Research collaboration and co-authorship in the social sciences

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PhD Dissertation

Politica

ISBN: 978-87-7335-230-4

Cover: Svend Siune
Print: Fællestrykkeriet, Aarhus University
Layout: Annette Bruun Andersen

Submitted April 24, 2018
The public defence takes place August 22, 2018
Published August 2018

Forlaget Politica
c/o Department of Political Science
Aarhus BSS, Aarhus University
Bartholins Allé 7
DK-8000 Aarhus C
Denmark

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Acknowledgement

"It was the best of times, it was the worst of times". The beginning of Charles Dickens' famous work *A tale of two cities* has often been in my thoughts when I tried to sum up my experiences as a PhD fellow. Someone asked me after I handed in, "was it worth it?" I could not immediately respond. I had to think about the pros and cons of my experiences during my PhD life. But after crossing the finish line and putting it all in perspective I can say, "yes it was worth it".

It was worth it because of the wonderful people I met along the way. The people who made it "the best of times". People who supported and encouraged me when life was dark and I was ready to give up. Those who made me dance, smile and laugh. Those who showed me the light, who reminded me that research can be fun, but also that there is more to life than academia.

There are numerous people who were a big part of my PhD life and who helped me cross the finish line. I owe thanks to my supervisors Jesper Wiborg Schneider and Carter Bloch, who both had great influence on my PhD project. Thank you, Jesper, for introducing me to the field of Scientometrics almost ten years ago and helping me get started on the PhD project. Your inputs and thoughts have helped shape the project, and I'm grateful for your expertise. Thank you, Carter, for helping me finish the project, it would probably not have happened without your inputs and thoughts. You are an amazing listener and you have an incredible skill to help one out of 'writer's block'.

Moreover, there are many people from the department I would like to thank. First the administrative staff at Political Science, particularly Jane Frølund Irming, Malene Poulsen and Birgit Kanstrup for all their help and support with various questions and issues during my PhD. It is amazing to have someone help you with travel expenses, budgets etc. Also thanks to Lone Winther, Anja Dalsgaard and Annette Bruun Andersen for language revisions and editing of the dissertation and articles. You have my sincere gratitude for all your help; you definitely improved all of my publications. Also, I would like to thank the political science PhD coordinator Christoffer Green-Pedersen. Even though I was not in "your" program, you still took your time to provide encouragement and help when needed. On that note, I would also like to thank the head of department Peter Munk Christiansen for your attentiveness, as well as Lasse Lindekilde for helping me in a difficult period. Without your help and support I do not think this project would have been finished.

I would also like to thank the PhD and postdoc group at the department, who has provided a great social environment, particular Ekatherina Zhukova,

Maria Clausen, Fenja Møller, Åsne Aarstad, Bruno Martins, Anne Pintz, Rachel Beach, Philipp Pechmann, Nicholas Burmester, Lisa Hirsch, Alexander Bor, Vilde Djuve, Julian Christensen, Thomas Ryan, Emil Madsen and Kristina Jessen. Thank you Ekatherina for being my first friend at the department, it was a really lonely start working at the center and I was so glad you invited me into the larger social group. Thank you, Anne, Philipp and Nicholas, for giving me housing, hugs and chocolate when I need it, you were lifesavers in a though period. Thank you, Rachel and Lisa, for going bouldering with me. Also, thank you Kristina for being an amazing friend and confidant, who gave me support and guidance.

Another group who gave me support, discussions, fun and laughter was my office mates Fereshteh Didegah, Carita Eklund, Andreas Kjær and Allan Rye Lyngs. Thank you Fereshteh for being wonderful and supportive; you have an infectious laughter that lightens the office. It was amazing to have someone to discuss my project with, and I was so sad when you left for Vancouver, even though the candy sticks help. Thank you, Carita, for helping me rediscover what I find fun in research and academia, the number of dog and cat pictures/videos/memes decreased a lot when you left, and you were truly missed. Thank you, Andreas, for your calm and positive attitude, it was nice to discuss everyday events with you. Thank you, Allan, for your sarcastic and dry humor, which helped me keep sane during the last part of the project. It was nice to have someone to discuss life and work with. Furthermore, I would like to thank the junior group at CFA for creating a social environment at the center and making it possible to discuss academic interests and issues. I also owe thanks to Jens Peter Andersen and Qi Wang for help with data and algorithms, it was a great help, as well as Tine Ravn with her feedback while I conducted my interviews. Moreover, I owe thanks to Massimo Graae Losinno and Emil Alnor, who helped transcribed all my extremely long interviews. I know it was a tough and tedious task, and I'm grateful for your help.

During my PhD, I had a six-month research stay in Montréal, where I was lucky to visit Vincent's amazing research group. It was incredible to experience how fun research can be and improved by discussion with peers. I would like to thank Sarah, Adele, Philippe, Diane, Maxime, Ghita, Elise, Annaëlle, Corrado, Nadine and Steffie for making it an experience for a life time. I would also like to thank the Danish group I became a part of in Montreal, especially Heidi who became a great friend.

I also should thank Aarhus Crossfit (Havnen) for providing a positive aspect of my life while I worked on my PhD. This community has helped me grow stronger both physically and mentally. In the last phases of my dissertation, I realized the similarities (and differences) between doing Crossfit and a PhD. Both require a set of skills you will get and/or improve by hard work.

Both are hard, tough and cost blood, sweat and tears. Both push your boundaries to the point that you want to give up. The amazing thing about the Crossfit community is that you are guaranteed that someone will give you a hand and support when you are struggling. You will receive constructive feedback, and improvements are celebrated. There are so many amazing people at Havnen, but I would like to give a special thanks to "morgenholdet" and Heidi Tjerrild, who have been a big part of my final year working on the PhD. Thank you, Heidi, for being a great workout buddy as well as a good friend.

I would also like to thank my friends, especially Marlene Strandgaard, Solveig Røgild, Louisa Rasmussen, Tine Mikkelsen and Jesper Overgaard for giving me a life outside of academia, whether it is bouldering, shopping, playing board games or drinking various alcoholic beverages. I'm looking forward to finally spending more time with you all.

Moreover, I would like to thank my big family for all their help and support. I would like to thank my grandparents Hans and Mie for always having an open home and coffee ready, I hope to visit you more after finishing this PhD project. I would also like to thank my aunt Jette and uncle Kjeld. Thank you for your support, being my second parents and helping me move numerous times, as well as coming to visit me in Montréal (and bringing my mom). Also thank you to my parents for your support and encouragement to keep studying. I'm glad to finally show a "finished" product. I also owe thanks to my brother Hans for all your help with moving, practical stuff and talks. I would also like to thank my sister Britta and brother-in-law Henrik for giving a home during a tough period. I really enjoyed living with you, even though my Spotify is still affected by my nieces' and nephew's music taste …. On that note, I would also like to thank my nieces Mie, Laura, Olivia and nephew Storm. You all make my life lighter and funnier by convincing me to climb, crawl, build Lego or hide from a lion.

Finally, I would like to thank René, the love of my life. You have been my rock ever since you came into my life. My life would be boring without you, and you make me laugh every single day. You remind me that working is not everything and it is important to have enjoy life and relax. This PhD project would truly not have been finished without your support, love and PS4.

Chapter 1. Introduction

Authorship, co-authorship, multi-authorship, hyper-authorship, kilo-authorship or mass-authorships; as the number of authors on a publication increases, new terms are coined to embrace the changes in what authorship is in a collaborative research era. The debate and study of authorship has been dominated by a focus on the physical and life sciences, where research collaboration is a well-established norm, and researchers rarely publish as a single author (Abt, 2007; Claxton, 2005). However, research collaboration is becoming an essential part of academic life in most disciplines in the sciences (Endersby, 1996; Henriksen, 2016; O'Brien, 2012), so even in the social sciences, the lone scholar in the ivory tower is becoming a minority.

This trend is visible in the form of co-authorship. The number of authors and share of co-authored articles have increased in most fields during the last century (Henriksen, 2016; Lariviere, Gingras, Sugimoto, & Tsou, 2015; Price, 1963). The increase in co-authorship has led some researchers to predict the demise of the single author (e.g. Greene, 2007; Price, 1963). According to Abt (2007), however, this is very unlikely, since the decrease of single authorship is exponential and will never reach zero.

Co-authorship has increased over the last century, and many studies refer to the period during and after the Second World War (WW2) as the beginning of "big science" (e.g. Beaver, 2001; O'Brien, 2012). The term "big science" captures how research has changed from the endeavour of an individual researcher to a collective effort that requires substantial resources, such as manpower, equipment and funding. As research projects became larger, the number of authors began increasing (Price, 1963).

Larger research projects create an interdependence among researchers because such projects require theoretical, technical as well as administrative knowledge to succeed. This has also changed the notion of authorship (Biagioli, 2003; Galison, 2003). The collaborative authorship trend started in the physical sciences (Biagioli & Galison, 2003; Knorr Cetina, 1999), emerged later in the life sciences (Biagioli, 1999; Müller, 2012), and is now becoming a phenomenon in the social sciences, as this thesis will demonstrate.

The different fields have reacted differently to the increases in co-authorship and larger authorship groups. Issues of co-authorship have mostly been ignored by the physical sciences, which have taken a collective and inclusive stance. They operate under the rationale that research cannot be conducted without everyone contributing and therefore everyone should receive formal

recognition (Birnholtz, 2006; Galison, 2003; Pritychenko, 2016). The best recognition that exists in the current reward system is authorship credit (Cronin, 2001; Galison, 2003). This collective approach also means that misconduct or individual responsibility is not considered an issue, since most tasks are done in collaboration (Brumfiel, 2002; Knorr Cetina, 1999). Hence, the collaborative process should also ensure internal review and scrutiny of the results (Birnholtz, 2006; Knorr Cetina, 1999). However, the large groups of authors and reliance on internal review do not prevent misconduct, and there have been multiple cases where authors had to admit that they have not read their own publication (Pritychenko, 2016).

The life sciences have taken a different approach to co-authorship. Already in the 1970s, editors of life science journals began noticing and discussing the trend of co-authorship, and the implications for the notion of authorship (Biagioli, 1999). Biagioli (1999) points out that the focus on responsibility has caused the International Committee of Medical Journal Editors' (ICMJE) authorship guidelines to become stricter over time. This means that if researchers want authorship credit for their contributions they must accept full responsibility for the whole publication. Thus, while research itself has become more collective, corporate and industrial-style, there seems to be a reluctance to do something similar regarding authorship (Biagioli, 1999).

Furthermore, multiple studies have shown that the strict and perhaps idealistic authorship guidelines do not correspond to the reality of life in the laboratory (Colledge, Elger, & Shaw, 2013; Haeussler & Sauermann, 2013). It seems that unless there are problems with misconduct, life scientists also focus exclusively on the credit aspects of research. Some researchers have therefore suggested that the life sciences should abandon the notion of authorship and use the concept of contributorship, where each researcher has to state their contribution and role in the creation of the publication. Advocates claim that it would create more transparency and better reflect how contemporary research is conducted, since researchers only get authorship credit and responsibility for their contribution (Borenstein & Shamoo, 2015; Rennie, Yank, & Emanuel, 1997). This debate has not changed the notion of authorship, but is has made some journals require a contribution statement by the authors (Lariviere et al., 2016; Sundling, 2017).

The social sciences have only recently moved towards multi-authorship, and several studies show that co-authorship is increasing significantly in economics (Medoff, 2007; Nowell & Grijalva, 2011; Polyakov, Gibson, & Pannell, 2016), management (Liu, Olivola, & Kovács, 2016), sociology (Hunter & Leahey, 2008; Moody, 2004), political science (Adams, Infeld, Minnichelli, & Ruddell, 2014; Fisher, Cobane, Vander Ven, & Cullen, 1998; McDermott & Hatemi, 2010), and public administration (Corley & Sabharwal, 2010). The

extent of co-authorship differs between these disciplines, and according to social network studies few researchers always work and publish alone (Acedo, Barroso, Casanueva, & Galan, 2006; Cainelli, Maggioni, Uberti, & de Felice, 2012; McDermott & Hatemi, 2010; Metz & Jäckle, 2017). In contemporary social sciences, the majority of researchers both single- and co-publish.

Few studies address how and why researchers collaborate, and they often focus on how collaboration results in authorship. The studies that do address this topic focus mainly on the physical and life sciences, where all research is done in collaboration and often requires multiple researchers' skill sets (e.g. Degn, Franssen, Sørensen, & de Rijcke, 2017; Fochler, Felt, & Muller, 2016; Müller, 2012). Hence, there is typically a great degree of interdependence in these sciences.

Large physics projects often entail extensive coordination of subprojects, where researchers collaborate in smaller teams with a leader. The leaders then coordinate and collaborate on the projects. The success of these projects requires the research efforts of multiple types of contributions; intellectual, financial or technical (Biagioli, 2003; Birnholtz, 2006; Galison, 2003). There is often an idealistic view of the collaborative process in physics with focus on the larger project. Some describe this mode using a popular business saying "There Is No "I" In Team" (Pritychenko, 2016, p. 462). However, Birnholtz (2006) shows that the individual credit and recognition is still important for furthering one's career. In his ethnographic study, some of the researchers express frustrations about just being little ants (Birnholtz, 2006, p. 1766), and he claims that this can create incentives to find other ways to get notice (Birnholtz, 2006, p. 1769).

Life scientists often work in research groups where each is responsible for a minor project and at the same time contributes to other projects in the group. This is especially the case in biomedicine, and the head of the laboratory will try to ensure that there is a mix of short publishable project and more risky experiments (Müller, 2012, 2014). This mixture of projects is seen as necessary in this "publish-or-perish" era, where the constant focus on publishing and research performance shapes the way research is conducted.

Hence, researchers need to have short-term projects to uphold the publishing stream that is required to secure further funding. By collaborating, researchers diminish the risk of a no-publishing period, which is seen as detrimental to their career (Degn et al., 2017; Müller, 2014; Müller & de Rijcke, 2017; Rushforth & de Rijcke, 2015; Tijdink et al., 2016). The riskier experiments are needed to create "breakthrough" or "high quality" research that enhances the reputation of the laboratory. However, the extensive usage of bibliometric performance indicators influences researchers' understanding of

"quality". This means that researchers refer to the impact factor when discussing where to publish and use it as synonymous for "quality" (Hangel & Schmidt-Pfister, 2017; Rushforth & de Rijcke, 2015).

Research projects in life science laboratories are based on junior researchers executing the research experiments while the senior researchers deal with publishing and attracting funding to facilitate the research. Thus, there is some interdependence, and many projects require both technical and intellectual skills. However, as Müller (2012) demonstrates, junior life scientists try to avoid having too many collaborators on their personal projects, since it diminishes their own credit, even if they still are first-authors. At the same time, the bar for what is sufficient publications is rising, so they also collaborate and co-author to have enough publications to further their careers.

To sum up, it is clear from previous studies that research collaboration is essential for conducting research in the physical and life sciences, since research in both branches requires intellectual, technical and financial contributions. However, there are problems with the individual credit as the reward system in science is built on a structure with sole authorship or small author groups. For life scientists, this influences their willingness to collaborate, because they risk diminishing their share of the credit. It also creates incentives for physics scientists to be creative in order to be noticed, since the inclusive approach to who is added as co-author deflates the value of authorship. Both behaviours could qualify as adverse regarding the ideals of academia (Anderson, Ronning, De Vries, & Martinson, 2010; Merton, 1973).

Knowledge about why and how researchers collaborate and co-author in the social sciences is scarce. Studies addressing the increasing tendency to co-author in the social sciences often explain that contemporary research requires more complex statistics and is more empirically driven, which means that research projects often require the skill sets of different individuals (e.g. Hunter & Leahey, 2008; Schymura & Loschel, 2014; Sutter & Kocher, 2004). This implies that qualitative and theoretical research is mainly single authored.

