figure 5.4. Percentage of women by academic rank



In the natural sciences there are many female students who major in pharmacy in order to obtain a national license as a pharmacist. For a long time, the percentage of female students in pharmacy has been over 60%. Although many female students in the natural sciences often proceed to master's courses, and, in the case of engineering, the percentage of female students on doctoral courses has increased, in pharmacy, female students generally quit school once they acquire the national license.

The causes of first-level segregation may be found in math and science education in junior high school in Japan. The 2003 Trends in International Mathematics and Science Study (TIMSS 2003) shows the percentage of female science and math teachers in junior high. The reasons why female teachers in S&T are well-represented in some countries vary. Where junior high school teacher salaries are low, for example, few men want to become a teacher. In Japan, the percentage of both female science and math teachers is extremely low (19.7% and 31.7%, respectively). In the Netherlands, the percentage of female science and math teachers (26.6% and 31.9%) is low. Yet in the EU, the

Netherlands is regarded as a comparatively developed country as regards equal participation of men and women in science and engineering. In the cases of Japan and the Netherlands, the small number of female teachers may discourage female pupils from taking an interest in science and math.

Analysis of changes over time

The proportion of pupils who complete compulsory education and go on to university is increasing for both boys and girls. The rate for boys is about 50%, and around 35% for girls. Since the Equal Employment Opportunity Law was passed in 1986, the number of female university students has increased sharply. Around 1990, the employment rate for female university students caught up with those of female two-year college students at 81%. By 1996, the proportion of pupils who completed compulsory education to go on to university outnumbered the share of female students at two-year college.

However, in spite of recent growth, the percentages of female graduates of B.A. (39%), M.A. (26%) and Ph.D courses (23%) remain small, and are, in fact, the lowest among OECD member countries. As the OECD averages register 55% for B.A., 51% for M.A., and 40% for Ph.D courses, Japan has a 16-25 point gap with the OECD averages. However, the increase in female graduate students at doctoral level is nevertheless remarkable.

Figure 5.5. Changes in the proportion of female students by department

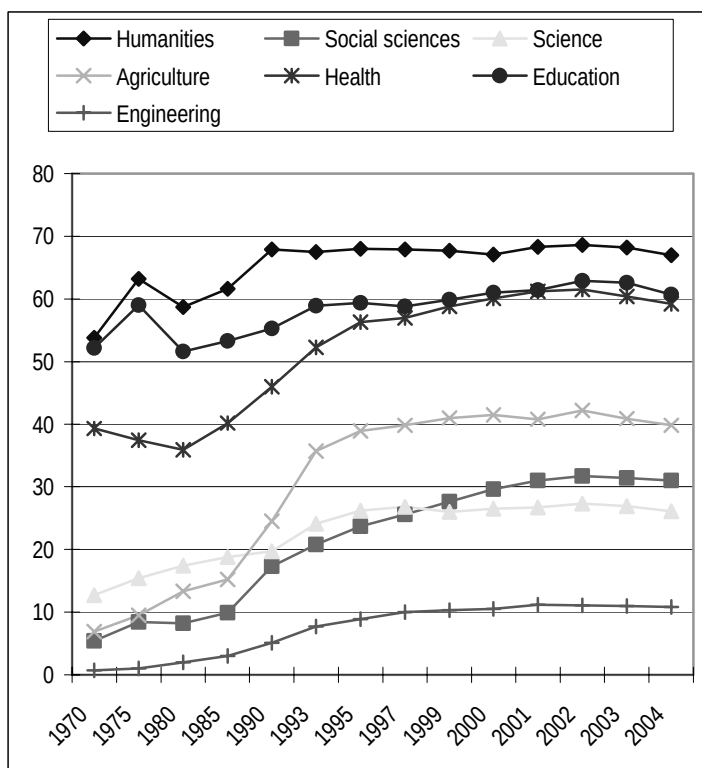
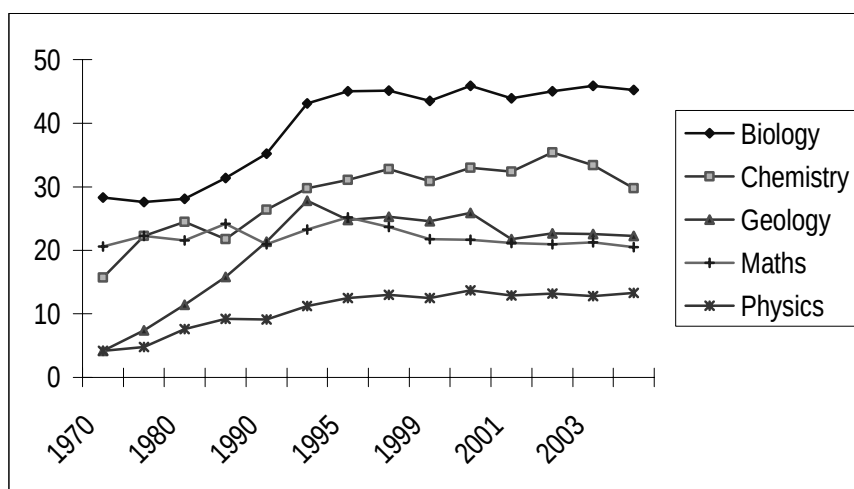


Figure 5.5 shows the changes over time in the proportion of female students in each academic area. The tendency of female students to favour particular majors has not changed over the last five years. Figure 5.6 shows the second level of horizontal segregation in science. The proportion of female students who major in chemistry has decreased somewhat. However, the tendencies in choosing other science majors have not changed.

Figure 5.6. Share of female students majoring in S&T, by field, 1970-2003



Pharmacy, in which about 60% of students are women, has a long tradition in Japan. From 2006, pharmacy training will take the form of a new six-year system like for medicine. What effect will this two-year extension of training have on the numbers of women planning careers in pharmacy? Another question concerns the fact that graduation from departments of science and engineering does not involve any national licenses. In contrast, female students in pharmacy and medicine can enjoy the advantage of a national license. It is important to let female students know about possible role models in science and engineering, and for their choice of career paths.

The overall number of students in Japan is gradually decreasing, due to the falling birthrate. For this reason, some women's universities have opened new science departments in order to secure enough students to justify their existence. In 2005, two famous private women's universities opened a pharmacy department. Both are Christian universities with long traditions of preparing young women to be good wives and mothers. Recently, some women's universities have opened new departments for nationally licensed technicians. Career paths for female students in S&T are gradually increasing, but those for postgraduates are still narrow.

Summary

In S&T, the numbers of female students and staff in Japan are increasing but are still very low when compared to OECD averages. Statistics show that more female students are choosing university over two-year-college now than was the case ten years ago. The proportions of female students choosing particular majors have remained almost the same for the last five years. In order to introduce more female students to S&T, new policies should be called for.

Revolutionary new policies

The following are some recent incentives for increasing the number of female students and researchers in S&T. These stem from the activities of the Japan Inter-Society Liaison Association Committee for Promoting Equal Participation of Men and Women in Science and Engineering (EPMEWSE) and the Science Council of Japan (SCJ), and two new programmes of the Ministry of Education, Culture, Sports, Science and Technology (MEXT). These incentives will contribute to a decrease in the horizontal segregation of female students in S&T and female scientists and engineers.

1. The founding of EPMEWSE in 2002.
2. An SCJ initiative to mainstream gender equality.
3. Another MEXT programme which offers information and support in choosing career paths.
4. A new programme from the MEXT which encourages female researchers to return to work after having a child.

EPMEWSE was founded in 2002 with only 12 starting member societies, but has now expanded to include 27 full member societies and 20 observer societies as of 2005. This is a unique meta-committee. Year after year, EPMEWSE's activities have become more influential. The expansion of the application frame for research grants means that eligibility will be extended to part-time lecturers. This is because female scientists and engineers still find it difficult to obtain permanent positions. This committee has developed lobbying power, so it exerts great influence both on the election of members of the SCJ and on the policies of the MEXT.

A science summer school for girls in high school was held for the first time in 2005 under the joint auspices of the Physical Society of Japan, EPMEWSE, the National Women's Education Center and the special committee of SCJ, with the sponsorship of the MEXT and the Cabinet Office. One hundred high school students and teachers took part. All participants hope to take part in similar events in future. It takes a long time to change something at this early stage of education, but it is the steadiest path to reform.

In the SCJ election of September 2005, the number of female members increased dramatically. Before the election, EPMEWSE submitted a request for more female members to be elected from member societies. In 2000, the greatest expectation for female researchers was only that the amount of female members would reach 10% within the next ten years. However, this figure has reached 20% in the last five years.

The Science and Technology Basic Plan for the third term (2006-2010) has been put forward in basic form. The MEXT's two positive initiatives for female students and female researchers are groundbreaking. One is to provide information on various career paths in S&T for female students at junior high school, high school, and university as well as for their parents; it also provides exchange opportunities between students and researchers in S&T. The other initiative is to balance research and childcare.

There are few female role models for scientists and engineers in Japan. Those that exist are in the public sector, not in the private sector. It is therefore important to extend career paths for women into the private sector. This is especially true because in Japan it is often the private sector that leads the way in scientific and technological innovation and discovery, reflected by recent Japanese Nobel Prize winners. A new MEXT programme

aims to make junior high school and high school students aware of such role models in order to encourage them to choose majors in S&T; similar presentations will be made to university students to encourage various S&T-related job choices.

The interruption of research by childbirth and childcare is a big problem for female researchers in Japan. After childcare, the barriers to returning to work are so high that many of them often give up their careers. However, a new MEXT programme will supply these researchers with grants to encourage their return to work. The MEXT is planning to allot EUR 1.56 million to the programme.

Conclusion

- The founding of EPMEWSE in 2002 brought about a new trend and real changes in promoting equal participation in S&T.
- The current dramatic increase in female membership of SCJ seems to be the beginning of an equal relationship between the sexes in S&T.
- New policies to be proposed by the MEXT in 2006 will revitalize the activities of female scientists and engineers.

As it stands now, the percentage of female researchers in Japan remains at 11.6%. However, the MEXT's Science and Technology Basic Plan for 2006-2010 has the target of raising the percentage of female researchers up to 25% because the shortage of young researchers will become a serious problem in the near future. Female researchers will be indispensable for R&D in Japan in the 21st century. Now policies introduced by the MEXT will encourage female students and female researchers. Japanese society is putting gender mainstreaming in S&T in gear. This will eventually bring about profound changes in dissolving horizontal segregation and even in the way we do science.

The Science and Technology Basic Plan for 2006-2010 of the MEXT aims to form an Asian S&T community. At this stage of the project, the network of women in S&T will play a crucial role. In line with this objective, I have launched a project on women and S&T in Asia, involving many Asian researchers with the support of the Toyota Foundation. I intend to collect basic data at first by distributing a worksheet to research collaborators of various Asian countries. In another development, the International Workshop on Asian Women in Physics was held at the headquarters of APCTP (Asia-Pacific Center for Theoretical Physics) in Pohang, South Korea on 23-25 November 2005, and created an important channel to exchange information on promoting gender mainstreaming in S&T in the Asian community. These movements will collaborate to supply reliable data to OECD. The MEXT will invite Dr. Neelam Kumar of the National Institute of Science, Technology and Development Studies, New Delhi in order to offer her lectures on women in S&T in India in February 2006.

As I found that the term "home economics" puzzled some participants in my presentation at the workshop in November, I would like to add the following note. At university level, home economics is an integrated science, and a practical science centering around family life. Research is conducted to arrive at a better understanding of the interaction between human beings and the environment; natural, sociological and anthropological studies are made on the basis of this research material as well as on the more 'human' aspects of our life. The results obtained may be used as the foundation for improving our living conditions as well as promoting our welfare.

Chapter 6

TRENDS IN GENDER SEGREGATION BY FIELD OF WORK IN HIGHER EDUCATION

Christian Suter
Institut de Sociologie, University of Neuchâtel
Switzerland

Abstract

Despite the expanding access for women to higher education and the growing proportion of female graduates in engineering and other branches of technical sciences, horizontal gender segregation has declined surprisingly little in most countries. Recent Swiss research has shown that the overall level of horizontal gender segregation has not significantly reduced over the past 25 years. This paper examines these trends and seeks explanations for the persistence of horizontal gender segregation. Here I argue that the fact that men and women are still choosing different fields of study is attributable to a complex interplay of factors operating at individual, interpersonal, organizational, and societal levels.

Horizontal gender segregation in higher education and inequality research

In a 1996 review article, Jerry A. Jacobs described the state of research regarding gender inequality and higher education as follows: “women fare relatively well in the area of access, less well in terms of the college experience, and are particularly disadvantaged with respect to the outcomes of schooling” (Jacobs, 1996: 154). This statement still applies today, ten years later. The huge increase in participation of women in higher education (what Jacobs meant by “access”) has neither led to a corresponding change in the ratio of women to men in particular fields of study or professions – that is, a change in horizontal gender segregation (what Jacobs meant by “experience”) – nor has it eliminated the gender-specific wage gap (what Jacobs meant by “outcomes”).

The fact that men and women choose different fields of study in higher education, effectively channeling them into distinct professions, shall not immediately be interpreted as infringing on equality principles and standards. From an equal opportunities perspective, it is the question of whether equal access to highly valued social goods and institutions exists that is of primary importance and not the question of differential outcomes. If horizontal segregation entails restricted access to such goods then it surely contributes to the reproduction of inequality structures. This is, for example, the case when men and women are paid different salaries or when typically male or typically female professions are associated with particular levels of prestige, leading to different career opportunities (Sousa-Poza, 2003).

The sociological inequality research has been interested in horizontal and vertical occupational segregation for a long time. In the beginning, the question of ethnicity and race was the focal point rather than that of gender. In general, sociology is interested in how and why societies and groups are stratified, how the access to highly valued social goods is restricted and how inequality outcomes are legitimized. In modern societies, inequality structures based on ascriptive characteristics such as gender, race, and age are regarded as particularly illegitimate, since they often are not based on performance criteria such as skills, productivity, efficiency, commitment, responsibility, and risk.

Inequality research has established a number of different segregation indicators (James and Taeuber, 1985; Semyonov and Jones, 1999). Among them is the classical index of dissimilarity employed by Duncan and Duncan (1955). This measure is still often used today as it is easy to apply and simple to interpret. In regards to occupational gender segregation, the index of dissimilarity indicates the proportion of women or men that should be shifted to other professions in order to achieve equal ratios. The standardized index of dissimilarity proposed by Gibbs (1965) calculates the degree of segregation independent of the marginal distributions – in the case of Duncan and Duncan's index of dissimilarity, larger fields of study count for more than smaller fields. A more recent segregation index, the index of association, which allows for field-specific comparison, has been developed by Charles (1992) and Charles and Grusky (1995). The index of association indicates the factor by which women or men are over-represented in specific professions or fields of study.

A first question addressed by this contribution refers to the Swiss case of horizontal gender segregation in higher education. Hence, the subsequent section presents recent trends in segregation indices for Switzerland. The second question deals with the mechanisms of horizontal gender segregation. It is argued that these causal factors are operating at the individual, interpersonal, organizational, and societal levels.

Recent developments in horizontal gender segregation: the Swiss case

In recent years various studies comparing countries and historical periods in light of horizontal gender segregation in higher education have been presented. They indicate that in the past twenty years the number of women in engineering has increased in most countries. This increase, however, is rather small and often lower than in alternate professions and fields of study. In other words: the increase in the number of women is occurring mostly in fields of study that already had a high percentage of females

This is particularly true for Switzerland, as shown in a recent study (Franzen *et al.*, 2004). Between 1978 and 2003, the number of women with a university degree in electrical and mechanical engineering in Switzerland increased from 1% to 8%. This translates into the fact that in 1978 only *three* female engineers completed their studies – in 2003, *just* 40 did so. The situation is similar in physics, where the number of female graduates increased from 6% to 13% in the same 25-years period. The figures are slightly better for civil and environmental engineering, mathematics, and chemistry; the percentages of women in these fields increased from 4% to 20%, 18% to 27%, and 16% to 28%, respectively. Other fields of study that started off with a quite similar low percentage of women like engineering and science, have, interestingly enough, reached gender parity. This is the case for theology, a field in which the proportion of women increased from 7% (1978) to 48% (2003), agricultural and forestry sciences (with an increase from 10% to 44%), geography and geology (with an increase from 12% to 41%), dentistry (with an increase from 18% to 50%) and even sociology (with an increase from

17% to 58%). Moreover, during the same time period the percentage of female graduates in modern (European) foreign languages increased from 50% to 75%, in psychology, it increased from 50% to 80%, and in educational science, it increased from 58% to 82% (Franzen *et al.*, 2004: 326-327).

In Switzerland, as a result of the huge increase in the number of women in fields of study with previously high percentages of females, the degree of horizontal gender segregation has remained almost unchanged since the late 1970s. Therefore, the index of dissimilarity varies throughout the 1980s and 1990s by 35%. This means that 35% of men or women need to be shifted to alternate fields of study in order to achieve equal ratios of men and women in all fields (this calculation is based on 32 fields of study). The standardized index of dissimilarity is slightly higher (about 40%) but has also hardly changed in the last 25 years – the same is true for the index of association (Franzen *et al.*, 2004: 322).

Looking at the development in different fields of study, in Switzerland – as well as in other countries – there is a small decrease of horizontal segregation in engineering. This can be illustrated by using the segregation index for different fields of study, which indicates the factor by which women or men in a specific field of study are under- or over-represented (the value 0 indicates equal distribution). During the 1970s and 1980s the coefficient of under-representation of Swiss women in mechanical and electrical engineering was between 3 and 4, but decreased to 2.5 by 2003. Over the same time period, the over-representation of men in civil and environmental engineering was reduced from a factor of 3 to a factor of 1.5 (Franzen *et al.*, 2004: 328).

The situation in Switzerland is, to a large extent, the same as in many other developed countries. The 12-country study presented by Charles and Bradley (2002) indicates that, in all countries examined – among them the United States, England, Germany, Japan, Italy, Canada, Spain, and Sweden – women are massively under-represented in the field of engineering on the one hand, and clearly over-represented in the fields of the humanities, and the arts, on the other hand. This, as well as other studies (such as Bradley, 2000; Ramirez and Min Wotipka, 2001; Bradley and Charles, 2004) show surprisingly few differences between the different countries or country groups. Unfortunately, Charles and Bradley's (2002) study refers to data from the mid-1990s and considers only seven fields of study, some of them very heterogeneous. This is problematic, since the segregation indicator becomes lower as the aggregation level of the data becomes higher, *i.e.* as the number of fields of study surveyed in the research decreases.

Mechanisms of horizontal gender segregation

What are the reasons for the under- and over-representation of men and women in specific fields of study? Various factors and mechanisms have been analyzed by empirical research. As suggested by Reskin's (2003) discussion on models of ascriptive inequality I would like to divide these factors in four groups. Firstly, causes and mechanisms on an individual level; secondly, factors that are important on an interpersonal level; thirdly, organizational and institutional mechanisms; and fourthly, societal factors and mechanisms that influence gender segregation.

Individual factors

The starting points of the analyses that emphasise individual factors of horizontal gender segregation are the different motives and preferences of men and women when it comes to their choice of fields of study. This can be illustrated by a survey conducted at four Swiss universities in 2002: 1 600 first-year students have been asked about the motives behind their choice of field of study. The empirical evidence suggests that young men made their choice mostly based on career prospects, whereas women were also motivated by social and/or political commitments (Gilbert *et al.*, 2003). Also according to this study, although men and women have different approaches to mathematics – a factor that is mentioned in various other studies as well (*e.g.* Wilson and Boldizar, 1990) – women do not seem to be any less interested or talented in this field than men (*cf.* also Steele, 1997). The Swiss survey on the motives driving one's choice of field of study suggests rather that men have a more instrumental relationship to mathematics than women (Gilbert *et al.*, 2003).

Another group of individual factors refers to gender stereotypes. Gender stereotypes are simplified but often deep-rooted perceptions of male and female characteristics. They support the continuity of specific gender roles and occupational gender segregation. Some approaches assume that gender stereotypes are formed during the socialisation process whereas others suggest a lifelong process of production and reproduction of gender roles (*e.g.* Jacobs, 1989, 1995 “social control model”). Typical male characteristics – according to gender stereotypes – include, among others, their interest in technical issues, analytical competences, talent for craftsmanship, career focus and professional ambition, ability to assert themselves, dominance, selfishness, and willingness to “impression management”. On the other hand, typical stereotypes of female characteristics include beliefs that they are child-friendly, have an interest in family, value harmony, and are empathetic, emotional, and altruistic. Engineering, obviously, is associated with male rather than female stereotypes – hence professions in engineering are considered to be typically male in nature and tend not to be a woman's first choice.

Gender stereotypes are not only important to the choices men and women make regarding their fields of study, they can also influence the decision making process associated with job allocation or research funding. In a recent empirical study of 770 American law firms, Elizabeth Gorman (2005) found a relationship between the frequency of gender stereotypes associated with hiring criteria and the gender of individuals hired: Hiring criteria with male gender stereotypes lead to a preference for hiring men whereas hiring criteria with female gender stereotypes lead to a preference for hiring women.

Rational choice and human capital approaches also emphasize the importance of individual factors, *i.e.* the individual aim for maximum personal benefit (Becker, 1971). According to this perspective women and men think and decide differently when it comes to individual benefits, among other things, because women often (have to) combine their career with running the household and child care. This entails a higher probability of breaks in their working life and therefore planning a career is more difficult. Accordingly, women should have a preference for professions that enable them to combine professional and family careers and for professions, which permit career breaks. Likewise, it is argued that women choose specific fields, such as education, psychology, or medicine, because they are not only beneficial for their professional career but also for caring for children.

Interpersonal factors

“Interpersonal factors” refers to mechanisms of gender segregation that are rooted in the interaction processes between two persons or within social groups. Homophily, the tendency to interact with others similar to oneself, such as in the case of “same gender preference,” are a fundamentally important mechanism operating at the interpersonal level. Gender homophily was discussed in Kanter’s (1977) classical study on the allocation of managerial positions. Similar empirical evidence has been reported in a more recent study by Gorman (2005), who found that organizational decision makers in large US law firms favor hiring candidates of their own sex.

A second mechanism underlying gender segregation involves social networks providing access to information and/or specific resources (*e.g.* job offers). Differences between women’s and men’s access to personal networks (*e.g.* exclusion of women from informal “old boys networks,” or restricted access to professional networks due to family obligations) and in the quality and utility of networks available to them are widely discussed (Granovetter, 1995; Ibarra, 1997). A recent Swiss study on the scientific career of young female researchers found that scientific networking among women, particularly among those raising small children, was significantly restricted in comparison to that among men (Leemann, 2002). It is also argued that women can maintain their network connections more effectively when working in female-dominated environments. Thus, choosing a male-dominated field of study can result in the loss of established social network connections.

Family background, as well as inclusion and exclusion mechanisms among peer groups, are also factors at play on the interpersonal level. If a young girl plays with computers and technical toys during her childhood, she might be regarded as an outsider by her female friends. In this situation support and encouragement from the family turns out to be an important social resource. Thus, female students in engineering and other branches of science often have at least one parent with a profession in one of these disciplines. This also points to the importance of having a female role model working in a male-centred profession or field of study.

Organizational and institutional factors

Organizational and institutional factors of gender segregation include inequality mechanisms operating at the level of establishments such as firms, research institutes, or research funding institutions. Important institutional mechanisms affecting gender segregation are 1) the recruitment processes of employers, 2) the promotion practices, 3) the decision making and evaluation processes for allocating research funds, and 4) the presence of gendered workplace cultures.

1. Recruiting and hiring processes are still rarely studied, mainly due to difficulties in accessing the relevant institutional data. Gender segregation in recruitment and hiring processes play out in a number of consecutive stages: firstly, the way in which potential applicants are informed and attracted to positions (by advertisement, headhunters, or on-campus recruiting, and/or through personal networks or previous professional contacts), secondly, the invitation to a first and/or a second interview, thirdly, the receipt of a job offer, and, fourthly, the quality of the received offer, *i.e.* the starting salary and benefits offered. Each of these stages may be influenced by differential treatment of men and women. As mentioned previously, hiring decisions can be affected by gender stereotypes or by same-gender preferences. For example, Peterson *et al.* (2000) found in their study of

35 000 applicants to a US high-technology company, significant gender differences in the starting salaries offered (11% higher salaries for men) – differences which, however, may be explained by age and education.

2. The role that promotion and evaluation practices play in generating gender segregation is even less documented than that of recruitment practices. The lower probability that women have of surviving in a professional career (*e.g.* engineering) and gaining access to higher employment positions has been attributed to the “revolving door effect” (Jacobs, 1989), that is, to the high exit rates of women who enter male-dominated fields of studies and professions and to the “glass-ceiling effect”, that is, to the slow or blocked career progress of women. Thus, Guran (1997) reports a 13% gender difference in exit rates in engineering over seven years (*cf.* Tang (1997) and Morgan (1998, 2000) for a controversial debate on the glass-ceiling effect for engineering).
3. Institutional mechanisms of gender segregation may also influence the selection and allocation processes of research funding institutions. As a member of the Gender Equality Commission of the Swiss National Science Foundation I have been directly confronted by the question of whether or not women and men have equal access to research funding resources. One way of measuring the gender equality of this access is to look at the “success rate,” that is the number of approved research applications for men versus women. An internal survey of the Swiss National Science Foundation conducted from 1995 to 1999 regarding project funding did indeed find differing success rates for men and women in certain fields of study. The success rates of women were lower than those of men, especially in technical sciences such as mathematics, chemistry, or physics (SNF 2001). Interestingly, however, of all fields surveyed, engineering was a clear exception. The success rate of men (65%) and women (62%) was identical for the years 1995-1999. Furthermore, during the past five years (2000-2004) female engineers have been more successful in regards to project approvals (76%) than their male counterparts (62%).

We can conclude that – at least in Switzerland – the assessment and approval process of institutions for research funding does not prevent female applicants in engineering from embarking on a research career. Instead, the very low number of applications submitted by women in engineering is a much more limiting factor. This number has not increased much in the past ten years. From 1995 to 1999 and from 2000 to 2004, only 10% of project applications in engineering were submitted by women. This percentage, however, must be considered in light of the percentage of the entitled applicants – that is the professors and the scientific university personal with a doctorate in the field – comprised of women. There is no exact data available – but the percentage of these positions filled by women is most likely less than 8% – the number of female professors is a mere 3%. The dearth of applications from women may therefore be explained by the low number of female professors – *i.e.* the vertical gender segregation. But this conclusion does not apply to all natural science fields of study. A detailed analysis completed in the field of chemistry showed that, although 24% of all entitled applicants were women, only 10% of applications actually came from females (Jänchen and Schulz, 2005).

4. Just as other fields of study and professions, engineering and other branches of technical sciences have a specific workplace culture. McIlwee and Robinson (1992) and others have argued that there is a distinct, male-centered “culture of engineering,” that generates an unfavorable climate for women and thus makes their access to this profession, particularly to the most prestigious positions in research and development, more difficult (*cf.* also Hacker, 1989; Heintz *et al.*, 1997; Knorr-Cetina, 1999; Marry, 2004). This “culture of engineering” emphasizes fascination with tinkering and with machines, and demonstrations of technical competence, skill in mathematics, and mastery of technology. Fitting in the field is dependent upon how well an individual presents itself as conforming to this “culture of engineering.” As Robinson and McIlwee (1991: 406) put it: “To be taken as an engineer is to look like an engineer, talk like an engineer, and act as an engineer. In most workplaces this means looking, talking, and acting male”.

Societal factors

Societal mechanisms and factors that have an impact on horizontal gender segregation include normative aspects and values on the one hand, and social and structural changes on the other. Among the most important normative factors are the social acceptance of gender equality standards and the implementation by political and legal authorities of interdictions against discrimination. Acceptance of “gender egalitarianism” is the main explanation given for horizontal gender segregation in the aforementioned 12-country study by Charles and Bradley (2002).

There are a number of structural changes in society that are expected to influence horizontal gender segregation. According to Charles and Bradley (2002), educational expansion and the diversification of educational institutions other than universities contribute to a deepening of horizontal gender segregation. The authors argue that the fact that more women are studying may lead to the establishment of new fields of study specifically for women. It is also argued that the diversification of tertiary education may impact on gender segregation by leading more women to take shorter and less prestigious professions at educational institutions other than universities.

The most important structural changes influencing horizontal gender segregation concern the increased participation of women in the labor market and the gender division of labor in the private sphere. Despite general acceptance of the principle of equally shared responsibility for men and women in child rearing, the obligation of family work still falls more heavily upon women than men (*cf.* Suter *et al.*, 2004 for the Swiss case). The difficulties encountered in attempting to combine professional and family work have to be considered as a key factor in many women’s decision to leave their professional career. More flexible work arrangements, better child care support, and a changing division of labor within families may create a more favorable environment for the success of women in scientific and professional careers.

Concluding remarks

As the case of Switzerland demonstrates, the overall level of gender segregation has not been significantly reduced over the past 25 years. There have been some improvements though in female representation in certain specific fields of study, including engineering. Some fields have even converted themselves from being male-dominated to being female-dominated (in Switzerland this has been the case for theology, dentistry, and sociology) – the opposite movement, however, a massive entrance of male students into female-centered fields of study, has not occurred.

The changes during recent years regarding horizontal gender segregation in higher education, and particularly in the field of engineering, can be summarized as “too little and too slow.” As a result, even from the beginning, *i.e.* at the university degree stage, the number of female engineers is small. Considering this, gender-specific selection processes involved in deciding subsequent career steps, have a correspondingly large impact. In other words: potential factors that prevent women from graduating, from applying for research projects, and from assuming occupational career positions have more serious consequences for gender parity in the fields of science and engineering than in other fields.

While there is ample information about the degree and pattern of horizontal gender segregation in higher education, its causal mechanisms remain less clear. Empirical research and theories on gender inequality suggest that a complex interplay of various factors must be considered. The mechanisms that affect horizontal gender segregation are operating at individual, interpersonal, organizational, and societal levels. Gender stereotypes certainly play an important role at the individual level. Interaction mechanisms, networks, and family background are relevant factors at the interpersonal level. The implementation of gender equality standards and the difficulties to reconcile professional career and family responsibilities are important factors at the societal level.

From a sociological point of view, allocation mechanisms operating at the organizational level are of particular importance. I have mentioned four such mechanisms: recruitment processes, promotion practices, processes involved in the allocation of research funding, and the establishment of gender boundaries by gender-specific workplace cultures. Our knowledge of these organizational mechanisms is still limited – partly due to the difficulty of accessing the relevant data at the institutional and organizational level. Organizational practices, however, are also shaped by individual, interpersonal and societal factors. Generally, more formalized and standardized institutional selection and evaluation criteria reduce the potential for gender inequalities. Furthermore, transparency of the allocation and decision making processes, accountability of decision makers, and the existence of sanctions are expected to reduce potential gender biases.

