

University researchers' engagement with industry, the public sector and society

— Results from a 2017 survey of university researchers in Denmark

Publishers

Copenhagen Business School (CBS) and the Think Tank DEA,
November 2017

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This report was written in collaboration between CBS and DEA,
drawing on data collected in the Triple-I-Research Survey of
Academics in Denmark 2017, a survey undertaken in October 2017
by the team of researchers from CBS.

This report presents key results from the survey. For more detailed
results of the survey, please see the Appendix tables, which can be
downloaded separately.

The CBS authors carry sole responsibility for the contents and results
of the survey. The CBS authors thank Angeliki Karavasili and Sara
Vardi for their excellent research assistance. They would also like
to thank the many researchers from different scientific fields who
generously agreed to share their time and their valuable thoughts
about many different aspects of academic life in interviews – as well
as the colleagues who helped us in piloting the survey. Both the CBS
group and DEA are responsible for the analysis of survey results and
conclusions presented in this report.

The survey and the contributions of the CBS researchers to the
making of this report was financed via a grant from the Novo Nordisk
Foundation. The contribution of the analysts from DEA to the making
of this report was funded by DEA.

Date of publication: November 2017

Design by: Spine Studio

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Introduction and key findings

University researchers are increasingly expected to embrace so-called “third mission” activities, which include engaging with industry, the public sector, and the wider society, while actively pursuing the commercialisation of their research findings. These expectations stem from, among others, policymakers, research funders, and university managers seeking to increase the speed and effectiveness with which university research is disseminated and applied beyond the walls of academia.

In the quest for greater impact from public investments in science, policymakers have tended to focus on commercialisation-oriented activities such as the establishment of spin-off firms and licensing or sale of university-owned patents. Ironically, however, these mechanisms only account for “the tip of the iceberg” when looking at universities’ overall interaction with industry and society at large (Perkmann & Salter 2012).

In fact, academic research suggests that other, less visible mechanisms are both greater in overall volume and in their contribution to the dissemination and, ultimately, application of university-generated knowledge, methods, and technology (see e.g. DEA 2016). For example, Cohen et al. (2002) found that firms place greater value on collaboration with academia (e.g. in the form of consulting, contract research, and joint research) than on the licensing of academic patents. Agrawal & Henderson (2002) showed that transfer of patents accounted for less than 10 pct. of knowledge

transfers from Massachusetts Institute of Technology (MIT) to industry. In addition, universities generally generate more income from various forms of collaborative projects than from the sale of patents (Perkmann et al. 2011). In this light, it is unfortunate that official statistics tend to focus on quantifying formal interactions between researchers and firms as well as commercialisation-oriented activities such as patenting, licensing, and the creation of spin-off companies.

Research also indicates that commercialisation-oriented activities and other forms of engagement between universities and industry are not entirely distinct from each other but rather interrelated and possibly even interdependent (see e.g. Landry et al. 2010). For instance, commercialisation is often not a stand-alone activity but rather the result of or an activity subsequent to direct collaboration between a university and a private firm (Perkmann et al. 2013).

Much emphasis is placed today on supporting academic researchers in their interplay with private or public collaborators, for instance by establishing technology transfer offices, providing legal support, and developing university or faculty-wide strategies and initiatives. However, several academic studies argue that while such efforts are important, university-industry collaboration is to a large extent the result of individual researchers’ decision to invest resources in building and maintaining ties to firms, public institutions or other non-

academic organisations (see DEA 2016 for references). Such decisions are in turn largely based on the perceived costs and benefits of collaborating with firms, acting as a consultant to government, or starting a spin-off firm.

In summary, to effectively promote university–industry collaboration and thus ultimately achieve greater impact

of societal investments in science, we need greater insight into the actions, motivations, and perceived barriers of the individual researchers behind university–industry interactions. We also need greater insight into the full range of both formal and informal interactions between university researchers and the users of their research.

BOX 1. DEFINING ENGAGEMENT WITH NON-ACADEMIC STAKEHOLDERS

This report focuses on researchers employed at Danish universities and their engagement with non-academic stakeholders. **Non-academic stakeholders** include **private organisations** (both private firms and third-sector organisations, e.g. interest organisations, unions, non-profit organisations, NGOs etc.), **and public institutions** (i.e. all public sector organisations, including government agencies and ministries, regional and local authorities, public hospitals and schools, excluding academic organisations).

Engagement is defined broadly to include a wide range of forms of interaction between university researchers and non-academic stakeholders or the wider community, including:

- Engaging in **joint research agreements** (original research work undertaken by both partners) in collaboration with non-academic stakeholders
- **Contract research** (original research work conducted by university researchers alone) for private organisations or public institutions
- Providing **consulting** to private organisations or public institutions
- **Co-supervising PhD students or postdocs** in collaboration with non-academic partners

- **Training of employees** in private organisations or public institutions (through either course enrolment or temporary personnel exchanges)
- Serving as a member of **scientific or technical advisory boards**
- Providing **informal advice** (through personal contacts, participation in meetings etc.)
- University researchers' **attendance at conferences** with a significant representation of participants from industry, the public sector or other non-academic organisations
- Giving **public lectures**, e.g. at schools, museums, community organisations etc.
- **Publishing articles** in either the daily press or popular science outlets (including online outlets)
- Making **appearances on TV or radio**

The report also addresses **commercialisation-oriented activities**, including

- **Entrepreneurial activity**, i.e. involvement in starting a company based on scientific research
- **Seeking intellectual property rights** to scientific research results with a view to the sale, licensing, or other forms of transfer or commercial use of these rights.

This report presents key findings from a survey of researchers employed at Danish universities. The survey, which covers all eight Danish universities, was undertaken in October 2017 by researchers at the Department of Innovation and Organisational Economics, Copenhagen Business School (CBS), led by Assistant Professor Valentina Tartari and Professor H.C. Kongsted.

The survey is a part of the research project “Investments, Incentives, and the Impact of Danish Research (Triple-I-Research)” funded by the Novo Nordisk Foundation. The project is aimed at improving our understanding of the way universities, firms, and research funders interact and how research impacts society at large with a focus on the pivotal role of individual researchers and their interactions with firms, funders, and universities. See www.cbs.dk/triple-i for more information on the research project.

The population targeted by the faculty survey are researchers who, by mid-2017, were employed by a Danish university in their capacity as a researcher and within the last five years have conducted research work, for which a PhD or equivalent qualifications would usually be required.

The population definition for this report excludes PhD students, scientific assistants, research assistants, technicians as well as people who are employed in administrative positions with no research work conducted within the last five years. Postdocs are included in the faculty survey. Also included are emeritus professors/emeritus associate professors who still have an affiliation with a Danish university, and who report to have conducted research work within the last five years. The faculty survey also addressed issues on research funding, researcher mobility, and academic life in general. Only results for the engagement section will be reported here. Further information on the survey can be found at www.cbs.dk/triple-i.

For researchers at four universities, the University of Copenhagen (KU), Copenhagen Business School (CBS), the Technical University of Denmark (DTU), and Roskilde University (RUC), we obtained administrative lists of faculty and enrolled PhD students. We are grateful to the four universities for their willingness to provide us with the essential information on staff names, positions, and e-mail addresses.

For researchers at the remaining four universities, Aarhus University (AU), Aalborg University (AAU), the University of Southern Denmark (SDU), and the IT University of Copenhagen (ITU), we compiled lists of names, positions, and e-mail addresses from information available on the universities' public homepages. In total, the faculty survey was administered by e-mail to 12.791 recipients within the population definition. A total of 4.832 faculty members responded to the survey, equivalent to an overall response rate of 38 pct. The overall response rate is higher than in previous surveys in Denmark and abroad. We are indeed very grateful to all researchers who took the time to participate and contributed their answers to the survey.

The survey extends the findings of a related survey undertaken in 2014 by the Think Tank DEA. Direct comparisons between the surveys are not feasible because they partly used different questions, and because the 2017 survey on academic engagement is part of a larger and comprehensive survey on a number of different academic domains, including research funding and researcher mobility. However, when it comes to academic engagement, the overall findings from the two surveys are comparable.

Key findings of the 2017 survey of academic engagement at Danish universities are presented on the following pages, along with some of the implications of these findings for policymakers, research funders, and university managers interested in supporting university researchers' interaction with users and other stakeholders in their research.

Engagement with stakeholders is common among researchers at Danish universities, but there is a high degree of variation in the extent to which researchers engage

The vast majority of the researchers surveyed have engaged in some form of interaction with non-academic users and other stakeholders in their research within the two-year period leading up to the survey. Across all forms of engagement considered, 71 pct. of the total number of survey respondents report at least one instance of engagement, while only 2 pct. report having no engagement during this two-year period. For the remaining survey respondents (27 pct. of the total) we have no direct information about their actual engagement activity. But even disregarding any unreported engagement activity among the latter group of researchers, an overall rate of 71 pct. of positive engagement responses on the survey sets an estimate for the level of engagement that shows widespread engagement with industry, the public, and the wider society among academics in Denmark.

Researchers with higher academic ranks are, generally speaking, more likely to engage in non-academic collaborations than their younger colleagues, with full professors standing out from other groups. This is in line with findings from academic studies, and not surprising, as more established researchers are likely to be more visible to external partners, and to have experience and resources that enable and facilitate collaboration with partners from outside academia.

