FACULTY OF PSYCHOLOGY AND EDUCATIONAL SCIENCES

The road less traveled: A comparative study of PhD holders' sector of employment

Word count: 22 007

Lucas Dierickx
Student number: 01504310

Promotor: Dr. Anneleen Mortier
Co-promotor: Prof. Dr. Katia Levecque

A dissertation submitted to Ghent University in partial fulfilment of the requirements for the degree of Master of Psychology

Academic year: 2019 – 2020

GHENT UNIVERSITY

Acknowledgements

First, I would like to say that studying at Ghent University has been a pleasure. I will be the first one to admit that the last five years were a challenging and sometimes frustrating endeavor, but I wouldn't trade the experience for anything else.

Most importantly, I would like to thank my promotor, dr. Anneleen Mortier. Her knowledge, expertise and guidance were invaluable in helping me accomplish this thesis. I can honestly say that I am glad to have her as a promotor.
I also thank prof. dr. Katia Levecque for giving me the opportunity to write on an interesting topic which can hopefully contribute to knowledge on the employment outcomes of PhD holders.

I would also like to thank Veronique, Elie and Eveline for being companions throughout this five year journey. It is a true pleasure to graduate alongside you.

My father was very important in the reviewing of this thesis and gave me countless helpful suggestions. He acted as a discussion partner with whom I could share ideas and insights. Without him, it would not have been possible to write this thesis.

Additionally, I would like to thank my mother for providing me with the necessary inspiration throughout the writing of this thesis. I would also like to thank her in general for being a positive and optimistic influence in my life.

Out of fear of forgetting someone, I will not be putting down the names of all of my family and friends. Regardless, I hope they realize how important they have been to me.

Finally, I would like to thank Leonie for her continuous support, understanding and encouragement throughout the last couple of years.

Preamble concerning COVID-19

As this thesis used secondary research data, data collection was not affected by the current ongoing COVID-19 crisis. There are no implications for the end result of this thesis.

This preamble was made in agreement between the student and the promotor.

Corona preambule

Aangezien deze masterproef gebruik maakte van secundaire data, was deze masterproef niet onderhevig aan de effecten van de huidige COVID-19 crisis. Er waren geen implicaties voor de uitwerking van de masterproef.

Deze preambule werd in overleg tussen de student en de promotor opgesteld en door beide goedgekeurd.

Abstract

English

Typically, the achievement of a PhD is connected to a career in academia, for instance in the role of postdoctoral researcher. Nowadays, this traditional view of the PhD is no longer the standard. More and more PhD holders now make the transition – voluntarily or involuntarily – away from higher education and into other sectors. This trend has attracted a growing interest among researchers and policymakers with regard to the employment outcomes of PhD holders. This study attempts to contribute to this topic by contrasting the employment of PhD holders to the employment of other tertiary graduates. Four different sectors were defined (business enterprise, government, higher education and private non-profit) according to guidelines prescribed in the Frascati Manual. Eurostat R&D data was used to analyze how educational level and gender were related to sector of employment in four different European nations (Belgium, Finland, Bulgaria and Portugal). These analyses showed that educational level was significantly related to sector of employment, with PhD holders mainly being employed in higher education whereas other tertiary graduates were mostly employed in the business sector. This was the case for each of the four nations. In terms of gender, men were more frequently employed in business, while women were more frequently employed in higher education. Further, this study analyzed sector and gender differences in three different satisfactory aspects (salary, quality of work-life balance and job security) among Flemish PhD holders. Women were less satisfied with salary in both the business

enterprise and non-profit sector, and less satisfied with job security in the higher education sector. There were however no significant gender differences in satisfaction with quality of work-life balance in each of the four sectors.

Nederlands

Traditioneel gezien is het behalen van een doctoraat verbonden aan een carrière binnen de academische wereld, bijvoorbeeld als postdoctoraal onderzoeker. Tegenwoordig is dit carrièrepad niet meer de standaard en maken meer en meer doctoraatshouders de overstap – vrijwillig of onvrijwillig – weg van hoger onderwijs naar andere sectoren. Vanwege deze trend heeft onderzoek rond de tewerkstelling van doctoraatshouders aan belang gewonnen bij onderzoekers en beleidsmakers. Deze studie probeert bij te dragen aan dit onderwerp door de tewerkstelling van doctoraatshouders te vergelijken met de tewerkstelling van personen met een ander tertiair diploma. Vier verschillende sectoren werden gedefinieerd (business, overheid, hoger onderwijs en privé non-profit) volgens richtlijnen zoals voorgeschreven in de Frascati Manual. Eurostat R&D data werd gebruikt om te analyseren hoe het opleidingsniveau en gender van een individu gerelateerd zijn aan de sector van tewerkstelling. Deze relatie werd bekeken in vier verschillende Europese landen (België, Finland, Bulgarije en Portugal). De analyses toonden aan dat doctoraatshouders voornamelijk tewerkgesteld zijn in het hoger onderwijs terwijl de business sector de primaire bestemming is voor personen met een ander tertiair diploma. Deze bevinding was zichtbaar in elk van de vier verschillende landen. Op vlak van gender waren mannen vaker tewerkgesteld in de business sector, terwijl vrouwen vaker tewerkgesteld waren in het hoger onderwijs. Verder bestudeerde dit onderzoek ook geslachtsverschillen in drie verschillende tevredenheidsaspecten (salaris, kwaliteit van work-life balans en jobzekerheid) bij Vlaamse doctoraatshouders. Hier waren vrouwen minder tevreden op vlak van salaris in de business en non-profit sectoren, en minder tevreden op vlak van jobzekerheid in het hoger onderwijs. Er waren echter in geen enkele sector significante verschillen in de tevredenheid met kwaliteit van work-life balans.

Contents

The emergence of a knowledge economy has assigned a unique and important role to the PhD holder. According to Di Paolo & Mañé (2016), the current knowledge economy has highlighted the importance of intellectual capabilities such as knowledge and skills rather than depending on natural resources and physical inputs. In this knowledge economy, PhD holders are perceived to have developed the intellectual capabilities that are necessary to play an important role in the economic and societal development of a nation (Gokhberg, Meissner & Shmatko, 2017). Therefore, doctoral education is now considered to be a key priority for governments and international organizations with the goal of developing a mass of people that is needed to sustain knowledge economies. The importance of PhD holders for governments and international organizations can for instance be found in the higher education reforms that were initiated by the Bologna Process (Keeling, 2006). One of the goals was to implement an overarching framework for qualifications, with the intention of creating doctoral programs that are more structured (Bergen Communiqué, 2005). PhD holders have also been assigned an important role in the research and innovation strategy envisioned by the European Union, striving to be an innovation leader worldwide (European Commission, 2019). Besides policy changes on the level of the European Union, several European nations have made significant investments in the development of new PhD holders, for instance Finland, Denmark and Portugal (Ahola, 2007; Corado Simões, Mira Godinho & Sanchez-Martinez, 2018; Knudsen, Christensen & Christensen, 2017). In short, these reforms show that doctoral education is an important topic for policymakers.

The recognition of the importance of PhD holders to innovation and increased investments have led to a significant increase in the number of new PhD holders. According to a 2013 report of the OECD, 213.000 doctoral degrees were awarded by universities in OECD countries in 2009 (Auriol, Misu & Freeman, 2013). This is a significant increase compared to the year 2000, in which 154.000 doctoral students graduated. Since 2010, rates of new PhD holders have continued to rise in European nations, for instance in Belgium (European Commission, 2019; Kelchtermans & Robedo-Bottcher, 2018). The increase in overall PhD holders means that there are fewer opportunities for PhD holders to work in an academic context, while demand for researchers in the business sector has increased, thus becoming a larger source of employment for PhD holders. Therefore, the topic of PhD holders has garnered more attention and has become a more important topic in research literature.

In the past, a student pursuing a doctoral degree usually implied that they were aspiring an academic career. Nowadays, a doctoral degree does not necessarily have to lead to the doctoral student pursuing a career in academia. In 1996, Stephan pointed out that the business enterprise sector was becoming an increasingly important sector of employment for PhD holders (Stephan, 1996). For instance, a study by Proudfoot and Hoffer (2016) in the US showed that academia was still the largest sector of employment for PhD holders by 44%, but closely followed by business with 38%. In fact, a part of the PhD holders deliberately choose to join the labor market instead of the traditional academic career. In Flanders, only 28% of PhD holders stay at their home university to start a career as a postdoctoral researcher (Vlaamse Raad voor Wetenschap en Innovatie, 2015). The other 72% follow a different path and join either the private labor market or an academic career outside of their home university (either domestically or internationally). The idea that the traditional academic career is no longer the standard career path raises a lot of questions for research.

Schwabe (2011) notes that not working in an academic career is usually not a voluntary choice for PhD holders, with the obstacles being limited job opportunities and the uncertainty of long term career prospects. This notion has been supported by Gould (2015), citing high attrition rates among PhD students, bleak job prospects and insecure contracts as reasons for not pursuing a PhD. It has also been suggested that PhD holders working in the non-academic sector are less likely to pursue a career in the academic sector in their later careers. The fact that there is often a discrepancy between the ambitions of PhD holders and their actual source of employment, makes this subject an important topic in both the academic and non-academic sectors. Some research concerning this topic has described this issue as a crisis (Cuthbert & Molla, 2015). The key feature in this rationale is considered to be the idea that universities are now producing too many PhD holders, fearing that the imbalance might be unsustainable. A second key issue is that there are concerns that PhD holders are trained mainly to perform research. Therefore, it is not known whether PhD holders have the right set of skills to be able to perform outside of academia (Cuthbert & Molla, 2015).

Whilst it might be easy to paint a bleak and pessimistic picture about PhD's, it does not mean that PhD's do not have added value. The skills and knowledge that PhD holders are able to deliver, aren't just a benefit for their own personal lives and career. They have the possibility to act as a benefit for the labor market and society as a whole. Although there has been an increase in interest on the topic of PhD holders, research on this topic is still relatively scarce. Some studies on PhD holders have focused on labor

market outcomes for PhD holders, for instance the Careers of Doctorate Holders survey (Auriol et al., 2013; Boosten, Vandevelde, Derycke, te Kaat & Van Rossem, 2014). However, the existing CDH studies only elaborate on outcomes for PhD holders and do not make a comparison with other levels of employment. Therefore, it is not yet known whether the choice of sector of employment is different for PhD holders when compared to other tertiary graduates. In this study, the umbrella term “tertiary graduates” will be used to describe anyone with a degree from educational level 5 to 7, according to the International Standard Classification of Education (UNESCO, 2012). Using this classification, the levels 5 to 7 correspond with Associate’s, Bachelor’s, and Master’s degrees.

The goal of this study will be twofold. With the trend of more and more PhD holders going to alternate sectors of employment above academia, it is a possibility that PhD holders’ employment choices are becoming more similar to other tertiary graduates. First of all, this study will utilize Eurostat R&D statistics to determine whether PhD holders work in different sectors of employment compared to other tertiary graduates. Four different sectors have been distinguished, namely business enterprise, government, higher education and private non-profit. For the sake of clarity, industry and academia are used throughout this study as synonyms for business and higher education. Additionally, the interaction of gender on this relationship will be tested. These effects will be compared for four different European countries (Belgium, Bulgaria, Finland, Portugal). The purpose of this is to provide a relatively representative view of the employment of PhD holders compared to tertiary graduates in the European Union. On the other hand, the aim is to compare employment of PhD holders compared to tertiary graduates in Belgium to other European countries. The selected countries are based on their geographical location and on innovation performance as defined by the European Innovation Scoreboard (European Commission, 2019). Additionally, this study will compare the employment rates of female and male PhD holders and tertiary graduates. Besides the possible differences between PhD holders’ and other tertiary graduates’ sector of employment, there is a possibility that male and female PhD holders are employed in different sectors.

The second goal of the study is to look at a couple of satisfactory aspects that might influence the employment of PhD holders in different sectors. With the aid of the PhD Career Survey (Mortier, Levecque and Debacker, 2020), outcomes in terms of satisfaction with salary, quality of work-life balance and job security will be analyzed for

PhD holders in Flanders in each of the four sectors. Again, a comparison between male and female PhD holders will be made.

In the literature study, this study will first give an overview of the perceived value of PhD holders to the labor market and to themselves. Outlining how PhD holders are valued on the labor market could serve to explain why PhD holders might be employed in different sectors compared to other tertiary graduates. Second, this study will elaborate on some job aspects and outcomes that PhD holders are often confronted with. These job aspects are factors that could potentially have an impact on the sector that PhD holders are employed in.

Literature review

The value of PhD holders

Following on from previous statements about the importance of PhD holders in the knowledge economy, this segment will illustrate the potential benefit of a PhD to an employer and the PhD holder themselves and how this could impact their sector of employment. According to Halse and Mowbray (2011), the benefits and effects of the PhD are increasingly attracting interest from a variety of different stakeholder groups. Doctoral education is now considered a key priority for governments and international organizations with the goal of developing a mass of people that is needed by knowledge economies. While it is clear that PhD holders are considered important for many policymakers, PhD holders can also have a beneficial impact on employers and their organizations. Where PhD holders were mostly important in an academic setting in the past, the value of PhD holders in other sectors of employment is now being recognized.

Employer value.

In the first place, PhD students are trained to carry out research in academia and this is still considered to be the end goal for many PhD holders. Nowadays, there are many different opportunities for them outside of research, for instance in consultancy, management and software development (Boosten & Spithoven, 2016). Still, PhD holders are often employed in the R&D departments of organizations with the objective of performing research. The Irish Advisory Science Council (ASC, 2009) states that there are two sides to R&D; first, there is an absorptive capacity for new knowledge and technology and second, innovation. This all depends on the internal capabilities of the companies which is often represented by the quality and quantity of the staff they employ. According to Garcia-Quevedo, Mas-Verdú and Polo-Otero (2012), PhD holders can be considered a key element in the creation, commercialization and diffusion of innovations. PhD holders accumulate an expansive collection of scientific knowledge, and are able to transfer this knowledge from universities to firms for the sake of applying this knowledge in practice. This insight is important for policymakers throughout Europe, who are trying to ensure that the knowledge of PhD holders is spread outside of the realm of academic research (Christensen, 2005). This transfer of knowledge in mutually beneficial to academia and other sectors of employment (Herrera, Muñoz-Doyague & Nieto, 2010). Further, PhD holders help the process of innovation by increasing the inputs and outputs of the process. The mobility of PhD holders from academia to other sectors and vice versa is therefore a powerful mechanism to transfer knowledge.

Besides the transfer of knowledge, PhD holders bring unique skills, working techniques and a network of relationships to their employers. Originally, the PhD was mainly seen as a product; as a way to contribute to the advancement of knowledge by providing original research (Durette, Fournier & Lafon, 2016; Park, 2005). Nowadays, this role has expanded and the PhD is seen as a process: the most important part is that doctoral training provides the necessary competencies to be able to fit the needs of the global labor market in a knowledge economy. These competencies were the subject of a study by Durette et al. (2016). When asking PhD holders about their most important competencies, they were more likely to cite transferable competencies (e.g. communication, analytical and critical thinking skills) than specific knowledge and skills. Acquiring these transferable competencies is one of the key challenges that policymakers and doctoral training are focused on (Christensen, 2005).

While a PhD signifies competence in analytical and critical thinking skills, the PhD can only provide value for the employer if the employer recognizes the benefits of having an employee with a PhD (Haapakorpi, 2017). Even though PhD holders have the potential to quickly add value to an organization, employers often have to overcome a couple of barriers to unlock this potential (Park, 2007). PhD holders are often considered to be overspecialized, lack commercial awareness and have difficulties adapting to a work environment outside of academia. Similarly, some firms consider PhD holders to purely be experts, thus lacking a larger understanding of the wide range of competencies PhD holders possess (Durette et al., 2016). Golde and Dore (2001) note that the business sector, government and non-profit sector need intelligent, skilled employees, and there is no doubt that PhD holders adhere to this description. Still, PhD holders often struggle to make the transition from academia to other sectors and it is often difficult for PhD holders to transfer from academia to the business sector because they are not valued equally in different sectors (Bloch, Graversen & Pedersen, 2015).

To illustrate this, a study by Rayner and Papakonstantinou (2016) showed that employers in STEM fields rated most Bachelor honors degrees (a more advanced version of the bachelor degree) and Master's degrees higher than PhD's. This finding might be explained due to employers in STEM fields perceiving PhD holders as missing some of the more valuable employability skills, in this case mainly adaptability and flexibility. On the other hand, De Grande, De Boyser, Vandevelde and Van Rossem (2010a) found that employers were mainly looking for teamwork and initiative as most important competencies. Employers that are already employing PhD holders seem to value research skills, leadership and scientific knowledge more than other employers.

Employers that are not employing PhD holders appreciate technical skills, independence and self-confidence more. Further, the study by Rayner and Papakonstantinou (2016) showed that there was a significant difference between the employment rates of PhD holders and how they are rated by employers.

These previous studies seem to show that employers often have mixed opinions about employing PhD holders. While this may be the case, employment rates of PhD holders are generally higher than Bachelor's and Master's graduates. Additionally, a 2010 study by Rubio and Hooley found that 73% of employers would be happy to recruit (more) PhD holders and that a third of employers were already actively targeting PhD holders. Unfortunately, only 6% of employers have experience related to the recruitment and retention of PhD holders while 22% of employers are not interested in PhD holders at all. This is mostly based on the perception these employers have about PhD holders, while this perception is not always grounded in reality. Similarly, 37% of employers simply do not have job positions for which a PhD is necessary. Often, there are no differences in the recruitment process between PhD holders and other university graduates. Only 11% of employers have recruitment processes that are specifically tailored to evaluating the skills of PhD holders. These results seem to signify that the difference in employment rates and opinions of employers is often influenced by the skepticism of a select group of employers. Given that 73% of employers would welcome more PhD holders and given the high employment rates of more than 90%, it is hard to say that PhD holders are unwanted or unpopular employees. For instance, a study by Diamond et al. (2014) found that even during times of economic recession, PhD holders kept high employment rates and were still wanted by employers. The research on this topic thus seems to suggest that the opinions of employers on PhD holders has an impact on PhD holders' sector of employment.

Personal value.

While it seems like there is a lot of discussion on whether or not employers outside of academia value PhD holders, Casey (2009) suggests that employers might be valuing the contributions of PhD holders higher than PhD holders do themselves. The reason for this is that it is not certain whether the doctoral program adequately prepares PhD holders for the labor market. Aanerud, Homer, Nerad and Cerny (2006) found that PhD holders report that their doctoral program gave them skills that were very useful in their later careers and across a wide variety of settings. On the other hand, some of their occupations – even for those in academia – required skills that these PhD holders never

had the chance to develop. According to De Grande et al. (2010a), PhD holders often suffer from a lack of awareness when it comes to their own skills, resulting in a possible failure to prepare for their future careers. This could make them blind for expectations outside of academia, as well as for the skills that they acquire during their doctoral training. Therefore, Durette et al. (2016) consider it beneficial to provide both PhD holder and employer with a clearer vision of the competencies acquired during doctoral training.

As Parada and Peacock (2015) showed, performing research within academia is a preferred destination for many aspiring PhD students. In most countries, at least 50% of the PhD students mentioned that they would consider a non-academic research career. A majority of these students believed that achieving their PhD would give them a very high chance of being employed in academia. Interestingly, PhD students were not as optimistic of employment prospects outside of academia. In line with findings of De Grande et al. (2010a), this may point to future PhD holders having unrealistic expectations towards academia (Parada & Peacock, 2015). Golde and Dore (2001) suggest that opportunities to explore career options outside of academia are relatively scarce in doctoral programs. PhD students indicate that workshops on conducting a job search in academia are more widespread than those outside of academia. With this comes that only around 30% of PhD students feel encouraged to attend non-academic job search workshops (Golde & Dore, 2001). These findings suggest that PhD students in training are not really encouraged to look for alternative career options during their doctoral programs. This insight combined with the idea that PhD holders are often not sure of their value outside of academia, could have an impact on the choice of sector of employment for new PhD holders.