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Chapter 7

THEORIES INTO GENDER SEGREGATION IN SCIENTIFIC CAREERS

Yu Xie

Department of Sociology, University of Michigan, Ann Arbor, United States

It has been well documented that women are not only underrepresented in science, they are also particularly underrepresented in hard sciences. For example, women constituted 43.4% of all US doctoral degree recipients awarded in 2001, but only 16.8% in engineering and 25.9 in physical science (Xie and Shauman, 2003, with updated figures at www.yuxie.com). I call the varying degree of underrepresentation of women among scientists “gender segregation in science”.

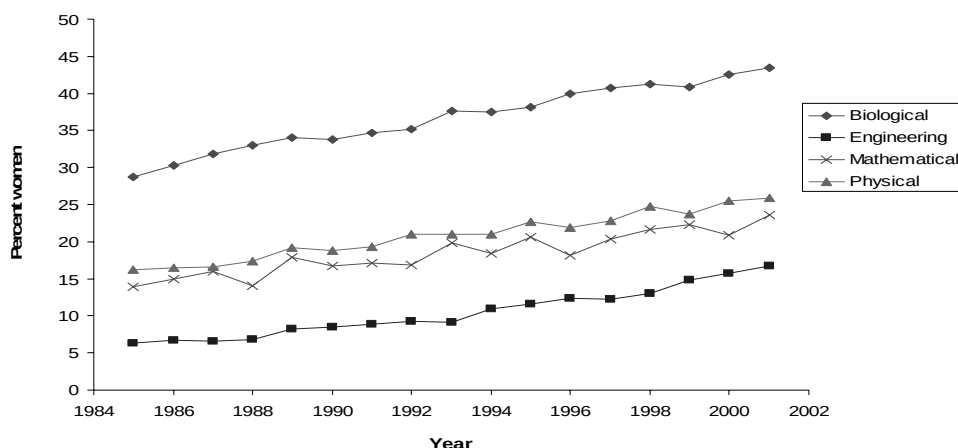
Why should we be concerned with gender segregation in science? There are two main reasons. First, certain fields of science are of higher status than others; underrepresentation of women in higher status fields (such as physics) means that, in aggregate, women scientists have lower status than men scientists. Second, we may face a shortage of scientific personnel in demanding fields. If talent for doing very demanding scientific work is unrelated to sex, the pool for these fields would be much larger with women fully participating in science.

As I have argued elsewhere (Xie, 2005), a central task of social science is to understand heterogeneity. Very often, group differences, say gender differences, are masked through aggregation at higher levels of analysis. For example, researchers have found that, in the US labor market, about one third of the discrepancy in pay between male workers and female workers can be explained by the fact that they are segregated in different occupations, *e.g.* occupational segregation (Treiman and Hartmann, 1981). However, if segregation is considered not at the level of occupations but at the level of concrete job positions in establishments, almost all gender discrepancy in pay can be explained (Petersen and Morgan, 1995).

Hence, for the study of women in science, aggregation across fields carries the risk of masking important gender differences at lower levels. However, there are costs of keeping fields at a detailed, disaggregated level. First, this prevents us from summarizing and communicating statistical results in a parsimonious manner. Second, it demands on more and higher quality data that are often not available to us. For these reasons, I propose a pragmatic approach: we examine between-group sex differences empirically, realizing that there can be hidden biases due to aggregation within groups. Here, “groups” are “fields,” provisionally defined. They are convenient ways to organize data but are not true social realities to be studied. With this caveat, I present, in Figure 7.1, the trend data for women’s representation by major fields in the United States between 1967 and 2001 (based on Xie and Shauman, 2003, with updated figures at www.yuxie.com). We observe that women’s representation does vary greatly by field, and this variation changes over time.

What are the explanations for gender segregation by field? I do not think that we have a single simple answer, as the phenomenon being studied is highly complicated. Here, I review six prominent explanations: 1) math ability, 2) human capital, 3) values, 4) role models, 5) family responsibility, and, finally 6) sex discrimination. Below, I discuss their relevance and plausibility in turn.

Figure 7.1. Percent women among recipients of doctoral degrees in science and engineering, 1967-2001 US



Math ability

In the book *Women in Science* (Xie and Shauman, 2003), we spend a large amount of space on the proposition that women's underrepresentation in science is caused by their lack of training in high school mathematics. However, we find, at least in the US context, that:

- Gender gap in average mathematics achievement is small and has been declining.
- Gender differences in neither average nor high achievement in mathematics explain gender differences in the likelihood of majoring in S/E fields in college.

In light of these findings, I do not think that math ability alone, especially if it is interpreted narrowly as innate math ability, explains gender segregation by fields. Many women with math talent pursue either non-science or relatively “soft” sciences.

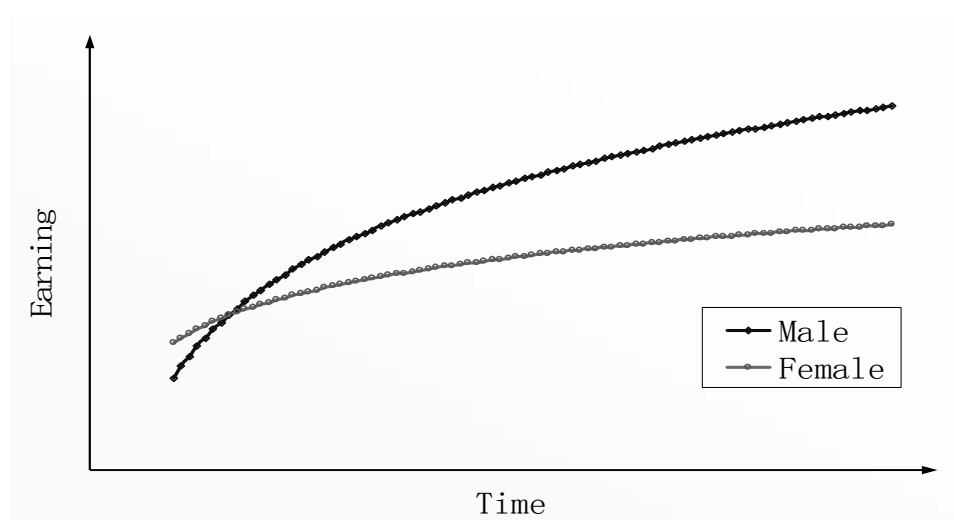
Human capital

Becker (1973, 1974, 1991) has greatly influenced the study of the family through his theory of role specialization within the family, with the wife specializing in household work and the husband specializing in market labour. Extending this reasoning to gender differences in the labour force, economists (e.g. Polachek, 1979, 1981) have proposed that women prefer to work in female-typical jobs that are characterized by relatively high starting earnings, but low or no penalty for withdrawal due to family-related responsibilities. This theory, called “human capital theory”, predicts that, whereas men pursue jobs with a rising trajectory, women work in jobs that have flat growth over the life-cycle.

Applying human capital theory to gender segregation across fields in science, we would predict that women would be interested in fields of study that reward early careers but not sustained work experience. In contrast, men are more likely to work in careers that start at a low disadvantage but accrue rewards (say pay) over time. This difference is illustrated in Figure 7.2. It is hypothesized that certain fields have trajectories that are more typical for female jobs than for others.

Empirical validity of human capital theory for gender segregation by occupations has been debatable. Paula England (1984), for example, has found evidence inconsistent with the theory. In addition, for our concern, it is not clear that the career trajectories actually differ in the way depicted in Figure 7.2. Talents for scientific work in hard sciences, say physics, are recognized early and rewarded early.

Figure 7.2. Trajectories hypothesized to be typical of “female” versus male fields



Values

It is also possible that women and men are channelled into different fields of study because they have been socialized (or through other means) to have different values as to what they wish to get from their careers. In a classic study (Davis, 1965), for example, female college students are much more interested in working with and helping “people” as a career goal than their male counterparts, and male students are found to be much more interested in making a lot of “money” as a career goal than female students. In turn, Davis also showed that students who are interested in “people” are likely to pursue soft fields of study, and students who are interested in “money” are likely to pursue hard fields such as physical science and engineering.

So, it seems plausible that gender differences in fields are driven by gender differences in career interests. However, even if this explanation holds true, we still do not know the sources of the gender differences in career interests. Particularly, women’s representation in many fields that were previously dominated by men has increased in recent decades, such as law, medicine, and science and engineering. Clearly, the gender differences in career interests are not fixed and subject to the influence of social forces.

Role models

One possible mechanism through which social forces affect the gender differences in career choice is through role modelling (Bandura, 1986; Xie and Shauman, 1997). Role modelling means that youths learn from the experiences of adults actually working in the labour force. According to this reason, youths make occupational choices on the basis of adult workers' experiences. It is hypothesized that the choice of role models is sex linked. Thus, when women become successful in a field, the next generation of women is more likely to emulate their success.

This perspective basically puts limits to the rational choice reasoning. It argues that individuals' choices may seem rational but are actually influenced by society at large. Success breeds future success, and failure feeds back to discouragement. And this process is sex-linked. That is, rational choice is bounded by social structure and acts as an agent for social structure.

Family responsibility

In the *Women in Science* book, (Xie and Shauman, 2003), we pay particular attention to the role of the family. Some earlier studies in the literature seem to portray women's disadvantage as a result mainly of within-family gender inequality. In our work, we actually find that marriage per se does not seem to matter much. Instead, married women are disadvantaged only if they have children: They are less likely to pursue careers in science and engineering after the completion of S/E education, less likely to be in the labour force or employed, less likely to be promoted, and less likely to be geographically mobile. Given the importance of family to women scientists' careers in general, it seems reasonable that it also plays an important role in gender segregation across fields. For example, it may be harder to combine family and work in some fields (say, which demand many lab hours) than in other fields (say in social science).

Sex discrimination

Sex discrimination is always a possible cause of women's under representation in science. Given the vigilance against sex discrimination in most modern societies, overt discrimination against women may not be common or tolerated by other scientists. Discrimination is difficult to operationalize and difficult to measure. However, we should not dismiss it just because it is hard to pin down precisely. For example, we may try to use an experimental method to see if it is more difficult for a female applicant to find a job than it is for a male applicant. More empirical research is needed in the area.

We also need to distinguish between discrimination of material impact (such as denial of job or tenure) versus covert or perceived discrimination that discourages women. In this context, it may also be of interest to see how women and men may handle failure or setback differently. For example, Cole and Singer (1991) developed a theory of limited differences to explain gender differences in success. Is it possible that women may not be used to dealing with frank and harsh criticisms and choose to withdraw even when the criticisms do not necessarily stop them from becoming successful scientists?

Conclusion

In conclusion, gender segregation across fields in science is a complicated phenomenon that has no simple explanation. While I cannot give specific reasons why women tend to be concentrated in certain fields rather than in others, I would like to offer the following conclusion. There are multiple levels of influence that interact across levels: the individual, the family, and the society. Individuals “choose” fields, based on their personal interests and circumstances and their family’s circumstances and needs. However, these seemingly rational “choices” are affected by social forms, social structures, and other individuals in society. Further, men and women constantly readjust their career paths based on the feedback from others and their own experiences on the paths. It is through the dynamic and iterative career process involving the individual, the family, and society that men and women are channelled into different tracks.

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Chapter 8

DISPARITIES BETWEEN MEN'S AND WOMEN'S CAREERS IN SCIENTIFIC RESEARCH: THE CASE OF AUSTRIA

Ingrid Schacherl

*Joanneum Research, Institute for Technology and Regional Policy
Vienna, Austria*

Abstract

Women are significantly under-represented in research and technology-intensive professions in Austria. Although the overall number of researchers has been expanding since 1998, the share of female researchers stagnated at 10% in the industrial research over the period from 1998 to 2002.

The situation of women in the academic field (higher education sector) in the last 30 years is well documented, but gender-related data on women in the non-academic research area are lacking, particularly on vertical segregation. For this reason the Austrian Ministry of Transport, Innovation and Technology started an initiative to systematically collect gender-related data in applied science and technical research centres in Austria.

The results of the survey are presented in this paper. The data give an overview of the participation of women in science and technology with results that are indicative for both horizontal and vertical segregation. The 20.3% share of women scientists is generally speaking quite low. Most of them work in the fields of the life sciences, chemistry and biotechnology.

It can also be shown that quite a large share of both female and male researchers are junior researchers at the beginning of their careers. It is therefore necessary to encourage female researchers to continue their careers in science and technology. There is a demand for “cultures of success” (Sagebiel, 2005) for women scientists to advance in their careers.

For the equal participation of women and men in science and technology, gender mainstreaming is one strategy for changing structures in organisations. Other strategies relate to measures in the field of human resource management in research institutions.

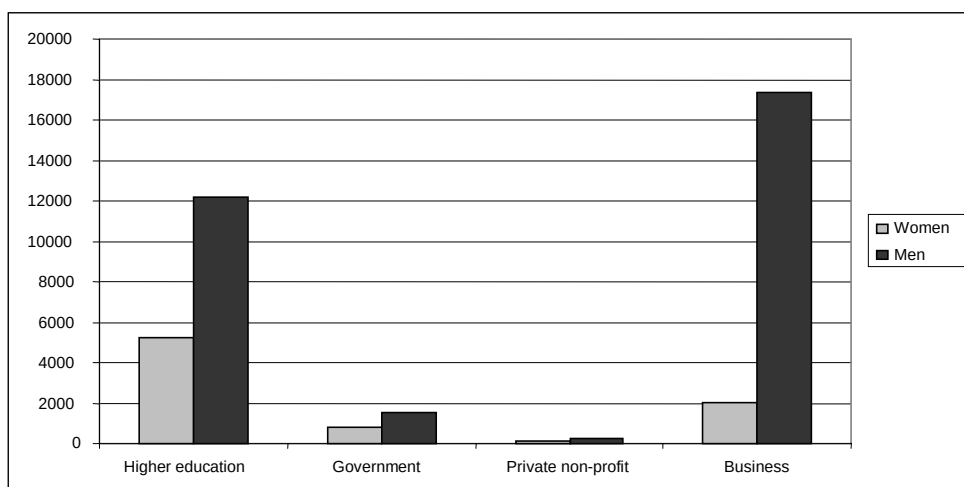
In my opinion, there is an enormous demand for gender competence and increasing awareness in this field.

Introduction

There is a paradoxical situation in Austria. On one hand, there is great interest in participating in the European development of science and technology. There is no question that female and male researchers are needed to reach the Lisbon targets (3% R&D quota). The argument is that “science, development and innovation are today the essential factors for productivity and economic wealth” (Austrian Report on Science and Technology 2005, p. 8)

On the other hand, there is an increase in the number and percentage of women among science and engineering graduates, but women still remain under-represented in scientific and technical careers. One of the characteristics is that men still dominate the scientific engineering and technology fields. The proportion of all female researchers in Austria is 20.7%. The proportion of female researchers in the Austrian business enterprise sector (BES) is 10.4%.

Figure 8.1. Female and male scientists in research and development in Austria by sector 2002 (head count)



Source: Statistics Austria R&D survey, 2002.

Women scientists are significantly under-represented in research and technology-intensive professions in Austria. The share of female researchers stagnated at 10% in the business enterprise sector from 1998 to 2002. This gender-related disproportion is even more obvious in management positions. The results of the gender booklet show that only 8% of the leading positions in research centres are taken by women.

In most cases, the difficulties that women experience arise because most institutions have developed in such a way that they fit the male pattern of working. Some women have adapted to this environment, obscuring the fact that it poses serious problems for the majority. Gender bias occurs for the most part unconsciously and one policy target is to raise awareness in the community.

One strategy for change is gender mainstreaming. Gender mainstreaming is a strategy for making women’s as well as men’s concerns and experiences an integral dimension of the design, implementation, monitoring and evaluation of policies and programmes in all political, economic and societal spheres so that women and men benefit equally and inequality is not perpetuated. Gender mainstreaming is defined as a political instrument to

enable us to reach greater democracy between the sexes. Hence, gender mainstreaming must not be considered a voluntary exercise but a duty in a democratic political system. Its objectives and their implementation should have a binding force.

For this reason the Austrian government started an initiative for the advancement and encouragement of women in science and technology (fFORTE)¹. FEMtech-fFORTE is part of the initiative and was designed by the Ministry of Transport, Innovation and Technology to improve equal opportunity in enterprises strongly oriented towards research and technology, in research institutions, polytechnic colleges, and in research and technology programmes. On behalf of the ministry, FEMtech allocates funds for the implementation of measures designed to advance women scientists careers and to modify structures in enterprises and organisations with the intention of raising awareness of, and sensitivity towards, women in research and technology as well as increasing their visibility.

One idea of the FEMtech programme is that research centres will benefit from policies that allow women scientists to be successful in their careers. Therefore industrial managers and research directors should ensure that gender equity in recruitment and promotion practices is adopted and enforced. Too often a “glass ceiling” terminates the advancement of women’s careers.

Furthermore, they should take an active part in providing family-friendly practices such as childcare facilities and flexible working schedules for all employees. Surveys have shown repeatedly that a major concern for women is balancing career and family life; having a family should not impede the successful participation of women in scientific research. An annual project of FEMtech is the Gender Booklet.

Gender Booklet

As part of gender mainstreaming, the primary purpose of the Gender Booklet was to develop an instrument for monitoring the situation of women (and men) in science and technology in Austria.

The main subject was to make visible the participation of female scientists and engineers in research institutes at different levels: type of employment (full time, part time, others), income, age groups, leading positions, boards. Based on a questionnaire, the data collected forms the basis for the next steps in implementing strategies to increase women’s participation and to work out measures supporting their career progression.

Data base

Sixty-one of the respondent institutions are non-academic research centres in applied natural and technical science (*e.g.* information technology, life sciences, mechatronics, chemistry and biotechnology, environment, energy and light, etc.). They are part of the business enterprise sector. Thirty-seven centres are part of the Christian Doppler Research Association (CDG). This non-profit association aims at promoting development in the areas of natural sciences, technology and economy as well as for their economic implementation and utilisation.

1. <http://www.fforte.at>

Table 8.1. Female and male scientists in technical and engineering research centres in Austria, 2004 (head count)

	Total	Women	Men	Women (%)	Men (%)
<i>Kind</i> ²	372	53	319	14.2	85.8
<i>Kplus</i> ²	663	143	520	21.6	78.4
Joanneum Research	294	59	235	20.1	79.9
Salzburg Research	44	8	36	18.2	81.8
Austrian Research Centres	707	110	597	15.6	84.4
Christian Doppler Labs	306	87	219	28.4	71.6
Upper Austrian Research	45	5	40	11.1	88.9
Austrian Cooperative Research	344	99	245	28.8	71.2
Total	2775	564	2211	20.3	79.7

Source: Gender Booklet 2004.

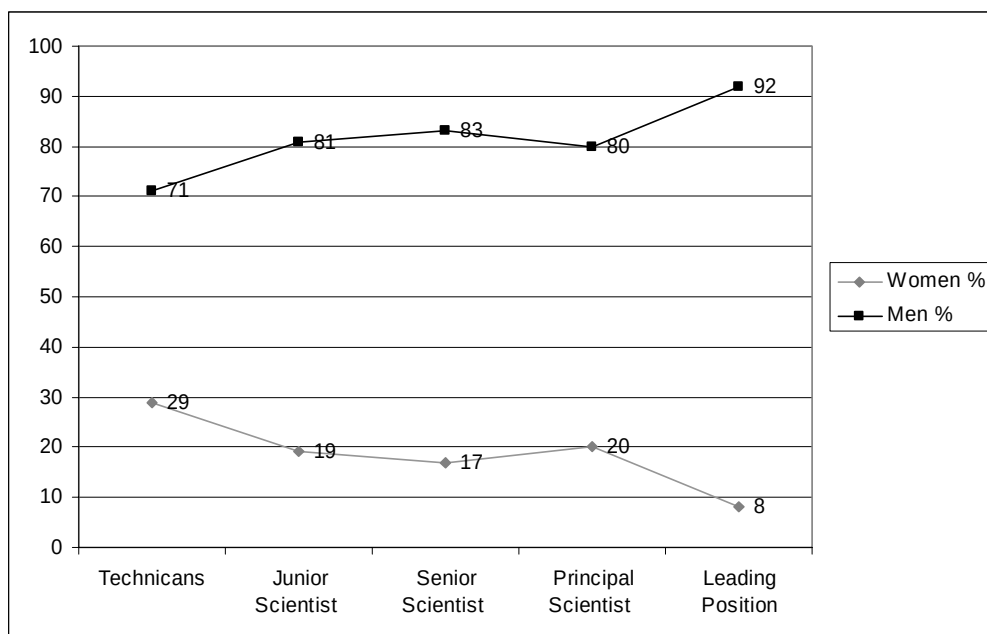
Results

The following figures give an overview of the mode of employment, age, income, distribution of leading positions and participation of women on boards. The results show that women are significantly under-represented in research and technology-intensive professions in Austria. This gender-related disproportion is even more obvious in management positions.

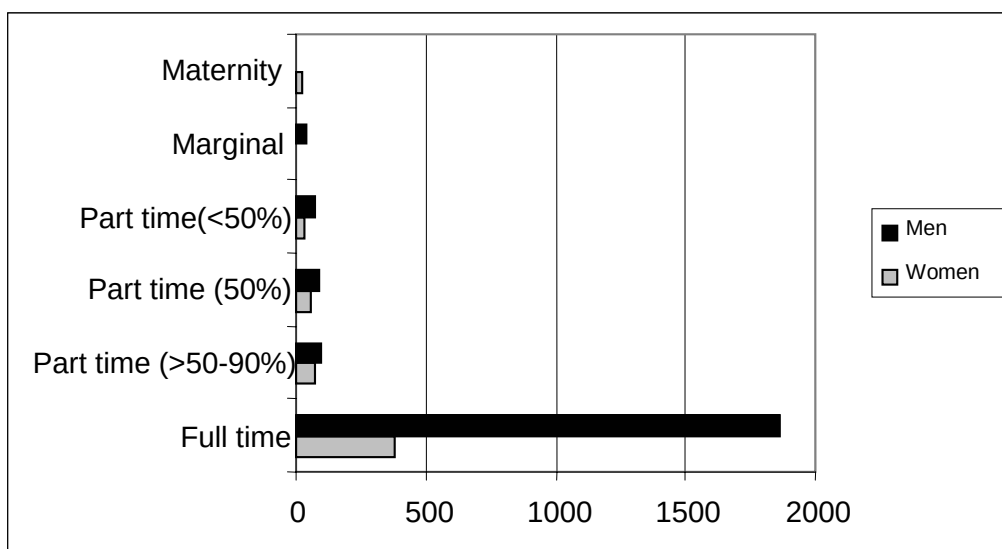
Figure 8.2 shows the percentage of women and men in scientific positions. There is an almost constant rate of women in the group of junior, senior and principal scientists. With a share below 20%, women are still a minority in these positions. The gender bias deepens even more when looking at the group of leading positions. The percentage of women in decision-making positions in research institutions is only 8%.

Figure 8.3 shows that the predominating mode of employment in the scientific field is full time work or even more. If comparing full time work between sexes, the difference is not too big: 70% in the group of women and 86% in the group of men work full time. If full time work is a critical factor for a successful scientific career, this can be one reason for women to keep out of or leave this field if they have (or want) children.

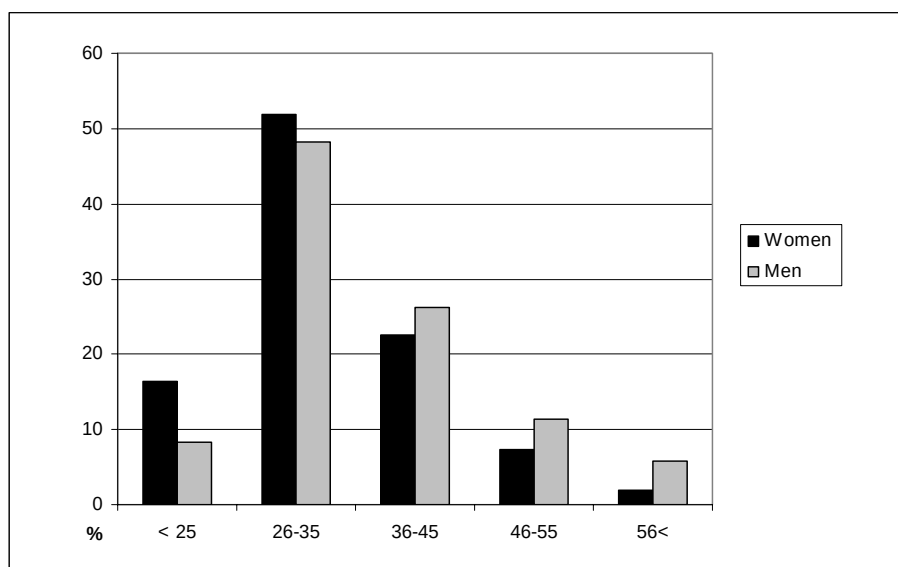
2. *Kind* and *Kplus* are centres of competence which are part of the national strategy to enhance co-operation between industry and the scientific community. They were founded in 1998 and are comparable to small and medium-sized enterprises.

Figure 8.2. Scissors diagram of women and men in scientific positions, 2004 (head count)

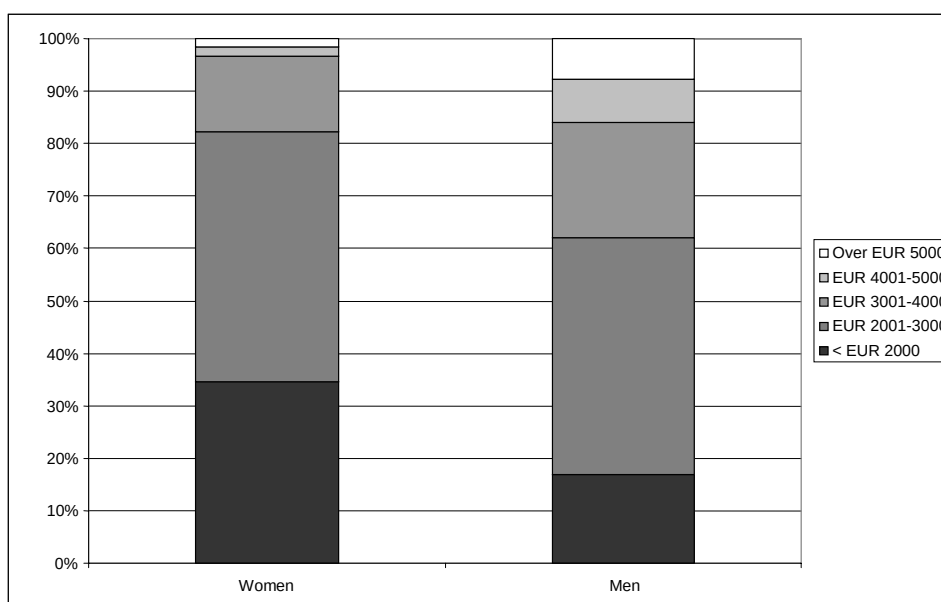
Source: Gender Booklet 2004.

Figure 8.3. Distribution of women and men by mode of employment, 2004 (head count)

Source: Gender Booklet 2004.

Figure 8.4. Distribution of women and men by age, 2004 (head count)

Source: Gender Booklet 2004.

Figure 8.5. Distribution of income for women and men, 2004 (head count)

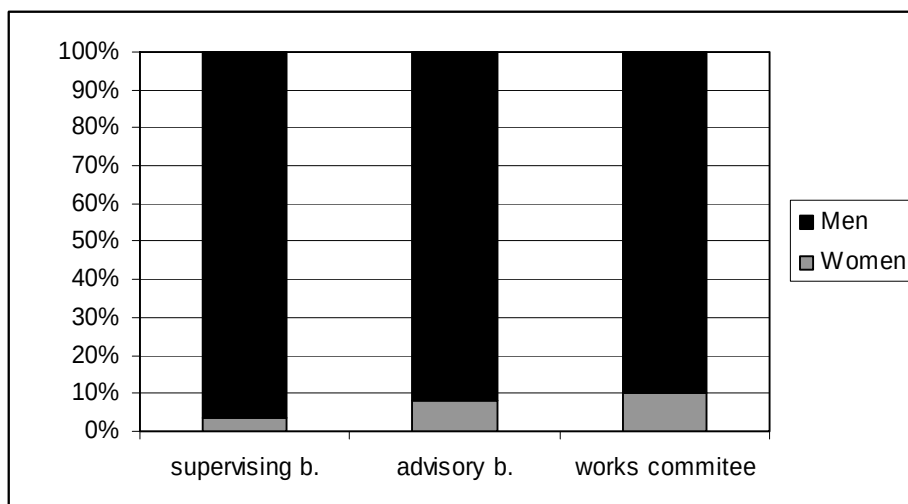
Source: Gender Booklet 2004.

Figure 8.4 shows that nearly 50% of the scientists represented (women and men) are 26-35 years old. The percentage of women in the groups of young researchers is higher compared to the men. This situation changes in the older age groups.

Figure 8.5 shows that most of the women are situated in the lower income groups. Comparing the findings to Figure 8.4 (age groups) this seems reasonable as most of the women are at the beginning of their scientific career.

A rather small representation of women was also found in supervising (4%) and advisory (8%) boards as seen in Figure 8.6. The highest rate of women is in works committees with 10%.

Figure 8.6. Participation of women and men on boards and committees, 2004 (head count)



Source: Gender Booklet 2004.

Conclusions

The results clearly demand a number of recommendations to enhance the rate of women in science and technology throughout their careers. These are:

- Intensification of activities to promote female scientific careers.
- Assurance of implementing gender mainstreaming in all national programmes.
- Development of scientific career opportunities for female and male researchers across the academic and non-academic research field.
- Installation of a cross-disciplinary human resource development programme for small research centres.
- Provision of certified advanced programmes for leading scientific positions in a module system, *e.g.*:
 1. Interdisciplinary and intercultural communication.
 2. Gender competence.
 3. Management skills in science.
 4. Coaching/supervising, mentoring competence, etc.

The data give the impression that a new generation of women scientists has entered into the field of science and technology. It is a basic aim to encourage these female researchers to continue their careers. In the future, equal career opportunities should be ensured between women and men at all levels. This will change the situation of women in science and technology in the long term.

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Part 3

**BARRIERS FACED BY WOMEN RESEARCHERS:
SEGREGATION BY HIERARCHY**

Chapter 9

GENDER AS A CAREER FACTOR IN ACADEMIC RESEARCH

Iiris Aaltio

*Department of Business Administration
Lappeenranta University of Technology, Finland*

Introduction

The number of female researchers in doctoral programmes has increased. However, men still outnumber women in professorships and the number of female deans and university rectors is low. There appears to be a glass ceiling separating women from higher academic decision-making positions in academic fields, as in other areas.

