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CHAPTER 9

Discussion
9.1. Introduction

In the introduction of this dissertation, we highlighted the increased attention to career conditions in science and observed that many identify a lack of career opportunities, long spells of employment on temporary contracts, and dependence on third party funding as problems that impair the attractiveness of science as a career. The figures on the composition of the academic workforce in, for example, the U.S. and Germany reviewed in this dissertation and elsewhere (e.g., Hill & Einaudi, 2010; Konsortium Bundesbericht Wissenschaftlicher Nachwuchs, 2013, p. 181; Schuster & Finkelstein, 2006, p. 46; VSNU, 2015a), point to an increasing share of junior staff and decreasing share of senior staff. In the U.S. especially, the number of postdoctoral researchers has increased spectacularly. This evokes questions such as why this development took place and whether it will continue, what the relation is between the formal academic career structure and actual publication career spans, and whether changes in academic career structure and resulting changes in career opportunities and employment conditions have actually affected those in the academic workforce.

In this concluding chapter, the findings of this dissertation are summarized, put into perspective, its main strengths and limitations are listed, directions for future research are given, and policy recommendations formulated.

9.2. Main findings in perspective

The first research question identified in the introduction is:

1. What are the key topics discussed in Science and Nature editorials relating to academic career policy?

Chapter 2 answers this question through a description of the issues in career policy that are seen as most important according to Science and Nature editorials. In total, almost one in ten editorials in Science and Nature published 2000 – 2012 was on career policy. The six main clusters of issues identified are career conditions in science, the attractiveness of science as a career, merit-based career policies, the effect of research funding on careers, specific groups underrepresented in science (including women), and mobility of scientists. The editorial writers (distinguished scientists, high level policymakers and Nature editors) worry about the conditions for careers in science, which they characterize as uncertain and lacking in career prospects, especially when it comes to permanent positions.

1 Very recent numbers on postdoctoral researchers in U.S. biomedical science tentatively point to a halt in the previous trend of ever-increasing numbers of postdocs (Garrison, Justement, & Gerbi, 2015).
This characterization is not new. Already in 1918 the famous sociologist Max Weber stated: “The career of the academic man in Germany is generally based upon plutocratic prerequisites. For it is extremely hazardous for a young scholar without funds to expose himself to the conditions of the academic career. He must be able to endure this condition for at least a number of years without knowing whether he will have the opportunity to move into a position which pays well enough for maintenance.” (Weber, 1918, p. 1).

Hence, the fact that academic careers can be considered as quantized and highly uncertain is not unique to current times. Therefore, the second research question of this dissertation was:

2. Historically, how has the composition of academic positions changed in Germany and how has the span of publication careers of PhD recipients from the United States changed (both before and after the PhD)?

Chapter 3 constitutes the first assessment of developments in the academic career structure in Germany over such a long period of time (i.e., from the early 19th century until now). The chapter showed an increasing differentiation in academic positions, i.e., over time, more and more “lower” positions were added to the career system. The assessment also showed how important the professionalization of these positions was. In many cases, persons were already performing the job activities that belong to these lower positions, but these jobs were not recognized as proper positions and remunerated through a salary. Only with the literal professionalization of these positions they appeared in official statistics. Therefore, it is through professionalization that differentiation took place. Hence, one should be careful in inferring conclusions about the make-up of the academic career system, as only recognized and paid positions are reported on.

Furthermore, the growth of the whole academic workforce is correlated with the opportunities of higher (usually permanent) academic positions: when the growth rate is high, the opportunities for such positions increase, but when the growth rate slows down, the opportunities decrease. This is not the case for temporary positions; the opportunity to obtain such positions still increased despite the slowing down of the growth of the academic workforce. This relation between expansion and career opportunities has also been described in an almost forgotten paper by Ben-David and Zloczower (1961), but we are the first to empirically show this relation using post-1950 figures on academic positions. Thus, universities follow a basic economic principle: in economically prosperous times, there is a large demand for skilled employees. To attract these skilled employees in a tight labor market, many are

2 Luckily for the author of this dissertation, and countless numbers of other women, there have been other developments through time: the fact that Weber only talks about the “academic man” is now an outmoded notion.
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hired on permanent contracts and thus have large opportunities for career progression. However, when growth slows down, the demand falls and there may even be an oversupply of skilled employees. Universities respond by shifting to temporary employment. In addition, because so many higher, permanent positions have already been filled up, chances for career progression diminish for new entrants.

