Exploring quotas in academia

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Exploring Quotas in Academia
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The contents of this report reflect the authors' understanding of the workshop discussions and of our own research. The participants in the workshop and others who were interviewed are not authors of this work. Rather, they assisted the authors in understanding the scope of the issue, provided subject matter expertise and in some cases, reviewed a draft of this report. Only the authors are responsible for the report and the accuracy of its contents.

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Table of contents

Summary
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The use of gender quotas in academic hiring and awards is one tool that could mitigate disparities in the number of women and men at the highest levels of academic research. The use of such quotas, however, is controversial.

There are striking imbalances between the number of women and men at the highest levels of academia. Even accounting for differences between fields and the lag time in implementing policies intended to mitigate such disparities, the overall numbers and ratios of women to men in senior academic positions are much smaller than would be expected given the number of female university graduates in the last decades.

Such imbalances have been seen as well in government positions (particularly as reflected in national parliaments) and in corporate boards. A rationale for mitigating such imbalances in national parliaments is that such bodies should reflect the demographics of the citizenry as much as possible; for corporate boards, gender balance is thought to at least be a matter of good governance.

But as well, an increased representation of women in academia may be a value in itself. Universities are for the most part publicly supported, and thus perhaps they also should reflect demographics.

If it is a policy goal to reach a more balanced gender representation at the highest-ranking positions in academia, particularly for the top professorial positions within a reasonable time frame, direct actions will almost certainly need to be taken. One direct way to address the imbalance is the use of quotas.

Quotas as a policy tool may be controversial. Especially in academia where merit is a very important but ill-defined concept, the use of quotas may be seen to be undermining a merit system. On the other hand, at least in some fields, the current merit system seems to have favored men, so using quotas might help improve the system. This study focused on these concerns and ambiguities.

About the study

This report reflects the proceedings of a year-long study by staff at EMBO funded by and in partnership with the Robert Bosch Stiftung. The key component was a two-day workshop, held in May 2014, comprising an expert group of 16 participants, plus EMBO and Robert Bosch Stiftung staff.

This report is a synthesis of literature on binding and voluntary quotas, interviews that were conducted with leaders in analyzing and implementing quotas, and the proceedings of the closed expert workshop.

The report offers no recommendations about the use of quotas. Rather, it summarizes the positive and negative aspects of the implementation of different types of quotas, and describes a range of conditions of implementation to assist decision-makers in formulating their choices. The potential benefits and real or perceived harms of the use of these quotas will vary depending on who would implement them, and the conditions under which they would be implemented.

In the report the term binding quotas is used to indicate measures that are accompanied by sanctions in case of non-compliance; in the literature these are sometimes simply called quotas. The term voluntary quotas is used to indicate measures that are not accompanied by sanctions; these are sometimes called targets.

This report provides an overview of quotas that could be applied to the mitigation of gender imbalances in academia in three areas:

Hiring at the full professorship level and below

Cascading models. In these approaches the number of slots ultimately intended for each gender is determined by the ratio of women to men in the career level immediately below. Such models may be legislated or voluntary. The critical policy question then

is, at which level is the base number set and how is it calculated?

Composition of evaluation committees, including university oversight bodies

Representation and critical mass. The possibility that better-balanced evaluation and oversight committees will result in a better gender balance for the resulting selections and decisions comes from the concept of critical mass; that is, the premise that until a certain percentage of the underrepresented gender is reached, that gender's views will not be represented in committee proceedings. The evidence on this is mixed.

Quotas for research funding

Precluding gender biases. For research grants and fellowships, a quota to assure equal success rates for women and men would be employed to preclude subtle gender biases that could lead to reductions in the number of successful grants by female applicants over time and thus to reductions in the number of female academic researchers. Evidence of such biases varies by field, nation, and funder and thus the use of such a quota would require careful consideration.

Three major routes for implementation were examined:

Legislated by a government

Although legislation is a blunt instrument, it would almost certainly lead rapidly to the desired gender balance.

Set by an academic institution

This option presents two clear benefits: the involvement of those most affected by any changes in helping to design the quota system, and the linking of the mechanism of filling a quota to usual institutional hiring practices. The major potential problem is that without an external motivation, institutions could discuss the details of a quota at length without ever implementing it.

Required by a funder

Funders have significant power in attaching conditions to individual grants. While it may seem apparent that funders could extend that influence to the institutional level (i.e., denying grants to individuals at institutions with gender imbalances), it is not clear that funders would want to exclude meritorious proposals on non-scientific grounds.

Findings

For **hiring**, the most-studied model that we evaluated was a flexible cascade model, where quotas are based on the percentage of women at the level immediately below for each type of position; applied at all career levels; mandated by a government; with strong financial incentives for reaching the quota, and sanctions for non-compliance. The benefits of this model are that it is based on real numbers for each individual department or other unit, precluding the dangers of one-size-fits-all quotas that do not reflect the recruitment pool; and, the model requires the active participation of the unit in defining their quotas, thus ensuring that the values are attainable. Potential advantages to be gained from the incentives may also ensure the buy-in of academics. The caveats include unnecessarily complicated calculations, potentially leading to a skewing of the estimated target values, and the possibility of perpetuation of small numbers due to low numbers at the entry level.

For **review committees** and **oversight bodies**, it is clear that the presence of more than one woman on committees reduces isolation and tokenism and broadens the points of view during discussions, including minority concerns. The main potential harm of such quotas is a work overload for the few women in high positions who would be requested to sit on many committees. This would limit the amount of time they can invest in research and penalize them in terms of scientific output. These harms could be mitigated by, for example, relief from administrative duties and support for research and non-research related academic duties.

In **funding**, available data does not show a systematically lower success rate of female researchers for all funding schemes in all countries. Since monitoring of success rates of any given scheme is relatively simple, all funders and employers could be encouraged to publish their data and be required to address the issue (e.g., through a quota) if a persistent difference in success rates is evident.

Exploring quotas in academia

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I. Introduction

There are striking imbalances between the numbers of women and men at the highest levels of academia. Focusing on Europe, in the academic sector only 20% of full professorships are held by women (EC, 2013). Even accounting for differences between fields and the lag time in implementing policies intended to mitigate such disparities, the overall numbers and ratios of women to men in senior academic positions are much smaller than can be reasonably expected given the number of women university graduates in the last decades.

This is perhaps not entirely a surprise given the overall lack of women in leadership or senior positions in a wide range of areas. On average, about 22% of the members of national parliaments worldwide are women (Inter-Parliamentary Union, 2014); in the EU the average is 27% (EC Justice a, 2013). At the same time, "big business", a sector that has daily impacts on people's lives, is run almost exclusively by men. In companies with greater than 10,000 employees only 2% of CEOs are women (McKinsey & Company, 2012).

What do these numbers reflect? Beside any time lag for the outcomes of new policies or changes in demographics, some research points to issues of gendered preferences for particular jobs (e.g., Tolbert and Moen, 1998; Beutel and Marini, 1995). But neither of these would appear to explain the very large imbalances. Rather, this seems to reflect in the first instance the traditional roles assigned to men and women in our societies (Haveman and Beresford, 2012). These traditional roles not only hold women back from engaging in traditionally male dominated areas, but also likely influence gatekeepers' views of their abilities to perform in certain jobs. As a consequence society may not be taking advantage of a large part of its human capital in government, business and academia.

Focusing still on the situation in Europe, if it is a policy goal to reach a more balanced gender representation at the highest-ranking positions in academia (particularly at the professorial levels) within a reasonable time frame, direct actions will almost certainly need to be taken. One direct way to address the imbalance is the use of quotas.

While in Sweden gender quotas in academia have been used for some time, in other European countries gender quotas are beginning to be used now as one way to address disproportionate gender representation in several aspects of academia. Apart from the Swedish experience that we have analysed in the report, there is not yet enough information to determine what the overall effects of their use would be. Further, the possible consequences of the use of gender quotas for individuals and academia as a whole have not been fully delineated. This project was oriented toward understanding the possible outcomes of the use of gender quotas, with the intent of providing decision makers policy options for the use (or non-use) of quotas in academic hiring, in the composition of evaluation and oversight bodies, and in research funding.

We draw on the experience from the use of gender quotas in other areas, in particular in parliaments and business, which have been used in many countries over time, and the effects of which have been fairly well studied. Moreover, this report is based on interviews with experts and discussions during a workshop involving a range of stakeholders.

II. Methodology

Our goal for this project was to analyse how individuals and academia as a whole could benefit or be harmed by the use of gender quotas. The emphasis of our analysis was on potential policy interventions using gender quotas for hiring, for awarding grants, and the composition of evaluation committees, including university oversight bodies.

In this report we use the term binding quotas to indicate measures that are accompanied by sanctions in case of non-compliance. In the literature on gender quotas these are sometimes simply called quotas. We use the term voluntary quotas or targets to indicate measures that are not accompanied by sanctions. In this report we analyse both kinds of measures.

Literature review

In order to understand the scope of the problem and proposed or tested interventions to mitigate gender imbalances, we conducted a thorough literature review. This included academic literature, reports in the popular press, and others' project reports. We first looked at parliaments and business since gender quotas have already been used and studied in these areas. We also explored the work that has already been carried out with respect to the situation in academia.

Interviews

Next, we interviewed individuals who have been responsible for implementing quotas in their respective fields, who have done work to analyse the use of quotas and other measures in their areas, who are members of institutions or businesses where quotas are or are not implemented, leaders of national and international scientific institutions not using quotas, a representative of a national funding body, and a representative of a national government's gender equality section. These interviews were to allow us to check our understanding of the current state of the use of quotas, to clarify issues raised in previously published works, and to verify that we understand the scope of the uses of quotas for parliamentary elections, company boards and academia.