The survey confirmed that engagement, like many other activities and performance indicators in academia, is highly skewed: the majority of researchers have had a small number of interactions in the two years leading up to the time of the survey, while a small number of researchers engaged in a very high number of interactions with external stakeholders. This, along with a high degree of variation in individual researchers' patterns of engagement, motivations, and perceived barriers,

underlines the importance of paying greater attention to the individual researcher's activities and perceptions to allow for more effective support of researchers' engagement with non-academic stakeholders of their research. For university managers in particular, but also for research funders and policymakers, approaches to stimulating or rewarding engagement that are tailored to individual researchers or to groups of researchers who share traits related to engagement are likely to be more effective than "one size fits all" approaches.

Researchers engage with non-academic stakeholders in a wide variety of ways, including many "hidden" mechanisms not visible in official statistics

Survey results show that researchers engage with a broad set of stakeholders, including private firms and public institutions, but also the wider society. Moreover, researchers engage with these stakeholders using a broad range of mechanisms, ranging from informal interactions to formal research collaborations and entrepreneurship.

Formal and informal collaboration as well as dissemination activities aimed at the wider society are much more widespread than often assumed. For instance, the most common forms of engagement among survey respondents were: attending conferences with participants from outside academia (71 pct. of researchers who engaged during the period); providing informal advice to public partners or private partners (69 pct. and 64 pct., respectively); giving public lectures (60 pct.), and publishing articles in non-scientific outlets (56 pct.). It is also interesting to note that 44 pct. of the respondents have served as members of at least one scientific or technical advisory board over the last two academic years. Formal engagement was less common but still practiced by around half of the respondents. This includes joint research agreements with public partners (52 pct. of survey respondents); contract research with

public partners (42 pct.); joint research agreements with private partners (41 pct.), and contract research agreements with private partners (41 pct.).

Splitting modes of engagement by their degree of formalisation, it appears that almost all (96 pct.) of the actively engaging researchers report some informal mode (conference attendance, advice, public lectures, and appearances in daily press or radio/TV). The more formal modes of engagement (joint research, contract research, training) that presumably require more coordination or paperwork are reported by 82 pct. of those who engage.

The survey also investigated researchers' activities related to the commercialisation of research findings. Among other things, survey responses indicate that roughly one in ten respondents have been involved in starting one or more companies based on their research at some point during their academic career. Respondents from the STEM disciplines were asked about their knowledge and use of the technology transfer office, or TTO, of their university; here it is worth noting that while a quarter of the respondents had used the services of the TTO on at least one occasion, almost half indicated that they were "not at all" familiar with the services of the TTO. The remaining respondents indicated that they were familiar with the services offered by the TTO, although they had never used them.

Overall, the survey underlines the variety in the mechanisms by which university researchers interact with the world beyond academia. Unfortunately, the value of universities' so-called "third mission" activities is often reduced to what we can measure using indicators such as the number (or financial value) of collaborations with industry and the number of invention disclosures, granted university patents, licensing agreements, spin-out companies etc. Many of the types of interactions captured in this survey are not reflected in official statistics and indicators on universities' engagement with industry and other non-academic stakeholders. As such, policymakers are likely to underestimate both the number of university

researchers who engage with their surrounding community, and the scope of their engagement.

These findings underline the need for policymakers but also research funders and university managers to recognise the entire spectrum of mechanisms for researchers' interaction with external stakeholders. In particular, more attention should be focused on how to support engagement through informal mechanisms that, according to the academic literature, can play a key role in strengthening ties between individuals inside and outside of academia.

Engagement is not limited to the STEM disciplines; it is also common in the social sciences and humanities

The survey sheds light on the activities of researchers from the STEM disciplines (here defined broadly to include the natural sciences, the medical and health sciences, engineering and technology, the agricultural and veterinary sciences) – and from the social sciences and humanities (SSH).

Because of the focus on university patenting, spin-off creation, and large formal research agreements, university-industry ties are often associated more with the STEM disciplines, where these types of activities are more common, than with SSH. Yet the survey showed that SSH researchers are, overall, as likely to engage with stakeholders beyond academia as their colleagues in the STEM disciplines. They are, however, more likely to engage in dissemination activities aimed at the wider society, e.g. through public lectures, publications in non-scientific outlets, and appearances on TV or radio. They are less likely to engage in formal types of engagement such as joint research agreements and contract research.

When it comes to entrepreneurial activities among university researchers, perhaps a bit surprisingly, the

rate at which SSH researchers report having been involved in starting a company based on their research is 12 pct., only slightly lower than the corresponding rate of 13 pct. for researchers in STEM disciplines. It is, however, likely that the entrepreneurial activity among SSH researchers includes many smaller consultancies that can be effective vehicles for additional dissemination and diffusion of research findings to non-academic stakeholders.

Researchers are motivated to engage with non-academic stakeholders by benefits to their research and teaching rather than direct personal gain

In line with findings from academic research, *accessing additional funding for research* was cited by most respondents (74 pct.) as an important factor in motivating their engagement with non-academic stakeholders. Other important factors identified by respondents included *developing or refining ideas for new research paths and projects* (60 pct.); *accessing equipment, facilities, technical expertise, research materials and/or data* (50 pct.); *to test the usefulness or strengthen the utilisation and/or commercialisation of their research* (47 pct.), and *to gain non-academic contacts and insights that can be used in teaching activities* (46 pct.).

Thus, the key motivations for engagement expressed by the respondents are related to reaping benefits for universities' core missions, i.e. scientific research and research-based education. This indicates that researchers see engagement as being complementary to their research and teaching activities rather than as an independent or even competing activity. On a related note, more than 70 pct. of the researchers in the 2014 survey by DEA (DEA 2014) indicated that engaging with the non-academic sector had a positive effect on the quality or scientific impact of their research and/or on the quality or relevance of their teaching activities. This suggests that engagement should be viewed as a

natural complement to research and teaching rather than a "third mission", as this phrase signals that engagement poses an added task for researchers that is more or less distinct from their other professional activities.

The findings also hold implications for the reward systems designed by university managers, research funders, and policymakers. The fact that researchers are (or at least believe themselves to be) far more motivated to engage in non-academic collaboration by the expected benefits to their research or teaching than by formal requirements, possibilities for career advancement, or opportunities to supplement their personal income, implies that policies and initiatives to stimulate non-academic collaboration are likely to be more effective if they highlight, and help realise, potential benefits for research and teaching activities. This may be supported by e.g. career-related benefits or explicit requirements to engage in non-academic collaboration, but such tools are unlikely to be effective on their own.

Across the main scientific fields, SSH versus STEM, the rankings of motivations are fairly similar, though with some notable exceptions. For instance, STEM researchers were more likely to be motivated by *access to equipment and training of young researchers*, and their SSH counterparts by motivations related to *use in teaching* and *access business/public sector knowledge and information*. The top-ranked motivation remains *access to funding* for both groups of researchers, although it is cited significantly more by STEM researchers (79 pct. versus 67 pct. for SSH researchers), which is not surprising in view of the higher costs and larger research groups associated with many STEM fields.

Conflicting goals and time frames in academia and industry were identified as the most common barriers to engagement

The two deterrents or barriers to collaboration with non-academic organisations cited by most respondents were *conflicting goals in industry and academia* (41 pct.) and *conflicting time frames in industry and academia* (33 pct.). Academic studies indicate, however, that the impact of such barriers on university-industry collaboration can be mitigated through e.g. prior collaboration experience (especially between the collaborating parties), and by increased trust among collaborators.

Other barriers cited by more than a quarter of the respondents include: *It's difficult to find or get through to suitable, qualified partners* (32 pct.); *My research is not (sufficiently) relevant for non-academic organisations* (28 pct.); *It takes many years to build good, trust-based relationships with partners* (28 pct.); *University management does not sufficiently prioritise or reward such activities* (27 pct.); *Such activities take too much time away from research and/or teaching activities* (27 pct.).

Perceived barriers and deterrents to collaboration were fairly consistent across all stages of the academic career, though young researchers (and postdocs in particular) are more likely to experience difficulties related to finding suitable partners or seeing their research as being relevant for external stakeholders, suggesting they might benefit from guidance from senior colleagues and access to their networks.

Looking across scientific disciplines, the top-rated concern was the same for SSH and STEM researchers. However, SSH researchers are significantly more likely than their STEM counterparts to experience barriers such as: *taking time away from research and/or teaching; benefits do not outweigh costs, and insufficient prioritisation by university management*. This seems to suggest that SSH researchers are faced with a less supportive environment in their organisations in rela-

tion to engagement activities, as they may be less institutionalised, and therefore codified, than in STEM fields. STEM researchers, in contrast, tend to put more emphasis on other barriers such as: *Partners may limit or slow down publication of research results or Expectations regarding ownership of IP*.

Gender differences in university researchers' engagement with industry, the public sector, and society

As a special focus of this report we analyse if survey results show evidence of significant gender differences in terms of the forms of engagement adopted, the partners involved, the motivations to engage, and the barriers to engagement as perceived by female and male researchers. Previous studies have found that male researchers are more likely to engage with industry than their female counterparts. We investigate if such differences can indeed be found in the Danish context and across a wider set of engagement partners and scientific fields.

According to survey results, women do indeed engage less with private organisations than their male counterparts. At the aggregate level, 69% of women who engage have had some form of engagement with private organisations (both formal and informal), while 73% of their male colleagues engaged in similar activities in the same time period. This small but statistically significant difference is present only in STEM fields, while in social sciences and humanities women do not seem to engage differently with private organisations than their male colleagues. Interestingly, there seems to be no gender difference in any form of engagement with public organisations, neither in STEM fields nor in the social sciences and humanities.