Therefore, in times of high growth a larger share of new entrants experience career progression than in times of low growth. If the distribution of talent is the same in both periods, it follows that in slow growth periods, the average talent of the incumbents is lower than that of recent entrants promoted to a higher position. It must even be presumed that a substantial part of incumbents has less talent than a part of the recent entrants who are not promoted and leave academia. This necessarily implies that science does not employ the highest possible talent pool.

With a shift from senior to more junior positions in science, it would be expected that a smaller percentage of scientists have long publication careers. Surprisingly, it turns out that in the U.S., the span of publication careers has not changed very much in the majority of the studied fields, despite profound changes in the composition of the academic workforce since the 1950s (chapter 4). This implies that people are not “leaving” academia more often, but they stay in junior, temporary positions for a longer period of time. In contrast, pre-PhD publication careers became longer: whereas in the 1950s, most PhDs published their first article after the year of PhD, in the 2000s they published it several years before the year of PhD. The study in this chapter is the first to investigate the publication careers of such a large sample of doctorate recipients over such a long period of time. Furthermore, it is the first to empirically show that the year of first publication shifted in many fields. Finally, it is the first to empirically show that the span of post-PhD publication careers remained stable in many fields.

These findings show that changes in the composition of the academic workforce do not affect the length of publication careers by much. So is it possible after all to make employment conditions more sober with no consequence to the people in the system? This brings us to this dissertation’s third main research question:

3. What are the effects of career prospects and employment conditions on early career researchers in the Netherlands?
This question was answered through two surveys, one among recent PhDs from five Dutch universities and one among PhD candidates at a Dutch university. The first sub-question answered, was:

a. How are career prospects in academia and other sectors perceived by recent PhDs from Dutch universities, and how is this perception related to their job choices?

Chapter 5 shows that recent PhDs rate career prospects in academia as much slimmer than in non-academic research and outside research, especially the availability of permanent positions. The perception of academic career prospects is related to actual sector of employment: PhDs outside academia are even more negative about academic career prospects than PhDs in academia. This association remains even when controlling for factors such as appealing job attributes and several personal characteristics. Whether PhDs find employment outside academia depends heavily on which job attributes they value, such as intellectual challenge, creativeness and contribution to society. For academia, this leads to a selection against certain types of PhDs, such as those who find contribution to society important. The fact that in the job choice of PhD students and graduates, preferences for certain job attributes play a large role, is confirmed by other studies (Balsmeier & Pellens, 2014; Bloch, Krogh Graversen, & Skovgaard Pedersen, 2015; Roach & Sauermann, 2010). Our study is the first to show conclusively that the perception of career prospects is indeed correlated with the actual sector of employment.

Our findings imply that the job choice of PhDs is dependent on personal preferences and labor market conditions. An interesting stream of future study would be to assess to which extent the personal preferences are shaped by socialization into academia during the PhD, and to which extent they are based on more stable preferences belonging to the individual itself (although this is a very difficult distinction to make, of course). Socialization has been described as a process in which prospective group members incorporate the norms and values of the group of people they would like to join (Austin, 2002). It has been described as a mechanism that “effectively isolates [graduate students] from competing vocational and intellectual interests and (...) [makes them] extremely dependent on [their] teachers” (Hagstrom, 1965, p. 9). As also discussed in section 1.4, socialization into academia may lead to the expectation of relatively poor career prospects in academia and long periods of temporary employment. Hence, the psychological contract between an early career researcher and employer may not include the expectation of job security. In psychological contract theory, a lack of job security would then not lead to a breach of contract and thus not lead to dissatisfaction or job exit either. The study presented in chapter 5, and many others (e.g., Cyranoski, Gilbert, Ledford,
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Nayar, & Yahia, 2011; Stanford et al., 2009; van der Weijden, Teelken, de Boer, & Drost, 2016), show that a majority of early career researchers see poor career prospects and employment conditions as a problem, but that job attributes such as degree of independence still attract them to academia. This shows that indeed, personal preferences (which may be caused in part by socialization into academia) function as a buffer to changes in labor market conditions – one that prevents early career researchers to search and find employment outside academia. Still, chapter 5 also shows that if such a buffer is at play, it is stronger for some PhDs than for others. In fact, for some PhDs, the balance has swung to job exit from academia. This shows that, at least for these PhDs, the buffer did not prevent them from searching and finding employment outside academia. It is also likely that the forces of personal preferences and labor market conditions are not stable but dynamic over time, with negative factors playing a larger role over time and positive factors playing a smaller one: the "hangover" effect (Boswell, Shipp, Payne, & Culbertson, 2009; Lawler, Kuleck, Rhode, & Sorensen, 1975; Vroom & Deci, 1971). This means the buffer to the effect of labor market conditions becomes smaller over time.