Workshop

A workshop was held from 20 – 21 May 2014. The participant list and agenda are contained in Appendix 3. The composition of the workshop group was a representation of stakeholder views and, along with our interviews that included people who could not attend the workshop, we were able to take into account a wide range of views. The project participants included:

- representatives of national and international research institutes and organizations
- representatives of national and international funding organizations
- academic researchers in gender issues in politics, industry, academia and economics
- legal experts
- practicing life scientists working in academia
- individuals working for organizations focused on gender issues
- industry representatives
- national ministerial representatives
- representatives (staff) of the European Commission

The workshop was closed and held under the Chatham House Rule to allow participants to work through difficult and sometimes contested issues in a thorough fashion. It also allowed the participants to test ideas and change their minds as the work progressed.

The workshop was structured so as to provide a minimum amount of background information so that participants generally had an idea of concerns in areas outside of their particular expertise. A key feature of the workshop was the analysis of potential actions of decision makers, leading to a description of specific options for the uses of quotas, and focusing especially on perceived, potential, and real harms. In addition to the authors being able to gather knowledge from the group, the participants learned from each other's experiences and knowledge as well. Participants discussed a linear progression from student to full professor, points where policy interventions might be used in the progression, and specific policy

options. More details on these analyses are contained in Section IV on gender quotas in academia.

Follow-up and report

Following the workshop, we re-contacted several workshop participants and interviewees for clarification where needed. Integrating information from these queries, we drafted this report, which reflects our understanding of the published literature, interview material, and workshop discussions.

The contents of this report reflect the authors' understanding of the workshop discussions and of our own research. The participants in the workshop and others who were interviewed are not authors of this work. Rather, they assisted the authors in understanding the scope of the issue, provided subject matter expertise and, in some cases, reviewed a draft of this report. Only the authors are responsible for the report and the accuracy of its contents.

III. Use of quotas in politics and the corporate world and their effects: What lessons can we learn for academia?

Quotas have been employed for some time in politics and business. The implementation and results of such quotas have been studied in some detail and may inform models or lessons for gender quotas in academia. We analysed the existing literature and talked to experts who have studied the use and the effects of these gender quotas.

Gender quotas for legislatures

Electoral gender quotas are the most used and most studied type of gender quotas. Although there has been a substantial increase in the percentage of women in parliaments in the past 20 years, most countries in the world are still far from achieving gender balance (International IDEA, 2013).

Currently women occupy about 22% of all seats in national parliaments worldwide (Inter-Parliamentary Union, 2014). In the EU the average representation of women in parliaments is 27%. Scandinavian countries have the highest overall representation of women in parliaments, with Sweden at the top with 43%; Hungary has the lowest representation with 10% (EC-Justice b, 2014).

A number of European countries have introduced national legislation requiring gender quotas for parliamentary elections, including Belgium, France, Greece, Portugal, and Spain; in other countries political parties have set themselves voluntary targets, e.g., Germany, the Netherlands, Norway, Sweden, and the United Kingdom (Inter-Parliamentary Union, 2014).

The introduction of either a legislated quota or a voluntary target has led to an immediate increase in women's representation in most national parliaments that use them. This is well documented in a study commissioned by the European Parliament's Committee on Gender Equality of the change in women's political representation in 10 countries after their first use of quotas. In Belgium, for example, women's political representation jumped from 12% to 36.7% in the course of just a few elections following the introduction of the legislation. In Germany, the adoption of a voluntary gender quota by two political parties seems to have led to the increase of the percentage of women in the parliament from 15.4% in 1987 to 26.3% in 1994 (Dahlerup and Freidenvall, 2013), although the traditional concept of bread-winning husband and house-keeping wife was still strong in the German society (Geissel, 2013). Germany has now

36% women in the parliament. Worldwide, most of the countries with more than 30% women in national parliaments have some form of quota (International IDEA et al., 2013).

A closer analysis of the use of quotas in different countries shows that quotas need to be well designed and well implemented to be effective. A determining factor is the use of sanctions for non-compliance when quotas have been introduced by law (Dahlerup and Freidenvall, 2010). Sanctions must be strong to be effective. For example, in Belgium, where women have now reached 39% representation, party lists lacking gender balance cannot be published for election (International IDEA et al., 2013). On the other hand, in France an equality law passed in 2000 imposed a 50% representation of each gender on party lists, but the monetary sanctions were so low that parties did not comply with the law and rather paid the fines (Murray, 2012). To date France has 26% women in the parliament, despite a 50% gender quota.

Different types of electoral procedures may influence the final level of female representation once quotas are applied. Elected versus reserved seats, details such as how names alternate on a ballot, and whether an electoral system is proportional can affect outcomes (Dahlerup and Freidenvall, 2010).

Possible effects of gender quotas that have been identified in the literature pertain to policy outcomes, attitudes towards female politicians, and women's self-confidence. These effects have mainly been studied in India, where the random use of quotas in different districts has allowed changes after quotas were introduced and then dropped to become apparent. These studies found that the implementation of quotas increased the percentage of women in leadership positions and generated better attitudes towards female politicians in the long-term. Moreover, they resulted in the implementation of socially relevant policies, and policies addressing women's needs (Pande and Ford, 2011).

We thus were able to identify four concepts from the use of quotas in politics that are likely to be relevant in implementing quotas in academia:

- → Quotas, either legislated or voluntary, can lead to an immediate increase in women's representation.
- → The mode of implementation is crucial: the interplay of many different factors needs to be considered.
- → Sanctions are effective if they carry substantial penalties.
- → Quotas can lead to a change in policy preferences (e.g., addressing policy problems that might not have otherwise been recognized or addressed).

Gender quotas for corporate boards

Another area where gender quotas have been used and studied quite extensively is in business, where the use of quotas is more recent than in politics. Quotas have been implemented mainly at the level of companies' advisory boards. In a number of European countries including Belgium, France, Italy, Spain and Norway, the government has introduced gender quota legislation for boards of state owned companies or stock listed companies (EC Justice a, 2013). In some countries, single firms have adopted voluntary gender quotas for their boards.

The introduction of these quotas has led in general to an increase in the presence of women on boards of large listed companies in Europe. Norway, outside the EU, was the first country to introduce quota legislation for women on company boards in 2003. Its introduction lead to a gradual increase and eventual reached the 40% quota from 2003 to 2009. Still now, with about 40%, Norway has the second higher percentage of women on company boards in Europe, the first being Iceland with 46% (EC Justice c, 2014).

In a number of other European countries the introduction of gender quotas has led to an immediate increase in the proportion of women members of company boards. This is evident merely by looking at the increase in the percentage from 2003 to 2013 in the EU. From 2003 to 2010 the increase was 3.4 percentage points (from 8.5% to 11.9%). But in the three years from October 2010 to October 2013 the rate of increase accelerated and became 4 times higher than the previous rate of change, bringing the current representation to the average of 17.8% (as of October 2013, EC Justice d, 2014).

This change was due to the introduction of legislated quotas in some countries like Belgium, France, Italy, and the Netherlands between 2010 and 2012 (EC Jus-

tice a, 2013). For example in the period between October 2010 and October 2013, France recorded a large percentage increase (+17.4%), after the French government introduced legislated quotas in 2011 (EC Justice d, 2014) requiring that public listed companies have 40% women on their boards of directors by 2017. The law had also set an interim deadline by which companies would have to have reached at least 20% women board members by 2015, which was already met at the end of 2013.

The European Commission proposed legislation in 2012 to ensure that women occupy at least 40% of non-executive company board seats throughout Europe (EC a, 2012). In an effort to avoid the adoption of this regulation, a number of countries and companies have introduced gender quotas or implemented measures to increase gender balance (EC Justice d, 2014).

In some countries, sanctions for companies that do not comply are in place, e.g., in Norway, the quota law allows the government to dissolve non-compliant companies (Storvik and Teigen, 2010). Other countries have introduced incentives: in Spain, companies that comply are preferred suppliers for public contracts. Moreover, in some cases companies are required to publish their gender data in their annual reports, and to explain why they did not reach the target, if this was the case (Walby, 2013).

In addition to increasing the sheer number of women on boards, other outcomes have been documented. For example, in Norway, the same female directors were nominated to different boards at the same time (the so called "golden skirt" effect), so the increase in the percentage of female board members is not proportionate to the change in the absolute number of women on boards. Moreover, some companies found ways to avoid the legislation by changing legal status (Storvik and Teigen, 2010). A hoped-for consequence of mandating more women on boards was a concomitant increase in the number of female CEOs, directors and managers. But the figures in Europe show that not much has changed at that level: the average in the EU is 3% female CEOs and 12% female executives (EC Justice e, 2014).

A further effect of the adoption of gender quotas that has been studied is on companies' financial performance, although a correlation is not clear. Studies from Scandinavia observed a negative impact on firm value in the short term (Ahern and Dittmar, 2012) and short-term loss of profits (Matsa and Miller, 2013). On the other hand, other reports (e.g., McKinsey & Company, 2007; Dawson et al., 2014) have found that the companies' financial performance is higher when the board and senior management is more diverse. Konrad and Kramer conclude after interviewing over 60 female directors of Fortune 1000 companies that more than three female directors can cause a fundamental change in the boardroom and enhance governance (Konrad and Kramer, 2006).