Gender, organisations and academic work

Even if gender is included in organisational analysis, individuals often are more frequently identified by other characteristics, such as age, ethnicity or disabilities. Academic life is a particular context, but organisational and management practices relating to gender are just as important there as anywhere else. Academic careers, creation of knowledge and educating people in universities should be carried out by both women and men. However, work segregation does exist in university education, as seen for instance in the numbers of entering students, with women more often entering the fields of education, healthcare, and the life sciences, whereas men tend more to enter the fields of technology and natural sciences. In addition to this horizontal segregation of work, there is vertical segregation with a remarkable majority of men in academic management.

Gender is an integral part of socially constructed individual identity, both constituting and embodying it. In addition, gender constitutes and restructures a multitude of cultural and societal phenomena. The understanding of gender is a key theoretical category in the analysis of organisations and working lives.

Statistics indicate that sex discrimination is still very evident at universities. In a recent study of faculty and students having experienced such discrimination, it emerged that women often made first attempts to address the situation informally and were hopeful that changes would result. Although the situations were sometimes resolved this way, responses to these informal appeals were generally characterised by non-response, denial of responsibility, or retaliation. Fewer of the women reported that they were hopeful that further pursuing the matter more formally would solve the problem, as many had difficulty accessing official channels for such matters. For the most part, universities responded to the formal complaints in the same way as they had responded to the informal ones, compelling the women to seek justice outside the university (Golz, 2005, 763-797). Women are often reported as being outsiders in university cultures even if physically they are there (Aisenberg and Harrington, 1988).

Female managers in organisations

According to the United Nation's "World's Women 2000" report, women account for less than 30% of the administrative and managerial labour force in all regions of the world. Women's share in professional administrative and managerial positions is lower than their total share in the labour market but has risen in every region of the world, except Southern Asia, between 1980 and the early 1990s; the share of women doubled in Western Asia (from 4% to 9%) and in sub-Saharan Africa (from 7% to 14%). (United Nations, 2000).

Even though the number of women in middle management positions accounted for 44% in the United States in 1998 (Powell, 2000), women hold only 1% to 5% of top executive positions (Wirth, 2001). In the European Union countries, the share of women in top management positions has barely changed since the early 1990s, and has remained at less than 5% (Davidson and Burke, 2000). Women tend to hold top management positions in areas that are female-dominated. For example, in Finland, these areas include the hotel and catering businesses, human resource management, and public services. The least number of women in top positions are found in male-dominated areas, such as heavy industry and construction business, where the amount of female leaders is below 10%. There are also fewer female directors in organisations that employ mostly men (Kauppinen, 2002).

Looking at the numbers, management is still a male-dominated area. Leadership and power are related in multiple ways. Leadership refers to public power, *i.e.* positions people hold in organisations and society, which give them means to use power over other individuals, groups and organisations. Leadership can also be defined as personal influence over other people, *i.e.* having an effect on their behaviour with the aim of achieving better results in their work (Weiss, 1996). Power can also be defined as one's ability to influence other people (Cornforth, 1991). Leaders and managers in organisations both use power, but in general, leadership is value-laden.

Alvesson and Due Billing (1998) argue that the amount of women managers should increase not only because there should be equality between the sexes, but also since women can contribute to work life in a way that men cannot. They bring forward four reasons to support their case: 1) there should be equal opportunities for both sexes; 2) women's competencies should be fully utilised; 3) women's contribution as leaders should be taken into account, especially their values, experiences and behaviour; and 4) women's values enrich an organisation and work life in general. In terms of universities, the same argumentation holds: academic workplaces should be equally accessible for women and men; women's competences should be utilised there as much as men's; women might contribute to academia as leaders; and different points of view could enrich the organisation and work life of academia.

Glass ceiling

The "glass ceiling" is a symbolic term for the existence of an invisible line in the hierarchical structures of working life, above which it is difficult for women to rise (Wirth, 2001). Auster (1993) claims that the glass ceiling is a gender bias that occurs all the time and takes many forms. Women encounter both internal and external obstacles in their careers. It has been easier for a woman to reach a middle management position in an organisation than to rise to the very top management level. If she does, however, she is often still a "loner", *i.e.* the only or one of very few representatives of her sex. (Kauppinen-Toropainen, 1987).

The reasons behind why there are so few women in management positions, and especially in top management, have been addressed by many researchers (e.g. Acker, 1992; Oakley, 2000; Powell, 2000, Aaltio, 2002). Though researchers categorize the reasons differently, most distinguish them as societal, organisational, behavioural and psychological. Izraeli and Adler (1994) use three main perspectives to explain the fact that women are under-represented in management. The first perspective concentrates on individual level differences; it claims that the paucity of women in management is due to behavioural characteristics and personal traits. Men's characteristics and behaviour have been taken as a norm, thus making it difficult for women to enter male-dominated areas. Auster (1993) argues that in order for women to be successful in organisations, they have to be very self-conscious of their own behaviour and keep constant control of what they say and how they act. Oakley (2000) claims that women in middle and lower management positions often play down their femininity and instead adopt a masculine style in order to increase their credibility.

According to Izraeli and Adler (1994), organisational context, an organisation's culture and its way of treating women often shape attitudes and behaviour more than an individual manager's behaviour. Powell (2000) makes a similar point by arguing that women's entry into top management positions is influenced by the way decision-making is structured in an organisation and whether the decision-makers can be held accountable for the decisions they make. Eyring and Stead (1998) claim that women's under-representation in management is due to the fact that men prefer supporting people like themselves for top positions in organisations.

The third perspective, institutional discrimination, claims that organisations are not gender-neutral and that this fact leads to gender discrimination. Gender discrimination forms in managers' basic assumptions about society and in the organisational culture. Powell (2000) refers to the same phenomenon as a societal factor; men are more taken aback by women in top positions than in lower positions, since men have traditionally had the higher status in society. He claims that this norm is reinforced in subtle ways, for instance in stereotypes of what makes a good leader. Izraeli and Adler (1994) bring forward a fourth perspective that focuses on senior managers' greater ability to influence, and limit, women's access to top positions. They argue that societal and organisational institutions that privilege men have persisted simply because senior managers do not want competition or change. Senior executives are more able than lower-level managers to protect their sphere of influence from outsiders. This explains why women have succeeded in entering the lower levels of management, but, once in, have failed to move up into senior management.

Green *et al.* (1997) claim that built-in societal structures, such as women's role in maternity and raising children, may help to explain why husbands do not support their wives' careers in the same way as women support men's careers by doing most of the child care and housework (Auster, 1993). In many societies there appears to be a tendency for high-level positions to be occupied mainly by married men with children while women in the same type of positions tend to be single, divorced and childless. (Woodward, 1996; Hewlett, 2002). Women often have to make more sacrifices in their personal lives than men do. Many top-level jobs require long and antisocial working hours that exclude many women with children. Women also still carry most of the responsibility for housework in dual-career families, and thus it is the woman's career that suffers more than the man's (Vanhala, 2002). The same applies to families where both parents are in top positions. Even as a manager, the woman still has greater family responsibilities.

University administration supporting equality between the sexes

There are few women in university management. For instance, in European universities, there are few female rectors. The majority of deans are also men. In many areas there appears to be a kind of “scissors phenomenon”: female students are the majority when coming into universities, but there are fewer female lecturers than male (Aaltio, 2003). In professorships, this tendency is even greater: women are the majority in these positions. This tendency also explains why women’s salaries in universities are lower than men’s. However, there are no simple explanations for why there are fewer women in university management positions. No evidence is found that women are unwilling to do managerial tasks. Management theories emphasize the contextual nature of managerial work, *e.g.* the importance of situationality as opposed to individual personality. Why men would be better leaders in universities and why universities recruit more men than women to leadership positions is an open question.

The description and analysis of the experience in academia of two female researchers show the invisibility of values and gender blindness in universities, as well as its long inherited history (Katila and Meriläinen, 2002, 187): “...We sought full membership in academia mostly by imitating and repeating practices that we believed would take us there. Often we failed, but did not understand why. As novices in the scientific community, it took us years to realise that the core values of scientific knowledge production – that is, the values of objectivity, separation and neutrality – are powerful myths which have for the most part been used to produce, control, and normalize reality rather than explain it... It took us even longer time to realise that the norms and values of scientific thought, as well as our everyday academic practices, are gendered and as such limit women’s opportunities for full membership in academic organisations.”

According to research results, there are multiple ways to develop gender equality and break through the glass ceiling in the future.

- Changes are needed in norms and practices in the system.
- Mentoring, training, networks, and an increase in the number of women in middle management have slowly had an impact on the share of women in top-level management.
- Diversity management slowly opens the way for equality between the sexes.
- In general, career opportunities for women also benefit from state-supported measures as well as measures put in place by employers to help reconcile work and family life.
- In universities, there should be a focus on the background history of equality issues.
- Evaluation by experts outside universities can provide new insights, *e.g.* “We need images of outsiders to construct the insider, the ‘self’” (Loomba, 1998, 104).

More open tenure policy criteria (Collins *et al.*, 1998, Hora, 2001), expert nominations which include women experts (Siskind and Kearns, 1997; Reskin, 1977), equality education, mentoring programmes and appreciation of diversity in organisations are factors that have an impact on equality among university staff. For instance, women-to-women mentoring programmes provide support through communication, comparison of experience, strengthening self-confidence and building networks. Academic careers, especially in fields where women are “loners”, can pull women out of these informal networks.

Gender equity plans

Equity plans that follow the numbers of female and male students, faculty and other staff, salary trends, etc., will certainly prevent some inequalities but do not explain the reasons for trends in the proportions of women and men. Follow-up investigations are also important. If the top management of a university lends its support to equity plans, this support has an impact on the overall credibility of the plans. The existence of equity plans also shows progress in good practices and the establishment of a critical reflection on gender, thereby diminishing gender blindness in academic organisations. However, equity plans are political instruments and cannot solve the actual day-to-day equality problems in universities. Changes are also needed in human involvement and attitudes.

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Chapter 10

INITIATIVES AND EXPERIENCES IN GENDER EQUALITY AT THE NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

Eivind Hiis Hauge

Former Rector, Norwegian University of Science and Technology

Background

This paper briefly summarizes efforts at The Norwegian University of Science and Technology (NTNU) to increase the number of women studying science and technology, and to encourage women graduates to go for a university career in those fields.

First, a few words about NTNU. We are located in Trondheim, a town of 150 000 inhabitants, 500 kilometres north of Oslo. The number of students is close to 20 000. Roughly half of them are in science and technology, but we also cover other fields: medicine, social sciences, humanities and fine arts. Cross-disciplinary activities are encouraged. As the completely dominating Norwegian university within technology (we educate about 85% of the national output of Masters in engineering fields), we have a special responsibility in that sector. That responsibility includes, of course, a focus on recruiting women into such fields, traditionally male-dominated.

NTNU is, unfortunately, not exceptional as far as the participation of women in S&T is concerned. Very roughly the situation is as follows:

- The percentage of female students at the Bachelor and Master level is too small, typically in the low twenties (varying considerably among the different programmes).
- The percentage of graduating Masters continuing towards a PhD is reasonable, roughly the same among males and females.
- The number of women in permanent academic positions is rising slowly; at present the level is about 20% for the university as a whole. The number is definitely less in S&T, and varies considerably over disciplines.
- The percentage of women drops as the level increases.

Altogether, this is an unacceptable situation. Nevertheless, even if change is slow, the movement is in the right direction. Over the last 10 to 15 years, considerable progress has, in fact, been made.

Our philosophy

Basic to our approach is a holistic view: We must consider *every* link in the chain, also including those links for which the university does not have the primary responsibility. This means that:

- Girls (and boys) must be encouraged to choose mathematics and science in junior high and high school. NTNU is in dialog with the Ministry of Education on the form and content of teaching of S&T on this level, and takes part in projects, nationally and locally, aimed at introducing inspiring new S&T content and didactics into the classroom.
- Young women must be encouraged to study S&T at the university level (more details on a concrete case below).
- Graduating Masters must be welcomed into PhD studies. The university must demonstrate to young women that, as an employer, NTNU not only respects the legal rights of women connected with pregnancy and childbirth. NTNU must be recognised as an encouraging and flexible employer, taking concrete steps to make the combination of PhD studies and the raising of small children a realistic option.
- Talented PhDs must be encouraged to choose an academic career, again taking the needs of young women specifically into account.
- Finally, female applicants must be welcomed to permanent academic positions, and they must be encouraged and supported in their career development.

The last three points apply to *all* fields, not only S&T.

The first point is of (inter)national concern: Too few youngsters, not only girls, but girls in particular, choose mathematics and science in school, and an S&T career afterwards. This trend is, with few exceptions, seen in “all” economically developed western societies, and is clearly rooted in deep sociological mechanisms. We should not delude ourselves into thinking that increasing the participation of women in S&T can be quickly secured by easy fixes.

How to recruit women to S&T studies

Unfortunately, I know of no magic wand. All I can do is report some positive and some negative experiences from NTNU.

In 1996, the relative number of female students starting their engineering studies in computer science (five years towards a Master’s degree) had dropped to 6%. This was considered unacceptable, especially in the field of ICT which, as we know, penetrates all walks of life. NTNU therefore asked for, and received from the Ministry, permission to introduce a quota specifically for female students. At most 15% of the places were reserved for this purpose, and the weakest (referring to points mostly based on grades from high school) girl allowed could not be more than 10% weaker than the weakest boy.

This measure provoked considerable discussion at the time. The principle arguments against were, firstly, that computer science by this mechanism would “steal” female students from other engineering programmes, with a net effect of zero, and, secondly, that female students of computer science would be branded as being inferior.

Initially, the measure proved a great success. The percentage of girls in computer science rose from 6% to above 30%, the number of female applicants rose in *all* engineering programmes (except one), and the computer science students were all good ones, quota or no quota. No negative branding was possible. These positive results were, in retrospect, probably strongly correlated to the fact that the NTNU initiative was hotly debated, locally and nationally, and the net effect of it all presumably was the general message that NTNU indeed *welcomes* women as students of S&T, and not only in computer science.

Since 1997 the percentage of female students in computer science has not evolved as we hoped. The first few years the tendency was positive, but when the “dot com bubble” burst, youngsters in general began looking elsewhere for a future career. In particular, the number of female applicants dropped dramatically, so that by 2004 the fraction was back to 10%.

The reasons for the overall decline are obvious, tied to basic market reasoning (possibly correct, but probably mistaken!) among high school graduates. But the reasons for the *relative* decline are less clear, and open to speculation. One reason could be that NTNU is no longer in the news as an institution that welcomes girls into computer science, although the positive mechanisms remain in place. It has also been suggested, rightly or wrongly, that girls are more risk-averse than boys, and that this is part of the explanation. We don’t really know. However, our commitment to encouraging girls into S&T, and into computer science in particular, remains as strong as ever.

Fortunately, we have registered one permanent success in this respect. Until ten years ago, only about half of the girls that were offered a place in one of the engineering programmes actually showed up. We then organised (first in computer science, later the scheme was extended to more engineering programmes) a “girls’ day” before the beginning of the semester for those female applicants that had been accepted. Their travel costs to Trondheim are covered, and during this day they are showed around campus, given relevant information of all sorts, and are exposed to female students enthusing about student life (on and off campus) in Trondheim. This worked. The no-show rate immediately dropped from around 50% to around 15%. And the success has turned out *not* to be a temporary one. This trick works, again and again.

How to recruit, encourage and keep women in academia?

NTNU is working on this, in the central administration, and locally, in faculties and institutes. We realise that the various mechanisms explored need patient follow-up, and they need a realistic budget. As an illustration, the central NTNU budget for 2005 in this sector reads (approximate amounts in euros):

• “Girls in technology” (recruiting efforts)	90 000
• Mentor programme for female PhD students	10 000
• Start packages for women in male-dominated fields	200 000
• Stipends to qualify for full professorships	90 000
• “Women-career-culture” (aimed at women in industry)	50 000
• Various	60 000

Which sums up to EUR 500 000 for 2005.

A few words about three of these programmes:

Mentor programme for female PhD students

The mentor programme couples female PhD students (if they are interested in participating in this programme) to a senior member, male or female, of the scientific staff for a period of one year. The programme invites *all* women working for a PhD, not only those in S&T. The capacity is 15-20 per year. The professional field of the mentor should *not* be that of the mentoree (or “adept”). On the contrary, our experience is that interaction between mentor and adept is more fruitful when they work within quite different disciplines. For example, a professor of engineering could be paired up with a PhD student in literature, or a sociology professor could interact with a PhD student in cybernetics.

There are several reasons for choosing such long professional spans, the most important being that the role of the mentor should not be confused with the role of the advisor. In addition, cross-disciplinary pairing is likely to make the interaction more interesting for the mentor. Mentors confronted with the attitudes and culture of quite a different scientific field typically consider this a broadening, educational experience.

But what do the mentor-adept pairs actually do? They typically meet on a monthly basis during the year that they are paired. The role of the mentor is basically to help the adept seeing her work in a wider perspective and, in particular, to help her plan realistically, not only the PhD work itself, including a thesis to be finished on time, but also the career after graduation. Part of this is helping her build networks. Also, in her work for a PhD, the adept could have problems, large or small, in her relation to the advisor. Confronting such problems directly can be difficult, and here the mentor can be a seasoned sparring partner in the search for constructive actions.

The meetings of the mentor-adept pairs constitute the heart of the mentor programme at NTNU. But this core activity is framed by a systematic set of seminars to help mentors and adepts make the most of the interaction. The programme each year starts with a seminar that sets the stage, and where all adepts and mentors participate. In addition, there are three specialised seminars through the year for the adepts alone. And, finally, the programme closes with an evaluation meeting at the end of the year.

The success of this programme as seen from individual adepts varies. As one would expect, much depends on the personal chemistry between mentor and adept. (If that chemistry is quickly seen as deficient, the adept can ask for a change of mentor.) But on the whole, the mentor programme, which has now been running for about five years, has proven an undisputable success. NTNU intends to further develop and strengthen this programme.

Start packages for women

The need for targeted resources to newly appointed faculty members is quite a general one, but the size and shape of such problems vary considerably over disciplines. NTNU has yet to formulate a general policy in this respect, but at least there is now a central pot dedicated to newly appointed *female* members of the scientific staff. The content and size of these start packages depends on the local circumstances. Typically, the package could include technical assistance, equipment, and travel money, or money to help finance a PhD student. The faculties and institutes are, of course, free to add to the resources made available by the central administration of the university. Clearly, a total yearly budget of

EUR 200 000 for the whole university does not meet all reasonable demands. But targeting this for newly hired women faculty sends a strong signal, especially to potential female applicants.

Stipends for career development

In the Norwegian university system there is a mechanism for promotion to full professor which allows the individual associate professor to have her scientific level evaluated by an independent, national committee. If considered qualified, she (or he) will be promoted.

In order to encourage women to use this mechanism, stipends are offered to those who consider themselves (and are considered by their institute) sufficiently close to the promotion level that six months sabbatical (internal or external) should be enough to finish projects, tie things up, and write the papers necessary to document recent work and pass the magic line. The pot to finance these stipends (EUR 90 000 in 2005) is administered by NTNU centrally. The success rate of those women who received this stipend has been high. The mechanism, therefore, is seen as an effective one.

Conclusions

Traditionally, S&T disciplines have been male-dominated. Fortunately, the attitudes and the numbers within the professions have been slowly changing during the last 30 years or so, with the rate of change increasing somewhat the last 15 years. The university as an institution can certainly help in this respect, by actively inspiring girls to enter these fields, by encouraging women to pursue a career in science, and by introducing concrete mechanisms to help facilitate women's career in academia. I have briefly described some of our efforts in these directions at NTNU.

But the efforts of universities alone are certainly not sufficient to encourage young people, and especially girls, to choose careers in S&T. In a society increasingly dependent on technology, high-quality recruitment into S&T fields is of vital importance. There are signs that this is now becoming widely recognised as a basic premise for further progress.

Our experiences at NTNU can be summed up very simply. Promoting women in S&T takes focus, patience, and realistic budgets associated with the various mechanisms introduced. One should not expect fast results, and should be prepared for temporary setbacks. Our efforts must be judged relative to a slowly changing sociological background, and on this slower scale, there is every reason to be optimistic. The change over the last 30 years has been dramatic, and my perception is that the rate of change is increasing. As the Norwegian University of Science and Technology, NTNU is certainly committed to a strategy for change.

Chapter 11

DOES GENDER MATTER IN SCIENTIFIC LEADERSHIP?

Rossella Palomba

Research Director, CNR-IRPPS, Italy

Women in science: a flawed career

For years, excellence in science has been considered neutral from a gender standpoint. Gender differences and gaps in scientific careers, research outputs, earnings and funding have been overlooked and equal opportunities between men and women in scientific and academic careers were not considered a priority in setting up scientific policies. The situation is now changing due to the availability of better gender-sensitive data at European level, which allow for improving the understanding of the mechanisms underlying women's under-representation in the higher echelons of science.

We should consider that percentage figures of women and men in science are necessary but not sufficient to explain why women are so few in the top grades. From this point of view, it is very important to introduce indicators measuring segregation¹ in the scientific occupations, and in particular vertical segregation. The measurement of vertical segregation reflects a country's ability to optimise female human resources. It also investigates women's share of top positions in scientific careers, which indicates the level of female participation at the highest decision-making levels. The recent European Commission *ETAN* report (2000) on women in the sciences and the *She Figures* report (2003) have shown that in all European countries there are few women in top university and research positions. This under-representation of women compromises the attainment of excellence in scientific work. Furthermore it represents a waste of talent because men and women are evaluated and considered on the basis of their sex and not of their work.

Indicators on vertical segregation by gender require data on the number of men and women occupying leading positions in the scientific "hierarchy". Existing inter-country differences in the career pathways both in academia and in scientific governmental bodies as well as in the educational systems make comparisons difficult. Most countries have higher education surveys with similar questions, but up to now a common methodology for harmonising data about positions in scientific careers could not be found. Data concerning grade A (the top grade) allow for better comparability than for the lowest grades (C or D depending on the national career ladders), which are more affected by the lack of harmonisation in data collection.

In all European countries, the percentage of women grade A (apical position) out of the total staff grade A never exceeds 25%. In all countries the percentage of women (all grades) out of the total staff doubles the percentage referred to grade A. If vertical segregation were not present, the value of the two indicators should be the same.

1. The term segregation is used here instead of concentration, though only part(s) of the system are considered.

Most of the measurements concerning the scarcity of women at the top of the academic and scientific hierarchy, as for example percentage of women or feminisation ratios, are cross-sectional period indicators. Because of the observed increase in the access to science of younger cohorts of women, it could be argued that it is simply a matter of time before gender equity is achieved. But waiting for equality may require a long waiting time. For example, if women's shares in the different grades continue to increase at the current annual growth rate, in Belgium it will take 40 years to reach equality in the C grade, 140 years in the B grade and 211 years in the A grade. In Italy, equality between the sexes in the A grade could be reached in 179 years (Palomba, 2003). Therefore, the point under discussion is the following: is really vertical gender segregation in scientific and academic careers transient? One way of answering this question is to undertake longitudinal studies on the careers of men and women who have all entered academies and/or research organisations during a given year. If gender inequalities persist, when seniority and other related factors are held constant, then this explanation can no longer be regarded as valid.

Survival analysis: the Italian case²

The hypothesis of a “natural” recovery in vertical gender segregation can be confirmed by comparing longevity in grades of the career ladder. We can, in fact, hypothesise that there is a relationship between promotion and longevity in that women and men with the same length of service in a certain career grade and the same capacities and merit have the same probability of being promoted to the upper level. In the absence of gender discrimination in career trajectories and assuming that the quality of the scientific work done by women is comparable to that of men, the increase in the female presence at the entry level should result in an increasing female share in the top scientific grades. In this study, a cohort of 1 022 scientists – 224 women and 798 men – who entered the B grade at the CNR-National Research Council in the same year was studied, in order to measure the existence of vertical gender segregation³. CNR is the largest Italian public research body with over 6 000 scientific personnel.

Survival analysis techniques were used and, in particular, the proportional hazard method or Cox Model⁴. The analysis had two stages. Firstly, a univariate analysis of the longevity in the grade was carried out, and the survival function was estimated using the Kaplan-Meier method. The survival function measures an individual's probability of surviving until a given event within a certain time interval. In our case, the “event” is the promotion to A grade. The results are shown in Figure 11.1.

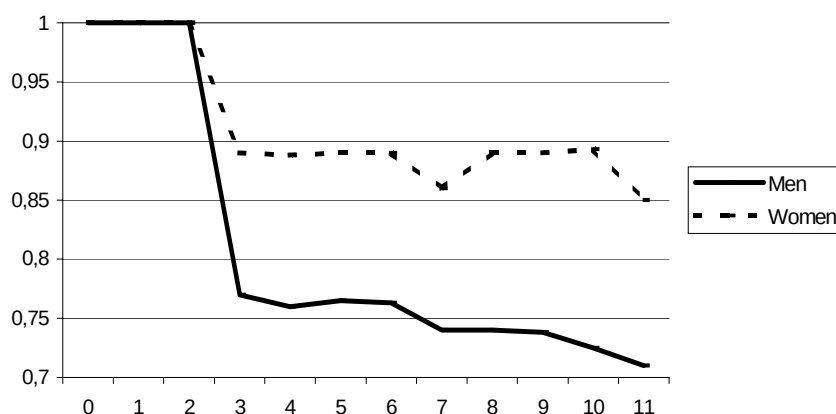
2 This paragraph is based on R. Palomba (ed.) (2000), *Figlie di Minerva*, Franco Angeli, Milano.

3 The grades used here are referred to the Italian career path that is in three grades: C, B, and A, where C is entrance level and A is the top level.

4 In order to apply the Cox Model, all the conditions of proportionality of the hazard functions have been checked. Among all the candidate co-variables, proposed in the definition of the model, a selection was made on the basis of statistical criteria, using the so-called “forward” selection method of co-variables, based on the partial likelihood ratio test. In this method, the partial likelihood, under the alternative hypothesis, is updated stepwise, using at every step the co-variate which maximises the value until a chosen threshold is reached.

Figure 11.1. Survival curves of women and men in B grades by seniority at CNR, Italy, 2000

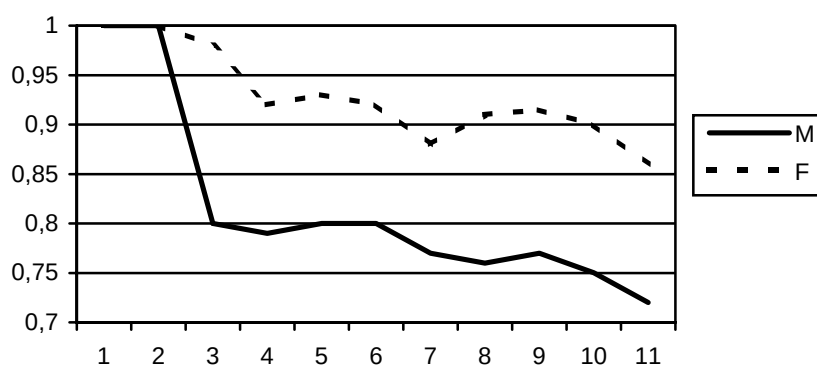
Probability of being promoted



Source: Palomba, 2000.

It emerges that there exists a positive relationship between the length of stay in the B grade and the probability of being promoted to the A grade: the longer the duration of the stay, the higher the probability of being promoted. We also note that the female curve is always overtaking that of men, demonstrating a systematic longer time in the B grade for women than for men. For example, after 11 years in the B grade, women have a 16% probability of being promoted, but their male colleagues have a 39% probability.

But seniority is not the only factor affecting the possibility of being promoted. For this reason a multivariate analysis was carried out, using the proportional hazard method or Cox Regression Model. Therefore the probability of being promoted, other factors being held constant,⁵ was estimated thus:

Figure 11.2. Survival curves of women and men in B grades by seniority other factors being held constant, CNR, Italy, 2000

Source: Palomba, 2000.

5. The factors considered were: age at entrance into B grade, age at recruitment, number of publications, disciplinary field, geographic area.

Still, differences emerged between the sexes. For example, after seven years on the B grade men have a 23% probability of being promoted to A grade, while women only have a probability of 11.9%. After 11 years of permanence in the B grade, men have a 28% probability of being promoted, women less than half the chance with just 13.5%. The same analysis carried out for university professors showed that again men are twice as likely as women to become an associate professor and have a 30% better chance of becoming a full professor (Micali, 2001).

To conclude, results demonstrated that factors such as age at promotion, disciplinary fields, number of publications are only a partial explanation of the gender differences in the career pathways in science. The main explanatory factor is and remains gender. Therefore, it would be absurd to accept that waiting for equality is sufficient when the evidence suggests that the wait would be a waste of time. Even to condone a short wait would be symptomatic of the patronising attitude towards the question of women's participation in science.

Conclusion

Achievement of gender equality in scientific excellence is a long-term process in which existing social and political norms and rules must undergo profound changes. It also implies a new way of thinking in which the stereotyping of women and men no longer limits their opportunities or continues to reward just one of the two sexes. We have demonstrated the pointlessness and wastefulness of “waiting for equality” and the impossibility of a “natural” recovery.

We are still fighting to demonstrate that the low female presence at the highest levels of the scientific hierarchy is an indicator of the incapacity of research institutions to follow changes in society (such as women's increase in higher education) which in turn highlights the dysfunction of a system for the evaluation of scientific excellence that did not abolish or weaken the “old boys network system” of co-optation, a system well-known by those who participated in whatever procedure for evaluation or selection where the antinomy between the criteria of “being part of” (a discipline, a “school”, an academic circle, etc.) and those of merit enter inexorably into conflict, to the full advantage of the former.

The final effect is that of discouragement, self-exclusion, mortification of the weakest subjects of the system, women. The increase in female personnel recruitment in scientific institutions and universities during the 1970s and the 1980s, which reflected the high educational “boom” for women, was not followed by an adequate leap forward in female career pathways, so that recent generations of graduated women – who often, as statistics show, pass through the training period with higher speed and better performances than men – are discouraged by the limited destiny and the flawed careers of the older generations of female researchers, and tend to avoid scientific careers. This is a vicious circle which responds in a very negative way to the heavy cultural resistances, still working in the scientific environment and reinforces the selection of those individuals who accepted and internalised the behavioural models of the old boys group -- and therefore are able to reproduce them.

Rethinking the rules of scientific engagement from the point of view of equal opportunities will hopefully result in the creation of conditions for an increase in the number of women scientists in positions of excellence and leadership. On the one hand, as their numbers grow, they will serve as positive role models for the next generations of women. On the other hand, we have to expect strong opposition on the part of men who are used to being the dominant sex in scientific environments.