Some studies claim that the implementation of performance-based research evaluation systems influences researchers' degree of publishing, choice of publishing channel and language in the social sciences and humanities (e.g. Butler, 2003a; Hammarfelt & de Rijcke, 2015). Hammarfelt and de Rijcke (2015) find that researchers experience disagreement between the focus of the performance indicators and the disciplinary norms. Performance-based research evaluation systems are constructed to fit how research is conducted and published in the sciences, but conflict with how it is done in the humanities and some areas of the social sciences. Researchers in these areas will be more likely to change behaviour accordingly. Likewise, Butler (2003a)

demonstrates that incentives steer researchers' publication practices, and that bibliometric-based performance systems can have unintended effects.

Other studies show that the publish-or-perish culture in academia puts pressure on researchers to mainly focus on publishing and optimize their behaviour accordingly (Fanelli, 2010; Hangel & Schmidt-Pfister, 2017; van Dalen & Henkens, 2012; Wilson, 1942). None of these studies focus exclusively on the social sciences, but Hangel and Schmidt-Pfister (2017) demonstrate that the publish-or-perish culture is prevalent in all areas of research. One might expect that social scientists engage in co-authoring to secure higher publishing productivity.

Few studies examine researchers' collaborative and co-author behaviour, fewer include the social sciences, and even fewer focus solely on the disciplines in the social sciences. Existing knowledge often comes from large interview studies that include all sciences (e.g. Degn et al., 2017; Lewis, Ross, & Holden, 2012), survey questionnaires of co-authorship motivation and perception in one discipline (Holder, Langrehr, & Schroeder, 2000; Kumar & Ratnavelu, 2016) or researchers' anecdotal knowledge combined with bibliometric data (Adams et al., 2014; Laband & Tollison, 2000). The latter often includes references to the sciences. Comprehensive in-depth studies of "how and why social scientists collaborate" and deeper discussions of what co-authorship entails are lacking.

Objective and research questions

The overall aim of this dissertation is to provide more insight into the evolution of research collaboration and co-authorship in the social sciences and the factors that shape when and how collaboration and/or co-authorship occurs. This knowledge is of increasing importance with the growing use of bibliometric performance indicators and co-authorship in the social sciences. Furthermore, studies of research collaborations in the sciences demonstrate that multiple types of collaborations and contributions result in co-authorship and that these have changed over time (Jabbehdari & Walsh, 2017; Youtie & Bozeman, 2016). In other words, collaboration and co-authorship are not static concepts but they are often treated as such in performance evaluations.

Therefore, is it necessary to gain a better understanding of the extent to which social scientists co-author, what co-authorship entails, the relationship between research collaboration and co-authorship, and why researchers collaborate and co-author. This includes the question of how collaboration and co-authorship behaviour is affected by the trend of bibliometric performance evaluations and the publish-or-perish culture.

First is it necessary to investigate how co-authorship has developed over time in the social sciences. As stated in the previous section, several studies demonstrate an increase in the individual disciplines (Hunter & Leahey, 2008; Polyakov et al., 2016; Schymura & Loschel, 2014; Tewksbury & Mustaine, 2011) and in the branch of social sciences (Lariviere, Gingras, & Archambault, 2006; Wuchty, Jones, & Uzzi, 2007). However, none of the studies examine or compare the increase in multiple individual social science fields. It is therefore necessary to begin the investigation of co-authorship in the social sciences by doing an overview study. The lack of knowledge in the literature shapes the first research question, "To what extent has co-authorship in the social sciences increased?" The focus on co-authorship means that the research question only includes the type of research collaboration that is visible in the form of co-authorship. The decision to first focus on co-authorship was based on the consideration that it is the best available indicator to study research collaboration over a longer period.

The article that answers the first research question is presented in Chapter 4 of this dissertation. It shows that there is a general increase in the share of co-authored articles and the number of authors per article. The greatest increase in co-authorship occurs in fields that according to earlier studies have a tendency to employ quantitative research methods, experiments and labour division (e.g. Corley & Sabharwal, 2010; Cronin, Shaw, & La Barre, 2003; Laband & Tollison, 2000). However, few studies actually investigate these claims empirically.

Fisher et al. (1998) investigate the content of articles published in three leading political science journals over 45 years and find that the increase in co-authorship is partially due to the growth in empirical articles. Hunter and Leahey (2008) examine the content of a sample of articles published in two sociology journals over 70 years and find that quantitative research is more co-authored than qualitative articles and theoretical articles. Both studies show that co-authorship has become the norm. However, neither study fully shows how the usage of certain research methods and approaches is related to the number of authors.

Schymura and Loschel (2014) study the content of articles published in an environmental and resource economics journal over the past 36 years. They show that quantitative content is related to a higher number of authors and uses this finding to confirm their division of labour hypothesis. It thus appears that tasks related to quantitative research are easier to divide among team members, and they sometimes require different expertise. However, this study is only based on one journal in a subfield of economics, and it would be interesting to extend the study. Hence, these previous studies and the results of the

first article motivate the second research question: "What factors are associated with increasing co-authorship in Danish economics and political science?"

Economics was chosen because it displays a strong rise in the share of co-authored publications, and the majority of publications are co-authored (see Chapter 4 or Henriksen, 2016). Political science was selected because some research approaches and methods are similar to economics, although it is more heterogeneous. Still, the increase in the share of co-authored publications is smaller than in economics and most publications are still single authored (see Chapter 4 or Henriksen, 2016). It is therefore interesting to examine similarities and differences in the two fields. Denmark was chosen as case country because it is a top research-performing country with stable funding of universities and extensive focus from policy makers on the importance of being a research nation (Aagaard & Schneider, 2015). The second study goes further than the first study, since it examines not only the trend of co-authorship but also whether it relates to certain factors.

The article answering the second research question is presented in Chapter 5. It describes how research approaches and methods have changed over time, and how some of them have a stronger tendency to be done in collaboration. Like previous studies, it finds that empirical and/or quantitative research is more co-authored and has more co-authors than theoretical or qualitative research. However, it also finds that over time, all areas of research in economics and political science are increasingly co-authored by more co-authors. This means that the need for more expertise or different skills is only half the story. Increases reflect a change in what research is being conducted and how, as well as the researchers' co-authoring behaviour.

The first two research questions focus on the finished product of the research process and collaboration: co-authorship. They do not examine how and why researchers collaborate or what kind of collaboration has resulted in a publication. To tell the other half of the story is it necessary to explore the link between research collaboration and co-authorship in addition to researchers' collaboration behaviour.

Studies of how researchers collaborate, what motives them and what co-authorship entails are few. Most studies focus either on a discipline in the health, life or physical sciences (e.g. Birnholtz, 2006; Müller, 2012) or include all the sciences (e.g. Lewis, Letina, & Woelert, 2016; Lewis et al., 2012). Most claim that the criteria for being included as a co-author have changed and expanded. In addition to intellectual contributions, technical and financial contributions are to a larger degree considered valid grounds for being co-author, especially the former. However, these studies also find that co-authorship

does not reflect the same kind of research collaboration, not even within the same discipline.

Street, Rogers, Israel, and Braunack-Mayer (2010) demonstrate how difficult it is to interpret researchers' contribution to a publication based on the author by-line. The by-line of a health science publication may reflect those who have "done the work", but it may also reflect the research group's norms and culture. Birnholtz (2006) shows how the culture in HEP creates an inclusive norm for co-authorship, meaning that everyone who has contributed should be offered co-authorship. Hence, the way co-authorships are assigned depends largely on both the field and the research group.

Multiple studies claim that the publish-or-perish culture and increasing use of quantitative performance evaluations influence how researchers collaborate, conduct research and publish (Hangel & Schmidt-Pfister, 2017; Müller, 2012; Müller & de Rijcke, 2017). There are multiple parameters beyond research becoming more complex and the need for bigger laboratories to consider when exploring how and why researchers co-author. Hangel and Schmidt-Pfister (2017) demonstrate in their study of why researchers publish that academic survival is an essential factor, so researchers do not solely publish because they want to but often because they have to. Furthermore, it leads junior researchers into a co-publishing dependence relationship with senior researchers and supervisors, because top-tier publication may benefit their careers.

To recap, other studies find that researchers have multiple reasons to collaborate and co-author, and how they do it depends on the research culture in which they are embedded. However, none of them focuses exclusively on the branch of or a discipline in the social sciences, and more exhaustive knowledge about social scientists' collaboration and co-authorship behaviour is lacking. This dissertation addresses this knowledge gap by asking the third research question: "Why do Danish economists and political scientists collaborate and co-author? And how does co-authorship reflect collaborative research in the fields of economics and political science?"

The article answering the third research question is included in the dissertation as Chapter 6. Based on in-depth interviews, it explores economists and political scientists' personal experience with and motivation for collaborating and co-authoring. The article shows that researchers experience a larger degree of collaboration and in larger groups, that they perceive collaboration to be beneficial to the epistemic value of their research and optimizing their publication production. The latter is very much an effect of the publish-or-perish pressure that seems to move focus from research to publishing.

The interviews lead to the formulation of the fourth research question: "What is the author order norm in economics and political science and why?"

The question emerged because the interviewees put great emphasis on using/not using alphabetic author order. It became apparent during the interviews that author order norms had changed, especially in political science. Chapter 7 answers the fourth research question by demonstrating that alphabetic authorship has been and is the norm in economics, both in Denmark and internationally. It is more unclear whether it has been or is the norm in political science, since the trend towards alphabetic authorship is more country based and weaker. However, in general the norm of alphabetic authorship seems influenced by the increasing tendency to co-author.

To sum up, the dissertation addresses the scarce knowledge about collaboration and co-authorship in the social sciences by examining different aspects in four research questions:

- RQ1: To what extent has co-authorship increased in the social sciences?
- RQ2: What factors are associated with increasing co-authorship in economics and political science?
- RQ3: Why do Danish economists and political scientists collaborate and co-author? And how does co-authorship reflect collaborative research in the fields of economics, and political science?
- RQ4: What is the author order norm in economics and political science, and why?

The studies in the articles complement each other by providing different insights into research collaboration and co-authorship in the social sciences. The limitations to these studies are discussed in the Chapter 3, “Research design”, and Chapter 8, “Conclusion and discussion”.

Structure of the dissertation

This dissertation proceeds as follows. Chapter 2 provides an overview over existing studies of research collaboration and co-authorship in the sciences as well as a definition and discussion of the central concepts used in the dissertation. The last section in Chapter 2 discusses some limitations and issues that arise when dealing with social science disciplines and publishing.

Chapter 3 outlines the research design of the four articles in more detail than in the articles. It argues why it was necessary to use mixed methods to answer the research questions and discusses some of issues concerning the chosen research designs. Chapter 4 addressees the first research question by providing an overview over the development in co-authorship in the social sciences. Chapter 5 answers the second research question by demonstrating what factors are associated with co-authorship.

Chapter 6 answers the third research question and provides insights into why social scientists collaborate and co-author. Chapter 7 answers the fourth research question, sheds light on the different author order norms in economics and political science, and addresses how the publish-or-perish culture and the research collaboration trend may affect these norms. Chapter 8 concludes and discusses the implications and importance of the results.

Chapter 2.
Background, concepts and topic

This chapter presents the essential concepts and topics addressed in this dissertation. A brief overview of previous research collaboration and co-authorship studies is followed by a review and discussion of the concept research collaboration: How is it defined in the literature, does it depend on the science branch, and how does this dissertation define it? The next section discusses the concept of co-authorship and how it differs from authorship. The dissertation presents different definitions of authorship and co-authorship, as well as how it developed along with the reward system. This section emphasizes why the dissertation mainly uses the concept co-authorship instead of authorship. Finally, the concept of disciplines, the difficulties in analysing them, and the heterogeneousness of social science publishing are discussed. The latter is done with weight on the limitations of the dissertation.

Research collaboration and co-authorship studies

Research collaboration and co-authorship have been the focus for a variety of studies and debates over the last 50 years and more (e.g. Beaver & Rosen, 1978; Finholt, 2002; Jabbehdari & Walsh, 2017; Price, 1963). The collaborative journey in academia started around the Second World War, where research projects became larger and institutionalized at large research facilities. These changes caused an increase in research publication productivity, co-authored publication and number of co-authors (Price, 1963), changing research from the endeavour of the lone researcher to a collaborative team effort.

Several studies demonstrate how this is reflected in more co-authored publications and a higher number of average authors per publication across all science branches (Lariviere et al., 2015; Wuchty et al., 2007). Collaborative publishing is the norm in the life sciences (e.g. Baek et al., 2015; Baerlocher, Gautam, Newton, & Tomlinson, 2009; Geminiani, Ercoli, Feng, & Caton, 2014; Levsky, Rosin, Coon, Enslow, & Miller, 2007; Liu, Zhang, & Hong, 2011), the natural sciences (e.g. Cronin, Shaw, & Barre, 2004; Glanzel, 2002; Pritychenko, 2016; Wagner, 2005) and in most disciplines in the social sciences (e.g. Endersby, 1996; González-Alcaide, Melero-Fuentes, Aleixandre-Benavent, & Valderrama-Zurián, 2013; Hollis, 2001; Ossenblok, Verleysen, & Engels, 2014; Tewksbury & Mustaine, 2011). Social network studies of co-authorship in the life and physical sciences claim that it is unusual in these areas to work and publish alone. Social scientists still do a lot of single authoring,

but few always publish alone (Glänzel & Schubert, 2005; Hoekman, Frenken, & Tijssen, 2010; Metz & Jäckle, 2017).

The studies above highlight that collaborative publishing has become the norm and debate the changes in scholarly communication in relation to the value and meaning of authorship. The first area where researchers indicated that the increase in co-authors is problematic is the life sciences (Biagioli, 1999). After the journal *BMJ* in 1957 published an article with seven authors, life scientist Asher (1957) wrote an opinion paper in which he emphasized that it was impossible that all seven authors had written the article. He suggested a maximum of three authors, preferably two, in future publications so that the "real" authors would not be robbed of credit.

Since then, the possible number of authors has risen way beyond seven. Today, co-authorship groups in the hundreds are not uncommon, and some even have thousands of authors in the by-line (Cronin, 2001; Cronin et al., 2003; Milojevic, 2010). Furthermore, there is no clear definition of research collaboration, authorship or co-authorship across or sometimes within disciplines. It is therefore debatable what a "real" author is and whether it has ever existed. This issue and whether the reward system fits the current collaboration trend will be further discussed in the following sections.

Definition(s) of research collaboration

Research collaboration has been the topic of multiple science studies (Beaver, 2001; Beaver & Rosen, 1978; Katz & Martin, 1997; Sonnenwald, 2007). However, few studies offer a definition of research collaboration, and those that do offer a variety of definitions from everyone who builds on existing knowledge is part of a grand knowledge network (Subramanyam, 1983) to collaborations that result in a co-authored scientific publication (Ossenblok, 2016).

Sonnenwald (2007, p. 645) offers a definition between "research collaboration is the interaction taking place within a social context among two or more scientists that facilitates the sharing of meaning and completion of tasks with respect to a mutually shared, superordinate goal". This is still a broad and vague definition, especially since she does not define "goal" beyond "a number of unspecified tasks have to be completed to achieve it". Most definitions in the literature are vague or limited to collaborative efforts that result in publications.

Since it is difficult to offer one precise definition, most studies describe different types of research collaborations (e.g. Bennett & Gadlin, 2012; Kyvik & Reymert, 2017; Traore & Landry, 1997). Probably because research collaboration can be anything from two people working together to thousands of researchers working on a large project. It can occur between people with the

same or uneven hierarchical status, and the hierarchy can exist in multiple levels. It can be easy or it can be problematic and conflict-ridden. It exists in multiple disciplines with different cultures, practices and purposes.