The aforementioned studies give the impression that PhD holders are not always certain of their own value. But, when asked about where the strength of the PhD lies, a substantial amount of PhD holders mention their specialization, independence and passionate approach to knowledge (De Grande et al., 2010a). Other valuable characteristics include the acquisition of transferable skills such as networking and writing skills during doctoral training (De Grande et al., 2010a; Durette et al., 2016). In general, PhD holders report high levels of job satisfaction, regardless of job sector (Aanerud et al., 2006). Most of the PhD holders were of the opinion that their work was fulfilling and catered to their personal needs, for instance compensation, support and intellectual challenge. This was even the case for PhD holders working outside of academia. Similarly, Diamond et al. (2014) saw that PhD holders in general were mostly satisfied with their current role, especially with the intellectual challenge. In this study

PhD holders working as researchers in academia were slightly more concerned than those in industry, especially with regard to job security and career prospects. Despite this, PhD holders working as researchers are more satisfied than non-researchers (Auriol et al., 2013). In particular, they are more satisfied with intellectual challenges and opportunities for advancement. A career as a researcher might therefore be more attractive to a PhD holder than a career outside of research. Overall, on the question whether PhD holders think their PhD was worth it, about 90% of PhD holders answer positively (Aanerud et al., 2006).

In conclusion, PhD holders aren't always secure of job prospects outside of academia, despite being able to recognize their strengths and the versatility of their acquired skill set. In turn, this has the ability to impact the employment of PhD holders throughout different sectors.

Job aspects

The main idea in this segment is to describe some aspects that could potentially influence the employment of PhD holders. This will not be an exhaustive list but will rather serve to demonstrate in which ways job aspects can influence PhD holders' decisions of sector of employment.

Monetary rewards.

Given that PhD holders follow long trajectories with lots of training and specialization, it can be assumed that a PhD adds value on top of a Master's degree or any other tertiary degree. Because of the investments that are put into graduating with a PhD, it should be expected that PhD holders and their employers receive benefits and rewards that are higher than the ones of Master's graduates, but it isn't always easy to define the things that truly add value.

One of the issues in defining the added value of a PhD is that many of the benefits and costs associated with the PhD are for the most part unquantifiable (Casey, 2009). The people that are more likely to pursue a PhD often possess certain, unobservable characteristics such as an independent mind or strong cognitive abilities (van der Steeg, van der Wiel & Wouterse, 2014). These characteristics could be related to measures of return such as wages and employment possibilities and could lead to an under- or overestimation of the true rate of return. While it is difficult to determine the added value of a PhD, there are some factors that indicate what kind of value the PhD could potentially have.

The most well researched factor that could offer value for PhD holders above Master's graduates is linked to monetary rewards. Casey (2009) studied the differences in wages between different types of education levels. The study found that male Master's graduates earned 29% more than non-graduates, while female Master's graduates earned 55% more. Compared to PhD's, male PhD holders earned 31% more than male non-graduates, and female PhD holders earned 60% more. Similar results were found by Conlon and Patrignani (2011), in which Master's qualifications provide average earnings of about 8% higher than someone with an undergraduates degree (bachelor or associate degree). For PhD holders, this return was around 16% higher. In Belgium, PhD holders earn an average of €490 per month more than Master's graduates (Levecque, Baute, Van Rossem & Anseel, 2014). Additionally, this study found a wage gap between men and women for both Master's graduates and PhD holders, with men earning more than women in comparable jobs. Interestingly, this wage gap was larger for PhD holders than for Master's graduates. A study by Auriol, Misu and Galindo-Rueda (2016) shows that the earnings premium of PhD holders compared to other postgraduates has increased. In the period of 1995-2002 this premium was around 11%, in the period of 2003-2011 it had gone up to 15%. Compared to the bachelor degree, PhD holders earn up to 28% and 34% more. Still, Casey (2009) argues that there is a very small difference in the earnings of Master's graduates and PhD holders, suggesting that there are diminishing returns associated with graduating with a PhD.

In some cases, PhD holders have lower lifetime earnings than Master's graduates, for instance when comparing a PhD in biological sciences to an MBA (Master of Business Administration) (Waaijer, 2016). Similar results were found by Rubio and Hooley (2010) which showed that PhD holders earn more than other university graduates, excluding MBA graduates. While an MBA might earn more than some PhD holders, van der Steeg et al. (2014) found that PhD holders in the Netherlands have higher lifetime earnings than Master's graduates. This effect is not seen straight away, as it takes 12 years of employment for PhD holders to start earning more than Master's graduates and 20 years in total to achieve a positive rate of return. Part of this finding could be explained due to PhD holders being less likely than Master's graduates to find employment in the private sector. According to van der Steeg et al. (2014), PhD holders are more spread out through different sectors, while Master's graduates are more likely to work in the better paying private sector. Interestingly, female PhD holders earn more than female Master's graduates for the first 20 years of employment, while male PhD holders earn less than male Master's graduates for the same amount of time. This can

be partially explained by the fact that female PhD holders work more hours than female Master's graduates, while this is not the case with men (van der Steeg et al., 2014).

Rubio and Hooley (2010) report that a couple of fields do give an earnings advantage for PhD holders above Master's graduates, more specifically in banking, energy, science and engineering. Similarly, Mertens and Röbken (2013) found that PhD holders in social sciences and engineering benefit the most from their degree in terms of monetary rewards. Additionally, while PhD holders do not necessarily earn more than Master's graduates, PhD holders are more likely to be offered non-monetary benefits such as autonomy and intellectual challenge, which might function as a buffer (Rubio & Hooley, 2010).

A study by Roach and Sauermann (2010) suggests that PhD holders are heavily influenced by job attributes such as salary when deciding on their preferred sector of employment. This can be linked to a study by Agarwal and Ohyama (2013) which found that PhD holders were more likely to choose an academic career if they rated non-monetary job aspects as more important. For instance, PhD holders rating independence, job security and contribution to society as important had a higher probability of working in academia. In comparison, PhD holders that rated salary as important were more likely to work in industry instead of academia. Indeed, a study performed in Belgium found that gross annual salaries of PhD holders in industry were on average €12 000 higher than those working in higher education (Boosten & Spithoven, 2016). Another study in the US found that PhD holders employed in the business sector earned more than those in education and government sectors (Webber & Canché, 2015). Interestingly, this difference is larger for men than women. It is however not always the case that the business sector pays better than the government sector. For instance, PhD holders in Lithuania and Latvia employed in the government sector earn more than those employed in the business enterprise sector (Auriol et al., 2013). Roach and Sauermann (2010) suggest similar results to Agarwal and Ohyama (2013), stating that PhD holders working outside of academia have a stronger concern for salary and access to resources. Additionally, PhD holders working in academia show a strong "taste for science". They have a desire to conduct basic research, as well as preferring to freely choose research projects. PhD holders who prefer industrial employment are less likely to possess a strong "taste for science" (Roach & Sauermann, 2010). The findings of Roach and Sauermann (2010) also show that PhD holders wanting a high grade of responsibility prefer employment in startups over employment in

academia. In contrast, PhD holders with a preference for job security are less likely to prefer startups above academia.

To summarize, these studies show that monetary rewards are an important driver for PhD holders in their choice of sector of employment. A larger concern for salary and monetary rewards could result in PhD holders preferring business to academia. On the other hand, this could come at the cost of independence and intellectual challenge. In the next segment, this study will describe two potential problems that PhD holders are often confronted with. Understanding how these job aspects influence PhD holders could lead to a greater understanding of decisions relating to PhD holders' sector of employment.

Temporary contracts.

One of the potential problems that PhD holders are frequently confronted with is that they are often employed with temporary contracts. However, it must first be noted that employment rates among PhD holders are considered to be quite high. PhD holders have an employment rate of about 93%, compared to other tertiary graduates where this number is only 81%. In OECD countries, males usually have a higher employment rate than females, with the exceptions being in Chinese Taipei, Malta, Bulgaria and Finland (Auriol et al., 2013). Unfortunately, PhD holders are relatively frequently employed with temporary contracts, especially in the first five years after achieving their PhD (Auriol et al., 2013). Auriol et al. (2016) note that the business sector often offers more attractive contractual arrangements to recently graduated PhD holders. Therefore, temporary contracts have mainly become a concern for PhD holders in academia. The rates of temporary contracts among PhD holders differ through both region and fields of study. The rates among PhD holders who graduated less than five years ago can be quite high, for instance in Portugal (57%), while there are also countries with rates less than 5%, for instance Bulgaria and Turkey. A study in Belgium showed that about a quarter of all PhD holders were employed with a temporary contract (Boosten & Spithoven, 2016). In the Netherlands, 76% of PhD holders working on a temporary contract are employed in academia. In some countries such as the United States, the Netherlands and Germany the rates of temporary employment are considered to be increasing (Duarte & Mendonça, 2016; Waaijer, Belder, Sonneveld, van Bochove & van der Weijden, 2017). This evolution is more pronounced among PhD holders working in academia but is also present in those working in other employment sectors. Boosten and Spithoven (2016) found that in Belgium, only 56% of PhD holders in academia were employed on a

permanent contract, compared to 98% in industry. For the majority of OECD countries, the rate of PhD holders in the higher education sector employed on a permanent contract is lower than 50% (Auriol et al., 2016). In all OECD countries, the rates of PhD holders in industry on a permanent contract are higher. Usually, female PhD holders are employed on a temporary contract much more often than male PhD holders, especially in Germany, Belgium and the Netherlands. These studies show that temporary contracts could have a significant impact on the sector of employment of PhD holders.

Waaijer et al. (2017) found that PhD holders with a temporary contract are less satisfied with the content of their job than PhD holders employed on a permanent contract. Bender and Haywood (2009) found that PhD holders that consider the contents of their job to be close to their degree reported more job satisfaction. A possible explanation for this is that 80% of the PhD's working in the academic sector say that their degree relates to the contents of their job, while only half of the PhD's working in the non-academic sector can say the same. The number of PhD holders working in academia that says their job relates to their degree also differs throughout countries. 95% of PhD holders in countries such as Romania, Bulgaria and Hungary note that their job in academia relates to their degree. In countries such as Belgium and the Netherlands this number ranges from 70% to 85% (Auriol et al., 2013). It is possible that some fields are less likely to produce PhD holders working in related fields because they are more focused on generic skills and theoretical knowledge instead of domain-specific practical skills (Fenesi & Sana, 2015).

Waaijer et al. (2017) also found that temporary contracts are a negative influence on the satisfaction with the terms of employment. PhD holders working outside of academia are usually more satisfied with the terms of employment. This is consistent with a study conducted by Di Paolo (2016), where it was found that PhD's working in a non-academic career were more satisfied with their earnings and future career prospects. Boosten and Spithoven (2016) note that a change from temporary to permanent contract leads to a significant improvement in terms of salary. In general, PhD holders employed on a temporary contract earn less than those with permanent contracts (Auriol et al., 2016). Interestingly, PhD holders on a permanent contract in Belgium are slightly less likely to earn more than those on a temporary contract (Duarte & Mendonça, 2016). Temporary contracts also have a negative impact on satisfaction with work-life balance (Waaijer et al., 2017). The biggest concerns among PhD holders with temporary contracts are usually regarding job security, while the intellectual challenge of the job can act as a buffer and provide a positive effect on job satisfaction. This result is

consistent with a study by van der Meer and Wielers (2014) where job security had a strong impact on job satisfaction and well-being of the employee. Overall, temporary contracts have a slightly negative impact on job satisfaction. As seen by these studies, the type of contract a PhD holder is employed on can potentially have an impact on employment decisions. A PhD holder strongly influenced by the prospects of job security might therefore deliberately choose for employment outside of academia.

Overqualification.

Overqualification is another potential problem that PhD holders could potentially be confronted with. In the first place, PhD students are trained to carry out research in academia. This implies that PhD holders are best suited for jobs within academia. As stated before, PhD holders most often have the intention of working in academia. Unfortunately, there is usually a discrepancy between the number of positions available for PhD holders and the actual number of PhD holders. The number of new PhD holders each year is considered to have increased over the last 20 years while the amount of available academic positions has remained the same (Larson, Ghaffarzadegan & Xue, 2014). Therefore, a newly hired PhD holder is often a replacement of someone else, either through retirement or other means. Additionally, Proudfoot and Hoffer (2016) state that PhD holders stay active on the labor market longer than other postgraduates. Therefore, a significant amount of PhD holders have to find employment outside of academia. The employment rates of PhD holders are still higher than the average higher education graduate (Auriol et al., 2013), which implies that a PhD degree holds a lot of value even outside of academia. The problem that could occur is that a mismatch is created between the skills and competencies the PhD holder acquired throughout their degree, and the skills and competencies that are needed to function in certain jobs outside of academia (Di Paolo & Mañé, 2016). This so-called “education-job mismatch” is created because the demand for the most highly educated workers in workplaces is limited (Park, Jang & Shahiri, 2018), resulting in some PhD holders having to settle for jobs in which they could be considered overqualified. These jobs are most often at the level of a Master’s degree, as PhD holders are very rarely severely underemployed to the point of having to find a job for which no qualifications are needed (Fox & Stephan, 2001). The problem of overqualification is linked to several individual and societal costs, for instance due to skills remaining unused (Bender & Heywood, 2009). Overqualification can affect a significant portion of the population with a higher education degree. Green and Zhu (2010) found that overqualification in the United Kingdom was as high as 22%

in 1996, and that this number had steadily increased to more than 30% in 2006. In a study conducted in Canada, Frenette (2004) found rates of around 21% to 29% for PhD holders. Park et al. (2018) found that at least 4 out of 10 PhD holders on the South Korean labor market are overqualified. A meta-analysis conducted by Groot and van den Brink (2000) found that the overall rate of overqualification was about 26%.

An important consequence of overqualification is that it is linked with a lower salary compared to individuals with the same level of education but without the education-job mismatch (Park et al., 2018). Bender and Heywood (2009) found that PhD holders in the United States working outside of academia earn about 10% less than PhD holders working in academia. PhD holders who reported that their job did not relate to the subject of their education, earned about 14% less than PhD holders that do have a job that relates to their education. In a similar study in Spain, Di Paolo and Mañé (2016) found that overqualified PhD holders earned about 12% less than those who had a job and education that were well-matched. In a South Korean study carried out by Park et al. (2018) this effect was around 6.5%. These studies show evidence that overqualified PhD holders are frequently penalized in terms of salary. On the topic of satisfaction with salary, there is some discussion. Several studies have found that overqualification leads to a decreased satisfaction with salary (Allen & van der Velden, 2001; Fleming & Kler, 2008) while others have not found significant effects on satisfaction with salary (Di Paolo & Mañé, 2016).

Besides the effect that overqualification has on the wages of PhD holders, there is also evidence that overqualification affects the job satisfaction of PhD holders. Tsang (1987) found that overqualification was negatively and significantly related to job satisfaction, while job satisfaction was significantly positively related to the production or output of a firm. Therefore, Tsang argues that the underutilization of skills could lead to reduced output in firms. Similarly, Verhaest and Omey (2006) found that overqualified individuals are significantly less satisfied with their job compared to well-matched individuals with the same level of education. Di Paolo and Mañé (2016) note that it is not the educational mismatch by itself that has a negative effect on job satisfaction, but that it is the underutilization of skills that is detrimental for the job satisfaction of PhD holders. Similar results were found in a study by Allen and van der Velden (2001), in which underutilization of skills had a strong negative effect on job satisfaction. Additionally, job characteristics were also found to have a strong negative influence on job satisfaction. Consistent with the findings of Di Paolo and Mañé, overqualification by itself did not have a significant impact on job satisfaction.

Additional consequences include the effect of overqualification on training participation. Verhaest and Omey (2006) found that overqualified workers are significantly less likely to participate in training programs than well-matched workers with the same level of education. Similar results were found by Hersch (1991). Further, Alba-Ramirez (1993) found that overqualified workers show higher rates of turnover, a finding that was also seen in a study by Hersch (1991). Fortunately, overqualification is often seen as something that is temporary in nature. Often, overqualified workers either get promoted to a function that matches better with the level of education, or overqualified workers find a new job in which they are no longer overqualified (Schwabe, 2011). This notion is supported by a meta-analysis carried out by Groot and van den Brink (2000) which showed that overqualified workers are more likely to move up to a job level that is adequately matched with their education level than the other way around.

Finally, while overqualification can present a significant problem in the career of a PhD holder, PhD holders seem to have an advantage in terms of rates of overqualification compared to Master's graduates. Frenette (2000) found that the rates of overqualification for Master's graduates range from about 48% to 72%. A follow-up study (Frenette, 2004) found once again that more than half of Master's graduates are overqualified. This is a much higher rate than the 21-29% that is reported in the same study among PhD holders. While there is a clear numeric advantage in favor of the PhD holders, the effects of overqualification on Master's graduates are not the same. Typically, overqualified Master's graduates are employed in jobs that require Bachelor's degrees (Frenette, 2000). In this situation a Master's graduate retains an earnings advantage, earning more than a Bachelor's graduate employed in the same position. This advantage is less pronounced for PhD holders. A possible explanation for this difference is that Master's graduates are able to fully use the skills that were acquired during the graduation process, while PhD holders frequently experience underutilization. In this case Master's graduates are able to offer more than Bachelor's graduates in the same position, while often PhD holders in the position of Master's graduates do not get the chance to utilize the skills that would make them more valuable than those Master's graduates. While there are significant differences in the rates of overqualification between Master's graduates and PhD holders, these rates do not have the same effects and implications. Therefore, overqualification could still be considered as an important side effect for PhD holders that have to find a job outside of academia. Knowing this, it becomes clear that overqualification could potentially influence the sector of employment of PhD holders.

Current research

PhD holders and sector of employment.

To introduce the research questions, this study will first give an overview of the literature researching PhD holders' sector of employment. In a study by Kannankutty and Kang (2001), 48% of the recently graduated PhD holders in science & engineering were employed in academia. Meanwhile, 32% were working in the business enterprise while about 9% were working for the government. The remaining 11% were employed in other sectors (for instance non-profit and self-employment). Prior to graduating, 61% of these PhD holders expressed hopes of working in academia, while only 24% wanted to work in the business enterprise and only 4% wanted to work for the government. This is similar to a study by Fox and Stephan (2001) which found that 59% of PhD students preferred a career in academic teaching or academic research, while the remaining 41% preferred a career outside of academia. Diamond et al. (2014) also found similar results to the previous study, in which 50% of PhD holders were working in academia, although some fields had higher rates of PhD holders working in academia, notably arts and humanities and social sciences at rates of over 60%. The study of Diamond et al. also adds that the proportion of PhD holders working as researchers seems to have declined over time. Although this study found that social sciences and humanities PhD holders were the most likely to work in academia, this is not the case everywhere. Further, the share of PhD holders working as researchers is comparable in each of the four different sectors (Proudfoot & Hoffer, 2016). Unsurprisingly, the sector with the highest rate of PhD holders as researchers was academia with 65%. Government had the second highest rates with 62%, closely followed by business enterprise and private non-profit with respectively 60% and 58%. When looking at different fields, Ballarino and Colombo (2010) found that Italian PhD holders in science fields had more chances of a job in academia than PhD holders in social sciences and humanities. Adding to that, De Grande et al. (2010a) showed that humanities PhD holders were also the most likely to prefer a career in academia.

Although the current figures on the labor market seem to correspond with the rates as found by Fox & Stephan and Kannankutty & Kang, there are quite large differences between nations in terms of employment of researchers (Auriol et al., 2013). South Korea and Japan's researchers are primarily employed in the business sectors (more than 60%), with the second biggest sector being higher education (ASC, 2009). This is in contrast with some countries such as Poland and Slovakia, where about 80% of researchers work in higher education with only 10% in the business sector. The government sector is always the smallest source of employment, although there are

large differences between nations. It must be noted however that the study of the ASC only distinguished three different sectors and did not account for the private non-profit sector. In Iceland and Slovenia more than 20% of researchers work for the government, while this percentage is lower than 5% for Switzerland. The current literature has focused on describing where PhD holders are employed, as well as analyzing whether the rates of PhD holders differed throughout fields of research and nations. What has not yet been researched is whether the proportions of PhD holders employed in the four different sectors are different from the proportions of other tertiary graduates. This study will research the relationship between educational level and sector of employment. Therefore, the first research questions is as follows:

Research question 1a: Are there overall significant differences between the proportions of PhD's and other tertiary graduates employed in the four different sectors?