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Chapter 12

GENDER AND THE CAREERS OF FRENCH UNIVERSITY INSTRUCTORS AND RESEARCHERS¹

Frédérique Pigeyre

IRG – ESA, Université de Paris 12 Val de Marne

Introduction: Issues and research methodology

A vast body of international research has highlighted the diversity of career profiles of women in higher education and research. France is no exception: a recent report drew attention to the fact that women were under-represented on university faculties (Boukhobza *et al.*, 2000). Whereas women accounted for 36% of senior lecturers (*maîtres de conférences*)², only 15% of professors (all disciplines combined) were female. Similarly, at the French National Centre for Scientific Research (CNRS), women made up 37% of research fellows (*chargés de recherche*), but there were only 21 female research directors (4%).

The research we began in 2002, and which is not yet fully complete³, endeavours to understand the mechanisms that can explain such a situation. The facts may startle: how can it be that so-called “professional” organisations generate such eviction effects against women, despite having mechanisms that purportedly ensure gender equality (recruitment via gender-blind competitions, seniority-based salary scales, and so forth)?

Roughly speaking, there are two hypotheses: first, that women are victims of discrimination, the mechanisms of which need to be dismantled; or second, that women themselves refrain from applying for the most senior jobs, for a variety of reasons which remain to be explored.

To try to ascertain the respective impacts of these two explanations, we constructed a research methodology involving three complementary phases.

The first was to perform statistical and econometric analysis, using inputs from the official database provided by the Ministry of Education – the employer of teacher researchers – to determine precisely which variables are relevant in shaping their career paths.

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1. Research contract of the French Ministry of Education on the careers of women in higher education and research. Multidisciplinary team co-ordinated by V. Mangematin and C. Musselin (with M. Carrère, S. Louvel, C. Marry, F. Pigeyre and A. Valette).
 2. The level at which universities recruit and integrate faculty members.
 3. The findings we present here are therefore only partial.

The second, which is now complete, was to conduct semi-directive interviews with members of specialised recruiting panels that had hired senior lecturers in their respective disciplines. The purpose of this was to gain a clearer understanding of how these panels worked, so as to identify any practices that might tend to discriminate against women.

Lastly, the third phase involves compiling what teacher researchers have to say about careers in general and their own career paths in particular. Extensive interviews are under way with teacher researchers representative of the standard profiles identified via statistical analyses.

This methodology was employed to study three specific disciplines from a gender and/or recruitment/selection standpoint. History was chosen as a literary discipline in which the proportion of women is substantial. In addition, initial training and success in the *agrégation* competition for the recruitment of top secondary school teachers play a paramount role in history instructors' careers. Biology is a discipline in which the proportion of women, substantial at the beginning-of-dissertation phase (50%), subsequently declines over the course of a career to the point where the proportion of female professors is one of the lowest in the hard sciences (less than 10%). Lastly, business administration is a relatively recent discipline, and one with a fairly high percentage of women. It features a system of promotion handed down from the field of law, with the bulk of promotions involving success at the *agrégation* competition for higher-education instructors (two competitions being held alternately every other year).

Quantitative data

The Ministry database showed 6 619 individuals working in one of the three chosen disciplines as either senior lecturers or professors. The population studied comprised 40.5% women and 59.5% men. Biologists accounted for 51% of the individuals, historians 28.7% and business administration instructors 20.3%. Persons hired by a university directly with professorial rank were deleted from the base because our focus was on people who rose to that position. In all, then, the available data covered 5 920 individuals.

Statistics from the first phase of the research show that women account for 38.6% of the sample population. It is in biology that women are most numerous. In history, teacher researchers are older, and women have a greater tendency to be professors than they do in other fields of study. Overall, women account for 25.7% of the professors; the proportions by discipline are: 17.7% in business administration; 27.1% in biology; and 29.2% in history.

Econometric analysis can estimate the time it takes for teacher researchers to rise to the rank of professor, bearing in mind that some of the people who will ultimately achieve this have not yet done so. It can detect effects *all else being equal* – i.e. it can assess the length of time needed for individuals sharing similar characteristics except for the one we wish to study, which in this case is gender.

Thus econometric analysis can quantify the time needed to rise to professorial rank by discipline, depending on gender. It factors in individual data: gender, family status, possession of accreditation to supervise research (HDR) and graduation from a specialised higher education institution (*grande école*). It also incorporates data relating to career progression: promotion to professorial rank, time taken to do so, HDR degree, post-doctoral studies, international mobility, and leaves of absence.

Analysis of instantaneous rates of promotion to professorial rank in the three disciplines shows that:

- Hazard rates (the chances of becoming a professor) are non-monotonous, and that they increase until roughly 350 months (30 years) into a career; and then they decrease after 30 years. In other words, until 30 years' service, the chances of becoming a professor increase regularly, and thereafter they decline.
- The promotion rate of women is less than that of men (roughly half as great), the differential widening with length of career. The longer she works, the more unequal a woman's chance of becoming a professor is, relative to a man with equal seniority.
- Depending on status⁴, senior lecturers are more likely than others to become professors, and they do so earlier in their careers.

Promotion rates by discipline are fairly similar in terms of overall patterns: rates are non-monotonous, and they peak at career's end. Biologists have the lowest promotion rates, except at the end of their careers, when the rate exceeds that of historians. Business administration teachers have the highest hazard rates (*i.e.* they have a greater chance of becoming professors than their counterparts in the other disciplines).

Specialist panels and recruitment of senior lecturers

Interviews about the workings of specialist panels that recruit teacher researchers were conducted in six establishments in Paris and elsewhere in France, both small and large (two per discipline). Each panel comprised senior lecturers and a professor. We questioned them about procedures for recruiting teacher researchers with the objective of identifying the key moments of existing procedures and the potential risks of gender discrimination.

Common recruiting rules

To become senior lecturers, applicants must have a doctorate (or a degree recognised as equivalent). They must also have their qualifications certified by the relevant section of the National Council of Universities (CNU), which authorises them to apply. The list of posts open to competitive recruitment in each establishment is published yearly in the *Bulletin Officiel de l'Éducation Nationale*. Promotion to professorial rank requires accreditation to supervise research. In all disciplines except those for which an *agrégation* competition for university-level teaching is held⁵, prospective lecturers can submit their applications after being certified by the CNU.

These panels all operate in accordance with official procedures which are identical for all universities. Two types of recruitment are possible: direct recruitment and transfers. In the latter case, the recruitment is considered internal insofar as persons already occupying a post in one establishment would like to be transferred to another. Transfer requests are examined by the panels before external applications, selections being made on the basis of the applications alone.

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4. There are other ranks of teachers in French universities, such as associate professors (*professeurs agrégés du second degré*). Others, which are remnants of former categories that have been transformed, are being phased out, but there are still teaching assistants (*assistants*) and assistant teachers (*maîtres-assistants*).
 5. There are four such disciplines: law, political science, business administration, and medicine.

In external recruiting, the first step is to assign each applicant two rapporteurs who prepare a report which can be forwarded to the applicants upon request. Reports are then examined by the panel, which decides whether or not to interview each applicant. The number of applicants interviewed varies widely, depending on the circumstances: from two or three applicants if the post profile is highly specialised, to more than ten in some cases. The panel then ranks the applicants it has interviewed. The procedure entails a vote. Successful candidates, who in many cases have applied for more than one post, then consent to work at the institution of their choice. The ranking procedure emerges as especially tricky, insofar as it entails trying to assess the likelihood that an applicant will actually come to work for a given institution if selected.

A system deemed to work properly

A feeling emerged from the general consensus of the persons interviewed that the panels work properly. There would seem to be a form of self-regulation so that things “go smoothly”.

Nevertheless, these common regulations are interpreted differently from case to case, depending on three types of criteria:

- Teaching requirements: Senior lecturers, if they are teacher researchers, must above all teach courses that in many cases have already been prepared. As a result, the nature of these courses is often a major selection criterion between applicants whose scientific worth has been demonstrated.
- Attractiveness of the establishment: Not all establishments are equally attractive for prospective applicants. Apart from the reputation enjoyed by some schools, often for scientific reasons, other factors influence prospective candidates’ decisions whether or not to apply: proximity to Paris, facility of access and the availability of nearby housing.
- The special features of each discipline and the discipline’s relative standing at the university in question: A history or biology department can vary greatly in size from one school to another, and some institutions consider a given discipline more “strategic” than others. For example, business administration may be considered advantageous for its capacity to draw students. For this reason, a given department may be allocated more resources than other disciplines when choices have to be made between them.

With regard to the recruitment process within the panels, it emerges that the selection criteria used are relatively uniform. Nevertheless, the profile of the “right candidate” may vary from one school to another and from one recruiting session to another. It all depends on the exact requirements in terms of teaching and/or research. It also depends on the number of applicants. This may prompt a panel to downplay the importance of scientific criteria alone (scientific quality and productivity) in favour of teaching ability primarily.

The interview remains a crucial step. This is when panel members forge a precise opinion of the candidates and also try to ascertain with whom they would like to work. Because of the specific dynamic inherent in each recruiting drive, it might be considered that the panels constitute a place where there could easily be some form of discrimination against women. And yet, that is not the case at all: because women are present on the panels, and because there is a virtually balanced number of female and male candidates in most situations, it proves virtually impossible to encounter behaviour overtly hostile

towards women. Moreover, the virtual parity between men and women amongst senior lecturers is proof of this.

All things considered, analysis of the workings of the specialist recruiting panels for senior lecturers would tend to suggest that the proportions of women diminish later on in the career, in particular at the stage of promotion to professor.

Recruitment of professors

Recruiting features a widespread shortage of candidates

As with the recruitment of senior lecturers, the procedures for recruiting professors are codified precisely and are valid across the board. Institutions may also choose between external recruitment and transfers. Panels rarely opt for a transfer because of the risk entailed. The transfer option means not reviewing applications from potential recruits. If a prospective transferee ends up not accepting the post – having been selected by another institution which (s)he deems preferable, for example – the institution in question will not be able to fill its vacancy.

The profiling of professorial posts in the institutions questioned would appear relatively narrow, shaped by a number of non-mutually exclusive objectives. In some cases, it is the institution's research policy that takes precedence, and the department in question will stipulate a profile that strengthens the specialities that the school deems strategically important. In other cases, teaching needs are paramount, as when an institution endeavours to respond to growing demands on the part of students. Profiling can also be used to recruit a candidate selected in advance, either because (s)he is already working in the department or because (s)he corresponds exactly to what the department is looking for and they want to discourage any other applicants.

The recruitment of professors is characterised by a widespread shortage of candidates, with the average number of applicants ranging from 0 to 4, depending on the panel surveyed. This scarcity can be analysed from the standpoint of either supply (with a reduction in the pool of potential applicants) or demand (construction of scarcity and ways of alleviating it).

From a supply standpoint, the size of the applicant pool is directly dependent on the requirements for certification by the CNU, *i.e.* for accreditation to supervise research. In the field of history, for example, accreditation requires extensive work which discourages many a potential applicant. Since some institutions give experienced senior lecturers more autonomy and greater administrative and/or scientific responsibilities, the people in question are less inclined to apply for promotion as professors. In addition, such a promotion in most cases entails a geographic mobility constraint which is another impediment to candidacies.

Lastly, professorial status does not always strike potential applicants as a sufficient material and symbolic improvement. In other words, while being a professor may seem prestigious, it also entails especially burdensome scientific, pedagogical and administrative responsibilities for which the financial rewards may be perceived as insufficient.

From a demand standpoint, one must look at how the scarcity is used, and at its potential benefit(s). Indeed, the scarcity of candidates is not always perceived to be a problem. In some cases, it allows the panel to recruit exactly whom they want, who in many cases is the in-house candidate. In other situations, the scarcity of candidates

reflects the scarcity of recruiting: when no new posts are created, recruiting takes place only to replace professors who retire.

The scarcity of applicants may also be perceived as a problem. It often stems from the fact that departments do not wish to recruit in-house. Available posts may also constitute an instrument of an offensive research policy or enable an institution to develop new specialised fields of instruction.

This situation has prompted schools to change the way they search for potential applicants. Such persons may be identified in other universities or in research centres. Here, mutual acquaintances and networking play a vital role, and the role of specialised panels is in fact relatively limited.

The scarcity of women at this level is thus still quite a relevant issue, although – as with most research into gender-related topics – it is very difficult to identify any one factor that on its own (or almost) would explain why women are scarce at this level. Regarding the six institutions studied, it must be noted that the existence of some women professors, albeit in an extremely small minority, tends to mask the extent of the problem: since some women are professors, what is the problem? The initial difficulty is to create an awareness – primarily among men, but among certain women as well – of the scarcity of women professors. Then, the reasons cited to shed light on the phenomenon vary but are well-known: in no particular order, these include the family responsibilities assumed by women, their lesser ambition and the fact that they devote more effort to administrative tasks and less to research.

The last matter to explore is the reasons why there are fewer women in the networks that could enable them to fill vacant posts, or, if this is not the case, why those women are less sought after.

For business administration, things are different insofar as promotion entails passing the specific *agrégation* competition, which we shall study below.

Agrégation judges in business administration

There are two distinct competitions, depending on the candidates' profiles. The first one, known officially as the *agrégation externe*, is for applicants at the beginning of their careers. The second – the *agrégation interne* – is for applicants aged 40 and over with at least ten years' experience in higher education. The external competition is held regularly, every other year. The internal one, which was held for the first time in 1999 and is still hotly contested by certain people who have passed the external competition, had been held only three times at the time of the survey.

Both competitions start out identically: candidates write a paper summarising their careers and their scientific work. They supply examples of their publications. These papers are then studied by two designated rapporteurs on the panel of judges. The external competition then involves three tests: in the first one, candidates trace the history of and elaborate on all the research they have done; in the second, they give a “general lesson” on a fairly broad topic encompassing all areas of business administration; and the third test involves a “speciality lesson” corresponding to their own chosen field. At each stage in the process, some candidates are dismissed. The judges rank the candidates still in the running after the final test. The internal competition involves two tests – the first on their work, the second on “texts”. All candidates take both tests, with the final ranking being decided after the second one. As a rule, the judges certify no more candidates as qualified than there are vacant posts.

Each panel of judges is unique and totally autonomous, having been constituted on an ad hoc basis: most of the judges serving on a panel have never before done so and do not know each other. Thus each panel develops each own dynamics, which can be extremely different from one session to another and produce divergent decisions.

For the Chair, the first difficulty is to arrange for a balanced panel. The Chair is appointed by the Ministry, essentially on the basis of seniority, alternating between a Chair in Paris and a Chair elsewhere in France. The judges must comprise representatives of the main fields of business administration, with professors from both Paris and the provinces, and at least one woman.

Panels then formulate and discuss their own selection criteria, establishing the relative weighting of each test. It would seem that external competition judges pay more attention to research profiles, while internal competition judges attach equal importance to teaching capacities.

No particular bias was detected in the competition procedure, apart from the high importance attached to scientific activities. A number of mechanisms ensure a certain impartiality: the fact that panel members do not know each other very well, the fact that common criteria are set, the system of two rapporteurs, and the fact that the subjects for each candidate's tests are chosen at random. Nevertheless, it emerged from our discussions that the persons interviewed considered the external *agrégation* difficult to reconcile with family choices – and thus not very favourable to women. In contrast, the internal *agrégation* competition is perceived as giving a chance to people whose career paths have been altered, for family-related reasons in particular, and thus as favourable to women.

Conclusion

The findings are still provisional and incomplete. They provide the outline for an analysis of the place of women in universities that highlights the difficulties of promotion to professorial rank. It would appear that parity has now been achieved in the recruiting of senior lecturers. Ongoing extensive biographical interviews with teacher researchers having a variety of different profiles should enable us to identify other, probably subtler, factors for the scarcity of women professors.

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Part 4

**INSTRUMENTS FOR CHANGE:
EXISTING POLICY MEASURES AND PROGRAMMES**

Chapter 13

THE SUCCESS OF FEMALE SCIENTISTS IN THE 21ST CENTURY: AN AMERICAN PERSPECTIVE¹

Wanda E. Ward

*Deputy Assistant Director, Directorate for Social, Behavioral and Economic
Sciences, United States National Science Foundation*

The focus of women in science constitutes an important component of the US National Science Foundation's (NSF) strategic investment portfolio. The mission of the NSF is to promote progress across all fields of basic science and engineering through its investment portfolio in research and education. A high priority within that portfolio is broadening participation in science, technology, engineering and mathematics (hereafter, S&E). Some of the many NSF programs supported to broaden participation in S&E focus on women. The reasons for such investments include the benefits derived from the intellectual diversity in perspective brought to bear on the scientific enterprise and the progressive decline in women's participation at advanced levels of S&E, especially relative to their representation in the general US population as well as their greater representation at earlier levels of the educational and career pathway. A few data reveal this latter point.

Relevant data

Women represented 50.6% of S&E bachelor degrees awarded in 2001, 47.2% of S&E master's degrees, 42.3% of doctoral degrees, and 26.3% of S&E doctoral faculty². Looking within academe, data on women as a percent of full-time S&E faculty by rank (*i.e.* instructors, assistant/associate/full professors) across a number of fields reveal a steady erosion of participation at higher levels. For example, instructors comprised 42% of S&E faculty overall in the United States in 2001, while assistant, associate, and full professors comprised 38%, 29% and 16%, respectively. Similar patterns emerge in engineering (9% overall, 20% – instructor, 15% – assistant professor, 9% – associate professor, 3% – full professor), computer and mathematical sciences (15% overall, 39%, 25%, 16%, 10%, respectively), life sciences (33% overall, 52%, 40%, 34%, 19%), and the social and behavioral sciences (32% overall, 50%, 45%, 39%, 23%), with a slightly different pattern in the physical sciences (14% overall, 15%, 25%, 16%, and 6%, respectively). These data also show, of course, the variation in representation across the

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1. Full presentation, including graphs with additional data on women scientists and engineers by sector of employment as well as women *doctoral* scientists and engineers by sector of employment, available at www.oecd.org/sti/stpolicy.
 2. NSF/Science Resource Statistics (SRS), Science and Engineering Degrees, by Race/Ethnicity of Recipients: 1992-2001; Science and Engineering Doctorate Awards: 2003; Survey of Doctorate Recipients, 2001.

fields, for example, noticeably greater in the life and social/behavioral sciences at the associate and full professor levels than in engineering and the physical sciences³.

Key NSF policies, practices, and programs

A number of key policies and practices have also guided NSF in its efforts on this front. Importantly, NSF is the only US federal agency with congressional authorization to promote diversity in S&E. The Science and Technology Equal Opportunities Act of 1980 authorizes the NSF to make awards to encourage the education, employment, and training of women in science and technology. Within the Foundation, a number of its disciplinary organizations, *i.e.* directorates, have instituted practices to promote women's participation. For example, the Assistant Directors in the Directorate for Biological Sciences and the Directorate for Social, Behavioral and Economic Sciences implemented practices in the early 1990s to ensure women's participation in all conferences, meetings, workshops and international congresses for which those directorates provided funds.

The Science and Technology Equal Opportunities Act of 1980 empowered NSF to implement its earliest programs to promote the participation of women, namely, the Visiting Professorships for Women in Science and Engineering Program (VPW), established in 1982. Our programs have evolved considerably over the past two decades and included Research Opportunities for Women Program (ROW), established in 1985. In 1989, the then NSF Director established the Task Force on Programs for Women, that recommended the establishment of a new program designed to recognize and advance outstanding women faculty to the senior ranks. That recommendation led to the establishment of Research Planning Grants and Career Advancement Awards for Women Scientists and Engineers program (RPG & CAA) in 1990, followed by Faculty Awards for Women Scientists and Engineers program (FAW) in 1991. In 1997 programs for women were integrated and incorporated into the POWRE (Professional Opportunities for Women in Research and Education) Program.

The ADVANCE Program

A major evolution in our thinking about programs to promote women in S&E occurred at the Foundation between 1998 and 2000. We engaged in extensive discussion about how best to address gender underrepresentation in these fields. That process resulted in the design of a new multi-component program, *ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Careers*. Formally implemented in 2001, the goal of ADVANCE is to increase the representation and advancement of women in academic science and engineering careers, thereby contributing to the development of a more diverse science and engineering workforce. Importantly, the development of this program took into account numerous factors that have created formidable barriers that, cumulatively, have adversely impacted women's advancement into the higher ranks of academe. These factors include, among others, competing conflicts between work and family demands, unequal access to scientific resources such as space and supporting facilities, and differentials in salary and scientific awards.

3 . NSF/SRS, Survey of Doctorate Recipients.

This multi-component program consists of three types of awards: 1) institutional transformation (IT) awards, designed to catalyze change that will transform academic environments in ways that enhance the participation and advancement of women in senior and leadership ranks of S&E, are funded at up to USD 750 000 per year for up to five years; 2) leadership awards recognize the contributions of individuals, small groups, and organizations that have widespread and systemic impact on diversifying academic leadership largely through faculty and leadership development activities; these are funded at up to USD 300 000 total over three years; and 3) fellows awards, which enable promising individuals to establish or re-establish full-time independent academic careers, are funded at up to USD 60 000 per year for up to three years, plus USD 25 000 per year for career development.

The Institutional Transformation Award constitutes a significant expansion in the scale of programmatic effort and increase in the level of support provided for women's programs at NSF. The emphasis in these awards is on organizational behavior and change and derives from the recognition that the lack of full participation at the senior ranks of academe often stems from systemic challenges within the academic culture. Issues addressed through these awards include leadership involvement and attention to factors critical to success, recognition that "one size does not fit all" in approach to transformation, and the diversity among women. IT projects are informed by research from a variety of fields, including sociology, psychology, organizational behavior, and management and business. Examples of the types of activities supported include: guidelines for searches (*e.g.* recruitment tool kits), tenure and promotion decisions; release time for work on gender-related issues or the collection and analysis of institutional data; the planning and initiation of programs; examination and revision of institutional policies; and training for department chairs.

NSF currently supports two cohorts of IT awards, having made nine institutional awards in 2001 and 10 in 2003, for a total of 19 such awards to date. A third class of awards will be made this fiscal year (FY 2006). The nine institutions who received merit-reviewed awards in 2001 were: the University of Colorado at Boulder; the University of California, Irvine; Hunter College, City University of New York; New Mexico State University; University of Washington; University of Wisconsin, Madison; Georgia Institute of Technology; University of Puerto Rico, Humacao; and the University of Michigan. The 2003 awardee institutions were: Kansas State University; Utah State University; Case Western University; University of Alabama, Birmingham; University of Texas, El Paso; University of Rhode Island; University of Montana; Virginia Institute of Technology; University of Maryland Baltimore County; and Columbia University, Earth Institute. In addition, NSF has supported approximately 25 leadership awards and approximately 60 fellows. See www.nsf.gov/advance for a wealth of information from various award sites, including posted climate surveys, recruitment and retention toolkits, etc.

Learning from experience

Much has been learned about the ADVANCE program over the past five or more years. A recurring theme that we hear from the community is how significant the NSF role has been in enabling institutional transformation. Beyond the funding level alone, awardees articulate how much prestige an NSF award provides them, thereby, further legitimizing and bringing credibility to their efforts to advance the status of women in S&E. In addition, NSF and awardees have learned the criticality of requiring the integration of scholarship on gender into fabric of institutional transformation to help

inform effective intervention and to avoid re-inventing the wheel; the importance of mid-course refinement/correction; the benefit of administrator professional development, especially at the level of department chair; the need for strong institutional cooperation; and the ongoing need for quality data collection and access as well as evaluation and assessment.

ADVANCE Program Assessment

Evaluation and assessment are important at both the project and program level. Considerable time and effort have been expended by ADVANCE awardees to assess their respective projects and some have developed “toolkits” in order to share and disseminate those efforts more broadly. At the program level, NSF also had an Interim Assessment of the ADVANCE Fellows Program conducted in March 2004. This was an initial step taken to assess the smaller scale component of ADVANCE.

That interim assessment of 36 awardees (the total number of the first cohort of awards) revealed a number of findings. They included the following: 34% awardees vs. 24% declinees had acquired a tenure-track position since the time of application; 2/3 of the non-tenure-track awardees indicated that ADVANCE research support had facilitated their research productivity and better positioned them to secure a tenure-track position; 57% declinees reported essentially no change in professional circumstances; and 20% of those declinees said that their circumstances had worsened. One of most important benefits reported was to prevent women from leaving academe. Other benefits included: time and resources to conduct research, buy-out of teaching loads, the ability to build independent research programs; better positioning to look for permanent jobs; use of the award as a negotiating chip in interviews; opportunity to retool, build new skills and become more marketable; recognition, especially from external sources; leverage for bringing in additional funding; serving as a solution to balancing dual academic careers; and academic re-entry, retention, career development. Finally, one awardee articulated the value of her award in the following way:

“My NSF ADVANCE Affiliated Fellows award immediately improved my life, both professionally and personally...I had long suspected that the lack of respect from those around me was due to lack of funding; personally, I was saddened to confirm to myself that the “success = money equation” affected many of those around me...My ADVANCE Fellow status, with full financial trimmings, immediately gave me credibility among different divisions within...my host institution.” – Fellow, January, 2004.

In June 2005, the ADVANCE program undertook an assessment of its overall programmatic portfolio through a Committee of Visitors (COV) review. NSF employs this process annually to assess the integrity and efficiency of the system for proposal review and the overall health of a program through the accomplishments of its awardees. COVs consist of external experts (selected to help ensure programmatic coverage, broad and balanced representation, and independent judgment) who render their expert judgments to assess the strengths, weaknesses and areas of needed improvement in a program. The ADVANCE COV made a number of findings such as: “IT grants are the best hope for making major changes in Science and Engineering cultures and practices that will ultimately increase the participation of women in these areas. We would like to note that the positive change in climate and culture will have the effect of increasing the number of Americans (both male and female) who decide to pursue careers in Science and Engineering. This is neither a program for women only, nor for science only – this is

a program that transforms an institution for the betterment of all. The impact has positively affected even schools that are not part of the program, as they see how ADVANCE galvanizes universities around the issues of gender equity and advancement.” In terms of programmatic future directions, the COV supported the implementation of a new component, Partnerships for Adaptation, Implementation and Dissemination (PAID) as a viable dissemination and synthesis mechanism to leverage successful practices from ADVANCE awards to broader audiences; but also noted the need to increase the representation of women of color across disciplines and types of academic institutions, acknowledging that the latest ADVANCE program solicitation more explicitly attends to this issue.

ADVANCE – next steps?

There are three notable directions for the future of ADVANCE. Consistent with input from the scientific community and the recent ADVANCE COV, immediate next steps for this program include the implementation and maximum development of the PAID component and increased representation of women of color through the program. The potential value-add of the PAID component is the above-cited opportunity to synthesize and disseminate very broadly organizational/institutional scale best practices. The focus of these awards is to provide support to broaden the impact of evidence-based, institutional transformation efforts, and to expand the network of institutions and individuals knowledgeable about institutional factors that underlie the under-representation of women in academic S&E.

The benefits of increasing the representation of women scientists of color include drawing from another source of intellectual diversity and optimizing scientific talent from all available or potential talent pools. It is lamentable that women from groups under-represented in S&E comprise only 2% of the S&E workforce and a comparable level of S&E faculty in four-year colleges and universities.

An especially exciting future opportunity for the ADVANCE Program is forge international networks and collaborations. Gender equality is arguably one of the most pressing global S&E workforce challenges that we face today worldwide. ADVANCE offers an impressive human resource development infrastructure with national and international benefits to all participants. Such collaborations could take many forms, such as consortial arrangements, institution-institution partnerships, departmental level partnerships, faculty- and student-level research exchange opportunities, as well as conferences and workshops as a means of exchange of best practices, etc. This program already supports international activities, but I envision more substantive, strategic arrangements that are clearly mutually beneficial, with the collective potential to strengthen the global S&E enterprise.

Challenges

There are a number of remaining challenges to ensuring the success of ADVANCE as an enabler of the advancement of female scientists in the 21st century as well as broader policy issues. An important issue within the United States is whether federal agencies are doing enough to comply with key US legislation, Title IX, enacted in 1972 to prohibit discrimination on the basis of sex in education programs and activities receiving any federal assistance. To date, Title IX has proven to be far more effective in ensuring greater representation and inclusion of women and girls in sports than in academics. Therefore, in 2004, the US General Accounting Office (GAO) conducted a study to

examine the legislation and regulations to identify key areas of compliance relevant to the federal agencies reviewed, namely, the following US agencies – the Department of Education, the Department of Energy, the National Aeronautics and Space Administration, and the National Science Foundation (for a fuller discussion, see GAO-04-639). The report focused specifically on women's participation in mathematics, engineering and the sciences, given the relatively limited participation of women in these fields. Succinctly, the report found that Federal science agencies have indeed made efforts to ensure that federal grantees comply with Title IX in these fields by conducting various compliance activities (*e.g.* investigating complaints, providing technical assistance and outreach materials, etc). However, most have not required monitoring activities, the report found. That is, most of the agencies reviewed have not themselves actually monitored their grantees by conducting self-initiated periodic Title IX compliance reviews to determine whether their grantees are complying with the law. Since that report was issued, most of the affected agencies, including the NSF, have taken active steps to redress this situation, including ongoing discussions concerning key assumptions about who was to conduct the actual monitoring, the agency itself or a representative entity on behalf of the agency. Also see the RAND Technical Report, *Gender Differences in Major Federal External Grant Programs* (Hosek *et al.*, 2005), for a related report on federal external grant funding.

Finally, within the ADVANCE Program itself, two notable challenges remain. First, there is a continuing need to integrate gender scholarship into the fabric of the program. This might entail topics such as understanding and integrating the linkages among cognition, attitudes, and behavior and gender; and drawing on research on organizational culture, change, leadership, and gender in the academy. A second issue of paramount concern is that of sustainability. What happens at the end of NSF support for ADVANCE awards? What changes are in place and how will they be sustained? As mentioned earlier, NSF envisions that PAID will provide some measure of sustainability and adaptation. A number of ADVANCE Institutional Transformation awardee institutions are making commitments to continue the transformation underway within their academic communities. It is very encouraging also that the program has served as a catalyst for a number of non-ADVANCE awardee institutions to undertake various forms of institutional transformation to promote greater inclusivity, participation and advancement of women in S&E on their campuses.

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Chapter 14

ENCOURAGEMENT TO ADVANCE: A PROGRAMME TO PROMOTE CAREER STRATEGIES FOR WOMEN IN GERMAN ACADEMIA

Andrea Löther

*Centre of Excellence, Women in Science
Bonn, Germany*

A programme to promote career strategies for women in German academia

Special funding schemes for women researchers on their way to a professorship have been established in Germany since the beginning of the 1990s. These programmes are organised on a decentralised level, but financed by the federal government and the governments of the *Länder*. Since the start of these programmes, the participation of women in “habilitations” – leading to qualification to be appointed as a university professor – increased from less than 10% in 1989 to nearly 24% in 2004. However, the percentage of newly appointed female scientists did not rise in the same way: in 2003, 17% of newly recruited professors were women.