All these variables and more should be taken into consideration when we discuss what research collaboration is and perhaps is not. Existing research collaboration studies often contain one or more recurrent elements: 1) an agreement that no clear definition of research collaboration exists; 2) caveats against using co-authorship as synonym for research collaboration; 3) a tendency to use co-authorship statistics to demonstrate an increasing tendency to collaborate. Furthermore, there is an overweight of studies of the physical and life sciences where research collaboration is viewed as essential in solving contemporary research problems (Biagioli & Galison, 2003; Birnholtz, 2006; Galison, 2003; Knorr Cetina, 1999). Fewer studies have been done in the social sciences, but there is consensus that social scientists collaborate in different ways and for different reasons than physical and life scientists (Laband & Tollison, 2000; Ossenblok & Engels, 2015). The main difference is the lower degree of interdependence among researchers, technical equipment, experiments and need for large laboratories.

The central study of research collaboration is Katz and Martin (1997), who discuss different aspects of research collaboration, such as what research collaboration is and how to measure it. They list different types of research collaboration that sometimes are or are not visible as co-authorship, as well as examples of co-authorship that do not reflect a research collaboration. However, their study does not explain how to measure or define research collaboration. Instead, Katz and Martin (1997) provide a list of criteria to distinguish collaborators from non-collaborators followed by a disclaimer that exceptions are possible for all of them. The conclusion is that a precise definition of research collaboration is impossible because it has “fuzzy” borders and varies depending on social conventions.

Many studies refer to Katz and Martin (1997) when they offer the usual caveats for using co-authorship as indicator of research collaboration, since it is only a partial indicator, and justify using it since co-authorship is the best available measurement, even though it only measures co-authorship and not research collaboration (e.g. Henriksen, 2016; Ossenblok et al., 2014; Ponomariov & Boardman, 2016). Thus, everyone seems to know that research collaboration and co-authorship are not synonymous, but many studies still treat them as such (e.g. Endersby, 1996; Moody, 2004).

Other studies take a more binary approach to defining or analysing research collaboration dividing it into formal or informal collaboration (Kyvik & Reymert, 2017; Laband & Tollison, 2000; Lewis et al., 2012). The former is

visible and measurable as co-authorship. The latter is often invisible and executed as comments, feedback and discussions of papers or stated in the acknowledgement section, which is becoming more popular in research collaboration studies (e.g. Cronin, 2012; Laband & Tollison, 2000; Laudel, 2002; Paul-Hus, Mongeon, Sainte-Marie, & Larivière, 2017). It is considered a more comprehensive method to measure research collaboration, but as Chapter 6 shows, the extent to which research collaboration is fully presented in the author by-line and acknowledgement section varies greatly between disciplines, at least in the social sciences.

An interesting aspect of the acknowledgement studies is the exclusion of certain acknowledged individuals as collaborators. In some studies, technical contributors are not counted as or assessed to be collaborators (Katz & Martin, 1997; Laudel, 2002). In Laudel (2002) there is a strong emphasis on the hierarchy in the judgement of who counts as collaborators. However, as multiple editorials and studies show, a lot of research is impossible without technical contributions (Birnholtz, 2006; "Technical support," 2015), which are often executed by researchers or technicians lower in the academic hierarchy (Lariviere et al., 2016).

This dissertation takes the inclusive approach to defining research collaboration. It defines it as an interaction taking place within a social context among two or more researchers that facilitates the sharing and exchange of knowledge and/or tasks. A research collaboration does not require a finished product (publication) or equal hierarchy status among the involved parties. Furthermore, researchers are here defined as anyone directly contributing to the research process. The dissertation is aware that research collaboration is not always visible neither as co-authors or acknowledgements, which will be discussed in the different chapters.

Definition(s) of co-authorship

The concept of authorship is, like research collaboration, hard to define. The issues of defining authorship and co-authorship have been the topic of numerous studies, correspondence and editorials (e.g. Biagioli, 2012; Borenstein & Shamoo, 2015; Garfield, 1995). Most do not distinguish between authorship and co-authorship but treat them as uniform concepts by referring to issues of authorship credits and responsibilities. The general agreement among these studies is that both authorship and co-authorship are not uniform, stable concepts but have evolved over time, and full agreement on them across fields does not exist.

Studies asking researchers for a definition of what constitutes authorship find that it varies from a strict definition (the author has been part of all aspects of research and has written the publication) to a looser definition (the author has contributed substantially to the publication) (e.g. Marusic, Bosnjak, & Jeroncic, 2011; Street et al., 2010). The strict version is often not realistic if researchers are collaborating, since one would expect a certain division of tasks among the researchers. The looser definition has the problem of what "substantially" means. Researchers interpret this differently depending on their field, research group, institution and country, i.e., their epistemic culture (Cronin, 1984; Knorr Cetina, 1999). To find a definition of co-authorship, it is necessary to examine the concept of academic authorship by looking at how it emerges and evolves in research and thoroughly discuss the distinction and relationship between authorship and co-authorship as well as research collaboration and co-authorship.

The concept of authorship and reward system

The concept of authorship has changed over time, and according to Foucault (1979), the author is influenced by discourses within a society. The earlier reasons for assigning authorship of texts, books and ideas was not to ensure the author's legal rights over the work and avoid plagiarism. In the sixteenth century, it was used to assign responsibility and accountability in case the work was deemed subversive or heretical (Biagioli, 1999). Later, as the liberal economy evolved, authors were not just responsible for their work, it was also their intellectual property, which gave the author benefits. This liberal doctrine of copyright from the eighteenth century ensures researchers ownership of their work and prevents plagiarism or direct reproduction of their publications, while the content and ideas in the work are free to be built on (De Bellis, 2009, p. 270; Foucault, 1979).

The reward system evolved in parallel with the liberal economy. The main difference is that authors are rewarded with money in the liberal economy, while they receive recognition in the reward system. According to Merton's (1973) idealistic description of the reward system, researchers gain their position in the reward system by publishing their research and knowledge claims. They claim their position by referring to existing research (citations) while demonstrating the novelty and validity of their own research. In return, they receive recognition in the currency of citations, which builds up their symbolic capital (Bourdieu, 1975).

Both the liberal economy and the reward system build on the notion that it shall always be possible to identify the individual's contribution to a work. In the liberal economy, it is necessary to know who owns the copyright; in the

reward system, it is important to know who should receive both recognition and responsibility of the work's knowledge claim. Hence, it is often referred to as the two-sided coin of the academic or scientific realm (Cronin, 1984; Merton, 1968; Rennie et al., 1997). However, the currency of recognition risks inflation if it is no longer possible to identify "who speaks", i.e., who is accountable in cases of research misconduct and who should be rewarded. Likewise, the system is undermined when researchers start focusing solely on recognition in the reward system while ignoring potential responsibility.

All of this is not an issue if the work is by a single author. However, when the number of authors in the by-line increases, the identification of the individual's contribution becomes more complex and difficult; especially since co-authorships do not reflect and are not the end-result of the same type of research collaboration. Instead, studies show that culture, field and institutional differences affect who is recognized in the by-line and whether the author order reflects the individual's research contributions (Baerlocher, Newton, Gautam, Tomlinson, & Detsky, 2007; Birnholtz, 2006; Laband, 2002; Lake, 2010; Lariviere et al., 2016). The next step is therefore to examine and discuss the concepts authorship and co-authorship.

Authorship and co-authorship

What is authorship and what is co-authorship? The simple answer is that when someone writes a publication, they become "author" of that work, and when two or more people are authors of the same work, they become "co-authors". This definition is aligned with the dictionary description of authorship: "the state or act of writing, creating, or causing" (Merriam-Webster, 2017). However, this definition can mean that everyone who has contributed to a creation or discovery is an author. In a research context this means that all who have contributed to the creation of a research project or publication are entitled to co-authorship, which is how it is perceived in the physical sciences (Birnholtz, 2006). However, other fields still abide by more traditional definitions of authorship. An example is the widely used definition in the health and life sciences proposed by ICMJE (2010), which recommends 4 criteria for authorship:

- Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND
- Drafting the work or revising it critically for important intellectual content; AND
- Final approval of the version to be published; AND

- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

These criteria for authorship have inspired the Danish Code of Conduct for Research Integrity (DCCRI), which aims to support and promote a common understanding of responsible conduct of research in Denmark (Science, 2014). Especially the last criterion for co-authorship is inspired by a traditional view of authorship and research practices with minimal division of labour in the research process and a highly integrated process from idea to publication. This criterion could be reformulated to: "Agreement to be accountable for the work the researcher has contributed to, and ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved". This small change would be a more appropriate definition of criteria for co-authorship in this collaborative era of research. Furthermore, it fits the reasoning that researchers collaborate with experts in other areas or methods to enhance the publications quality and research. The motivation and possibility to collaborate decreases if one should be fully knowledgeable in all aspects of methods and data analysis. In addition, it makes division of labour impossible. Hence, trust is an essential part of research collaboration.

The idea that one must be fully involved in all aspects of the work to be co-author fits the traditional authorship view, where being an author is the state or act of writing the research results. This definition fits the cases of the lone author, where you can expect that the author knows, has written and is accountable for all aspects of the work. However, as far as the "big science" team-production model that emerged around WW2 (Biagioli & Galison, 2003; Müller, 2012), it can be questioned to what extent we can expect that the researchers could be accountable and fully involved in all aspects of the creating and writing process.

Furthermore, as the findings in Chapter 5, 6 and 7 will demonstrate, the team-production model also exists in economics and political science, which means that social science disciplines with the increasing tendency to co-author in larger groups also need to address their authorship criteria or lack thereof. Especially since several studies demonstrate that it can be arbitrary who is named co-author, and these decisions are often affected by power differentials and/or "publish or perish" pressures (Freda & Keamey, 2005; Geelhoed, Phillips, Fischer, Shpungin, & Gong, 2007; Tarnow, 2002). Moreover, multiple studies claim that the current authorship guidelines for co-authorship are not suitable or followed because they do not fit current collaborative research practices (Rennie et al., 1997; Sismondo, 2009; Street et al., 2010).

The dictionary definition of authorship is better suited to the collaborative research approach with three aspects of being an author: writing, creating OR causing, and it is much more inclusive than the ICMJE or DCCRI definitions. Of course, the dictionary version does not have to embrace and facilitate the different aspects of research ethics, such as accountability and integrity. The health and life sciences created the ICMJE criteria because some co-authors did not fulfil authorship requirements and refused to take responsibility in cases of research fraud. These issues should not be ignored, but contributor statements may be a better long-term solution and enhance the visibility of individual contributions. Hence, each publication should state who has contributed from idea to publication, and who is responsible for what research tasks. This approach has its flaws, since it will still be affected by the different research cultures and institutions' perceptions of co-authorship. However, it could be a great step towards a more transparent research process and enhance the individuals' possibility for reward and responsibility.

The social sciences have not to the same degree experienced cases of fraud, and formal authorship guidelines or research code of conduct do not exist in most fields. However, the increasing tendency to collaborate and co-author has also brought the first infamous cases of research misconduct in the social sciences. For example, the case from 2015 with political scientists LaCour and Green (Phillips, 2015), where the graduate student LaCour falsified the raw data used in the study without Professor Green noticing. The article got through peer review and was published in *Science* before problems with data was noticed (Phillips, 2015). However, political science has not created specific authorship criteria.

This is an extreme case of research fraud, but it reflects a division of labour in a mentor-mentee collaboration, where the graduate student executes all or most of the data sampling tasks, which are becoming more common in many areas of economic and political science research (see Chapter 6 and 7). This division of labour would be more transparent with a contributorship statement in the publications to highlight who was responsible for and executed the different parts of a study. Generally, a thorough discussion of co-authorship definitions and practices in most social science fields is needed. It is important to question both who has done what and who gets formal credit, so a definition or realistic co-authorship guidelines can be made.

Social science disciplines and publishing

In general, the social science disciplines study society and humans in their social context. The approach to and focus in these disciplines varies, sometimes even within the same discipline. Social science does not have clear boundaries,

and some disciplines can also be classified as belonging to the humanities or life sciences. Besides, it can be difficult to clearly define a discipline, since the peripheral areas can overlap with neighbouring disciplines. This section first presents different definitions of disciplines with special focus on the social science disciplines economics and political science, followed by publishing practices in the social sciences. These definitions are presented to clarify how difficult it can be to limit an examination to one discipline and to discuss collaboration and publishing practices in social sciences and how they vary depending on the discipline.

Defining disciplines

The definition of disciplines has been a topic for multiple sociological and philosophy of science studies (Becher & Trowler, 2001; Krishnan, 2009; Trowler, Saunders, & Bamber, 2012; Whitley, 2006). A recurring problem is finding a definition that is concise and embraces the various aspects of the disciplines. One reason is that academic disciplines are not static but constantly evolving and adjusting to changing political and societal environments (Ossenblok, 2016). Hence, disciplines develop in parallel with a professionalization of knowledge and establishment of universities.

Therefore, creating organizations to educate new professionals and produce new knowledge in certain subjects is often essential in the establishment of a discipline. The first established disciplines, theology, law and medicine, were created because of external demands (Klein, 1990). Later, industrialization, technological advances and the growing complexity of society created a need for new disciplines of knowledge and education of new specialists (Krishnan, 2009). New disciplines emerged while others disappeared or became embedded in other disciplines (e.g. theology became religious studies) (Ossenblok, 2016). A discipline is often viewed as established when it becomes institutionalized at an esteemed university and has a journal dedicated to its research (Sugimoto & Weingart, 2015).

Disciplines are often formally organised around taught subjects, academic departments, professional associations and/or academic journals. Studies often define them as sociocultural entities within which researchers share common norms, values, work practices and modes of interaction (Becher & Trowler, 2001; Pahre, 1996; Whitley, 2006). The restrictions or boundaries of these sociocultural entities depend on the disciplines. For example, Krishnan (2009, p. 9) proposes the following checklist to assess the extent to which a discipline is established and has strong boundaries:

1. Disciplines have a particular object of research (e.g. law, society, politics), though the object of research maybe shared with another discipline.
2. Disciplines have a body of accumulated specialist knowledge referring to their object of research, which is specific to them and not generally shared with another discipline.
3. Disciplines have theories and concepts that can organize the accumulated specialist knowledge effectively.
4. Disciplines use specific terminologies or a specific technical language adjusted to their research object.
5. Disciplines have developed specific research methods according to their specific research requirements.
6. Disciplines must have some institutional manifestation in the form of subjects taught at universities or colleges, respective academic departments and professional associations connected to it.

The natural science discipline physics fulfils all six requirements, while a discipline like political science only fulfils some of these requirements. As in many social science disciplines the theories and concepts in the political science are not well-established paradigms but rather competing paradigms. Furthermore, the majority of methods applied in political science are shared with sociology, psychology and economics. Economics is a more established discipline with a high degree of agreement on methods, theories and object of research. However, the peripheral areas of economics overlap especially with political science and psychology.

Instead of a checklist, Whitley proposes a theoretical framework to understand the intellectual and social organisation of sciences where disciplines or research fields are viewed as "work organisations which construct knowledge in different ways in different contexts" (Whitley, 2006, p. 6). The framework consists of two dimensions: "mutual dependency" (the extent to which the individual researcher is dependent on colleagues to conduct research) and "task uncertainty" (the extent of agreement on methods, stability of research outcome, intellectual priorities and goals of the field). Both dimensions are further divided into two types.

Mutual dependency consists of functional dependency (the extent to which researchers rely on similar techniques, methods, materials and fellow researchers' results to make a knowledge claim) and strategic dependency (the extent to which researchers have to persuade colleagues of the significance and importance of their study to obtain a reputation in the reward system)

(Whitley, 2006, p. 88). According to this framework, the social sciences generally express a low functional dependency due to many competing methodological approaches and little interdependence among researchers to fulfil research tasks. High or low strategic dependency depends on the discipline and on the formality and restrictedness of the communication system (Whitley, 2006, p. 112).