Additionally, this study will research whether the effect of educational level on sector of employment differs throughout four different European nations (Belgium, Bulgaria, Finland and Portugal). These nations were selected based on their geographical location and their innovation performance as defined by the 2019 European Innovation Scoreboard (European Commission, 2019):

Research question 1b: Is there a significant difference between the four nations (Belgium, Bulgaria, Finland and Portugal) in the relationship between educational level and sector of employment?

PhD holders and gender.

Secondly, this study will research the importance of gender in the employment of PhD's and Master's. Previous research has shown that the proportion of women achieving a PhD has significantly increased. A study in Belgium showed that there was still an uneven distribution of males and females among PhD holders with between 29% and 33% of PhD holders being female, mainly due to the low percentage of women in higher education in the 1980s (De Grande, De Boyser, & Van Rossem, 2010b, Proudfoot & Hoffer, 2016). Despite this, female PhD's are now quickly catching up, a trend which is also seen in a lot of other OECD countries. Similarly, from 1971 to 2002 in the United States, the share of women achieving a PhD raised from 14% to 46% (England et al., 2007). Similarly, in the period from 1993 to 2013, the amount of PhD holders in the United States went up by 45%. While 25% more men achieved PhD degrees during this time,

the increase can be mainly attributed to the increase in female PhD holders, which has doubled since 1993 (Proudfoot & Hoffer, 2016).

In terms of gender, there are no differences between men and women in the preferences for non-academic careers, but women were more likely to prefer a career in academic teaching while men were more likely to prefer research (Fox & Stephan, 2001). In contrast, Waaijer (2016) found that female PhD holders were more likely to work in academic research while male PhD holders were more likely to work in non-academic research. To explain these findings, Waaijer suggests that fields where females are traditionally underrepresented (mainly STEM fields) are more likely to have PhD holders working in non-academic research. A study by Golde and Dore (2001) in the United States found that men were significantly more likely to want a career as a faculty member than women. The study by Fox and Stephan also found that women almost have the same probability to be employed in research universities compared to men, with a few exceptions in certain fields.

In general, the proportion of male and female PhD holders throughout different fields of study has been relatively stable through time (Bornmann & Enders, 2004). Further, the study by Bornmann and Enders (2004) found no significant association between gender and employment inside or outside of academia. This is in contrast with a study by Aanerud et al. (2006) in which two groups of PhD holders in the labor market were compared. The two groups that were chosen were PhD holders in English and mathematics, to compare the more traditional arts with the science fields. While the group of English PhD holders only had slightly more women than men, the mathematics PhD holders were 80% male and 20% female. In both fields, the representation of women in academia was lower than the representation of men in academia. In other words, men were disproportionately more likely to work in academia than women in both English and mathematics. In the business enterprise, government and non-profit sectors the representation of female PhD holders was also higher than the male PhD holders. This contrasts with the finding of Fox and Stephan (2001), where men were also more likely to work in industry and government than women.

Further, Bornmann and Enders (2004) found that about 50% of PhD holders are employed in high-level occupations in academia, government and industry, while the other 50% are in low-level occupations in the same sectors. While male PhD holders are about evenly matched throughout high-level and low-level occupations, female PhD holders are more likely to be in low-level occupations, with only 31% of female PhD holders being employed in a high-level occupation. Additionally, Bornmann and Enders

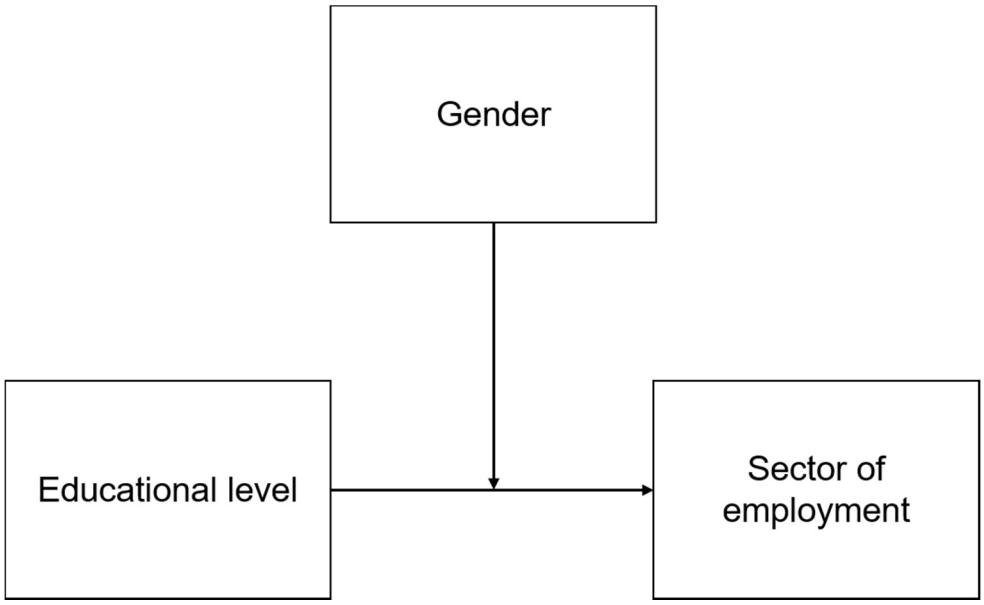
(2004) found that male PhD holders earn between 20% and 46% more than female PhD holders and that this is present in most fields of study. While there has been research on the impact of gender on sector of employment, it is not quite clear yet whether there are any significant differences between male and female master's and PhD's in terms of sector of employment. Therefore, the second research question is as follows:

<u>Research question 2a</u>: *Are there overall significant differences between the share of female PhD's in comparison to other female tertiary graduates in the four different sectors?*

Additionally, this study will research whether the interaction effect of gender in the relationship between educational level and sector of employment differs throughout the four different European nations, namely Belgium, Bulgaria, Finland and Portugal:

<u>Research question 2b</u>: *Is the interaction effect of gender on the relationship between educational level and sector of employment significant for each of the four nations?*

Finally, the research model of this study can be represented as follows:



PhD holders and satisfaction with salary.

Further, this study will analyze some of the satisfactory aspects in the jobs of PhD holders. The first satisfactory aspect considered in this study is satisfaction with salary. Eurostat (2020a) data show that women earn on average 14,8% less hourly than men in

the countries of the European Union. Research on this wage gap has shown similar results among PhD holders, with female PhD holders earning less than male PhD holders across all age categories (Boosten et al., 2014). Further, Levecque et al. (2014) found that this wage gap was larger among male and female PhD holders than it is for male and female Master's graduates. Based on these findings it may be intuitively tempting to say that women are less likely to be satisfied with salary compared to men. However, research on this topic has once again shown to provide mixed results. Sabharwal and Corley (2009) state that a majority of studies on the relationship between satisfaction and gender have found that male faculty members show more job satisfaction than female faculty members, particularly when considering salary. On the other hand, some studies have found no significant gender differences in satisfaction with salary (Klecker, 1997; Till & Karren, 2011), while Oshagbemi (2000) suggests that female academics are more satisfied with their salary than male academics. It is possible that these gender differences are influenced by the sector of employment. Schwabe (2011) states that only a small share of Austrian PhD holders are dissatisfied with their salary. Additionally, Schwabe's study found that PhD holders employed in the business sector were more likely to be very satisfied with salary compared to PhD holders employed in higher education or the non-profit sector. Similar results were found by Escardíbul and Afcha (2017), who state that PhD holders working outside of higher education report higher satisfaction with regard to salary and benefits. Combining gender and sector, Sabharwal and Corley (2009) found that men in social science, science and engineering were more satisfied with salary compared to women. There were however no significant differences in satisfaction with salary in the health sector. This leads to the next research question, which is defined as follows:

Research question 3: *Are there significant gender differences in satisfaction with salary in each of the four sectors?*

PhD holders and satisfaction with quality of work-life balance.

The next question this study poses relates to PhD holders' satisfaction with quality of work-life balance. Lockwood (2003) defines work-life balance as "a state of equilibrium in which the demands of both a person's job and personal life are equal". Research on work-life balance among PhD students and PhD holders plays an important role as work-life balance could affect well-being. For instance, a study by Levecque, Anseel, De Beuckelaer, Van der Heyden and Gisle (2017), showed that conflicting demands between family and work predicts psychological distress and increases risk of

a common psychiatric disorder among PhD students. Another study analyzing PhD holders employed at British universities showed that more than half of these PhD holders were dissatisfied with work-life balance (Hunt, Jagger, Metcalfe & Pollard, 2010). While there have been a lot of studies on gender differences in work-life balance, the existing research has provided mixed results. Some studies have found that there are no significant gender differences in work-life balance (Baptiste et al., 2017; Smith, 2010), while others report that either women (Fox, Fonseca & Bao, 2011; Granleese, 2004; Wilson, Vilardo, Fellinger & Dillenbeck, 2014) or men (Gröpel & Kuhl, 2009) report lower satisfaction with work-life balance. The findings of Dilmaghani and Tabvuma (2019) suggest that potential gender differences in work-life balance are affected by the sector of employment. For instance, women in management and education are less satisfied with work-life balance compared to their male counterparts, while the opposite can be found in the transport sector. The inclusion of this fourth research question aims to build upon these previous findings by comparing gender differences for four different sectors as defined by the Frascati Manual. Therefore, this research question can be defined as follows:

Research question 4: *Are there significant gender differences in satisfaction with quality of work-life balance in each of the four sectors?*

PhD holders and satisfaction with job security.

The third and final satisfactory aspect to be considered in this study is satisfaction with job security. Moguérou (2002) states that job insecurity is one of the key elements in explaining an employee's job dissatisfaction. Similarly, a report of the European Science Foundation (ESF) states that job security is an important factor in aiding early career researchers to make an impact on research (Phillips & Heywood-Roos, 2014). More specifically, researchers on a permanent contract are more likely to have had a significant impact on policy and are more likely to have received media coverage compared to those on a temporary contract. Further, Schwabe (2011) found that PhD holders in the higher education and private non-profit sector were the least likely to be very satisfied with job security. As highlighted before, this is not surprising as PhD holders in higher education are more likely to be employed on a temporary contract. In contrast, PhD holders in the business sector and especially the government sector are more likely to be very satisfied with regard to job security (Schwabe, 2011). Further, Kaiser (2007) analyzed satisfaction with job security in fourteen different European Countries. In half of these countries, women were more satisfied with job security than

men, while men were more satisfied than women only in Portugal and Finland. In the rest of the countries there were no significant gender differences. The idea that gender and sector are both capable of influencing satisfaction with job security begs the question as to how sector of employment and gender interact with regard to satisfaction with job security. Therefore, the fifth and final research question can be defined as follows:

Research question 5: Are *there significant gender differences in satisfaction with job security in each of the four sectors?*

Method

Data

Research questions 1a & 1b and 2a & 2b.

Research question 1a, 1b, 2a & 2b are based on Eurostat (European Statistical Office) statistics on research and development (Eurostat, 2020b), which are freely available on the Eurostat website. These statistics were collected according to the guidelines prescribed in the Frascati Manual (OECD, 2015), an internationally recognized methodology for the collection and use of R&D statistics. The data contain information on all EU member states, candidate countries, EFTA countries (Liechtenstein, Norway, Switzerland, Iceland), the Russian Federation, China, Japan, South Korea and the United States (Eurostat, 2020b). The data of Member States are aggregated and transmitted biannually, after which they are compiled by Eurostat. Data for China, Japan, South Korea and the United States are collected in cooperation with the OECD. At the national level, data is collected by national statistical offices, research councils and ministries. The collection is done through sample or census surveys, administrative registers, or through a combination of different sources. Specifically, the gathering of data is done through national questionnaires in a paper and/or digital format. Non-respondents are followed up with reminders, e-mails and telephone calls (Eurostat, 2012). According to Eurostat (2012), these data are mainly used in policy preparation and trend analysis. Besides being used by scientific organizations and universities, these data are also utilized by international organizations such as the OECD and UNESCO, as well as being used by Directorate Generals of the European Commission.

Research questions 3, 4 & 5.

The second part of this study containing research question 3, 4 and 5 is based on the PhD Career Survey performed in 2017 by ECOOM (Centre for Research & Development Monitoring), an interuniversity consortium with participation of all Flemish universities (KU Leuven, UGent, VUB, UAntwerpen and UHasselt) (Mortier et al., 2020; ECOOM, 2020a). The PhD Career Survey has the goal of systematically mapping the career paths of PhD holders at Flemish universities. To serve this purpose, questionnaires were sent out to all PhD holders that graduated from Flemish universities for whom contact information could be found. The PhD Career Survey mainly provides information on the career paths of PhD holders, for instance about the employment sector, type of contract and work schedule of PhD holders' first and current jobs. Additionally, the PhD Career Survey has information on a number of satisfactory aspects of PhD holders' jobs. The relevant satisfactory aspects for this study include satisfaction

with salary, work-life balance and job security. Finally, the survey acquired information about some of the skills that were learned during doctoral education and whether these skills are used in PhD holders' jobs.

Quality of data

Research questions 1a & 1b and 2a & 2b.

The R&D statistics are compiled for activities performed in the whole economy. They are based on the Statistical Classification of Economic Activities in the European Union (Eurostat, 2008) and comprise information on many types of economic activity, e.g. manufacturing, construction, real estate, etc. In general, the coverage of the data is good, although there are some concerns regarding the coverage of the business enterprise sector (Eurostat, 2020b).

The overall accuracy of the R&D statistics is considered to be very good (Eurostat, 2020b). The nations collecting data report making great efforts to prevent errors as well as performing rigorous testing to detect possible errors. Non-sampling errors such as coverage errors are reported to be very low or negligible.

Further, it is possible that the comparability of data across countries can be affected by the usage of different survey methods. As said before, the R&D data are compiled by nations according to the guidelines prescribed in the Frascati Manual. While there are few differences in particular concepts as written in the Frascati Manual (Eurostat, 2012), it is possible that there are some differences in the implementation of these guidelines (Eurostat, 2020b). However, this should not significantly alter the comparability between nations. Overall, the comparability of statistics between nations is very good. Still, comparability in the business enterprise sector might be lower than the government, higher education and private non-profit sectors. This is mainly attributed to higher non-response rates and the under-coverage of R&D activities in smaller enterprises (Eurostat, 2012, 2020b).

The comprehensive nature of the data and the large sample size provides the main motivation for the usage of Eurostat R&D statistics in this study. The dataset used provides extensive information on the occupational choices of PhD holders and other tertiary graduates. Additionally, the data provides information on the gender and region of these graduates. The data used in this study dates back to 2017, as this is the most recent and most complete data available.

Research questions 3, 4 & 5.

The representativeness of the PhD Career Survey can be estimated by comparing the data of the PhD Career Survey to the Human Resources in Research Flanders database (HRRF) (Mortier et al., 2020). This database contains information on the entire academic career of researchers at the five Flemish universities since 1990 (ECOOM, 2020b). Therefore, the HRRF contains population data which allows comparison with the survey data of the PhD Career Survey. This analysis of representativeness is not found in other initiatives to document the careers of PhD holders such as the Careers of Doctorate Holders by the OECD and the 10 000 PhDs Project by the University of Toronto (Mortier et al., 2020). The analysis of representativeness shows that the participants of the survey represent the entire population in terms of gender with a 99,9% reliability. However, there was an overrepresentation of PhD holders in social sciences and PhD holders that graduated from Ghent University. There was also a strong overrepresentation of PhD holders that graduated after the year 2000. Finally, it is quite likely that there is an overrepresentation of PhD holders employed in universities, as the contact information of these PhD holders is generally easier to find compared to PhD holders employed in different sectors (Mortier et al., 2020).

Measures

Research questions 1a & 1b and 2a & 2b.

Sample. The sample for the research questions involving the Eurostat data are built up out of data concerning four different European nations. The sample provides information on the education level, gender, and sector of employment of four different European nations (Belgium, Bulgaria, Finland, Portugal). The sample contains information on 307 981 individuals in total. Of this, the largest group can be found in Belgium with 117 861 individuals, and the smallest group is Bulgaria with 26 541 individuals. The data used is the most recent data, dating back to 2017. The only exception to this is in Belgium, where the amount of female subjects was extrapolated from the most recent available data in 2016. In Table 1, the proportions of individuals in each of the four sectors of employment can be found. The first sector, business enterprise, is the proportionally largest sector of employment in three of the four countries. The exception is Portugal, where higher education is the largest sector of employment. The proportions of employment in the business sector are highest in Belgium with 56,7% and lowest in Portugal with 36,6%. For every country besides Portugal, the higher education sector is the second highest sector of employment. The

highest proportion is found in Portugal, with 56,3% and the lowest rate in Bulgaria with 33,6%. In Belgium, Finland and Portugal, the higher education and business enterprise sector make up more than 90% of the total employment. This is not the case in Bulgaria, where about a quarter (24,2%) of individuals are employed in the government sector. The lowest proportion employed in the government sector can be found in Belgium (5,7%). In all four countries, the private non-profit sector is the proportionally smallest sector of employment. This sector only accounts for around 1% of employment, with the highest rates in Finland at 1,3% and the lowest in Belgium at 0,6%. Of the complete sample, 47,7% are employed in the business sector, 43,4% in the higher education sector, 8,1% in government, and 0,8% in the non-profit sector.

Table 1

Sector of employment by country

Nation	Belgium	Bulgaria	Finland	Portugal
Business enterprise sector (BES)	66 733 (56.7%)	10 962 (41.3%)	32 249 (51.7%)	37 004 (36.6%)
Government sector (GOV)	6 731 (5.7%)	6 441 (24.3%)	5 349 (8.6%)	6 368 (6.3%)
Higher education sector (HES)	43 725 (37%)	8 903 (33.5%)	23 939 (38.4%)	56 994 (56.3%)
Private non-profit sector (PNP)	672 (0.6%)	235 (0.9%)	831 (1.3%)	845 (0.8%)
Total	117 861	26 541	62 368	101 211

Looking at Table 2, men make up the majority of the sample. Finland has the highest proportion of men in the sample, with men outnumbering women two to one. The lowest proportion of men can be found in Bulgaria, being close to a 50/50 even distribution (51,4% vs 48,6%). Finally, Table 3 shows the distribution of educational level throughout the sample. As can be expected, educational level 5-7 (associates, bachelors, masters) are more prevalent than educational level 8 (PhD holders). The rates

in Bulgaria and Portugal are almost identical, the difference is just 0,1%. The largest difference is found in Belgium, where 77,6% of the sample own an associate's, bachelor's or master's degree, compared to 22,4% PhD holders.

Table 2

Gender by country

Nation	Belgium	Bulgaria	Finland	Portugal
Male	73 067 e (62%)	13 631 (51.4%)	41 133 (66%)	55 970 (55.3%)
Female	44 797 e (38%)	12 910 (48.6%)	21 235 (34%)	45 241 (44.7%)
Total	117 861	26 541	62 368	101 211

Note: e = estimated

Table 3

Educational level by country

Nation	Belgium	Bulgaria	Finland	Portugal
ED5-7	91 471 (77.6%)	17 153 (64.6%)	46 127 (74%)	65 245 (64.5%)
ED8	26 390 (22.4%)	9 388 (35.4%)	16 241 (26%)	35 966 (35.5%)
Total	117 861	26 541	62 368	101 211

Sector. The Eurostat R&D statistics provide information on individuals in four institutional sectors of performance: the business enterprise sector (BES), government (GOV), higher education sector (HES) and private non-profit (PNP). This classification is based on the System of National Accounts (SNA), an international standard system and statistical framework (United Nations Statistical Commission, 2009). In the SNA, higher education institutions are regarded as entities in the non-profit sector. For its importance and relevance to policymakers, the higher education sector is defined as a separate sector in the data (Eurostat, 2020b). Additionally, the household sector (e.g. agriculture, housing, domestic staff) has – by convention – been merged with the private non-profit sector.