While the survey has not investigated in depth the reasons for these “gender” and “gender-related” patterns, it is suggestive that most differences in

engagement activities between men and women are present in STEM fields and for activities involving private organisations. Since female scientists in STEM work in strongly male dominated environments, both in academia and in industry, they are likely to have to spend more time and effort than their male colleagues to engage with industry.

Gender differences in motivations to engage with non-academic organisations reveal some interesting patterns. For instance, there is some evidence that women are less motivated by obtaining resources (both private and for their research) than their male colleagues. As obtaining additional funding for research is the most important factor motivating academics to engage in external collaborations, this may (at least) partly explain why we observe some disparity in the patterns of engagement between women and men.

When it comes to gender differences in the perception of barriers to engagement, male and female researchers in both the STEM and SSH disciplines do not seem to perceive the top-rated barriers, *Conflicting goals* and *Conflicting time frames*, with any noticeable difference. This suggests that the perception academics have of the challenges in reaching agreements with their non-academic partners on the focus of research projects, working priorities, and expectations about research as well as on the timing of the dissemination of research findings does not seem to depend on the gender of the researchers involved.

Finally, the survey documents important gender differences in commercialisation-oriented activities. Overall, the proportion of female researchers who report having been involved in starting a company based on their research (8 pct.) is half of the rate that applies to male researchers (16 pct.) The difference is less pronounced in SSH fields (10 pct. versus 13 pct.) whereas STEM fields show a ratio of approximately 1:3 in terms of company creation by female and male researchers. While the survey can only be suggestive of the causes of such differences, and part of the differences can probably be ascribed to differences in average seniority between gender groups, the numbers do suggest a significant gender dimension in commercialisation-oriented activities, mainly related to STEM fields of research.

1. About the survey



Introduction and key findings

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5. Researchers' involvement in commercialisation-oriented activities

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The survey is part of the research project “Investments, Incentives, and the Impact of Danish Research (Triple-I-Research)” funded by the Novo Nordisk Foundation. The project is aimed at improving our understanding of the way universities, firms, and research funders interact – and how research impacts society at large with a focus on the pivotal role of individual researchers and their interactions with firms, funders and universities. See www.cbs.dk/triple-i for more information on the research project.

The survey has two main strands, one directed at the population of PhD students at Danish universities, another at the faculty population at Danish universities. In addition to the part on university researchers’ engagement, the faculty survey also addressed issues on research funding, researcher mobility, and academic life in general. Only results for the engagement section will be reported here. The results for the other sections and also for the PhD strand of the survey will be reported in subsequent work.

The survey population

The population targeted by the faculty survey are researchers who, by mid-2017, were employed by a Danish university in their capacity as a researcher and within the last five years have conducted research work for which a PhD or equivalent would usually be required.

The population definition excludes PhD students, scientific assistants, research assistants, technicians as well as people employed in administrative positions with no research work conducted within the last five years. Postdocs are included in the faculty survey. Also included are emeritus professors/associate professors who still have an affiliation with a Danish university, and who report to have conducted research work within the last five years.

For researchers at four universities, the University of Copenhagen (KU), Copenhagen Business School (CBS), the Technical University of Denmark (DTU), and Roskilde University (RUC), we obtained administrative lists of faculty and enrolled PhD students. We are grateful to the four universities for their willingness to provide us with the essential information on staff names, positions, and e-mail addresses.

For researchers at the remaining four universities, Aarhus University (AU), Aalborg University (AAU), the University of Southern Denmark (SDU), and the IT University of Copenhagen (ITU), we compiled the lists of names, positions, and e-mail addresses from information available on the universities’ public homepages. Further information on the survey can be found at www.cbs.dk/triple-i.

In total, the faculty survey was administered by e-mail to 12.791 recipients within the population definition. Our initial assessment of who would qualify for the survey population by the above definition was validated by self-reported academic position, and of having been active in research within the last five years.

A total of 4.832 faculty members within the population definition responded to the survey, equivalent to an overall response rate of 38 pct. The overall response rate is higher than in previous surveys in Denmark and abroad. We are indeed very grateful to all researchers who took the time to participate and contributed their answers to the survey.

The response rates do vary somewhat across universities from a high of 48 pct. at CBS, the “home” university of the survey, to a low of 34 pct. at DTU (cf. table 1.1). Still, in all cases it remains very high in comparison with previous surveys in Denmark and similar surveys abroad.

TABLE 1.1

Survey response rate by university

Source: Triple-I-Research Survey of Academics in Denmark 2017.

	AAU	AU	CBS	DTU	ITU	KU	RUC	SDU	Total
Response rate (pct.)	41,6	41,1	48,0	34,4	35,5	35,6	36,8	36,1	37,8
No. of respondents	562	1.093	224	637	43	1.451	160	662	4.832

The distribution of survey respondents by gender and discipline shows that a little more than a third of respondents are female. It also reflects well-known differences in gender ratios across disciplines. Gender differences in researchers' engagement activities and perceptions will be a special focus of this report; here it is important that there is a sizable number of researchers of both genders within disciplines, which is indeed the case here.

For comparisons of engagement activities across disciplines, we will generally group disciplines into the social sciences and humanities (SSH) on the one hand, and STEM disciplines on the other (here, the term is used broadly to include the natural sciences, the medical and health sciences, engineering and technology, and the agricultural and veterinary sciences), which has been the main distinction in the academic literature.

TABLE 1.2

Distribution of survey respondents by gender and scientific discipline

Source: Triple-I-Research Survey of Academics in Denmark 2017. Information on gender/discipline is missing for 17 respondents.

	Arts and Humanities	Social sciences	Engineering and technology	Medical and health sciences	Natural sciences	Agricultural and veterinary sciences	Total
Female researchers (pct.)	291 (47,7)	426 (38,6)	120 (19,8)	514 (43,7)	316 (26,9)	64 (43,2)	1.731 (36,0)
Male researchers (pct.)	319 (52,3)	677 (61,4)	485 (80,2)	661 (56,3)	858 (73,1)	84 (56,8)	3.084 (64,0)
Total (pct.)	610 (100,0)	1.103 (100,0)	605 (100,0)	1.175 (100,0)	1.174 (100,0)	148 (100,0)	4.815 (100,0)

To assess the representativeness of the actual survey sample of respondents, we compare to recent (that is, end of 2015) information on the overall composition of faculty at Danish universities. Faculty at all Danish universities are represented in proportions that are very close to the faculty totals, with minor exceptions for a small overrepresentation of SDU researchers and a small underrepresentation of DTU researchers in the sample.

TABLE 1.3

Respondents and faculty population by university

Source: For respondents: Triple-I-Research Survey of Academics in Denmark 2017. For faculty population: Uddannelses- og forskningsministeriet: Videnskabeligt personale på universiteterne 2015 (November 3, 2016). Number of persons in positions at the level of assistant professor (including postdocs), associate professor, full professor.

	AAU	AU	CBS	DTU	ITU	KU	RUC	SDU	Total
Total faculty (pct.)	1.197 (11,1)	2.397 (22,3)	492 (4,6)	1.756 (16,3)	81 (0,8)	3.176 (29,5)	357 (3,3)	1.296 (12,1)	10.752 (100,0)
Survey respondents (pct.)	562 (11,6)	1.093 (22,6)	224 (4,6)	637 (13,2)	43 (0,9)	1.451 (30,0)	160 (3,3)	662 (13,7)	4.832 (100,0)

We can also compare the proportions of faculty employed in academic positions at different levels in the survey sample and the totals for all Danish universities. Again, we observe that faculty at all Danish universities in different academic ranks are represented in proportions that are very close to the national totals.

Based on these comparisons, we can hence conclude that the survey sample seems representative of the total population of Danish university researchers.

This report presents selected key findings from the survey. For more detailed insight into the results of the survey, please see the Appendix tables, which can be downloaded separately.

TABLE 1.4

Respondents and faculty population by academic position

Source: For respondents: Triple-I-Research Survey of Academics in Denmark 2017. Emeritus faculty is excluded (N=166). For faculty population: Uddannelses- og forskningsministeriet: Videnskabeligt personale på universiteterne 2015 (November 3, 2016). Number of persons in positions at the level of assistant professor (including postdocs), associate professor, full professor.

	Assistant/postdoc level	Associate level	Professor level	Total
All Danish universities (pct.)	3.981 (37,0)	4.451 (41,4)	2.320 (21,6)	10.752 (100,0)
Survey respondents (pct.)	1.696 (36,3)	2.017 (43,2)	953 (20,4)	4.666 (100,0)

2. Researchers' engagement with industry, the public sector, and the wider society

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In this chapter, we focus on the nature and extent of university researchers' engagement with non-academic stakeholders. Commercialisation-oriented activities will be addressed in chapter 5.

We examine both formal and informal mechanisms for engagement, and engagement with industry, the public sector, and the wider society. The chapter is based on self-reported engagement by survey respondents who were asked to describe the type and the extent of their engagement activities in the two years leading up to the time of the survey, i.e. the academic years 2015/2016 and 2016/2017.

What is the overall level of engagement?