It is important to note that the adoption of gender quotas either via legislation or voluntarily has frequently been accompanied by the parallel adoption of other measures aimed at recruiting more women and increasing the rate of retention and promotion of women to higher positions. For example, Deutsche Telekom adopted a quota of 30% for women in all managerial positions by 2015. In order to reach this goal Telekom has introduced systematic measures for talent development within the company, targeted recruitment actions, and developed a more family friendly work environment (Thomas Sattelberger, personal communication, 14 May 2014 by telephone).

In short, the adoption of quotas for companies' boards has had an effect on the number of women at high positions in industry, at least in the near term. Because company boards may be a good comparator for academic committees to the extent that they involve a small number of people tasked with evaluation, the following observations about the use of quotas in filling board seats may be relevant in academia, particularly as they would relate to any relationship between the composition of the committee and the overall balance of faculty in any academic unit:

- → Quotas for boards have led to an increase in the number of women in these positions. However, if the pool of women to choose from is limited, quotas can lead to a small number of women serving on a large number of boards. This has implications both for the women themselves (potential over-commitment), and for business governance.
- → Quotas for boards do not produce a significant increase in the number of women hired in top managerial positions.
- → Incentives and sanctions are effective to encourage compliance.

→ Having to reach a certain quota may lead to the adoption of diverse strategies and measures to increase the pool of women candidates to choose from.

Common and unique issues in politics, industry and academia

To try to understand if the experience from politics and industry could be relevant to the use of gender quotas in academia, the differences or similarities between the three areas were considered. We looked first at the values central to the three sectors to appreciate how gender quotas do or could respond to a central need in each area.

In politics, representation is an essential value, because democracies intend to represent their societies. An approximately equal number of men and women representing the population is thus likely to be the ideal situation. This is probably what makes gender quotas in politics acceptable and explains their extensive use worldwide. The relevance of this observation to academia is discussed below.

In business, profit is the primary motivating goal. On the one hand, this is different from academia in the strictest sense: academia is not-for-profit. On the other, business and academia may be similar in having clearly defined goals (profit in the first case; contribution to the knowledge base, generally as measured by publications, in the latter). One argument against the use of quotas in business and in academia is that the specified goals lead to self-governance and the selection of the best people, because those doing the selecting know best who will contribute to those goals, and that the use of quotas negatively influences this selection process.

Academic research is mainly publicly funded, a clear distinction compared to the realm of business, and thus there are arguments that underrepresented groups (in this case, women) need to have a route to correct their underrepresentation, as seen as well in the other public realm we discuss here, government. The use of quotas would show political will to see an equal participation of both genders in science. An increased representation of women in academia is seen by many as a value in itself.

But one concern of critics of quotas is that un- or under-qualified people would be hired or promoted. This points to a need to explore the meritocratic process that has contributed to the current imbalance. What is being rewarded and why?

In academia the primary goal is to generate new knowledge, which is perceived as being for the common good, and at least in part the reason why it is publicly funded. Individuals are generally selected on the basis of merit, i.e., their proven ability to contribute to that endeavour. Academia has been trying to find foolproof, quantitative ways to judge quality or merit for a very long time and it is readily apparent that no algorithm for this exists (Merton, 1968; van Arensbergen et al., 2012; Cole et al., 1981). In addition, the attribution of merit has been shown to be gendered (van den Brink et al., 2012; Castilla et al., 2010). The current definition of merit in academic research emphasises career paths that are generally agreed to be more typically male and contain characteristics that are not emulated by women (or people with non-traditional career paths, etc.), thereby putting these groups at a disadvantage (van den Brink et al., 2012; Castilla et al., 2010).

IV. Gender quotas in academia: Potential benefits and potential harms

We then wanted to understand as comprehensively as possible what is known about gender imbalances in academia and what interventions have already been tried to mitigate these imbalances. This would allow us to construct options for decision makers considering the use of quotas.

As in politics and business, academia is characterised by a strong gender imbalance at the highest levels. On average in the EU, only 15.5% of institutions in the higher education sector are headed by women and 10% of universities have a female rector. Moreover, on average, 36% of members of scientific and management boards are women. Also at the highest career level for research, that is, the full professor position, the situation is characterized by a strong imbalance: the gender ratio is 80:20 male to female. There are differences between subject areas, with engineering and technology having the lowest proportion of female full professors (8%); in the life sciences this is 13.7%. But even in the humanities and in the social sciences women represent respectively only 28.4% and 19.4% of full professors (EC, 2013).

This gender gap is particularly striking considering that women represent the majority of the general student population: 55% of undergraduate and 59% of graduate students (EC, 2013). After graduation the proportion of women decreases with each career stage. Over the past 20 years the European Commission, national governments, scientific bodies and universities have implemented measures to keep women on the academic career path. These range from providing on-site childcare to mentoring targeted to women and to special training for female researchers (EC b, 2012). (See Appendix 1: Measures other than quotas for improving gender balance in academia.)

But these measures have not led to a large increase in the presence of women in senior positions in academia. In light of this situation, and to speed up the pace of change, a number of scientific bodies and research organizations have been discussing introducing gender quotas at different levels. Some have already been introduced to a limited extent.

The three areas where quotas have been discussed or introduced are:

a. for hiring at the full professorship level and below;
b. for the composition of evaluation committees (including university oversight bodies); and
c. for research grants and fellowships.

a. Quotas for hiring faculty at full professorship level and below

In Europe only 20% of full professorships are held by women (EC, 2013). Mandating the proportion of full professor positions to be held by women is a possible policy measure to correct the imbalance. While gender quotas to increase the percentage of women in government representation and on company boards have been implemented in many countries, in academia, gender quotas for the highest career levels have been implemented so far in very few cases. However, discussions on their introduction, either as voluntary or binding measures, are under way in various countries, and at different levels: by governments, funding agencies, scientific organizations and individual universities.

From the literature and the working group discussions, we were able to characterize two models for the use of these quotas. One is currently being introduced in some parts of Germany, and one has been in place in Sweden for more than 15 years.

Cascade model

A model to increase the number of women in top academic positions through the use of quotas, called a cascade model (*Kaskadenmodell*), has been supported most prominently in Germany by the Research Council (Wissenschaftsrat, 2007) and by the German Research Foundation (DFG, 2008).

The *Kaskadenmodell* is a quota system for the hiring of women at all levels of the academic career in order to ultimately increase the number of women in the very highest (i.e., full professor) positions. According to the DFG, it is flexible because the values to be reached are based on the proportion of women at the career level directly below for each area and are determined for each institution individually. No sanctions are foreseen if the quotas are not met.

The main German scientific bodies have expressed their support for the *Kaskadenmodell* and its implementation, and since 2012 German universities and research institutes have been obligated to implement a gender quota according to it (Gemeinsame Wissenschaftskonferenz, 2013). In Germany the percentage of female full professors across all disciplines is lower than the European average: 15% (EC, 2013), despite the fact that different measures to mitigate the imbalance have been implemented by many universities following the guidelines set by the DFG in 2008 with the Research-Oriented Standards on Gender Equality (DFG, 2008). It is still too early to see the effects of the use of the *Kaskadenmodell* as the deadline for its implementation is not until 2017/2018. As well, in the North Rhine-Westphalia state a quota regulation for universities was introduced in October 2014, based on the *Kaskadenmodell* (HZG NRW, 2014).

Analysis of the potentional benefits and potential harms of a cascade model

The use of hiring quotas from the lowest levels of academia through full professorships and conceivably even as far as top administrators such as provosts, deans and presidents may be taken up under the German *Kaskadenmodell*; this was discussed by our workshop group and as well with additional interviewees. Targets are based on the percentage of women at the career level immediately below within an institution. Each institution sets its own quota based on the current ratios of women to men at each level. At what level to draw the initial ratio for comparison remains unclear.

Generally, this type of quota appears to be useful for leading to a sustainable balance of women and men in academia. Because it would start from the entry level of academia, it would lead to a "new normal" where actions taken to assure balance are integrated into hiring processes.

Positive aspects of a cascade model were identified:

- → All levels of academia are addressed.
- → Would effect long–term change in academic units.
- → Quotas are determined by the institutions based on the composition of their workforce, i.e., quotas are based on realistic and attainable values, which can be expected to increase the acceptance from other academic staff.
- → Institutions themselves are part of the solution, encouraging them to devise supporting measures to attain their goals.

Points of concern were identified:

- → Workshop participants reported that the determination of the numbers is not as straightforward as might be expected, and may involve complex calculations that could be manipulated.
- → The process could perpetuate low numbers by precluding faster increases where they otherwise might be possible.
- → The process might not be acceptable to many academics as it circumvents meritocratic processes (see also Kaube, 2012, Hirschauer, 2012).
- → Individuals hired and institutions using this process may carry a quota stigma (see also Hirschauer, 2012).

It was also noted that the use of quotas may not address the reasons why women drop out in larger numbers after the postdoctoral level, in particular in the life sciences and chemistry. Moreover, students's choices of subject, i.e., the entry level, may not be addressed.

Swedish model

A narrowly focused cascade model has been used in Sweden since the late 1990s. The government has set voluntary quotas for universities for the recruitment of female full professors during periods of three to four years. The targets are calculated for each research area based on the percentage of the level below, e.g., female associate professors, at the national level. There are no sanctions for non-compliance, but there is an expectation that these quotas are met. The idea behind this model is that universities would have to make efforts to increase the number of women at the levels below, who would then become professors. These voluntary quotas were first intro-

duced in 1997, and have probably contributed to the increase in the share of women among full professors from 9% in 1996 to 24% in 2013 (Statistics Sweden, 2014). But despite the presence of these targets, the proportion of female full professors is not much higher than the EU average, i.e., 20% (EC, 2013).