In this context, the business enterprise sector (BES) can be defined as all enterprises that are known or supposed to perform R&D activities on a continuous or occasional basis (Eurostat, 2012). The sampling frame of the BES is based on a register of known or supposed R&D performing enterprises and occasionally other enterprises not previously known to perform R&D activities. The information in this register is collected from e.g. national business registers and business surveys such as the Community Innovation Survey. In general, nations adhere to the recommendations of the Frascati Manual by surveying all known enterprises performing R&D activities and drawing at least a random sample from the rest of the enterprises. The sampling frame of the BES results from either a census survey or a combination of census and random surveys.

Following the guidelines of the Frascati Manual (OECD, 2015), the government sector comprises “all units of central (federal), regional (state) and municipal (local) government”. Therefore, the sampling frame of the government sector contains all possible R&D performing units in the sector, including but not limited to: central government (ministries, departments), local councils, government research institutes, non-profit institutions, and national banks, museums and libraries (Eurostat, 2012). The statistics for units in the government sector is further broken down into fields of science and socio-economic objective. While most countries adhere to the recommendations of the Frascati Manual, Germany, Finland and Norway also incorporate units in the private non-profit sector into statistics on the government sector.

As said before, the higher education sector is not encompassed in the private non-profit sector as written in the SNA (United Nations Statistical Commission, 2009). In accordance with the Frascati Manual guidelines and due to its relevance to policymakers, the higher education sector is distinguished as a separate sector. Specifically, the higher education sector includes “all units whose primary activity is to provide formal tertiary education programs” (OECD, 2015). This does not just include universities and colleges, but also research institutes and centers, clinics, etc., that are under the direct control of tertiary education institutions.

Finally, the private non-profit sector contains all non-profit institutions serving households, as well as private individuals and households (OECD, 2015). This could be foundations, associations, consortia, joint ventures, charities, etc. Usually, the private non-profit sector accounts for a limited share of the total R&D expenditure of nations (Eurostat, 2012). Only Cyprus and Portugal report this share as being higher than 5%. Therefore, nations often include units in the private non-profit sector in other sectors, for

instance the business enterprise and government sectors. While households and individuals are included in the private non-profit sector by convention, they account for a very small portion of the total sampling frame. Accordingly, the statistical unit is considered to be legal entities such as foundations and associations, in line with the Frascati Manual (Eurostat, 2012).

Educational level. In addition to information on the institutional sector, Eurostat R&D statistics provide information on the educational level of individuals in different nations. The data makes use of the International Standard Classification of Education (ISCED) to make analysis between nations viable (UNESCO, 2012). The ISCED contains nine levels, each corresponding to a different level of educational attainment. The lowest level is level 0, which corresponds with not having completed primary education. From level 1 to level 4, primary, secondary, and post-secondary non-tertiary education can be found. In the Eurostat R&D statistics, level 0-4 are grouped together. Since this study will only look at forms of tertiary education, level 0-4 will not be discussed further.

Level 5 captures the lowest level of tertiary education and corresponds to short-cycle tertiary education, which generally provides students with practical knowledge, skills and competencies (UNESCO, 2012). They are less theoretically oriented than levels 6 and up, but may provide a pathway to other tertiary education programs. In Europe, this degree is referred to as an associate degree (in Belgium this is equal to “hoger beroepsonderwijs” (HBO5) or “graduaatsopleiding”).

Programs at level 6 are described as being at “bachelor or equivalent” level and are usually theoretically based but may include practical components (UNESCO, 2012). Traditionally, these programs are offered at universities or equivalent institutions. At level 7, programs are described as “master or equivalent”. These programs are typically theoretically based and include a substantial research component. In the Eurostat R&D statistics, level 5-7 are grouped together. Therefore, this study will compare the highest level of education (the doctorate) to all other levels of tertiary education. Being the highest level of the ISCED, the doctorate is situated at level 8. These programs are devoted to advanced study and original research.

Gender. While the Eurostat R&D statistics give information on the gender of the respondents, the specific dataset does not discern between men and women. Rather, the data gives information on the amount of female subjects and the total amount of subjects. As Eurostat R&D statistics generally only report male and female subjects

(Eurostat, 2019) (the surveys do not account for e.g. transgenders), the amount of male subjects can be extrapolated from the difference between total and female subjects.

Region. In addition to comparing PhD holders and other tertiary graduates in terms of occupational sector and gender, this study will compare proportions between countries. The study will compare four different European countries. The amount of PhD holders and the transition of PhD holders to the labor market are considered to have an important effect on innovation performance (Vlaamse Raad voor Wetenschap en Innovatie, 2015). Therefore, four countries have been selected based on innovation performance (European Commission, 2019) and geographical regions. The European Innovation Scoreboard ranks nations' innovation performance by giving them a score relative to the European average. In the most recent European Innovation Scoreboard, a nation can get one of four possible rankings. Innovation leaders are the top innovators in the European Union, scoring above 120% of the EU average (European Commission, 2019). There are four innovation leaders in the European Union in 2019, namely Finland, Denmark, the Netherlands and Sweden. The second group (strong innovators) belongs to the nations that score around average, with a performance between 90% and 120% of the EU average. There are eight member states in this category, examples include Belgium, Germany and France. Moderate innovators are the third group, scoring below average at around 50% to 90% of the EU average. This is the largest group, containing fourteen member states (e.g. Portugal, Spain, Czech Republic). The fourth and last group are called modest innovators, scoring below 50% of the EU average. Only two member states belong to this category, namely two of the more recent additions to the European Union, Bulgaria and Romania. One nation of each of the four innovation groups has been selected. Additionally, these four countries are all EU member states and are located in four different geographical regions of Europe. A category that was previously included in the European Innovation Scoreboard was the status of catching-up country (European Commission, 2007). These countries had scores well below EU average and consisted mainly out of a lot of former socialist republics, for instance Bulgaria, Lithuania, Latvia and Poland. Nowadays, these countries have improved their innovation performance to gain the status of modest or moderate innovators.

In the case of Western Europe, Belgium was selected. According to the European Innovation Scoreboard (European Commission, 2019), Belgium is considered a strong innovator, scoring close to the EU average. Despite a steady growth over the last 10 years, Belgium is not yet considered to be an innovation leader. With changes in EU strategy such as the Lisbon and EU 2020 strategy, many EU member states have

increased their focus on PhD holders. The same can be said for Belgium (and in particular Flanders), where the amount of PhD holders has increased threefold over the last 20 years. This is higher than the EU average, although still below innovation leaders such as Finland and Denmark.

In Eastern Europe, Bulgaria was selected. One of the most recent additions to the European Union, Bulgaria was ranked as a “catching-up” country in the European Innovation Scoreboard upon joining the EU in 2007 (European Commission, 2007), scoring way below the EU average. Since then, it has transitioned into a modest innovator (European Commission, 2019), although still scoring below EU average. Interestingly, a sizeable amount of Bulgaria’s R&D personnel are employed in the government sector (see Table 1). In other EU countries, this is usually centered around the business enterprise sector and the higher education sector (Todorova & Slavcheva, 2016).

Moving on to the third European region, Finland was analyzed as the country in Northern Europe. Finland is the only country in this study considered to be one of the four innovation leaders (European Commission, 2019). Finland is one of the best performing countries in the EU in terms of innovation and R&D and scores well above the EU average. In the first half of the 1990s, Finland made investing in doctoral education one of the key R&D policy issues (Ahola, 2007). This policy choice clearly reflected itself in the number of new PhD holders, as this amount went up by 120 percent during the 1990s. Today, Finland has the third highest amount of new doctoral graduates in the EU (European Commission, 2019).

In Southern Europe, the fourth and final region, Portugal was selected. Portugal is ranked as a moderate innovator, scoring around the EU average (European Commission, 2019). After the Portuguese revolution of 1974, the growth of Portugal’s number of students in tertiary education was amongst the highest in European Union (Perista & Silva, 2004). From 1974 to the beginning of the 2010s, investing in PhD students was an important policy choice for the Portuguese R&D system (Corado Simões et al., 2018; Godinho, Simões & Zifciakova, 2016). Around the beginning of the 2010s, the global financial crisis originating in 2007 was ongoing in Portugal. This way, the idea that there was a surplus in the amount of PhD holders began circulating in Portugal through mass media (Santos, Horta & Heitor, 2016). This has resulted in a decrease in funding of grants for new PhD graduates. Santos et al. argue that this reasoning does not hold up and that there is in fact a shortage of PhD holders in Portugal.

Today, Portugal scores around the EU average when it comes to new PhD holders per year (European Commission, 2019).

Research question 3, 4 & 5.

Sample. The sample taken from the PhD Career Survey contains 2 642 PhD holders. Of this sample, 45,5% are female and the average age is 39.7 (SD = 7.22; range = 27 – 78). 95,1% of the sample have Belgian citizenship, while 2,4% have citizenship in one of the other EU28 nations (including the United Kingdom). Additionally, 2,0% of the PhD holders in the sample have citizenship in a nation outside of the European Union. The citizenship of the remaining 0,5% are unknown. Further, more than half of the PhD holders (58,6%) are employed in the higher education sector as defined by the Eurostat R&D data and the System of National Account. The second biggest sector is the business enterprise with 26,4% followed by the government sector (10,3%). The smallest sector is the private non-profit with 4,3%. For twelve individuals (0,4%) the sector of employment was unknown.

Sector. The sectors used for the analysis of research question 3, 4 and 5 have been grouped together based on the sectors defined by the Eurostat R&D data, the Frascati Manual and the System of National Accounts. In line with the SNA, the higher education sector encompasses universities and colleges as well as research institutes (e.g. IMEC and VIB) and clinics that are under the direct control of tertiary education institutions.

In the original PhD Career Survey, the business enterprise sector was split up into private enterprises performing R&D activities and those not performing R&D activities. Eurostat R&D data includes all enterprises known to perform R&D activities as well as at least a random sample of enterprises not previously known to perform R&D activities. To test research questions 3 through 5, all subjects employed in either R&D performing or non-R&D performing enterprises were included in the business sector.

The government sector was defined the same as it is in the Eurostat R&D data and the SNA. Therefore, the government sector included “all units of central (federal), regional (state) and municipal (local) government” (United Nations Statistical Commission, 2009). Additionally, the government sector also included PhD holders employed in one of the institutions of the European Union (e.g. the Parliament or Commission).

Finally, the private non-profit sector was defined in the same way as in the Eurostat R&D data. The original PhD Career Survey also contained PhD holders employed in “other” sectors (e.g. self-employed, freelancers, culture, etc.). For uniformity

and because these “other” sectors were not defined in the Eurostat R&D data, PhD holders belonging to this category were not included in the final sample.

Satisfaction with salary. A simple 5-point Likert scale was used to measure PhD holders’ satisfaction with salary in their most recent job. This scale ranged from 1 (very dissatisfied) to 5 (very satisfied). The item used is “In your current/last job, please indicate how you felt about the following aspects: salary”.

Satisfaction with quality of work-life balance. Same as above, a 5-point Likert scale ranging from 1 (very dissatisfied) to 5 (very satisfied) was used to measure satisfaction with quality of work-life balance. The item used is “In your current/last job, please indicate how you felt about the following aspects: quality of work-life balance”.

Satisfaction with job security. Once again, a 5-point Likert scale ranging from 1 (very dissatisfied) to 5 (very satisfied) was used to measure satisfaction with job security. The item used to measure satisfaction with job security is “In your current/last job, please indicate how you felt about the following aspects: job security”.

Results

Research question 1

To test the hypothesis that PhD holders are employed in different sectors compared to other tertiary graduates a Pearson’s chi-square test for independence was performed to examine the relation between educational level and sector of employment. For the complete sample, proportions of PhD holders employed in the different sectors differ significantly from the proportions of other tertiary graduates employed in the different sectors, $\chi 2$ (3, N = 307 981) = 55 421.96, $p < .001$. Cramer’s V is an adequate measure to define the strength of an association between two categorical variables when using a contingency table larger than 2 × 2 (Field, 2009). Using Cohen’s (1988) guidelines on effect sizes, the corresponding Cramer’s V = 0.424 indicated a large effect size. This shows that educational level is strongly related to the sector of employment. These results show support for research question 1a. Post-hoc z-tests were performed to compare the proportions of PhD holders and other tertiary graduates in each of the four sectors. The .05 criterion of statistical significance was employed for all tests. A Bonferroni correction was performed to correct for multiple comparisons. As seen by the frequencies cross tabulated in Table 4, PhD holders were significantly more likely to be employed in the higher education sector compared to other tertiary graduates (73,8% vs 31,2%). The opposite can be found for the business enterprise sector, where PhD holders were less likely to be employed compared to other tertiary graduates (14,7% vs

60,9%). Rates in the government and non-profit sector were also significant, but the differences were smaller than they were in the higher education and business sector. 10,5% of PhD holders were employed in the government sector compared to 7,1% of other tertiary graduates. In the private non-profit sector this was respectively 1,1% and 0,7%. These results imply a reasonably large divide between business and academia.

Table 4

Cross tabulation of educational level and sector

Sector	BES	GOV	HES	PNP	Total
ED5-7	134 049 (60.9%)	15 667 (7.1%)	68 659 (31.2%)	1 621 (0.7%)	219 996
ED8	12 899 (14.7%)	9 222 (10.5%)	64 902 (73.8%)	962 (1.1 %)	87 985
Total	146 948	24 889	133 561	2 583	307 981

Note: Cramer's V = .424

Continuing on, a Pearson's chi-square test was performed for each of the four different countries separately to test research question 1b. For Belgium, the relation between educational level and the sector of employment was significant, $\chi 2$ (3, N = 117 861) = 9 792.43, $p < .001$, Cramer's V = 0,288. Table 5 (Appendix A) shows the proportions of PhD holders in the different sectors compared to other tertiary graduates. For Bulgaria, the test statistic was also significant, $\chi 2$ (3, N = 26 541) = 7265.99, $p<0.001$, Cramer's V = 0,523, with table 6 (Appendix A) showing proportions in each of the different sectors. The same was true for Finland, $\chi 2$ (3, N = 62 368) = 10 949,40 = $p < 0.001$, Cramer's V = 0,419. Table 7 (Appendix A) shows proportions in each of the different sectors. Lastly, the test statistic was significant for Portugal $\chi 2$ (3, N = 101 211) = 28 085,62 = $p < 0.001$, Cramer's V = 0,527. Table 8 (Appendix A) shows proportions in the different sectors in Portugal. These results provide support for research question 1b. When looking at effect sizes for Portugal, Bulgaria and Finland, it is clear to see that these were large effects (a large effect size for chi-squared tests and Cramer's V is >.29 (Cohen, 1988; Kim, 2017)). In the case of Belgium however, the chi-square test shows a Cramer's V of .288. When rounded, this is also a large effect size (>.29). These results show that the strength of the association between educational level and sector of employment was not as strong in Belgium as it is in Portugal, Bulgaria and Finland.

Post-hoc z-tests were performed for each of the four countries separately to compare the proportions of PhD holders and other tertiary graduates in each of the four sectors. Again, the .05 criterion of statistical significance was employed for all tests and a Bonferroni correction was performed to correct for multiple comparisons. In each of the four countries, the proportions of other tertiary graduates in the business sector were higher than for PhD holders. In every country, more than half of other tertiary graduates were employed within the business sector. At 64,3% the highest rates can be found in Belgium, while the lowest rates can be found in Portugal with 54,2%. For PhD holders, employment in the business sector ranged between 30,1% and 4,5% for respectively Belgium and Portugal. Continuing on, PhD holders were employed more frequently in higher education compared to other tertiary graduates for all four countries. As seen in Tables 5 through 8, higher education made up at least half of the employment for PhD holders. The lowest rates were found in Bulgaria with 56,6%. In Portugal rates were very high, with 9 out of 10 PhD holders employed in higher education. For other tertiary graduates, the rates employed in higher education were lowest in Bulgaria with 20,9% and highest in Portugal with 37,2%. Moving on, PhD holders were more frequently employed in the government sector than other tertiary graduates in Belgium, Bulgaria and Finland. In Portugal, PhD were less likely to be employed in the government sector. Finally, PhD holders were more frequently employed in the private non-profit sector than other tertiary graduates in Belgium and Finland. In Bulgaria, no significant difference was found between the proportions in the private non-profit sector.

Research question 2

To test research question 2a, a multinomial logistic regression was performed to model the interaction effect of gender and educational level in the four groups. The .05 criterion of statistical significance was employed for all tests. The addition of the predictors to a model that contained only the intercept significantly improved the fit between model and data, $\chi 2$ (9, N = 307 981) = 73 625.90, Cox and Snell R2 = .21 Nagelkerke R2 = .25, $p < .001$. The pseudo-R2 measures Nagelkerke R2 and Cox and Snell R2 provided an indication of the adequacy of fit for the multinomial logistic regression model (Smith & McKenna, 2013). The pseudo-R2 measures showed a reasonable fit of the model with the data (Field, 2009). As seen in Table 9, significant unique contributions were made by gender, educational level and the interaction effect of educational level and gender. These results show support for research question 2a.

Table 9

Predictors' unique contributions in the Multinomial Logistic Regression (N = 307 981)

Predictor	X^2 (df)
Gender	16 391.89 ** (3)
Educational level	13 104.23 ** (3)
Gender x educational level	539.73 ** (3)

Note: $\chi 2$ = amount by which -2 log likelihood increases when predictor is removed from the full model. *p < .05, **p < .01

Cox & Snell R^2 = .213

Nagelkerke R^2 = .249

The reference group was the business enterprise sector. The parameter estimates are shown in Table 10.

Table 10

Parameter Estimates Contrasting the Business Enterprise Sector versus Each of the Other Groups (N = 301 981)

Predictor	*B* (SE)	*OR*
Government sector vs business enterprise sector		
Intercept	-0.57 (0.02)	
Educational level†	-1.55 ** (0.03)	0.21
Gender*	1.04 ** (0.02)	2.83
Gender x educational level	-0.46 ** (0.03)	0.63
Higher education sector vs business enterprise sector		
Intercept	1.42 (0.01)	
Educational level†	-1.99 ** (0.02)	0.14
Gender*	1.03 ** (0.01)	2.79
Gender x educational level	-0.53 ** (0.02)	0.59
Private non-profit sector vs business enterprise sector		
Intercept	-2.92 (0.05)	
Educational level†	-1.62 ** (0.06)	0.20
Gender*	1.11 ** (0.05)	3.03
Gender x educational level	-.35 ** (0.08)	0.70

Note: *p < .05, **p < .01

† Reference category = PhD level

* Reference category = Male

All predictors had a significant parameter for comparing the business enterprise sector with the other sectors. The educational level and gender of a person significantly

predicted whether they were employed in the business sector as opposed to the other sectors. As educational level changes from ED5-7 to ED8, the odds ratio of working in the government sector compared to the business sector was 0.21. In other words, the odds of a PhD holder working in the government sector compared to the business sector was about 20 % more likely than for a tertiary graduate. In the same fashion, the odds of a PhD holder working in the higher education sector compared to the business sector was 14% more likely than for other tertiary graduates. Finally, the odds of a PhD holder in private non-profit compared to business was 20% more likely than for a tertiary graduate. For the interaction effect, the odds ratio tells us that as the value of gender changes from female (0) to male (1) in the model in combination with educational level changing from ED5-7 (0) to ED8 (1), the odds ratio of working in the government sector vs business was 0.63. In other words, when educational level is lower (relative to the PhD level), it was less likely for men to be employed to be employed in the government sector compared to the business sector. The same can be said when comparing the higher education sector and the private non-profit sector to the business enterprise sector.