Across all forms of engagement considered, 71 pct. of the total number of survey respondents report at least one instance of engagement (3.428 researchers). Only 102 researchers (2 pct.) report having no engagement during the two-year period. The remaining survey respondents (1.302 researchers, or 27 pct. of the total) did not respond to survey questions on engagement. We hence have no direct information about their actual engagement activity.

The overall rate of 71 pct. of positive engagement responses on the survey sets a (probably conservative) estimate for the actual level of engagement among academics in Denmark, showing that engagement with industry, the public, and the wider society is indeed widespread among academics in Denmark.

This is broadly in line with a previous survey of Danish researchers by DEA (2014), which found that 75 pct. of researchers reported some form of engagement. High levels of non-commercial forms of engagement were found in a recent study of UK researchers (Hughes et al. 2016). They found that a full 88 pct. of researchers engaged in so-called people-based interactions (conferences, networks, invited lectures), 45 pct. in problem-

solving activities (joint research, joint publications, giving informal advice), and up to 41 pct. of researchers were involved in broader community-based activities.

By this conservative measure of academic engagement, differences between groups of researchers are small (although in some cases statistically significant due the large overall number of respondents in the survey, see Appendix tables). Researchers with higher academic rank are, generally speaking, more likely to engage in non-academic collaborations than their younger colleagues, with full professors standing out from other groups. This is in line with findings from academic studies, and not surprising, as more established researchers are likely to be more visible to external partners and to have experience and resources that enable and facilitate collaboration with partners from outside academia. Differences between genders or across academic fields in terms of the rate at which different groups report having some engagement activity are generally insignificant.

We next turn to investigating if this overall picture hides important differences between groups of researchers in terms of how they engage or the partners they engage with.

What are common forms of engagement?

Looking across 3.428 researchers who report having engaged at least once over the two-year period, the common forms of engagement (as listed in figure 2.1) are: attending conferences with participants from outside academia (71 pct. of engaging researchers) and providing informal advice to public partners or private partners (69 pct. and 64 pct., respectively). These types of engagement are closely followed by giving public lectures (60 pct.), publishing articles in non-scientific outlets (56 pct.), and joint research agreement with a public partner (52 pct.). Less common types of engagement, although still practiced by more than a quarter

of researchers, include the training of employees (44 pct.); contract research with public partners (42 pct.); engagement with private partners (for joint research agreements (42 pct.); contract research agreements (33 pct.); and training of employees (28 pct.) as well as TV or radio appearances (28 pct.)

Splitting modes of engagement by their degree of formalisation, a quite natural pattern appears in that almost all (96 pct.) of the actively engaging researchers report some informal mode (conference attendance, advice, public lectures, and appearances in daily press or radio/TV). The more formal modes of engagement (joint research, contract research, training), which presumably require more coordination or paperwork, are reported by 82 pct. of those who engage.

The most common “partner” in academic engagement is the general public (attendance at conferences, public lectures, publishing in non-scientific outlets, press/radio/TV appearances). It attracts the attention of 89 pct. of the researchers who engage. 80 pct. of the researchers who engage have experience with a public partner for research or training purposes. 73 pct. of the actively engaging researchers have engaged with private partners.

Also worth noting from figure 2.1 is that engagement, like many other activities and performance indicators in academia, is highly skewed, in that a majority of researchers report small numbers of instances of engagement (five or less, say) in the two years leading up to the time of the survey, while a minority of researchers engage in a high number of interactions with external stakeholders (ten or more).

Does engagement differ between main fields of research?

We also examined differences in forms of engagement across scientific disciplines. Figure 2.2 compares the percentage of researchers who had participated in various forms of engagement among respondents from the social sciences and humanities (SSH) and respondents from the STEM disciplines.

SSH researchers are, overall, as likely to engage with stakeholders beyond academia as are their colleagues in the STEM disciplines. They are, however, more likely to engage in dissemination activities aimed at the wider society, e.g. through public lectures, publications in non-scientific outlets, and appearances on TV or radio. They are less likely to engage in formal types of engagement such as joint research agreements and contract research. These results are again in line with prior findings from the academic literature.

FIGURE 2.1.

“In the last two years, how frequently have you been engaged in the following types of activity in your capacity as an academic researcher?” (as a percentage of all respondents who reported some engagement)

Source: Triple-I-Research Survey of Academics in Denmark 2017. Number of respondents: N=3,428.

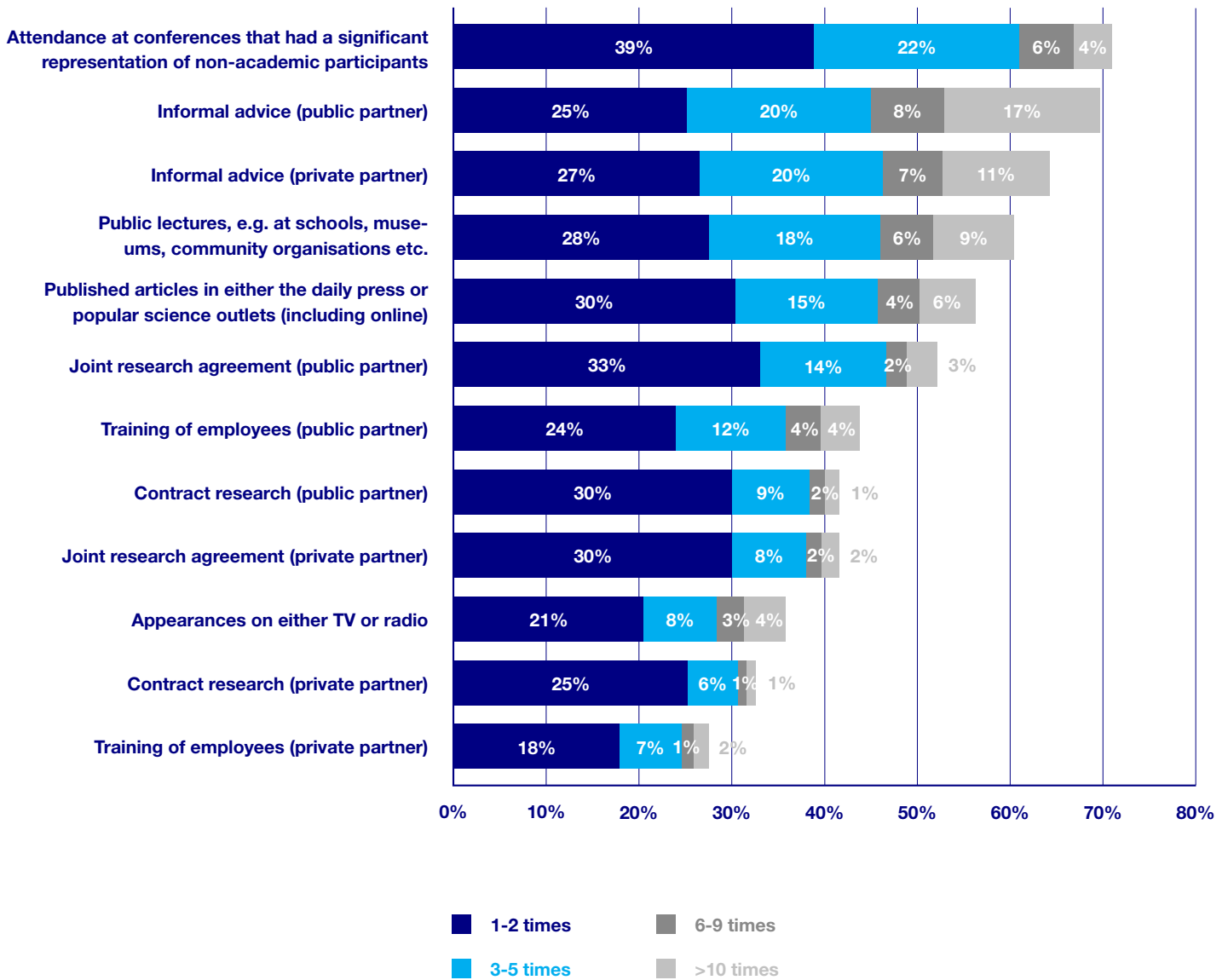
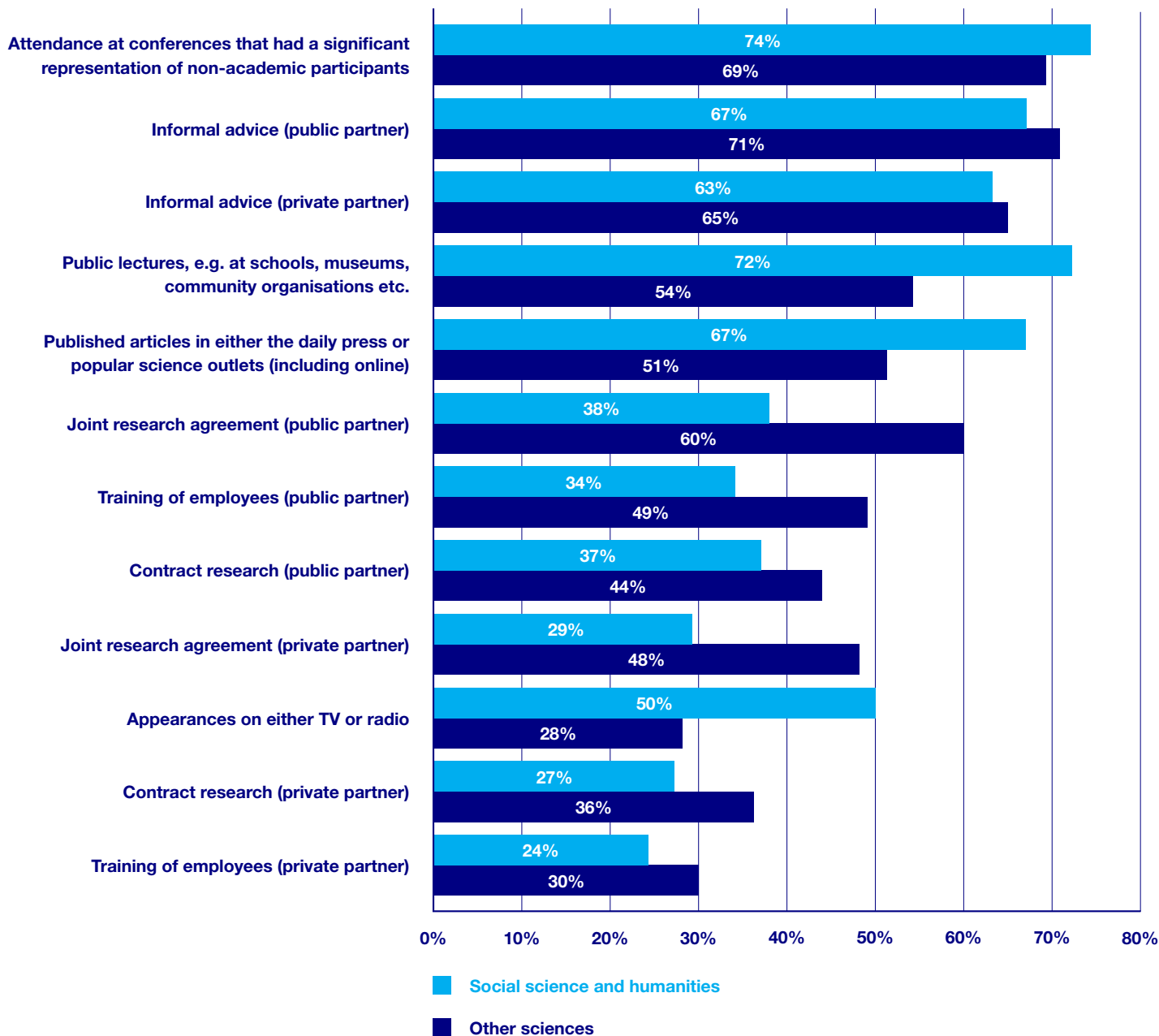