We next considered the consequences, advantages and disadvantages of quotas for the recruitment of female professors at universities as a voluntary measure as implemented by the Swedish government, described above, which has resulted in an increase of female professors nationwide, but not significantly above the European average.

Positive aspects of the Swedish model were identified:

- → Quotas were based on realistic values (i.e., on the level of associate professors in this specific case).
- → The time frame for attainment of the quotas was spread over a period of several years.
- → The measure was not called a quota, but rather a target, so it did not get rejected out of hand by opponents of quotas.
- → Universities were free to devise their own mechanisms for how to improve their numbers.

Points of concern were identified:

- → The use of one reference point (i.e., the number of associate professors at the national level, which is small to begin with) would lead to the perpetuation of small numbers and would not lead to the feeding of the pipeline.
- → The resulting increase was not above the average observed in Europe.

Possible outcomes of quotas for hiring female professors

The clear benefit from this approach is that change will be immediately visible in new hirings. But overall the percentage of female professors would change slowly, because if we assume positions will be filled as they are available, rather than created anew, the process may still take decades (Marschke et al., 2007). On the other hand, relying on training decision makers about biases (systemic and intrinsic), or relying on generational changes (see Box 1) may take much longer. Certainly, rapid change of the status quo is a legitimate policy preference, but minimizing disruptions may be a preference as well. These two preferences may need to be balanced.

Box 1 Generation Y: a corrective to gender imbalance?

Some societal concerns are resolved simply through generational change. Could it be the case that by waiting for researchers to emerge from a generation with different values, there will be no need for quotas or other hard measures? The developing generation of researchers (i.e., current postdoctoral fellows) is in a demographic sometimes called "Generation Y". This generation is thought to be more dedicated to life/work balance and to actively working towards gender equality than previous generations (e.g., Bund, 2014). At least two potential outcomes can be imagined:

1. As these researchers move through the tenure track, more women will become full professors as they will have better support from their partners, their universities, and their communities;
2. Men and women will both drop out, because of the difficulty to balance work and life in academia which could result in removing otherwise highly qualified people from the academic workforce.

b. Quotas for the composition of evaluation committees and university oversight bodies

The most common gender quota in academia addresses the composition of evaluation committees and panels. Support for the use of such quotas comes from studies on discrimination against women during the review process. The rationale is that if male evaluators are biased against women, having more female evaluators would increase female candidates' chances of success.

The minimum number or percentage of women (or any set of individuals) necessary to make a difference in a committee is unclear, but frequently estimated to be 30%. This is often referred to as "critical mass", and has been derived mainly from studying the corporate environment and in relation to politics. (See Box 2)

The correlation between the gender composition of review committees and the success rate of female applicants is not clear, and different studies have found different results, indicating the difficulties in evaluating this effect. Among these studies, in an effort to understand the reason for the different success rates between male and female applicants for its grants, the European Research Council (ERC) analysed the effect of the number of women on its evaluation panels between 2008 and 2012, and found "no correlation between the success rate of female applicants and the gender balance of evaluation panels" (Vernos, 2013).

In contrast to this, a study from Spain (Zinovyeva and Bagues, 2011) found that the gender composition of evaluation committees was relevant when selecting for full professor positions, but not for associate professor positions: the presence of one woman in a committee of seven members was enough to increase the number of women promoted to full professor.

A recent study from Italy (Bagues et al., 2014) found a completely different result: an inverse relation between the presence of women in an evaluation committee and female scientists' chances to be promoted to associate or full professor: "In a five-member committee, each additional female evaluator decreases by 2 percentage points the success rate of female candidates relative to male candidates."

It is interesting to note that the authors of the first and most widely known study that demonstrated gender discrimination in research funding, Wennerås and Wold, stated in their report that "We are not confident that a simple increase in the percentage of women reviewers would solve the problem of gender-based discrimination" (Wennerås and Wold, 1997).

Taking these studies together, it appears that there is no basis to support or dispute the notion that having gender quotas in review committees is sufficient to avoid gender discrimination. On the other hand, female and male committee members report that in general the presence of more women makes men (and sometimes women) more aware of gender issues and intrinsic biases.

An indirect effect of such quotas, which also was a concern among our workshop participants, is that the few women in high positions might need to sit on many committees, and more often than their male colleagues. This would limit the amount of time that they can invest in research, and penalize them in terms of scientific output. Thus, in the absence of a mechanism to assure a larger pool of female candidates for review committees, gender quotas for such committees could mitigate any other gains in female representation.

Committee quotas are becoming more widespread: some governments, e.g., Austria, Finland, Iceland, Norway, Spain (see Frutos et al., 2012), the North Rhine-Westphalia state in Germany, the EC; research councils, e.g., Swedish Research Council and the Research Council of Norway; and scientific organizations have already introduced quotas for committees and oversight bodies, and others are discussing them (see Appendix 2). EMBO, for example, has for many years strived for and reached 30% women on its committees.

Analysis of the potential benefits and potential harms of quotas for evaluation committees and university oversight bodies

Women or any underrepresented group on a committee may be faced with a dichotomy of role that those in the majority do not have; for example, women may be expected to be a proponent for women's interests as well as an impartial judge of scientific merit. These roles may sometimes be perceived as contradictory and unfair.

As noted above and in Box 2, the concept of "critical mass", however, does not lead to a clear recommendation regarding committee composition and whether a certain number or percentage of women on hiring or other committees leads to an increase in the success of women who are being evaluated.

Moreover, there were serious concerns expressed about overburdening the few women in the system with committee work. This concerns not only hiring

or other evaluation committees, but also, e.g., dissertation committees. How to mitigate such burdens would need to be discussed further in the context of specific organizations' goals and resources. For example, it was suggested that compensation, such as relief from administrative duties and support for research and teaching, might be offered for committee service.

Positive aspects of quotas for committees were identified:

- → More women on a committee could reduce isolation and tokenism.
- → A more diverse committee could broaden the points of view in committee discussions.

Points of concern were identified:

- → The few women qualified to sit on committees would be overburdened with committee work, thereby their scientific output could be limited.
- → The positive effects of increasing the number of women on committees on the number of women selected by these committees has not been clearly demonstrated.

Box 2 Critical mass: How many women on boards/committees makes a difference?

In chemistry and physics critical mass refers to the minimal amount of fissionable material that will sustain a chain reaction, or a condition that will cause an abrupt change in a quality or material property.

The term was first introduced in the context of women as a minority in politics by Drude Dahlerup (Dahlerup, 1988), based on work by Rosabeth Moss Kanter from the 1970s. Kanter looked at the status and experience of women in large American corporations. She described that in groups with large proportions of one gender, race, or ethnicity these "dominants" control the group and its culture, whereas the minority group is reduced to "tokens" representing the stereotypes held for their group. She defined four types of groups, according to the ratio of majority to minority: uniform (100:0), skewed (85:15), tilted (65:35) and balanced (50:50, 60:40). In skewed groups, the "tokens" are subject to greater visibility, performance pressure, isolation and role entrapment. According to her analysis two women (e.g., 20% in a group of 10) are too few to form an effective alliance (Kanter, 1977).

Dahlerup extends Kanter's theories to the study of women in politics and defines 30% representation as the critical cut-off point ("critical mass") for gauging the impact of women on politics. Both Kanter and Dahlerup have pointed out though that women (or minorities) do not necessarily form alliances, may hold different opinions, and may not always work for the advancement of other women (Childs and Krook, 2008).

In academia, Henry Etzkowitz refers to the "paradox of critical mass" (Etzkowitz et al., 1994). On the one hand, as the numbers of women faculty increase, overt male behaviour towards women is mitigated, which the authors attribute to a threshold effect of critical mass. On the other hand, women divide into distinct subgroups, following "the traditional male" or the "relational female" model; thus, some of the expected effects of critical mass dissipate. The authors conclude that "a modest increase in the numbers of women in science, without a change in the structure of the scientific workplace, creates a paradox of critical mass".

In 2010 Carol de Wet analysed the effects of increasing numbers of women faculty and staff at Franklin and Marshall College (Pennsylvania, US), and wrote, "instead of a sense that there were only a few isolated voices agitating about unimportant issues, the presence of a critical mass of women in the institution gave the concerns legitimacy and a sense that a broad spectrum of the institution's population was involved" (de Wet, 2010).

Using data from over 1000 US colleges and universities, Ronald Ehrenberg et al. reported that "institutions with female presidents/chancellors and female provosts/academic vice presidents, as well as those with a greater share of female trustees, increase their shares of female faculty at a more rapid rate"; and that "a critical share of female trustees must be reached before the gender composition of the board matters" (Ehrenberg et al., 2009).

→ The percentage of female committee members that would effect a fair handling of female applicants has not been clearly demonstrated.

c. Quotas in research funding (grants and fellowships)

These measures target one of the central mechanisms to advance careers in academia, which is the funding of individual or group grants and fellowships to carry out research projects. In Europe they have already been adopted by a few funding bodies. For example, the Swedish Research Council (Swedish Research Council, 2010 and 2014), the Research Council of Norway (Research Council of Norway, 2014) and the Helmholtz Association in Germany (Helmholtz Association, 2013) request that success rates for applications for funding from some of their schemes are the same for male and female applicants. There are no direct sanctions if this goal is not met.