As seen in Figure 1, male tertiary graduates were most likely to be employed in business enterprise. Both female and male PhD holders were less likely to be employed in business compared to other tertiary graduates. Additionally, male PhD holders were slightly more likely to be employed in business than female PhD holders. When looking at the government sector, male tertiary graduates were least likely to be employed, at around 5%. The percentages for the other groups ranged between 9,8% and 11,3%. The third sector, higher education, showed again that PhD holders were much more likely to be employed in higher education. Once again, male tertiary graduates were least likely to be employed in this sector. Finally, male tertiary graduates were least likely to be employed in private non-profit (0,5%), although the differences were quite small. Female PhD holders were most likely to be employed here at 1,3%. Interestingly, the difference in employment between male and female PhD holders was much smaller than for other tertiary graduates. This figure once again points to a significant interaction effect of gender on the relationship between educational level and sector of employment.

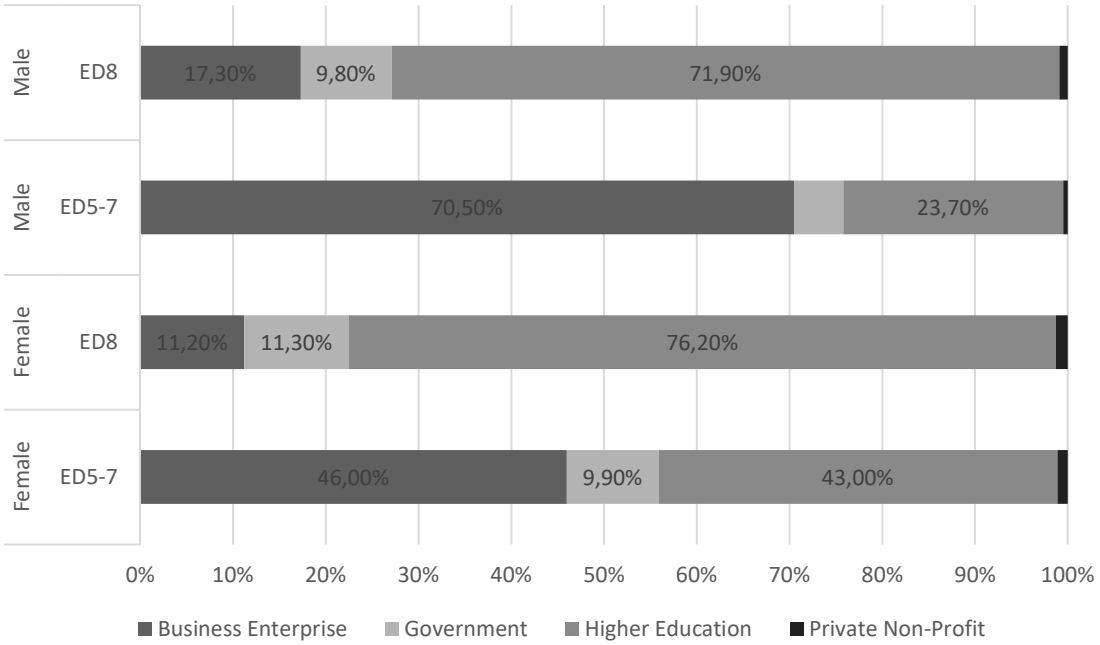


Figure 1. The share of female and male tertiary graduates and PhD holders by sector of employment

To test research question 2b, multinomial logistic regressions were performed for each of the four countries separately. For Belgium, the addition of the predictors to a model that contained only the intercept significantly improved the fit between model and data, $\chi 2$ (9, N = 117 861) = 14 144.53, Cox and Snell R2 = .11, Nagelkerke R2 = .14, $p < 0.001$. As seen in Table 11 (Appendix B), significant unique contributions were once again made by gender, educational level and the interaction effect of educational level and gender.

The same can be found in Bulgaria, $\chi 2$ (9, N = 26 541) = 8945.57, Cox and Snell R2 = .29, Nagelkerke R2 = .32, $p < 0.001$., Finland, $\chi 2$ (9, N = 62 368) = 18 176.29, Cox and Snell R2 = .25, Nagelkerke R2 = .30, $p < 0.001$., and Portugal, $\chi 2$ (9, N = 101 211) = 36 486.36, Cox and Snell R2 = .30, Nagelkerke R2 = .36, $p < 0.001$. In all of these models, significant unique contributions were made by gender, educational level and the interaction effect of educational level and gender. Results can be found in table 12, 13 and 14 respectively (Appendix B). These results supported research question 2b. Gender seems to have a significant effect on the relationship between educational level and sector of employment. The strength of this interaction effect differed throughout nations. In Figures 2 through 5, percentages of male and female PhD holders and tertiary graduates in each of the four sector can be found.

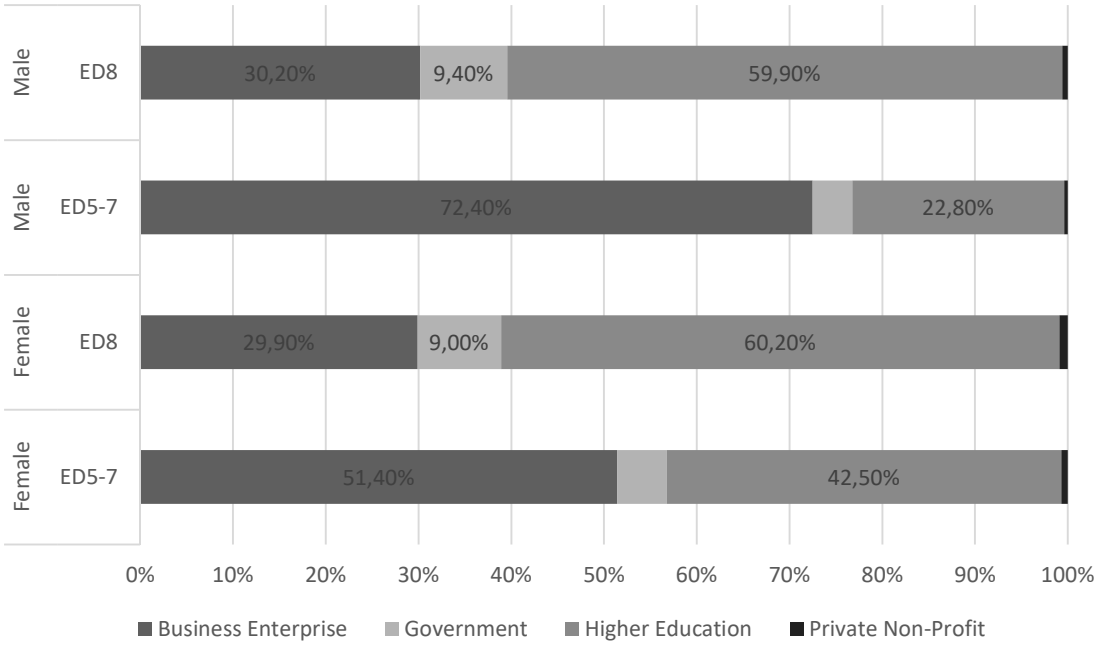


Figure 2. The share of female and male tertiary graduates and PhD holders by sector of employment in Belgium

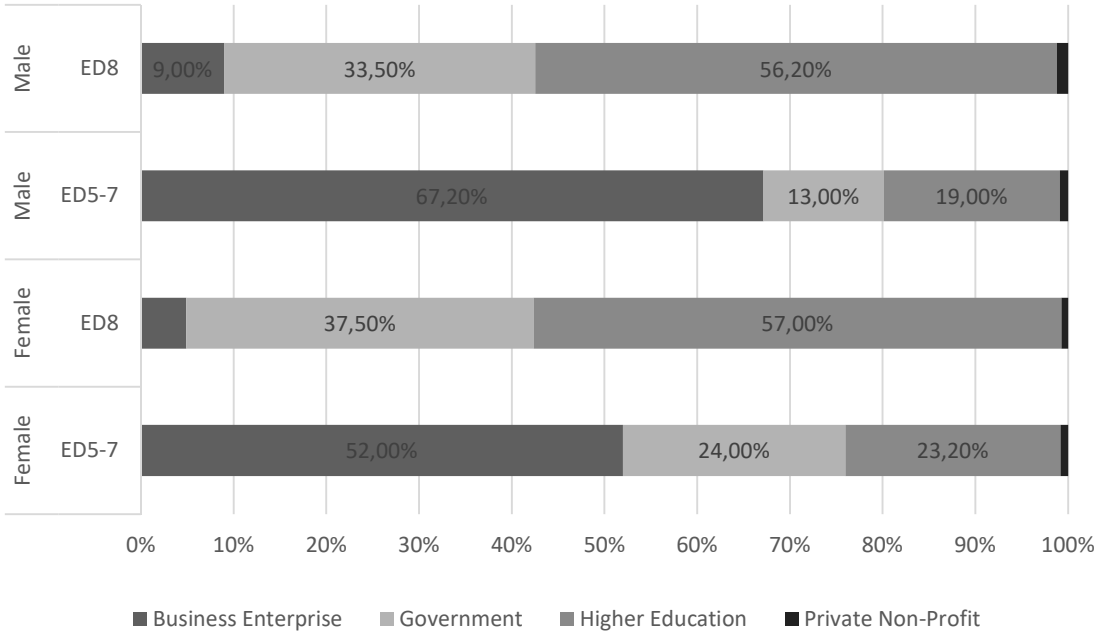


Figure 3. The share of female and male tertiary graduates and PhD holders by sector of employment in Bulgaria

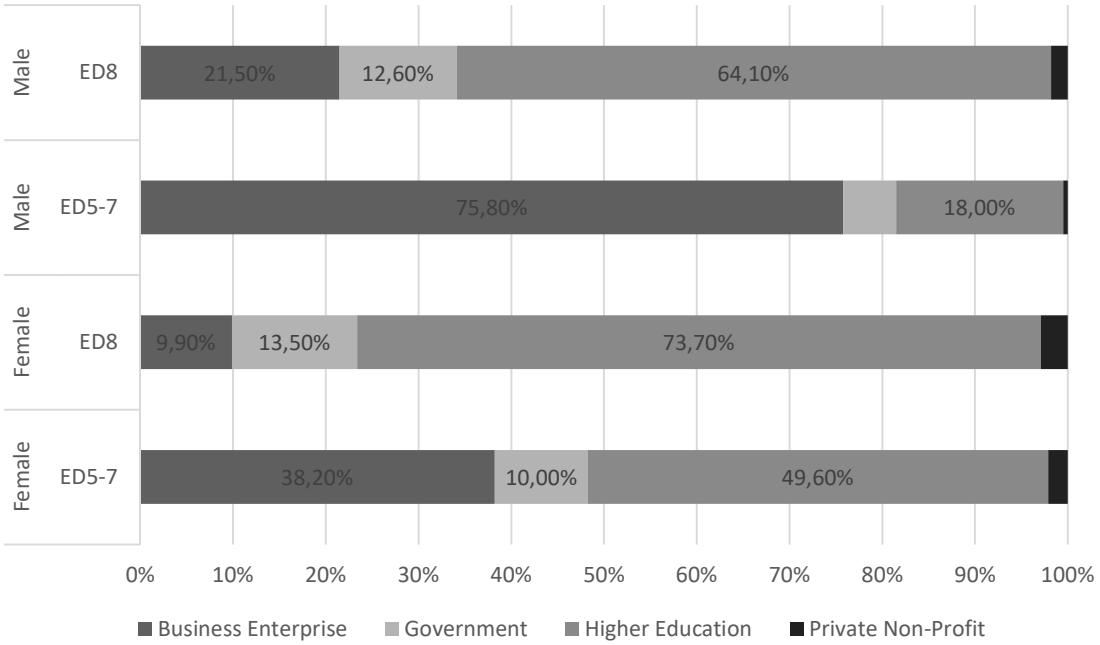


Figure 4. The share of female and male tertiary graduates and PhD holders by sector of employment in Finland

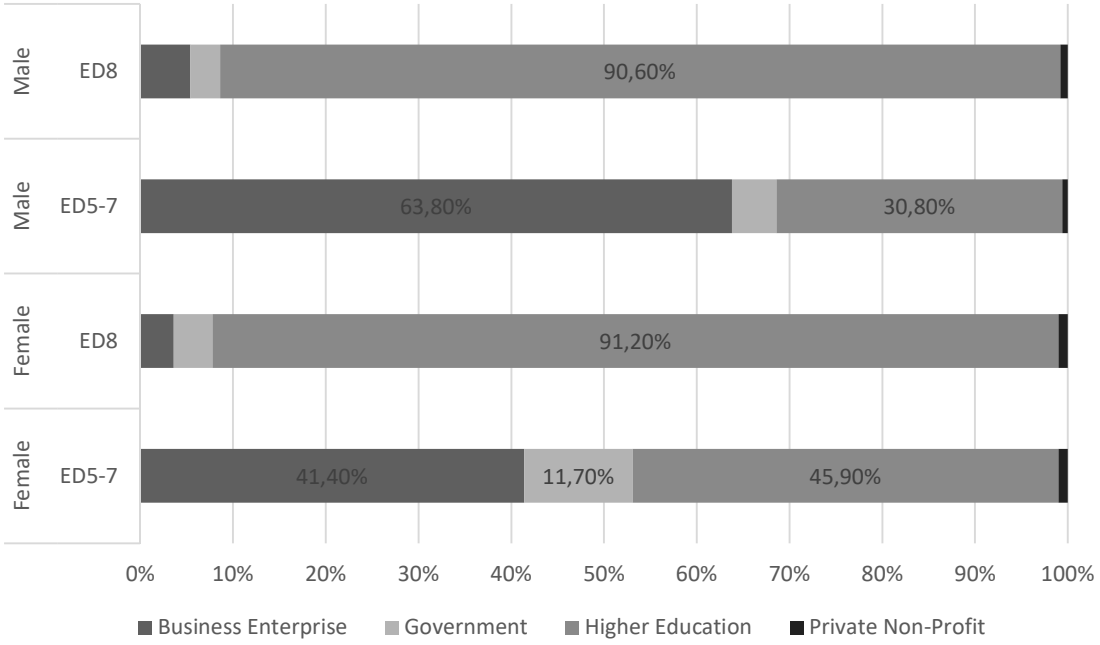


Figure 5. The share of female and male tertiary graduates and PhD holders by sector of employment in Portugal

When looking at Belgium in Figure 2, it can be seen that the employment of tertiary graduates and PhD holders was similar to the pattern that is seen with all four countries combined. Tertiary graduates were most likely to be employed in business, while PhD holders were more likely to be employed in higher education. The main difference compared to Figure 1 is that PhD holders were more frequently employed in business and less in higher education. Still, Belgium had the highest rates of PhD holders employed in business of the four different countries. Interestingly, the employment choices of PhD holders did not seem to differ much for males and females. The difference in percentages for each of the four sectors was only between 0,3 and 0,4%.

Looking at Figure 3, more than half of male and female tertiary graduates were employed in the business sector. In comparison, less than 10% of PhD holders were employed in business. Males were more frequently employed in business for both groups. As said before, the government sector made up about 24% of total employment in Bulgaria. For PhD holders, government made up a quite substantial percentage of total employment. With 37% and 33% for females and males respectively, the government sector ranked second behind higher education and in front of business. Figure 3 shows that there was a reasonable gap between employment for PhD holders and other tertiary graduates in the government sector. For higher education the order of the four groups was identical to Figure 1. Female PhD holders were most likely to be employed in higher education, closely followed by male PhD holders. Other tertiary graduates followed at a large distance of more than 30%. Interestingly the differences between male and female tertiary graduates were not as pronounced as they are for the combined sample. Once again, differences in employment in private non-profit were limited (at maximum 0,5%).

For Finland, percentages of employment were comparable to those for the complete sample. As seen in Figure 4, the differences with other countries were most pronounced in the business sector. Around 3 out of 4 male tertiary holders were employed in business, which was a significant difference with male PhD holders where only about 1 out of 5 are employed in business. When looking at female PhD holders, only 10% were employed in business. The gap in employment between male and female PhD holders in the business sector was the highest out of all four countries. Further, employment in government was comparable to what can be found in the complete sample. Similar to business, the difference between the employment of male and female PhD holders in higher education was higher than any of the other countries in the sample. Overall, Finland shows the largest differences in employment for males and females.

Figure 5 shows the employment percentages for Portugal. Here, the percentages of employment were relatively comparable to those for the complete sample. The biggest difference can be found among PhD holders. Interestingly, more than 90% of PhD holders were employed in the higher education sector, with little differences in gender. Also, Portugal was the only country in the sample where PhD holders are less frequently employed in the government sector than other tertiary graduates.

Research question 3

To test research question 3, a two-way ANOVA was performed to examine the effect of gender and sector of employment on satisfaction with salary. First, a dummy variable was created for the independent variable sector of employment. The reference level was higher education. For the independent variable gender, the reference level was set to male. Second, it is important to note that a Levene's test was utilized to test for the assumption of homogeneity of variances. The resulting F-statistic showed that the variances cannot be assumed to be equal ($F = 3.943$, $p = < .001$). Therefore, the assumption of homogeneity of variances was violated. The violation of the assumption of homogeneity might lead to the estimation of the regression parameters being biased and inconsistent (Hayes & Cai, 2007). This could have negative effects on inference, for instance Type I error inflation or reduced statistical power. To deal with the assumption of homogeneity of variances being violated, standard errors were adjusted to be robust in the presence of heterogeneity (Field & Wilcox, 2017). In other words, an alternative method to estimate the standard errors is used that does not assume homoscedasticity (Hayes & Cai, 2007). More specifically, Davidson and MacKinnon's HC3 heteroscedasticity-consistent covariance matrix estimators were used (Cai & Hayes, 2008) to estimate the parameters of the model. Using this method, the effect of gender and sector of employment on satisfaction with salary was estimated. The estimated model included one main effect for gender, three main effects for sector (dummy 1: government versus higher education; dummy 2: business enterprise versus higher education and dummy 3: non-profit versus higher education) and three interactions (gender x dummy 1; gender x dummy 2; gender x dummy 3).

First, the overall model (Table 15) showed a significant contribution in explaining the variance in satisfaction with salary ($F(7, 2859) = 5.98$, $p < .001$; $R^2 = .014$) with the interaction contributing .006 in the explained variance of the model (R^2 change = .006; $F(3, 2859) = 5.97$, $p < .001$). Inspecting the interactions resulted in a significant contribution of the business enterprise sector relative to the higher education sector together with gender ($b = -.30$, 95% CI [-.47, -.13], $t = -3.52$, $p < .001$) and a significant

interaction of non-profit sector relative to higher education sector together with gender (b = -.41, 95% CI [-.70, -.13], t = -2.87, p < .01).

Simple slope analyses (Figure 6) showed that for both the business enterprise sector and non-profit sector, women reported lower scores of satisfaction in salary in comparison to men (business enterprise sector: b = -.31, CI[-.45, -.17], t = -4.31, p < .001; non-profit sector: b = -.43, CI[-.69, -.16], t = -3.11, p < .01). There was no significant difference in reported satisfaction levels of salary between men and women in the higher education and government sector (higher education: b = -.01, CI[-.10, .08], t = -.26, p = .79; government sector: b = -.17, CI[-.37, .04], t = -1.59, p = .11).

Table 15

Linear model of independent variables of the change in satisfaction with salary levels (standard errors reported in parentheses). 95% bias corrected and accelerated confidence intervals and standard errors based on 5000 bootstrap samples. Standard errors corrected with HC3 for heteroscedasticity.

	b (se b)	CI intervals
Constant	3.80*** (.03)	[3.74, 3.86]
Gender	-.01 (.05)	[-.10, .08]
Dummy 1: higher education sector vs. government	.22** (.08)	[.06, .37]
Dummy 2: higher education sector vs business enterprise sector	.02 (.05)	[-.08, .12]
Dummy 3: higher education sector vs non-profit sector	.18 (.11)	[-.03, .39]
Gender x dummy 1	-.16 (.11)	[-.38, .07]
Gender x dummy 2	-.30*** (.08)	[-.47; -.13]
Gender x dummy 3	-.41** (.14)	[-.70, -.13]

Note: R^2 = .014 (p < .001).

