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Mapping gender differences and measuring gender inequality in science and research – the European perspective

There have been strong calls for «more and better sex-disaggregated data» at EU level ever since the inception of a Women & Science initiative. A strong statistics programme has therefore been implemented as an integral part of the Women and Science Policy Unit in DG Research. Today I am going to outline the main areas of work undertaken by the Women and Science Statistical Programme, concentrating in particular on what has been achieved so far, and giving a couple of examples of some new equality and gender-sensitive Science & Technology indicators, in line with the objectives of this session and the conference as a whole.

Because of the policy importance for a range of stakeholders of the question of human resources in European Science, and due to the increasing recognition of the potential value of women scientists in the economy, there has been extremely rapid development in the availability of comparable sex-disaggregated statistics in the last few years. In concrete terms, Eurostat and OECD have both started collecting the sex breakdown for the human resource variables in R&D since 2002, (Eurostat since 2001 for the candidate countries). OECD collects data for R&D personnel by sector of the economy, occupation and sex in both Head Count and Full-time equivalent and Eurostat collects the breakdown of Researchers by sector, main field of science and sex and will introduce the NACE codes by sex next year for the BES. Eurostat collects the sex breakdown for researchers in Head Count across all sectors and by main field of science in the Higher Education Sector and Government research institutions. Age by sex and citizenship by sex for researchers was collected by Eurostat for the first time in 2003 in the framework of the R&D Benchmarking Questionnaire. The forthcoming European legislation on Science and Technology and Innovation statistics will broaden the scope of sex-disaggregated data collected by Eurostat still further.

These developments have coincided with progress in the domain of HRST data, which are derived from the Labour Force surveys and which are already sex-disaggregated, providing a further source of information.

There are a number of tools or resources at the disposal of the Unit which have been mobilised in order to respond to the growing demand. Apart from the legal and administrative basis for the statistics of the «*She Figures 2003*» (EUROPEAN COMMISSION, 2003b) bear witness, I really must take this opportunity to acknowledge the input and resolve of the statistical correspondents of the Helsinki Group who often work over and above their normal job descriptions in order to report the crucial data on aspects of scientific life that enable us to get a better understanding of the inter-personal dynamics between women and men in the work place. And I should also mention the colleagues at Eurostat and OECD who were quick to respond to this new climate and to implement changes to their questionnaires.

Inequality and the social dynamics that produce it are known to be difficult to measure in supra-level statistics. Measuring gender inequality is only made easier by the facts that there are just two sexes and that the differences between them are usually easy to define.

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Despite the implementation of data collection at national and supra-national level, the R&D and other relevant surveys are still hampered by problems of incorrect, missing or infrequent data. This impacts our capacity to calculate accurate EU averages. The need for comparable data means that more frameworks for harmonisation and better definitions need to be developed in new areas, and in emerging areas of specific interest to the Women and Science platform. There are areas such as the main fields of science, where the existing standards do not yield the information that we are looking for from a W&S perspective – for example women in ICT research.

We also know that many of the most generalised percentages hide – and even tell the wrong story about more complex patterns, so it is important to ensure that gender indicators are not incorrectly interpreted.

So what are the tangible results of this co-operative effort? Firstly there is a list of Women and Science indicators (published in She Figures 2003) that has been elaborated with the Statistical Correspondents of the Helsinki Group. It serves the double purpose of putting the short, medium and long term objectives of the statistical work on the table as well as providing a succinct guide for people working in Women & Science statistics at national/institutional level. An updated version of this list will form the core of a manual on gender-sensitive indicators for Women and Science which will be produced in 2004. Secondly, there are a number of publications, two of which have been released this year: *She Figures 2003* contains the latest available data for 31 countries as well as accompanying texts, methodological notes, the indicators list and other source references. The Women & Science dossier in the European Report on Science and Technology Indicators (European Commission 2003a) authored by the chairperson of this session, Rossella Palomba, uses the available data to present the strongest arguments to dispel some of the incorrect excuses that attempt to explain the lack of women in science, particularly in senior positions.

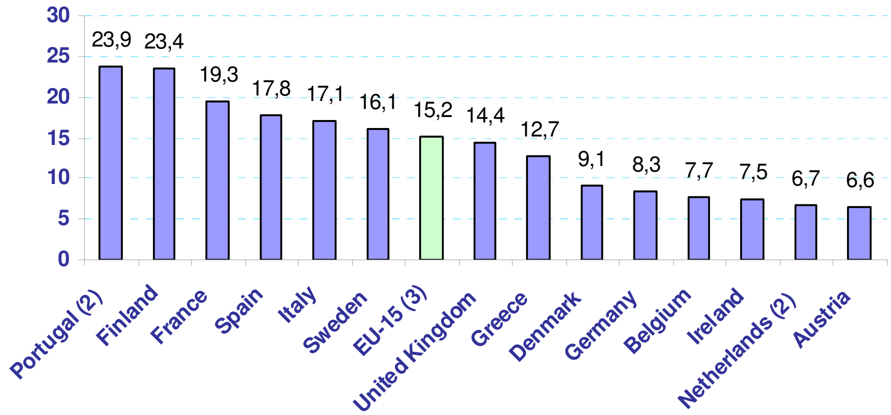
All the data can be downloaded from the W & S Units web pages. But perhaps most of all, these results provide a springboard for policy debate in Europe, on the national W&S steering committees, in other national organisations and in research institutions.

