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DISCUSSION PAPER SERIES

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OCTOBER 2017

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ABSTRACT

Antecedents of Overtime Work: The Case of Junior Academics¹

Despite the ongoing public debate about precarious working conditions in academia, there is only little evidence on working hours and overtime work for the group of (non-tenured) junior academics. By using unique longitudinal survey data on the occupational situation and careers of doctoral students and doctorate holders in STEM fields in Germany, we explore potential antecedents of overtime. We find that overtime hours are less pronounced among firm employees holding a doctorate and among postdocs than they are among doctoral students. This result holds in the cross-section and also when examining status changes (from doctoral student to postdoc or to firm employee holding a doctorate) in difference-in-differences estimations. In contrast to firm employees, overtime hours are considerably positively associated with part-time contracts for doctoral students. Furthermore, our results reveal that individuals' career orientation is positively associated with extra hours. In contrast, individuals with family responsibilities and a stronger preference for leisure time spend significantly fewer hours at work.

JEL Classification: I23, J22, M51

Keywords: working time, overtime, part-time employment, academia

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Antecedents of Overtime Work - The Case of Junior Academics

1 MOTIVATION

Average working hours have considerably decreased since the early years of industrialization, when many individuals worked more than 14 hours per day (Ausubel and Grübler, 1995). However, there are recent hints of increasing dispersion in working hours. Whereas the share of part-time employees is becoming larger, there is also general evidence of excessively long working hours for a meaningful number of employees (Messinger 2011 provides an overview for Europe). With regard to academia, long working hours have been often linked to an academic culture and to a notion of researchers escaping from everyday life into the “ivory tower” of science, where they can fully dedicate themselves to puzzle-solving activities. However, recent developments in the higher-education environment, such as growing student numbers, increased administrative duties and the accelerating commercialization of universities (Bentley and Kyvik, 2012; Sang et al., 2015) have led to more vigorous competition and to intensification of work. Thus, reasons to invest longer hours are no longer solely due to a pure devotion to research but are also essential in order to succeed careerwise in academia. On account of the meritocratic reward structure in the academic career system as well as high competition and insecurity on the path to a professorship with tenure, academic success is seen by most scholars as being highly connected to scientific output, and thus only to be achieved through hard work and long working hours in excess of their employment contract.

There is a substantial body of research on the antecedents of overtime work which focuses on the group of managers in particular, on the issue of work-life balance and on the reimbursement of overtime work (e.g. Feldman, 2002; Greenhaus et al., 2012; Ylijoki, 2013; Zapf, 2015). Empirical evidence for the group of academics and scientists is rather limited, though.

The few studies focusing on the sample of academics mainly provide descriptive analyses of the working hours and use of working time for different tasks. Jacob and Teichler (2011) report that in Germany, university professors work on average 54 hours per week (year 2007), thus indicating that long working hours are a relevant issue in academia. In a more recent study,

Wang et al. (2012) analyse working habits of scientists and find that the majority of them are working beyond the usual working hours, even at night and weekends. Results of qualitative interviews with academics reveal that this group of employees has to cope with a high stress level and with time pressure (Ylijoki and Mäntylä, 2003). Nevertheless, reliable information and appropriate quantitative data sets on the working habits of academics are lacking, and thus it remains unclear as to what factors are related to their excessive working hours. As there is also an ongoing debate on precarious working conditions in academia, understanding the factors of overtime work is of high interest for policy makers next to higher education institutions as employers as well as for the individuals themselves.

In our contribution we want to address the following two research questions in particular: What factors are related to overtime (the difference between actual working time and contractual working time) of doctoral students compared to postdocs and firm employees holding a doctorate? To what extent are career transitions (e.g. from being a doctoral student to being engaged in postdoctoral employment inside academia or in private-sector firms) related to changes in the working time allocation?

By using a unique longitudinal survey data set on the occupational situation and careers of German doctoral students and doctorate holders, focusing on STEM (Sciences, Technology, Engineering & Mathematics), we are able to compare the actual and contractual weekly working hours of different groups of highly educated individuals. We distinguish between doctoral students and postdocs and use firm employees (holding a doctorate) as a comparison group. Tracking the participants' career development, we also are able to observe the adjustment processes of the working time allocation after completion of doctoral studies. Thus, to our knowledge, we are the first to analyse working time habits of academics longitudinally next to a cross-sectional examination.

The remainder of the paper is structured as follows: We proceed by presenting some characteristics of doctoral studies in Germany (section 2). In section 3, we first derive hypotheses with respect to antecedents of overtime. Subsequently, we introduce our data and variables in section 4 before presenting our empirical findings in section 5. Section 6 concludes.

2 CONTEXT: DOCTORAL EDUCATION IN GERMANY

In 2015, about 29.000 doctoral titles were awarded in Germany (OECD, 2015). Unlike in many other countries, where doctoral studies are predominantly pursued by those individuals who want to start an academic career, the doctoral degree is of great value both inside and outside of academia in Germany (Bundesbericht Wissenschaftlicher Nachwuchs, 2017). Many individuals consciously and voluntarily leave academia after receiving their doctoral degree and start a career in a private-sector firm, for instance.

There are different ways to work towards a doctorate with regard to the financial backing of doctoral students in Germany. Many doctoral students are employed on fixed-term contracts by a university either on a full-time or a part-time basis. Apart from working on their own dissertation project, the candidates then also have obligations with regard to teaching and administration at some chair or institute. It is prescribed by the so called *Wissenschaftszeitvertragsgesetz* (*academic employment law*) that academic staff can be employed by German universities for an overall period of 12 years on temporary contracts, inclusive of up to six years before the completion of the doctorate. Wages are determined by collective agreements. Gross monthly pay of doctoral students with full-time contracts starts at about € 3,500 in the first year and increases to € 3,900 in the second and € 4,100 in the fourth year (salary grade TVL-13 in 2017). Hence, starting wages are comparable to those of university master graduates who begin a career in a private firm (Absolventa 2017).