Task uncertainty also consists of two types: technical and strategic. The more paradigm-bound the discipline is, the more predictable, visible and replicable the research results. Technical task uncertainty represents the extent to which work techniques are understood and produce reliable results. If it is low, well-established research techniques can produce predictable and replicate results; if it is high, results will be ambiguous and subject to conflicting interpretations. The strategic task uncertainty reflects the degree to which the disciplines have a clear ordering of goals and intellectual priorities (Whitley, 2006, pp. 121-123).

According to Whitley (2006), economics is characterized by low functional dependency, high strategic dependency, high technical task uncertainty and low strategic task uncertainty. This implies that it is a field with partitioned bureaucracy, which produces analytical, specific and ambiguous, empirical knowledge. The core of the field focuses on specialised theoretical and analytical knowledge, while the peripheral areas are more ambiguous and empirically oriented. Thus, economics has a high technical task uncertainty because of issues with reproducibility (Chang & Li, 2015; Maniadis & Tufano, 2017) and applying the core theoretical models to empirical phenomena (Whitley, 2006, p. 126). The low strategic task uncertainty is visible in the broad agreement on the core goals.

The high strategic dependency means that strong norms influence how economists communicate their findings as displayed in their usage of esoteric and standardized symbol systems (Laband & Tollison, 2006; Maciejovsky, Budescu, & Ariely, 2009). Thus, there is a strong tendency to use mathematical models to explain social phenomena, a clear structure in journal articles and a strong tendency to apply alphabetic authorship. The low functional dependence is reflected in the lower mean number of authors and lower tendency to execute a division of labour compared to the sciences. Research tasks and problems rarely require much different expertise, but economists suggest that increasing specialization has made it necessary to combine the skills of two or more researchers (Barnett, Ault, & Kaserman, 1988; Jones, 2009). This is reflected in an increase in co-authorship and greater tendency towards division of labour, as well as indicates an increase in functional dependency in the field.

Political science is, like economics, a field with low functional dependency, which the low average number of authors reflects (Adams et al., 2014; Corley & Sabharwal, 2010). Political science is also a more heterogeneous field than economics, since it largely forms subgroups around objects of study and distinct methodological approaches. Unlike economics, that to a large degree relies on secondary data from databases and archives, political science embraces a broader spectrum of social science research methods and data, such as secondary, questionnaire, text, interview and ethnographic data, to mention the most central.

The usage of these different methodological approaches often depends on the political science subgroup, which corresponds to Whitley's (2006) description of political science as fragmented adhocracies with diffuse results and discursive knowledge of common-sense objects. The subgroups have different focuses and goals, so they display a high strategic task uncertainty. Political science is also a discipline with high technical task uncertainty, since it, as many social science disciplines, has problems with reproducibility, and the results can be subject to various interpretations. The variety of audiences and research strategies means it has low strategic dependency. Since political scientists largely apply exoteric language and concepts when communicating their research, they have to elaborate on the meaning and understanding of concepts in order to justify a specific interpretation, and often communicate in a national language and in a greater variety of communication forms and publication types. This is also reflected in a lower tendency to coordinate research at an international level but to a greater degree at the local level through personal contacts.

The intellectual and social organisation of economics and political science influences how researchers construct and communicate knowledge, the extent and mode of collaboration, as well as the degree to which this dissertation can examine co-authorship development using journal articles, since it depends on the preferred communication form of each discipline. The next section presents and discusses publishing and communication patterns in the social sciences in relation to the empirical studies of this dissertation.

Social science publishing

The social sciences have a more diverse publishing behaviour than the physical and life sciences. Research in the physical and life sciences is predominantly published as articles in English journals, most of which are indexed in WoS. It is more "messy" in the social sciences, where research is published in variety of languages and publications types; books, book chapters and articles (Hicks, 2005; Nederhof, 2006). The disciplines economics and psychology

display a publishing pattern like the physical and life sciences, but most social science disciplines have a more mixed publishing pattern (Hicks, 2005).

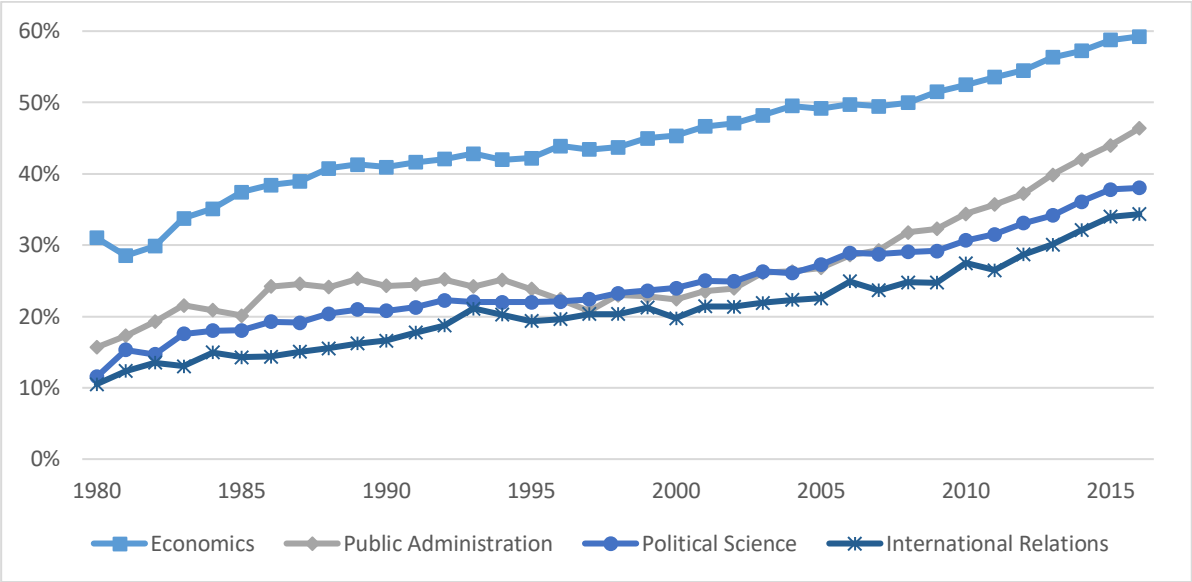
Hicks (2005, p. 480) claims based on exchange of data and personal communication with Butler (1998) that the more book-oriented the discipline is, the less it is covered by SSCI. These findings correspond to the results in the study by Ossenblok, Engels, and Sivertsen (2012), where it is apparent that fields known for book publishing are less covered, even if the study focuses on articles. Other studies reveal that large national differences within the same discipline in the extent articles are published in journals indexed in WoS. The coverage of disciplines often correlates with that disciplines' tendency to apply local language instead of English (Archambault, Vignola-Gagne, Cote, Lariviere, & Gingras, 2006; Ossenblok et al., 2012).

This dissertation examines the extent to which WoS covers a discipline by calculating the coverage of references to indexed journals articles, which is the share of the indexed articles' references. So if an article has 20 references, 10 of which are to journal articles indexed in WoS, then the coverage is 50 %. Coverage is therefore also an indicator of how book- and nationally oriented a discipline is, since references to these publications types will not be covered. The appendix (SSCI coverage) shows the development in coverage in the different social science disciplines over 37 years. The majority (91 %) of subject categories display an increase in coverage. The five categories[1] with declining coverage can all be categorized as belonging to the humanities and as areas with a larger tendency to publish in national languages.

Since the dissertation mainly focuses on the disciplines economics and political sciences, the coverage of these areas is presented in Figure 2.1. It shows the development in coverage of references for journal articles indexed in the four subject categories economics, public administration, political science and international relations in WoS. All four categories have experienced a great increase in coverage over the last 37 years, though it is still less than half of the political science references that are covered. This calculation is repeated with Danish articles exclusively and it displays a similar picture of increasing coverage (see appendix table Danish & International coverage). The tendency of the political science disciplines to be more national and book oriented fits the definition of political science in Whitley's framework in the previous section. The increase in coverage could indicate that political science is focusing more on international article publishing.

[1] Cultural Studies; Psychology, Psychoanalysis; Hospitality, Leisure, Sport & Tourism; History & Philosophy of Science; Linguistics

Figure 2.1. The coverage of economics, public administration, political science, and international relations in WoS



Ossenblok and Engels (2015) detect a similar tendency in the publishing distribution between articles and book chapters in the humanities and social sciences in the period 2000-2011. Overall, articles have become the dominant research output in the social sciences. In their comparison of publishing in book chapters and articles, the former only comprise 16 % of the economics and 31 % of the political science publications in their sample.

A study of monograph authors in Belgian find that only 3 % of the social scientists (4 % of the economists and 9 % of the political scientists) have published a book in the period 2000-2011 (Verleysen & Ossenblok, 2017). Some areas of the social science thus seem overall to become less heterogeneous in their publishing and more oriented towards publishing articles. A similar trend can be observed using data harvest to calculate the Danish Bibliometric Research Indicator[2]. In the period 2009-2017, the share of journal articles[3] rose from 54 % to 67 % in the social sciences, the share of book chapters decreased from 37 % to 29 % and books have decreased from 10 % to 4 %. It seems that Danish social scientists also adapt their publishing behaviour to what gives the best "score" in the indicator.

[2] The publication data from 2009-2011 was provided by Jesper Schneider; the publication data from 2013-2017 was downloaded from the Danish Bibliometric Research Indicator webpage "Høstresultater" https://bfi.fi.dk/Publication/NationalAnalysis.

[3] The sample includes the following publication types: journal articles, book chapters and books.

However, these studies also show that to fully investigate co-authorship in the social sciences, the study needs to include books and book chapters as well as articles published in journals not covered by WoS. This means that there are some limitations to the dissertation's empirical studies. Nevertheless, it is also evident that journal articles have become the preferred research output in most social science disciplines, and it would be interesting to investigate if the increase in journal articles is an ongoing trend.

Summary

The chapter introduced the essential concepts and topics addressed in the dissertation. The first part provided a short overview of research collaboration and co-authorship studies followed by definitions of the concepts research collaboration and co-authorship. The chapter discussed the issues of examining and measuring research collaboration, the extent to which co-authorship reflects research collaboration and the usefulness of authorship guidelines.

The second part of the chapter focused on social science disciplines and publishing. First, it presented and discussed the issues of defining disciplines as a focus of study, since they often do not have a clear definition or boarder. It showed how the intellectual and social organisation of the disciplines influences researchers' collaboration, co-authoring and research behaviour. This was followed up with an examination of social science publishing focusing on how heterogeneous it is and how it can be an issue in the dissertation's quantitative studies.

Chapter 3. Research Design

This dissertation applies multiple studies to investigate the evolution of co-authorship, the relationship between research collaboration and co-authorship, and why social scientists collaborate and co-author. The studies complement each other by examining research collaboration and co-authorship at different levels. It uses quantitative analysis to examine whether and how co-authorship is increasing and qualitative analysis to understand why it is increasing. The qualitative analysis also sheds light on how and why researchers collaborate. Table 3.1 provides an overview of the studies, data collection, and how they are incorporated in the dissertation.

The first study is conducted at an aggregated level to show the extent of co-authorship and is solely descriptive. The purpose is to demonstrate the increase in co-authorship and number of authors in the different disciplines at macro-level. The second study is also based on bibliometric data, but data about the articles' research approaches and methods is added through content analysis to investigate whether suggestions that increase in co-authors is due to more empirical and quantitative research are valid.

The first two studies only address co-authorship, i.e. research collaboration that leads to a finished product. To fully explore research collaboration in the social sciences, it was necessary to look beyond the publications and focus on the researchers as the unit of study. Interviews were selected as method, because they make it possible to explore different aspects of research collaboration that has not necessarily resulted in a co-authored publication. The advantage of interviews over survey questionnaires is that they can produce more details because the interviewer is able to ask the interviewee to clarify or elaborate, and the interviewer can go a new direction if the interviewee reveals interesting information. Some of the questions might have been answered in a questionnaire, but then the fourth research question would not have emerged. Hence, one of the strength of the interviews was the possibility of paying more attention to certain questions, and then examine whether similar conclusions could be drawn from the bibliometric data or this is a special case.

The detailed description of empirical studies in this dissertation is included in the articles in Chapter 4-7. The four sections in this chapter discuss some of the limitations of these studies and provide some details that were excluded from the method section of the articles.

Table 3.1. Research studies

Chapter	Article title	Methodological approach	Research methods and data
4	The rise in co-authorship in the social sciences (1980-2013) https://doi.org/10.1007/s11192-016-1849-x	Quantitative	Approx. 4.5 million articles (bibliometric data) from Web of Science Social Science Citation Index
5	What factors are associated with increasing co-authorship in the Social Sciences? A case study of Danish Economics and Political Science https://doi.org/10.1007/s11192-017-2635-0	Quantitative	Bibliometric data from Web of Science Social Science Citation Index. Content analysis of 4,548 articles (Full-text); 3,157 economics articles, 1,391 political science articles. 193 articles belong to both fields
6	Research collaboration, *it is like there is synergy, so one and one becomes more than two in a way*. Interviews with Danish Economists and Political Scientists	Qualitative	In-depth interviews with 17 researchers: 9 economists and 8 political scientists with 3-50 years of research experience
7	Alphabetic or contributor author order. What is the norm in Economics and Political Science and why?	Mixed methods	In-depth interviews with 17 researchers. Bibliometric data: 212,170 economics articles and 104,235 political science articles

Macro-level descriptive study

The first study, presented in Chapter 4, focuses on the evolution of co-authorship in all fields of social sciences. Studies of co-authorship can be divided into two overall categories. Either they focus on the development in a few fields or they investigate the main branch of research, the physical, life and social sciences and humanities, which means that developments in the individual fields are not visible.

This study addresses a gap in the literature by providing an overview of the development in co-authorship in the social sciences over a 34-year period. Thus, it answers the first research question: "To what extent has co-authorship in the social sciences increased?" To answer this question, the study uses aggregated bibliometric data downloaded from the Centre for Science and Technology Studies (CWTS) enhanced version of Thomson Reuters' Web of Science (WoS) Social Science Citation Index (SSCI). The decision to focus solely on articles registered in WoS's SSCI subject categories to measure the development in co-authorship is problematic for two reasons. First, as demonstrated in the section "Social science publishing", the mean coverage of social science varies from only 11 % for the subject category History to 77 % for the subject

category Psychology, Biological in the selected period. Thus, using these data has some strong limitations, which may affect the validity of the study (see also appendix SSCI coverage).

Ossenblok et al. (2014) show that the mean number of authors in general is higher for articles indexed in WoS than for articles indexed in the Flemish Academic Bibliographic Database for the Social Sciences and Humanities. However, as also stated in Chapter 4, the usage of WoS data makes it possible to see whether there are changes over a longer period and with a larger set of data. Nevertheless, it could be interesting to do a similar study based on library or national research publication databases and examine how much the mean number of authors differs depending on publication type and the possible development over time.

The second problem with the data sample is the usage of WoS subject categories as proxy for disciplines. First, as discussed in "Defining and analysing disciplines" there is no clear definition of disciplines or fields. The discipline boxes do not have strong boundaries, and especially the more peripheral areas might overlap. Furthermore, the indexed journals are assigned to one or more WoS subject categories based on evaluations of the journal's citation data and the Hayne-Coulson algorithm, which has never been published (Pudovkin & Garfield, 2002). It is therefore impossible to know the full criteria for what journals are assigned to the different subject categories or how these subject categories were defined in the first place, beyond the available scope notes (SSCI, 2012).

Content analysis study

This study is conducted in order to answer the second research question: "What factors are associated with increasing co-authorship in the economics and political science?" The disciplines economics and political science were selected based on two main criteria: Both fields display an increasing tendency to collaborate, though the degree differs between them, and they are mostly assessed to belong to the social sciences, whereas, e.g. psychology has a disciplinary range that places it in the medical field, social sciences as well as humanities.