FIGURE 2.2.

“In the last two years, how frequently have you been engaged in the following types of activity in your capacity as an academic researcher?” (by field, as a percentage of all respondents in the same field who reported some engagement)

Source: Triple-I-Research Survey of Academics in Denmark 2017. Number of respondents: N=3.428. All differences between SSH and other sciences are significant at the 5 pct. level, except for “Informal advice (private partner)”.



Other forms of academic engagement

Supplementing the common forms of engagement listed in figures 2.1 and 2.2, respondents were also asked to indicate how often they had engaged in activities such as serving as a member of scientific or technical advisory boards, co-supervised PhD students or postdocs in collaboration with non-academic partners, or provided consulting to private companies, government or non-profit organisations.

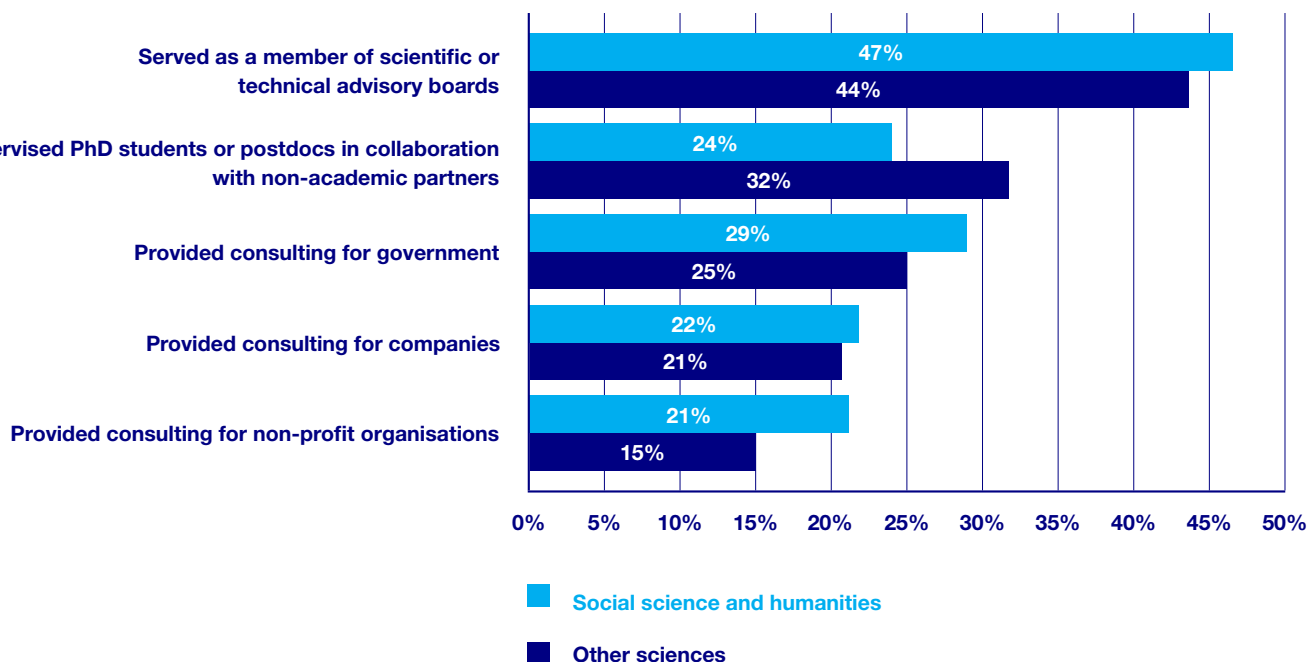
As apparent in figure 2.3, almost half of actively engaging researchers served as members of at least one scientific or technical advisory board in the last

two academic years, while a third of researchers or less were involved in the other forms of engagement. Perhaps surprisingly, SSH researchers seem to have a slight edge over researchers in other fields in terms of scientific/advisory boards (47 pct. over 44 pct.), and they are also more likely to provide consulting for government (29 pct. over 25 pct.) or for non-profit organisations (21 pct. over 15 pct.). A higher proportion of STEM researchers than SSH researchers have engaged in co-supervision of PhD students or postdocs in collaboration with non-academic partners (32 pct. over 24 pct.).

FIGURE 2.3.

Other forms of academic engagement (respondents who reported in the affirmative/positive numbers as a percentage of respondents in the same field)

Source: Triple-I-Research Survey of Academics in Denmark 2017. Number of respondents: N=3.428. All differences between SSH and other sciences are significant at the 5 pct. level, except for "Providing consulting for companies".



As a final item, we also asked respondents if they maintained a professional blog or a website (other than the one provided by their university). Overall, about 19 pct. of researchers who actively engage answered in the affirmative (23 pct. of SSH researchers and 17 pct. of researchers in other sciences).

Gender differences in engagement

Finally, we address the existence of any gender differences in types of engagement or the partners involved. Several empirical studies (e.g. Ding et al. 2006, Colyvas et al. 2012, Tartari and Salter 2015) find that male researchers are more likely to engage with industry than their female counterparts. We investigate if such differences can indeed be found in the Danish context and across a wider set of engagement partners and scientific fields.

For the gender composition of the population of scientists engaging with non-academic organisations, we observe that, in line with previous studies, women seem to engage less with private organisations than their male counterparts. At the aggregate level, 69 pct. of women who engage have had some form of engagement with private organisations (both formal and informal) in the academic years 2015/2016 and 2016/2017, while 73 pct. of their male colleagues engaged in similar activities in the same time period. Looking in more detail, we can see that this difference is present and significant only in STEM fields, while in social sciences and humanities women do not seem to engage differently with private organisations than their male colleagues. The significant difference in engagement with private organisations between men and women in STEM fields relates to all forms of engagement, including providing informal advice.

Interestingly, there seems to be no gender difference in any form of engagement with public organisations, neither in STEM fields nor in social sciences and humanities.

Finally, a broad look at gender discrepancies in other forms of interactions does not reveal any statistically significant difference; however, when analysing STEM disciplines separately, we can observe that women tend to be significantly less involved in interactions with broader audiences (83 pct. versus 87 pct. for men). Female in STEM to a lesser extent attend conferences that have a significant participation of non-academic audiences, and give fewer public lectures, than their male colleagues. Also, independent of the discipline, women researchers appear less on TV and radio.

While this survey has not investigated in depth the reasons for these gender patterns, it is suggestive that most differences in engagement activities between men and women are present in STEM fields, where women tend to be underrepresented in all levels of seniority, particularly at the top of academic careers, and for activities involving private organisations. Since female scientists in STEM work in strongly male dominated environments, both in academia and in industry, they are likely to have to spend more time and effort than their male colleagues to engage with industry. Researchers have suggested that the industrial culture in science and technology can be hostile or unreceptive to women (DiTomaso et al. 2007), therefore raising the costs for female scientists to negotiate mutually productive exchanges with industry partners.