Mandating that women and men have to be equally successful would preclude gender bias in the competition for funding. To understand the extent of gender bias in research funding we looked at the existing evaluations of the success rates of women and men in different funding schemes.

Some of these studies found that women had a small, but significantly lower success rate than men (Wenneräs and Wold, 1997; Ledin et al., 2007, Bornmann et al., 2007, Jacobsson et al., 2007). In the ERC grant competitions only 29% of Starting Grants and 15% of Advanced Grants applications have been from women across all disciplines since the beginning of the scheme. Differences in success rates at the ERC vary over the years and disciplines, but on average the success rate of women is lower than that of men. The area where the difference in success rate is largest is the life sciences (ERC, 2013).

Similarly, an analysis of grant data across the Research Councils in the UK has shown that women are slightly less successful than men (3–5% over three years 2009–2012) (Biotechnology and Biological Sciences Research Council, 2013).

On the other hand, other studies have found little or no difference in success rates between women and men in some grant schemes. Evaluations by national funding agencies like the Wellcome Trust (Grant and Low, 1997) and the German Research Foundation (Hinz et al., 2008) found no relevant difference between men and women's chances to obtain funding in their schemes.

An assessment of the main funding bodies of the 27 EU member states contacted by the European Commission for the year 2007 found differences, sometimes in favour of men and sometimes in favour of women, but no clear general patterns (EC, 2009).

In the cases where a difference in the success rate between women and men has been observed, the reasons for it remain unclear. There are indications in the literature that there could be systematic biases against women, due to gender stereotypes (Moss-Racusin et al., 2012) or because women may struggle with issues outside academia (e.g., family life) to a different extent than men do (Ledin et al., 2007; Ceci et al., 2009; Martinez et al., 2007).

The Swedish Research Council has performed a qualitative study of grant selection committee behaviour (Ahlqvist et al., 2013), with gender experts sitting in during committee meetings. They did discern patterns that pointed towards subtle gender differences both for the behaviour of male and female committee members as well as in the way male and female applicants were talked about. But it was not immediately obvious how much this has led to the gender gap in funding. Interestingly, emotional arguments did play a role in the judgement of candidates. On the other hand, EMBO gender blinded its committee for two rounds of selection for EMBO postdoctoral fellowships in 2006; the difference in success rates persisted, leading to the conclusion that the committee did not hold an inherent gender bias (Ledin et al., 2007). Further studies of this type may show a more detailed picture of the situation.

Analysis of the benefits and harms of quotas in research funding

Thus we wanted to know in this context what the advantages and disadvantages of mandating an equal success rate for men and women in grant applications (and other types of awards) might be.

We are aware that there are critical concerns about the initial ratios of female to male applicants in many pools for grants. However, we did not analyse this here. Rather we considered this only from the perspective of relative success based on application rates.

Positive aspects of mandating an equal relative success rate for male and female applicants were identified:

- → Systematic biases would be excluded.
- → The applicant pool would be reflected and thus full inclusion (i.e., some approximation of proportional representation) would be ensured.
- → Guaranteeing equal success might provide a positive signal to the underrepresented group, encouraging a higher rate of application.

Points of concern were identified:

- → Since systemic biases have not been shown conclusively throughout all funding schemes, applying a corrective across the board could be perceived as unfounded.
- → Mandating equal success rates would give preference to weak applicants over strong ones, thereby thwarting the merit system.
- → Equal success rate quotas might then also have to be applied to other groups with low success rates, e.g., applicants from underrepresented countries/regions or scientific fields.

Additionally, as a way to address problems in achieving a precise number every year, it was proposed to use averages over specified time periods, rather than relying on snapshot measurements.

V. Options for implementing specific types of quotas in academia: Potential benefits and harms

After examining the potential benefits and harms of the specific types of quotas described above, the group went on to consider a set of options for their implementation. We wanted particularly to consider what the benefits and harms of any possible implementation mechanism might be.

The group was able to delineate a number of specific benefits and harms depending on who requires a quota. We focused on this aspect because the identity of the agency may influence how the mandate is implemented and whether or not it is successful, and how acceptable it is to stakeholders (academic, and perhaps more broadly in society).

A summary of the discussion can be found in Table 1.

Quota legislated by a government:

As discussed above, legislated quotas are rather blunt instruments, but they do produce results. The advantage of this approach would be an immediate and universal change in hiring patterns in a country as a whole. In principle, incentives are not needed, if the legislation specifies actions that would need to be taken in case of no compliance.

One concern is that if the legislation is not clear, e.g., leaves room for interpretation, or does not stipulate clear consequences for non-compliance, the law may not lead to change. Another concern is that goals might be unrealistic or unattainable for individual institutions or departments.

Quota set/requested by the academic institution:

We looked in some detail at the possible use of quotas mandated by the institution itself.

Two significant benefits were immediately apparent in the discussion. First, this approach makes the people most affected by changes, i.e., the staff

themselves, part of the solution. Second, there would likely be a direct link between the decision and the implementation; that is, the formulation of a quota system would inherently include processes that would work best for the specific institution devising them.

At the same time, there was concern expressed that this approach could result in "all talk no action"; i.e., that this gives universities the possibility of continually discussing the problem without correcting it.

Quota required by a funder:

Among the benefits of funders mandating a quota is that both philanthropic and governmental funders have the power to attach conditions to grants, certainly with respect to the activities of the grantee (the most obvious recent example is some funders' requirements of making all work published on grant-funded activities open access). In principle funders could extend conditions further to institutions: specifically, a funder could potentially deny grants to anyone at an institution in the case where that institution has a gender imbalance. Moreover, this approach could serve as an example of best practice to other funders.

Table 1 Who can set quotas?

DECISION MAKERS	BENEFITS	HARMS OR CONCERNS	UNKNOWNS
A government through legislation	Immediate and universal impact. Ensure that change takes place.	Goals might be unrealistic/unattainable for individual institutions/ departments. If the terms are not clear or strong enough may not lead to change.	
An institution	Direct link between decision and implementation. People affected are part of the solution. Tailored to the institution's situation.	Talk without action.	
A funder	By attaching conditions to awards made or to the eligibility criteria, funders can indirectly influence grantee or host institute behaviour and policies; such conditions may serve as best practice examples to other funders	Potential applicants could be excluded on non-scientific grounds. Quota stigma for women who are funded.	Would funders go so far as to deny funding on the basis of gender imbalance?
A professional society		No effect as professional societies have no direct power to elicit change.	

A current example is set by the Department of Health in the UK, accepting applications only from researchers at institutions that have an Athena SWAN Silver award certifying "a significant record of activity and achievement by the institution in promoting equality and in addressing challenges across the whole institution" (Equality Challenge Unit, no date). This would be effective, but from our discussions we understood that it is unlikely that funders would go so far as to deny funding on the grounds of gender imbalance.

One concern expressed about this type of approach is that potential applicants could be excluded not on scientific grounds, but on the basis of working in an institute that does not comply with the required standards. Furthermore, the women funded may carry a quota stigma.

Quota required by professional societies:

Professional societies were generally thought to have no power to oblige academic bodies to correct gender imbalances. In general the workshop participants thought the power of professional societies would be more through their ability to interact with decision makers to influence their thinking on the use of quotas.

Incentives and sanctions

Sanctions were perceived as a negative but efficient measure that forces change, as demonstrated by political elections and company boards.

Incentives on the other hand are perceived as positive: pulling rather than pushing.

Both incentives and sanctions are ineffective if they are not strong enough: incentives need to be valuable enough to be strongly desired, e.g., the Norwegian government had offered a one-time incentive of about €50,000 per every female professor hired at universities, but this measure was not effective (Aukland, 2012). Sanctions need to be painful enough, as seen in the monetary sanctions connected to non-compliance with the composition of electoral lists in France (see above).

Incentives or sanctions could be coupled to certain recognition or awards, as in the case of the UK Athena SWAN award.

VI. Findings and conclusions

Discussions about using quotas in academia to achieve better gender balance are becoming more widespread, and more focused and insistent. In this project, we wanted to understand the state of the current uses of quotas in academia, to investigate the potential for their use, and to seek comparisons with areas other than academia.

Potential benefits of quotas for hiring professors, composition of committees, and distribution of grants:

- → Quotas would ensure that change does indeed happen. The current good will declarations have not effected the substantial changes that were expected given the number of women entering and graduating from university in the past decades. It was thought by the workshop participants that quotas carry the benefit of the fastest possible increases in numbers of the under-represented gender compared to other measures in place. It can be envisaged that the overall environment of academia would improve quickly enough such that any potential harms would be mitigated, and in fact quotas would become obsolete due to a more balanced workforce.
- → Quotas also preclude problems inherent in approaches that rely on training academic decision makers to be aware of biases (both systemic, and intrinsic) and to correct them.

Potential harms of quotas:

- → Stigma for individuals hired or selected through a quota process, and stigma towards a department, university or organization that uses this mechanism.
- → Many academics will not want to accept quotas since they interfere with the practice that scientific advancement and allocation of funds is best judged by scientists on scientific grounds (i.e., merit) only.

A general criticism voiced for all quota processes was the fact that quotas do not directly address two central problems that lead to the underrepresentation of women in the higher levels of a research career:

- → Women leave at disproportionally higher rates after their postdoctoral period (especially in the life sciences and chemistry) and are thus not available for recruitment (National Research Council, 2010).
- → Only a small number/percentage of women study the hard sciences and engineering, leading to a significant underrepresentation from the start that will not be addressed by the cascading model (or realistically any type of quota).