She Figures 2003

She Figures 2003 is the most complete collection of quantitative European W & S information available today. The main body of the publication presents the more pertinent indicators and the raw data can be found in the Annexes. There are four chapters, each concerned with a different policy theme: How Many?; Horizontal segregation; Vertical segregation and Fairness & success rates.

What new information did we elicit when analyzing the data presented in *She Figures 2003*? It is now clear that level of qualification can no longer be regarded as an excuse for the under-representation of women in advanced research education (PhD) programmes or in research posts. The only possible exception to this is still in engineering, where only a fifth of graduates are women. There was a slight increase in the EU average of senior academic staff that are women from 11.6 % in 1999 to 13.2 % in 2000 (equivalent to 15.2 women for every 100 men), but this still remains disproportionately low compared to the overall figure of 31% among all academic staff in the EU-15 (equivalent to 44.8 women for every 100 men). The sex composition of scientific boards was presented for the first time in *She Figures 2003* and again it is possible to see that in most countries the representation of women is very low at this level. More encouragingly, the growth rates are generally higher for women PhD graduates and researchers than they are for men, with only a handful of exceptions.

Number of women per 100 men among senior academic staff (grade A) in EU Member States, HC, 2000 (1)



Source: DG Research, WiS database
Notes: (1) Exceptions to the reference year: DE, IT, SE: 2001; BE, ES, PT: 1999; AT: 1998.
(2) FTE as exception to HC.
(3) EU-15: estimate excludes LU. Above exceptions to reference year apply
Data are not yet comparable between countries due to differences in coverage & definitions.

The Women & Science Unit hosted a workshop on vertical segregation in September 2002 to see what the possibilities would be to obtain one or two new and comparable measures on either researchers or academic staff. The conclusions were that since compiling a measure of vertical segregation in the strictest sense of the term requires anywhere between 20 and 200 rankings, and in view of the diversity of different national systems, something simple needs to be developed in the short-term. So we have developed a four-tier frameworkfor analysing vertical segregation among academic staff.[1] This is also about to be applied to Government Research Institutions. The advantage of this framework is that it replaces the previous idea of categorising the different levels according to the titles which was misleading. The definition of the senior staff presented in this graph is therefore: «*The single highest grade/post at which research is normally conducted within the institutional or corporate system*».

[1] In this framework each tier refers to one of more positions in a national system which are categorised into grades (grades A, B, C and D) according to common definitions. Until now, only the results for Grade A have been regarded as comparable, but it is hoped that comparable statistics relating to all 4 Grades will be available in lid-2004.

Measuring Gender Inequalities in Science

Although the proportions of women as researchers and as academic staff indicate that there is certainly gender bias in the appointment of scientists in Europe, they do not tell us whether this bias represents inequality for either sex. Some slightly more sophisticated measures are needed for this. In line with the theme of the Conference, and especially with the theme of this session, I am therefore going to present three measures that we are working on at present in an attempt to quantify gender inequality: the GEMS, the Index of Dissimilarity and the Honeypot.

The first, which is still under development by Rossella Palomba, consists of applying scientific parallels to the components of the Gender Equality Measure (GEM), taken from the UNDP's *Human Development Report*: political participation and decision-making; economic participation and decision-making; power over economic resources. The exact composition of the three Equally Distributed Equivalent Percentages (EDEP) necessary for this still needs to be agreed by the Statistical Correspondents, so I cannot at this stage show you any results. However, an EDEP was convincingly presented by Rossella in the 2003 REIST report (EUROPEAN COMMISSION, 2003a) and the resulting indicator will probably be referred to as the Gender Equity Measure for Science (GEMS).

The second indicator is the Index of Dissimilarity (ID), which we have applied to the three R&D occupations as a proxy for the vertical dimension. The Index of Dissimilarity is another useful measure of occupational segregation, and here we have applied it to the three R&D occupations - researchers, technicians and support staff – identified in the Frascati Manual and for which countries systematically collect and report data.