The traditional path is also compatible with employment at a university of applied sciences, research institutions (e.g. Fraunhofer, Helmholtz, Max-Planck) or as an external doctoral student in a private-sector firm, as long as the candidate's dissertation project is being supervised by a university professor (Bundesbericht Wissenschaftlicher Nachwuchs, 2017). Further institutions, such as the DFG (Deutsche Forschungsgemeinschaft), the European Union and the BMBF (Federal Ministry of Education and Research), also provide universities and research institutions with financial resources or directly offer *scholarships* for young researchers (Bundesbericht Wissenschaftlicher Nachwuchs, 2017).

Apart from traditional doctoral studies, there is also a possibility to earn a doctorate by being involved in a *structured doctoral programme* at special Graduate Schools. Similarly to the US

case, candidates acquire important fundamental methodological skills, often in an interdisciplinary atmosphere. Usually, doctoral candidates in structured doctoral programmes are funded through scholarships or are employed by the involved institutes as research assistants (Bundesbericht Wissenschaftlicher Nachwuchs, 2017).

3 THEORETICAL CONSIDERATIONS AND HYPOTHESES

“Overtime” is defined as working hours that exceed contractually fixed working time. Overtime work often has a negative connotation, implying the involuntariness of working long hours. Drago et al. (2009) distinguish two types of employees working overtime, though: The first type, called “conscripts”, do not prefer to work long hours. The second type, called “volunteers”, however, autonomously choose to work longer hours. We do not distinguish explicitly between voluntary and involuntary overtime work in this contribution. Indeed, we think that for academia in particular it would be hard to separate these two types. Individuals might not be forced to do overtime by a supervisor, but might be implicitly driven to do so by the approaching end of a temporary contract or by the competition for tenured positions. Others might just be intrinsically motivated or might interpret overtime hours as an investment in career-enhancing human capital.

Employees at various stages of their careers in different jobs might have various motives for spending extra hours at work. We refer to the three groups of doctoral students, postdocs and firm employees (holding a doctoral degree) in the following:

At the early career stage as a *doctoral student*, working unpaid overtime hours may act as a *signalling device* (Spence, 1973). Although usual applications to the labour market refer to the recruiting context with asymmetrical information, it can also be transferred to the ex post hiring period, in particular when an employee’s productivity is incompletely observable (Anger, 2005; Golden and Altmann, 2008). In this sense, a negative link between workers’ productivity and the cost of working additional hours is assumed. Performing extra work beyond the contract specifications, then, can be interpreted as a signal of a doctoral student’s greater commitment towards an academic career. Hence, doctoral students with a higher dedication to the profession face lower costs and perceive a lower disutility from work when performing extra working

hours. Following this argumentation, doctoral students may work additional hours in order to demonstrate their intention of acquiring a postdoc position.

Apart from signalling considerations, according to *human capital theory* extra working time may also be considered to be an investment in career-enhancing human capital (Becker, 1962). Franck and Opitz (2007) argue that the traditional German doctorate can be considered to be more an indicator of a general form of human capital than it is of narrowly specified abilities to do research. This view is supported by the considerably high share of top managers holding a doctoral degree compared to other countries such as France or the U.S. Since extra working hours can be used for work-based learning and the accumulation of additional career-enhancing skills, a positive relationship between overtime and future returns can be established. Thus, by accumulating further human and social capital during additional productive working hours, doctoral students may aim to increase their productivity and yield positive returns in the future.

Numerous studies, indeed, show that additional working hours go hand in hand with job promotions and higher future wages (Anger, 2005; Booth et al., 2003; Campbell and Green 2002; Pannenberg, 2005). Thus, empirical evidence confirms the investment character of unpaid overtime. Nevertheless, from a theoretical point of view this effect is not clearly attributable to either human capital or to signalling considerations.

In the case of *postdoctoral researchers*, next to human capital and signalling considerations an additional suitable model that can be used to explain the motives for working in excess of contractual hours is the *tournament theory* (Lazear and Rosen, 1981). According to this theory, the number of winner prizes (future promotions, etc.) within a firm is limited. Thus, employees enter into a competition between each other, getting an incentive to increase their performance in order to achieve higher future rewards (e.g. future promotions to better positions). Since tenured positions for post-docs in academia are very scarce (Cyranowski et al., 2011), researchers could offer overtime work in order to increase their performance and to improve their employment perspectives in academia. Academic careers often even have the character of an up-or-out tournament (Gosh and Waldman, 2010). If a postdoc does not manage to get a tenured position within a limited period of time, this probability will decrease substantially afterwards. Thus, career insecurity is considerably high in academia and may increase the incentive to perform additional hours in order to increase the probability of winning the career tournament. We

therefore assume postdoctoral researchers to do more overtime compared to doctoral students. Whereas postdoctoral researchers are more focused on academic careers and compete directly with other postdocs for the limited tenured positions in academia, doctoral students are far less restricted in their career choices.

The argumentation of the tournament theory (Lazear and Rosen, 1981) can also be transferred to employees who have already left academia in order to work in a firm. Similarly to postdoctoral researchers, *firm employees* holding a doctorate also compete with their colleagues for the few promotions within a firm if internal labour markets in the sense of Doeringer and Piore (1971) are relevant. Thus, this group also has incentives to work additional hours in order to increase their chances of winning a certain promotion tournament. Nevertheless, the incentives may be less strong compared to those of postdocs. Due to the aforementioned characteristics of a career tournament in academia, the costs involved are relatively high compared to a career tournament in a firm where employees holding a doctoral degree can participate in a greater variety of job or career tournaments.