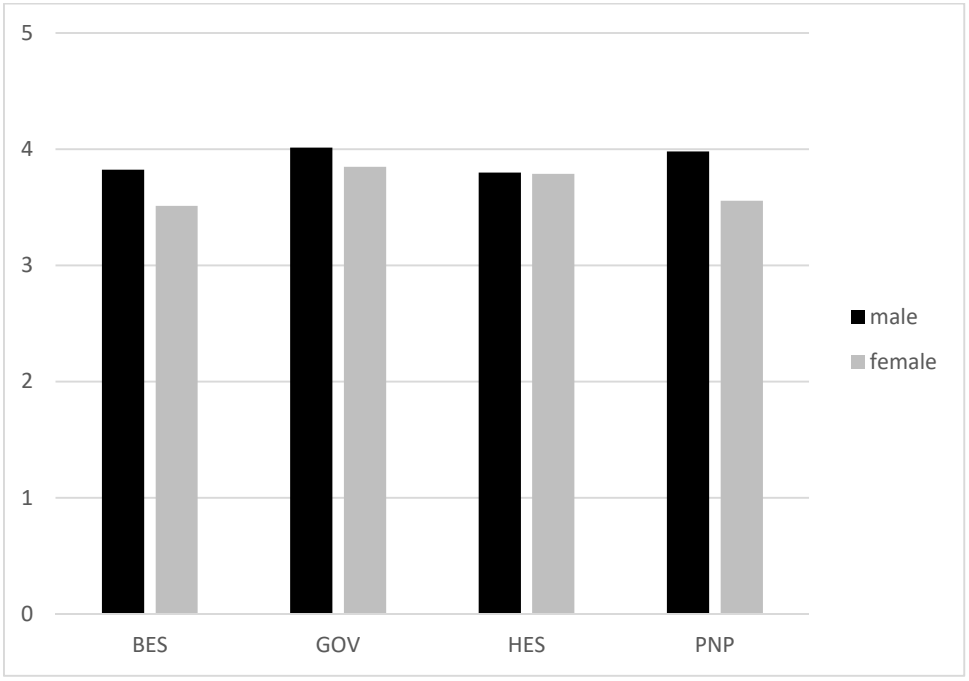
Model: F(7, 2859) = 5.98 , p < .001

* = significant at the p < .05

** = significant at the p < .01

*** = significant at the p < .001)

Figure 6. Mean satisfaction scores in satisfaction with salary



Note: BES = Business enterprise sector; GOV = Government sector; HES = Higher education sector; PNP = Non-profit sector

Research question 4

Moving on to research question 4, a two-way ANOVA was performed to examine the effect of gender and sector of employment on satisfaction with quality of work-life balance. Again, dummy variables were created for the independent variable sector of employment. The reference level was higher education. A Levene's test showed that the assumption of homogeneity of variances was violated (F = 6.191, $p < .001$). Therefore, HC3 heteroscedasticity-consistent covariance matrix estimators were again used to estimate the effect of gender and sector of employment on satisfaction with quality of work-life balance. First, there was a significant contribution by the overall model (Table 16) in explaining the variance in satisfaction with quality of work-life balance ($F(7, 2858) = 15.04$, $p < .001$; $R^2 = .034$). The interaction contributed a non-significant .0004 in the explained variance of the model (R^2 change = .0004; $F(3, 2858) = 0.42$, $p = .74$).

Further, simple slope analyses (Figure 7) showed that there were no significant gender differences in satisfaction with quality of work-life balance in any of the four sectors (higher education: b = -.06, CI[-.17, .04], t = -1.16, p = .25; government: b = -.06, CI[-.28, .17], t = -.47, p = .64; business enterprise: b = -.13, CI[-.29, .02], t = -1.70, p = .09; non-profit: b = .07, CI[-.29, .43], t = .38, p = .70).

Table 16

Linear model of independent variables of the change in satisfaction with quality of work-life balance (standard errors reported in parentheses). 95% bias corrected and accelerated confidence intervals and standard errors based on 5000 bootstrap samples. Standard errors corrected with HC3 for heteroscedasticity.

	b (se b)	CI intervals
Constant	3.26*** (.04)	[3.19, 3.33]
Gender	-.06 (.05)	[-.17, .04]
Dummy 1: higher education sector vs. government	.50*** (.10)	[.32, .69]
Dummy 2: higher education sector vs business enterprise sector	.32*** (.06)	[.21, .43]
Dummy 3: higher education sector vs non-profit sector	.39* (.16)	[.08, .69]
Gender x dummy 1	.006 (.13)	[-.25, .26]
Gender x dummy 2	-.07 (.09)	[-.26; .11]
Gender x dummy 3	.13 (.19)	[-.25, .51]

Note: R^2 = .034 (p < .001).

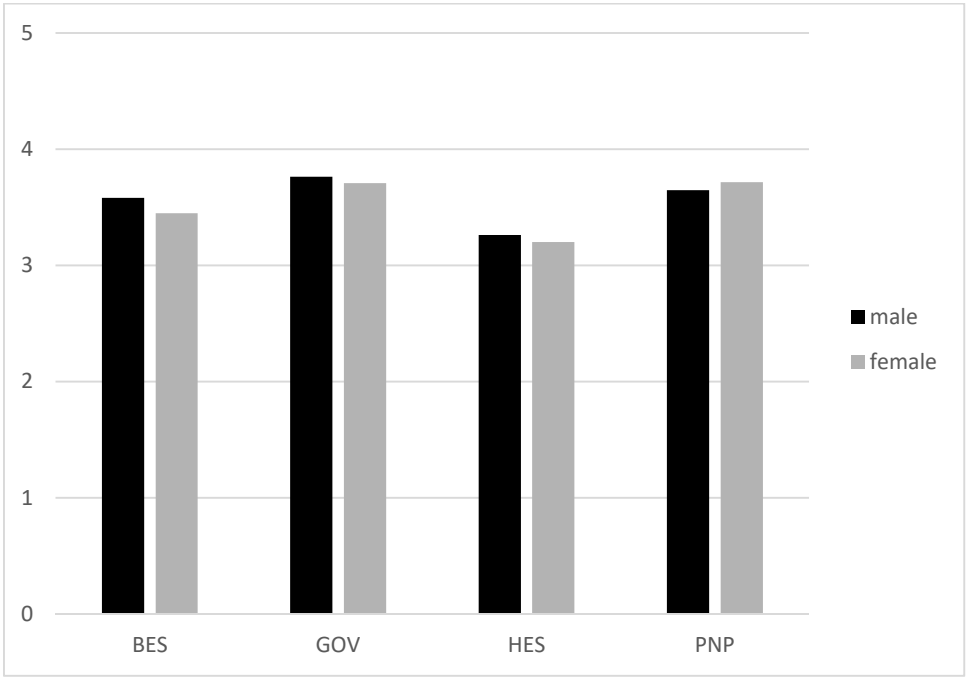
Model: F(7, 2858) = 15.04 , p < .001

* = significant at the p < .05

** = significant at the p < .01

*** = significant at the p < .001)

Figure 7. Mean satisfaction scores in satisfaction with quality of work-life balance



Note: BES = Business enterprise sector; GOV = Government sector; HES = Higher education sector; PNP = Non-profit sector

Research question 5

Finally, research question 5 examined the effect of gender and sector of employment on satisfaction with job security. Dummy variables were created for the independent variable sector of employment. The reference level was higher education. A Levene's test indicated a violation of the assumption of homogeneity of variances (F = 88.816, p < .001). Again, HC3 heteroscedasticity-consistent covariance matrix estimators were used to estimate the effect of gender and sector of employment on satisfaction with job security. The overall model (Table 17) showed a significant contribution in explaining the variance in satisfaction with job security (F(7, 2862) = 29.26, p < .001; R^2 = .063). The interaction contributed .003 in the explained variance of the model (R^2 change = .003; F(3, 2862) = 3.95, p < .01). Further inspection of the interaction showed a significant contribution of the business sector relative to the higher education sector (b = .31, 95% CI [.13, .49], t = 3.41, p < .001).

Next, simple slope analyses (Figure 8) showed that for the higher education sector, women reported lower scores of satisfaction in job security in comparison to men (b = -.32, CI[-.45, -.18], t = -4.66, p < .001). There was no significant difference in reported satisfaction levels of job security between men and women in the government, business enterprise and non-profit sector (government: b = -.09, CI[-.31, .13], t = -.81, p = .42;

business enterprise: b = -.002, CI[-.12, .12], t = -0.04, p = .97; non-profit: b = -.17, CI[-.49, .14], t = -1.09, p = .28).

Table 17

Linear model of independent variables of the change in satisfaction with job security (standard errors reported in parentheses). 95% bias corrected and accelerated confidence intervals and standard errors based on 5000 bootstrap samples. Standard errors corrected with HC3 for heteroscedasticity.

	b (se b)	CI intervals
Constant	3.58*** (.05)	[3.49, 3.67]
Gender	-.32*** (.07)	[-.45, -.18]
Dummy 1: higher education sector vs. government	.66*** (.09)	[.48, .84]
Dummy 2: higher education sector vs business enterprise sector	.34*** (.06)	[.23, .46]
Dummy 3: higher education sector vs non-profit sector	.38** (.13)	[.12, .64]
Gender x dummy 1	.22 (.13)	[-.04, .48]
Gender x dummy 2	.31*** (.09)	[.13; .49]
Gender x dummy 3	.14 (.17)	[-.20, .48]

Note: R^2 = .063 (p < .001).

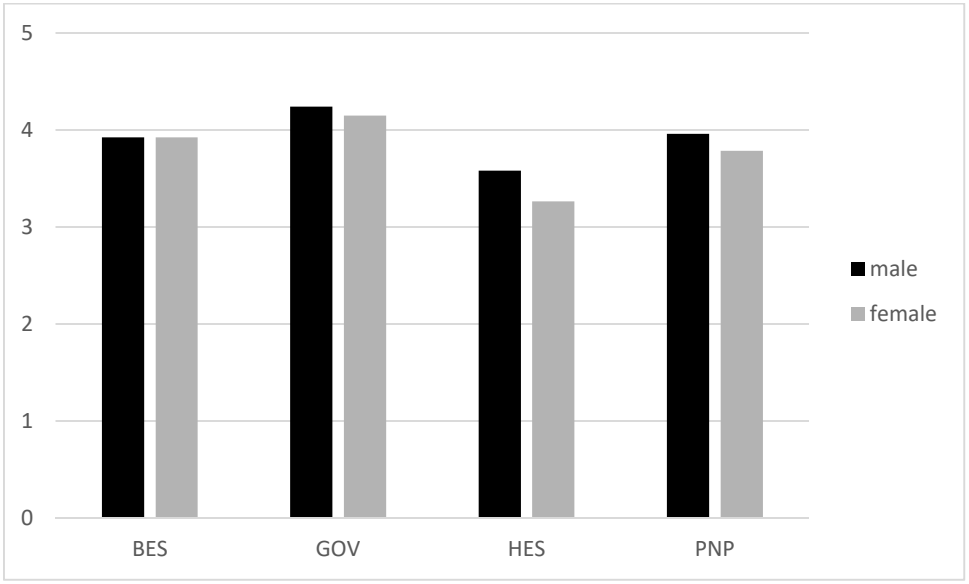
Model: F(7, 2862) = 29.26 , p < .001

* = significant at the p < .05

** = significant at the p < .01

*** = significant at the p < .001)

Figure 8. Mean satisfaction scores in satisfaction with job security



Note: BES = Business enterprise sector; GOV = Government sector; HES = Higher education sector; PNP = Non-profit sector

Discussion

Research question 1a & 1b

The purpose of this study was to identify the sectors in which PhD holders were employed, to determine whether PhD holders make different employment choices when compared to other tertiary graduates, and whether this differed between nations. Going back to research question 1a, there is support for the notion that PhD holders and other tertiary graduates were still mainly employed in different sectors. As said before, one of the main motivations for this study was that careers of PhD holders are changing and that the idea of the typical academic career is no longer the standard. The results of research question 1a showed that the majority of PhD holders were employed in the higher education sector (which contains a broad variety of institutions including universities, colleges, academic clinics, research institutes) and that the majority of other tertiary graduates were employed in the business sector. Additionally, the results of research question 1a showed that there is a strong association between educational level and sector of employment. In other words, these results provided support for the notion that educational level was related to an individual's sector of employment. It must however be noted that this association was stronger in Bulgaria and Portugal than Belgium. While Portugal had over 90% of its PhD holders seeking employment in higher education and only around 5% in business, Belgium had around 60% of PhD holders in higher education and 30% in business. Finland also showed a higher rate of PhD holders

in business compared to Bulgaria and Finland (16,6% vs respectively 6,8% and 4,5%), while having a large majority of PhD holders in higher education (68,1%). Still, these results might suggest that countries with a high innovation performance have higher rates of PhD holders working outside of academia and within business.

Meissner, Gokhberg and Shmatko (2016) state that PhD holders were one of the important determinants in the innovation performance of countries, leading to increased economic competitiveness. As said before, it is assumed that PhD holders provide value to the innovation process by transferring scientific knowledge from academia to industry (Herrera et al., 2010; Garcia-Quevedo et al., 2012). Therefore, it is a possibility that higher rates of PhD holders employed outside of higher education contribute to higher innovation performance. This could also be interpreted the other way around, in the sense that PhD holders are employed more frequently in the business sector when innovation performance is high. R&D expenditure in the business sector is considered to be one of the determinants for innovation performance according to the European Innovation Scoreboard (2019). Both Belgium and Finland score above average (more than 120% of the EU average) when it comes to R&D expenditure in the business sector. In comparison, Bulgaria and Portugal score below 50% of the EU average.

Another possible determinant of the higher rates of PhD holders in the business sector might be found in the rates of cooperation between the business and higher education sector. Linkages between the public sector (which can include higher education) and private sector are an important innovation dimension according to the European Innovation Scoreboard (2019). When it comes to these linkages, Belgium and Finland score above 120% of the EU average. Belgium and Finland score above average on all three categories within this dimension, namely innovative SME's collaborating with others, public-private co-publications, and private co-funding of public R&D expenditures (European Innovation Scoreboard, 2019). On most of these categories, Portugal and Bulgaria score below 50% of EU average. Knowing this, Garcia-Quevedo et al. (2012) state that cooperation between higher education and business encourages firms in the business sector to recruit PhD holders. Mangematin (2000) found similar results, stating that PhD holders collaborating with firms in business have increased probabilities of working in the business sector. In other words, the high scores of Belgium and Finland on the innovation dimension of linkages could lead to more PhD holders being employed within the business sector.

Garcia-Quevedo et al. (2012) also remark that firms belonging to medium-high and high-technology sectors are more likely to employ PhD holders. Similarly, Santos et

al. (2016) suggest that the transfer of PhD holders from academic to non-academic sectors is mainly relevant in countries with well-developed high-tech sectors. When looking at medium and high-tech product exports for all four countries, it must be noted that all of them score below EU average, with Finland and Belgium scoring slightly higher than Bulgaria and Portugal (European Innovation Scoreboard, 2019). However, Finland and Belgium do have higher shares of medium high-tech and high-tech firms in the total manufacturing sector. For Finland, 6% of the total labor force was employed in the high-tech sector in 2008 (Simonen, Svento & McCann, 2016). The economic recession and the decline of Nokia were said to have caused a decline in R&D expenditure and had a negative effect on high-tech firms (Halme, Saarnivaarna & Mitchell, 2016). Since then, it is attempting to change back to a specialization in medium high and high-tech sectors. For Belgium, it is important to note that there is a strong concentration of R&D, which means that 60% of business R&D is performed in high-tech sectors (Kelchtermans & Zacharewicz, 2016). It is a possibility that this is another way to partially explain the higher rates of PhD holders working in the business sector in Belgium and Finland. Additionally, Santos et al. (2016) suggest that the very high rates of PhD holders in higher education in Portugal can be explained by the structure of the economy and the large concentration of smaller firms that do not hire PhD holders.

Looking at these findings, further research into the ways PhD holders can impact innovation performance might be important to policymakers. In light of the report on the Bologna Seminar written by Christensen (2005), policymakers are trying to ensure that the knowledge of PhD holders is spread outside of academia. Therefore, a higher proportion working outside of higher education might prove to be beneficial in trying to increase innovation performance. On the other hand, research is needed to check to which degree PhD holders employed in business are an effect of increased innovation performance.

Research question 2a & 2b

Moving on to the results of research question 2, a couple of findings stand out. In general, it seems like men were more likely to be employed in business, while women were more likely to be employed in the higher education, government and private non-profit sectors. This was the case for both PhD holders and other tertiary graduates. Additionally, both male and female tertiary graduates were more likely to be employed in the business sector than PhD holders. For higher education, both male and female PhD holders were more likely to find employment than tertiary graduates. These results can

be found in each of the four countries separately. In general, female PhD holders were most likely to be employed in the government sector, although there were some differences between countries. For instance, in Portugal female tertiary graduates were most likely to work in government while in Belgium male PhD holders were most frequently employed in the government sector. In all four countries, male tertiary graduates were the least likely to find employment in the government sector. In general women were the most likely to find employment in the non-profit sector. The only exception was in Bulgaria, where men were slightly more likely to be employed in non-profit.

Interestingly, it seemed that male and female tertiary graduates show clearer differences in sector of employment for each of the four sectors, especially in the business and higher education sector. For PhD holders the differences were much smaller. Where the difference in employment between male and female tertiary graduates is 24,5% in the business sector and 19,3% in higher education, the differences for male and female PhD holders are only 6,1% for business and 4,3% for higher education (see Figure 1). This is comparable to a study by Bornmann and Enders (2004) which claims that there is no significant association between gender and a career inside or outside academia for PhD holders. Similarly, Fox and Stephan (2001) state that there are no differences between male and female PhD holders in the preferences for non-academic careers. Of course, it must be noted that preferences do not always correspond with actual career decisions. In the context of the results of the current study, male and female PhD holders were less likely to be employed in different sectors compared to other tertiary graduates. This finding was most prominent in Belgium, where the employment rates for PhD holders only differ around 0,3-0,4% in each sector (see Figure 2).

To explain these findings, one of the answers may be found in literature on occupational segregation. For instance, Cross and Bagilhole (2002) found that men are more frequently represented in e.g. construction, energy and manufacturing. In contrast, women are more frequently employed in education and health and social work. The idea that there are occupations that are traditionally segregated by gender could explain the differences between male and female tertiary graduates. In Finland, all educational levels see the fields of education and health care dominated by women (Vuorinen-Lampila, 2016). This is congruent with the differences as seen in Figure 4. However, it does not account for the lack of differences between male and female PhD holders in for instance Belgium. The results of Lampousaki (2010) might provide a hint to why this is not the

case. In this study, some traditional occupations were more frequently associated with a certain gender. For instance, the jobs of plumber and pilot are more frequently linked to men, while the job of nurse is more frequently related to women. This is less common among some "highly qualified" occupations, for instance lawyers, doctors and economists. In other words, it is possible that PhD holders are more frequently employed in jobs that do not have a traditional gender segregation, as could be more often the case with tertiary graduates. Similarly, Fernandez and Friedrich (2011) note that women are more likely to apply for stereotypically female jobs (e.g. receptionist) while men more frequently apply for stereotypically male jobs (e.g. computer programmer). Again, it is possible that jobs for PhD holders do not adhere to a stereotypical gender role as frequently as jobs for lower levels of tertiary education.

While this is one of the possibilities for why male and female PhD holders are more frequently employed in the same sectors compared to other tertiary graduates, a lot remains unclear. More research is necessary to determine why male and female PhD holders are more frequently employed in the same sector, while this isn't the case for male and female tertiary graduates. For instance, Barbulescu and Bidwell (2013) suggest that perceived work-life balance can impact employment choices for men and women differently. The way in which work-life balance impacts employment might differ between tertiary graduates and PhD holders. Therefore, more research should be performed to identify the determinants of employment choices for male and female PhD holders.