We found that sanctions and incentives applied to all types of quotas could be effective. However, in academia, where merit and autonomy have a central value, sanctions and incentives could be seen as compromising either, and therefore corrupting the system. The current understanding of merit may derive from the historical circumstances under which our review processes emerged. These circumstances may have consequences for many underrepresented groups in research, not just women. For example, there is a gap between the success rates of individuals from different national systems. We cannot explore here any problems related to gendered, regionalized, or classed views of merit, but we do want to note this appeared through our study as a significant systemic problem and may benefit from additional investigation.

Quotas for high-level academic positions

The application of a quota to hire women at the highest career levels (professorships, group leaders) as a mechanism for correcting gender imbalance would effect long-term change in academic units. A relatively rapid change in gender composition has been evident in both politics and company boards. Given that academic positions are long-term appointments and their availability is limited (either by turnover or creation of new positions), the effects on the overall representation of women in these positions will be relatively small in the very short-term (years), but highly significant in the long-term (decades). A quota will ensure that this increase does take place.

The path to implementation of such a quota is crucial. No model that we analysed is perfect; all have potential benefits and harms.

The model most compelling to the workshop group was a flexible cascade model, where quotas are based on the percentage of women at the level immediately below for each type of position; applied at all career levels; mandated by a government; with strong financial incentives for reaching the quota, and sanctions for non-compliance.

A benefit of the cascade model is that it is based on real numbers for each individual department/subject area, precluding the dangers of one-for-all quotas that do not reflect reality (i.e., the recruitment pool). Moreover, the model provides a logical solution that requires the active participation of the universities/departments/institutes in defining their quotas, thus ensuring that the values are attainable. This, and the potential advantages to be gained from the incentives may ensure the buy-in of academics.

The caveats identified with this model were based on real experiences from some of our workshop participants. Firstly, calculations could become unnecessarily complicated, potentially leading to a skewing of the estimated target values. Secondly, the possibility of perpetuation of small numbers due to low numbers at the entry level.

Workshop participants also recommended a flexible time frame for the attainment of quotas, such that values may be overachieved in one year and underachieved in another. This would allow departments or institutions to react to a variable hiring pool.

Quotas for review committees and oversight bodies

The data on the effect of women's presence in committees ("critical mass") necessary to prevent gender discrimination and on the success of female applicants is mixed, although there is consensus that the presence of more than one woman on committees reduces isolation and tokenism and broadens the points of view during discussions, including minority concerns.

The main harm of such quotas is a work overload for the few women in high positions who would be requested to sit on many committees. This would limit the amount of time they can invest in research and penalize them in terms of scientific output. These harms could be mitigated by compensation for committee service, such as relief from administrative duties and support for research and non-research related academic duties.

Quotas for funding

The available data do not show a systematically lower success rate of female researchers for all funding schemes in all countries. Since monitoring of success rates of any given scheme is simple, each funder (and employer) could be mandated to publish their data and be required by law to address the issue if a persistent difference in success rates is evident.

Table 2 Benefits and harms of quotas

TYPE OF QUOTA	BENEFITS	HARMS OR CONCERNS	UNKNOWNS
Quotas for higher academic positions – cascade model	Would effect long-term change in academic units. Realistic, based on the composition of individual departmental/ institutional workforce. Require active participation of the institute.	Quota calculations may become complicated and can be manipulated. Perpetuation of small numbers due to small entry numbers. May lead to promotion/ hiring of less qualified individuals. Stigma for those hired under a quota system. Stigma for institutions hiring under a quota system. Core problems may not be addressed: · students' choice of subject · high drop-out rate of women after postdoctoral period in life sciences, chemistry and humanities.	Should there be a time window in which the quota is reached?
Quotas for review committees and oversight bodies	Reduce isolation and tokenism. Broaden the points of view in discussions.	Cause work overload for the few women who qualify for committee work, thereby limiting their scientific output.	What is the "critical mass" that represents women effectively? What is the effect of the presence of women on a committee?
Quotas for funding (equal success rate for applicants of both genders)	Systemic biases would be excluded. The applicant pool would be fairly reflected, full inclusion is ensured. Equal success rates might encourage a higher rate of applications by the underrepresented group.	Possibly less qualified applicants may get funded. Other minorities may demand a quota as well. May be viewed as an unfounded measure, since systemic biases have not been demonstrated in all funding schemes.	Should there be a time window in which the quota is reached?

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Appendices

Appendix 1. Measures other than quotas for improving gender balance in academia

Besides analysing the use of quotas in academia, we wanted to have a view of other measures that have been tried. Because quotas seem to be viewed as a "last resort", we wanted to understand possibilities that had been tried or proposed, and whether those possibilities have been exhausted, indicating that quotas might be a necessary step. This is not a comprehensive list but rather a representation of the types of interventions that could be brought to bear on the general problem of gender imbalances.

Dealing with the merit issue

Scientists struggle when asked to define "excellence". Excellence and the way it is measured should be clearly defined in any call. Related to this, the selection process should be clearly described for any call to increase transparency for applicant and reviewer. For example, the DFG and BBSRC selection processes are described in application instructions (*http://dfg.eu/download/pdf/foerderung/antragstellung/begutachtung/dfg_begutachtungsverfahren_130715_en.pdf*; *http://www.bbsrc.ac.uk/funding/apply/application-flowcharts.aspx*).

Gender equality plans

Universities and other types of research institutes could be required to have a gender action plan in order to be eligible to receive any kind of funding (*http://www.leru.org/files/publications/LERU_Paper_Women_universities_and_research.pdf*).

For example, Spanish law requires all public research bodies to have a gender equality plan in place, which is monitored on a yearly basis; the German Excellence Initiative requires institutes, departments and universities that apply to provide a comprehensive gender action plan; and the Swiss federal government gives additional grants to universities to support gender action plans (*http://www.swissuniversities.ch/en/topics/chancengleichheit/suc-programme-p-4/*). The Scientific Council of the ERC also has a Gender Equality Plan: *http://erc.europa.eu/sites/default/files/content/pages/pdf/ERC_ScC_Gender_Equality_Plan_2014-2020.pdf*

Allowances for career breaks

With or without an overall gender action plan, allowances could be made for time taken off by applicants following the birth or adoption of a child, or for periods where an applicant had special care commitments. While it is true that in principle men may take on these commitments, for now, it is generally the case that women carry the larger burden of childcare, elder care, and house work. These allowances can take the form of extension of the age of eligibility for age-limited awards, or could be subtracted from the career age when judging numbers of publications, trainees, etc. For example, the EMBO Long-Term Fellowships allow 3 months of paid parental leave (*http://www.embo.org/funding-awards/fellowships/long-term-fellowships#benefits*), and the EMBO Young Investigator Programme automatically extends the eligibility period by one year per child for women with children (*http://www.embo.org/funding-awards/young-investigators/apply#eligibility*).

Better understanding of the work climate

In order to improve the knowledge base on which decisions about needing to use quotas (or any measure) are made, universities, funders, etc. could use surveys to investigate the climate at individual institutions. This will give leadership an overview how faculty (and employees, PhD students and postdocs) perceive their work environment. Measures can then be taken to improve unsatisfactory areas that reduce academic career success. The US NSF ADVANCE Program (*http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5383*), the Government of Australia (*http://www.insyncsurveys.com.au/resources/articles/exit-interview/2012/04/sample-custom-exit-interview-questions/*) and, e.g., Colorado State University in the US (*http://oeo.colostate.edu/exit-interviews*) have compiled a number of both ongoing survey and exit survey materials.

Gender bias

Gender bias can be subtle, so it is critical to inform and train personnel about implicit and explicit gender bias. Gender bias is the root cause for the unconscious discrimination against women. Implicit gender biases make us associate science, career and leadership with men. Women who succeed in those domains are viewed as out of place, both by men and women.

A large number of resources are available to help people become aware of their biases and the effects (e.g., Project Implicit allows to measure biases). There is evidence that at least some of these interventions have an effect on mitigating unconscious biases (*http://gap.hks.harvard.edu/seeing-believing-exposure-counterstereotypic-women-leaders-and-its-effect-malleability-automatic; http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3399596/*).

There is a clear lack of information about what actually happens in committees. Studying or monitoring committee behaviour to identify differences in the judgement of male and female applicants would be useful in drafting policies. For example, the Swedish Research Council has had gender-equality observers during panel meetings over the last years (*https://publikationer.vr.se/en/product/observations-on-gender-equality-in-a-selection-of-the-swedish-research-councils-evaluation-panels/*).

Project Implicit:
https://implicit.harvard.edu/implicit/

Gender Bias Learning Project:
http://www.genderbiasbingo.com/

AWIS Tools for Change:
http://www.toolsforchangeinstem.org/gender-bias-in-stem/

NSF ADVANCE resource:
http://www.portal.advance.vt.edu/index.php/categories/diversity/bias

Diversity training in the UK:
http://www.enei.org.uk/pages/unconscious-bias.html

Mentoring

A mentor informally provides knowledge, social capital and support towards the professional development of a mentee. Providing mentoring to students, postdocs and junior faculty will improve their career outcomes and increase the retention of women. Women less frequently have access to a mentor (*http://www.embo.org/documents/WIS_report_2007_persistent_problem.pdf*), but face obstacles when choosing and progressing in a career that may not be faced by men. Providing mentoring, in particular to women at the early stages of their careers (e.g., PhD and postdoc), can be expected to increase the retention of women. The US NSF ADVANCE, the UK's funder/employer Concordat, and Oxford University among many others have extensive explanations of the value of mentoring and practical approaches.