In addition, the presence of such a buffer does not negate that changes in labor market and employment conditions have other effects on early career researchers, such as an effect of employment conditions on job satisfaction. Therefore, the second sub-question went into the effects of employment conditions on the job satisfaction of recent PhDs, and asked:

b. What is the effect of temporary employment on the job satisfaction and personal lives of recent PhDs from Dutch universities?

Theories relevant for this question are dual labor market theory and psychological contract theory. Dual labor market theory proposes that temporary employment negatively affects the job satisfaction and well-being of workers. Importantly, disparities between workers on temporary contracts and those on permanent contracts tend to persist according to this theory. However, it is also hypothesized that certain groups, such as the young and highly educated, are an exemption to this rule, as they can use temporary jobs as a stepping stone to permanent employment. An explanation could lie in the psychological contracts between these employees and their employer. If employees think they can use a temporary job to gain experience and use it as a stepping stone in their career, there is a balanced exchange between them and the employer. In this case, the psychological contract includes no expectation of permanent employment and the temporary employment does not affect job satisfaction. Taken together, temporary employment need not affect PhDs.
However, our study shows that temporary employment does have a negative influence on PhDs’ job satisfaction – a strong negative influence on the satisfaction with employment conditions and a smaller one on the satisfaction with job content (chapter 6). Temporary employment also negatively affects the personal lives of PhDs. Thus, PhDs are not exempt from the negative effects of temporary employment. As our group of study included PhDs on various types of contracts (and also self-employed PhDs), and we had data on covariates such as sector of employment and job level, we were able to estimate the effect of temporary employment independently from these factors, something which other studies were unable to do (e.g., Bender & Heywood, 2006; Moguérou, 2002; van der Weijden et al., 2016).

An interesting phenomenon occurs with regards to sector of employment: on the one hand, academic jobs are much more likely to be temporary jobs, which negatively influence satisfaction with job content. On the other side of the balance, however, temporary jobs are more likely to be jobs at the level of educational attainment, which has a positive influence on satisfaction with job content. Non-academic jobs have the advantage that they are permanent jobs more often, but they also involve work below PhD level for a larger share of PhDs.

Other studies show that the adverse effect of temporary employment is not restricted to the employee but may also apply to scientific output. A majority of studies (usually in the private or service sector) find a positive influence of job satisfaction on productivity (e.g., Böckermann & Ilmakunnas, 2012; Schneider, Hanges, Smith, & Salvaggio, 2003). Furthermore, Smeenk (2007, pp. 47-86) showed that among European academics, employment security results in higher organizational commitment and slightly higher job performance. Thus, the current HRM policy at (Dutch) universities could hurt the universities’ performance, a conclusion also drawn by Thunnissen in her very recent dissertation on talent management in Dutch academia (2015, p. 183).

A more direct effect of employment conditions on early career researchers is shown in this dissertation’s study of PhD candidates at a Dutch university. Chapter 7 answered the sub-question:

c. What is the effect of appointment type on the availability of research infrastructure, work pressure, stress, and career attitudes of PhD candidates at a Dutch university?

The findings showed that externals are as satisfied with their PhD experience as internals, but they feel disadvantaged with respect to material infrastructure: they report less access to office

3 However, this effect only occurs in environments with low managerialism (Smeenk, 2007, pp. 47-66).
facilities, less funding for research and a much lower personal income. Thus, (differences in) employment conditions affect early career researchers in the way they are able to conduct their research. PhD candidates employed by the university had much more access to material research infrastructure than non-employed PhD candidates, although both groups were essentially working towards the same goal: a doctoral dissertation. This compromises organizational justice; to be more specific, distributive justice ("who gets what relative to one's input"), which has been shown to affect job satisfaction, organizational commitment and organizational citizenship behavior (although other forms of organizational justice are stronger influencers of the latter two; Colquitt, Conlon, Wesson, Porter, & Ng, 2001). Hence, the employment conditions of PhD candidates can influence the material infrastructure available to PhD candidates if no explicit policy is implemented to prevent inequalities.