Research question 3, 4 & 5

Knowing this, the satisfactory aspects analyzed in research questions 3 through 5 might provide an additional insight into the results of research questions 2a and 2b. First of all, research question 3 analyzed gender and sector differences in satisfaction with salary. The results of this analysis supported the notion that satisfaction with salary is not equal throughout sectors and that there were significant gender differences. Female PhD holders in the business enterprise and non-profit sectors were less satisfied with salary compared to men, while there were no gender differences in higher education and government. Barbulescu and Bidwell (2013) state that women are not less likely to apply to higher-paying jobs compared to men. As a result, it is unlikely that differences in satisfaction with salary can be attributed to gender differences in job preferences. In Flanders (Belgium), wages in higher education and government are determined by pay scales, which are generally based on an employee's (educational) level or their length of service. Therefore, contract negotiation is a much less common practice in government and higher education than it is in private non-profit or the business enterprise. A meta-

analysis by Mazei et al. (2015) shows that men are on average more likely to negotiate for better economic outcomes than women. While these findings do depend on context (e.g. negotiation experience), this is one of the possible ways to help explain the finding that there are gender differences in satisfaction with salary. Additionally, the overall model explained 1,4% of the variance in satisfaction with salary. While the model had a significant contribution in explaining variance in satisfaction with salary, it is clear that there are many other factors that could potentially impact satisfaction with salary.

Research question 4 analyzed gender and sector differences in satisfaction with quality of work-life balance. This analysis revealed that the interaction of sector with gender was not significant and there were no significant gender differences in any of the sectors. In research on job preferences, Barbulescu and Bidwell (2013) found that women are more likely to apply to jobs with a higher anticipated work-life balance compared to men. Knowing this, it might be expected that women are more satisfied with quality work-life balance, although this is not the case. It could be the case that as women have an increased preference for work-life balance, they also attach an increased importance to work-life balance. A possible explanation could be that women are indeed employed in jobs with better work-life balance, but that they are not more satisfied than men precisely because they attach an increased amount of importance to work-life balance. Future research could be based on the relationship between job preferences in work-life balance and satisfaction with quality of work-life balance. Further, the overall model explained 3,4% of the variance in satisfaction with quality of work-life balance, which was a significant contribution.

Research question 5 analyzed gender and sector differences in satisfaction with job security. The analysis showed that satisfaction with job security was not equal throughout sector and gender, with employment in the business sector contributing significantly to satisfaction with job security when compared to higher education. This is not entirely surprising considering PhD holders in academia are relatively frequently employed on a temporary contract (Auriol et al., 2013). However, it was noted in the literature study that PhD holders preferring employment in academia are more likely to place great importance on job security. Once again it might be the case that high demands for job security lead to a lower satisfaction with job security relative to other sectors. As a result, it is not unlikely that PhD holders with a strong preference for job security deliberately choose for a career outside of academia. Additionally, there were gender differences in satisfaction with job security in the higher education sector, but not in any of the other sectors. Female PhD holders in higher education were less satisfied

with job security compared to their male counterparts. The studies of Emmenegger (2010) and Marini, Fan, Finley and Beutel (1996) seem to indicate that there are little gender differences in preference for job security. If there are no differences in preferences for job security, there might also be no differences in actual satisfaction with job security. However, this does not account for the gender differences in the higher education sector. The study of Petrongolo (2004) indicates that being employed on a temporary contract leads to lower satisfaction with job security, with women being more negatively affected than men. Therefore, it is possible that female PhD holders are disproportionately employed on temporary contracts in higher education compared to men. Further research is needed to determine why gender differences in job satisfaction are only found in the higher education sector.

Finally, it is possible to try and integrate the findings for these satisfactory aspects with the results found in research questions 2a and 2b. To recapitulate, the results of research question 2a and 2b found negligible gender differences in sector of employment for Belgian PhD holders. In other words, the shares of male and female PhD holders in each sector were roughly equal across gender. Considering this was not the case among other tertiary graduates in Belgium, a part of the explanation might be found in some of the satisfactory aspects of PhD holders. As mentioned a couple of times throughout the literature study, satisfactory aspects could have an impact on the preferred sector of employment. As a result, if there are negligible gender differences in sector of employment, it is a possibility that there are also negligible gender differences in some satisfactory aspects of PhD holders. In this case, satisfaction with quality of work-life balance might be the most likely candidate of the three satisfactory aspects to help explain the results of research question 2. The results of research question 3 indicated that men and women were equally satisfied with quality of work-life balance in each of the four sectors. Therefore, it seems that experienced satisfaction with quality of work-life balance does not impact sector of employment for PhD holders. It is less clear how satisfaction with job security and salary could impact sector of employment for PhD holders, as there were significant gender differences in some sectors. Further research is needed to determine whether gender differences in satisfaction with job security, salary and quality of work-life balance influence the employment of tertiary graduates and PhD holders differently.

Limitations and future research

There are a couple of limitations to the study as presented. First of all, the cross-sectional design of the study can be seen as a limitation. Therefore, the design in its

current state makes it difficult to make any statements on causality. This study is based on the most recently available statistics of Eurostat on research and development, which date back to 2017. As EU member states collect and report R&D statistics annually or biannually to Eurostat, it would be possible to utilize a longitudinal design. This way, it is an option to research how choices of sector of employment for both PhD holders and tertiary graduates have changed throughout time and continue to change.

Another limitation can be found in the comparability of the data. As said before, the comparability of the data between countries is considered to be very good (Eurostat, 2020b). It is however possible that the comparability of the business sector between countries is less good than for the government, higher education and private non-profit sectors. This can be attributed to higher non-response rates and an underrepresentation of smaller organizations performing R&D (Eurostat, 2012, 2020b). Additionally, countries take care to compile the R&D statistics according to the guidelines and definitions as proposed by the Frascati Manual (OECD, 2015). Still, it is possible that data comparability across countries is affected by the usage of different survey methods (Eurostat, 2020b). Overall, countries delivering R&D statistics take good care to prevent these errors, but it is still important to keep this in mind when interpreting the results.

A limitation to keep in mind is that the data on gender for Belgium was not available for the year 2017. Therefore, the figures that are used in the analysis are an estimation of the total amount of men and women in the Belgian sample. As there was data available from the year 2016, an estimation of the amount of men and women in the Belgian sample was based on the 2016 data. It is possible that this is a slight under- or overestimation of the true 2017 gender statistics.

A limitation and some possibilities for future research can also be found in the selection of the four EU countries. The Eurostat R&D statistics provide information on the EU28 countries (which still contains the United Kingdom) as well as EU candidate countries and a couple of countries outside of Europe such as the US, Japan, South Korea and China. In its current form, this study discusses four different EU member states based on their geographical location in Europe and based on innovation performance as defined by the European Innovation Scoreboard (European Commission, 2019). Additionally, these four member states provide information on the gender of the subjects in the sample. The purpose of this selection was to create a relatively representative subsample of EU member states. Of course, a sample in which more or all current 27 EU members are represented would allow better and more accurate predictions and would improve external validity. This could be the subject of a

study in the future and would make it possible to see if patterns can be found across the entirety of the European Union.

Another limitation is the violation of the assumption of homoscedasticity in the analyses of research question 3 through 5. While not being an ideal solution, the usage of HC3 heteroscedasticity-consistent covariance matrix estimators as a correction can be considered acceptable (e.g. Cai & Hayes, 2008). Still, caution should be applied when interpreting the results.

Finally, the large sample sizes could be seen as a benefit but also as a limitation for this study. As mentioned before, the Eurostat R&D statistics provide information for R&D activities performed in the economy as a whole. The countries compiling the data also report taking precautions to avoid sampling and non-sampling errors (Eurostat, 2020b). Therefore, the large sample size should be representative for all firms and institutions performing R&D within the EU member states. On the other hand, the current study has a very large sample size which provides information on more than 300 000 PhD holders and other tertiary graduates. As stated by Faber & Fonseca (2014), the larger the sample size, the higher the analysis power. Faber & Fonseca state that this "implies an exaggerated tendency to reject null hypotheses with negligible differences". In other words, differences that might not be statistically significant with smaller sample sizes, become significant because of the large sample size. This does not seem to be too much of a problem when considering the values of Cramer's V in research question 1a and 1b, as they represent a strong association between educational level and sector of employment. The same can be said for the pseudo R^2 measures used in research question 2a and 2b, which represent a relatively good fit with the data. It could however be more of a problem when considering the post-hoc z-tests performed in research question 1a and 1b. Even when using a Bonferroni correction to correct for multiple comparisons, a statistically significant difference was found in some cases in the private non-profit sector. To give an example, 0,5% of tertiary graduates are employed in private non-profit compared to 0,7% of PhD holders. While considered to be a statistically significant difference according to the post-hoc z-tests, this might not be the case when using a smaller sample size. It is therefore important to carefully interpret the results and placing them into the context of the large sample size.

Next, a couple of suggestions have already been made in this study concerning future research. For instance, a longitudinal design would make it possible to see how rates of PhD holders in the different sectors of employment have evolved over the years. Another possibility is to use the Eurostat R&D data to include more EU member states

in the analysis. This way, it would be possible to see patterns across the entire European Union. This would also make it possible to see how the employment of PhD holders in Europe differs when comparing to the United States or Asian countries such as Japan and South Korea. Besides research on the level of the European Union, added value could be found in performing research that is country-specific. Some assumptions can be made when comparing the employment rates of PhD holders between countries, but it remains difficult to make statements about the situation of a specific country. Country-specific research would therefore make it easier to interpret the results of the current study. Also, it could be beneficial to assess the impact of innovation performance on the employment of PhD holders. Another option is to look at international mobility of PhD holders. The 2009 Careers of Doctorate Holders shows that on average 14% of PhD holders have shown international mobility over a period of 10 years (Auriol et al., 2013). It is also likely that this is a low estimate and that the actual percentage of PhD holders with international mobility is even higher. It could be interesting to see how international mobility among PhD holders has an impact on the sector of employment. For instance, the study of Labrianidis and Vogatzis (2013) highlights the impact of highly skilled migration or a “brain drain” on the Greek labor market.

Besides looking at how PhD holders differ from other tertiary graduates in terms of sector of employment, it is a possibility to research which type of jobs are more likely to be filled in by PhD holders compared to other tertiary graduates. Similarly to this study, research on this topic could also look at gender differences in different types of jobs.

Finally, it might be interesting to research how the employment of PhD holders may be affected by the recent and ongoing coronavirus pandemic. A study by Monastersky (2009) states that the US saw significant increases in students enrolling into PhD programs as an alternative to finding employment in a labor market affected by an economic recession. If the same patterns were to be seen again, it could therefore be an option to see how a potential economic crisis could affect the employment of PhD holders. It is for instance possible that a sharp increase in new PhD holders could drive more PhD holders towards different sectors of employment. On the other hand, it is also possible that universities will have to cut funding for new PhD students which could lead to a decrease in new PhD holders on the labor market.

Implications

The research in its current state brings a couple of theoretical and practical implications. First of all, the results of this study could be important to policymakers concerned with the diffusion of academic knowledge towards different sectors. As

mentioned before, PhD holders employed outside of higher education might have a positive impact on the innovation performance of a country. Therefore, policymakers might find it important to stimulate PhD holders to find employment outside of higher education more frequently. On the other hand, policymakers could stimulate firms performing R&D activities and medium-high and high-tech firms to employ more PhD holders. The results of research question 2 might also be important to policymakers interested in gender inequality on the labor market for PhD holders. While the findings of this study suggest that male and female PhD holders are frequently employed in similar sectors, this does not mean female PhD holders are employed under the same circumstances in these sectors. For instance, some studies detailed how female PhD holders have a harder time and take longer to achieve tenure, as well as taking longer to achieve full professorship (Kahn, 1993; Toutkoushian, 1999). Additionally, there has been research on the gender wage gap among PhD holders, with many studies describing how female PhD holders earn less than their male counterparts (Alfano, Cicatiello, Gaeta, & Pinto, 2019; Porter, Toutkoushian and Moore III, 2008; Toutkoushian, 1999; Umbach, 2007). Interestingly, the gender wage gap seems to be larger among PhD holders than it is for Master's graduates (Levecque et al., 2014). The idea that male and female PhD holders are employed in similar sectors but do not experience the same conditions and trajectories (e.g. Etzkowitz & Ranga, 2011), raises questions for researchers and policymakers. The satisfactory aspects of research questions 3, 4 and 5 illustrate this. The gender differences in satisfaction with salary and job security could for instance be indicative of structural problems (e.g. discrimination). If so, these results could also be of interest to policymakers.

Conclusion

The first and main purpose of this study was to research PhD holders' sector of employment. The employment of PhD holders was contrasted to the employment of other tertiary graduates to see whether there were significant differences in each of the four sectors (business enterprise, government, higher education and private non-profit). Also, gender differences in each of the four sectors were researched for both PhD holders and other tertiary graduates. The second purpose of this study was to check for sector and gender differences among PhD holders in three different satisfactory aspects: salary, quality of work-life balance and job security. These research questions were put into perspective by detailing the added value and some satisfactory and job aspects of PhD holders and how they could relate to choice of sector of employment. The results of

this study showed that educational level is related to choice of sector of employment, with PhD holders being employed in different sectors compared to other tertiary graduates. This was the case for each of the four countries tested (Belgium, Finland, Bulgaria and Portugal). The same was found with regard to gender differences and the interaction effect between gender and educational level. In terms of the satisfactory aspects, there were significant gender and sector differences in satisfaction with salary and job security. However, this was not the case for satisfaction with quality of work-life balance. These results provide a better understanding of the employment of PhD holders and some of the satisfactory aspects that could impact this employment. To summarize, the idea that prompted this study was the premise that there has been an increase in PhD holders transitioning away from the traditional academic career. While this might be true, the majority of them are still employed in the higher education sector. This is in contrast to other tertiary graduates, who are mainly employed in the business enterprise sector. Further, the results showed that the gender differences in sector of employment were smaller among PhD holders than for other tertiary graduates, especially in Belgium. These results contribute to knowledge on the employment outcomes of PhD holders, a field which has seen relatively limited research up to now.

References

Aanerud, R., Homer, L., Nerad, M., & Cerny, J. (2006). Paths and perceptions: Assessing doctoral education using career path analysis. *The assessment of doctoral education: Emerging criteria and new models for improving outcomes*, 109-141.

Advisory Science Council (2009). The Role of PhDs in the Smart Economy. (December).

Alfano, V., Cicatiello, L., Gaeta, G. L., & Pinto, M. (2019). *The gender wage gap among PhD holders: an empirical examination based on Italian data* (No. 393). GLO Discussion Paper.

Agarwal, R., & Ohyama, A. (2013). Industry or academia, basic or applied? Career choices and earnings trajectories of scientists. *Management Science, 59*(4), 950-970.

Ahola, S. (2007). Doctoral education in Finland. Between traditionalism and modernity. *Doctoral study in contemporary higher education*, 29-39.

Alba-Ramirez, A. (1993). Mismatch in the Spanish labor market: overeducation?. *Journal of Human Resources*, 259-278.

Allen, J., & van der Velden, R. (2001). Educational mismatches versus skill mismatches: effects on wages, job satisfaction, and on-the-job search. *Oxford economic papers, 53*(3), 434-452.

Auriol, L., Misu, M., & Freeman, R. (2013), Careers of Doctorate Holders: Analysis of Labour Market and Mobility Indicators, *OECD Science, Technology and Industry Working Papers*, 2013/04, OECD Publishing. http://dx.doi.org/10.1787/5k43nxgs289w-en

Auriol, L., Misu, M., & Galindo-Rueda, F. (2016). Doctorate holders' labor market and mobility: The academic career as the first choice. In *The science and technology labor force* (pp. 51-74). Springer, Cham.

Ballarino, G., & Colombo, S. (2010). Occupational outcomes of PhD graduates in Northern Italy. *Italian Journal of Sociology of Education, 2*(2).

Baptiste, D., Fecher, A. M., Dolejs, S. C., Yoder, J., Schmidt, C. M., Couch, M. E., & Ceppa, D. P. (2017). Gender differences in academic surgery, work-life balance, and satisfaction. *Journal of Surgical Research*, *218*, 99-107.

Barbulescu, R., & Bidwell, M. (2013). Do women choose different jobs from men? Mechanisms of application segregation in the market for managerial workers. *Organization Science*, *24*(3), 737-756.

Bender, K. A., & Heywood, J. S. (2009). Educational mismatch among Ph. Ds: determinants and consequences. In *Science and engineering careers in the United States: An analysis of markets and employment* (pp. 229-255). University of Chicago Press. https://doi.org/10.3386/w12693

Bergen Communiqué (2005). The European higher education area–achieving the goals. In *Communiqué of the conference of European ministers responsible for higher education* (pp. 19-20).

Bloch, C., Graversen, E. K., & Pedersen, H. S. (2015). Researcher mobility and sector career choices among doctorate holders. *Research Evaluation, 24*(2), 171-180.

Boosten, K., Vandevelde, K., Derycke, H., te Kaat, A. J., & Van Rossem, R. (2014). Careers of doctorate holders survey 2010. *R&D and innovation in Belgium research series*, *13*.

Boosten, K., & Spithoven, A. (2016). Pecuniary and Scientific Motives as Drivers of PhD Careers: Exploring the Evidence from Belgium. In *The Science and Technology Labor Force* (pp. 121-143). Springer, Cham.

Bornmann, L., & Enders, J. (2004). Social origin and gender of doctoral degree holders. *Scientometrics, 61*(1), 19-41.

Cai, L., & Hayes, A. F. (2008). A new test of linear hypotheses in OLS regression under heteroscedasticity of unknown form. *Journal of Educational and Behavioral Statistics*, *33*(1), 21-40.

Casey, B. H. (2009). The economic contribution of PhDs. *Journal of Higher Education Policy and Management, 31*(3), 219-227.

Christensen, K. K. (2005). Bologna seminar doctoral programmes for the European Knowledge society. *General Rapporteur's Report. Salzburg*, 3-5.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences. Abingdon. *England: Routledge*.

Conlon, G., & Patrignani, P. (2011). The returns to higher education qualifications.

Corado Simões, V., Mira Godinho, M., & Sanchez-Martinez, M. (2018). RIO Country Report 2017: Portugal.

Cross, S., & Bagilhole, B. (2002). Girls' jobs for the boys? Men, masculinity and non-traditional occupations. *Gender, Work & Organization*, *9*(2), 204-226.

Cuthbert, D., & Molla, T. (2015). PhD crisis discourse: a critical approach to the framing of the problem and some Australian 'solutions.' *Higher Education, 69*(1), 33–53. https://doi.org/10.1007/s10734-014-9760-y

De Grande, H., De Boyser, K., Vandevelde, K., & Van Rossem, R. (2010a). Transitions from academia to industry: how do doctorate holders fit in?. *M&SS Working Paper, 8.*

De Grande, H., De Boyser, K., & Van Rossem, R. (2010b). Carrièrepaden van doctoraathouders in België. *HR2 e-document*.

Di Paolo, A. (2016). (Endogenous) occupational choices and job satisfaction among recent Spanish PhD recipients. *International Journal of Manpower, 37*(3), 511–535.

Di Paolo, A., & Mañé, F. (2016). Misusing our talent? Overeducation, overskilling and skill underutilisation among Spanish PhD graduates. *The Economic and Labour Relations Review, 27*(4), 432-452.

Diamond, A., Ball, C., Vorley, T., Hughes, T., Moreton, R., Howe, P., & Nathwani, T. (2014). The impact of doctoral careers. *Final Report*, CFE Research, Leicester.

Dilmaghani, M., & Tabvuma, V. (2019). The gender gap in work–life balance satisfaction across occupations. *Gender in Management: An International Journal*.

Duarte, J., & Mendonça, J. (2016). Determinant of careers patterns for doctorate holders. In *The Science and Technology Labor Force* (pp. 193-229). Springer, Cham.

Durette, B., Fournier, M., & Lafon, M. (2016). The core competencies of PhDs. *Studies in Higher Education*, *41*(8), 1355-1370.

ECOOM. (2020a). *About | Ecoom*. Retrieved on 21 June 2020, from https://www.ecoom.be/en/about

ECOOM. (2020b). *Human Resources in Research Flanders (HRRF) | Ecoom*. Retrieved on 21 June 2020, from https://www.ecoom.be/nl/onderzoeksdomeinen/carrieres_van_onderzoekers/methodes/HRRF

Emmenegger, P. (2010). Gendering insiders and outsiders: Labour market status and preferences for job security. *Economics, Management, and Financial Markets*, *5*(3), 90-130.