For women at later career stages, the University of Tromsø in Norway initiated a project, called The Promotion Project, with the aim to identify possible candidates for promotion, and organize writing and mentoring sessions for them. The management of the university was actively involved, and funding was available to support individual women during the project (*http://curt-rice.com/wp-content/uploads/2012/11/6-Steps-to-Gender-Equality1.pdf*).

NSF ADVANCE resource:
http://www.portal.advance.vt.edu/index.php/categories/initiatives/mentoring

The "Concordat to support the career development of researchers" in the UK calls for mentoring of junior researchers:
https://www.vitae.ac.uk/policy/vitae-concordat-vitae-2011.pdf

Guidance on setting up a mentoring scheme from Oxford University:
http://www.learning.ox.ac.uk/media/global/wwwadminoxacuk/localsites/oxfordlearninginstitute/documents/supportresources/Guidance_on_setting_up_a_mentoring_scheme.pdf

Training women for leadership roles

Women in leadership positions are in the minority. Standards for behaviour in these roles are often artefacts of those who held the roles earlier, which is to say, men's patterns. Women can define and find their own style to succeed (EMBO Laboratory Management Course, *http://events.embo.org/FemaleLeadersinScience/*). In Germany, "Fast Track - Excellence and Leadership Skills for Outstanding Women in Science" is an intensive education program by the Robert Bosch Foundation for outstanding female postdocs. It offers intensive seminars, preparing female postdocs to leadership positions in research (*http://www.bosch-stiftung.de/content/language2/html/11732.asp*).

Incentivizing good behaviour/accredited institutes

Institutes/departments/universities that commit to and want to further advance in equality and diversity can be accredited in the UK by the Athena SWAN award, supported by the government, in Germany by the Total E-quality rating, an independent association (*http://www.total-e-quality.de/das-praedikat/wissenschaft.html*) and the Audit Familiengerechte Hochschule (*http://www.beruf-und-familie.de/index.php?c=22*). In the UK, the Athena SWAN silver award is a prerequisite for eligibility to apply for research funding from at least one UK Research Council (*http://www.ecu.ac.uk/equality-charter-marks/athena-swan/*).

Financial incentives for hiring female professors

Funding agencies can provide financial incentives to research bodies for hiring female professors. The funding needs to be substantial in order to serve as an incentive to hire more women. For example, the Norwegian government launched a temporary incentive scheme in 2010 to encourage the institutions to appoint women to permanent academic positions (professors and associate professors) in mathematics, natural science and technology. Up to NOK 300 000 was awarded to institutions per woman employed in such a position (*http://eng.kifinfo.no/nyhet/vis.html?tid=80513*). The German ministry for education and research (BMBF) financially supports the hiring of female professors at German universities (*http://www.bmbf.de/en/494.php*).

Databases

Women are frequently overlooked when considering to fill posts on committees, when looking for speakers at conferences or generally when looking for experts or persons for leadership positions. Databases that highlight highly qualified female academics can considerably facilitate the search for female experts. For example, AcademiaNet is a searchable database of outstanding female academics in Europe from all disciplines that has been established by the Robert Bosch Foundation and Spektrum der Wissenschaft in 2010. Currently, 47 academic partner organizations throughout Europe participate in nominating highly qualified women academics. Over 1,700 scientific profiles of excellent female researchers are listed in the database (Robert Bosch Stiftung, *http://www.academia-net.org*). EMBO hosts a database called WILS (Women in the Life Sciences), listing over 800 female researchers (*http://www.embo.org/science-policy/women-in-science/wils-database-of-women-in-life-sciences*).

Prizes

Prizes awarded to women exclusively serve to increase the number of women who are visible, as women are frequently overlooked by those who award prestigious prizes. The L'Oréal UNESCO Awards for Women in Science, the ASCB Women in Cell Biology awards, and the FEBS/EMBO Women in Science Award are good examples of this.

Appendix 2. Implemented quotas

Examples of quotas for public boards

Finland: Equality Act: at least 40% women should be represented on public boards (Act 609/1986 as amended).
http://www.tasa-arvo.fi/en/publications/act2005

Iceland: Act on Equal Status and Equal Rights of Women and Men No.10/2008: at least 40% women should be represented on public boards.
http://eng.velferdarraduneyti.is/media/acrobat-enskar_sidur/Act-on-equal-status-and-equal-rights-of-women-and-men_no-10-2008.pdf

Norway: Gender Equality Act: at least 40% women should be represented on public boards (EC 2009, The Gender Challenge in Research Funding).
https://www.regjeringen.no/en/dokumenter/the-act-relating-to-gender-equality-the-/id454568/

Spain: Law on Science, Technology, and Innovation: equal presence of women and men is required in committees, bodies and boards (Frutos et al., 2012).
http://www.idi.mineco.gob.es/stfls/MICINN/Ministerio/FICHEROS/UMYC/WhitePaper_Interactive.pdf

The European Commission has committed to reaching 40% female participation in its advisory structures for Horizon 2020 (EC 2011, COM(2011) 808 final)
http://ec.europa.eu/research/horizon2020/pdf/proposals/com%282011%29_808_final.pdf

Examples of quotas for academic evaluation committees, panels and scientific boards

The European Research Council plans to set specific goals for each of its evaluation panels based on the percentage of women in the relevant scientific communities or in the pool of ERC candidates, with the aim of reaching gender balance in the future (ERC Scientific Council Gender equality plan 2014 – 2020).
http://erc.europa.eu/sites/default/files/document/file/ERC_ScC_Gender_Equality_Plan_2014-2020.pdf

The German Helmholtz Association requires that 30% of the members of programme review panels for all competitions for funding are female (Hermann von Helmholtz-Gemeinschaft, Helmholtz Research for Change, Annual report 2013).
http://www.helmholtz.de/fileadmin/user_upload/2013_AnnualReport_HelmholtzAssoication_EN_web.pdf

The Swedish Research Council demands that at least 40% representation of either sex is required in its evaluation panels.
https://www.vr.se/download/18.15b99fa512c61b7e53880001059/1340207441417/Strategy+for+gender+equality.pdf
http://www.vr.se/download/18.70a7940b146b-8f937949f953/1403793852159/Strategy+Gender+Equality+SRC+2014.pdf

Examples of quotas for funding schemes introduced by funders

In Germany, **the Helmholtz Association** has set a 50% quota for women in the funding programme for postdoc posts in 2013 (Annual Report 2013).
http://www.helmholtz.de/fileadmin/user_upload/2013_AnnualReport_HelmholtzAssoication_EN_web.pdf

The Research Council of Norway in its policy Gender Balance and Gender Perspectives in Research and Innovation (2013-2017) has introduced gender quotas in the distribution of research funding.
http://genderedinnovations.stanford.edu/Norway-2014Policy.pdf

In its Strategy for Gender Equality published in 2014, the **Swedish Research Council** has stated its goal to "ensure that women and men have the same success rates and receive the same average grant amount, taking into account the nature of the research and the type of grant".
http://www.vr.se/download/18.70a7940b146b-8f937949f953/1403793852159/Strategy+Gender+Equality+SRC+2014.pdf

Examples of quotas in recruitment

The cascading model and equity initiatives by the German Research Foundation (DFG) have triggered initiatives and statements by other bodies and research organizations such as The German Council of Science and Humanities (Wissenschaftsrat), the Joint Science Conference (Gemeinsame Wissenschaftskonferenz – GWK), The German Rectors' Conference (Hochschulrektorenkonferenz) who all support the implementation of flexible quotas for universities and research centers based on the cascading model.
http://www.gleichstellung.uni-bonn.de/pdf-dokumente/wissenschaftsrat-2012

The Helmholtz Association has established a 30% quota for recruiting women into leadership positions, (Hermann von Helmholtz-Gemeinschaft, Helmholtz Research for Change, Annual report 2013).
http://www.helmholtz.de/fileadmin/user_upload/2013_AnnualReport_HelmholtzAssoication_EN_web.pdf

The Leibniz Association has committed itself to increasing the share of women in leadership positions to 20% by 2016. At the same time, it will implement the decision by the Joint Science Conference to use flexible quotas at all levels of qualification. It is also acting to ensure that more women are represented on Leibniz committees by changing the nomination procedures.
http://www.leibniz-gemeinschaft.de/en/karriere/equal-opportunities-and-gender-equality/

In 2012, **the Max-Planck-Gesellschaft** made a voluntary commitment to increase the proportion of female scientists in W2 and W3 positions (professor level) and in remuneration groups E13 to E15 of the Collective Wage Agreement for Government Service Workers (TVöD). The aim is to increase the numbers by one percentage point each year up to 2017. This target was agreed with the Federal Ministry of Education and Research (BMBF) and the Joint Science Conference.
http://www.mpg.de/7999136/women-science