3. Motivations for engagement

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Several academic studies have examined *why* researchers decide to collaborate with private firms or engage in efforts to commercialise their research findings. Generally speaking, these studies conclude that researchers are motivated – not because they expect personal financial rewards – but rather by access to additional funding and other resources for their research; to strengthen their academic position; to gain access to insights, skills or facilities in industry; to improve their network outside academia, or to test or demonstrate the value of their research (see e.g. Lee 2000; D’Este & Perkmann 2011).

Most frequently cited motivations for engagement with non-academic actors

Our survey seeks to extend its perspective to include engagement with public organisations as well as the wider society. Survey respondents were asked which reasons they considered important in motivating the decision to interact with non-academic organisations in general. The main findings are shown in figure 3.1.

In line with findings from previous research, more than two thirds (74 pct.) of respondents indicated that *accessing additional funding for research* is important in motivating their engagement with non-academic stakeholders.

Other important factors identified by respondents included *developing or refining ideas for new research paths and projects* (60 pct.); *accessing equipment, facilities, technical expertise, research materials and/or data* (50 pct.); *to test the usefulness or strengthen the utilisation and/or commercialisation of their research* (47 pct.), and *to gain non-academic contacts and insights that can be used in teaching activities* (46 pct.). Career-related concerns (*chances of advancing*) and *personal income*, on the other hand, rank among the least cited motivations for engagement.

Thus, the key motivations for engagement expressed by the respondents are related to reaping benefits for

universities’ core missions, i.e. scientific research and research-based education. This suggests that researchers see engagement as being complementary to their research and teaching activities rather than as an independent or even competing activity.

Motivations are fairly consistent across academic positions, though with some notable and significant differences. For instance, postdocs are the group most likely to identify resource-related factors (*accessing additional funding and access to equipment etc.*) and career-related factors (*chances of advancing*) as motivations when compared to associate and full professors. Full and associate professors, on the other hand, are the groups most likely to be motivated to engage with non-academic stakeholders for the purpose of *training of young researchers* or simply because it is *required of them in their position*. The latter differences seem closely related to the formal obligations associated with these more senior positions.

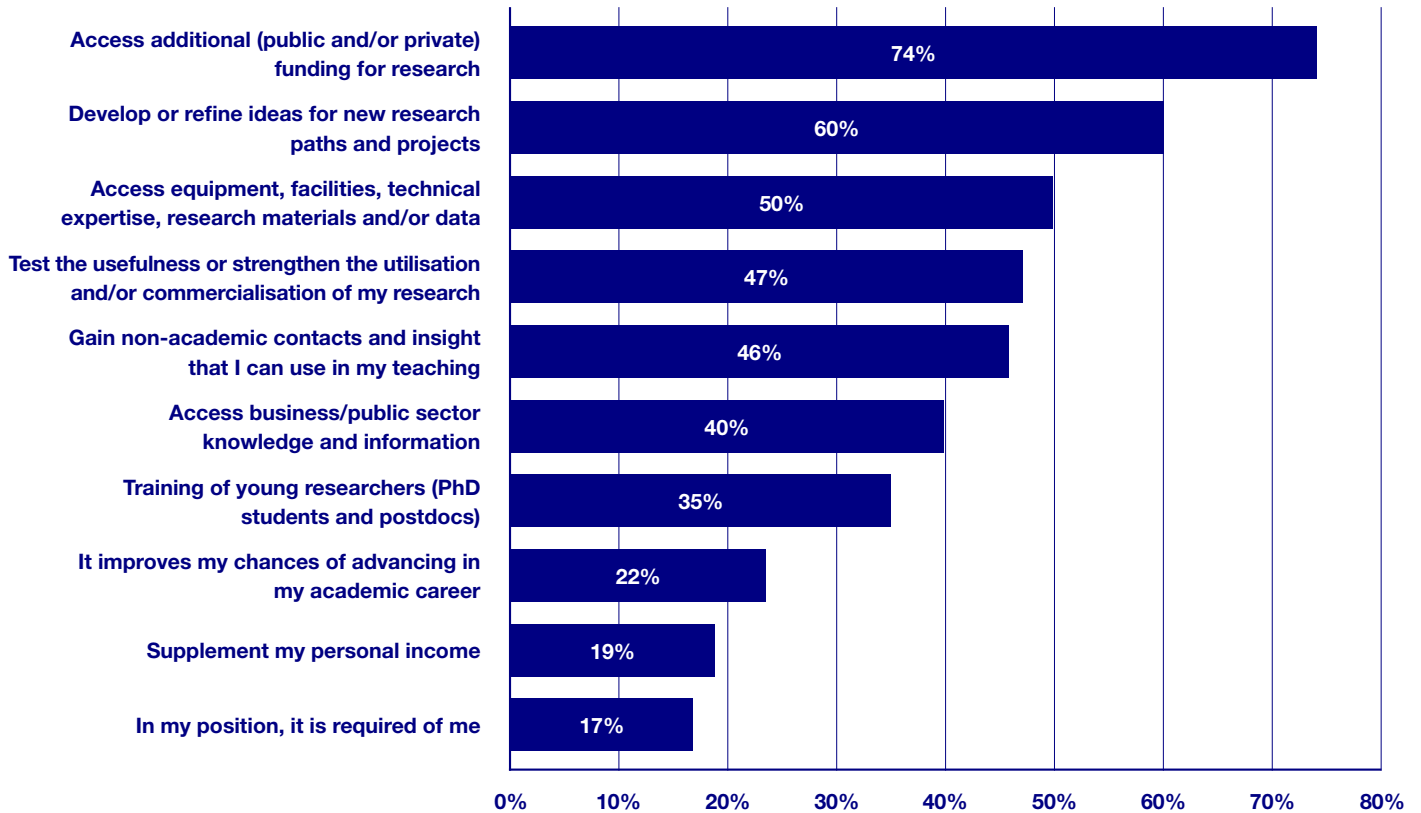
Across the main scientific fields, SSH versus STEM, the rankings of motivations are fairly similar, again with some notable exceptions. *Access to equipment and training of young researchers* gained higher priority as motivations for engagement activities by STEM researchers than by their SSH counterparts. This picture is reversed when it comes to motivations related to *use in teaching* and *access business/public sector knowledge and information*. The top-ranked motivation remains *access to funding* for both groups of researchers, although it is cited significantly more by STEM researchers (79 pct. versus 67 pct. for SSH researchers). This is not surprising in view of the higher costs and larger research groups associated with many STEM fields.

Interestingly, SSH researchers are significantly less likely to indicate *it improves my chances of advancing in my academic career* than respondents from the STEM disciplines; they are more likely to be motivated by the opportunity to *supplement their personal income*, although it remains a relatively minor concern also for this group.

FIGURE 3.1.

“Which reasons do you consider important for interacting with non-academic organisations?”

Source: Triple-I-Research Survey of Academics in Denmark 2017. Number of respondents: 3.315.



Gender differences in motivations for engagement

Gender differences in motivations to engage with non-academic organisations reveal some interesting patterns. First of all, there is some evidence that women are less motivated by obtaining resources (both private and for their research) than their male colleagues. As obtaining additional funding for research is the most important factor motivating academics to engage in external collaborations, this may (at least) partly explain why we observe some disparity in the patterns of engagement between women and men. There may be several reasons why women find obtaining resources less important in determining their engagement patterns. However, a lower interest in the funding benefits that engagement can stimulate may create a vicious circle for female researchers who generally lead smaller labs and draw fewer resources, which, in turn, might provide them with fewer opportunities for career advancement (Murray and Graham 2007).

Secondly, female researchers seem more motivated to interact with non-academic organisations because of reasons related to acquiring additional information and knowledge for their research. Research in the past has shown that women in science tend to have less rich and diverse social capital, and fewer bridging ties outside their local work contexts than their male colleagues (Etzkowitz et al. 2000). Results in our survey seem to indicate that female researchers proactively reach outside the boundaries of academia in order to expand their network and to benefit both their research projects and their teaching.

4. Deterrents and barriers to engagement

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In a scientific article on obstacles in university–industry collaboration, Tartari et al. (2012) identified two main types of obstacles: first, orientation-related “Mertonian” barriers created by the fact that firms and academic researchers are intrinsically different in their norms and behavior. In particular, two types of costs associated with engagement may be perceived by academics as strong barriers: secrecy and subject skewing (Tartari and Breschi 2012). For example, firms often have to produce results in the short term, while academics can work under a much longer time frame. The two parties also have different ways of dealing with their research results: firms generally seek to protect their R&D investments by patenting valuable results or keeping them secret, while academics have incentive to publish their findings. University researchers need to establish priority, i.e. be the first to publish key new knowledge, while firms need to turn a profit; this can be a source of conflicts. Secondly, transaction-related “Williamsonian” barriers include conflicts over the ownership of intellectual property (usually patents) developed during the course of the collaboration and conflicts over university administration and bureaucracy, as academics need to develop new contractual relationships with their external partners and to deal with their university’s TTO and legal department.

Most frequently cited barriers and deterrents to engagement with non-academic actors

Survey respondents were asked which barriers they encounter when interacting with non-academic stakeholders. The two barriers to collaboration with non-academic organisations cited by most respondents are *Conflicting goals in industry and academia* (41 pct.) and *Conflicting time frames in industry and academia* (33 pct.). These barriers are in line with the “orientation-related barriers” identified by Tartari et al. (2012), who also argued that such barriers can be reduced by e.g. prior collaboration experience (especially between

the collaborating parties), presumably as university researchers gain greater insight into industry and vice versa, and by trust among collaborators.