Finally, chapter 8 looked at the role of gender in post-PhD careers. Much of the research on gender and careers in science is on academia only, whereas a large share of the scientific workforce works in other sectors. Therefore, chapter 8 answers the sub-question:

d. What is the effect of gender on the type of employment, occupation, career perception and research performance of recent PhDs from Dutch universities?

The assessed outcomes included sector of employment, job level, employment contract, perception of career prospects, the reception of research grants, the perception of the own scientific oeuvre, and occupation. To determine occupation, we introduced a novel, fine-grained classification scheme for classifying PhDs' jobs.

Gender is a factor that moderately influences both the perception of career prospects and temporary employment and thus, has a small, mediating role in the effect of employment conditions on early career researchers. There also are other gender differences: female PhDs go into academic research more often than male PhDs, and female PhDs are more involved in teaching. Much larger gender differences were found in the field of study: women are underrepresented among recent PhDs in engineering and the natural sciences. This gender difference already occurred earlier in the educational career, namely in high school (Statistics Netherlands, 2015). Although it is far too soon to draw definitive conclusions, this gap may be closing, as more female high school students are now following a curriculum oriented towards the natural sciences and engineering (Statistics Netherlands, 2014). Another large gender difference was found in part-time employment: female PhDs work part-time much more often than their male counterparts, especially when working in the Netherlands or having young children. At later stages in the career, this may hold back female PhDs in the...
development of their careers, in combination with other small gender differences through cumulative disadvantage (Jacobs, 1996). To put it more bluntly: many mole hills together could become a large mountain (Maes, Gvozdanovic, Buitendijk, Rahm Hallberg, & Mantilleri, 2012). However, in most aspects of early post-PhD careers no or only small gender differences were found, which may be a sign that there will be gender equality also in later career stages.

9.3. Strengths and limitations of the dissertation

This final, nuanced, conclusion on the role of gender in post-PhD careers brings us to the main strength of this dissertation: its separation of hear-say from hard evidence through critical empirical testing, also when evaluating the hypotheses proposed in the dissertation itself. The scientific literature on academic positions often mentions the increasing precariousness of academic careers (see for example chapter 7 in this dissertation). Chapter 3 confirms this image when comparing career opportunities in 2010 to those in 1970, but also shows that employment conditions were arguably better in 2010 than before 1950. Chapter 4 tested the superficially obvious presumption that fewer opportunities to obtain a tenured or tenure-track position at a U.S. university and an increasing share of postdoctoral positions would lead to shorter publication careers, and proved this presumption to be wrong. Nothing of the sort was observed; publication career spans appear to have remained quite stable in most fields studied, or became even longer. Similar nuanced pictures were painted on the effect of career prospects and employment conditions (chapters 5 to 7). Our studies found an effect of poor career prospects on job choice, of temporary employment on job satisfaction and of non-employee status of PhD candidates on the availability of material research infrastructure. At the same time, they also explicitly described that job characteristics such as intellectual challenge and independence tend to be more important to early career researchers than employment conditions, and non-employee status of PhD candidates does not affect PhD supervision.

Another strength of this dissertation is that it empirically examines several aspects of the academic career system: key issues, historical development, and its effect on early career researchers. It does so using a variety of methods: text mapping, analysis of official statistics, bibliometric analysis and surveys among large numbers of respondents. In order to answer the dissertation’s three main research questions using an appropriate subject of study and to take advantage of available data and data collection opportunities, different samples and datasets were used. For the key issues, the sample consisted of Nature and Science editorials in order to map the key topics in academic career policy as identified by a variety of distinguished scientists, high level policymakers and Nature editors (chapter 2). To study historical
developments in academic positions, the composition of academic staff in Germany was chosen, as the research university originated in that country (chapter 3). To study historical developments in publication careers of doctorate recipients from the 1950s, the United States was chosen as that country became the leader in science after the Second World War and good data are available for that country – the ProQuest database constitutes the highest quality database on doctoral dissertations (chapter 4). To study the effect of the academic career system on early career researchers, the Netherlands was chosen as it is a representative country of good quality (though not necessarily elite) science. This makes the Netherlands a suitable country to study the effects of career prospects and employment conditions for PhD graduates with good quality degrees, who are important in shaping the knowledge economy (OECD, 1996; chapters 5, 6 and 8). The effect of PhD appointment type naturally had to be studied in a sample of PhD candidates, still another group of researchers (chapter 7).