The study chose to focus on Danish economics and political science to follow up the findings in a qualitative interview study as well as to compare the evolution in co-authorship to changes in Danish university policies. Due to extensive manual and time-consuming coding based on full text articles, it was necessary to limit the number of articles included. The data sample consists of

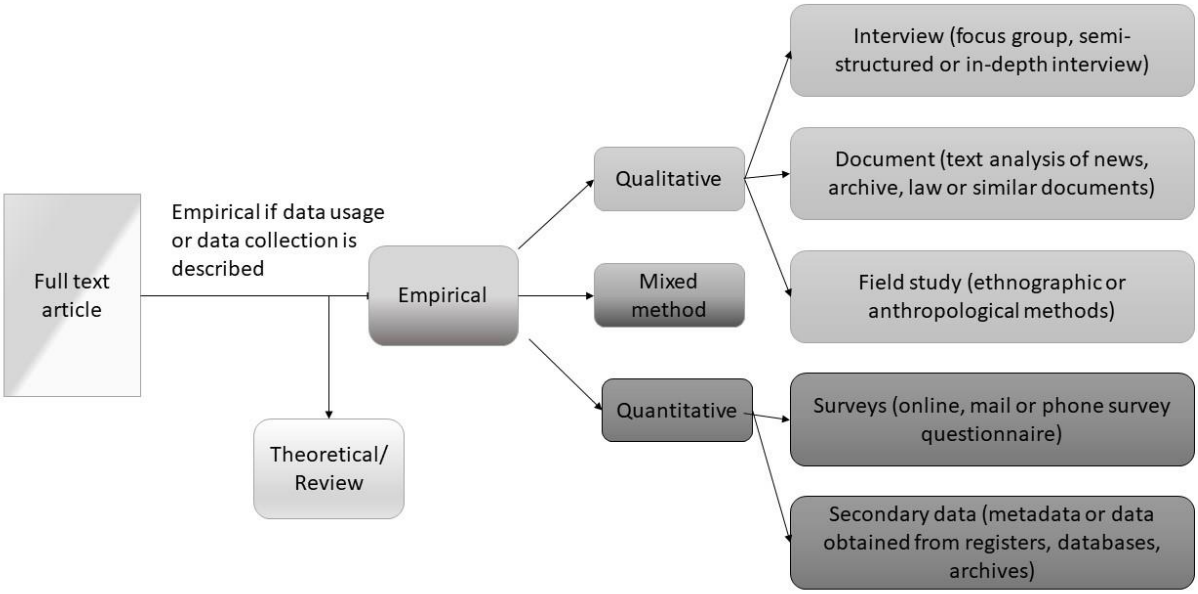
all research articles belonging to economics and political science subject categories with at least one Danish address downloaded from SSCI in WoS (see Chapter 5 method section for more details).

In order to execute the content analysis, a full-text of each article was located and assessed. The majority of articles could be found by googling title and author and applying Aarhus University's extensive on-site access to journal or publisher websites. In some cases, the researchers' own preprint version was applied in the coding. If this attempt proved unsuccessful, Aarhus University Library webpage was applied to search for the journal name. In most cases, it was possible to access the journal's webpage and use the bibliographic information to locate a full-text of an article. If this was unsuccessful the article was discarded from the sample. Only 6 % of the articles in the sample was discarded.

After the full-text was located, the coding algorithm displayed in Figure 3.1 was used. This algorithm is based on distinction between quantitative and qualitative research suggested by several social science methods books (Bryman, 2008; Bøgh Andersen, Møller Hansen, & Klemmensen, 2012). Qualitative research is all research that cannot be defined as quantitative research and does not employ measurement. Quantitative research often consists of surveys or structured interviews, data from databases or archives and content analysis of documents. Qualitative research often consists of ethnographic or participant observation, in-depth or semi-structured interviews, focus groups or document analysis. Studies using both quantitative and qualitative research are defined as mixed methods.

Further details about the coding are included in the method section in Chapter 5. The dissertation is aware that the extensive focus on empirical research implies some limitations, since the study could have been improved with more details about the theoretical or review articles. Furthermore, an assistant to help code and verify coding might have improved the validity the research and increased the sample. Finally, as mentioned above, the selection of articles indexed in WoS has some limitations, and the study could have benefitted from inclusion of books and book chapters in the sample.

Figure 3.1. Coding algorithm (also available in Chapter 5)



Interviews with Danish economists and political scientists

The intention of the interview study was to answer the third research question: "Why do Danish economists and political scientists collaborate and co-author? And how does co-authorship reflect collaborative research in the fields of economics and political science?" However, as stated in the "Objective and research question section", the results of the study gave rise to a fourth research question: "What is the author order norm in economics and political science, and why?"

The interview study chose to focus on Danish researchers from one university to get as homogenous a group as possible. This made it possible to prevent different work conditions or directives from university management to interfere with how the researchers perceive and practice collaboration and co-authorship. However, the decision to focus on one university also means that it is possible that researchers at other universities or in other countries have different perceptions and practices. It could therefore be interesting to repeat the study at another university and/or in another country.

The collected interview data is used in the articles in Chapter 6 and 7 (see overview in Table 3.1). It consists of data from 17 in-depth interviews with nine economists and eight political scientists. A more detailed description is available in the method sections in Chapter 6 and Chapter 7. The method section in Chapter 6 also includes a description of the Danish Context.

The interview study began by contacting the interviewees via email. Each email was based on a specific templet for either a junior or a senior researcher (see appendix, invitation templet). The templet was modified to economics and political sciences and to the researchers' experiences listed in their online resume. All emails were addressed to the researchers personally in Danish in an informal tone since Danes rarely address others using titles.

An interview guide was used to guide the interviews and secure that all intended topics were covered. However, the structure of the interviews differed depending on the information provided by the researchers. Parts of the interview guide changed twice during the data collection period. Four hypothetical cases about contribution and co-authorship were added after the pilot interview, and a question about co-authorship credit was removed after the next three interviews (see also appendix, interview guide).

Furthermore, the interviewer decided to spend a little more time on questions about author order decision since that seemed more important to researchers than the interviewer had expected. However, the main focus was stable throughout the interview period. For more details about the interview process, see the method section in Chapter 6 and 7.

After analysis of the interview data, it became clear that the interview study could use more data to further explore changes in co-authorship trends, career pressures and research over time. The study might have been improved by a larger sample, especially more interviewed researchers with over 30 years' experience. Some of the researchers have interesting insights in good and bad changes in work conditions and behaviour, and more interviews could explore whether these insights only apply to special cases.

Another aspect the interviews reveal is the high pressure the junior researchers experience to publish and sometime co-author. Some were torn between staying or leaving academia and unsure of whether they ever would reach a constantly moving bar. Furthermore, the interviews only touch on the relationship with and importance of supervisors, and it would be interesting to investigate this further by including researcher who have left academia.

Finally, the decision to focus solely on Danish researchers provides some limitations (some are described in "the Danish context" in Chapter 6). It is, for instance, impossible to explore whether the detected changes in researchers' behaviour have occurred in other countries and if researchers in other countries have similar motivations to collaborate and co-author. It would be interesting to conduct a similar study in, e.g., Germany, Great Britain or USA, or extend the current study by interviewing researchers who have immigrated to Denmark.

Bibliometric author order study

This study was motivated by the fourth research question: "What is the author order norm in economics and political science, and why?" This question emerged during the interview study, and the bibliometric data is collected as a supplement to the interview data. The bibliometric author order study consists of data about economic and political science articles from Web of Science (WoS). Parts of the bibliometric data used are from the previous study using content analysis. The sample was updated and expanded adding articles with Swedish (SE), German (DE), British (UK), and American (US) addresses. The only addition to the bibliometric data set is the binary variable "Alphabetic author order"; 1 for alphabetic author order and 0 for contribution author order.

The bibliometric author order study is included in Chapter 7, which discusses the issues of examining alphabetic author order trend in the social sciences in great detail. It uses an algorithm to calculate the estimated intentional alphabetic author order to not overestimate the share of alphabetically ordered articles in the study. The detail of the algorithm is presented in Chapter 7. Thus, the chapter goes to great length to prevent overestimation of the share of alphabetically ordered articles. However, in doing so, the study might also underestimate it. Another limitation of this study is that the lack of other publication types than articles makes it uncertain whether researchers are more or less inclined to apply alphabetic or contribution author order for books or book chapters.

Summary

Chapter 3 provides a short overview of the empirical studies included in the dissertation as well as some of the limitations of these studies. The main issue is the lack of bibliometric data for books and book chapters in the examination of co-authorship. It is difficult to estimate how much an extended bibliometric data sample would affect the results. Hence, the usage of quantitative empirical studies and the increases in co-authorship may be overestimated.

The interview study might benefit from more interviews, especially with more senior researchers, to fully explore changes over time. However, it is difficult to examine a time perspective, since it is only possible to get reflections over what they believe have changed. Furthermore, the decision to mainly focus on Danish research in economics and political sciences also implies some limitations, since the approaches and focuses might be different in other countries.

Chapter 4. The rise in co-authorship in the social sciences (1980-2013) (paper 1)

https://doi.org/10.1007/s11192-016-1849-x

Chapter 5. What factors are associated with increasing co-authorship in the Social Sciences? A case study of Danish Economics and Political Science (paper 2)

https://doi.org/10.1007/s11192-017-2635-0

Chapter 6. Research collaboration, *it is like there is synergy, so one and one becomes more than two in a way*. Interviews with Danish Economists and Political Scientists (paper 3)

https://orcid.org/0000-0002-2541-3819

Chapter 7. Alphabetic or contributor author order. What is the norm in Economics and Political Science and why? (paper 4)

https://doi.org/10.1002/asi.24151

Chapter 8.
Discussion and Conclusion

This dissertation set out to address the scarce knowledge about research collaboration and co-authorship in the social sciences by examining different aspects of it. This was mainly done by answering the research questions posed in Chapter 1. This chapter summarizes the main results of the dissertation, discusses results, implications of the findings and addresses future concerns and future work.

There is an increasing tendency to collaborate and co-author in academia. As mentioned in the introduction, this trend has moved from the physical sciences to the life sciences and now to the social sciences. However, the extent to which social scientists collaborate and co-author was unclear, since most studies focus on the branches of science (physical, life and social sciences) (Lariviere et al., 2015; Wuchty et al., 2007) or one individual field; economics (Barnett et al., 1988; Nowell & Grijalva, 2011), political science (Adams et al., 2014; McDermott & Hatemi, 2010), sociology (Hunter & Leahey, 2008) and psychology (Cronin et al., 2003). These studies do not examine whether co-authorship is increasing in all areas or how it differs between social science fields.

As emphasized in the beginning of the dissertation, studies why researchers collaborate and co-author in the social sciences are to a large degree non-existent. This dissertation addresses the gap in knowledge about what co-authorship entails, the relationship between research collaboration and co-authorship in the social sciences, and how or if collaboration and co-authorship are affected by bibliometric-based performance evaluations and the publish-or-perish culture. The four research questions are examined in Chapter 4-7. Chapter 4 asks: "To what extent has there been an increase in co-authorship in the social sciences," and provides an overview of the increase in number of authors and share of co-authorship per article in all social science disciplines over a 34-year period. The study confirms that there is an increasing tendency to co-author but the increase varies substantially between fields. Social science fields with collaboration and publication patterns similar to fields of the humanities have a minor increase.

An example in the study is the four subject categories History, Cultural Studies, Area Studies and History of Social Sciences where the changes in co-authorship and number of authors are minimal. At the other end of the scale are disciplines with relations to the medical and life sciences, which display large increases. The mean number of authors has risen by approximately 2-3

authors in the subject categories Psychiatry, Health Policy and Services, Public, Environmental and Occupational Health, Substance Abuse, Gerontology, Rehabilitation, Biomedical Social Sciences, Nursing, Ergonomics and Special Education. These are fields or categories where research is often based on experiments, large data sets, statistical methods and/or team-production models (Biagioli, 1999; Biagioli & Galison, 2003; Norris, 1993).

The study offers another example of how the methodological differences can influence the co-authorship patterns by looking at the subject categories within Psychology. Research in the subject category Psychoanalysis often focuses on theory building and abstract concepts, and it could methodologically be defined as belonging to the humanities. At the other end of the spectrum are Psychiatry and Developmental Psychology, where research is often empirical, based on experiments and conducted in collaboration with other researchers. Therefore, researchers in these areas often work in a team-production model where the research tasks are allocated to different individuals. The findings in this chapter indicate that more quantitative and experimental areas of research are more co-authored and by larger numbers of authors, while theoretical and qualitative areas of research tend more towards single authorship and fewer authors. However, most of these explanations are based on anecdotal knowledge and suggestions from other studies (e.g. Hunter & Leahey, 2008; Laband & Tollison, 2000), and the next step in the dissertation was to further investigate these indications.

The dissertation investigates this in Chapter 5 by answering the second research question: "What factors are associated with increasing co-authorship in Economics and Political Sciences". The study conducts a thorough examination of the research approaches and methods used in economics and political science articles published in the period 1980-2014, and it provides some interesting insights. First, it finds that economics research has changed from a theory-focused to an empirical discipline over those 35 years. The changes in research focus are minor in the political sciences.

The study confirms the findings from other studies that empirical research and especially quantitative survey-based research is more co-authored and has more co-authors in Danish economics and political science than theoretical and qualitative research (Corley & Sabharwal, 2010; Fisher et al., 1998; Schymura & Loschel, 2014). In theoretical economics, the average number of authors increased by 1 and the share of co-authored articles by 58 %; while in empirical economics the mean number of authors rose by almost 1.5 and the share of co-authored articles by 61 %. According to the regression model for economics, survey-based articles generally have three times more authors than a theoretical article.

In theoretical political science, the increase in the mean number of authors is only at 0.6 and the share of co-authored articles is 24 %. In empirical political science, the mean number of authors is 0.8 and the share of co-authored articles is 41 %. The general increases in mean number of authors are thus low. The regression model shows that survey-based articles in political sciences generally have 1.5 authors more than theoretical articles.

Based on these results, it is apparent that there is a greater tendency to co-author empirical research, but it is also clear that the tendency is occurring regardless of the research approach or method used in economics and political sciences. This means that collaboration is more common in economics and political science research, and that it might be the researchers' behaviour that is changing. However, little is generally known about social scientists' collaborative and co-authoring behaviour, so it is uncertain what influences it. It could be caused by greater competition for advancement, greater usage of bibliometric indicators, or the increase in collaboration in empirical areas is influencing the theoretical areas in a discipline. The latter indicates a change in research culture towards a greater norm for collaborating. The next step is to explore these explanations as well as why and how social scientists collaborate and co-author.

This is done in Chapter 6 by answering the third research question: "Why do Danish economists and political scientists engage in research collaboration and co-authorship, and what is the relationship between research collaboration and co-authorship in economics and political science". The chapter explores economists' and political scientists' motivations for and practices of collaborating and co-authoring. It shows that researchers have epistemic, pragmatic as well as personal reasons for collaborating and co-authoring. The analysis reveals four motivations for collaborating and three motivations for co-authoring, though the distinction is to some extent of an analytical character, since the motivations are to a large degree entangled.

Economists and political scientists collaborate because unifying different types of expertise facilitates knowledge exchange, which improves and enables research; it creates a setting with better possibilities for discussions and scrutinizing of the research, which generates synergy among the collaborators; and it creates a setting for socializing, which makes the work day more enjoyable, as the research process in the social sciences can be a lonely endeavour.

The fourth and pervasive motivation for collaborating is to enhance the possibility to publish more by co-authoring. This is also very connected to the motivations for co-authoring, which is viewed as a method to optimize publication production, advance ones career and prevent having to "publish-or-perish". Researchers live in a performance or publish-or-perish culture, and it influences how they view research as well as their publishing and co-authoring

behaviour. This was especially evident in the interviews with younger researchers who see co-authoring as a means to survive and stay in academia. They see collaborating and co-authoring as a way to optimize their publication production both quantitatively and qualitatively. The notion is that collaboration improves research and makes it publishable in "better" journals. Furthermore, it is seen as less time-consuming, since each researcher does not have to be omniscient but can delegate or divide tasks between them.