Other barriers cited by more than a quarter of the respondents include: *It’s difficult to find or get through to suitable, qualified partners* (32 pct.); *My research is not (sufficiently) relevant for non-academic organisations* (28 pct.); *It takes many years to build good, trust-based relationships with partners* (28 pct.); *University management does not sufficiently prioritise or reward such activities* (27 pct.); *Such activities take too much time away from research and/or teaching activities* (26 pct.). As such, more “transaction-related barriers” such as conflicts over ownership to IP did not figure heavily in survey responses.

Perceived barriers and deterrents to collaboration were fairly consistent across all stages of the academic career. Interestingly, the two top-cited barriers, *Conflicting goals in industry and academia* and *Conflicting time frames in industry and academia*, both orientation-related, are agreed upon as very important across all ranks of university researchers. However, among the overall top-cited barriers, young researchers (and postdocs in particular) are more likely than their senior colleagues to identify the *Relevance of their research for non-academic organisations* or the *Difficulty of finding partners* as barriers for engagement. This would suggest that more transaction-related concerns, especially when they relate to the importance of having a trusted network of collaborators outside universities, weigh more heavily among junior faculty. Young researchers more often cite *I don’t know who my research would be relevant for* and *Partners may limit or slow down publication of research results* as barriers to engagement, than do senior faculty.

Looking across scientific disciplines, the top-rated concern for both SSH and STEM researchers is *Conflicting goals in industry and academia*. However, there are also some notable differences in perceived barriers such as

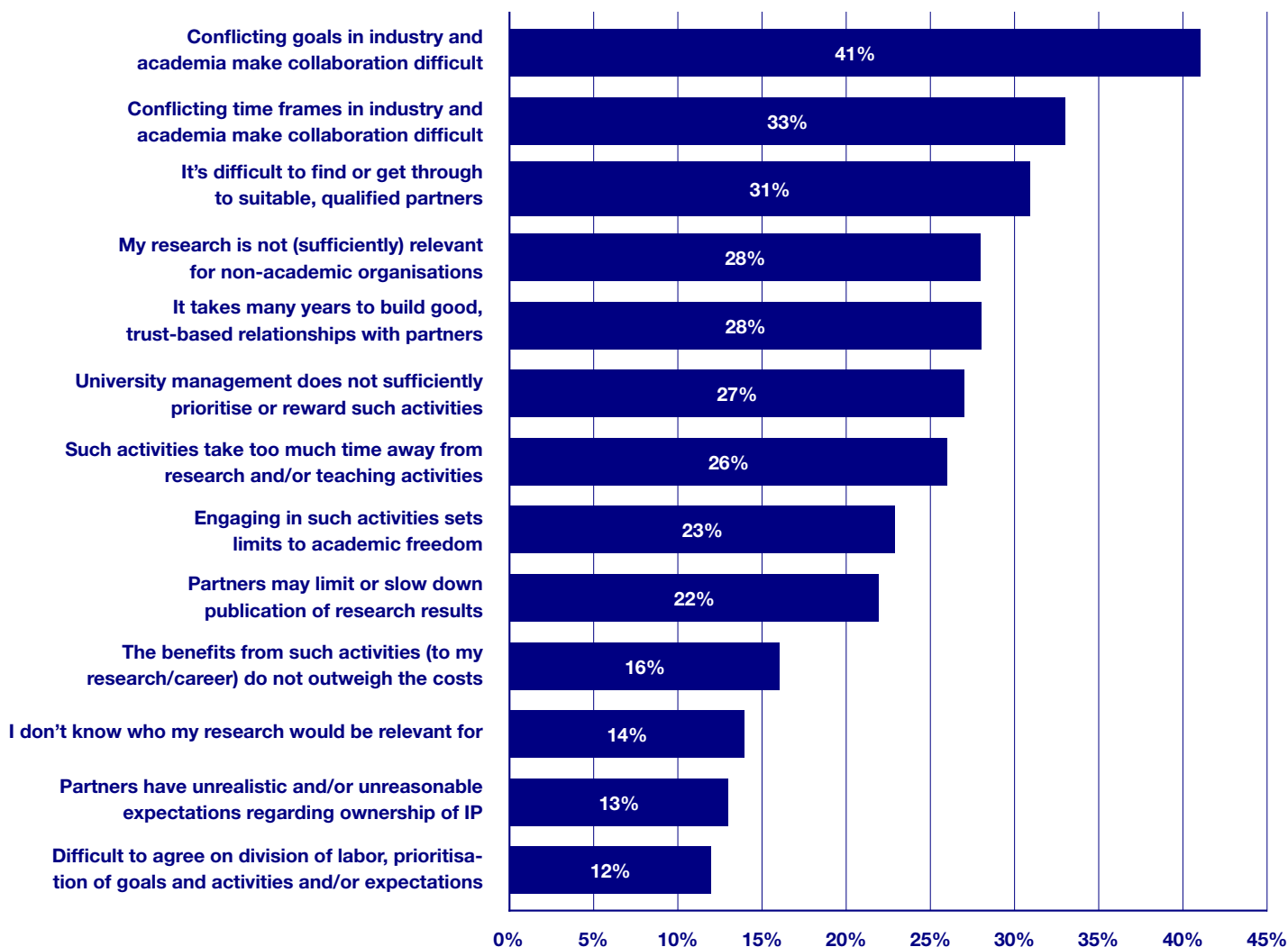
Conflicting time frames; Taking time away from research and/or teaching; Benefits do not outweigh costs, and Insufficient prioritisation by university management, all of which are rated significantly higher by SSH researchers. This seems to suggest that SSH researchers are faced with a less supportive environment in their organisations in relation to engagement activities, as they

may be less institutionalised, and therefore codified, than in STEM fields. STEM researchers, in contrast, tend to put more emphasis on the Relevance of their research for non-academic organisations; Difficulty of finding partners; Partners may limit or slow down publication of research results or Expectations regarding ownership of IP as barriers for engagement.

FIGURE 4.1.

“Which barriers and/or deterrents do you face when interacting with non-academic organisations?”

Source: Triple-I-Research Survey of Academics in Denmark 2017. Number of respondents: 3.047.



Gender differences in perceived barriers for engagement

Looking at gender differences in the perception of barriers to engagement, one will notice that male and female researchers, in both the STEM and SSH disciplines, do not seem to perceive orientation barriers differently. This includes the top rated barriers in terms of importance, *Conflicting goals* and *Conflicting time frames*, with no noticeable difference between how they are perceived by female and male academics. This suggests that the perception academics have of the challenges in reaching agreements with their non-academic partners on the focus of research projects, working priorities, and expectations about research – as well as on the timing of the dissemination of research findings – do not seem to depend on the gender of the researchers involved.

Transaction-related barriers, on the other hand, seem to be experienced differently by male and female researchers, and also across disciplines. There is some evidence that female academics in STEM fields are less deterred from engagement by potential IP ownership issues and by the long time required to create trust with collaboration partners. Interestingly enough, there

are indications that female academics in SSH fields do perceive the long term commitment in building relationships with collaborators as a significant barrier to engagement (more so than their male colleagues), along with the difficulty in reaching agreement on division of labour and prioritisation of goals, and lack of reward from university management. Research has shown that gender is indeed associated with transactional barriers, with women experiencing higher Williamson-type barriers in their engagement activities (Tartari et al. 2012). Research also suggests that these types of barriers are highly correlated with the breadth of experience an academic has: the more diversified the engagement activities a researcher takes part in, the more he or she will perceive transactional barriers as detrimental to collaboration, and women tend (also in our population) to engage in a lower number of channels of engagement, especially in STEM fields.

5. Researchers' involvement in commercialisation-oriented activities

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We finally turn to researchers' activities related to the commercialisation of research findings. We focus on researchers' involvement in starting research-based companies and their interaction with the technology transfer office (TTO) at their university in connection with intellectual property rights to research results; to the transfer of such rights, or the establishment of companies.

Survey respondents were asked whether they had been involved in starting one or more companies based on their research at some point during their academic career. A total of 451 researchers, or 13 pct. of respondents for this question (cf. figure 5.1), answered in the affirmative. The vast majority of respondents, or 3.055 researchers, report having started no companies during their academic career. For 1.326 survey respondents, we have no direct information about their actual activities in this area. Still, even if we include those non-respondents among likely non-entrepreneurs, we find a probable lower limit on the proportion of entrepreneurial researchers at about 9 pct.

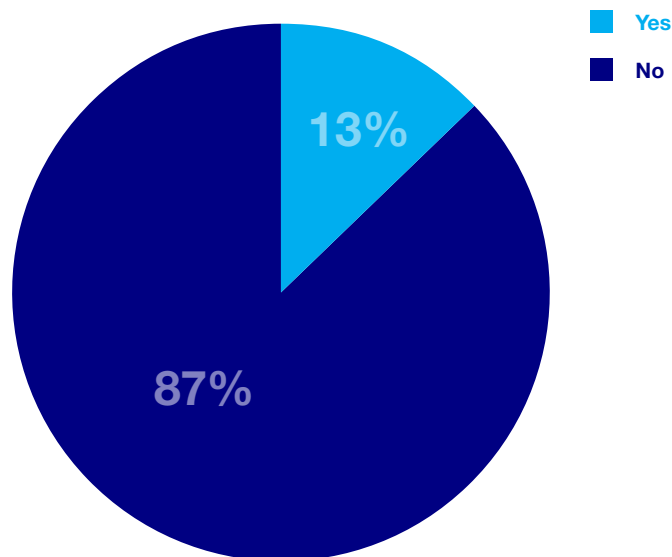
Most of the respondents with entrepreneurial experience (69 pct.) have been involved in the establishment of a single company; the remaining respondents have been involved in multiple companies during their academic career. Unsurprisingly, in line with the academic literature and consistent with their longer career spans, senior researchers are most likely to have been involved in starting a company based on their research.