Of course, this choice of appropriate samples and datasets by research question implies that the answer to one research question is not directly generalizable to the sample used in another research question. For example, the developments in the composition of academic staff in Germany showed a differentiation of academic positions and strongly implied decreased opportunities to obtain a permanent position due to a slowdown of higher education expansion. This dissertation did not look into these developments in the United States and the Netherlands, which means the findings from Germany are not directly translatable to these countries. However, it is likely that a similar development occurred in the U.S. and the Netherlands, as the literature on academic positions in the U.S. (as presented in chapter 4) sketches a very similar picture of differentiation of academic positions, and data from the Netherlands show an increase in temporary positions over the past decades (VSNU, 2015b). Based on the literature on U.S. academic positions, we concluded that a differentiation of academic positions did not lead to shorter publication careers of U.S. doctorate recipients. The findings on the publication careers of U.S. doctorate recipients themselves are less readily generalizable to Germany and the Netherlands; this topic is an excellent candidate for further inquiry. Finally, the effects of career prospects and employment conditions are, in a way, very dependent on the national context, as the exact career prospects and employment conditions vary by country. A case in point here is that in most countries, PhD candidates are formally treated as students, but in the Netherlands treated as employees if they are appointed by the university. Still, in another way, the effects of career prospects and employment conditions appear to persist globally – which is easily illustrated by the Nature and Science editorials studied in chapter 2.
Another characteristic of this study is that its sphere of study is large – by design, the dissertation does not focus only on top researchers, research groups or universities. While *Nature* and *Science* editorials do focus somewhat on science in the developed world (especially *Science*, which is the flagship journal of the American Society for the Advancement of Science), a large minority of editorials also explores academic careers in other parts of the world. This means that the identification of key issues in policy regarding the scientific workforce is also based on this wide scope (*chapter 2*). Similarly, the chapter on developments in academic positions focused on all German universities (*chapter 3*) and publication career spans focused on all research doctorate recipients from U.S. institutions (although five specific fields were chosen and the analysis was based on a sample of doctorate recipients with rare names; *chapter 4*). The sample of the PhD graduates survey included all PhDs who obtained a PhD from one of five Dutch universities in a defined period of time (*chapters 5, 6 to 8*), and all PhD candidates at Leiden University could have participated in the PhD candidate survey (*chapter 7*). Since differences in policies and scientific achievement between Dutch universities are small, much smaller than between, for example, leading U.S. universities and the U.S. average, our findings are representative for the Netherlands as a whole and probably also for a group of countries and groups of university worldwide – those where good quality but not necessarily top research is conducted. As talent distribution in science is very skewed (De Solla Price, 1963, p. 41), it might be interesting to study whether similar results hold true for elite researchers in different countries and universities. It is conceivable that elite early career researchers respond differently to perceived career prospects and employment conditions – perhaps they have a stronger “taste for science” (Roach & Sauermann, 2010) and are therefore even more sensitive to degree of independence and less sensitive to unattractive employment conditions and career prospects than the PhDs in our sample. This would merely mean that they are in one part of the spectrum our sample revealed, not that they are outside that spectrum, though. However, this does not quite seem to be the case, as postdoctoral researchers at Harvard University, too, see a lack of career prospects in academia as a problem (Polka & Krukenberg, 2014). Anyway, as a strong knowledge economy requires a broad base of scientifically educated persons (OECD, 1996), it is the situation of representative early career researchers that is essential, not just elite researchers.

A limitation of the studies in this dissertation into the effect of career prospects and employment conditions on early career researchers is that they rely on the reports on these effects by researchers themselves, either directly through analyzing which issues they write about (the study of editorials and some analyses from the survey-based studies) or indirectly by analyzing the relationship between different answers to survey questions. Through multiple mechanisms, it is possible that surveys do not accurately measure the value of a variable the researcher is interested in (de Leeuw, Hox, & Dillman, 2008). Other possible study
designs include choice experiments of several job characteristics, or conducting open-ended interviews with early career researchers. However, such study designs also have drawbacks. Choice experiments do not measure actual employment outcomes and interviews provide more background details to the job choice of individuals, but are not suited to obtain data on many individuals. Consequently, as always in research into a relatively new subject, the inevitable conclusion is that further research is needed.