Analogously to the group of doctoral students, considerations of the signalling theory (Spence, 1973) may also be applied to the group of firm employees holding a doctorate. Working additional hours could also be considered by an employer to be a credible signal of a worker's underlying productivity, motivation and loyalty (Anger 2008). Hence, overtime hours could increase chances of future promotions and pay rises and could decrease the danger of being laid off. Signalling considerations may be less relevant compared to the group of doctoral students, though. Since doctoral students are at a more critical point in their careers, they have to make more effort in order to increase their chances of a new job after earning the doctorate. The incentive may be the strongest for those doctoral students who pursue an academic career, because the path to a professorship is considered to be more selective. Thus, in general, we assume that the incentives to work extra hours will be less pronounced among firm employees compared to among doctoral students. In the case of status changes (from doctoral student to firm employee), overtime hours might increase due to initial training in the short run, though.

Altogether, the aforementioned argumentations illustrate that different motives can be in place when looking at the amount of extra hours at different career stages. Apart from more individual-driven (voluntary) reasons for performing overtime, it is also conceivable that working extra

hours is demanded by an employer. Besides, the specific working culture prevailing in academia requires academics to be fully committed to their jobs and to sacrifice private interests for professional ones (Acker and Armenti, 2004; Ylijoki, 2013). Due to contractual constraints and competition for tenured positions, doctoral students and postdocs in particular may experience higher time pressure, forcing them to work in excess of their contracts.

The aforementioned considerations lead to

Hypothesis 1a: Postdoctoral researchers will do more overtime compared to doctoral students.

Hypothesis 1b: Firm employees (holding a doctorate) will do less overtime compared to doctoral students.

Next to job status, other job-based characteristics may be related to overtime. The type of employment contract (part-time vs. full-time employment) can be considered to be an important driver of the supply of overtime hours. Part-time is the most widely spread form of nonstandard employment. In 2015, about one of six employees in OECD countries was working on a part-time basis (OECD, 2017). In Germany, the part-time rate is even higher (0.22). In academia, this employment form plays a substantial role, since often only part-time positions are offered in particular for doctoral students (Jacob and Teichler, 2011). Consequently, in Germany around 38% of research assistants at universities have part-time contracts.

Following the *human capital theory* (Becker, 1962), working hours can be interpreted as an investment in human and social capital. Since part-time employees have fewer hours at their disposal to acquire human capital, it is conceivable that this group of employees could suffer future economic disadvantages (e.g. lower promotion probability and future wages) compared to full-time employees. A number of studies have confirmed negative consequences of part-time employment by showing that part-time employees have fewer opportunities to learn on the job (Billett, 2001) and to establish social relations at work (Walsh, 2007). With respect to overtime patterns of part-time compared to full-time employees, there is hardly any empirical evidence, in particular for the subsample of junior academics. Using representative data of the German Socio-Economic Panel (SOEP), Zapf (2015) finds a significant negative correlation between part-time employment and unpaid overtime hours, but a positive association between part-time employment and paid overtime in general. Whereas the positive link hints at the role

of overtime as compensation instrument for low wages in part-time employment, the negative relationship rather points at the lower willingness of part-time employees to invest in human capital. This could explain why part-time workers often occupy less responsible jobs with fewer promotion opportunities. There is also empirical evidence that part-time employees exert less effort compared to their full-time colleagues in the public sector (Frank and Lewis, 2004).

Since - in academia - overtime is not compensated, one could first expect a negative link between part-time employment and overtime. This could also hold true for private-sector employees for whom the collective pay scale does not apply. Depending on the job status, the negative consequences of part-time employment could turn out to be different. It is conceivable that at earlier career stages, part-time employment and the concomitant fewer opportunities to acquire career-enhancing human capital could have more detrimental effects compared to later career stages. As doctoral students have a longer future employment period compared to employees holding a doctorate, foregone human capital might be associated with greater financial burdens. Besides, part-time employment at later career stages could be related to different motives. For instance, postdocs and firm employees could enter part-time employment because of family obligations or personal preferences. Doctoral students, however, could potentially be forced into part-time employment because of the lack of full-time positions, as is often the case in academia (Jacob and Teichler, 2011). Following a simple costs-utility perspective, it could be worthwhile for part-time employed doctoral students to invest in longer hours in order to reduce the period of precarious employment and to achieve higher utility in future (e.g. a full-time position as a postdoc or outside academia) due to completion of their doctoral studies. Dörre and Neis (2008), indeed, state that most doctoral students accept this condition of precarious part-time and fixed-term employment because they perceive this period to be transitional and temporary in nature and consider it necessary in order to improve their situation in future.

Hypothesis 2:

Part-time employment positively moderates the link between the status as doctoral student and overtime.

Apart from job characteristics, individual characteristics may play an important role for overtime. Motivational theories such as the *need theory* (Alderfer, 1972) suggest that for individuals

with high needs of self-actualization, the work itself can be as stimulating as/or more stimulating than leisure activities. Thus, those employees who perceive their jobs to be intrinsically rewarding in terms of stimulating activities, social-interactions and self-growth (Feldman, 2002; Golden and Altman, 2008) may be more driven to work additional hours.