This is why the Center of Excellence Women and Science (CEWS) organized the “Encouragement to Advance” programme. The programme consisted of training and coaching seminars for female scientists to support them in applications procedures for professorships.

Description of the programme

The programme focussed on the support of senior female scientists on their way to a professorship. The central topic of the training programmes has been the application procedure. During a three-day seminar, the entire application procedure was simulated. Individual coaching during and after the seminar was also part of the programme. A seminar covers the following elements:

- Mock interviews.
- Application lecture.
- Coaching.
- Application papers.
- Networking.
- Talk with a female professor.
- Wardrobe advice.

The first measure to ensure the quality of the programme was a public call for tender for the training concepts and the trainers. Twenty-six agencies and trainers submitted proposals, from which the programme's advisory board selected two teams.

Between December 2001 and December 2003, 706 female scientists took part in 52 seminars. More than 1 000 female scientists had applied in response to advertisements for the programme published in the weekly journal "ZEIT".

The programme was supported by the Federal Ministry of Education and Research and sponsored by the L'Oréal Group, Germany. The total budget amounts to EUR 1.04 million.

Methodology of the evaluation

Six months after the seminar, CEWS sent a questionnaire to participants including 134 items. The high rate of return (70%) demonstrates the participants' commitment to the programme.

Profile of the participants

The programme was targeted at female scientists who were qualified to apply for a junior professorship or a regular professorship.

The evaluations show that we reached this target group: nearly 90% of the participants had finished their PhD. During the seminars the trainers were able to use participants' experiences with application procedures: 60% of the participants had already applied for a professorship.

Two-thirds of them were employed at a university, mostly as scientific staff. Nearly 15% were working in a public research institution.

We also asked what the participants thought about a "career": 85% of them thought that a career is a positive thing, but they were more interested in scientific matters than in professional advancement and positions which, according to other studies, are quite typical for female academics and scientists.

The age of the participants ranged from 26 to 56, with most between 38 and 40. Most of them, 80%, were living in a partnership. A quarter of these did not live in the same city as their partner.

60% of the participants did not have children. Those who did have children normally had one child; less than 3% had three or more children. Nearly 50% of all participants wanted a first child or more children.

50% of the female scientists who participated in the programme have one academic parent. A quarter of them came from families where both parents have an academic background. Considering that the participants grew up in a period when less than 8% of their parents' age group and less than 5% of the women went to university, the participants form a highly selective group.

The socio-demographic patterns comply with other studies on female scientists in Germany. In all aspects of the qualification, including private life and career attitudes, the participants are quite similar to other highly qualified female scientists.

Appraisal of seminar and coaching by the participants

Did the seminar and the coaching fulfil participants' expectations? Was the content of the seminar useful for their professional life? How did the participants evaluate the different modules of the seminar? Did the seminar have an effect on the position of the participants? Do they perform better in application procedures? These are some of the questions we asked in order to assess the effectiveness of the programme.

Overall, the participants scored the seminars 5.15 on a scale from one (very poor) to six (very good). The score for coaching is 4.72 (see Table 14.1).

Table 14.1.

	Seminar	Coaching after the seminar
Valid N	487	313
Average	5.15	4.72
Standard deviation	0.95	1.3
Minimum	1	1
Median	5	5
Maximum	6	6

Evaluation of seminar and coaching by the participants

All in all, most of the participants are satisfied with the programme. Nearly 60% said that the seminar fulfilled their expectations totally. Concerning the different seminar modules, most modules got a score of four or better. Also, the participants think that every module is necessary. Only the wardrobe counselling received lower scores, but it is interesting to note that participants with very high career expectations scored the wardrobe component more highly.

Evaluation of seminar modules by the participants

By surveying participants six months after the seminar we aimed to improve the reliability of the evaluation. Most participants finished the seminar very enthusiastically. Before they received the evaluation questionnaire, they had six months to test the experiences of the seminar in their professional life. Because of this, the high scores are more reliable than any answers given directly after the seminar.

But the evaluation of a programme does not stop with a survey of participants' satisfaction. A good programme must also prove its effects on the qualification and the position of the participants. For these questions, six months is too short a period, especially in academia where recruiting procedures may last more than a year.

Concerning qualifications, there were nevertheless some relevant changes. In the period between the seminar and the survey, the percentage of female scientists who had completed their "habilitation" increased (20% before the seminar, nearly 30% after the seminar). In the same time the percentage of women preparing a habilitation did not decrease because more women with a PhD decided to begin a habilitation.

Most of the participants did not change their professional position. Most of the participants were employed as scientific staff at a university or a research institution. The percentage decreased slightly. Finally, there were more women on a professorship than before the seminar. When surveyed six months after the seminar, 20 female scientists reported that they worked as professors at a university, a university of applied sciences or a college of art, and 31 participants reported that they worked as stand-in professors.

The following table breaks down changes in participants' professional position in four categories:

Table 14.2.

	N	%
Relegation	23	4.6
No change	366	73.8
Advancement	71	14.3
Exit/time-out	5	1.0
Ambiguous	31	6.3
Total	496	100.0

Nearly three-quarters of the participants did not change position, while 14% were promoted. The most influential factor for these changes was the professional position the female scientists held before the seminar: Women in an unstable position, *e.g.* on a grant, working as a temporary lecturer or as a graduate assistant, or unemployed, improved their position more often than those employed as scientific staff, for example. It takes more than six months to get a professorship and it is probable that over a longer period of time more participants will get a better position. To really evaluate the effects of the programme, we would need an evaluation two years afterwards and to compare the data with a group of female scientists who did not participate in such a programme. At present, we are not sure whether we will be able to carry out such an evaluation due to the financial resources it would require.

Still, it is not only through the questionnaire but also by e-mail or phone calls that we got feedback on the programme – and occasionally still are getting it. Participants have contacted us to say that they got a professorship or wrote to let us know that the seminars helped them to perform better in their application procedures.

Influences on career patterns

The data also give insight into career patterns of female scientists. We found, for example, a strong correlation between integration into the scientific community and parents' academic background, a fact we explain with the *habitus* concept of Bourdieu. Furthermore, we used an instrument to score self-efficacy. In total, the participants had a high score and there are some interesting correlations between self-efficacy scores and some career patterns.

Conclusions and perspectives

Training and coaching are good instruments to support female scientists in their professional career. They give women scientists the possibility to reflect on their career strategies, and to improve their performance in the application process.

In addition, the seminars provide an opportunity for networking between participants and this allows for many discussions about scientific careers, balancing work and private life, dual careers and other issues.

As a result of such seminars female scientists might act more professionally in application procedures. They could better prepare papers and interviews, gather as much information as possible, adjust their lecture to their audience, and know how to react to questions from the application commission.

Female scientists might perform better in application procedures but all too often the decision makers evaluate them and their male rival applicants by different standards. Because of this, it is time that those who participate in application commissions also take a more professional approach. This means more transparency and a clear and open procedure. Finally, a professional approach to recruitment at universities includes a reflection on the gender bias in peer review.

The Encouragement to Advance programme ended in 2003. Motivated by the positive results of the evaluation, CEWS co-operates with different partners, such as universities or professional organisations to offer this support to female scientists on a national level. Pushed by the understanding of the impact of such seminars on a European level, in July 2004 an international pilot project took place. In this pilot project 18 women life scientists currently working in Austria, Belgium, the Netherlands, Germany and Switzerland were trained. The positive experience resulted in a proposal for the 6th European Framework Programme, submitted in October 2005.

With the Encouragement to Advance programme, CEWS established a concept of training and seminars to support female researchers at a critical juncture -- the application for a professorship. We invite other countries to transfer our experiences to the needs of their female scientists.

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Chapter 15

DUTCH RESEARCH COUNCIL POLICY ACTIONS TO ENCOURAGE THE PARTICIPATION OF WOMEN IN SCIENCE

Wilma van Donselaar

The Netherlands Organisation for Scientific Research (NWO)

Introduction

Following the publication in *Nature* of an article by Wennerås and Wold showing that grant applications from women were judged more severely than those from men¹, NWO (Netherlands Organisation for Scientific Research, Dutch Research Council) immediately launched an internal inquiry about success rates among female post-docs applying for their own grants. The outcome of the inquiry showed that there was no reason to believe that women submitting applications had a significantly lower chance of success than male candidates, but far fewer applications were submitted by women than might be expected on the basis of the figures for university personnel in the Netherlands.

Policy actions

NWO felt that this was a major reason both to continue monitoring women in science and to launch various new policy initiatives:

- Abolition of age limits for grants.
- Extension of time limits. Extensions are possible on grounds of pregnancy, parental leave or part-time appointments in combination with care responsibilities in the case of programmes subject to time limits, such as the maximum number of years of post-doctoral experience (*e.g.* the present Innovational Research Incentives Scheme, better known as Veni-Vidi-Vici).
- Systematic collection of data on male/female application and success rates. NWO annual reports provide yearly information on the net success rates among men and women (*i.e.* the number of grant awards divided by the number of complete applications submitted per sex).

1. C. Wennerås and A. Wold (1997), "Nepotism and Sexism in Peer Review", *Nature* 387, 341-343.

Table 15.1.

Yearbook 2004	Success rates	
	Male	Female
Grants		
Talent (a.o. Veni-Vedi-Vici)	31%	35%
NWO themes	46%	39%
Internationalisation	70%	82%
Infrastructure	50%	75%
New developments	34%	31%
(Open competition)		
Other	73%	59%
Total	45%	48%

As these figures show, women outperform men right across the board. European statistics also show that the Netherlands is doing fairly well in this respect: an EU report (She Figures 2003) shows that in many EU countries men are more successful at obtaining research funding than women. This is especially true in Great Britain, Germany, Sweden and Austria.

So where does the impression that women are less likely to be awarded NWO grants than men come from? A survey of the number of complete applications submitted in 2004 shows that considerably fewer were received from women than from men. The women's success rate was no lower, but the absolute numbers of applications submitted, and therefore the number of grants awarded to them, was indeed far lower. In other words, women should submit more applications! The Veni-Vidi-Vici schedule has shown a substantial increase in female participation over the years.

Table 15.2.

Yearbook 2004	Number of applications submitted	
	Male	Female
Talent (a.o. Veni-Vidi-Vici)	562	271
NWO themes	323	46
Internationalisation	461	157
Infrastructure	58	4
New developments	1 070	135
(o.a. open competition)		
Other	296	79
Total	2 770	692

Membership of boards and committees

At the end of 2000, the NWO governing board set numerical targets for the ratios of men/women on boards and committees. The system used to set the targets was based on proportional representation of the two sexes in the various sectors. In addition, every NWO board, council or committee must have at least one female member. The figures are collected each year from all fields of study and reveal a gradual year-by-year increase in

female membership. Female (associate) professors are actively encouraged to express their interest.

Wanted: female committee members!

It is often difficult for NWO to find female academics willing to serve on boards and committees. This is a pity because memberships of this kind offer many potential benefits: the chance for academics to expand their networks, to gain an ‘insider view’ of NWO assessment procedures, and to enhance their track records in administration. Female full professors and associate professors (UHDs) who would like to serve on assessment committees are invited to express their interest by writing to *aspasia@nwo.nl*, stating their specific discipline and providing contact details.²

Introduction of special programmes for women

These include Aspasia, Meervoud and FOM/v.

Aspasia

The Aspasia programme is designed to alleviate the under-representation of women in senior academic posts by providing incentives for the promotion of female academics to associate professor or full professor level. The programme was initially established as a temporary measure and evaluated following the 2000 and 2002 subsidy rounds. Women lecturers wanting to qualify for the programme wrote a research proposal. Each proposal submitted to NWO had to be supported by the university board involved. There was a large number of applications for those rounds and the percentage of senior lecturers who were women was doubled (from 7% to 14%). Following the evaluations and a discussion day on the future of Aspasia (held in the autumn of 2003 and attended by recipients of Aspasia premiums, university governors and policy officials, and representatives of NWO and the Ministry of Education, Culture and Science), it was decided that the Aspasia programme should continue with some modifications.

The new-style Aspasia programme (2005) is linked to the Innovational Research Incentives Scheme (“Veni-Vidi-Vici”). Female participation in the mainstream competition for individual grants has been fairly low (for example, 22% in the Vidi round and 18% in the Vici round in 2002-2004) and it is considered very important to encourage greater participation. Grants under the Innovational Research Incentives Scheme are not coupled to immediate promotion. In order to introduce this possibility, it has been decided to award subsidies (Aspasia premiums worth EUR 100 000) to universities that promote women to associate professor or full professor level within one year of success in the Vidi and Vici grant competitions. At the request of the Ministry of Education, Culture and Science, the new-style Aspasia scheme is to be evaluated in the spring of 2008.

The Dutch Ministry of Education, Culture and Science has made EUR 1.5 million available for the 2005 round, which is enough for up to 15 Aspasia premiums. In the 2006-2008 period, the annual amount available will be EUR 2 million and it will be possible to award up to 20 Aspasia premiums a year.

2. See www.nwo.nl/women-in-science

Meervoud

The Meervoud programme is designed to enable female post-docs engaged in research in biology, the earth sciences, mathematics, computer science, chemistry and other physical sciences to obtain positions as assistant professors (UDs). The programme was launched in 2000 and evaluated in 2005. Its aim is to create temporary part-time (0.8 fte) posts at assistant professor (UD) level coupled to a guarantee of a further appointment at that level or above within the same research institution.

FOM/v

The FOM/v incentives programme was launched in 1999 and consists of a broad range of measures by means of which women are encouraged to pursue a career in the physical sciences in the Netherlands. Among the incentives on offer are bridging subsidies for the award of permanent appointments to female physicists, individual post-doc appointments for women, grants for small-scale activities (travel, attendance at conferences), a publications prize, etc.

Mainstreaming in the Innovational Research Incentives Scheme (Veni-Vidi-Vici)

The Innovational Research Incentives Scheme has existed since 2001 and is set to continue until at least the end of 2007. Each year approx. 125 Veni grants (EUR 200 000 each), 75 Vidi grants (EUR 600 000 each) and 25 Vici grants (EUR 1 200 000 each) are available. The main aim is to give excellent researchers the opportunity to conduct their own research and so gain entry to or promotion within academic research institutions in the Netherlands.

NWO wishes to use this prestigious mainstream programme to promote women's careers in academic research. It has therefore agreed with the Ministry of Education that the success rates of female candidates should, averaged out over a number of years, be at least equal to those of male applicants. The universities have promised to encourage women to submit applications. Since 2005, the Innovational Research Incentives Scheme has been coupled to the Aspasia programme, to encourage female participation in the Vidi and Vici competition in particular. The Ministry provides EUR 2 million annually (since 2004) for extra Vidi and Vici grants for women who have been rated as 'very good or excellent'.

Table 15.3. Women's participation in the Veni-Vidi-Vici competition

Submitted (S) and awarded (A) proposals: (female / total male+female)

	Veni		Vidi		Vici	
	S	A	S	A	S	A
2002	34%	40%	21%	20%	13%	13%
2003	38%	38%	22%	16%	25%	23%
2004	40%	38%	26%	30%	18%	21%
2005	39%	45%	35%	34%	20%	14%

Communication

NWO publications and activities pay attention to female scientists and avoid stereotypical images. Complaints are treated seriously.

Participation in ESF EQUAL project

In 2005 NWO started working on the EQUAL project on participation of women as a priority for science, in close collaboration with the Centre for Gender and Diversity (University of Maastricht), the Ministry of Education, Culture and Science, the Association of Universities in the Netherlands (VSNU), and several other partners. The aim of this project to encourage participation of women and share good practices. NWO will focus on selection procedures, the visibility of female scientists and the effect of positive-action programmes versus mainstreaming.

Conclusion

Women's participation needs careful monitoring and a variety of policy measures. Although still too low, there has been an increase in grant submissions by women in the last five years. Positive action programmes like Aspasia have had a quick and substantial impact. Current policy measures are aimed at encouraging women's participation in the mainstream programmes. The joint efforts of NWO, the universities and the Ministry of Education have led to a considerable increase of female full professors and associate professors in the Netherlands within the last five years. The Dutch case – as the rather poor situation in the Netherlands was called earlier – is not a “case closed”.

The Dutch case – state of the art

1999:

20% female assistant professors

7% female associate professors

5% female full professors

2004:

27% female assistant professors

14% female associate professors

9% female full professors

Chapter 16

INSTRUMENTS FOR CHANGING GENDER INEQUALITIES IN SCIENTIFIC CAREERS

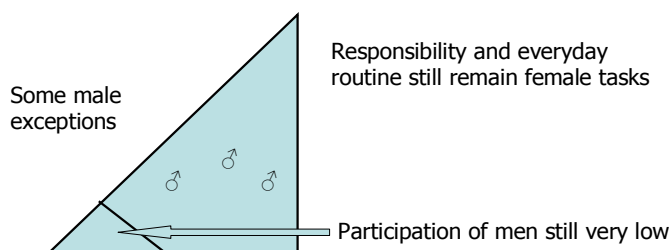
Christel Baltes-Löhr
University of Luxembourg

Well-known situations

It is well known that leading work positions are male-dominated, with the participation of women growing at the same time but still remaining below the average rate for men. Much more frequently than men, women still work part time.

On the other hand, it is also well known that responsibility for the household and related daily routines remain female tasks. The participation rate of men in this area is very low. There are few exceptions where men share the responsibility for household and related tasks with their partners.

Private life



When we look at the situation in Luxembourg we can observe the same tendencies:

- Lower rate of female participation in the labour market: 52.0% in 2003, against 73.3% for men.
- Part-time work in 2003: men 1%, women 15.8% (Eurostat, Labour Force Survey – 2003; 10/2004 – 10, Luxembourg 2004).
- The rate of men taking parental leave: 17% in 2005 (Ministry for Equal Opportunities, Luxembourg, 5th CEDAW report, Luxembourg, 2006, 20).
- A low rate of child care places (2%), especially for children below the age of six (Data provided by the Entente des Foyers de Jour Luxembourg, and own calculations).

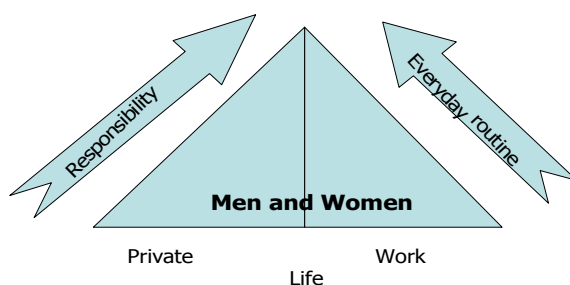
- The Luxembourg birth rate of 12.4 in 2001 defines its fourth position among the European member states (Eurostat, Preliminary Population Estimation; STAT/02/7, Luxembourg 2002).
- A low rate of women represented in science.

In a speech given by François Biltgen, Luxembourg Minister of Culture, Higher Education and Research at the international conference on the EU project on “Gender Roles and Stereotypes in Education and Training” (VP/2003/032) under the Community Framework Strategy on Gender Equality entitled “Promoting Change in Gender Roles and Overcoming Gender Stereotypes” in October 2005 in Luxembourg, he stated that women accounted for 37% of the active working population in Luxembourg in 2003. However, only 26% of the research staff at public research institutions were women, and in the private research sector, where only 14% of the research staff were women, the situation was even worse. In both cases most female researchers were employed in the field of social sciences, whereas their presence was the lowest in the fields of engineering and technical sciences.

Between 1997 and 2004, 35.18% of all applicants for PhD scholarships were women. Moreover, it became obvious that women still tend to be satisfied with a first degree, whereas men tend to continue their studies at a postgraduate level. However, the Minister pointed out that both female and male state-supported PhD students were equally successful (GBP 75%, m: 74%).

A further negative example to support this view can be derived from the distribution of chairs at the University of Luxembourg, founded in 2003. In October 2005, 52 out of 56 chairs were held by men, and only four by women.

The ideal model

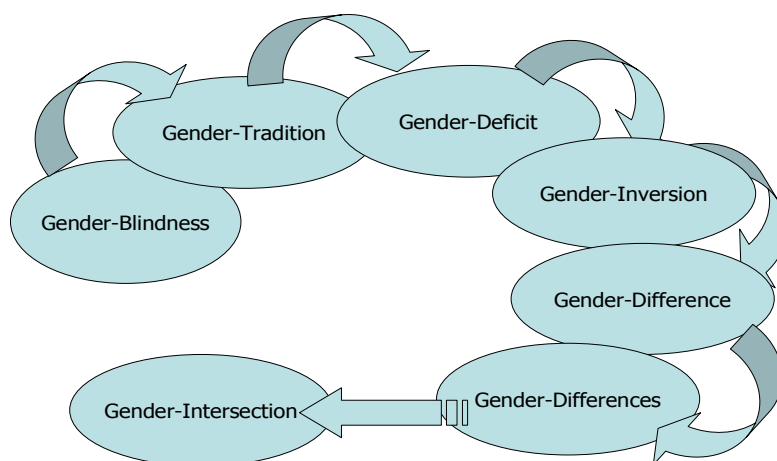


The ideal model that comprises an equal representation of men and women in all fields of societal life, in both working and private areas as well as in the political and public spheres without gender-segregated responsibilities or tasks, is still far from being achieved, despite the fact that a large number of activities on various national and international levels are aiming at changing the imbalance between men and women in science.

The inequality still remains daily reality because practice lags behind both theory and legislation. The tension field “*de theoriae* ≠ *de facto* ≠ *de jure*” still holds true.

Theoretical background of gender concepts

It is important to overcome the dualistic perspective between traditional and non-traditional gender role concepts. Based on different theoretical approaches – especially those developed by Judith Butler (1991, 1993, 2001, 2002, 2003), Andrea Maihofer (1995, 1997), Rosi Braidotti (1994), Sabine Hark (1999) and Gudrun-Axeli Knapp (2005), including my considerations as presented in my PhD thesis on “Identity and Migration”, I have developed the following gender concepts.



Gender blindness

Female/male stereotypes are perceived as “natural”; in other words, they are based on essentialist assumptions that describe culturally constructed norms as “natural” or “nature-given”. Human beings have to be that way, different opinions are considered as opposed to nature and normality; in other words, as human beings we are expected to conform to prevailing patterns of gender and to adopt prevailing gender roles.

Gender tradition

Here, *i.e.* particularly in white European middle-class concepts, women are reduced to “privacy” and expected to take care of “home”-related tasks such as housework, child-care and education. Men are in charge of the “public life” traditionally encompassing paid work, politics and non-private life. The concept of gender tradition is very close to traditional views of gender relations. Girls and women are seen as being, for instance, emotional, passive, sensitive, weak, soft, close to nature, body-related and dependent. Boys and men, on the other hand, are considered as being rational, active, hard, strong, civilised, intellectual, and autonomous. To be recognised as a real “girl, woman, boy or man”, individuals should conform to as many behavioural expectations as possible. The more one adopts these, the better. Deviations from these norms can be perceived as deviant, contagious, insane or abnormal.

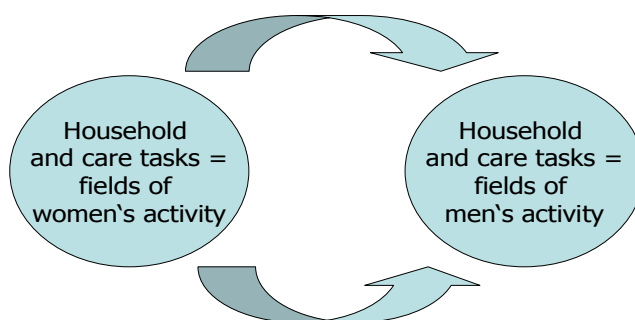
Gender deficit

Although women demand a stronger involvement in economic, political and public domains, they continue to construct themselves in relation to prevailingly male standards and norms, and therefore femininity is considered less valuable. The ideal “woman” is thus hardworking, confident, strong, rational and stern, intransigent and rather remote from being emotional and sensitive as women being mothers and housewives are meant to be. Women consider themselves “inferior” vis-à-vis males. Masculinity figures as the normative focus.

Gender inversion

This concept keeps up the traditional distinction between housework and work, but it inverts gender roles and labour distribution: the househusband is expected to do so-called “female” tasks, whereas the woman takes charge of the outside/public aspects of the couple’s life. The “behavioural medal” has just been turned over.

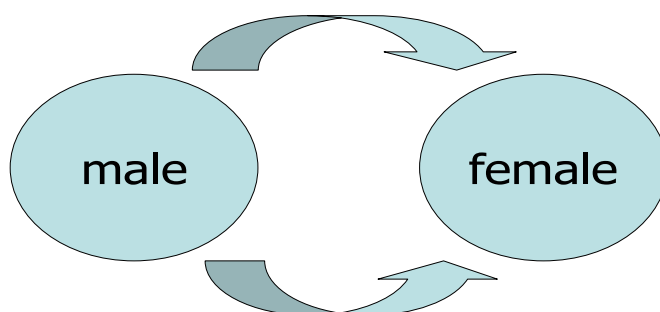
Behavioural medal



Gender difference

This concept involves all the different forms of gender relations that are based on an assumed essentialist female superiority. Here, the notions of the essence of female beings function as a normative template. The female way of living, working and creating is preferred to male working norms and institutions formed by men based on rationality, hardness, assertiveness, and competitiveness. Now women themselves define what a “real” woman is like. Women do not want to be treated as equals since they feel superior to men. Basically, this concept stands for the normative reverse of the gender role distribution and is far from a democratic gender culture. With the assumption of a specific female being, not only the other gender is discredited but at the same time all the other women who do not orientate themselves towards the norm of “femininity”. Women define who can be considered as a “real, straight, fit, correct” woman. Women define in a normative way for all women what it means to be a woman. The “medal” has just been turned over; this time on a normative level.

Normative medal



Gender differences

The gender-specific nature as well as the normative superiority of female beings come into question. This concept opens the discussion about the differences between women, differences between men and differences between the genders. Women and men are allocated responsibilities and competences in all areas of life without assessing masculinity or femininity being inferior or superior *per se*. By such a pluralistic view of the gender attribution, the lived realities can be described more precisely. Women do not only demand and realize their participation in the public life and labour market, but also demand the participation of their partner in housework and child-raising. The normative orientation is based on a pluralistic view on the capacities and qualities of women and men.

Gender intersection

Beside gender being characterised as a structural category and described as being body-related and biological, ethnical and socio-economic aspects as well as age play a role in the construction of identities, gender identities, and cultural and ethnical identities. The relevance of “femininity” and “masculinity” is rather dedramatized. Cultural origin, socio-economic status and age are considered to be important if it comes to people working and living together. This concept provides answers to the question of why so little has changed in lived realities during the last 40 years. If gender is understood as the structural category as such, other aspects are supposed to be given too little relevance. Thinking of success at school, for example, it certainly plays a role in which gender a girl or boy belongs to, which representations they have of women and men, and gender relations. The impact of cultural origin and socio-economic status are not to be underestimated.

Therefore the gender dimension is to be respected **not** as the one and only important category and **not** as a dimension to be neglected, but as an important analytical category amongst class and race.

First conclusions

As long as measures remain overshadowed by an approach of gender blindness, gender tradition, gender deficit, gender inversion or gender difference, they will be ineffective. We will have to develop measures and programmes aiming at the application of the concepts of gender differences and gender intersection. This conclusion can be underscored by some current research results which show their relevance to today's topics.

The representation of masculinity, femininity and gender relations of pupils and students will change directly and effectively, preferably when the father takes over responsibility for the so-called female areas: the kitchen and the children. The job activities of mothers do not have a major influence on the change of the representations as mentioned above (Baltes-Löhr *et al.*, 2005).

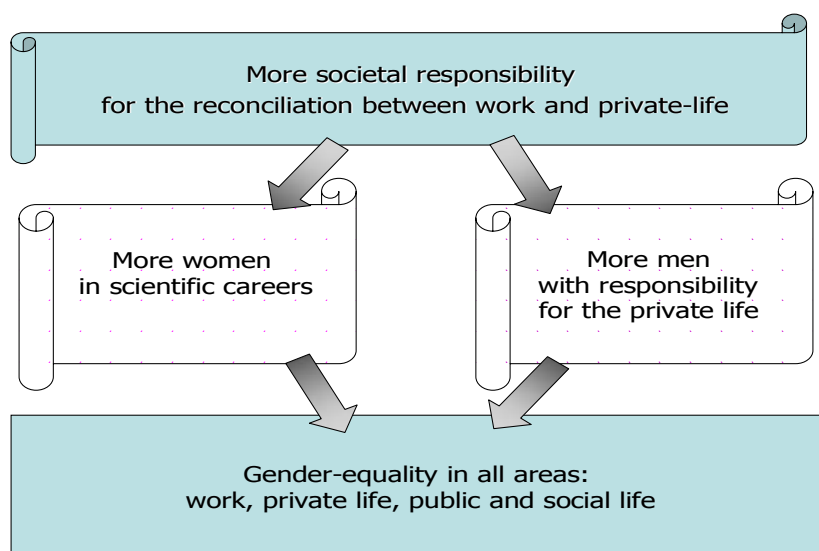
The relevance of this result for today's topics lies in the assumption that work and private life have to become areas for women and men, for men and women. This implies that stereotypes of femininity and masculinity have to be overcome. This leads to the thesis that the reconciliation of work life and private life can only succeed if women and men are represented in both parts of societal life to an equal extent. This cannot be achieved as long as measures and programmes on reconciliation start as late as university level. Measures to balance work and private life for women and men have to be implemented at the very beginning of their educational development. One example from the field of education can be the anchorage of the gender aspect in all curricula of university studies.

A gender-sensitive teacher might achieve a gender-sensitive education of pupils. Gender-sensitive pupils should be expected to become gender-sensitive adults and possibly female and male students for whom it would be "quite normal" to both work and raise a family and – perhaps – become a researcher.

The problem of under-representation of women as researchers also has to be tackled as early as possible. Some results of the survey on "representations of research by pupils and students: cognitions and perceptions concerning the research area" (Zunker & Baltes-Löhr, 2006) show that today pupils would like to see research in the classroom. They want to know more about research. They want to know more about the most recent research results. They receive their usually low knowledge about research from television or their parents.

For today's topic, these findings have the following relevance: the normality of work and private life for men and women in the sense postulated above has to be introduced into school curricula; the normality of research work for women and men has to be implemented in school programmes.

These ideas are illustrated by the following figure.



The design and the implementation of measures and programmes to facilitate child care, nursing and household activities for women and men on the job, both public and private, must always be embedded in the context of socio-economic and intercultural measures such as pay, working time, cultural-sensitive standards of work organisation and social surroundings.