9.4. Directions for future research

The further research should address some of the many questions raised by the work reported in this dissertation. First, there is an issue this dissertation has only scratched the surface of: the increasing importance of project based, competitive funding. Public R&D funds are distributed in roughly two manners: as block grants to whole universities or research institutes (Dutch: *eerste geldstroom*) or as project based grants to individual research groups or scientists, through intermediary agencies (Dutch: *tweede geldstroom*; Lepori et al., 2007). The last four decades have seen a shift from block funding to project based funding (Lepori et al., 2007; Kreckel, Burkhardt, Lenhardt, Pasternack, & Stock, 2008, pp. 62-64). In 2005, approximately one third of all research associates at German universities were funded through project based funding (Kreckel et al., 2008, p. 63). In the Netherlands, the increase of project based funding is often linked to the increase in non-permanent positions in academia (Jongsma, 2015; “Kwaliteit onderwijs en onderzoek lijdt onder de flexwerkende wetenschapper”, 2013; “Tijdelijk geld is onzeker geld”, 2015). This relationship is also mentioned by Kreckel and colleagues (2008, p. 64). The question is whether this is indeed the case. Although this relationship may seem straightforward, the increase in project based funding coincided with, for example, increased managerialism in higher education and increased reliance on new public management with its preference for indicator based, process oriented decision making over qualitative, content based leadership (Teelken, 2012). This makes it difficult to determine a causal relationship between mode of funding and career structure.

A second, new, research question is whether an earlier selection of academic talent for uncertainty reducing tenure tracks and permanent positions is possible. On the basis of which factors could this selection take place? Relatively straightforward measures would be the productivity and citation impact of researchers. Several studies into the predictive validity of past productivity and impact have been conducted. For example, Dennis (1956) found that past productivity is the best predictor of future scientific productivity. Cole and Cole (1967) found that scientists with a large number of citations to early work continue to be highly

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4 Of course, it is likely that there is not a mere coincidence, but rather, that managerialism and new public management may have links to both the reliance on project funding and with employment conditions.
productive. Similarly, Nederhof and van Raan (1987; 1989) found that the productivity and citation impact of physics and chemistry doctorates was higher for those who received their PhD degree with distinction than for those who did not receive their degree with distinction. This implies that early differences in productivity and citation impact occur. However, the authors also found that difference in productivity and impact became smaller after the PhD, which calls into question the notion that early productivity and citation impact are predictors of productivity and citation impact in the later career. In addition, in this example, the mean number of published papers and citations differed for the two groups. However, if there is large variance in the numbers of publications and citations – which is to be expected due to the skewed distribution of talent (De Solla Price, 1963, p. 41) – the predictive validity could still be low. Indeed, a recent study on the predictive validity of early publications by mathematicians showed that whereas early productivity is correlated with future publication rate, the predictive validity is far from perfect (Lindahl & Danell, 2015). If these findings also hold true for young scientists in other fields, earlier job security based on performance during the PhD and a short postdoctoral period would be possible, but there should remain opportunities for “slow starters” to prove themselves gradually.

A third research question involves the study population. When assessing the effect of career structure on researchers, the studies in this dissertation have focused on early career researchers, i.e., PhD candidates and recent PhD graduates. This leaves open the question what the effect of quantization is on researchers in a later stage of their careers. And what about prospective entrants into academic careers: bachelor and master students? Do they let employment conditions in academia influence whether they go into research, are they ignorant about employment conditions, or do they just not care about them? We already noted that although the effects of quantization of academic careers were only determined within a group of PhD candidates at a Dutch university and PhD graduates of Dutch universities in this dissertation, it is likely that they are representative of a much larger population of early career researchers. This is borne out by the fact that the quantization of academic careers appears to be quite a global phenomenon (as evidenced by the analysis of Nature and Science editorials; chapter 2). An important and interesting follow-up line of research similar to ours could be to verify whether our results are indeed representative of a larger population of early career researchers.

A fourth and final research question is whether science itself is affected by the structure of academic careers and employment conditions. It does not seem unreasonable to suggest that the trend towards quantization and less independence must have had an impact on the freedom and willingness to do “risky” research and therefore on the opportunity to achieve breakthroughs at an early time in the research career. In this respect, it is suggestive that the
age at which the breakthroughs were achieved that eventually led to a Nobel Prize increased substantially during the last century (Jones, 2010). Accordingly, it is clearly worthwhile to do follow-up research into, for example, the time between PhD and the most cited paper to assess whether the length of this period has increased over the past decades.