Furthermore, the *social identity theory* (Tajfel and Turner, 1985) provides a useful framework to explain why some individuals are more willing to spend extra hours at work. As posited by the social identity theory, individuals have a tendency to classify themselves into social categories (e.g. gender, age cohort). By socially classifying themselves, the individuals are able to define themselves in the social environment. Thus, self-identification with social roles can be an important part of an individual's self-concept. The stronger an individual's identification with a role is, the greater the time and energy which that individual invests in this role (Burke and Reitzes, 1991). Empirical evidence confirm that individuals act in accordance with salient aspects of their social identities and support organizations that embody those identities (Ashforth and Mael, 1989; Mael, 1988 Stryker and Serpe, 1982). Identity is shown to be related to loyalty, commitment and supportive behaviour (Mael and Ashforth, 1992, 1995; O'Reilly and Chatman, 1986).

Work can be seen as a central part of an individual's life (Kahn, 1990; Lloyd et al, 2011). Nevertheless, it can be assumed that there is much inter-individual heterogeneity with respect to the importance of work for one's self-concept. A construct that may explain such heterogeneities is that of *work identity*. Walsh and Gordon define an individual's work identity as "...a work-based self-concept, constituted of a combination of organizational, occupational, and other identities that shapes the roles a person adopts and the corresponding ways he or she behaves when performing his or her work" (2008, p. 47). Empirical findings demonstrate that individuals with a strong work identity devote more time to their work compared to those individuals with a weak work identity (Brett and Stroh, 2003; Greenhaus et al., 2012; Major et al., 2002; Ng and Feldman, 2008). According to Walsh and Gordon (2008), organizations and occupations play a crucial role in the work identity creation process. In the case of junior academics, the occupational identity may be an important source for the development of work identity. In this vein, Ashforth and Kreiner see occupational identity as "the set of central, distinctive and enduring characteristics that typify the line of work." (1999, p.417). Literature on occupational research shows that occupations are characterized by their own norms, values and culture

(Trice, 1993; Van Maanen and Barley, 1984). Junior academics' career orientation and the extent to which individuals prefer a special career path may be an expression of their occupational identity and may enhance a stronger work identity. Thus, we expect individuals with ambitious career goals to show more effort, and consequently, to be more inclined to spend more time at work in order to achieve these goals.

Another expression - or one dimension - of one's work identity might constitute an individual's *work involvement*. Lodahl and Kejner (1965) define work involvement as the degree of importance of work in an individual's total self-image. A number of studies have confirmed the positive relationship between working hours and job involvement (Major et al., 2002; Wallace, 1997). Although the level of work involvement is presumed to be relatively high among junior academics, there can still be much heterogeneity within this group. Thus, a higher level of work involvement may strengthen the salience of individuals' work identity and lead individuals to more easily identify themselves as members of their organization or occupation. Altogether, following the social identity approach, we assume a positive relationship between work identity and overtime, because individuals tend to invest more time in those activities that enhance their social identities the most (Ng and Feldman, 2008, p.856).

Thus, our next hypothesis is:

Hypothesis 3:

Junior academics with a more pronounced work identity will do more overtime.

In contrast to the aforementioned positive relationship between work identity and overtime, we predict a reversed association for academics with family identity. As individuals take on different roles that compete for a person's limited amount of time, a time-based role conflict can arise. Empirical evidence from social psychology indicates that individuals with multiple salient identities do indeed find it hard to satisfy all identities simultaneously in an equal way (Day and Chamberlain 2006). Thus, time spent on family activities cannot be dedicated to work activities (Greenhaus & Beutell 1985, Greenhaus et al. 2012). Those individuals who strongly identify themselves with the family role or those who put more emphasis on personal interests could be confronted with such a time-based role conflict and make hour restrictions to the disadvantage of work.

Hypothesis 4:

Junior academics who have family obligations will do less overtime compared to colleagues without family obligations.

We now go on to describe our data set and our methodology.

4 DATA, VARIABLES AND METHODS

4.1 DATA AND SAMPLE

We have conducted an online survey among young academics in STEM disciplines (science, technology, engineering and mathematics) which was carried out between 2014 and 2016 and consists of overall four survey periods at 6-month intervals. With respect to survey strategy, we first contacted universities, research institutions and associations in the field of natural sciences and engineering in Germany, asking them to forward information about our survey to potential participants. Besides, we collected information on e-mail addresses of potential doctoral students and postdocs working at German universities and research institutions and directly contacted these individuals by sending them information on our project. We complemented activities with regard to data collection by directly contacting possibly relevant individuals via social media and other career platforms in order to extend our sample to firm employees holding a doctoral degree, who are intended to act as a control group.

Participants, first, include doctoral students with employment contracts at universities or research institutions. Note that in the German university system it is very common for doctoral students to be employed as research and teaching assistants (Bundesbericht Wissenschaftlicher Nachwuchs, 2017). In most cases, it is explicitly written into the contract or it constitutes an implicit norm that a part of the working time can be used for the individual's own research. Second, we interview postdocs working in academia and employees who already hold a doctoral degree in a STEM discipline and work outside academia, as we are interested in contrasting the working hours of these three groups. We refer to the latter category as *firm employees* hereafter. The consideration of employees who left academia after earning the doctorate

constitutes a unique feature of our data set and enables us to contrast two different career systems appropriately. We restrict our sample to individuals with either part-time contracts of a minimum of 17.5 weekly hours or full-time contracts of up to 42 weekly hours². Besides, we exclude those participants who are not employed or are on parental leave at the time of the survey.

These restrictions lead to a sample of 1,984 observations in the cross-section. The majority (1,281 participants) in our sample are doctoral students; 478 are postdocs working at universities or research institutions and 225 are (firm) employees holding a doctorate.