In this context the instruments of gender mainstreaming can be helpful, but only if the approach is not based on the concepts of gender blindness, gender traditional, gender deficit, gender inversion or gender difference.

Other measures to raise interest in research training and then a professional career as researcher:

- Working in research groups, decent wages, working conditions, research planning without unnecessary time pressure, mobility centres.
- Creation of foundations, scholarships and other forms of financial support for young female and male scientists with children.
- The capacities of women should not be excluded from the research process.
- Development of gender-sensitive research design is a must. If the gender-sensitive research design is not respected, there will be cutbacks.
- Development of gender-sensitive scientific excellence criteria.
- Gender research as a quality feature.
- Gender-sensitive process as a quality feature.
- Child care, nursing, household responsibilities and social responsibilities should be given the same importance as professional work.

The supposed/imaginative advantage of strict segregation between work and private life should be cast into doubt. Perhaps matters would be easier if this segregation were abolished. We should dare to question to what extent the ties of love and sentiment and economic security realized by partnership should be replaced by other models.

One example: the University of Luxembourg

Founded in 2003, the University of Luxembourg consists of three faculties: Sciences, Technology and Communication (FSTC); Law, Economics and Finance (FDEF); Language and Literature, Humanities, Arts and Education (FLHASE). The university staff rose from a total of 277 in April 2004 to 346 in October 2005. In April 2004 there were 88 women and 189 men at work at the university. In October 2005, this ratio had changed to 114 women and 232 men. Despite an increase in numbers, the relative proportions stayed very much the same: 31.4% women (2004); 32.9% women (2005). As stated above, the gender segregated ratio of 52:4 between professors is even more drastic. A mere 7% are women.

In October 2005, there were 3 034 students enrolled, of which 1 557 were female and 1 477 were male. At first glance, this proportion appears to be gender-balanced. But as a matter of fact, it veils distinct gender segregation within the faculties.

The role of the women and gender representative

A women and gender representative post was created by university law of 12 August 2003. The women and gender representative is directly attached to the rector's office and is a member of the university council.

The rector's office and the deans have accepted and supported the women and gender representative's proposal to define the creation of a new gender culture at the university as her main aim, from which the following derive:

- Infrastructural measures.
- Development of gender research.
- Development of gender studies.

Infrastructural measures aim at:

- Increasing the ratio of women scientists.
- Enhancing the attractiveness of social sciences and humanities for male students.
- Measures for a better reconciliation between professional and private/family life.

Results up to now:

- In accordance with the deans, the women and gender representative appoints one member of each of the three faculty councils to act on her behalf.
- One gender-sensitive member is expected to take part in all appointment committees for the recruitment of professors. This member should be proposed by the women and gender representative.
- Planning of a day-care facility at the university with a gender-sensitive education programme.

- The convention to improve the reconciliation between private life and research activities at the University of Luxembourg was a common proposal of the rector's office and the women and gender representative. It was accepted by the University Council in April 2005 and by the University Governance Council in July 2005. In complement to the existing legal maternal and parental leave, parents of young children (up to four years of age) employed as researchers and teachers at the University of Luxembourg have the possibility to reconcile child education and scientific activity. Given that research activities are more sensitive to breaks, researchers who are raising children have the possibility to continue and even step up research activities by reducing teaching from 40% to 20%.

Measures to establish gender research aim at:

- Implementing the gender topic in each research project (transverse/horizontal axis) and in specific research projects with gender topics (vertical axis).
- Developing gender-sensitive research designs in all research projects: participation rate of women and men; family-friendly timetables.
- Implementing recent research results, when promoting gender aspects in study programmes.
- Last but not least, respecting and using research results within the ambit of social discourses and as a basis for political decision making.

Results to date

Alongside several research projects, documented in the activity reports for 2004 and 2005, two international and interdisciplinary workshops were successfully organised. In June 2005 another international seminar entitled “Mainstreaming, Research, Excellence: Normative Debates in Gender Research in the Context of Excellence (MAREX)” was held in co-operation with the EU Helsinki Group on “Women and Science” and the Luxembourg Ministry for Culture, Higher Education and Research.

Measures to establish gender studies aim at:

- Fixing the gender aspect in the programmes of all topics.
- Elaborating contents and methods for gender sensitive programmes.
- Developing a general gender theory.
- Creating an interdisciplinary, intercultural, innovative cross-gender group with university staff members.
- Establishing women's and gender studies at BA, MA and PhD levels.

Results up to now:

- The first four-year plan is currently in progress: the gender dimension will be integrated into the history, culture and society research unit.
- Planning of an MA in gender studies in co-operation with the University of Trier, Germany.
- For the winter term 2006/07, the gender aspect will be integrated into the curricula for the Bachelor of Arts in European Culture, the Bachelor of Arts in Educational Science and the Bachelor of Arts in Social Science.

The 2004 and 2005 activity reports are available from the University of Luxembourg upon request.

The creation of a Centre of European Gender Studies at the University of Luxembourg will be maintained as a long-term aim.

Conclusions

After almost two years of activity, some ideas of the women and gender representative have been implemented. Despite recent results, a lot of projects are still to be realized over the coming months and years. Why work thus far has been effective can be attributed to the following reasons:

- Strong networking inside and outside university: most notably, co-operation with the Ministries of Culture, Higher Education and Research, Equal Opportunities and the National Research Fund.
- A few open-minded deans and members of the rectorate office, including the first female vice-rector.
- A high and ever-growing gender interest amongst staff members.
- The chosen theoretical concepts of gender differences and gender intersection have proved to be successful.

However, only when both sides are willing to move will there be sustainable change.

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Chapter 17

BALANCING RESEARCH CAREERS AND PRIVATE LIVES: DO SOCIAL MEASURES MATTER?

Aliki Mouriki
National Centre for Social Research
Athens, Greece

Contextual background

The gender gap in employment

The gender gap in employment has many aspects but perhaps the most striking one is the difference in the labour market participation rates between women and men. The employment rates of female workers in Greece are among the lowest in Europe at 44%. Despite a relative improvement in female employment rates over the past 20 years, the gender gap remains the highest of the EU-15, almost 29%, as compared to only 4% in Finland, 9% in Denmark and 13.5% in Portugal (Employment in Europe, 2004).

The presence of young children in the household determines women's participation rate to a large degree, as a significant number of women withdraw from the labour market or delay their re-entry in order to raise their children, which is not the case with men. As a result, the employment rate of men with children under six is more than double than the employment rate of women in the same category (see Table 17.1). It seems that in the Southern European countries, child care is strongly related to the non-employment of mothers.

Table 17.1. Participation in employment depending on the presence and age of children

	Without children/with children over 6	With children aged 0-6
Men	64.1%	96.2%
Women	42.6%	49.0%

Source: N.A.P. 2002.

The disadvantages that women face in terms of access to and participation in the labour market are less marked in the case of highly qualified scientific personnel. Nevertheless, vertical as well as horizontal segregation still persist, even in the area of R&D activities.

Women and research

Women researchers are under-represented in most sectors, owing to their weak participation in scientific and technical professions.

Table 17.2. R&D personnel by sector

Sector	Total	Female	%
Business sector	4 611	1 599	34.7
Government sector	3 027	1 176	38.9
Higher education sector	20 507	7 567	36.9
Private non-profit sector	139	74	53.2
Total	28 284	10 416	36.8

Source: General Secretariat for Research and Technology, 2003.

Social research is, by contrast, highly feminised. The National Centre for Social Research – the sole public institution in this area – has a total of 55 researchers, working under a variety of employment contracts, of which 37 are women (67.3%). The fact that two in three social researchers are women can be attributed to the fact that professional careers and pay are less attractive than in higher education institutions, thus deterring many men that would otherwise have chosen this profession. On the other hand, public sector researchers enjoy job security and above the average wages, compared to other categories of employees.

The status of social research in Greece

The low status of research in Greece, and of social research in particular, is largely affected by two factors:

- The total spending on R&D activities is one of the lowest in Europe and amounts to EUR 950.56 million, representing only 0.4% of GDP.
- The use of research results by policy makers. Unfortunately in Greece, there is no tradition in evidence-based formulation of policies. This is especially true in areas where the contribution of social research could be the greatest, like social policies, labour market policies, xenophobia, gender equality, etc. Government agencies rarely rely on research findings and data produced by the research centres to formulate their policies and, only in exceptional cases, they commission research projects on specific issues. Even so, the implementation of findings is not in the least ensured.

Existing social measures in Greece for the reconciliation of work and family

Institutional framework on gender equality and on the reconciliation of work and family life

The current institutional framework in Greece affecting the reconciliation of family and work continues to place great emphasis on the protection of the family and offers very few options – despite some piecemeal and belated legislative improvements – regarding flexible working time patterns, which remain at employers' discretion.

Low incidence of flexible working patterns

Conventional working time patterns still have a very strong hold in Greece. Flexible working arrangements such as part-time work and weekend working were introduced only in 1990, whilst teleworking was introduced in 1998.

Other forms of flexible working arrangements that are widespread in most EU countries, such as “staggered hours” or flexitime, compressed working week, job sharing, “time-saving accounts”, career breaks, etc., are virtually non-existent. Even teleworking and working from home are extremely marginal. The majority of the workforce is, thus, caught in the straightjacket of rigid and non-negotiable working time schedules and largely inconvenient social infrastructure times.

- Part-time work: only 4.5% of total employment.
- Teleworking: very low incidence, around 1% of the working population.

By contrast, there is a broad range of family leaves available to both parents, in view of taking care of their children and other dependent relatives, such as:

- Maternity leave.
- Nursing leave.
- Parental leave.
- Time off to visit children’s school.
- Leave to care for ill children needing hospital treatment.
- Reduced working hours for parents of disabled children (one hour less, unpaid, in workplaces with over 50 employees).
- Unpaid leave to care for disabled relatives (children under 16, spouses, parents, siblings).

Equal opportunities legislation, although quite forward-looking, has proved unable to change the attitudes of employers and men in general. Moreover, Greece has not yet established – contrary to many European countries – an equal opportunities commission to monitor, evaluate and promote gender equality.

Social infrastructure on childcare and elderly-care

The provision of quality and affordable childcare in Greece has substantially improved over the past years, largely thanks to funding from the 2nd and 3rd Community Support Frameworks. It remains, however, unable to meet increasing demand from a steadily growing female workforce.

Subsidised childcare is available for only a small proportion of employees, whilst workplace nurseries are virtually non-existent, despite the obligation of companies with over 300 employees to set up crèche/daycare facilities for their staff.¹ Thus, the majority of employees have recourse either to costly private care facilities (nurseries, crèches, and, increasingly, home helpers or nannies), or to informal networks.

It is estimated that over 170 000 children of working women – especially under the age of three – are not covered by the existing crèches and nursery schools. Less than 3% of children under three are covered by childcare facilities. Working mothers to a large degree still have recourse to family networks, mostly grandparents, to meet their child-care needs.

1. This legislative provision is rarely applied, owing to resistance from employers, who request financial incentives from the state in order to set up a crèche.

Elderly care facilities lag behind dramatically in Greece, despite the rapid ageing of the population, the growing participation of women in employment, and the diminishing importance of family networks that have traditionally acted as a substitute for inadequate social welfare institutions. At present, only 0.5% of the elderly population is covered by some sort of elderly care unit, as opposed to 2% in Italy, 2.8% in Spain, 5% in Portugal and 7.2% in Finland.

Overall, the level childcare and the elderly care infrastructure still acts as a barrier, though to a lesser degree than in the past, to women's participation in paid employment, but also to their career advancement. However, other factors play an equally important role: the social security system, which does not take into account the changing patterns of labour force participation over the course of a lifetime, and the rigid working patterns that offer very few options to employees and also prevent women from enjoying equal opportunities at work.

Time schedules

The social organisation of time schedules in Greece remains adjusted to the traditional “male breadwinner” model and the extended family support network, neither of which are relevant any longer as women are increasingly participating in paid work (whether formal or informal), and the nuclear family has gradually replaced the formerly predominant form of the extended family.

The lack of compatibility between free time, business opening hours and work schedules is striking in Greece. Not only school hours, but a wide range of public services, banks and other social facilities operate exclusively in the morning, thus denying access to the majority of working people who have to work rigid and often long hours daily.²

Informal arrangements vs. a residuary regulatory framework

Given the overall unfavourable (if not hostile) environment, individuals struggle to juggle their conflicting responsibilities, and have widespread recourse to informal arrangements, such as:

- Family support networks.
- Colleagues' solidarity.
- Understanding and supportive employers.
- Private (and costly) services.

These informal arrangements are very much present at the NCSR and constitute an “invisible”, non-measurable asset for social researchers that should not be underestimated.

2. Greece has the second longest working week in the EU, after the United Kingdom (on average 41.8 hours a week, *i.e.* almost two hours above the EU average), owing to the widespread recourse to overtime work and the low incidence (4.3% of total employment) of part-time work (Eurostat, L.F.S., 2004).

The blurring of boundaries in a social researcher's professional and domestic life

Increasingly, work is penetrating (even colonizing in some cases) the private sphere of individuals lives, either explicitly – through teleworking and bringing work home – or implicitly, through devoting long hours to work activities (even when away from the office). This is especially true in the case of researchers who need to constantly update their skills and knowledge, travel frequently to participate in conferences, go away on field trips, etc. As demands on workers increase, it becomes more and more difficult to accommodate work with family responsibilities.

On the other hand, the office is often used to deal with domestic-related matters. Traditional methods of assessing employees' performance are clearly obsolete and need to be drastically reconsidered.

Policy suggestions: working time autonomy and affordable care

Towards a new organisation of working time

Working time regulations are one way of helping to strike a balance between work and family life. A wider spectrum of options is needed that will allow individuals to combine different forms and degrees of labour market participation and adjust their hours, days and periods of work to their changing needs. This requires a radically new perception of working time based on *chosen* rather than *imposed* time. It also requires moving away from conventional work/life patterns.

The new working time policy should allow individuals the possibility to alternate between various forms of employment insertion during the course of their total working life, *i.e.* switching between full-time and part-time work, making use of sabbaticals, career breaks, educational or parental leaves, semi-retirement or early retirement schemes, etc., without jeopardising their career prospects or the viability of the pension system. It should also allow for a wider use of flexible working time options, such as reduced hours, working time accounts, compressed working week, teleworking, *etc.*

These flexible options are meaningless, however, without ensuring decent pay for those who use them and without a radical reform of the social security, pension and social benefits systems, which are currently based on the full-time continuous employment norm and penalise any deviation. The institutional framework also needs to be improved, by removing the barriers to the full participation of women in employment as well as in career opportunities.

These issues must be considered, bearing in mind a number of challenges that need to be addressed:

- Time organisation and redistribution through working life.
- Trade-off between income and time; redistribution of income through working life.
- Availability of genuine options for individuals.
- Striking a balance between employers' and employees' needs and considerations.

Addressing care needs in a changing society

Improving care services is gaining new importance in a context of rising female employment, increasing elderly-care needs and an imminent crisis of the welfare state.

Affordable and good quality care services for children, the elderly and the disabled need to become widely available, perhaps along the lines of the successful Scandinavian model, and the French model as regards childcare. This implies the active involvement of the social sector economy. It also requires a change of attitude in public agencies, which should start to view the provision of care as a long-term investment rather than a budgetary burden that needs to be curtailed.

Main barriers to overcome

Women researchers – like all female employees – are faced with a number of overt but also (and mostly) invisible constraints in their attempt to ensure equal treatment with their male colleagues in terms of access to employment, training opportunities, career advancement (“the glass ceiling”) and work/life balance. The major barriers to overcome include:

- Workplace culture/organisation of work (especially the culture of long hours and rigid working patterns).
- Traditional and stereotypical attitudes and roles: as men have ceased to be the sole “breadwinners”, women must cease to be the sole family carers.
- Public spending constraints (reflected in inadequate social care infrastructure).
- Institutional rigidities.

The Women in Science Unit of the European Commission was first established in 1999 as a sector within the Directorate-General for Research. Its establishment was one step in the implementation of the general equal opportunities and gender mainstreaming policy of the European Commission. Indeed, the European Treaty contains a number of references to gender equality. It mentions in Article 2:

“The Community shall have as its task, ... to promote throughout the Community equality between men and women,...”

In Article 3 it continues:

For the purposes set out in Article 2, the activities of the Community shall include, ... the strengthening of the competitiveness of Community industry and the promotion of research and technological development.

In all the activities referred to in this Article, the Community shall aim to eliminate inequalities, and to promote equality, between men and women.

Article 13 refers to combating discrimination based on sex, whereas Article 137 deals with the labour market:

... the Community shall support and complement the activities of the Member States in the following fields: ... equality between men and women with regard to labour market opportunities and treatment at work.

And Article 141 deals with equal pay:

Each Member State shall ensure that the principle of equal pay for male and female workers for equal work or work of equal value is applied.

The Treaty gives a clear mandate to the Women and Science Unit, which has addressed all the issues covered by the treaty except pay gap, always focusing specifically on scientific research and researchers. While the treaty addresses human rights, anti-discrimination and equal treatment in a general way, the Women and Science Unit also addresses issues such as the functioning of the science system and the issue of scientific quality or scientific excellence. Can Europe maximize scientific excellence without achieving a balanced participation of women and men and without taking properly into account the gender dimension of research?

We know that in 1999, 52% of students in basic higher education studies were women. In 2003, 59% of those who graduated with a degree qualifying for PhD studies were women. Women are thus more successful in their studies, which contrasts starkly with the number of women who become full professors. In 2003, only 15% in Europe were women. These sorts of statistics raise serious doubts as to whether Europe succeeds in deploying all its talents in an optimal way.

What are we doing about it? Most importantly, a good knowledge base is needed to implement measures or to make proposals. We know that a multitude of factors are put forward to explain the low number of women in decision-making positions in research or the low number of women taking up certain science or engineering disciplines. What we do not know is what the relative importance is that can be attributed to each of the factors under discussion. We also have insufficient information on how – in quantitative terms – major societal trends influence career perspectives of today's students.

This is why in March 2005 the Commission put forward a staff working document on “Women and Science: Excellence and Innovation: Gender Equality in Science” (COM [2005]370) which described seven priorities for the years to come, among which “strengthening gender research” in the field of scientific careers. The development of gender research was then also put forward in the Commission proposal for the 7th Framework Programme. This type of research will also include the development of scenarios to demonstrate the consequences – for European research – of achieving or not achieving gender equality.

The subject of women and science is part of a larger community programme called “Science in Society” where issues such as ethics in science, governance of science, communication of science and science education are also dealt with. This reflects the Commission's opinion that the under-representation of women in research cannot be treated solely as a problem of availability of human resources – the lack of women also has impacts on priority setting, how research is carried out, and how decisions are taken. It is a problem of fair participation in research, as a researcher and/or as a decision maker.

This is why the Commission will not limit its activities to improving the knowledge base only. The Commission will continue to try to put gender mainstreaming research and research policy into practice.

Chapter 18

WOMEN IN LATIN AMERICAN SCIENCE AND TECHNOLOGY: A WINDOW OF OPPORTUNITY¹

Judith Zubieta²

Institute for Social Research, UNAM, Mexico

An overall view

For the last six years, UNESCO has been sponsoring a research and action-oriented program called GenTeC. As an initiative springing from Mr. Eduardo Martinez, a former Director of ORCyT–Uruguay, a gender perspective was to be included in any science and technology (S&T) program if a country or region is to benefit from the presence of women in research and development (R&D) and from designing and implementing S&T policies and programs to promote gender equity. As such, GenTeC started with representatives from Argentina, Brazil, Costa Rica, Mexico, Paraguay, Spain, Uruguay and Venezuela.

Gathering information from all eight countries and trying to get a single concluding picture out of its analysis and discussion seemed very difficult. There were strong evidences of great differences among them (population size, economic structure, social strata, education, poverty, rural and indigenous population, schooling, workforce, etc.) and even though they turned out to be highly heterogeneous, underdevelopment of their S&T national systems was unfortunately confirmed as a key characteristic of all Latin American countries included in GenTeC Program.

Indeed, with the exception of Spain, homogeneity was found in the lack of a strong scientific community, as well as in the relatively small number of females in certain disciplines, though large increases were found in women's enrollment at undergraduate and graduate level. Since most Latin American countries participating in GenTeC share trends and relative figures regarding the place women is taking in S&T, this paper leaves the Spanish case out and concentrates rather on that of the other seven nations.

A first finding from research conducted by teams working in each participating country was that in the last couple of decades a huge dynamism has been taking place in Latin America in many spheres of social life. To start with, the region has witnessed shifts in the rural-urban distribution of female population with a growing proliferation of them in urban areas.

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1. The author wishes to acknowledge UNESCO and OEI for supporting GenTeC Program, the main source of information for this paper. See: <http://www.unam.mx/iisunam/nuevos/gentec/index.html>
 2. Full professor and researcher at UNAM's Institute for Social Research. México, D.F. México.

Once away from the countryside, more and more Latin American urban women are changing their previous patterns of behavior and conduct, targeting education just like their male counterparts; getting training and information; participating in the labor market away from their households; assuming responsibilities arising from an increase in the proportion of female-headed households, and so on. Along with these changes, at a demographic level, women are also enforcing other social transformations: they are getting married at later ages or leaving marriage out of their immediate plans, childbearing less or having no children at all; they are also starting to consider living alone as another valid way of life, and, above all, they are bearing higher aspirations.

Table 18.1. Some education indicators

Country	Adult literacy rate, 2001 (% 15 years and older)		Feminine enrolment rate 2000-2001 (%) ¹			Professional and technical women (%) ²
	Women	Men	Primary	Secondary	Tertiary	
Argentina	96.9	96.9	107	82	60	--
Brazil	87.2	87.4	94	74	19	62
Costa Rica	95.8	95.6	91	52	18	28
Mexico	89.5	93.5	104	62	20	40*
Paraguay	92.5	94.5	92	48	--	54
Uruguay	98.1	97.2	91	74	47	52
Venezuela	92.4	93.3	89	55	34	58

Notes:

1. Rates greater than 100% are due to discrepancies among data referred to proportion of children enrolled and total population.

2. Data refer to most recent available year in the 1992-2001 period.

* According to INEGI, Mexican figure rises up to 50%.

Source: La Mujer y la Ciencia Iberoamericana, GenTeC, April 2004

See <http://www.unam.mx/iisunam/nuevos/gentec/index.html>

Table 18.2. Some economic indicators

Country	Economically active population (EAP), 2001 (in millions)	Female economically active population (%)	Youth unemployment, 2001 (% of active population, ages 15-24)	
			Women	Men
Argentina	14.99	33	33	31
Brazil	79.25	35	22	15
Costa Rica	1.63	31	16	12
Mexico	40.07	34	5	4
Paraguay	2.07	30	17	12
Uruguay	1.50	42	42	29
Venezuela	9.88	35	28	20

Source: La Mujer y la Ciencia Iberoamericana, GenTeC, April 2004

See <http://www.unam.mx/iisunam/nuevos/gentec/index.html>

It is evident that women who manage to avoid leaking the educational pipeline going from primary to high school face better chances to keep their place in their educational career than those who do not. This, however, does not guarantee integration into the labor market. A sort of dissociation between the course of her education and her performance in

the productive sector prevails, a finding which makes us think that women are not accepted in certain fields of the labor force for which they were prepared, just because of chauvinistic societal values.

Women taking college or university degree courses in all seven Latin American countries already outnumber men when speaking of areas of knowledge different from science and engineering. Percentages larger than 50% are found in some enrolment figures in areas such as psychology and biology, as well as in various social sciences. On the other hand, women hardly represent one third of the total number of students in physics, mathematics, computer science, and geosciences.

Relationships between men and women have been shifting in a way that a new ground for academic reflection is evolving where both roles should be analyzed, especially in education, science, and technology grounds. Moreover, recent trends of the observed gender gap in S&T show a reduction, motivating some governments to design specific programs and policies as well as offices to look after the consolidation of such trends and at the same time, to tackle gender issues.

Educational attainment is, without doubt, the most fundamental prerequisite for empowering women in all spheres of society for without education of comparable quality and content to that given to boys and men, and relevant to existing knowledge and real needs, women are unable to access well-paid, formal sector jobs, advance with them, participate in, and be represented in government and gain political influence (World Economic Forum, 2005; 5).

In spite of these findings, the small number of graduate women in S&T confirms that their access to higher education does not – in itself – imply the conquest of spaces traditionally occupied by men, nor does it mean that they managed to belong there, and least of all, that graduation rates are comparable. In fact, it is estimated that the number of graduated female scientists and engineers has increased substantially in the last decade; however, most of them do not practice their profession, a situation which may be understood as a waste of scarce and very valuable resources.

Table 18.3. Female participation in total number of graduates, 2001

Country	Number of graduates	% Women
Costa Rica ¹	296	41.6
Mexico ²	35 031	44.5
Uruguay ³	237	48.9
Venezuela ⁴	1 463	58.1

Notes:

1. Data refer to graduates from national universities in biology (biomedicine, ecology and environmental sciences), chemistry, physics, mathematics, engineering and architecture.

2. Number of graduates from all disciplines.

3. Data refer to graduates from Masters and PhD programs during the period 1995-1999 in biology, physics, engineering, chemistry and math.

4. Data refer to a calculated annual average number of graduates during 1990-2001 in five universities sampled.

Source: La Mujer y la Ciencia Iberoamericana, GenTeC, April 2004

See <http://www.unam.mx/iisunam/nuevos/gentec/index.html>

Though the aforementioned results suggest the gap between men and women in terms of education in S&T has been bridging in the last decades, there are still a great many barriers and obstacles, which must be overcome and removed in order to guarantee equal opportunities for men and women. Moreover, they should be eliminated if governments are to encourage female participation as a strategy to strengthen their national S&T systems.

Some additional background

Initiating the analysis of women's education in Latin America, the door opens to problems of implicit sexism in the access to knowledge. Historically, it could be argued that there has been a monopoly of learning (knowledge), held not only by men but also by a dominant social class in need of reproducing itself to guarantee their permanence in power.

Unfortunately, the history of education is one for men, and another very different for women. Approaching research into female education, we face an apparent double questioning: What is there about the feminine condition that prevents women from doing science? Or in a slightly different way: What is there about science that excludes women?

In the last fifteen years Latin American women have been gaining access to greater spaces at graduate and postgraduate level. Nevertheless, quantitative data has to be considered with great caution since the increase of women–men ratio in university registration and enrolment figures could be reflecting an increment in male dropouts, due to an early incorporation to economic activity, rather than a more numerous female presence, resulting from equal opportunities of access to education.

It must not be disregarded that greater participation of women could also be explained by the pressure of labor competitiveness, which obliges men and women to increase their skills and knowledge, in order to obtain better paid positions, and to consider applying to postgraduate programs, and thus becoming members of the most highly qualified group among the overall labor force.

Table 18.4. Female presence in graduate studies in Mexico and Uruguay

Disciplines	Mexico, 2001				Uruguay ¹			
	No. of students	Men	Women	% Women	No. of students	Men	Women	% Women
Mathematics	820	550	270	32.9	16	10	6	37.5
Physics	1 044	790	254	24.3	16	11	5	31.3
Chemistry	1 103	526	577	52.3	90	33	57	63.3
Biology	1 301	655	646	49.7	179	86	93	52.0
Engineering	14 184	10 842	3 342	23.6	92	62	30	32.6

1. Data refer to the number of students starting Masters and PhD programs during 1995-1999.

Source: La Mujer y la Ciencia Iberoamericana, GenTeC, April 2004

See <http://www.unam.mx/iisunam/nuevos/gentec/index.html>

Indeed, a greater participation of women in postgraduate studies is evident in all seven Latin American countries; however, it is not yet clear how important their presence is in scientific disciplines such as natural and exact sciences, as well as in engineering and technology. Figures corresponding to social sciences and humanities are usually largest in all seven countries under study, for it is generally accepted that the rhythm of academic careers in these disciplines is very different from that in the experimental and exact sciences.

Female population in PhD programs has increased in smaller proportions compared to the growth rates registered by women enrolled in master's degree programs. This is basically true for the Latin American countries included in GenTeC, where programs at master's level are more appealing to women than those at doctoral level. Moreover, it is well known that the largest number of applications for scholarships or other forms of economic aid to carry out postgraduate studies corresponds to the former level of education, regardless sex of the applicant.

It is now widely accepted that education is one of the most important variables in achieving full participation of both men and women if development is sought at a regional and national levels.

Although data shows the gap between men and women in education has been reduced significantly in the last years, there are still many challenges to be faced by government officials and policy makers in order to guarantee gender equity and equality.

Table 18.5. Female presence in PhD programs in Mexico and Uruguay

Disciplines	Mexico, 2001 ¹			Uruguay, 1995-1999 ²		
	No. of students	Women	% Women	No. of students	Women	% Women
Humanities	1 463	724	49	--	--	--
Exact and experimental sciences	3 499	1 424	41	123	66	53.7
Social sciences and law	2 084	873	42	--	--	--
Engineering and similar	2 087	555	27	10	5	50.0

Notes:

1. Includes exact, natural and health sciences, engineering, technology, agriculture and animal husbandry.

2. Data refer to the total number of students entering PhD programs in 1995-1999.

Source: La Mujer y la Ciencia Iberoamericana, Gen TeC, April 2004. See <http://www.unam.mx.iisunam/nuevos/gentec/index.html>

Unfortunately, most Latin American female scientists do not yet count on feminist associations or communities solid enough to facilitate their academic work and their organization and integration into scientific societies and professional groups. Indeed, scientific communities in some developed countries have made it easier for women to face the conflict between the “private” life (*i.e.* that which includes women duties at home) and the “public” life (*i.e.* the one referred to their role as a competitive researcher) through strong mechanisms which facilitate the establishment of links and networks. These groups have represented support spaces where it is possible to find answers, discuss alternatives, and to design strategies together.

Feminist theorists have emphasized the biased nature of science, pointing out that it is a human activity heavily influenced by prevailing social, political, and economic factors (Rosser 1988). Some have argued that a feminist science would differ from “masculine” science because of fundamental differences in female perspectives and female approaches to problem solving. Science, as commonly practiced, espouses an essentially male world view, and women scientists who wish to succeed must of necessity work within this view or perspective (Rathgeber, 1995).

Nonetheless, even when obligations at home are solved and the conflict between professional and traditional roles is defeated, women still face gender differences in terms of perceptions of job satisfaction, income level, and recognition from colleagues and society at large, regardless of their professional degree of success.

Finally, it is worth to mention that studies carried out in more developed nations show that integration of groups and formation of academic networks do not eradicate gender discrimination. Women show patterns which are far from a sense of solidarity. Actually, it has been recorded that female researchers in charge of scientific projects may discriminate against other women when selecting their assistants. Of course, it cannot be discarded that this behavior is also related to the fact that in many disciplinary areas, it is always easier to find a man colleague or a male apprentice than another woman researcher or student. It then becomes clear that mentoring could alleviate this situation as much as mainstreaming gender in the construction of new role models, free of gender biases.