Appendix 3. Workshop and interview information

Workshop agenda

Robert Bosch Stiftung Representative Office, Berlin, 20 – 21 May 2014

TUESDAY, 20 MAY 2014

9.00 – 9.30	**Welcome address** → **Ingrid Wünning Tschol**, Senior Vice President, Health and Science Department, Robert Bosch Stiftung → **Gerlind Wallon**, Deputy Director, EMBO **Introduction** → **Michele Garfinkel**, Manager, Science Policy Programme, EMBO
	SESSION I
9.30 – 10.45	**Approaching fair gender distributions** Moderator: **Gerlind Wallon** → **Gerlind Wallon**, *Overview of the current situation in Europe* → **Sarah Childs**, University of Bristol, UK *Electoral quotas in the UK* → **Petra Schott**, Legal Officer, European Commission - DG Justice, Belgium *Proposed EC regulation on company boards* → **Mari Teigen**, Institute for Social Research, Norway *Quotas on company boards in Norway* → Discussion
10.45 – 11.15	**Break**
	SESSION II
11.15 – 12.45	**Effects of the use of quota-driven systems** Moderator: **Sandra Bendiscioli**, Science Policy Programme, EMBO → **Sandra Bendiscioli** *Introduction and summary of pre-meeting interviews* → *Structured discussion, including recruiting Generation Y for leading positions in science*
12.45 – 14.00	**Lunch**

SESSION III

14.00–15.30 **Proposed uses of quota mechanisms for achieving gender balance in academic scientific research fields**
Moderator: **Katrin Rehak**, Science and Research, Robert Bosch Stiftung

- → **Carl Jacobsson**, Swedish Research Council, Sweden
  Actions taken by a government
- → **Anna Lönnroth**, ERC Executive Agency, Belgium
  Actions taken by a European research funder
- → **Ulrike Eickhoff**, German Research Foundation (DFG), Germany
  Actions taken by a national funder
- → **Curt Rice**, University of Tromsø, and Norway's Committee on Gender Balance in Research, Norway
  Actions taken by a university
- → **Sara de la Rica**, University of the Basque Country, Spain
  Economics perspective of the results of these actions
- → Structured discussion

15.30–16.00 **Break**

SCENARIO

16.00–17.30 **Envisioning the use of quotas from training to professorship, from the perspectives of the candidate, faculty members, the committee, and funders**
Moderator: **Michele Garfinkel**

19.00–22.00 **Dinner**

WEDNESDAY, 21 MAY 2014

SESSION IV

9.00–12.00 *(with break)* **Evaluating options**
Moderator: **Michele Garfinkel**

- → *Structured discussion of options*
- → *Portfolio analysis*

12.00–13.15 **Lunch**

SESSION V

13.15–14.30 **Re-visit options, next steps, concluding thoughts**

- → **Michele Garfinkel**
  Options review and participants' last-minute thoughts
- → **Sandra Bendiscioli, Gerlind Wallon**
  Next steps
- → **Gerlind Wallon, Ingrid Wünning Tschol**
  Concluding remarks and farewell

Workshop participants

Sandra Bendiscioli
Programme Officer, Science Policy Programme
EMBO, Germany

Sarah Childs
Professor of Politics and Gender
University of Bristol, United Kingdom

Sara de la Rica
Professor of Economics
University of the Basque Country, Spain

Ulrike Eickhoff
Head of Division Quality Assurance and Programme Development
German Research Foundation, Germany

Michele Garfinkel
Manager, Science Policy Programme
EMBO, Germany

Jackie Hunter
Chief Executive
Biotechnology and Biological Sciences Research Council (BBSRC), United Kingdom

Johanna Ivaska
Professor
University of Turku, Finland

Carl Jacobsson
Director, Research Policy Analysis
Swedish Research Council, Sweden

Anna Lönnroth
Head of Unit, ERCEA.B.3 Scientific Affairs
ERC Executive Agency, Belgium

Ricarda Opitz
Head of Division Research
Leibniz Association, Germany

Katrin Rehak
Head of Science and Research Section
Robert Bosch Stiftung, Germany

Curt Rice
Professor of Linguistics
University of Tromsø, and
Head of Norway's Committee on Gender Balance in Research, Norway

Eva Roth
Programme Officer
Robert Bosch Stiftung, Germany

Petra Schott
Legal officer, DG Justice
European Commission, Belgium

Linda Senden
Professor of European Law
Utrecht University, The Netherlands

Nina Steinweg
Researcher
Center of Excellence Women and Science, Germany

Mari Teigen
Research Director
Institute for Social Research, Norway

Cornelia Ulrich
Division Head, Preventive Oncology
German Cancer Research Center, Germany

Gerlind Wallon
Deputy Director
EMBO, Germany

Detlef Weigel
Director
MPI for Developmental Biology, Germany

Indra Willms-Hoff
Member of the Executive Management
Volkswagen Stiftung, Germany

Ingrid Wünning Tschol
Senior Vice President, Health and Science Department
Robert Bosch Stiftung, Germany

Interviewees

Ulrike Beisiegel
President of the University of Göttingen, Germany
Interviewed by phone on 2 April 2014

Eleanor Campbell
Head of School of Chemistry, University of Edinburgh, United Kingdom
Interviewed via Skype on 10 April 2014

Sara de la Rica
Professor of Economics
University of the Basque Country, Bilbao, Spain
Interviewed via Skype on 10 April 2014

Sarah Dickinson
Manager, Athena SWAN, London, UK
Interviewed by phone on 24 April 2014

Marc Gärtner
Gender und Diversity Expert
Europäische Akademie für Frauen in Politik und Wissenschaft EAF, Berlin, Germany
Interviewed by phone on 23 April 2014

Monica Gotta
Associate Professor, Faculty of Medicine, University of Geneva, Switzerland
Interviewed via Skype on 7 April 2014

Maria Leptin
Director, EMBO, Germany
Interviewed in person on 11 April 2014

Iain Mattaj
Director General, European Molecular Biology Laboratory, Heidelberg, Germany
Interviewed in person on 28 March 2014

Curt Rice
Vice President for Research & Development, University of Tromsø, Norway
Interviewed via Skype on 11 April 2014

Thomas Sattelberger
Initiative "MINT-Zukunft schaffen", Germany
Interviewed by phone on 14 May 2014

Ines Sanchez de Madariaga
Professor, Universidad Politécnica de Madrid, Spain, and member of REDS at UN Sustainable Development Solutions Network UN-SDSN
Interviewed by phone on 15 April 2014

Indra Willms-Hoff
Member of the Executive Management, Volkswagen Stiftung, Hannover, Germany
Interviewed by phone on 2 April 2014

Biographies and institute information

Gerlind Wallon
EMBO Deputy Director

Gerlind Wallon is the deputy director of the European Molecular Biology Organization (EMBO). A German native, she has as diploma in chemical engineering from Hamburg University of Applied Sciences and graduated with a PhD in Biochemistry from Brandeis University, Waltham, Massachusetts, USA, followed by a 4-year postdoctoral period at EMBL in Heidelberg.

At EMBO she is responsible for the EMBO Young Investigator Programme, the EMBO Installation Grants, the Women in Science activities and The EMBO Meeting. Gerlind has developed the EMBO Laboratory Management Courses for leadership development and started the Career Day that offers transferable skills training at The EMBO Meeting. She has authored studies on the selection processes and the effects of gender on application success at EMBO, as well as a number of articles on women in science. She is also co-chairperson of the FEBS/EMBO Women in Science Award committee and regularly organizes women in science sessions at *The EMBO Meeting*.

Sandra Bendiscioli
Programme Officer, EMBO Science Policy Programme

Sandra Bendiscioli joined the EMBO Science Policy team in 2011. She contributes to research on policy implications in areas such as genomics, biotechnology, open access in scientific publishing and gender issues in science. From 2001 to 2011, she worked in the EMBO Science and Society Programme, organizing activities and events to promote public understanding of science and to foster discussions on the ethical aspects of scientific research. She has an MA in Foreign Languages, Literature and Linguistics from the University of Pavia, Italy.

Michele S. Garfinkel
Manager, EMBO Science Policy Programme

Michele Garfinkel is the Manager of the EMBO Science Policy Programme, which focuses on policy issues in biotechnology, scientific publishing, and responsible conduct of research. Before joining the EMBO Science Policy team in 2011, she was a policy analyst at the J. Craig Venter Institute, Rockville, Maryland, USA, where her research focused on identifying emerging societal concerns related to new discoveries in genomics and crafting options for policy interventions. Her earlier work focused on health research policy at Columbia University's Center for Science, Policy, & Outcomes, and on stem cell research policy issues at the American Association for the Advancement of Science in the Scientific Freedom, Responsibility & Law Program. Michele graduated in Genetics from the University of California, Berkeley, and obtained her PhD in Microbiology from the University of Washington, Seattle. She holds an MA in Science, Technology, and Public Policy from the George Washington University. Michele is a Fellow of the American Association for the Advancement of Science.

About EMBO

EMBO is an organization of more than 1600 leading researchers that promotes excellence in the life sciences. The major goals of the organization are to support talented researchers at all stages of their careers, stimulate the exchange of scientific information, and help build a European research environment where scientists can achieve their best work.

EMBO helps young scientists to advance their research, promote their international reputations and ensure their mobility. Courses, workshops, conferences and scientific journals disseminate the latest research and offer training in techniques to maintain high standards of excellence in research practice. EMBO helps to shape science and research policy by seeking input and feedback from our community and by following closely the trends in science in Europe. *www.embo.org*

About the Robert Bosch Stiftung

The Robert Bosch Stiftung is one of the major German foundations associated with a private company. It has managed the philanthropic bequest of company founder Robert Bosch for over 50 years. It was his entrepreneurial vision, political farsightedness, moral fortitude and charitable initiatives that set the standards for the work of the Robert Bosch Stiftung. The Stiftung works predominantly in the fields of International Relations, Health, the Sciences, and Education. *www.bosch-stiftung.de*

Robert Bosch Stiftung

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