9.5. Policy implications and recommendations

Three main policy recommendations can be inferred from the studies in this dissertation. The first concerns job security, the second differentiation in career tracks for PhD graduates and the third is aimed at the incorporation of career policy in the steering of science in general.

The first recommendation is to provide more job security earlier in an academic career. The importance that early career academics attach to career prospects and job security in academia are shown in the studies in this dissertation. These studies imply an underinvestment employment relationship between the early career academics and their employers, similar to the relationship described by Thunnissen (2015, pp. 182-183) in her work on early career academics at Dutch universities. Quite possibly, the early career academics in both this dissertation and in Thunnissen’s have experienced a breach of the psychological contract between them and their employers. Such breaches do not necessarily lead to exit by the employee – an easy to observe negative consequence – but can, as noted before, instead lead to silence, the voicing of complaints, or neglect (Rousseau, 1995, pp. 136-138). The latter consequences are undesirable for the organization as well. By giving job security earlier in academic careers, especially to the most promising young researchers, these negative consequences could be counteracted, provided sufficient “slow starters” are still given the opportunity to prove themselves later if the predictive validity of early performance is good, but not precisely accurate.

A reason sometimes given for the many temporary contracts in academia, is the increase in project based funding. However, if a research group or department has a steady number of PhD candidates and postdoctoral researchers, the group’s funding does not lack stability. Some of these researchers could be hired on a permanent contract instead of being replaced every two to four years. Often, this is allowed by the rules of funding instruments. Thus, the guidelines of one of the most important funding instruments in the Netherlands, the Vernieuwingsimpuls, do not explicitly prohibit the funding of salary costs of permanently appointed employees as project researchers (NWO, 2015). Hence, if the funding in a research

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5 This feeling has recently begun to find political expression (“PvdA boos over tijdelijke contracten aan universiteiten”, 2015)
group is relatively stable, universities could be less hesitant in employing researchers in such a
group on a permanent contract. However, such a policy change does imply earlier selection of
individuals. Whether this is possible, is a question for future research (see section 9.4).

The second recommendation is to differentiate career tracks for PhD graduates, both in
academia and in other sectors. Formal career tracks in academia are heavily based on a
narrow view of scientific talent (van Arensbergen, Hessels, & van der Meulen, 2013, p.
78). A few decades ago, studies already described how tenure and merit pay decisions are
based more on accomplishments in research than in teaching or service (Fairweather, 1995;
Kasten, 1984). This dissertation showed that this also attracts a specific type of person, i.e.,
one who values intellectual challenge and independence (chapter 5). However, other types
of persons, such as the ones who value contribution to society, work outside academia more
often. To attract other types of people, career tracks should be diversified and reward a wider
range of skills. There has already been a development towards teaching-oriented careers
("Onderwijscarrière in zicht", 2014) and careers oriented on the societal impact of research
(de Jong, 2015). Related to this is the recommendation to increase the employability of PhDs
outside academia. Approximately thirty per cent of PhD graduates from Dutch universities
work in higher education (Auriol, Misu & Freeman, 2013, p. 19). This means that a majority
of PhDs find employment outside academia. Outside academia, a relatively large share of
PhDs indicate they work at bachelor or master level, not at PhD level. Such a lower job level
decreases job satisfaction. The fact that such a large share of recent PhDs work below their
level of educational attainment implies either an excess supply of PhDs or a mismatch between
the non-academic job market and PhDs' skills and experience. To decrease the mismatch,
first of all, universities should market the qualities of their PhDs to non-academic employers
better. Second, PhD candidates themselves should invest more in non-research oriented
skills. Indeed, a preliminary analysis from the same survey that chapters 5 to 7 are based on,
shows that recent PhDs feel they developed skills such as analytical thinking and writing
skills during their PhD sufficiently, but that they lacked the development of social, teamwork
and management skills. Similar results were obtained for PhDs from Flemish universities
(Boosten, Van de Velde, Derycke, te Kaat, & Van Rossem, 2014).

The title of this dissertation introduces the term “quantized careers”: today, people at the start
of a research career face a long string of disjointed temporary jobs and an extended period of
uncertainty about their immediate and long-term future. This affects their choices and well-
being, subtly more so if they are female, to the detriment of science and its societal impact.
Thus, the third and final policy recommendation is one to national science authorities. These
authorities should give priority to career policy in the steering of science. A shift to a more
“neoclassical” system with greater smoothness, coherence and predictability of individual
careers is duly needed.
9.6. References


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