Some additional sources of concern

In general terms, Latin American women are under-represented, under-employed and under-valued in most fields of work where they are hired; unfortunately R&D is no exception. In it, we find strong disparities starting from the number of school years and up to their acceptance, retention, and promotion in the academic sphere.

In most Latin American countries, government officials find it highly stimulating that student enrolment in higher education institutions already shows larger participation of women. At this point, they don't seem preoccupied with how small the group advancing to S&T higher degrees is. Due to the size of R&D communities, and the commitment to pursue a knowledge-based economy, Brazil might be the sole country in the seven Latin American countries participating in GenTeC moving effectively to escalate investment in S&T Human Capital. New policies and measures should be designed and implemented.

Governments are slowly acknowledging a long developed finding from demographic studies carried out all over the world: female participation in education and in S&T facilitates and promotes not only their own professional and economic individual development, but it also extends to other environments in their social and family life. For one, educated women have been shown to impact their children's health condition, not to mention their level of education.

It is still difficult for Latin American female scientists to obtain certain distinctions, to join some scientific societies or associations, or to attain decision making positions in universities as well as in science research centers. Academic rules –both formally and informally transmitted – indicate that there must be continuity in R&D endeavors and in the level of individual productivity; *i.e.* publishing results emerging from research projects.

Women at childbearing age resent these guidelines for they imply extra efforts and their lives become quite difficult during this period. Several studies carried out in the countries included in our study point at the complications women face when managing their professional careers; their life cycle and a double or triple work load are hardly compatible with full-time employment and research in the long term. The search for a balance between their “professional” and their “private” life is usually reached far from strict academic rules and well into teaching activities. Thus, regardless of the degree earned at school, while men publish research results, women raise families and perpetuate one of the most traditionally feminine roles: that of the educator.

In general, girls have a stronger interest in people and social issues, whereas boys often show interest in tinkering and understanding the mechanical foundations of technology (Kelly, 1985).

Available information shows, on the one hand, that male conform majorities in head and high responsibility positions in universities and R&D centers; it means that either men are not willing to share power, or that they are reluctant to rely on women’s capacity to occupy positions in those levels and perform satisfactorily. On the other hand, it is necessary to find out supporting data to disclose how many women in positions of power call or propose other women to occupy positions at similar or higher levels within an organization. As mentioned earlier, the absence of capable and available women to fill such positions is a reality.

Table 18.6. Female participation in S&T, by category

Country	1	2	3	4
	% women in S&T	% women	% women	% women
Argentina ¹	65	61	48	28
Brazil ²	38	35	25	--
Mexico ³	32	31	24	16
Uruguay ⁴	41	32	17	--
Venezuela ⁵	48	36	36	25

N.B.: Categories 1 to 4 refer to different increasing levels in the S&T system of each country.

Notes:

1. Data refer to faculty in national universities according to the five categories found in their “Incentives Program” (2001).
2. Data refer to “Productivity Bourses” given by CNPq (1999).
3. Data refer to researchers in the National Research System (SNI), 2001.
4. Data refer to researchers at Universidad de la Republica, 1994.
5. Data refer to the Researcher Promotion Program (PPI), 2002.

Source: La Mujer y la Ciencia Iberoamericana, GenTeC, April 2004

See <http://www.unam.mx/iisunam/nuevos/gentec/index.html>

There is a big gap between the quantity of women trained in S&T and the quality of the jobs they take and the activities they perform (the so-called “glass ceiling”). Despite the fact that we acknowledge a difference in the timing of highly qualified human resources, there is also another factor traditionally ignored and related to prevailing cultural values (the “sticky floor”).

However, as for women dedicated to R&D activities, there are few who manage to obtain a PhD degree, a full-time job, and a category as full-time researcher, all these being requisites of great importance for salary composition and access to grants and other forms of recognition. Even in the sphere of higher education institutions (HEI), female professors are more frequently found in short-term positions (contracts by the hour) or in categories such as part-time lecturers or researchers, all of which are inferior to the present-day full professor, who is the one with greater maturity and academic consolidation, characteristics which translate to higher income levels. Well enough, constraints of this sort have not prevented some women's entry to academia, and so, from successfully doing research.

Table 18.7. Female participation in national S&T systems

Disciplines	Argentina ¹	Brazil ²	Mexico ³	Uruguay ⁴	Venezuela ⁵
	% Women	% Women	% Women	% Women	% Women
Chemistry	65.2	49.1	0.34	61.1	*
Biology		53.0		46.6	55.8
Medicine and health sciences	65.9		0.38		
Mathematics	43.3	25.6	0.17	21.5	31.9
Physics		18.6		22.6	
Engineering	39.1	29.8	0.12	27.4	43.5
Agrarian and veterinary science	51.8	34.3	0.19	44.6	42.6
Social and legal sciences	69.7	58.8	0.31	43.56	58.6
Humanities	73.5	63.7	0.48		
Total (bourses)	59.7	45.6	28.6	41.0	47.8

Notes:

1. Data refer to Teaching Incentives Program, 2001.
 2. Data refer to CNPq individual bourses, 1999.
 3. Data refer to National System of Researchers, 2001.
 4. Data refer to faculty at the Universidad de la República, 1999.
 5. Data refer to Research Promotion Program, 2002.
- * Venezuela: chemistry data included in mathematics and physics.

Education, both formal and informal, transmits stereotypes; among them, gender biases which are reinforced by the lack of appropriate role models preventing women from considering scientific careers. It is therefore suitable to analyze available data from a gender perspective in every level of the educational pipeline. For instance, and even though it is difficult to get sex-disaggregated data in most developing nations, it might be interesting to analyze the categorization of universities' professorships as well as the contents of the materials being used in school for different disciplines.

Prevailing stereotypes of "appropriate" roles for girls and boys, men and women continue to inform the design of education programs at all levels, especially in countries where the influence of feminist thinking on curricular reform is still at an early stage (Rathgeber, 1995).

Organizing women scientific communities will surely contribute to accelerate the establishment of gender equality S&T policies as well as more adequate ways of integrating women scientists to carry out R&D projects.³ There is no doubt that a more active participation of women in the generation, diffusion, and application of knowledge still represents a goal to reach in many regions throughout the world. Latin American female scientists need to organize themselves and disrupt the characteristic individualism prevailing in the academic sphere in order to find solutions, which may lead them to achieve, in the short term, an adjustment in their roles and functions. It is assumed that if those changes are to take place in their working environment, they will certainly impact the roles and functions traditionally assigned to both men and women within the family and the society at large.

Some workable explanations and reasons to be hopeful

In the last years, women's participation in S&T has gained importance due to a greater awareness of the benefits her presence in these fields contribute to society, especially from the point of view of economic yields. Several rigorous studies have been carried out in order to document this situation, thus debilitating the long held attitude trying to explain the absence of women in education, science, and technology in terms of personal decisions rather than relating it to obstacles of the institutional or societal kind.

Traditionally, S&T have been masculine spheres, partially due to gender stereotyping but mostly to the lack of affirmative action programs and gender mainstreaming in almost all scientific disciplines. On the one hand, stereotypes have worked as ideological and social barriers preventing females from significantly impacting these professions; on the other, insufficient government policies and education-support programs have not yet influenced women's choices nor increased their presence in fields of knowledge where they have been traditionally absent.

A feminine labor force is not sufficiently represented in areas traditionally being occupied by men, such as science and engineering. Education policies have not yet emphasized the need to reinforce women insertion in this kind of careers or studies. That is why professional and job development have been restricted to females; even worse is the misuse of women's potential in terms of the impact of teaching in the process of tutoring future generations of both male and female scientists and engineers.

Undoubtedly, the relative absence of women in almost every educational level is closely related to their weak presence in national S&T systems. Several studies have been conducted with regards to this issue, in and out of the Latin American region; however, efforts should be multiplied in order to show conclusive evidences that scarce feminine participation is not solely related to the absence of policies designed to stimulate it; rather, it should be associated to a number of social, political, economic, and cultural factors.

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3. Interests promoting gender parity in every sphere of human action, especially in S&T, started in the United States in the 1970s. The *Association for Women in Science* was founded in 1971, while in Europe, it began in the 1980s. Following these initiatives, the European Union (EU) started its own efforts which in 1999 led to the formation of the "Helsinki Group" to examine the situation of women in Science for 30 countries. It is well known that a plan of action followed to promote gender equity in this area, and included the renowned ETAN Report, published in 2000. Unfortunately, no comparable efforts are yet found in Latin America or other developing regions of the world; nonetheless, some initiatives already being taken in a few countries should not be overlooked.

Most higher education institutions considered in GenTeC program were found to fall on the conservative side; they have a strong and rather inflexible hierarchical structure and their lately much-enforced evaluation systems without any doubt contribute to perpetuate some characteristics of the academic life they have to offer, among them the stereotyped masculine image of S&T. Women who make it to top positions sooner than later learn how to become less visible, thus affecting their own perceptions and degree of satisfaction as well as the image they portray before their students and colleagues.

There is a discussion on which are the factors encouraging female participation as well as those discouraging it, both in terms of her entry to the system and to her permanence in it.⁴ These two types of factors should be analyzed within specific socio-political, economic, and cultural contexts, besides those associated to the inner characteristics attached to each disciplinary field.

Women often end up in highly feminized fields such as teaching and nursing, while many more men enroll in engineering and scientific fields. Women are also most numerous in the field of education, where they often represent large percentages of Latin American University enrolments. In most of the countries covered by GenTeC, the second field of knowledge chosen by women turned out to be health and welfare, where women often account for more than half of the students. The next most frequent choice for women is humanities and arts. In contrast, female presence is weakest in engineering, manufacturing and construction courses and in science and agriculture.

Female participation in science has been recognized by UNESCO as a global challenge, and therefore, this point was included in the World Conference on Science, held in 1999. Among the various recommendations around science education, including the gendered dimensions, we highlight the following (OAS, 2004; 33):

- Governments should accord the highest priority to improving science education at all levels, with particular attention to the elimination of the effects of gender bias and bias against disadvantaged groups.
- New curricula, teaching methodologies and resources taking into account gender and cultural diversity should be developed by national education systems in response to the changing educational needs of societies.
- Educational institutions should provide basic science education to students in areas other than science.
- National authorities and funding institutions should promote the role of science museums and centers as important elements in public education in science.

In the same international context, a background event closely related to inequalities, insufficiencies, and disparities in the access of women to education and training, during the Beijing 4th World Conference on Women – and then again on Beijing +5 – one strategic objective was expressed precisely in terms of increasing female access to professional training, to science and technology, as well as to life-long education.⁵

4. It is assumed that if indeed there are female scientists, then there must have been various factors or conditions supporting them to pursue R&D as a professional activity. Thus, it is plausible to speak of “encouraging” factors.

5. See Beijing Declaration as well as the Action Platform of the Beijing 4th Conference, September 1995.

When analysing national S&T systems with a gender perspective, it becomes clear there are multiple factors generating existing differences among men's and women's participation; by doing so it is possible to design policies, programs and mechanisms to alleviate these and other inequalities which are evidently impeding social development as a whole. Among them, 1) access to every single educational level in the formal education system; 2) equal opportunity for both personal and professional development; 3) higher consideration of traditional feminine roles which, along with those arising from women's professional attainment are impacting their capacity to respond, their performance, and so on.

We cannot finish this section without mentioning that regrettably there are also under-represented minorities in S&T in many developing nations. Latin America is no exception to this statement, which makes women's situation even more deplorable since it is especially the female component of indigenous population the one left aside from education, not to mention whatever follows from there. It has been mentioned that women perform tasks as teachers and care givers; the issue is they do that regardless of their educational level and degree of consciousness on the responsibility they carry on.

Health practices are not modern neither westernized within most indigenous groups but it does not mean they do not own some kind of "local knowledge" and skills which are constantly evolving and allow them to build further social differentiations between men and women. The fact that indigenous knowledge is not patented nor is it "scientifically" framed entails a discussion which eventually lands in grounds full of myths instead of understanding the reasons behind common indigenous practices. If the west keeps underestimating this kind of knowledge, the whole world will soon face the risk of loosing it forever.

The invisibility of women's technology is linked to the domestic nature of their work (which denies its technical content) and the fact that women's techniques tend to focus on processes and organizations of production rather than "hardware" and are, therefore, less prestigious and have a lower profile. However, at the community level, it was clear that women's technical skills are critical in survival responses to crises and problems...(Appleton, 1995).

Incorporating minorities and indigenous populations to every educational program will eventually bring about the recognition of women as "guardians" of traditional knowledge in areas related to food production, biodiversity, traditional medicine (including *Herbolaria*; i.e. herbal medicine), and several practices related to resource management in their own environment.

Concluding remarks and some lines of action

Aside from its misuse, female under-representation in education, science, and technology is an injustice with a relatively high cost to society, not only for its negative impact on the pursuit of the general objective of equity, pretended to be reached by most nations.

In general terms, in the field of S&T all seven analyzed countries lack specific public policies to promote a more significant incorporation of women, or the consolidation of those who already are participating.

Though the enrolment of students in higher education already shows important female participation, only a small percentage is inclined to the study of disciplines linked with R&D. If every effort continues to remain at the individual and isolated level, these Latin American countries will linger behind in matters of S&T as well as in their effort to remedy underdevelopment. Indeed, the struggle to achieve higher levels of wellbeing for their populations is commonly related to S&T investment and performance.

It is highly recommended to include a gender perspective when analyzing the legal framework ruling R&D activities as well as Education; as long as gender is not given its proper dimension, marginalization and discrimination of women will continue deteriorating the likelihood of any developmental goal.

Finally, it is necessary to take measures to guarantee women equality at the entrance level as well as their participation in decision making processes and structures of power. If this is not done, it may reinforce the unfortunate fact that most of these countries will lose the opportunity of counting on qualified human capital whose potential could represent large benefits for higher education and for several sectors of their national economies, and especially for science and technology, where human resources continue to be a scarce good.

In the following paragraph several lines of action have been chosen to depict the kind of programs and policies needed to increase female participation in S&T. Even though some of them are already in practice and we have witnessed some promising results, there is still room for improvement in as much as some discriminatory evidences demonstrate the path that should be followed:

- Increasing women's participation in education at all levels and disciplines; especially with marginal, rural, and urban lower social classes.
- Diversifying female growth rates in education at all levels and among all disciplines, aiming at equaling men's numbers, at a regional and state level.
- Expanding R&D spending, both public and private; and scattering S&T personnel and activities, both currently concentrated in academic institutions in the center, a situation which promotes vertical and horizontal segregation, especially in the periphery.
- Enhancing the presence of female scientists in R&D and mobility in already small academic communities.
- Promoting support and special scholarship programs for the re-insertion of women back to the scientific community after a leave of absence.
- Raising numbers of young people interested in S&T, especially women, undoubtedly constitutes a window of opportunity to mainstream gender at an "early" stage while alleviating the burdens of career choices.
- Contributing to revise and re-design science curricula and its materials in order to shatter negative stereotypes about women's traditional roles and their performance in science.
- Looking for alternatives to the ageing faculty problem currently faced by many public HEI in Latin America constitutes another window for mainstreaming gender while recruiting and promoting.

- Escalating public interest in S&T, targeting women so that more modern and flexible feminine role models spring out for young students to emulate.
- Stimulating female participation in S&T networks and international associations in order to recover visibility and get recognition.
- Designing S&T policies and job descriptions that are sensitive to women's needs and requirements in different stages of their lives.
- Building the knowledge society through gender equity and equitability.

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Chapter 19

SUPPLY AND DEMAND-SIDE ACTIONS TO PROMOTE WOMEN IN S&T: LESSONS FROM THE UNITED KINGDOM RESOURCE CENTRE FOR WOMEN IN SCIENCE, ENGINEERING AND TECHNOLOGY

Jane Butcher

Women Returners Manager

UK Centre for Women in Science, Engineering and Technology

Introduction

In 2005 in the UK we celebrate the 30th anniversary of the Sex Discrimination Act and of the establishment of the Equal Opportunities Commission. Yet we also mark a mere 0.6% reduction over the past 12 months in the gender pay gap for male and female full-time earnings to 17.2%, and 1.1% for the gap between female part-time earnings and male full-time to 38.5%.

Recent work by the Equal Opportunities Commission has helped to refocus occupational segregation as the main contributor to the gender pay gap and place this in the context of skill shortages and drivers for economic growth and increased productivity in science, engineering, built environment and technology sectors. There are now more women than men in the UK labour force but they still remain concentrated in a woefully narrow range of occupational areas and at lower levels. This picture is equally true of academia and worse in SET academia.

UK is presently consulting on the new public duty on Gender Equality to largely bring the provisions for sex equality legislation in line with the more positive provisions for race and disability. However, there is some concern that the education sector will not be covered by specific duties.

Extension of maternity leave provisions, better parental leave arrangements and the right to request flexible working for parents of young children and those with disabilities also provide a more favourable context for the promotion of greater work life balance and focus on employee retention in the SET sectors.

Since the mid-1970s the UK has seen a variety of positive action measures to support women to consider and gain access to occupational areas where they are under-represented and specific schemes and organisations for women in SET. These have been largely characterised by being “run for women by women,” based within the voluntary sector or at the margins of mainstream further and higher education institutions. While successful in delivery, raising awareness and creating good practice models these initiatives have also been hampered by marginal status, small scale, short term and discretionary funding whether from local or central government or from European funding or charitable sources. The need to address mainstreaming and sustainability of initiatives is usually seen as a key criteria of funding approval, but is not adequately resourced or supported by the sponsoring organisations and difficult to achieve for small projects alone.

The Greenfield Report and subsequent Government Strategy for Women in SET identified the need for greater co-ordination to maximise impact and focus on creating change in the culture and working environments of SET.

The UK Resource Centre for Women in SET

The UK Resource Centre for Women in SET (UKRC) has therefore been established to provide a lead and focal point for both supply and demand side actions to support women’s participation, retention and progression in learning and work in key areas of science, engineering and technology and to concentrate on assisting women to senior levels to influence organisational culture and practice and provide greater visibility and encouragement to young women then entering these fields.

Following a competitive tendering process the contract for the UKRC was awarded to Bradford College as the lead for a core partnership of Sheffield Hallam University, the Open University and Cambridge University.

The UKRC currently has central government sponsorship to 2008. We are building on previous partnership work within the regions which included training for learning providers to change the culture of learning environments, and the development of mentoring approaches and networks. We have succeeded in drawing together a wider coalition of partners under the umbrella of Jive – Joining Policy, Joining Practice. We are utilising EQUAL ESF funding to add value to the UKRC activity and widen the scope to also include craft and technical occupations and work-based progression routes. This additional funding is enabling the establishment of national centres for Wales and Scotland and regional hubs in several English regions.

However, while benefiting from significant government funding relative to the identifiable prior spend on such initiatives, the UKRC does not have the leverage of governmental targets. The only significant public target relates to the representation of women on SET-related boards and committees – 40% by 2008, about which there remains some uncertainty about levels and measurement. Current baseline estimates stand at 26%. Some of the issues for metrics for the performance and impact of the UKRC relates to the lack of comprehensive baseline data and the lack of disaggregated statistics for private industry in particular. Maximising Returns and the Greenfield Report identified the huge gap between women with SET qualifications and those active in the SET workforce – only 25% of women with SET qualifications above degree level are working in SET occupations. It was then estimated that 50 000 women existed as a pool of potential returners to SET careers.

UKRC is backed by a high level Implementation Group looking at the overall success of the Government Strategy. Members of this group are independent individual practitioners appointed through the public appointments process. The membership is currently all women. They do not represent their sector or organisation. UKRC has also drawn together a National Advisory Group of stakeholders from the sectors to provide strategic and operational input with a commitment to assist in influence and access to key players in their sector.

The UKRC has therefore largely set its own initial delivery targets based on the key areas of intervention specified in the Government Strategy. UKRC activity covers co-ordination of initiatives for women in SET, influencing of funding, public policy development and employers' policy and practice, data-collection and development and sharing of resources, provision of funding for projects and direct delivery of services to women, employers and sector bodies.

Within our delivery agenda a key element is the support for women's career progression and specifically to encourage women with SET qualifications who are not working in SET to return to their career path and address the barriers to returning to SET after a career break.

The RETURN Campaign

The key elements of the RETURN campaign services are:

- Active promotion of RETURN as a campaign message.
- Information, referral and response to individual enquiries and support needs, with a target of 1 000 women.
- A new on-line course by the Open University addressing generic issues for returning to SET employment for women from a wide range of back-grounds with access to industry specialists to develop an individual action plan. We have a target for 600 women on this programme and aim for 300 to return to SET careers. 123 women are engaged on the first course which runs to December 2005. The women will be engaged in a research and evaluation project conducted by the Open University and wider evaluation of the usefulness of the RETURN services overall.
- Mentoring and networking activity for the RETURN participants including links to local support through hubs in the regions. The UKRC also has a wider mentoring strategy which includes schemes with large corporates, professional institutes and universities.
- Links for progression to other existing and funded projects such as the Daphne Jackson Trust Fellowship scheme and the Equalitec project for returners to ITEC careers.
- Partnership work with L'Oreal UK has also led to the design and launch of 3 new bursaries for women returners to SET research which will enhance the L'Oreal For Women in Science Programme in the UK.

We are currently developing a responsive package of progression support measures for women participants including placements with supportive employers willing to engage in further work with UKRC. We will also shortly be targeting employers to set up part-time and jobshare opportunities at senior levels suitable for women returners. This work will be linked to our promotion of a new kite-marking award for SET employers. Some large companies in the UK already have positive measures to retain existing staff, but not necessarily creativity in recruitment to enable returners to gain access.

Under the RETURN umbrella the UKRC is also supporting an evaluation of the work of the Daphne Jackson Trust in providing two-year part-time fellowship funding for around 130 returners mainly to research careers in SET since 1992. This report will be available in April 2006.

UKRC is also working with the Athena project to take forward a legacy strategy for the work which commenced in 1999. Since this time a wealth of reports and Good Practice Guidance has been produced as outcomes of work with HEIs. This has included two annual runs of the ASSET survey with over 40 participating universities and most recently a pilot of the ASSET survey with 4 of the 8 UK Research Councils.

UKRC is now working with Athena to ensure the ASSET survey findings inform individual action plans for equality and diversity with the Research Councils.

Athena has also now partnered with the SWAN initiative at London Metropolitan University to create the Athena/SWAN Charter which provides a comprehensive self-assessment and bench-marking tool for HEIs and science departments. We are now looking at adaptation of the award for use by the research councils for their directly funded staff.

Along with the UKRC's own Cultural Analysis Tool for SET employers and the forthcoming Kite-marking scheme, we now have a range of products at our disposal to assist employers in both the public and private sector, industry and academe and suitable for both small and medium-sized enterprise and large employers.

Strategic work for removal of structural barriers

The links developing with the Research Councils and with the new umbrella body for the eight councils, Research Councils UK, are also providing insight to the persistent barriers.

We know that when women apply for research funding they are equally successful as their male counterparts. However, women do not apply in proportion to the numbers in the potential talent pool. This is linked to the high level of attrition in research careers particularly at post-doctoral level.

The dual funding system for research in UK universities via the research councils and the Higher Education funding bodies seems to create a responsibility gap in proactive and assertive action to remove barriers. The HEIs are the employer for most research activity funded by the research councils and hence the implementation of the new EU Charter for Research Careers and Code of Conduct for Recruitment of Researchers will be taken forward via the formulation of a revised Concordat between the Research Councils the Higher Education Funding Bodies and the Universities. This will be a lengthy and bureaucratic process in which the positive spirit of the Charter is in danger of losing momentum.

The Research Assessment Exercise (RAE) for the allocation of quality marks and thereby research funding from the Higher Education funding bodies has also been shown to produce potentially discriminatory impacts for women who are at lower or more tenuous positions in the contract hierarchy. Guidance for assessment panels now includes explicit recognition of the impact of career breaks on research outputs and publication records, but HEIs are still able to select staff for inclusion in the RAE based on their own judgements. It is too early to tell if the impact of legislation and guidance to reduce the long term use of fixed term contracts will have positive effects for the many women who have spent years in such insecure employment.

Generally good employment and human resource management practice including induction, quality supervision, appraisal, access to staff development, inclusion of new and fixed term staff in the department structures, training for those with line management responsibility, transparent and open systems for recruitment and particularly for promotion, ensuring gender balance on panels, would all assist in supporting women to remain in research and academic careers and create the climate where women taking a career break are motivated to return.

The UKRC has identified a number of actions with the Research Councils UK to seek to remove myths and out-of-date perceptions of barriers to research funding. We intend to work together on the collation and analysis of diversity statistics on funding awards at all levels to review progress.

However, it is a long way off before progress on equality and diversity indicators is directly linked to funding awards to institutions or integrated into the scorecards for the performance of the funding bodies themselves.

But perhaps there remain wider and more conceptual and ethical issues relating to the attractiveness of research science to women for a long term career.

The different issues, climate and pressures in industrial research:

- Is it “science” – who defines and decides.
- Definitions of academic and research excellence.
- Look at men taking up flexible working, paternity/parental leave provisions, part-time working and comparable impacts on their career progression and status.
- More research on entrepreneurship as a route for both progression and return to SET careers?

Chapter 20

WOMEN IN SCIENTIFIC CAREERS: THE CASE OF ITALY

Sveva Avveduto

*Head of the Section on Human Resources and Knowledge Society
Institute of Research on Population and Social Policies
National Research Council, Rome, Italy*

Many organizations, institutions and scholars have analyzed the gender gap, which has been examined by different means and relative to different contexts. One recent report released by the World Economic Forum (WEF, 2005) measures the performance of 58 countries with regard to the *economic participation* of women (*i.e.* their presence in the work force in quantitative terms); *economic opportunity* (as the quality of women's economic involvement, beyond their mere presence as workers); *political empowerment* in terms of equitable representation of women in decision-making structures; *educational attainment* as the most fundamental prerequisite for empowering women in all spheres of society; and *health and well-being* as access to sufficient nutrition, healthcare and reproductive facilities, and issues concerning the fundamental safety and integrity of people. The gap, states the report, is still very wide for many features and in many countries according to the different indicators considered, but women's participation is by no means a question of gender equilibrium but rather, "countries that do not capitalize on the full potential of one half of their societies are misallocating their human resources and undermining their competitive potential". The report underlines that although much has been done, utilisation of the full potential of a nation's human resources is far from being reached.

The same considerations apply, possibly even more strongly, if we refer to the area of production and diffusion of knowledge. To reach the highest levels of attainment in higher education, research and innovation, it is necessary to rely on all potential talents and women often still continue to be not included at a level where they may allow society to benefit from all available talents in science. This turns out to be both a waste of individual intellectual capital, and of social and economic investments.

The OECD has recently studied extensively the topic by the means of its Ad Hoc Working Group on Steering and Funding of Research Institutions (SFRI), which has opened, as part of its work programme on human resources in science and technology, a line of activity on issues surrounding women in science.

Human resources for R&D: main trends in supply of S&E students and graduates in Italy

The growth in demand for human resources for science and technology (HRST) has been constant in OECD countries for the last decade. Occupations in the area of science and technology or those that require a related qualification represent some 20% to 35% of the labour force in the OECD countries and are growing at a constant rate (OECD, 2004). As the total number of researchers in the OECD area grows, the demand for researchers is diversified but the business sector has been the driving force in raising the demand since the 1990s.

The supply of highly skilled personnel is of course nourished by the education pipeline that creates the pre-conditions for an adequate inflow of skills and competencies at different levels. In particular, science and engineering graduates are regarded as the most relevant to assure the creation of a sound science base and to fill research positions. The number of this kind of graduates continues to grow at OECD level, although at a slow pace, and there are of course large country variations in supply by level of education (bachelor level vs. PhD) and by field of study (science vs. engineering).

In Italy, there has been a constant increase in university enrolment since the 1990s. Although there was a slowdown in the late 1990s and early 2000s, enrolment is on the rise again.

There was a more substantial slowdown in science enrolments, but since the 2003-2004 academic year more and more students are opting for science courses.

In 2004, enrolment in many science courses increased over the previous year. This increase reached 21.5% in chemistry, 13.3% in physics and 7.4% in biotechnology, while decreases occurred in biology (-6.4%), earth sciences (-8.4%) and informatics (-5.2%).

For the purposes of this paper, the relevant indicator is the share of female participation in education in science and engineering fields, and subsequently in science and technology careers. In female participation the imbalance is still high. In 2004, out of the 2 254 new enrolments in physics only 691 were female and out of the 2 347 in chemistry, 961 were women. As for biotechnology, there is a more equitable distribution: out of 4 441 new enrolments, 2 851 were female.

The most recent figures on new enrolments (Table 20.1) show a rising trend in female participation in science studies, particularly in chemistry and biological sciences.

Sine 1992, at graduate level (ISCED 5b) in all disciplines the female share, as a share of the total of all disciplines, has always exceeded the share of males. The last available figures for 2004 show a share of 58 females per 100 graduates (out of a total of 268 821 graduates in 2004, 154 698 were women).

In the same year, 16 456 of the 53 429 science graduates were women. Out of the total 34 543 engineering graduates, 6 625 were women (Table 20.2 and Figure 20.1). It should be noted that the growth in number of female graduates has been constant in absolute numbers between 1999 and 2004.

Table 20.1. University students newly enrolled in science and engineering fields by gender

Field of study	2004-05		2005-06	
	Total	Female	Total	Female
Biotechnology	4 441	2 851	4 350	2 744
Civil engineering	6 165	1 637	6 268	1 563
Information engineering	14 324	2 122	12 479	1 830
Industrial engineering	14 192	2 433	13 619	2 542
Biological sciences	9 782	6 673	10 234	7 044
Earth Sciences	1 458	424	1 351	459
Chemistry	2 347	961	3 232	1 516
Physics	2 254	691	2 312	742
Informatics and computer science	7 523	922	6 495	815
Natural and environmental sciences	2 798	1 229	2 662	1 263
Mathematics	1 850	961	2 094	1 110
Subtotal	67 134	20 904	65 096	21 628
Total new enrolments	346 233	189 367	329 440	183 643

Source: Ministry of Universities and Research Office of Statistics, 2006.