Fortunately, the majority of participants remain with our survey during the subsequent survey periods.³ Thus, we also make use of the longitudinal structure of our data set. By doing so, we want to elaborate the effect of career-stage change on overtime hours. For this purpose, we identify those participants who state in one of the four survey periods taking place every six months to have completed their doctoral studies, and we examine transitions from being a doctoral student in $t-1$ to taking up postdoc positions in academia or working as a firm employee in t .⁴ We refer to these groups by using the labels *new postdocs* and *new firm employee*, respectively. A number of 190 individuals complete their doctoral studies over the course of the survey. Whereas the majority of them (0.72) get a position as postdoc after earning the doctorate, 0.28 leave academia and start a job in a firm. We compare these cases with $n=1,820$ observations of maintaining status as a doctoral student from $t-1$ to t . We can therefore make use of $2,010 * 2 = 4,020$ observations in t and $t-1$ in our longitudinal analyses.

4.2 VARIABLES

DEPENDENT VARIABLE

Actual working hours are based on participants' self-reports of the number of average hours worked in a week (paid or unpaid overtime work included). Doctoral students (45.42 hours) and postdocs (45.30 hours) report similar actual weekly hours on average, whereas the mean is

² We excluded $n=26$ observations who report a number of actual weekly working time of less than 17.5.

³ A share of 0.68 of participants also participates in a subsequent survey period. Panel mortality is slightly higher for doctoral students than it is for postdocs and firm employees. We checked that there is no systematic mortality with regard to other individual or job characteristics.

⁴ As the career status changes occur at different survey periods, we pooled the information and summarized it into the variable t , which takes the value of 0 when there was no treatment and 1 when a treatment occurred in the period.

somewhat lower for the group of firm employees (43.41 hours). Percentiles show a considerable variation in each group. One of ten respondents reports at least 55 hours of weekly working time (see Table 1).

We also ask our respondents to state the number of hours as provided by their contract, without any overtime work. On average, the participants report having a contract of 34.75 hours. Again, some group-specific differences are observable. Among postdocs and employees holding a doctorate, full-time contracts are much more common compared to among doctoral students. Within the group of doctoral students, however, the dispersion regarding contractual hours is much higher and ranges between 20 hours (10th percentile) and 40 hours (90th percentile).

We define *overtime* by subtracting the actual working hours from the contractual working hours. The former exceed those of contracts by an amount of 10 hours on average. The number is less pronounced for firm employees (5 hours) than for postdocs (7 hours) or doctorate students (13 hours). One in ten respondents reports even more than 25 hours of overtime work per week.

Table 1: Descriptive statistics of actual working hours and overtime

		Whole Sample (n=1,984)	Doctoral students (n=1,281)	Postdocs (n=478)	Firm employ- ees (n=225)
Actual working hours	Mean	45.16	45.42	45.30	43.41
	SD	7.67	7.55	8.33	6.65
	10 th percentile	38	39	38	38
	Median	45	45	45	42
	90 th percentile	55	55	55	50
Contractual working hours	Mean	34.75	32.85	38.07	38.52
	SD	7.78	8.58	4.75	2.94
	10 th percentile	20	20	31	35
	Median	39.5	39	39.88	40
	90 th percentile	40	40	40	40
Overtime	Mean	10.41	12.57	7.23	4.89
	SD	9.82	10.45	7.36	5.92
Δ actual and contractual working hours	10 th percentile	0	0.5	0	0
	Median	8	10	5.5	4
	90 th percentile	25	27	18	10

INDEPENDENT VARIABLES AND CONTROLS

The survey provides us with a broad range of information which allows us to reach conclusions on the participants' current employment and private situation. Descriptive statistics are reported in Table 2.

We take three groups of variables into account: These are: job characteristics, demographics and individuals' career orientation.

First, we consider the respondent's current job characteristics. As mentioned above, we distinguish between three groups of respondents with regard to their job status: 0.65 of participants in our sample are doctoral students, 0.24 are postdocs and 0.11 are firm employees. Besides, we define those participants as *part-time* employees who have a contract of less than 35 hours.⁵ On average, one in three participants in our sample is employed on a part-time basis. However, there are substantial group-specific differences. Part-time employment is much more common among doctoral students (0.42) compared to among postdocs (0.12) and firm employees (0.11). Additionally, we know whether our participants manage or coordinate co-workers or a team, or whether they have the authority to hire and dismiss employees. We combine this information into a dummy variable called *managerial responsibilities* (1=yes). We also control for the *job focus* ranging from 1 (very basic job/research contents) to 6 (very applied or practical job/research contents).

Second, we consider demographics such as age, gender as well as the private situation. We account for the incidence of *children* (1=yes) and whether the respondent has a *partner* (1=yes). The majority (0.62) in our sample are males, which reflects their dominance in STEM fields. The share of men is somewhat higher for firm employees (0.71). On average, our participants are 31 years old. Four out of five participants have a partner and one in five has at least one child.

⁵ Note that there is no internationally accepted definition of the number of minimum hours in a week that defines full-time work. There are rather various country-specific thresholds for differentiating between full-time and part-time employment, depending on the distribution of part-time employment in a certain country. However, the 35 hours cut-off is the most commonly used one (van Bastelaer, Lemaître and Marianna, 1997).

Third, we want to take the participants' work identity into consideration. We make use of three dimensions: First, we use information on participants' *career orientation*. Respondents are asked about their career intentions via the following question: "How much do you aspire to the following career goals: i) professor and ii) executive function in industry?", each on a 6-point rating scale ranging from 1 (not at all) to 6 (totally). Second, the participants assess their *work involvement* (career involvement scale of Gould 1979) in the current job on a 6-point rating scale with the three items "I identify strongly with my current job", "The job I have chosen makes me proud" and "I sometimes wish I had chosen another profession". The reliability of this scale is regarded as being acceptable (Cronbach's Alpha=0.72). Third, we measure the *importance of leisure time* with three items. The items are "I want to have a job where I have time for my private interests and hobbies", "I don't have any problems with working at weekends" and "It is natural for me to work overtime". The Cronbach's alpha reaches a high value of 0.85 for this scale. By averaging and standardizing the items, we construct both a scale for work involvement and the importance of leisure time.