Table 1: Index of Dissimilarity of R&D personnel across the occupations by sector and sex, HC, 2000 [(1)]

Country	Index of Dissimilarity		
	Higher education sector	Government sector	Business enterprise sector
Czech Republic	23,5%	28,5%	21,5%
Cyprus	12,2%	13,8%	31,3%
Denmark	:	:	12,37%
Germany (2)	43,8%	:	:
Estonia	17,5%	26,1%	23,0%
Greece	11,9%	4,8%	27,0%
Spain	10,3%	11,2%	12,8%
Ireland (2)	:	:	10,3%
Italy	:	3,1%	11,6%
Latvia	4,7%	14,1%	10,9%
Lithuania	17,8%	18,5%	16,6%
Luxembourg	12,5%	14,1%	:
Hungary	27,7%	23,1%	28,5%
Austria	38,5%	17,7%	27,4%
Poland	15,3%	18,2%	14,4%
Slovakia (2)	12,1%	24,7%	18,0%
Slovenia	20,9%	9,1%	8,0%
United Kingdom	:	23,0%	:
Bulgaria	5,9%	20,3%	10,0%
Iceland	19,7%	8,6%	7,7%
Romania	14,1%	8,8%	12,6%

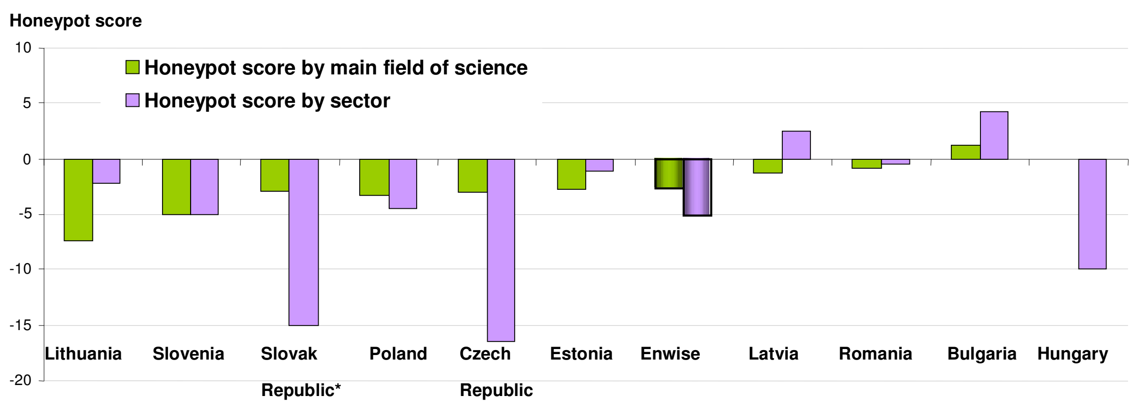
Source: Eurostat, S&T statistics
Notes: (1) Exceptions to the reference year: LV (BES), LT, LU: 2001; DK (BES), DE, EL, ES (BES), IE, IS, IT, FI: 1999; AT: 1998
(2) FTE as exception to HC

The results indicate in each case the percentage of all R&D personnel who would have to change occupations in order to achieve the overall proportions of women and men within each occupation. So, a high score means high segregation. By examining the components of the ID, it is also possible to establish the main cause of the segregation. In most cases it is due to higher than expected proportions of women as supporting staff and lower than expected proportions of women as researchers. There is an exceptional case for the BES in Italy. The 11.6% figure is due to a low proportion of women as technicians in this sector.

The rationale and formula for the ID, as a well as a worked example can be found in *She Figures 2003* and it will also be included in a manual for gender equality indicators in S&T planned for 2004.

The third indicator consists of quantifying the loss in terms of access to / control over R & D expenditure experienced by women because they tend to be distributed in the low expenditure areas. It is standardised and comparable across time and between countries. It is calculated by taking the difference between the 'expected' amount of R&D expenditure – which is the percentage of women among researchers applied to total R&D expenditure – and the 'observed' amount of R&D expenditure – which is the percentage of women among researchers within each sector or field applied to total R&D expenditure within each sector or field and then summed. This difference is then expressed as a percentage of the 'expected' R&D expenditure. We call this the Honeypot indicator because it reflects the different group behaviours of women and men in terms of orbiting around sources of finance. It was developed in the course of the Enwise[2] activity to examine the situations of women scientists in the 7 Central and Eastern European countries and the three Baltic States. In these countries there are generally higher proportions of women among researchers which demanded some more in-depth analysis.

Figure 2: Honeypot scores by sector and by main field of science, 2001



Source: Eurostat, S&T statistics; DG Research, WiS database
Notes: Exceptions to reference year: RSEs: BG, EE, LV (HES and GOV only), PL, SI: 2000
R&D expenditure: HU (GOV & HES): 1999
Honeypot scores by field are for HES and GOV sectors only
Data for researchers by field and sex are not available for HU
(*) Full-time Equivalent. HES expenditure data missing

The high negative scores for the Czech Republic and the Slovak Republic mean that women are losing out on 16.5 % + 15.1 % respectively of their expected share of R&D expenditure because they are disadvantageously distributed across the R&D sectors. The positive results on the other hand for Latvia and Bulgaria mean that women are gaining on men in terms of their distribution across the R&D sectors in these countries. However, these are also the countries with the lowest R&D expenditure *per capita* researcher.