Table 20.2. University graduates in science and engineering courses, 1999 and 2004

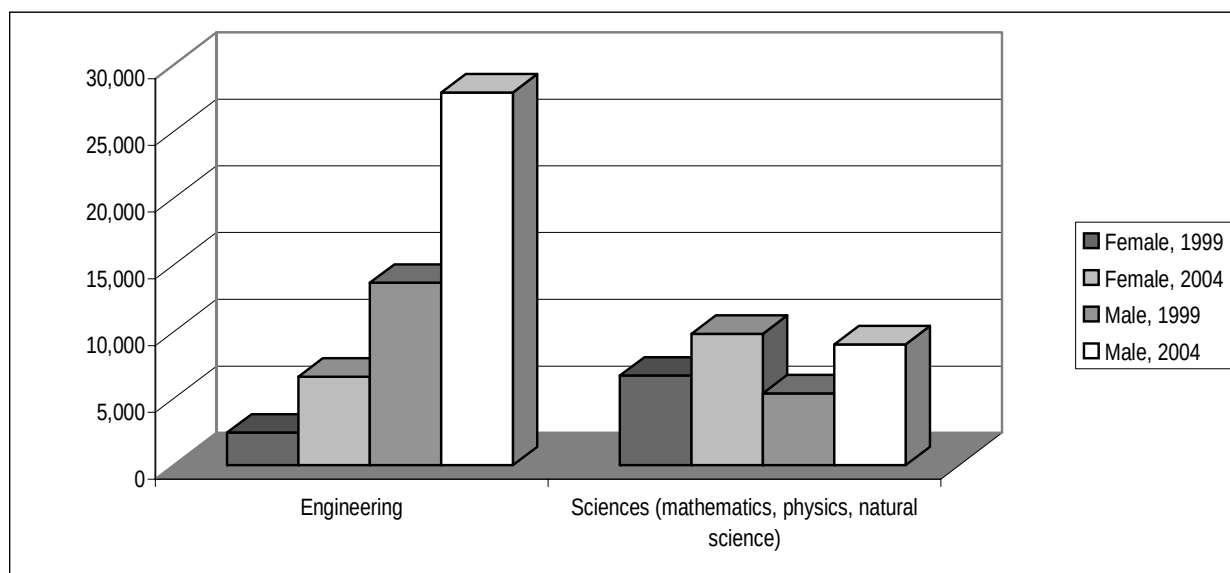
Field of study	1999 ¹			2004 ²		
	Total	Female	% Women	Total	Female	% Women
Engineering	16 117	2 450	15.2	34 543	6 625	19.2
Sciences (mathematics, physics, natural science)	12 098	6 710	55.5	18 886	9 831	52.1
Total	28 215	9 160	32.5	53 429	16 456	30.8

Notes:

1. Includes only 4 and 5-year courses.

2. After the reform, 3-year courses are also included.

Source: Ministry of Universities and Research Office of Statistics, 2006.

Figure 20.1. University graduates in science and engineering courses, 1999-2004

Source: Ministry of Universities and Research Office of Statistics, 2006.

If we look at the PhD level, in the OECD countries women account for around 27% of S&E doctorates, while in Italy they accounted for 46% in 2003. The share is very high in some fields, such as biology where 72.2% of PhDs are women, and chemistry (60%), while still very low in physics (28.5%) and informatics (15.6%), as seen in Table 20.3.

The current level, and the trend in the last few years, of women in science and engineering studies in Italy seems to underline a growing interest that may potentially lead to a future stronger placement of women in science careers.

Table 20.3. Science and engineering doctorates awarded in Italy in 2003, by gender

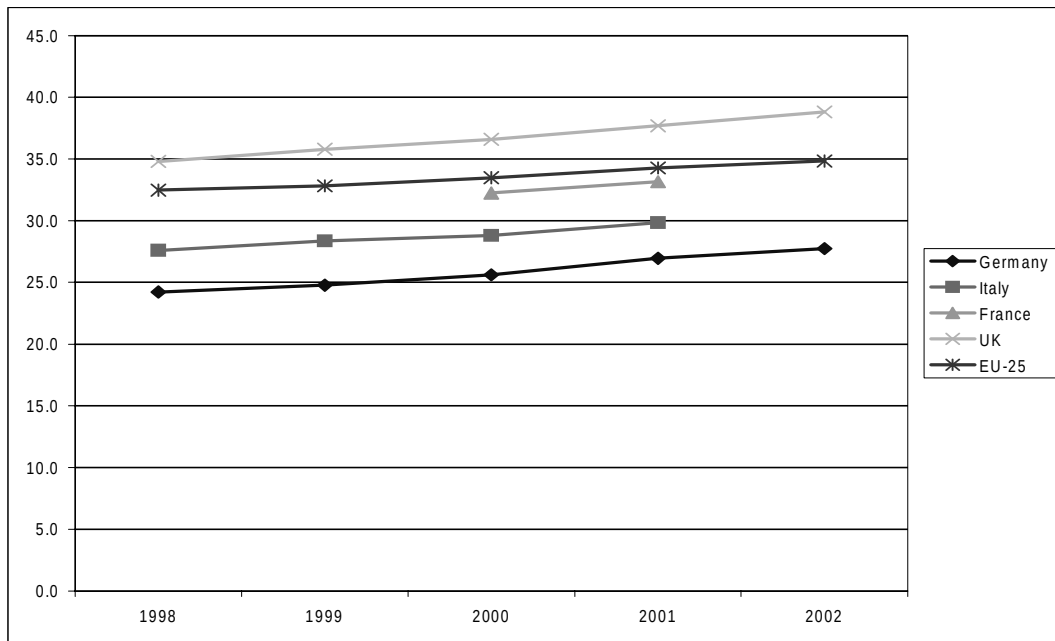
	Male	%	Female	%	Total	%
Civil engineering and architecture	222	51.0	213	49.0	435	13.3
Informatics	301	84.3	56	15.7	357	10.9
Industrial engineering	328	74.2	114	25.8	442	13.5
Agriculture sciences	131	48.0	142	52.0	273	8.4
Biology	187	27.5	493	72.5	680	20.8
Chemistry	164	41.2	234	58.8	398	12.2
Earth sciences	90	50.0	90	50.0	180	5.5
Physics	245	71.4	98	28.6	343	10.5
Mathematics	95	60.5	62	39.5	157	4.8
Total	1 763	54.0	1.502	46.0	3.265	100.0

Source: Ministry of Universities and Research Office of Statistics, 2006.

Women in science careers in Italy: some figures

The figures for some selected countries show a slight but constant increase in the presence of women in the academic sector in the period 1998-2002 (Figure 20.2). The distribution of women among academic staff by field of science varies across countries. In Italy, the highest share is to be found in humanities (Figure 20.3).

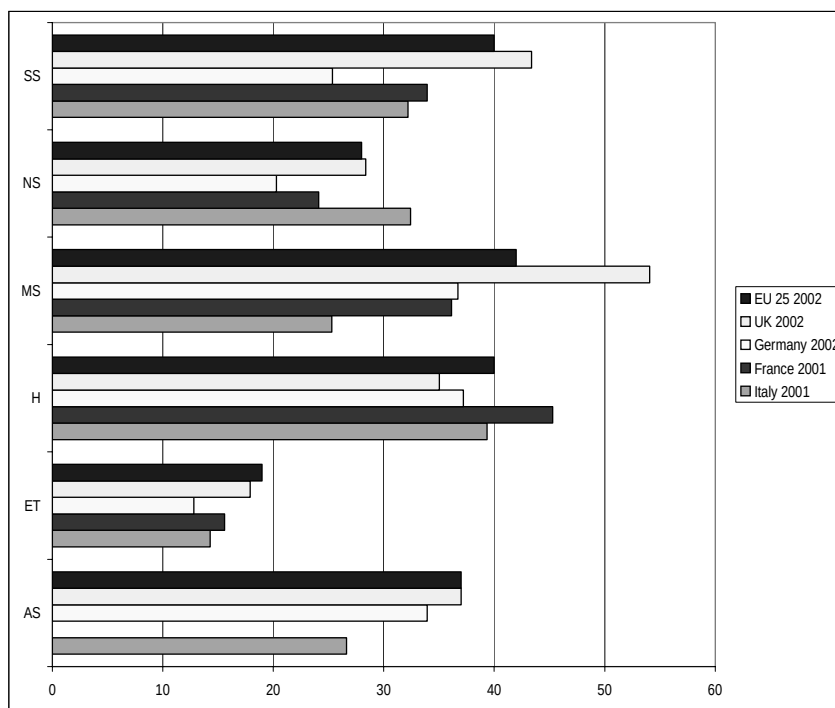
Figure 20.2. Percentage of women among academic staff, 1998-2002



Source: Eurostat, 2005.

Although they account for 46% of today's Italian PhD graduates in S&E, women in science careers are still well below parity. In 2002, they amounted to only 19% of researchers in enterprises, 38% of researchers in government institutions and laboratories, and 30% in higher education.

Although female presence in science careers is growing, the share of women reaching high-level positions in academia and research is rather low. In Italy, the most recent figures released by the Ministry for Universities and Research, referring to 2003, show that out of some 18 000 senior full professors, fewer than 3 000 are women (Table 20.4 and Figure 20.4). For the top positions, the situation is even worse: only two out of the 83 rectors of Italian universities are women, and in the research institutions the case is similar: there are no women among the presidents of public research institutions, and only two out of 105 directors of a research institute of the National Research Council are women. A thorough analysis of the under-representation of women in the Italian research institutions (Palomba, 2000) underlines how the question is not being tackled adequately at public level.

Figure 20.3. Percentage of women among academic staff, by field of science

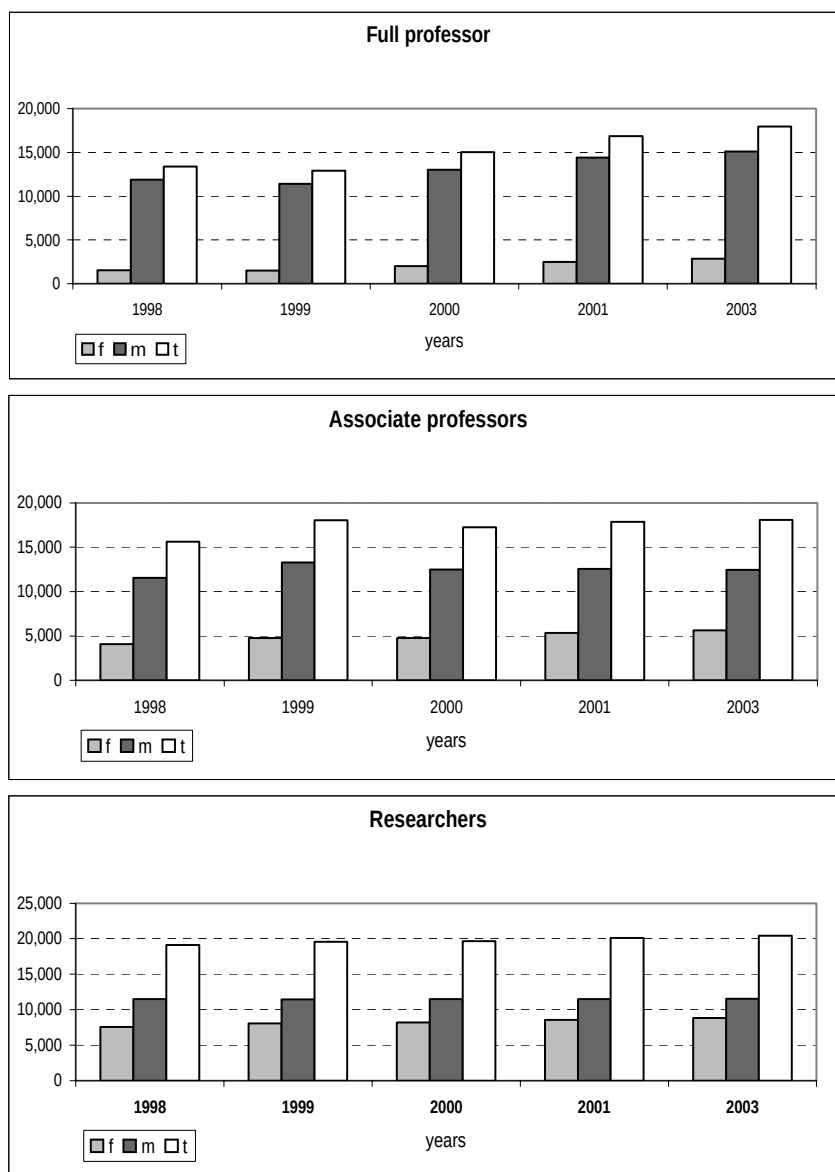
SS = Social sciences. NS = natural sciences. MS = medical sciences. H = humanities. ET = engineering and technology. AS = agriculture sciences.

Source: Eurostat, 2005.

Table 20.4. Academic staff in Italy, by grade and gender

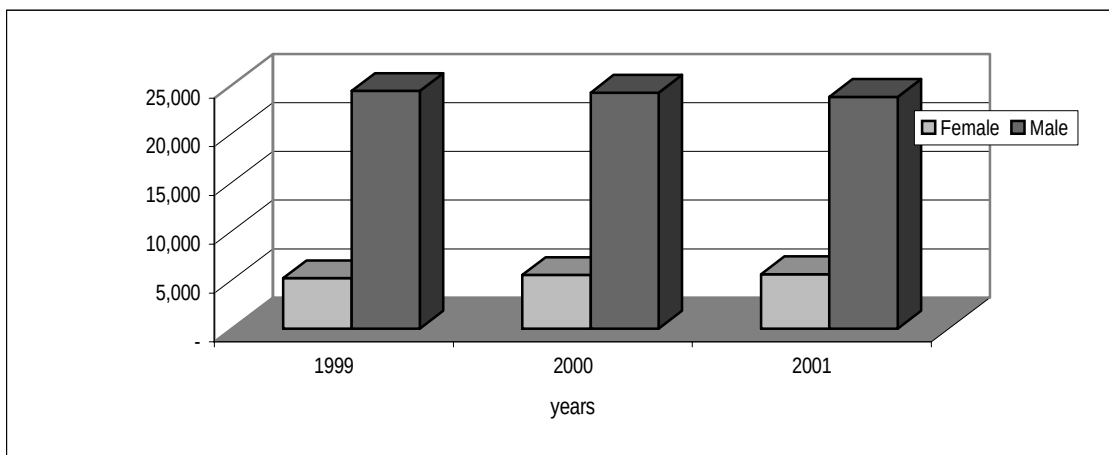
Grade	Gender	1998	1999	2000	2001	2003
Full professors	Female	1 525	1 497	2 002	2 468	2 863
	Male	11 877	11 416	13 024	14 423	15 093
	Total	13 402	12 913	15 026	16 891	17 957
Associate professors	Female	4 073	4 746	4 781	5 324	5 637
	Male	11 546	13 280	12 478	12 551	12 458
	Total	15 619	18 026	17 259	17 875	18 095
Researchers	Female	7 585	8 083	8 187	8 580	8 871
	Male	11 505	11 473	11 481	11 510	11 552
	Total	19 090	19 556	19 668	20 090	20 423

Source: Miur and Cnvsu, 2005.

Figure 20.4. Academic staff in Italy, by grade and gender

Source: Miur and Cnvsu, 2005.

In the business enterprise sector, the presence of women researchers is increasing (Figure 20.5) although the number of research personnel in industries has remained steady since 1999.

Figure 20.5. Researchers in the business enterprise sector in Italy by gender, 1999-2001

Source: Istat.

Policy initiatives

In Italy there are no specific policy initiatives at national level to attract and retain women in higher education and in scientific careers. Some initiatives are taken at individual institution level for women scientists already working in the organization. These initiatives are generally very practical in nature, aimed at helping women balance work and childcare. For example, this has been the case at the National Institute for Physics Matter, which organises day care during meetings and conferences on the Institute's premises. Although these are very minimal commitments, they are rare examples of direct support being provided.

UNESCO states that “education in science and technology has been based on stereotypes and approaches that do not favour women's involvement. A full and equitable participation of women in scientific and technological activities will contribute to the enrichment and re-orientation of science and technology programmes, approaches, practices and applications. It is necessary to develop strategies and policies to facilitate women's access to scientific and technological knowledge, simultaneously increasing their participation in all scientific and technological activities” (UNESCO, 2005).

If we agree with the statement above, a mix of formal and informal measures, and of direct and indirect initiatives should be put in place. Initiatives should be aimed both to change mentality and attitudes, and to introduce more direct measures, *e.g.* to favour the introduction of direct channels for obtaining specific grants and special positions. But the implementation of such kinds of measures to promote women's participation is an issue which is yet to be completely explored in Italy in order to both ease women's access to science careers and subsequently retain them.

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Part 5

CONCLUSION

CONCLUDING REMARKS

Maria Stratigaki
Department of Social Policy, Panteion University
Athens, Greece

I thank you for the invitation to participate in the concluding panel of this workshop, which I found very interesting and very encouraging for future OECD action in this field. Being the only person from academia on this panel, I would like to take the opportunity to highlight for the audience of policy makers (representatives of OECD member states) some aspects of the problem of women's under-representation in research and science. I examine them in the light of findings from women's and gender studies in the scientific and technological fields. I believe that policy making can greatly benefit from knowledge produced in universities that enables it to improve its efficiency.

Most of the speakers in this workshop seem to perceive the problem as one of women facing obstacles, visible or invisible, to progress in their scientific careers. This economic (and human resources) approach to the problem is of considerable significance. Much public policy reflects such an orientation, developing measures that may enjoy great success. In today's environment, where economic priorities tend to predominate in government decision making, arguments drawing on economic considerations seem to have better chances of being taken up and of influencing mainstream state policies. Nevertheless, policy measures may be improved and enabled to become more effective if a broader perspective is taken, so that a given problem may be seen in its true dimensions, embedding analysis in a wider socio-political context. This is in any case what in fact happens with all socially constructed policy problems, since society cannot be analysed purely and simply in economic terms.

I will accordingly summarize the debate in this workshop by drawing attention to two important aspects of the problem of women's participation in scholarly research and in science. My understanding of it derives from a theoretical conception of "gender" more as a social construction and relation than as an attribute of human biology, predicated on whether one is a woman or a man. Scientific and research structures (institutions, processes, policies) are in this sense gendered independently of the sex of scientists and other people involved in them. To highlight this, one need only cite two separate but closely inter-related aspects of the problem: namely, gendered scientists (and researchers) and gendered scientific (and research) systems.

Gendered scientists

Most workshop papers mentioned specific women's roles in the family, women's preferences and working arrangements in some scientific fields (typically those more closely associated with domestic work and caring activity), problems of reconciliation and obstacles caused by motherhood. The target of attracting more women to science could be achieved through removal of some of these 'obstacles' faced by women. But the relevant policies aimed at upgrading their involvement in their careers typically neglect

very important social aspects of women's everyday life and work. The fact that too few women are employed in scientific and technological fields is in no way unrelated to the fact that not enough men are employed in the social sciences, in caring professions, in domestic tasks and in childcare. Men's "preferences" for science, technology and professional life is the other side of the coin of women's "preferences" for everyday life, caring professions and social sciences. Women's position in the labour market is a direct consequence of men's position in the household. The position of "women" in economic and social terms (and even in political terms) cannot change in the absence of a corresponding change in the position of men, given that the social, economic and political position of women is inextricably interlinked with that of men.

Policies targeted at women as individuals encouraging them to upgrade their achievement and aim at equality with men in the research, technological and academic fields should be designed and implemented, as should corresponding programmes to encourage more participation by men in the social sciences and caring professions as well as in domestic tasks. Positive action favouring women can be successful in the long run only if there is parallel positive action favouring men in the sectors and occupations where they are underrepresented.

The introduction of parity (50% women-50% men) in all jobs, positions, posts of responsibility, *etc.* is in my view the only practical and efficient measure with the potential to secure equal sharing of human and economic resources, power and time between women and men. In France, host to this workshop, the Jospin government succeeded in introducing a law on parity in politics. Introduction of the principle of parity, in recognition of the fact that humanity is comprised both of men and of women, represents a consummation of French universalism. The basic principle (and rationale) of this law is, I believe, readily extendable to other fields of economic and social life. Public services, universities, boards of directors, and committees of public and private interest can become more "mixed" and thus more democratic and efficient if and when both sexes take part in equal numbers. Establishment of the goal of equal participation (parity) in all scientific fields and institutions will bring about significant changes of gender distribution in the physical sciences and among social scientists and care givers. Policy measures targeting women can never be sustainable if they are not accompanied by complementary policy measures targeting men.

Gendered scientific structures (institutions, processes and policies)

A number of presentations at the workshop highlighted major problems being caused by gender bias at all phases of the scientific development cycle. This applied for the operation of research institutions, for research management systems and for evaluation processes. The creation of images of "good" scientists, political discourse about science, nominations for prizes, awards, *etc.*: all these are gendered processes and mechanisms for shaping the gender roles of the women and men involved in them. "*Research by women, for women and about women*" was the European Commission's motto when it launched its policy on "women in science". These three dimensions of the interrelation between women and research (and science) are indicative of the extent to which the research process, and indeed science in general, is gendered, highlighting the way that these processes reproduce gender-stereotyped behaviour and shape scientific career paths. The concepts of scientific excellence, objectivity, scientific progress and other 'qualities' associated with science are all evidently highly gendered.

Johannes Klumpers of the European Commission has reminded us of the advantages of inclusiveness, diversity and the interdisciplinary approach in science. Quality in the sciences can be improved if actors (researchers) bring to their research activity a wide range of experience and knowledge as well as a variety of social and political standpoints. For the last 30 years gender studies have contributed to refining theoretical analysis of technological change and scientific development and to improving understanding of its social aspects. It has been widely demonstrated that science and technology are social products, incorporating social and economic priorities into every phase of their life cycle. Gender relations introduce new hierarchies into the social forces, so shaping the social and economic priorities embedded in the scientific process.

More, and better, research on how scientific systems (institutions, processes and policies) operate in promoting or challenging stereotyped attitudes towards women and men may be instructive for the design and implementation of related public policies. Maria Bordons's presentation was most illuminating in this respect. Refinement of the statistical analysis and further qualitative research into critical issues affecting women in science could place arguments of this kind on a solid basis. Hidden discrimination in selection and promotion criteria for men and for women and in decision-making determining the orientations of scientific research and technology may point not only to sex-based injustice in staffing but also to male bias in terms of procedures.

The role of the OECD in promoting women in science

Everyone knows that the OECD is an international economic organisation and not a feminist or socially oriented non-governmental organisation. The OECD enjoys high prestige among its member states. Its economic statistics and analysis and its policy recommendations are highly respected by the international political and scientific community. Such a reputation does not hinder the OECD from arguing in favour of more women in scientific and technological occupations. Quite the opposite: such policy goals are perfectly compatible with OECD's economic orientation when it highlights the waste of human resources and talent entailed in under-representation of women in scientific jobs. Other economic arguments frequently cited include the loss in terms of scientific excellence, competitiveness and productive efficiency.

An array of (traditional) policy instruments can be worked out on the basis of these arguments. They may be similar to those devised for other policy areas, *e.g.* benchmarking, promotion of good practice through exchange schemes, international comparisons (as with PISA for education), performance indicators for individual countries, specialized committees, the drawing up of recommendations for member states. OECD policy reports on women's entrepreneurship could inspire similar reports on women in science, encouraging national policymakers to promote specific policies of positive action favouring the under-represented sex in all sectors of the scientific labour market. In my view, the OECD's mission and mode of operation is absolutely compatible with active policy making in the areas we have examined today. What could conceivably impede further progress in OECD policies is a deficit in terms of genuine and stable political will on the part of national political leaderships. I am, however, optimistic that this workshop has generated substantial movement in the direction we wish to go.

Annex

WOMEN IN SCIENTIFIC CAREERS: UNLEASHING THE POTENTIAL

WORKSHOP PROGRAMME

16-17 November 2005

*French Ministry of Higher Education and Research
1, rue Descartes
75005 Paris*

Background and objectives

Against a background of growing demand for S&T professionals and despite the increase in the number and share of women among science and engineering graduates in many OECD countries, women remain under-represented in scientific and technical careers. In 2004, Science Ministers from 30 countries, including the United States, EU member states and Japan, asked the OECD to identify the reasons for the gap between growing participation of women in higher education and the low share of women in the research workforce and to identify good policy practices for attracting, recruiting and retaining women in scientific careers.

This workshop, under the auspices of the OECD's Working Group on the Steering and Funding of Research Institutions (SFRI) is part of the OECD's response to this Ministerial request and will bring together representatives from government, academia, public sector research and the business community to share experience and draw lessons and recommendations for all stakeholders.

The initiative for this workshop grew from an idea launched by France's Mission for Gender Equality in Research and Higher Education, following a conference bringing together OECD Ministers of Research in January 2004. The Ministers agreed to invite the OECD to help them not only to gain insight into supply and demand for science and technology graduates, but also to identify successful policy measures for increasing the participation of women in scientific and technological careers. Claudie Haigneré, at that time French Minister for Research, looked forward to France's involvement in this work, in conjunction with the OECD.

I am very pleased to see this workshop taking place here in Paris today, and hope that it will be the first step in some longer-range work that could be run on a shared basis with other countries. We need to find out where these highly skilled women are going, if not into research, and discuss how to go about attracting more female scientists to go into industrial research.

*Jacques Serris
Chairman of the OECD Committee for Scientific and Technological Policy (CSTP)
and Deputy Director, French Ministry of Higher Education and Research*

WEDNESDAY, 16 NOVEMBER 2005

WELCOME

Ms. Elisabeth Giacobino

Director for Research, Ministry of Higher Education and Research, France

OPENING REMARKS

Ms. Berglind Ásgeirsdóttir

Deputy Secretary-General, OECD

Ms. Claudie Haigneré

Former Minister for Research (2002-2004), France

Mr. François Goulard

Minister for Higher Education and Research, France

Session 1: Conditions of labour market entry and employment for women in research

Questions:

Statistical state of the art, the need to establish a set of comparable data.

Which are the relevant indicators? Which indicators will help to monitor the situation permanently? What performance measures exist?

Chair: **Mr. Johannes Klumpers**

European Commission, DG Research.

Ms. Camilla Gidlöf

Women in Science Unit, DG Research, European Commission.

Ms. Laudeline Auriol

Economic Analysis and Statistics Division

OECD Directorate for Science, Technology and Industry

Dr. Kamma Langberg

Senior Researcher, Danish Centre for Studies in Research and Research Policy

Dr. Maria Bordons

CSIC-CINDOC, Spain

Discussion

Session 2: Barriers faced by women researchers: horizontal segregation

Questions:

Why do women choose certain fields of research and not others?

How to explain the concentration of female researchers in certain fields?

Chair: **Dr. Claire Deschenes**

Chaire pour les femmes en sciences et génie au Québec

Natural Sciences and Engineering Research Council, Canada

Prof. Mariko Ogawa

MIE National University, Japan

Dr. Christian Suter

University of Neuchâtel Sociology Institute, Switzerland

Prof. Yu Xie

Department of Sociology, University of Michigan, United States

Ms. Ingrid Schacherl

Joanneum Research, Institute for Technology and Regional Policy, Vienna, Austria

Discussion

Session 3: Barriers faced by women researchers: vertical segregation**Questions:**

Is the career management adapted to women? Recognition and promotion: mobility; salaries inequity; career path; mentoring; network management.

Chair: **Mr. Mario Cervantes**

Science and Technology Policy Division

OECD Directorate for Science, Technology and Industry

Prof. Iiris Aaltio

Lappeenranta Technological University, Finland

Prof. Eivind Hiis Hauge

Former Rector, Norwegian University of Science and Technology

Dr. Rosella Palomba

Research Director, CNR-IRPPS, Italy

Prof. Frédérique Pigyere

Université de Paris XII Val de Marne, France

Discussion

Session 4: Instruments for change: existing policy measures and programmes (1/2)**Questions:**

Are the incentive systems and programmes for women to choose and stay in scientific jobs and careers sufficient – efficient, both in public research and business R&D? Does business view this as a key issue, and if so, why?

Chair: **Dr. Michèle Baron**

Ministry of Research, France

Dr. Wanda Ward

United States National Science Foundation

Dr. Andrea Löther

Centre of Excellence Women in Science, Bonn, Germany

Dr. Nicola Millard

British Telecom, United Kingdom

Dr. Wilma Van Donselaar

Senior Policy Officer at The Netherlands Organisation for Scientific Research.

Discussion

THURSDAY, 17 NOVEMBER 2005

Session 5: Instruments for change: existing policy measures and programmes (2/2)

Questions:

How to balance the profession of a researcher with one's "private" life? Do social measures have an influence on this? What lessons from firms in this area? Is gender mainstreaming adapted – and helpful?

Chair: **Ms. Heidi Kuusi**

Ministry of Education, Finland

Dr. Ruth McKernan

Vice President, and Head of Discovery Biology
Pfizer Global Research and Development, United Kingdom

Dr. Christel Baltes-Lohr

University of Luxembourg

Ms. Alikì Mouriki

Senior Fellow, National Centre for Social Research (EKKE), Greece

Dr. Judith Zubieta

Principal Investigator, UNAM, Mexico

Ms. Jane Butcher

Women Returners Manager, UK Resource Centre for Women in Science,
Engineering and Technology, United Kingdom

Discussion

Concluding panel

Questions:

Which conclusions to draw? Issues for further research? Issues for further OECD activities?

Chair: **Dr. Sveva Avveduto**

Research Council, Italy, Chair of the SFRI

Panelists from academia, government and industry:

Ms. Renée Clair

L'ORÉAL-UNESCO for Women in Science Partnership, UNESCO

Dr. Helga Ebeling

First Counselor, Science and Technology,
Embassy of the Federal Republic of Germany

Mr. Johannes Klumpers

DG Research, European Commission

Ms. Martine Lapierre

Chief Technical Officer, Alcatel Mobile Communications, France

Dr. Maria Stratigaki

Department of Social Policy, Panteion University, Athens, Greece

Closing comments by the French Ministry of Research and the OECD

OECD PUBLICATIONS, 2, rue André-Pascal, 75775 PARIS CEDEX 16

PRINTED IN FRANCE

(92 2006 06 1 P) ISBN 92-64-02537-5 – No. 55311 2006

Women in Scientific Careers

UNLEASHING THE POTENTIAL

Women have made important contributions to research and innovation in OECD countries, but their potential remains largely untapped. While women account for more than half of university graduates in several OECD countries, they receive only 30% of tertiary degrees granted in science and engineering fields. Not surprisingly, women account for only 25% to 35% of researchers in most OECD countries. The gender gap in science is greatest in Japan, Korea, Austria and Switzerland. The researcher gender gap is smaller in countries such as the Slovak Republic, Greece, Portugal, Spain and New Zealand. When women do conduct research, they tend to be concentrated in fields and industries such as biology, health, agriculture or pharmaceuticals, with low representation in physics, computing and engineering.

This publication presents the proceedings of a recent international workshop to assess the underlying causes behind the low participation of women in scientific careers, especially at senior levels, and to identify good practice policies to attract, recruit and retain women in scientific careers in public and private research.

The full text of this book is available on line via these links:

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ISBN 92-64-02537-5
92 2006 06 1 P