Table 2: Descriptive statistics of independent variables

	Whole Sample (n=1,984)		Doctoral students (n=1,281)		Postdocs (n=478)		Firm employees (n=225)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
<u>Job characteristics</u>								
Part-time (1=yes)	0.31		0.42		0.12		0.11	
Managerial responsibilities (1=yes)	0.43		0.35		0.61		0.53	
Job focus ([1] basic to [6] ap- plied)	3.67	1.61	3.52	1.57	3.30	1.55	5.33	0.78
<u>Socio-demographics</u>								
Male (1=yes)	0.62		0.62		0.58		0.71	
Age [years]	31.04	4.13	29.16	2.73	34.20	4.17	34.94	3.74
Children (1=yes)	0.22		0.13		0.37		0.42	
Partner (1=yes)	0.80		0.78		0.83		0.86	
<u>Career Orientation</u>								
Career goal professor	2.64	1.66	2.48	1.55	3.43	1.82	1.89	1.30
Career goal manager	4.05	1.48	4.24	1.34	3.24	1.57	4.63	1.38
Work involvement (standardized; 3 items)	0	1	-0.04	1	0.10	0.96	0.00	1.07
Importance of leisure time (standardized; 3 items)	0	1	0.07	0.98	-0.19	1.04	-0.01	0.96

4.3 EMPIRICAL STRATEGY

Our empirical analysis is divided into two parts. First, we examine potential determinants of overtime hours cross-sectionally by applying Ordinary Least Squares (OLS) estimations, which can be written as (1):

$$Overtime = \alpha + \beta \cdot Job\ status + \gamma \cdot X' + u. \quad (1)$$

As described above, we distinguish between the job status as doctorate student (reference group), postdoc and firm employee. The set of other job characteristics, demographics and individuals' career orientation is denoted by X' , and u is the error term. Next to general estimations for the whole sample, we also run estimations for different subgroups (e.g. full-time vs. part-time employees; doctoral students, postdocs and employees holding a doctorate).

Second, we also exploit the longitudinal structure of our data set and examine whether changes in career status (from doctoral student to new postdoc or doctorate holder in firm) are linked to changes in working extra hours. For this purpose, we apply a difference-in-differences approach. Such an approach allows us to better capture the issue of causation, since we follow the same individuals over time (different survey periods). The two groups *new postdocs* and *new doctorate holders in firms* act as treatment groups. Participants who remain doctoral students from $t-1$ to t serve as the control group.

The (difference-in-differences) estimation equation is specified as follows:

$$\begin{aligned} Overtime = & \alpha + \beta_1 \cdot t + \beta_2 \cdot new\ postdoc\ in\ t + \beta_3 \cdot t * new\ postdoc\ in\ t \\ & + \beta_4 \cdot new\ doctorate\ in\ firm\ in\ t + \beta_5 \cdot t * new\ doctorate\ in\ firm\ in\ t \\ & + \beta_6 \cdot X' + u. \end{aligned} \quad (2)$$

The dummy variable ' t ' captures general changes in overtime hours from the previous to the next observation period. The variables '*new postdoc in t* ' and '*new doctorate holder in firm in t* ' respectively, contrast differences between the treatment groups and the control group before the status change takes place. The diff-in-diff effects are represented by the coefficients of the corresponding interaction terms β_3 and β_5 (Wooldridge 2002).

5 RESULTS

5.1 ANTECEDENTS OF OVERTIME – CROSS-SECTIONAL ANALYSES

We start our empirical part with cross-sectional analyses regarding the determinants of overtime hours. Model 1 in Table 3 presents the results of OLS estimations on weekly hours of overtime work as the dependent variable for the whole sample.

First of all, contrary to our *Hypothesis 1a*, the results reveal that postdocs do significantly less overtime compared to the reference category of doctoral students. More precisely, postdocs work around 1.9 hours less in excess of their contracts. Doctorate holders working in a firm even do 3.2 hours less overtime compared to doctoral students. This result is in line with our *Hypothesis 1b*. On the one hand, one possible explanation could be that doctoral students have to familiarize themselves with their job and the different tasks they are responsible for during their doctoral studies and therefore have to invest more time in order to accumulate more human capital in the relatively short period of their doctoral studies. Due to the temporary nature of doctoral studies, doctoral students may also be under higher pressure to finish their studies in a timely manner and to qualify themselves for the next career stage.

Regarding other job-related variables, we find support for our *Hypothesis 2*. In detail, we observe a considerably positive relationship between part-time employment and overtime hours. Participants who have part-time contracts perform on average around 11 extra hours. Against the backdrop that there is only unpaid overtime in academia and thus no financial incentives to work longer hours, the effect appears quite large and seems to be distinctive for this specific group of junior academics.