Chapter 6 also demonstrates a tension between co-authoring and single-authoring in both economics and political science. The latter is viewed as a necessity in individual research assessments in connection with employment reviews and promotions. The former is seen as a method to optimize publication productivity to reach the ever-moving bar for publications required to succeed. Thus, the publish-or-perish culture seems to be partially counterbalanced by the cultural values and emphasis on demonstrating individual contributions in economics and political science. However, some junior researchers felt that the emphasis on both single- and co-authoring increased the pressure and raised the bar for succeeding.

The different motivations show that co-authorship is a result of multiple types of research collaboration, and this makes it hard to define clear co-authorship criteria. When interviewees were asked about what contribution was important to qualify as co-author, most found it difficult to offer precise criteria. The majority emphasize that being a writer is being an author, since one cannot write without being knowledgeable of the research leading to the publication. However, when further questioned about these criteria, it was revealed that especially in empirical research, the need for certain competences outweighs the writing criteria. Hence, even the individual researchers cannot provide a clear and static definition of co-authorship, so this needs to be taken into consideration when we discuss or define co-authorship.

Chapter 6 shows that research collaboration and co-authorship are often treated as synonymous, even in the mind-set of the researchers. Research collaboration is often viewed as the process leading to co-authorship and publications. However, when researchers were asked more thoroughly about the others' contributions to a publication, it was apparent that they are all part of a socio-cognitive network. They present, discuss and get feedback from others and receive technical assistance. The extent to which others' contributions are visible differs among researchers and especially between economists and political scientists.

Economists have a strong tradition for acknowledging almost everyone who has contributed in some way. They present their working papers multiple times and acknowledge the attendees at different workshops and conferences,

as well as colleagues and student assistants who help with different tasks during the research process. Danish political scientists do not have the same traditions, and the extent to which they write acknowledgements differs. During the interviews, it became apparent that others' contributions with data analysis, provision or collection are not always visible in the political science publications, and one can truly talk about the "invisible hands of science".

Finally, as stated in the objective and research questions section, it became apparent during the interviews that some researchers put great emphasis on using alphabetic author order or changing away from alphabetic author order. Chapter 7 answers the research question: "What is the author order norm in Economics and Political Science, and why". It shows the extent to which alphabetic author order is used in economics and political science internationally and in Denmark and examines economists' and political scientists' reasons for using alphabetic or contribution author order.

The study uses bibliometric data to confirm that economics has a strong tradition for using alphabetic authorship, though the trend is declining as the number of authors rises, especially when the author groups reach five authors. The interviews reveal that the majority of economists are inclined to use alphabetic authorship because it is the "right way" or "our way" and junior researchers were uncertain during the interviews if it is even possible to deviate from alphabetic authorship.

In political science, there is not a strong author order norm. Most of the interviewed senior political scientists prefer alphabetic authorship, while the junior political scientists are more inclined to use contribution author order. The bibliometric data show a trend towards alphabetic authorship. However, the strength of this trend is somewhat country dependent, and it strongly declines for author groups with four or more authors. During the interviews, it became clear that there is a local tradition for using alphabetic authorship, especially when the contributions are equal. However, it was also emphasized that this tradition is changing. The senior political scientists generally prefer alphabetic authorship, because they believe it is the proper way to organise researchers in the by-line. The key reason is often that it prevents conflicts and makes sure that researchers are only included as co-authors if they have made an appropriate contribution. Similar reasons were given by the economists.

During the interviews, the senior political scientists mentioned internationalization of the field as a major change in research over the last decades. The political scientists had observed a tendency to apply contribution author order internationally and to be able to compete against international colleagues, some of them had started to shift to contribution author order. The younger researchers are now more likely to use contribution author order.

When two co-authors have contributed equally, they are not always listed alphabetically. Instead, other personal factors intervene, such as how important the publication is for the individual researcher's career.

Furthermore, the trend of increasing number of authors and co-authorship means that the visibility of the individual is diminished. First-authorship is an effective method to distinguish one-self from the others in a co-authorship group. The pressure from the publish-or-perish culture may decrease the tendency to apply alphabetic authorship in political science, while the strong tradition for alphabetic authorship in economics may uphold status quo.

Both Chapter 6 and 7 demonstrate how the publish-or-perish culture affects researchers, and sometimes it seems that there is greater emphasis on publishing than on actual research. The need to publish and get funding seems to be guiding what kind of research is executed instead of where the researchers see issues or knowledge gaps. Similar concern was expressed by the senior interviewees, who observed that researchers are collaborating more, but it might be out of necessity instead of inclination. Furthermore, the tendency towards larger research projects might diminish the individual's freedom to pursue own research interests and influence researchers to only conduct research in publishable or fundable areas.

None of the research questions or Chapter 4-7 directly address the issues of bibliometric-based performance evaluations (Hammarfelt & de Rijcke, 2015; Rijcke, Wouters, Rushforth, Franssen, & Hammarfelt, 2015). Furthermore, it can be difficult to distinguish the influence of the publish-or-perish culture from the tendency to apply systematic bibliometric-based performance evaluations on the researchers (Bloch & Schneider, 2016; Aagaard, 2015). It was apparent during the interviews that the researchers were aware of the need to publish and publish in "better" journals. Both departments have an official publisher ranking to guide the researchers.

The economics department applies the Academic Journal Guide (CABS, 2015) with five levels. It is a part of their recruitment and promotion policy, which states that in tenure decisions the main research assessment has to be based on articles published in journals at level 3, 4 or 4*, while assessments of candidates for full professorships are primarily based on articles published in level 4 or 4*. Hence, the junior economists emphasized that it was important to focus one's publishing according to the list.

Similarly, the political science department uses its own list based on the Danish Bibliometric Research Indicator publishing list, which currently has two levels, and the department has added a third level consisting of 32 journals. If the researchers publish in one of these 32 journals, they receive a personal bonus. Furthermore, job adverts for permanent positions at the department put great emphasis on published journal articles in an even narrower

range of journals. A book published with an internationally recognized publisher also carries weight, but the interviewed political scientists emphasized that journal articles are the most important publication type if one wants to pursue a career in academia, since books take too long to write, and book chapters are not as prestigious. The economists focused exclusively on journal articles since other types of publications are not prestigious. It was apparent, that all interviewees are embedded in a culture with a clear focus on publishing (or perishing).

Discussion

This dissertation began by stating that it is necessary to gain a better understanding of the extent to which social scientists co-author, what co-authorship entails, the relationship between research collaboration and co-authorship, and why researchers collaborate and co-author. This section discusses whether the dissertation has succeeded, the implications of the findings, and it suggests future research to gain further knowledge about research collaboration and co-authorship in the social sciences.

First, based on all the studies in the dissertation, it is apparent that there is a general trend towards collaborating and co-authoring, and the trend is increasing in the social sciences. The first study in Chapter 4 demonstrates an increase in co-authored articles, but the dissertation does not show whether this is also the case for monographs and book chapters. Furthermore, as discussed in the section "social science publishing", the focus on WoS articles excludes most non-English articles. Therefore, it could be interesting to include national articles, book chapters and monographs in the sample and examine to what extent co-authorship has risen and whether these publication types really are more single authored. Especially since most of the interviewed political scientists had published articles, book chapters and books, and most were written in collaboration with other researchers. However, the economists mainly publish international English articles, so it will perhaps not affect the results much in this area.

The other three studies reveal a variety of reasons economists and political scientists collaborate and co-author more. The study in Chapter 5 shows that empirical quantitative research is more co-authored, and this confirms to some extent the labour division hypothesis demonstrated in multiple studies (e.g. Polyakov et al., 2016; Rutledge, Karim, & Reinstein, 2011; Traore & Landry, 1997). Likewise, as Chapter 6 shows, several interviewees state that research has become more methodologically complex, and they experience that the bar for what can be published has been raised during this develop-

ment. Thus, it requires a broader set of methodological skills, which are difficult for one person to acquire. If researchers co-author, they can divide tasks among them and do not need to spend time learning new skills. These statements fit very well with the findings in Chapter 5 and show that working in a team-production model is not exclusive to the physical and life sciences.

Furthermore, it seems that social scientists, like physical and life scientists, to a larger degree divide tasks according to rank. Typically, junior researchers execute the main tasks of data sampling and analysis, while the senior researchers provide the overall knowledge and insights. As cases of research misconduct have shown, this division of labour may be problematic as it sometimes means that only one person handles the data. One example is the case of the political science graduate student who falsified all data (Phillips, 2015). In other words, problems with misconduct and lack of insights into the research of publications are no longer just occurring in the physical and life sciences.

However, there are still no specific authorship criteria for political science or the social sciences. Perhaps because the case is seen as an isolated incident or because social scientists will not acknowledge that a systematic problem could be emerging. The social sciences need to define specific co-authorship criteria; as authorship becomes larger, the likelihood of such incidents seems to grow too (Jones, 2003; Pritychenko, 2016; Woolley et al., 2011). Although it is impossible to prevent all misconduct, more clarification and transparency would make it clearer who is responsible for what in collaborative research publications.

According to the interviewees, a positive aspect of the increasing tendency to engage in mentor-mentee collaborations is that it provides the junior researchers with better training and introduction to research and publishing, while the senior researchers benefits from the junior researchers' recent training in new methods. However, some interviewees pointed out that it is problematic if supervisors expect co-authorship for doing their job. Most interviewees abide by the norm that supervisors are not automatically co-authors, and some find that a supervisor has to contribute extra to be co-author. However, none of the interviewees were able to set the bar for what is a sufficient contribution to become co-author. The junior researchers expressed that co-authoring with a senior researcher gave them more feedback than if they work alone. Thus, co-authoring seems beneficial for most researchers.

The interviews reveal how pervasive and influential the publish-or-perish culture is. So yes, researchers collaborate to share tasks and exchange knowledge, but they also do it to optimize their time, as they do not need spend time learning a broad variety of skills. They can specialize in one area and pay others or get reimbursed with the coin of co-authorship. Instead of publishing

one article, they can be a fractional part of multiple publications, which boosts their publication list. Younger researchers describe this approach to research as the method to survive in academia. The disproportion between PhD and postdoc positions compared to tenure positions has raised the bar for what are the sufficient the number and quality of publications to gain advancement (Hirslund, 2017; *Videnskabeligt personale på universiteterne*, 2016). The pressure to publish seems to be constantly increasing and at a faster pace. Researchers with approximately 10 years' experience describe how the bar is constantly moving.

The need to engage in collaboration to stay in academia is also found in studies of the life sciences (Fochler et al., 2016; Müller, 2012) that demonstrate how postdocs try to be part of many projects to expand their publication list, while trying to secure that the authorship credit on their own project does not diminish. Hence, researchers try to optimize their research and collaboration behaviour according to how they can maintain or create a career in academia.

Several studies show that the increasing use of bibliometric-based research performance assessment influences researchers' behaviour (e.g. Butler, 2005; Hammarfelt & de Rijcke, 2015; Müller & de Rijcke, 2017). After the introduction of a performance-based research evaluation system in Sweden, researchers in the humanities started to publish more in English and in journals. Furthermore, researchers' selection of publishing channels is largely based on what provides the best bibliometric "score" (Hammarfelt & de Rijcke, 2015).

Butler (2003b) demonstrates that researchers start to focus on the lowest denominator in their publication practice when they are rewarded based on how much instead of where they publish. Thus, the quantitative output becomes more important than the quality of this output. Other studies show that performance metrics influence how researchers perceive and talk about "quality" (Degn et al., 2017; Müller & de Rijcke, 2017). Rushforth and de Rijcke (2015) show that researchers use the impact factor as a reference point for quality. They present numerous statements where researchers talk about the results of research simultaneous with the impact factor of the journal in which it is published.

The interviews presented in Chapter 6 and 7 tell a similar story. The interviewees frequently talk about how to get their articles in better journals, often followed by a reference to a journal ranking. Even though Chapter 6 and 7 do not directly address this, the bibliometric-based performance indicators are frequently referred to in the interviews, and all researchers orient themselves towards the official lists of their field or department. There is not a direct link between the usage of bibliometric-based performance assessment and in-

creasing tendency to collaborate or co-author. Nevertheless, during the interviews it was clear that many researchers saw research collaboration as synonymous with co-authorship and as a method to increase their publication productivity and get "further" in their research.

Still, many researchers also express that research collaboration makes their work more enjoyable, because it increases the possibility of social interaction with colleagues. Some of the senior researchers are part of long-standing collaborations, and they see it as a way of maintaining friendship and a collegial network. Liberman and Olmedo (2017) find that friendship are one of the main words express by physicists, mathematicians and chemists about co-authorship. This also explains why many researchers co-author numerous times with the same researchers (Metz & Jäckle, 2017).

Overall, it is evident that multiple kinds of research collaborations lead to co-authorship, which makes it difficult to define a clear criterion for who should be named co-author. The most common criterion is that being a writer equals being an author, but there are exceptions. It is difficult to assess whether the value and notion of co-authorship have changed over time. Both the senior economists and political scientists put great emphasis on single authoring, since it is necessary for researchers to prove they can publish and do research alone. They prefer alphabetic author order, since it ideally prevents adding more co-authors than those who have substantially contributed. One could argue that the decline in alphabetic authorship, which occurs when the number of authors rises, reflects a decline in equal and substantial contribution. However, the dissertation did not succeed in clarifying what a substantial contribution is, but it seems that fractional contributions to publications have become more acceptable.

The dissertation may have benefitted from more interviews with senior researchers, which perhaps could have provided more insights to changes in research collaboration and co-authorship. However, the interviewed senior researchers did state that the main changes were increased co-authoring, publishing and internationalization. They emphasize that researchers do not always want to collaborate but are forced by structural changes.

The structural changes in research funding systems have concentrated most funding in larger project grants and centres and reduced individual and smaller grants (Bloch & Sorensen, 2015). This makes it more difficult for younger unestablished individuals to receive funding and concentrates funding in a smaller group of researchers (Bloch & Sorensen, 2015). This tendency also decreases the possibilities for social scientists to pursue own research interests or go against the existing paradigm. In contemporary social sciences, the increase in large research projects means that junior researchers to a

greater degree are labour on existing projects with less possibility of creating their own projects or pursuing their own ideas.

It also reduces loneliness among researchers, as social science research to a larger degree becomes a collaborative effort. Furthermore, the greater awareness and possibility of collaboration could make new research projects emerge which would otherwise not be possible. Research collaborations may also occur because certain expertise is needed. This also makes research more fractionalized, since researchers to a greater degree specialize in certain areas and/or methods and provide a fractional input to a publication. Especially publications with three or more authors seem to imply more division of labour. Several studies claim that the growth in authorships and unique authors is larger than the growth in publications (e.g. McKercher & Tung, 2016; Plume & van Weijen, 2014). The overall number of publications does not increase even though the individual researchers' publication list becomes longer. Hence, fractionalized authorship is rising.

This dissertation shows that there are many aspects of research collaboration and co-authorship in social sciences, and especially in economics and political sciences. First, it confirms the suggestions from numerous studies that there is a greater tendency to co-author articles in the social sciences. Second, it demonstrates that empirical quantitative articles using surveys often are more co-authored than theoretical or qualitative articles. However, it also shows that if one looks at increases in co-authorship over time in relation to methodological approaches, something more than the application of certain research methods is influencing the co-authorship trend.

The interviews show that pressures for career advancement and improving bibliometric scores lead to greater collaboration and co-authorship. However, they also show efforts to uphold the value of authorship, for example through requiring contribution to writing and emphasis on single authorship. In addition, there appears to be efforts to preserve co-authorship norms such as alphabetic author order for small numbers of authors. It will be interesting to see whether these balancing forces are still present if the trend of increasing co-authorship continues. Further increases in numbers of co-authors may reach a tipping point where researchers are less likely to adhere to earlier norms and criteria for co-authorship.