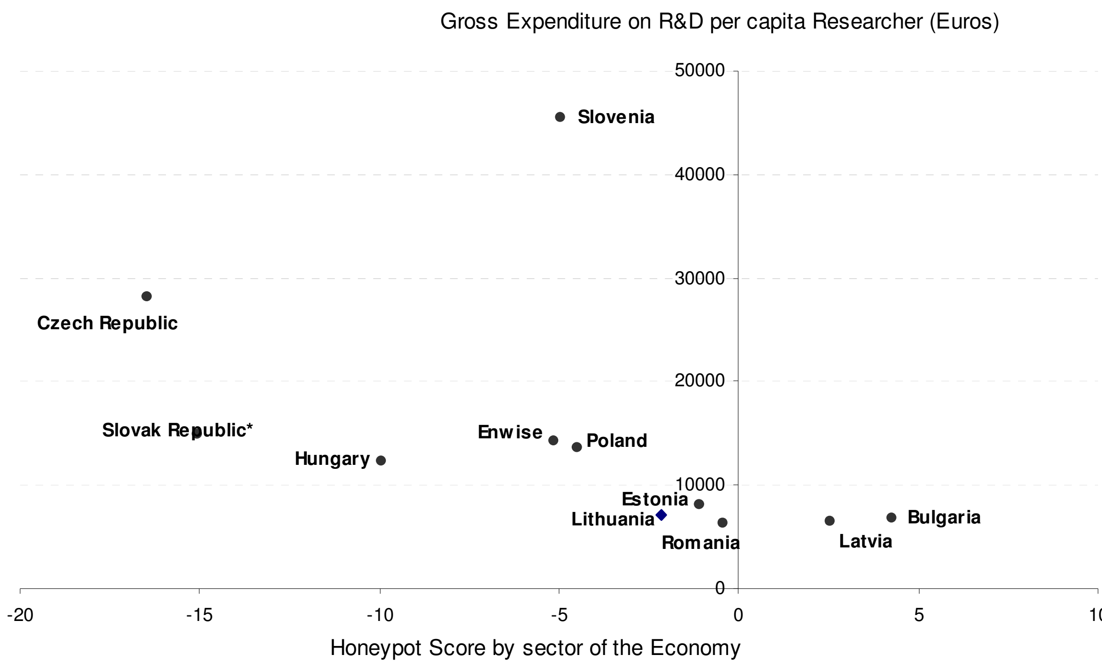
A small amount of variation between the sexes can be expected – it would be too much to require the results to be exactly zero. So for countries where the scores are between -5 and +5, it can be assumed that there is no evidence of a gender bias. However, it is also

[2] «Enlarging Women and Science towards the East» – this activity looks at the situations of women scientists in Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia.

crucial to equate these results within the gender context and within the economic context of R & D. We looked at the correlation between the Honeypot indicator and the percentage of women researchers and found that the relationship is strong and positive (r = 0.81). This means that women are more likely to be "badly" distributed across the sectors in the countries where there is already a poor critical mass among women researchers – and vice versa.

The relationship with Gross Domestic Expenditure on R&D (GERD) *per capita* researchers on the other hand is strong and negative (r = - 0.832) when Slovenia (an outlier because it has much higher GERD *per capita* than the other countries in the group) is excluded. This means that women are more likely to be losing out on their share of R&D expenditure in the sectors where the expenditure is highest – and less likely where expenditure is the lowest. These strong correlations also indicate that the Honeypot indicator is sensitive both to gender and to the economic context of R&D.

Figure 3: Relationship between Honeypot scores by sector and Gross Expenditure on R&D (GERD) *per capita* researcher, 2001



Source: Eurostat, S&T statistics; DG Research, WiS database
Exceptions to reference year: RSEs: BG, EE, LV (HES and GOV only), PL, SI: 2000
R&D expenditure: HU (GOV & HES): 1999
Notes: * FTE as exception to HC

In real terms, these results point out what we already know - that simple percentages tell us very little about inequality. More worryingly, they suggest that in the countries where there are fewer resources for R&D, women are used as a kind of «fall-back» human resource because the rewards are insufficient to attract men. The results here also indicate that the distribution of women and men across sectors is a stronger determinant of inequality between the sexes than the distributions across main fields of science for many countries.

To summarise the main points regarding measuring gender equality in European science, there is no doubt that the availability of data has improved significantly during the last three or four years and that this has opened up all sorts of possibilities for analysis. The down side is that the evidence that is being delivered through this improved system is that women are still being discriminated against and that progress to redress this is still slow.

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