England, P., Allison, P., Li, S., Mark, N., Thompson, J., Budig, M. J., & Sun, H. (2007). Why are some academic fields tipping toward female? The sex composition of US fields of doctoral degree receipt, 1971–2002. *Sociology of education, 80*(1), 23-42.

Escardíbul, J. O., & Afcha, S. (2017). Determinants of the job satisfaction of PhD holders: an analysis by gender, employment sector, and type of satisfaction in Spain. *Higher Education*, *74*(5), 855-875.

Etzkowitz, H., & Ranga, M. (2011). Gender dynamics in science and technology: From the ‘‘leaky pipeline’’to the ‘‘vanish box’’. *Brussels economic review*, *54*(2/3), 131-147.

European Commission (2008). European Innovation Scoreboard 2007. Luxembourg: European Commission. Retrieved on 24 July 2020, from https://ec.europa.eu/commission/presscorner/detail/en/MEMO_08_87

European Commission (2019). European Innovation Scoreboard 2019. Luxembourg: European Commission. Retrieved on June 25 2020, from https://ec.europa.eu/growth/industry/policy/innovation/scoreboards_en

Eurostat, N. A. C. E. (2008). Rev. 2–statistical classification of economic activities in the european community. *Office for Official Publications of the European Communities, Luxemburg*.

Eurostat (2012a). Rolling Review on Innovation and R&D statistics. Luxembourg: Eurostat. Retrieved on June 25 2020, from https://ec.europa.eu/eurostat/documents/64157/4375784/42_Innovation-and-RD-Statistics-RR-2012.pdf/18e002c9-ef4a-4d81-9e87-f39c7fdc0c55

Eurostat (2012b). Synthesis of National Quality Reports for 2009 R&D and GBAORD statistics. Luxembourg: Eurostat. Retrieved on July 24 2020, from https://ec.europa.eu/eurostat/cache/metadata/Annexes/rd_esms_an2.pdf

Eurostat. (2020a). Gender pay gap statistics - Statistics Explained. Retrieved on June 25 2020, from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Gender_pay_gap_statistics

Eurostat (2020b). Statistics on research and development. Luxembourg: Eurostat. Retrieved on July 24 2020, from https://ec.europa.eu/eurostat/cache/metadata/en/rd_esms.htm

Fenesi, B., & Sana, F. (2015). What Is Your Degree Worth? The Relationship between Post-Secondary Programs and Employment Outcomes. *Canadian Journal of Higher Education, 45*(4), 383-399.

Fernandez, R. M., & Friedrich, C. (2011). Gender sorting at the application interface. *Industrial Relations: A Journal of Economy and Society*, *50*(4), 591-609.

Field, A. (2009). *Discovering statistics using IBM SPSS statistics (Third Edition)*. Sage Publications.

Field, A. P., & Wilcox, R. R. (2017). Robust statistical methods: A primer for clinical psychology and experimental psychopathology researchers. *Behaviour research and therapy*, *98*, 19-38.

Fleming, C. M., & Kler, P. (2008). I'm too clever for this job: a bivariate probit analysis on overeducation and job satisfaction in Australia. *Applied Economics, 40*(9), 1123-1138.

Fox, M. F., & Stephan, P. E. (2001). Careers of young scientists: Preferences, prospects and realities by gender and field. *Social studies of Science, 31*(1), 109-122.

Fox, M. F., Fonseca, C., & Bao, J. (2011). Work and family conflict in academic science: Patterns and predictors among women and men in research universities. *Social studies of science*, *41*(5), 715-735.

Frenette, M. (2000). Overqualified? Recent graduates and the needs of their employers. *Education Quarterly Review, 7*(1), 6.

Frenette, M. (2004). The overqualified Canadian graduate: The role of the academic program in the incidence, persistence, and economic returns to overqualification. *Economics of Education Review, 23*(1), 29–45. https://doi.org/10.1016/S0272-7757(03)00043-8

Garcia-Quevedo, J., Mas-Verdú, F., & Polo-Otero, J. (2012). Which firms want PhDs? An analysis of the determinants of the demand. *Higher Education, 63*(5), 607–620. https://doi.org/10.1007/s10734-011-9461-8

Godinho, M. M., Simões, V. C., & Zifciakova, J. (2016). RIO Country Report 2015: Portugal. *JRC Science and Policy Report. Luxembourg: Publications Office of the European Union*.

Gokhberg, L., Meissner, D., & Shmatko, N. (2017). Myths and Realities of Highly Qualified Labor and What It Means for PhDs. *Journal of the Knowledge Economy, 8*(2), 758–767. https://doi.org/10.1007/s13132-016-0403-7

Golde, C. M., & Dore, T. M. (2001). At cross purposes: What the experiences of today's doctoral students reveal about doctoral education.

Gould, J. (2015). How to build a better PhD. *Nature News, 528*(7580), 22.

Granleese, J. (2004). Occupational pressures in banking: Gender differences. *Women in Management Review*.

Green, F., & Zhu, Y. (2010). Overqualification, job dissatisfaction, and increasing dispersion in the returns to graduate education. *Oxford Economic Papers, 62*(4), 740–763. https://doi.org/10.1093/oep/gpq002

Groot, W., & van den Brink, H. M. (2000). Overeducation in the labor market: a meta-analysis. *Economics of education review, 19*(2), 149-158.

Gröpel, P., & Kuhl, J. (2009). Work–life balance and subjective well-being: The mediating role of need fulfilment. *British Journal of Psychology*, *100*(2), 365-375.

Haapakorpi, A. (2017). Doctorate holders outside the academy in Finland: academic engagement and industry-specific competence. *Journal of Education and Work, 30*(1), 53–68. https://doi.org/10.1080/13639080.2015.1119257

Halme, K., Saarnivaara, V. P., & Mitchell, J. (2016). RIO Country Report 2015: Finland. *P. Saarnivaara, J. Mitchell*.

Halse, C., & Mowbray, S. (2011). The impact of the doctorate

Hayes, A. F., & Cai, L. (2007). Using heteroskedasticity-consistent standard error estimators in OLS regression: An introduction and software implementation. *Behavior research methods*, *39*(4), 709-722.

Herrera, L., Muñoz-Doyague, M. F., & Nieto, M. (2010). Mobility of public researchers, scientific knowledge transfer, and the firm's innovation process. *Journal of Business Research*, *63*(5), 510-518.

Hersch, J. (1991). Education match and job match. *The Review of Economics and Statistics*, 140-144.

Hunt, W., Jagger, N., Metcalfe, J., & Pollard, E. (2010). What do researchers do? (Doctoral graduate destinations and impact three years on). Cambridge: Vitae.

Kahn, S. (1993). Gender differences in academic career paths of economists. *The American Economic Review*, *83*(2), 52-56.

Kaiser, L. C. (2007). Gender-job satisfaction differences across Europe. *International Journal of Manpower*.

Kannankutty, N., & Kang, K. (2001). Employment Preferences and Outcomes of Recent Science and Engineering Doctorate Holders in the Labor Market. Issue Brief.

Keeling, R. (2006). The Bologna Process and the Lisbon Research Agenda: the European Commission's expanding role in higher education discourse. *European journal of education, 41*(2), 203-223.

Kelchtermans, S. & Robedo-Bottcher, N., (2018). RIO Country Report Poland, JRC Working Papers JRC111253, Joint Research Centre (Seville site).

Kelchtermans, S., & Zacharewicz, T. (2016). RIO Country Report Belgium 2015. *JRC Science for Policy Report*.

Kim, H. Y. (2017). Statistical notes for clinical researchers: chi-squared test and Fisher's exact test. *Restorative dentistry & endodontics*, *42*(2), 152-155.

Klecker, B. (1997). Male Elementary School Teachers' Ratings of Job Satisfaction by Years of Teaching Experience.

Knudsen, M. P., Christensen, J. L., & Christensen, P. (2017). RIO Country Report 2016: Denmark. *Bruxelles: Joint Research Centre, European Commission*.

Labrianidis, L., & Vogiatzis, N. (2013). Highly skilled migration: what differentiates the 'brains' who are drained from those who return in the case of Greece?. *Population, Space and Place*, *19*(5), 472-486.

Lampousaki, S. (2010). Stereotypes about gender and work. *European Working Conditions Observatory.* Retrieved on July 24 2020, from https://www.eurofound.europa.eu/publications/article/2010/stereotypes-about-gender-and-work

Larson, R. C., Ghaffarzadegan, N., & Xue, Y. (2014). Too many PhD graduates or too few academic job openings: the basic reproductive number R0 in academia. *Systems research and behavioral science*, *31*(6), 745-750.

Levecque, K., Baute, S., Van Rossem, R., & Anseel, F. (2014). Money, money, money... Over doctoraten, lonen en gender: *ECOOM Brief 9*.

Levecque, K., Anseel, F., De Beuckelaer, A., Van der Heyden, J., & Gisle, L. (2017). Work organization and mental health problems in PhD students. *Research Policy*, *46*(4), 868-879.

Lockwood, N. R. (2003). Work/life balance. *Challenges and Solutions, SHRM Research, USA*.

Marini, M. M., Fan, P. L., Finley, E., & Beutel, A. M. (1996). Gender and job values. *Sociology of Education*, 49-65.

Mazei, J., Hüffmeier, J., Freund, P. A., Stuhlmacher, A. F., Bilke, L., & Hertel, G. (2015). A meta-analysis on gender differences in negotiation outcomes and their moderators. *Psychological bulletin*, *141*(1), 85.

Meissner, D., Gokhberg, L., & Shmatko, N. (2016). The meaning of doctorate holders for human capital development of nations. In *The Science and Technology Labor Force* (pp. 343-350). Springer, Cham.

Mertens, A., & Röbken, H. (2013). Does a doctoral degree pay off? An empirical analysis of rates of return of German doctorate holders. *Higher education*, *66*(2), 217-231.

Moguérou, P. (2002). Job satisfaction among US Ph. D. graduates: the effects of gender and employment sector. *Note de travail de l'IREDU*.

Monastersky, R. The lure of the lab. *Nature* 457**,** 642–643 (2009). https://doi.org/10.1038/457642a

Mortier, A., Levecque, K., & Debacker, N. (2020). You have a PhD! What's next? The career paths of PhD holders. *ECOOM Brief 25.*

OECD (2015), *Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development*, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris, https://doi.org/10.1787/9789264239012-en

Oshagbemi, T. (2000). Gender differences in the job satisfaction of university teachers. *Women in Management review*.

Parada, F., & Peacock, J. (2015). The quality of doctoral training and employability of doctorate holders: The views of doctoral candidates and junior researchers. In *The European Higher Education Area* (pp. 593-612). Springer, Cham.

Park, C. (2005). New variant PhD: The changing nature of the doctorate in the UK. *Journal of Higher Education Policy and Management*, *27*(2), 189-207.

Park, C. (2007). Redefining the doctorate. Discussion paper. The Higher Education Academy

Park, K., Jang, D., & Shahiri, H. I. (2018). Over-Education Among Doctorate Holders in the Korean Labor Market. *Asia-Pacific Social Science Review, 18*(1), 32-45.

Perista, H., & Silva, A. (2004). Science careers in Portugal. *Centro de Estudos para a Intervenção Social, disponibilizado pela ABIC.*

Petrongolo, B. (2004). Gender segregation in employment contracts. *Journal of the European Economic Association*, *2*(2-3), 331-345.

Phillips, S., & Heywood-Roos, R. (2014). Job security for early career researchers is a significant factor in helping research make an impact. *Impact of Social Sciences Blog*.

Porter, S. R., Toutkoushian, R. K., & Moore III, J. V. (2008). Pay inequities for recently hired faculty, 1988-2004. *The Review of Higher Education*, *31*(4), 465-487.

Proudfoot, S., & Hoffer, T. B. (2016). Science and engineering labor force in the US. In *The Science and Technology Labor Force* (pp. 77-119). Springer, Cham.

Rayner, G., & Papakonstantinou, T. (2016). The nexus Between STEM qualifications and graduate employability: Employers' perspectives. *International Journal of Innovation in Science and Mathematics Education (formerly CAL-laborate International), 24*(3).

Roach, M., & Sauermann, H. (2010). A taste for science? PhD scientists' academic orientation and self-selection into research careers in industry. *Research policy*, *39*(3), 422-434.

Rubio, M. & Hooley, T. (2010). Recruiting researchers: Survey of employer practice 2009. Cambridge: CRAC

Sabharwal, M., & Corley, E. A. (2009). Faculty job satisfaction across gender and discipline. *The Social Science Journal*, *46*(3), 539-556.

Santos, J. M., Horta, H., & Heitor, M. (2016). Too many PhDs? An invalid argument for countries developing their scientific and academic systems: The case of Portugal. *Technological Forecasting and Social Change*, *113*, 352-362.

Schwabe, M. (2011). The Career Paths of Doctoral Graduates in Austria. European *Journal of Education, 46*(1), 153–168. https://doi.org/10.1111/j.1465-3435.2010.01465.x

Simonen, J., Svento, R., & McCann, P. (2016). The regional and sectoral mobility of high-tech workers: insights from Finland. *The Annals of Regional Science*, *56*(2), 341-368.

Smith, K. T. (2010). Work-life balance perspectives of marketing professionals in generation Y. *Services Marketing Quarterly*, *31*(4), 434-447.

Smith, T. J., & McKenna, C. M. (2013). A comparison of logistic regression pseudo R2 indices. *Multiple Linear Regression Viewpoints*, *39*(2), 17-26.

Stephan, P. E. (1996). The economics of science. *Journal of Economic literature*, *34*(3), 1199-1235.

Till, R. E., & Karren, R. (2011). Organizational justice perceptions and pay level satisfaction. *Journal of Managerial Psychology*.

Todorova, A., & Slavcheva, M. (2016). RIO Country Report 2015: Bulgaria. *Report. EUR*, *27878*, 1-116.

Toutkoushian, R. K. (1999). The status of academic women in the 1990s no longer outsiders, but not yet equals. *The Quarterly Review of Economics and Finance*, *39*(5), 679-698.

Tsang, M. C. (1987). The impact of underutilization of education on productivity: A case study of the U.S. Bell companies. *Economics of Education Review, 6*(3), 239–254. https://doi.org/10.1016/0272-7757(87)90003-3

Umbach, P. D. (2007). Gender equity in the academic labor market: An analysis of academic disciplines. Research in Higher Education, 48(2), 169–192.

UNESCO Institute for Statistics. (2012). International standard classification of education: ISCED 2011. *Montreal: UNESCO Institute for Statistics.*

United Nations Statistical Commission. (2009). System of national Accounts 2008. *European Communities, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations and World Bank, New York*.

van der Meer, P., & Wielers, R. (2014). Tijdelijke banen en welzijn. *Tijdschrift voor Arbeidsvraagstukken, 30*(2), 141-157.

van der Steeg, M., van der Wiel, K., & Wouterse, B. (2014). *Individual Returns to a PhD Education in the Netherlands: Income Differences between Masters and PhDs* (No. 276). CPB Netherlands Bureau for Economic Policy Analysis.

Verhaest, D., & Omey, E. (2006). The impact of overeducation and its measurement. *Social Indicators Research, 77*(3), 419–448. https://doi.org/10.1007/s11205-005-4276-6

Vlaamse Raad voor Wetenschap en Innovatie (2015). Doorstroom van doctoraathouders naar de arbeidsmarkt.

Vuorinen-Lampila, P. (2016). Gender segregation in the employment of higher education graduates. *Journal of Education and Work*, *29*(3), 284-308.

Waaijer, C. J. (2016). Perceived career prospects and their influence on the sector of employment of recent PhD graduates. *Science and public policy, 44*(1), 1-12.

Waaijer, C. J. F., Belder, R., Sonneveld, H., van Bochove, C. A., & van der Weijden, I. C. M. (2017). Temporary contracts: effect on job satisfaction and personal lives of recent PhD graduates. *Higher Education, 74*(2), 321–339. https://doi.org/10.1007/s10734-016-0050-8

Webber, K. L., & Canché, M. G. (2015). Not equal for all: Gender and race differences in salary for doctoral degree recipients. *Research in Higher Education*, *56*(7), 645-672.

Wilson, A., Vilardo, M., Fellinger, R., & Dillenbeck, T. (2014). Work-life balance satisfaction: An analysis of gender differences and contributing factors. *New York Journal of Student Affairs*, *14*(2), 3-17.

Appendix

Appendix A: Cross tabulations of educational level and sector

Table 5

Cross tabulation of educational level and sector for Belgium

Sector	BES	GOV	HES	PNP	Total
ED5-7	58 797 (64.3%)	4 294 (4.7%)	27 887 (30.5%)	493 (0.5%)	91 471
ED8	7 936 (30.1%)	2 437 (9.2%)	15 838 (60%)	179 (0.7%)	26 390
Total	66 733	6 731	43 725	672	117 861

Note: Cramer's V = .288

Table 6

Cross tabulation of educational level and sector for Bulgaria

Sector	BES	GOV	HES	PNP	Total
ED5-7	10 323 (60.2%)	3 097 (18.1%)	3 586 (20.9%)	147 (0.9%)	17 153
ED8	639 (6.8%)	3 344 (35.6%)	5 317 (56.6%)	88 (0.9%)	9 388
Total	10 962	6 441	8 903	235	26 541

Note: Cramer's V = .523

Table 7

Cross tabulation of educational level and sector for Finland

Sector	BES	GOV	HES	PNP	Total
ED5-7	29 555 (64.1%)	3 235 (7%)	12 871 (27.9%)	466 (1%)	46 127
ED8	2 694 (16.6%)	2 114 (13%)	11 068 (68.1%)	365 (2.2%)	16 241
Total	32 249	5 349	23 939	831	62 368

Note: Cramer's V = .419

Table 8

Cross tabulation of educational level and sector for Portugal

Sector	BES	GOV	HES	PNP	Total
ED5-7	35 374 (54.2%)	5 041 (7.7%)	24 315 (37.3%)	515 (0.8%)	65 245
ED8	1 630 (4.5%)	1 327 (3.7%)	32 679 (90.9%)	330 (0.9%)	35 966
Total	37 004	6 368	56 994	845	101 211

Note: Cramer's V = .527

Appendix B: Predictors' unique contributions

Table 11

Predictors' unique contributions in the Multinomial Logistic Regression for Belgium (N = 117 861)

Predictor	χ^2 (df)
Gender	1 425.80 ** (3)
Educational level	4 301.07 ** (3)
Gender x educational level	828.56 ** (3)

Note: $\chi 2$ = amount by which -2 log likelihood increases when predictor is removed from the full model. *p < .05, **p < .01
Cox & Snell R^2 = .113
Nagelkerke R^2 = .136

Table 12

Predictors' unique contributions in the Multinomial Logistic Regression for Bulgaria (N = 26 541)

Predictor	χ^2 (df)
Gender	3 734.22 ** (3)
Educational level	486.26 ** (3)
Gender x educational level	23.57 ** (3)

Note: $\chi 2$ = amount by which -2 log likelihood increases when predictor is removed from the full model. *p < .05, **p < .01
Cox & Snell R^2 = .286
Nagelkerke R^2 = .320

Table 13

Predictors' unique contributions in the Multinomial Logistic Regression for Finland (N = 62 368)

Predictor	X^2 (df)
Gender	2 051.13 ** (3)
Educational level	6 126.04 ** (3)
Gender x educational level	213.90 ** (3)

Note: $\chi 2$ = amount by which -2 log likelihood increases when predictor is removed from the full model. *p < .05, **p < .01
Cox & Snell R^2 = .253
Nagelkerke R^2 = .295

Table 14

Predictors' unique contributions in the Multinomial Logistic Regression for Portugal (N = 101 211)

Predictor	X^2 (df)
Gender	11 551.09 ** (3)
Educational level	3465.77 ** (3)
Gender x educational level	71.10 ** (3)

Note: $\chi 2$ = amount by which -2 log likelihood increases when predictor is removed from the full model. *p < .05, **p < .01
Cox & Snell R^2 = .303
Nagelkerke R^2 = .362