In order to check whether the results are different for full-time and part-time employed participants, we performed additional estimations. The corresponding results can be found in models 2 (5) and 3 (6) of Table 3. The results of the group-specific estimations reveal some differences with regard to career status. For the group of full-time employees, the results are roughly in line with the aforementioned observations. The corresponding coefficients are much smaller, though (models 2 and 6). When looking at the group of the part-time employed in model 3, the differences are seen to be much larger. In more detail, part-time employed postdocs report

working around 7.7 hours less overtime and firm employees even 11 hours compared to part-time employed doctoral students. These results are even more pronounced when controlling for participants' career orientation in model 6. Thus, differences across the three groups are driven by part-time employment in particular. Apart from group-specific analyses, we also conducted some estimations with additional interaction terms with regard to part-time employment and career stage. The corresponding results are displayed in Table A1 in the Appendix. The coefficient of the interaction term is statistically significant. In line with the aforementioned results, model 2 of Table A1 confirms that part-time employment positively moderates the link between the status as doctoral students and overtime.

As further antecedents of overtime hours, we find that individuals who have managerial responsibilities, i.e. who coordinate a team or give instructions to other employees, work significantly more overtime.

Looking at the private background, participants with a child are working around 3 hours less in excess of their contracts compared to their childless co-respondents. This result is in line with our *Hypothesis 4*. Since an increase in extra hours increases the complexity of coordinating job and household activities such as caregiving, this result appears quite plausible. Men report doing significantly more extra hours compared to women. Additional estimations with interaction terms with respect to gender and being a parent in Table A2 in the Appendix reveal that among respondents with children, women in particular report fewer overtime hours.

We add important dimensions of *work identity* in models (4) to (6). As expected, individuals' career orientation, incorporated by the two career goals of professor and manager, is strongly positively associated with overtime work. While we do not find any statistical relationship between work involvement and overtime hours, we observe a statistically significant negative link between leisure-time preferences and the extent of overtime hours. Thus, our *Hypothesis 3* is partly confirmed. Individual preferences, in particular the willingness to forego leisure time, play an important role for the supply of additional working hours. Thus, individuals with rather low work identification tend to give more attention to their leisure time. The negative effect of leisure-time preferences seems to outweigh the importance of work involvement.

Table 3: OLS estimations of overtime

	Whole sample (1)	Full-time (2)	Part-time (3)	Whole sample (4)	Full-time (5)	Part-time (6)
<i>Job status (Reference: Doctoral student)</i>						
Postdoc (1=yes)	-1.842*** (0.516)	-0.737 (0.512)	-7.736*** (1.535)	-2.157*** (0.492)	-1.207** (0.485)	-7.793*** (1.441)
Firm employee (1=yes)	-3.178*** (0.580)	-2.272*** (0.537)	-10.882*** (1.562)	-3.168*** (0.567)	-2.016*** (0.516)	-11.807*** (1.599)
<i>Job characteristics</i>						
Part-time (1=yes)	11.495*** (0.466)			11.715*** (0.449)		
Job focus	-0.372*** (0.125)	-0.244* (0.140)	-0.152 (0.220)	-0.314*** (0.118)	-0.184 (0.130)	-0.126 (0.208)
Managerial responsibilities (1=yes)	2.112*** (0.369)	2.252*** (0.382)	1.199 (0.803)	1.455*** (0.353)	1.671*** (0.365)	0.239 (0.766)
<i>Socio-demographics</i>						
Age [in years]	0.031 (0.060)	0.119* (0.061)	-0.209 (0.150)	0.008 (0.057)	0.077 (0.056)	-0.161 (0.147)
Male (1=yes)	0.881** (0.370)	0.583 (0.381)	0.049 (0.755)	0.473 (0.349)	0.414 (0.351)	-0.734 (0.733)
Children (1=yes)	-3.022*** (0.494)	-1.242*** (0.480)	-6.697*** (1.179)	-2.814*** (0.472)	-1.161*** (0.438)	-6.242*** (1.178)
Partner (1=yes)	-0.716 (0.491)	-0.035 (0.510)	-1.905* (1.020)	-0.589 (0.465)	0.060 (0.481)	-1.834* (0.971)
<i>Career orientation</i>						
Career goal professor				0.280** (0.115)	0.338*** (0.113)	0.166 (0.261)
Career goal manager				0.321** (0.127)	0.130 (0.131)	0.705*** (0.259)
Work involvement				-0.283 (0.174)	-0.285* (0.170)	-0.015 (0.356)
Importance of leisure time				-2.689*** (0.172)	-2.543*** (0.175)	-2.877*** (0.364)
Intercept	7.818*** (1.870)	3.226* (1.910)	28.784*** (4.346)	6.687*** (1.983)	3.157 (1.928)	24.906*** (4.610)
Observations	1,984	1,366	618	1,984	1,366	618
Adjusted-R ²	0.364	0.041	0.254	0.441	0.189	0.331

Notes: The table reports coefficients and robust standard errors (in parentheses). Significant results at the 10%, 5% and 1% levels are indicated by *, **, and ***.

ROBUSTNESS CHECKS

In addition to the aforementioned analyses, we performed group-specific estimations with respect to career status. Table 4 presents the corresponding results for the three groups of doctoral students, postdocs and firm employees.

When looking at the three groups separately, we observe substantial differences regarding the effect of part-time employment as also mentioned above. While we do not find any statistically significant relationship between part-time employment and overtime hours among firm employees (models 5 and 6), the great positive link between the two variables prevails for the group of doctoral students (models 1 and 2). More precisely, part-time employed doctoral students report working around 14 extra hours more compared to their full-time employed colleagues. Thus, it can be argued that in the private sector part-time employment is still used as a classical flexibility instrument to balance work and private life. In academia, however, in particular during the qualification period of doctoral studies, the motives to enter part-time employment seem to be different. Due to funding constraints and a lack of full-time positions, doctoral students are often “forced” to accept part-time positions. In order to get ahead with their studies and to complete the period of precarious employment more quickly, some might be more willing to spend longer hours at work.