Furthermore, the interviews show that co-authorship can be the result of multiple kinds of research collaborations, and that who is included as author or acknowledged is a result of epistemic and local norms. The findings in this dissertation show that it can be difficult to interpret researchers' contributions based on only the publication, since it is multiple kinds of research collaborations and contributions that result in co-authored publications. This also means that a discussion of co-authorship criteria is needed in economics and

political sciences, since currently none exists, so researchers apply the norms of their research group and/or colleagues. Thus, beyond writing is it unclear what kind of contributions qualify for co-authorship and whether it is good conduct to acknowledge others' contributions. Moreover, the current structure in research funding and performance evaluation should be reviewed since it seems to have moved the main focus from research to publishing.

Finally, it would be interesting to examine who is not included as co-authors and why on a research project, as well as the different norms for acknowledging other researchers' contributions to a work. This would be a further exploration of researchers' socio-cognitive network. The dissertation has only explored a very narrow part of the social sciences, and further studies are needed to examine the extent to which and why social scientists collaborate and co-author.

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English Summary

Over the last century, research has changed from being the endeavour of a lone scholar to a collaborative effort. The development from "small science" to "big science" started around the Second World War, as research began to require substantial resources, such as manpower, equipment and funding and manifested itself in larger research projects and greater tendency to co-author.

The execution of these projects created an interdependence among researchers, since they required both theoretical, technical as well as administrative knowledge to succeed. These changes have also changed the notion of co-authoring as reflected in increases in average number of authors. The collaborative authorship trend started in the physical sciences, then emerged in the life sciences, and is now a phenomenon in most social sciences, as this dissertation demonstrates.

Motivated by the observed changes in co-authorship in the social sciences, this dissertation sets out to provide more insights into the evolution of research collaboration and co-authorship in the social sciences and the factors that shape when and how collaboration and/or co-authorship occurs. It focuses on the extent to which social scientists co-author, what co-authorship entails, the relationship between research collaboration and co-authorship, and why researchers collaborate and co-author. Furthermore, it explores the extent to which bibliometric performance evaluations and the publish-or-perish culture influence social scientists' research, publishing and collaboration behaviour.

The dissertation uses a mixed method approach to explore the various aspects of research collaboration and co-authorship in the social sciences. It uses quantitative analysis to demonstrate the extent to which and how co-authorship is increasing and qualitative analysis to examine why it is increasing. The first study in the dissertation uses macro-level bibliometric data to demonstrate how co-authorship is rising in almost all parts of the social sciences, and it shows that the greatest increases occur in disciplines where research is based on experiments, large data sets, statistical methods and/or team production models.

This is followed up by a content analysis study of how methodological approaches can influence co-authorship patterns in economics and political sciences. The study shows that empirical quantitative research is more co-authored. However, over time it is evident that the rises in co-authorship are also occurring in qualitative and theoretical research. This suggests that it may be the behaviour of the researchers that is changing.

Researchers' collaboration and co-authoring behaviour is explored in the in-depth interview study, which explores economists' and political scientists' motivation for and practices of collaborating and co-authoring. It shows that researchers have both epistemic, pragmatic and personal reasons for collaborating and co-authoring. The analysis reveals four motivations for collaborating and three motivations for co-authoring, though the distinction is to some extent of an analytical character, since the motivations a large degree overlap.

First, the researchers collaborate because unifying different expertise facilitates knowledge exchange and improves and enables research. Second, they collaborate because offers better possibilities for discussions and scrutinizing of the research, which creates synergy among the collaborators. Third, it creates a setting for socializing, which makes the workday more enjoyable, since the research process in social sciences otherwise can be a lonely endeavour. Fourth, it enhances the possibility to publish more by co-authoring. The fourth motivation for collaborating is similar to the motivations for co-authoring, i.e., career, optimizing number of publications and publish-or-perish. These three motivations highlight the great pressure many of the researchers feel to publish more and in "better" journals if they want to have a career in academia. The interviews illustrate that the researchers feel that the pressure to publish is increasing exponentially.

Finally, the fourth study examines the influence of publish-or-perish and co-authoring on the author order norms in Danish economics and political science. It shows that the intellectual and social organization of the disciplines is significant in explaining why political science seems to be changing norms from alphabetic author order to contribution author order, while economics seems to uphold alphabetic author order, at least for less than four authors.

To conclude, the dissertation shows that there is an increasing tendency to co-author in the social sciences. In economics and political sciences, the tendency to collaborate and co-author is greater than previously. In those disciplines, co-authorship can be the result of multiple kinds of research collaborations, so who is named author is a result of epistemic and local norms. Who is acknowledged differs between the disciplines. Studies of "sub-authorship" should consider this, since the extent to which others' contributions are formally recognized seems to depend on the discipline.

Furthermore, the publish-or-perish culture is very influential on how researchers practice and perceive co-authoring and collaboration. Researchers have great focus on publishing because it is the only thing that matters, according to them, in performance evaluations. This means that they have to be time efficient and optimize their publication production. The best method to do so it through co-authorship and many of the interviewees consider co-authorship the best way to repay taking another person's time.

This emphasis on co-authoring and publishing can mean that researchers choose to focus their research on what is publishable and fundable. This trend is intensified by the structural changes in research funding systems, which concentrate most funding in larger projects and centres and reduce individual and smaller grants. This implies that researchers collaborate and co-author because they have to in terms of resources and not because the research demands it.

Finally, the dissertation shows why one should be careful with using both co-authorship and acknowledgement as measurement of research collaboration, since there are still many "invisible" colleagues in the social sciences. Furthermore, it shows how widespread the publish-or-perish culture is and how bibliometric-based performance evaluations seem to enhance its spreading.

Dansk resumé

I løbet af det sidste århundrede har forskning ændret sig fra at blive skabt af en enkelt forsker til at være resultatet af et større forskningssamarbejde. Det startede i perioden omkring anden verdenskrig, hvor forskning begyndte at kræve substantielle ressourcer i form af arbejdskraft, udstyr og finansiering. Denne udvikling afspejles i den øgede tendens til større forskningsprojekter og medforfattede publikationer og betegnes ofte som en ændring fra de små videnskaber til de store videnskaber.

Udførelsen af større forskningsprojekter har skabt en indbyrdes afhængighed mellem forskerne, da de ofte kræver teoretiske, tekniske og administrative kompetencer for at lykkes. Denne udvikling har både ændret, hvordan forskning bliver udført, og hvordan medforfatterskab bliver opfattet, hvilket afspejles i den øgede tendens til at medforfatte. Tendensen til at medforfatte i større grupper brød først frem i naturvidenskab, dernæst i sundhedsvidenskab og nu også inden for samfundsvidenskab, hvilket denne afhandling vil vise.

Afhandlingen er motiveret af ændringer i samfundsvidenskabelig medforfatterskab og vil demonstrere hvordan både medforfatterskaberskab og forskningssamarbejde har udviklet sig, samt hvilke faktorer har indvirkning på, at medforfatterskab og forskningssamarbejde opstår. Afhandlingen fokuserer på, hvor meget samfundsvidenskabelige forskere engagerer sig i medforfatterskab, hvad det indebærer at være medforfatter, linket mellem forskningssamarbejde og medforfatterskab, og hvorfor samfundsvidenskabelige forskere samarbejder og medforfatter. Derudover udforsker afhandlingen indvirkningen af bibliometriske forskningsevalueringer og publicer-eller-forsvind-kulturen på forskernes forsknings-, publicerings- og samarbejdsadfærd.

De forskellige aspekter af forskningssamarbejde og medforfatterskab er udforsket ved hjælp af mixed method. Det betyder, at afhandlingen bruger kvantitative analyser til at undersøge, hvor meget og hvordan medforfatterskab forøges, og kvalitative analyser til at undersøge, hvorfor det forøges. Det første studie i afhandlingen bruger makro-level bibliometrisk data til at vise, at medforfatterskab er stigende i de fleste samfundsvidenskabelige discipliner, især i de discipliner hvor størstedelen af forskningen er baseret på eksperimenter, store datasæt, statistiske analyser og/eller en arbejdsdelingsmodel.

Det efterfølgende studie bruger indholdsanalyse til at undersøge, hvordan metodiske tilgange kan påvirke tendensen til at medforfatte inden for økonomi og statskundskab. Studiet viser, at artikler med empirisk kvantitativ forskning generelt er mere medforfattede, men det viser også, at tendensen til

at medforfatte er stigende over tid inden for alle områder. Det betyder formodentlig, at stigningen i medforfatterskab skyldes en ændring i forskernes adfærd.

Forskernes samarbejds- og medforfatteradfærd udforskes ved hjælp af dybdegående interviews med økonomer og statskundskabere, som udforsker deres motivationer og erfaringer med at samarbejde og medforfatte. Det kvalitative studie viser, at forskerne har epistemiske, pragmatiske og personlige grunde til at samarbejde og medforfatte. Disse grunde opdeles i analysen i fire motivationer for at samarbejde og tre motivationer for at medforfatte. Opdelingen er i høj grad af analytisk karakter, da der er en del overlap.

Den første motivation for at samarbejde er ekspertise. Økonomer og statskundskabere samarbejder, fordi det faciliteter vidensdeling, som forbedrer og muliggør forskning. Den næste motivation er synergi mellem samarbejdspartnere, baseret på at samarbejde skaber en ramme, hvor forskerne har bedre mulighed for at diskutere og gennemgå forskningsresultater og idéer, hvilket forbedrer det endelig produkt. Den tredje motivation er muligheden for at socialisere, som gør arbejde mere hyggeligt og formindsker den ensomhed, nogle samfundsvidenskabelige forskere oplever. Den fjerde motivation er muligheden for at medforfatte og derved publicere mere. Denne motivation er meget lig de tre motivationer for at medforfatte, som er karriere, optimering af antallet af publikationer og publicer-eller-forsvind. Disse tre motivationer understreger det store pres, forskerne føler, der er for at publicere mere og i bedre tidsskrifter, hvis de ønsker en karriere i forskningsverdenen. Interviewene illustrerer, at dette pres føles som eksponentiel stigende.

Det sidste studie i afhandlingen undersøger, hvordan publicer-eller-forsvind-kulturen og medforfatterskabstendensen påvirker forfatterskabsordenen i dansk økonomi og statskundskab. Det viser, at den intellektuelle og social organisering af disciplinerne har betydning for, hvor stærke normer der er for alfabetisk forfatterskab. Det tyder på, at statskundskab er mere opdelt i sub-grupper, og der er ikke en stærk kerne til at sætte rammerne for feltets organisering. Derved er der ikke stærk enighed om en norm for forfatterskabsorden, og det tyder på, at der er sket et generationsskifte. Seniorforskerne er mere tilbøjelige til at bruge alfabetisk orden, mens juniorforskerne er mere tilbøjelige til at bruge bidragsforfatterskabsorden. I økonomi er der en stærk organisering af feltet og bred enighed om, at alfabetisk forfatterskabsorden er den rigtige måde at gøre det, så længe antallet af forfattere af en artikel er mindre end fire.

Overordnet kan afhandlingen konkludere, at der er en stigende tendens til at medforfatte i samfundsvidenskaberne. I økonomi og statskundskab kan medforfatterskab være et resultat af forskellige typer forskningssamarbejder. Derudover har epistemiske og lokale normer indvirkning på om folks bidrag

giver medforfatterskab, formel anerkendelse eller ingenting. Interviewene viser at graden af formel anerkendelse varierer meget imellem disciplinerne, og det bør tages med i overvejelserne i "sub-forfatterskabsstudier".

Derudover viser afhandlingen at publicer-eller-forsvind-kulturen har stor indflydelse på, hvordan forskerne praktiserer og opfatter medforfatterskab og samarbejde. Forskerne har stor fokus på publicering, fordi det ifølge dem er det eneste som har betydning i forskningsevalueringer. Derfor fokuserer de på, hvordan de kan effektivisere deres tid og arbejdsindsats i forhold til at optimere antallet af publikationer. Ifølge forskerne er medforfatterskab den bedste metode, og en del af dem anser også medforfatterskab som den bedste måde at gengælde for at tage kollegaers tid.

Denne vægt på medforfatterskab og publicering kan også betyde, at forskere fokuserer deres forskning på, hvad der er publicerbart og finansieringsmuligt. Denne trend er muligvis intensiveret med de strukturelle ændringer i forskningsfinansieringssystemet. Forskningsstøtte er blevet samlet i større bevillinger til store forskningsprojekter og centre, og mulighederne for at søge om mindre og individuelle bevillinger er blevet mindre. Dette medfører, at forskerne samarbejder og medforfatter, fordi de er nødt til det ressourcemæssigt, og ikke fordi forskningen i sig selv kræver det.

Endelig viser afhandlingen, hvorfor man skal være forsigtig med at bruge medforfatterskab og anerkendelse som indikator for forskningssamarbejde, da der stadigvæk er mange "usynlige" kollegaer i samfundsvidenskaberne. Den viser, hvor udbredt publicer-eller-forsvind-kulturen er, og hvordan bibliometrisk baserede forskningsevalueringer gør den endnu mere udbredt.

Appendix

Coverage of SSCI subject categories

SSCI subject categories	1980	1990	2000	2016	Index change
Anthropology	25.8 %	32.6 %	33.4 %	44.1 %	170.8083
Area Studies	10.8 %	13.9 %	12.4 %	22.2 %	205.471
Business	18.3 %	43.7 %	50.8 %	64.2 %	350.3497
Business, Finance	30.6 %	50.8 %	53.7 %	66.2 %	216.4985
Communication	22.5 %	34.3 %	34.7 %	43.2 %	191.7616
Criminology & Penology	23.0 %	28.4 %	34.7 %	51.6 %	223.9059
Cultural Studies	44.4 %	17.5 %	11.4 %	19.9 %	44.71196
Demography	25.1 %	34.1 %	38.0 %	53.2 %	212.1006
Economics	31.0 %	40.9 %	45.3 %	59.3 %	191.1591
Education & Educational Research	21.8 %	28.2 %	29.3 %	42.6 %	195.6901
Education, Special	37.6 %	47.0 %	47.4 %	64.1 %	170.5334
Environmental Studies	24.0 %	28.3 %	28.8 %	53.1 %	221.028
Ergonomics	45.3 %	34.0 %	36.1 %	56.4 %	124.5327
Ethics	27.9 %	35.0 %	38.5 %	50.5 %	181.1902
Ethnic Studies	10.9 %	20.1 %	20.2 %	41.4 %	379.1468
Family Studies	34.8 %	46.8 %	48.7 %	63.4 %	182.4179
Geography	43.9 %	27.7 %	29.2 %	46.4 %	105.6166
Gerontology	51.9 %	60.9 %	66.8 %	74.7 %	143.8979
Health Policy & Services	21.7 %	47.2 %	57.8 %	66.3 %	305.3671
History	12.1 %	13.3 %	11.7 %	12.3 %	101.9981
History & Philosophy of Science	46.2 %	30.1 %	25.0 %	36.8 %	79.63052
History of Social Sciences	19.6 %	24.5 %	20.8 %	25.6 %	130.1317
Hospitality, Leisure, Sport & Tourism	64.3 %	38.0 %	39.4 %	50.3 %	78.2415
Industrial Relations & Labour	15.4 %	31.1 %	31.3 %	50.3 %	326.1064
Information Science & Library Science	24.1 %	33.2 %	38.0 %	53.1 %	220.2777
International Relations	10.5 %	16.6 %	19.8 %	34.3 %	326.5429
Law	18.7 %	25.5 %	24.7 %	25.9 %	138.2932
Linguistics	40.7 %	31.9 %	40.3 %	39.2 %	96.35362
Management	26.7 %	46.0 %	46.0 %	64.2 %	240.1535
Nursing	39.5 %	43.4 %	45.2 %	63.3 %	160.1707
Planning & Development	9.4 %	20.2 %	23.9 %	46.9 %	497.0667
Political Science	11.5 %	20.8 %	24.0 %	38.0 %	329.6296
Psychiatry	60.1 %	71.0 %	76.3 %	81.8 %	136.0911
Psychology, Applied	35.8 %	51.3 %	53.2 %	68.0 %	189.9605
Psychology, Biological	57.6 %	71.6 %	80.4 %	84.9 %	147.49
Psychology, Clinical	44.1 %	58.4 %	62.6 %	73.1 %	165.7242
Psychology, Developmental	43.8 %	58.7 %	61.9 %	74.8 %	170.6371
Psychology, Educational	30.8 %	46.5 %	47.6 %	60.9 %	197.9151
Psychology, Mathematical	61.1 %	56.9 %	60.2 %	74.0 %	121.1673
Psychology, Multidisciplinary	52.4 %	58.1 %	62.4 %	74.3 %	141.9544
Psychology, Psychoanalysis	57.0 %	38.4 %	43.4 %	44.4 %	78.00082