When it comes to main fields of research, perhaps a bit surprisingly, the rate at which SSH researchers report having been involved in starting a company based on their research is 12 pct., only slightly lower than the corresponding rate of 13 pct. for researchers in STEM disciplines. It is, however, likely that the entrepreneurial activity among SSH researchers includes many smaller consultancies that can be effective vehicles for additional dissemination and diffusion of research findings to non-academic stakeholders.

FIGURE 5.1.

“Have you, at some point in your academic career, been involved in starting a company based on your research?”

Source: Triple-I-Research Survey of Academics in Denmark 2017. Number of respondents: 3.506



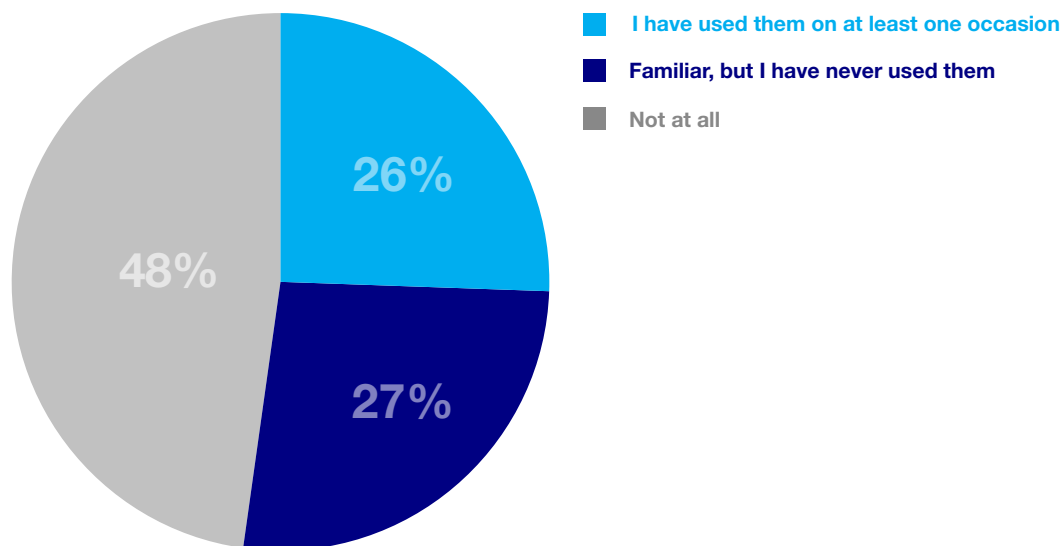
Survey respondents in STEM fields were also asked a few questions about their use of and familiarity with the technology transfer office (TTO) or similar institution at their university. Although we refer to the unit in the respondent's institution responsible for the commercialisation of inventions, negotiation of licensing contracts, and support for start-ups as the TTO, we also noted in the survey that these functions may take place in one centralised unit, or at the department level, and they may have a different designation in the respective organisations.

Here it is worth noting that almost half of all STEM respondents (48 pct., cf. figure 5.2) indicated that they were "not at all" familiar with these services. A quarter (26 pct.) had used the TTO's services on at least one occasion, and 27 pct. deemed that they were familiar with the services offered by the TTO, although they had never used them.

FIGURE 5.2.

"How familiar are you with the services offered by the TTO of your institution?"

Source: Triple-I-Research Survey of Academics in Denmark 2017. Number of respondents: 2,247



Respondents who had made use of TTO services were also asked about the purpose of their interaction with the TTO. The most common purposes were for assistance in connection with patent applications or disclosures of inventions (63 pct. and 54 pct., respectively, of respondents who had used TTO-services). Other purposes included transfer of intellectual property rights (45 pct.), licensing, sales and option agreements (24 pct.), and spin-off activities (21 pct.).

Respondents who had used TTO services or indicated that they were familiar with the services offered by the TTO at their university were also asked to state their level of agreement with three statements related to the TTO. Their responses (cf. figure 5.3) revealed substantial variation in researchers' perception of TTOs. For example, 56 pct. of respondents agreed or strongly agreed with the statement *The TTO has a stronger bargaining position for royalty shares and other compensation with prospective industry partners than I would have if I acted independently*

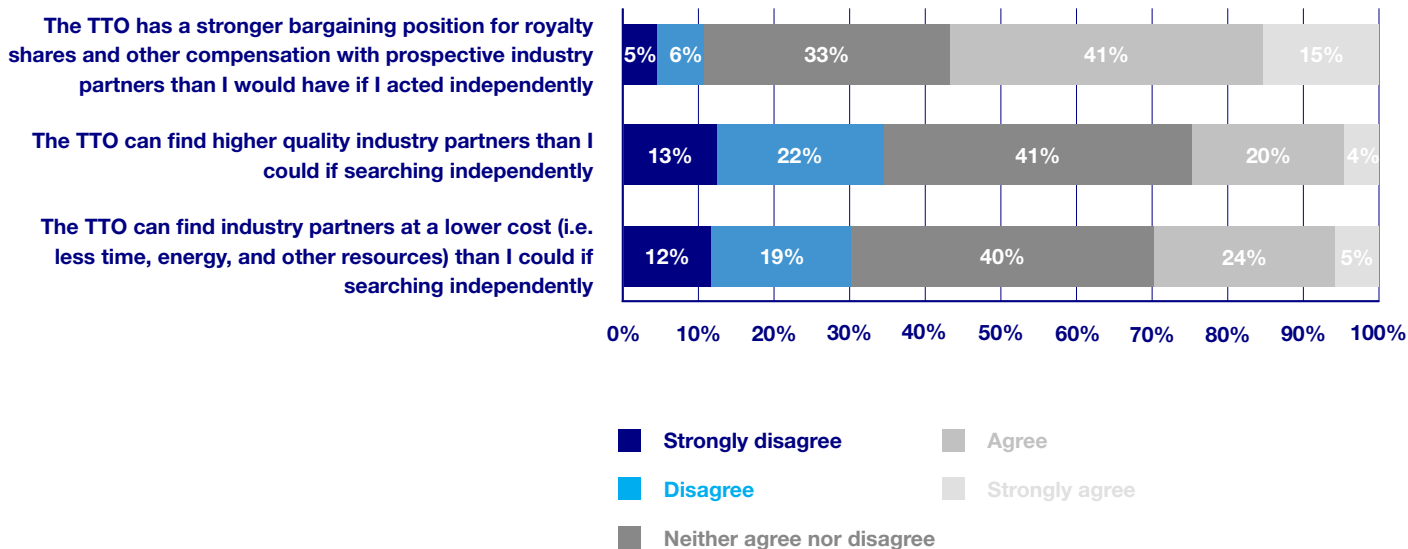
industry partners than I would have if I acted independently; only 11 pct. of respondents disagreed or strongly disagreed with this statement. On the other hand, for the statement that *The TTO can find higher quality industry partners than I could if searching independently*, only 24 pct. of respondents agreed or strongly agreed with the statement, while 35 pct. disagreed or strongly disagreed with the same statement. A similar pattern of responses can be seen for the last statement *The TTO can find industry partners at a lower cost [...] than I could if searching independently*.

Based on the survey, it is not possible to say whether this variation is due to differences in TTO competences, practices or performance; differences in individual experiences with the TTO and/or commercialisation of research; differences in individual perceptions explained by other factors, or some combination of all of the above. However, the results are worth noting and further investigating.

FIGURE 5.3.

“Please state your level of agreement with the following statements that relate to your perception of the TTO of your university”

Source: Triple-I-Research Survey of Academics in Denmark 2017. Number of respondents: N(stronger bargaining position)=1.187; N(high quality industry partners)=1.190; N(lower cost)=1.193. This figure only includes responses from respondents who had also indicated that they had either used the services of the TTO or that they were familiar with the services offered by the TTO, even though they had never engaged with it.



Gender differences in commercialisation-oriented activities

The survey documents important gender differences in commercialisation-oriented activities. Overall, the proportion of female researchers who report having been involved in starting a company based on their research (8 pct.) is half of the rate that applies to male researchers (16 pct.) The difference is less pronounced in SSH fields (10 pct. versus 13 pct.), whereas STEM fields show a ratio of approximately 1:3 in terms of company creation by female and male researchers.

When it comes to the familiarity with and use of TTO services within STEM fields of research, familiarity with TTO services is 27 pct. for both female and male researchers. The difference between genders lies in the actual use of TTO services as reported by 29 pct. of male researchers, but only by 19 pct. of female researchers in STEM fields of research.

While the survey can only be suggestive of the causes of such differences, and part of the differences can probably be ascribed to differences in average seniority between gender groups, the numbers do suggest a significant gender dimension in commercialisation-oriented activities, mainly related to STEM fields of research.

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