Psychology, Social	34.8 %	55.1 %	57.7 %	71.2 %	204.7754
Psychology, Experimental	58.3 %	59.6 %	69.3 %	77.1 %	132.2093
Public administration	15.7 %	24.3 %	22.4 %	46.4 %	295.6912
Public Environmental & Occupational Health	63.1 %	62.1 %	66.1 %	71.2 %	112.8747
Rehabilitation	25.0 %	51.2 %	58.9 %	73.1 %	292.1331
Social Issues	21.7 %	26.8 %	27.7 %	44.1 %	202.9698
Social Sciences, Biomedical	36.5 %	41.8 %	47.4 %	64.2 %	175.8643
Social Sciences, Interdisciplinary	20.4 %	29.8 %	31.0 %	48.9 %	240.1838
Social Sciences, Mathematical Methods	59.0 %	52.8 %	54.1 %	65.1 %	110.3269
Social Work	27.3 %	40.1 %	39.4 %	53.0 %	193.9567
Sociology	26.9 %	31.8 %	30.7 %	43.4 %	161.5427
Substance Abuse	58.3 %	65.7 %	71.4 %	76.1 %	130.5972
Transportation	41.9 %	32.8 %	36.5 %	56.9 %	135.6675
Urban Studies	15.5 %	24.3 %	27.1 %	46.7 %	300.9557
Women's Studies	25.8 %	37.1 %	38.8 %	46.6 %	180.6643

Danish & International coverage

	Economics		International Relations		Political Science		Public Administration	
	International	Danish	Interna-tional	Danish	Interna-tional	Danish	Interna-tional	Danish
1980	31 %	19 %	11 %	10 %	12 %	19 %	16 %	Missing
1981	29 %	31 %	12 %	0 %	15 %	37 %	17 %	Missing
1982	30 %	36 %	14 %	17 %	15 %	24 %	19 %	Missing
1983	34 %	37 %	13 %	33 %	18 %	15 %	22 %	Missing
1984	35 %	35 %	15 %	Missing	18 %	30 %	21 %	Missing
1985	37 %	33 %	14 %	20 %	18 %	20 %	20 %	Missing
1986	38 %	40 %	14 %	13 %	19 %	15 %	24 %	Missing
1987	39 %	39 %	15 %	4 %	19 %	13 %	25 %	Missing
1988	41 %	33 %	16 %	14 %	20 %	16 %	24 %	Missing
1989	41 %	40 %	16 %	4 %	21 %	22 %	25 %	9 %
1990	41 %	34 %	17 %	79 %	21 %	17 %	24 %	11 %
1991	42 %	30 %	18 %	13 %	21 %	15 %	24 %	12 %
1992	42 %	33 %	19 %	27 %	22 %	30 %	25 %	Missing
1993	43 %	41 %	21 %	6 %	22 %	11 %	24 %	22 %
1994	42 %	40 %	20 %	30 %	22 %	25 %	25 %	Missing
1995	42 %	39 %	19 %	14 %	22 %	23 %	24 %	6 %
1996	44 %	34 %	20 %	14 %	22 %	15 %	22 %	10 %
1997	43 %	38 %	20 %	31 %	22 %	16 %	21 %	12 %
1998	44 %	43 %	20 %	27 %	23 %	17 %	23 %	16 %
1999	45 %	41 %	21 %	18 %	24 %	21 %	23 %	12 %
2000	45 %	41 %	20 %	19 %	24 %	21 %	22 %	13 %
2001	47 %	47 %	21 %	26 %	25 %	17 %	24 %	12 %
2002	47 %	48 %	21 %	28 %	25 %	19 %	24 %	21 %
2003	48 %	46 %	22 %	18 %	26 %	24 %	26 %	22 %
2004	50 %	48 %	22 %	17 %	26 %	19 %	26 %	18 %
2005	49 %	51 %	23 %	21 %	27 %	27 %	27 %	30 %
2006	50 %	48 %	25 %	29 %	29 %	28 %	29 %	18 %
2007	49 %	47 %	24 %	24 %	29 %	28 %	29 %	25 %
2008	50 %	51 %	25 %	26 %	29 %	32 %	32 %	30 %
2009	52 %	53 %	25 %	26 %	29 %	31 %	32 %	31 %
2010	52 %	58 %	27 %	29 %	31 %	33 %	34 %	33 %
2011	54 %	57 %	26 %	34 %	32 %	36 %	36 %	39 %
2012	54 %	60 %	29 %	37 %	33 %	40 %	37 %	38 %
2013	56 %	61 %	30 %	39 %	34 %	43 %	40 %	43 %
2014	57 %	59 %	32 %	33 %	36 %	43 %	42 %	47 %
2015	59 %	59 %	34 %	35 %	38 %	45 %	44 %	51 %
2016	59 %	62 %	34 %	38 %	38 %	50 %	46 %	53 %

Invitation templet

Dear junior researcher

I'm doing the final study on my PhD project with a special focus on Political Science and Economics. The aim of the study is to investigate several aspects of research collaboration and how the culture and environment of your research field influence how and whether you cooperate.

The few existing qualitative studies have been carried out within the physical or life sciences, and my study aims at uncovering the degree of collaboration within social sciences. Therefore, I would like to do an interview with you to gain an insight into how much you collaborate and how you collaborate within Political Science/Economics from a junior researcher's perspective.

I am open for your suggestions about time and place for the interview. I propose that we meet at your office, unless you prefer to meet somewhere else.

Information about the interview

All interviews will be anonymized, and if you wish you may be informed about the ID number, which will be used in the final reporting. In general, the interviews will be recorded on a dictaphone to ensure all details.

The interview will begin by a word association checkup, which means that you will be given a stimulus word and asked to state ten associative words.

This will be followed by questions regarding how you collaborate with other researchers during your working day, and questions about the collaboration process in relation to one of your own co-authoring publications. I would like to ask you to bring one of your own publications, which is ideally submitted or going through the peer review process. This is to get an insight into a recent collaboration.

Finally, there will be some questions about different types of collaboration.

I hope you have the time and wish to participate in the survey. Please feel free to contact me, if you have any questions and if you need more information before you agree to participate.

Kind regards

Dorte Henriksen, PhD Fellow

Dear senior researcher

I'm doing the final study on my PhD project with a special focus on Political Science and Economics. The aim of the study is to investigate several aspects of research collaboration and how the culture and environment of your research field influence how and whether you collaborate.

The few existing qualitative studies have been carried out within the physical or life sciences, and my study aims at uncovering the degree of collaboration within social sciences. Therefore, I would like to do an interview with you to gain an insight into how much you collaborate and how you collaborate, and how it has changed over time within Political Science/Economics. Your knowledge about how Economics/Political Science has evolved regarding research, publication and conducting research will be of great value to my study.

I am open for your suggestions about time and place for the interview. I propose that we meet at your office, unless you prefer to meet somewhere else.

Information about the interview

All interviews will be anonymized, and if you wish you may be informed about the ID number, which will be used in the final reporting. In general, the interviews will be recorded on a dictaphone to ensure all details. I expect the interview to last about one hour.

The interview will begin by a word association checkup, which means that you will be given a stimulus word and asked to state ten associative words.

This will be followed by questions regarding how you collaborate with other researchers during your working day, and questions about the collaboration process in relation to one of your own co-authoring publications. I would like to ask you to bring one of your own publications, which is ideally submitted or going through the peer review process. This is to get an insight into a recent collaboration.

Finally, there will be some questions about different types of collaboration.

I hope you have the time and wish to participate in the survey. Please feel free to contact me, if you have any questions and if you need more information before you agree to participate.

Kind regards

Dorte Henriksen, PhD Fellow

Interview guide

Introduction to interviewees:
The purpose of this study is to examine different aspects of research collaboration and how specific research fields, cultures and environments affect how and whether researchers collaborate. Earlier studies have been conducted within natural sciences or health sciences. This study focuses on collaboration within the social sciences. All interviews will be anonymized, and if you wish, we will give the ID number that will be used in the report. The interviews will, as a rule, be recorded to capture all details.

Warm-up:
Fill out the form.
Word association, stimulus word "research collaboration", mention max. 10 words, following by ranking.

Questions about their own publications (one or two co-authored, one single-authored):

a. Idea.
b. Who was involved in the idea process? How did you meet them? Was someone not listed as author involved in some the previous phases (group meetings, coffee chat, etc.)?
c. How would you describe the research process? Did you discuss which methods to use? How were tasks concerning data collection, analyses and writing divided between you? How did the individual co-authors contribute to the different parts of the process? Was the research process divided or integrated?
d. When was it decided to publish and in which publication channel? Is it part of a larger research project, and what other publications are there from this project?
e. Was it clear from the start who would be among the co-authors, and what was the order of author names? Do you use the same model each time (alphabetical or by contribution)?
f. How had the persons in the acknowledgement contributed to the publication? Was there any doubt about whether they should have been listed as co-authors instead? (This is, of course, only relevant for publications with acknowledgements).
g. How does the research process distinguish itself in terms of making a single-authored publication? What are the different types of research?

h. Did you interact with anyone in connection with the single-authored publication? Did you receive any help and sparring in terms of idea, design, data collection, analyses, literature?

Questions about collaboration and co-author tendencies:

- Do you prefer to work alone or with others? Does the type of research affect whether you work in a group or alone? In your opinion, what are the advantages of working with other researchers? What are the advantages of working alone?
- Do you have one or more primary collaborators? How did you meet them? How do you meet new collaborators?
  (Inspiration for possible collaborator types)
  - Mentor-mentee
  - Colleagues
  - Project partners
  - International partners
  - Network
  - Conferences
- How many of these collaborators are also co-authors on publications? Is there someone you collaborate and interact with but do not publish with?
- How important is personal communication in terms of communicating via e-mail, Skype/Messenger/Facetime or telephone? Are some types of research or projects more suitable for long-distance collaboration? (divided work, integrated research project, synergy).

Questions about contributions and authorship:

I. When and how is it decided to contribute to a publication?

II. Which of the following contributions are required to be a co-author?
   a. Idea
   b. Study design
   c. Contribute data
   d. Gather data (interview, survey, etc.)
   e. Prepare data (transcription, download from databases, etc.)
   f. Analyze data
   g. Literature review
   h. Write
   i. Read through and comment

III. Which tasks are most important in terms of co-authorship?

IV. Would you expect everybody to be involved in all tasks? To what extent is it necessary to have knowledge about all aspects of research in an article?

Case 1:
PI has contributed with idea development and input to study design of the research project but after that not involvement beyond reading through and commenting on publications. Do you think PI should be listed as co-author or be mentioned in the acknowledgements?

Case 2:
The research project is past the idea process, design, data collection for a publications but needs assistance with statistical analyses. A statistician is found who can make the models and explain the analyses to the publication's authors but does not contribute to the rest of the research and publication process. Do you think the statistician should be listed as co-author or be mentioned in the acknowledgements?

Case 3:
A PhD student has to conduct a study as part of the PhD project. The PhD student has thought of an idea, but the idea and the research design has been developed in consultation with the supervisors. In addition, the supervisors have read and commented on the publication. Do you think that the supervisors should be listed as co-authors or be mentioned in the acknowledgements?

Case 4:
Two students have written a very interesting thesis that has the potential to be rewritten as a journal article. The supervisor offers to assist them in this process. The students have come up with the idea, the research design and have gathered the data. The supervisor's contribution is input to the process at two meetings. The students write the first draft, and the supervisor makes corrections and adds references to relevant literature. Do you think that the supervisor should be listed as co-author or be mentioned in the acknowledgements?

V. Does professional status affect which types of tasks you usually do? Have you experienced that professional status affects whether you are listed as co-author?
VI. Have you experienced that you can be added as co-author if you are good at technical aspects of data collection or analysis (statistics, methods, etc.)?
VII. Have you collaborated with researchers from other fields? If yes, which ones? Have you experienced that there are different ideas about when you are listed as co-author?
VIII. Are you familiar with any official author criteria? (APA, ICMJE, the Danish Code of Conduct for Research Integrity). Have you used or checked official author criteria in connection with assignment of co-authorship?

IX. Have you experienced or are you aware of gift or honorary authorship? What about career authorship?
X. Have you experienced or are you aware of cases of ghost authorship?

Reward system (junior):

- How many publications are required to advance from PhD to postdoc or assistant professor? Does it affect the assessment of these publications whether they are co- or single-authored?
- Do you think the requirements to continue in research have changed?
- Is it important to have both single- and co-authored publications?
- How important is it to have different types of publications? How important is journal or publisher?
- Are citations important?
- Are you familiar with the concept of contributorship? What is your opinion about this? Would it be relevant in your field?
- How important are publications in relation to grant applications? Does it help to list a renowned researcher as co-applicant?
- Have New Public Management indicators, e.g., the bibliometric research indicator or BFI, affected the degree of collaboration and assignment of co-authorships?
- Check word association entries for topics that have not been discussed.

Changes over time (only senior researchers):

- What has changed during the time you have worked in research? Have the types of research conducted changed? Have specialization or generalization increased?
- Has the tendency to collaborate changed? If yes, how? What is your personal experience with collaboration and has it changed over time in terms of how much you collaborate and the number of different collaborators?
- Have the types of publications changed? Is the focus on articles growing?
- How important is it to have different types of publications? How important is journal or publisher?
- Has it changed how much you have to contribute to the research and publication process to be listed as co-author? For example due to the publication pressure.
- Are you PhD supervisor? Do you co-author publications? If yes, can you give some concrete examples of how that works? How large does your contribution have to be for you to be co-author on one of your PhD student's publications?
- Did you collaborate with your supervisor?

Reward system (senior):

- How many publications are required to advance from PhD to postdoc or assistant professor? From assistant professor to associate professor? From associate professor to professor? Are certain types of publications required? Does it affect the assessment of these publications whether they are co- or single-authored?
- Have the requirements for advancement in research changed?
- Is it important to have both single- and co-authored publications?
- How important is it to have different types of publications? How important is journal or publisher?
- Are you familiar with the concept contributorship? What is your opinion about this? Would it be relevant in your field?
- Are citations important?
- How important are publications in relation to grant applications? Does it help to list a renowned researcher as co-applicant?
- Have New Public Management indicators, e.g., the bibliometric research indicator or BFI, affected the degree of collaboration and assignment of co-authorships?
- Check word association entries for topics that have not been discussed.

Removed question:

- If you should assign recognition for a co-authored publication, will you then recognize all co-authors equally, would you fractionalize it or would partial fractionalize it? Why?
- Example:
- Three researchers collaborate on a publication. Researcher1 is first author, researcher2 is second author, and research3 is last author.
- They all receive full reward for their contribution, thus they all get 1 point
- They all share the reward, thus they each get 1/3 point
- Because it is a co-authored publication, they should all receive a higher reward, thus they each receive 2/3 points
- The author order is important for assigning reward for the publication, so researcher1 gets 1/3 point, researcher2 gets 2/3 point and researcher3 gets 1/6 point
- Other