The correlation between overtime hours and hours mismatch (defined as the difference between actual and preferred working hours) might be interpreted as an indicator of involuntary overtime among academic employees (Wooden et al. 2009; Wunder & Heineck 2013). Table A3 in the Appendix presents the corresponding results.

Indeed, hours mismatch is positive both for academic employees in academia (7 hours) and firm employees (5 hours). The correlation between overtime and hours mismatch is remarkable ($r=.045$ for the whole sample). The highest correlation coefficients are found for postdocs ($r=0.57$) and firm employees ($r=0.56$). The corresponding correlation is somewhat lower for doctoral students, but still substantial and highly significant, indicating that overtime hours are not really overtime. We cannot distinguish involuntary overtime hours stemming from pressure

applied by the supervisor and “self-made” pressure to improve an individual’s own career chances, though.

Additionally to part-time versus full-time employment, we also checked whether fixed-term employment also plays a role for the supply of overtime hours for the two groups of postdocs and firm employees with a doctorate. Since all doctoral students have fixed-term employment contracts at German universities, we are not able to run corresponding estimations with the group of doctoral students. Corresponding OLS estimations with fixed-term employment as additional variable can be found in Table A2 in the Appendix. First, the share of fixed term employment is – not surprisingly - much larger among postdocs (0.87) compared to among doctorates working in a firm (0.10). Second, we observe a significant positive link between fixed-term employment and overtime hours for the group of firm employees. However, we do not find any statistical relationship for postdocs.

There are also some differences with respect to other potential determinants of overtime. Managerial responsibilities are associated with a slightly higher extent of overtime hours. Although this is true for both doctoral students and postdocs, the effect is more pronounced within the latter group.

When additionally controlling for individual career orientation (see models 2, 4 and 6 of Table 4), we find that doctoral students with the non-academic career goal of manager do more overtime. One possible explanation for this result could be that these individuals have the ambition to complete their doctoral studies in a shorter period in order to start to accumulate career-specific human capital faster. Note that the career goals *professor* and *manager* are not mutually exclusive and the coefficient for the goal *professor* is also positive but not significant, though. Within the group of postdocs, however, stronger academic career interests are associated with more overtime hours. As the path to a full professorship is highly selective and competitive, it is intuitive that an individual has to make more effort in order to achieve this specific goal. Career orientation and work involvement do not seem to play an outstanding role within the group of firm employees holding a doctorate⁶.

⁶ Around 10% of our respondents report not doing any overtime. Thus, we additionally run Tobit estimations in order to test the robustness of our results. The results stay the same with regard to both the significance level and the size of the coefficients.

Table 4: OLS estimation of overtime by career stage

	Doctoral students		Postdocs		Firm employees holding a doctorate	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Job characteristics</i>						
Part-time (1=yes)	13.660*** (0.495)	13.816*** (0.470)	2.977** (1.314)	3.764*** (1.247)	-0.885 (1.142)	-0.920 (1.213)
Job focus	-0.102 (0.149)	-0.079 (0.142)	-0.614*** (0.226)	-0.487** (0.202)	0.708 (0.463)	0.513 (0.418)
Managerial responsibilities (1=yes)	1.754*** (0.466)	1.181*** (0.442)	2.814*** (0.701)	1.664** (0.684)	1.107 (0.889)	0.761 (0.844)
<i>Socio-demographics</i>						
Age [in years]	0.074 (0.092)	0.075 (0.085)	0.005 (0.078)	-0.048 (0.079)	0.076 (0.171)	0.078 (0.156)
Male (1=yes)	0.333 (0.466)	-0.174 (0.440)	1.481** (0.727)	1.303* (0.664)	-0.473 (0.716)	-0.977 (0.686)
Child (1=yes)	-3.998*** (0.796)	-3.552*** (0.773)	-1.725** (0.716)	-1.729*** (0.647)	-0.595 (0.950)	-0.685 (0.903)
Partner (1=yes)	-0.903 (0.586)	-0.952* (0.560)	-0.332 (1.034)	0.368 (0.939)	0.304 (1.055)	0.011 (0.876)
<i>Career orientation</i>						
Career goal professor		0.152 (0.150)		0.555*** (0.196)		0.232 (0.264)
Career goal manager		0.450*** (0.173)		0.239 (0.224)		0.035 (0.278)
Work involvement		-0.264 (0.223)		-0.094 (0.330)		-0.043 (0.340)
Importance of leisure time		-2.723*** (0.218)		-2.735*** (0.322)		-1.890*** (0.390)
Intercept	5.435** (2.724)	3.669 (2.708)	7.081** (2.900)	5.411 (3.285)	-1.699 (7.270)	-0.513 (6.733)
Observations	1,281	1,281	478	478	225	225
Adjusted-R ²	0.424	0.492	0.052	0.225	0.009	0.079

Notes: The table reports coefficients and robust standard errors (in parentheses). Significant results at the 10%, 5% and 1% levels are indicated by *, **, and ***.

5.2 LONGITUDINAL ANALYSES

In the next step, we make use of the panel character of our data set. Figures 1 and 2 give a first impression of how overtime hours change from $t-1$ to t for different subgroups. In more detail, we contrast overtime hours of *new postdocs* and *new doctorate holders in firms* with the three groups of ongoing (i) doctoral students, (ii) postdocs and (iii) firm employees. Note that potential changes in overtime hours could have at least two reasons: either because of changes in contractual or/and actual working hours. Previous research has already revealed the relation between job changes and changes in working hours (Blundell et al. 2008). Figure 1 illustrates that while in the short-term overtime hours stay nearly stable for the group of doctoral students as well as for those participants who remain postdocs or firm employees over the course of our study, status changes from being a doctoral student to becoming a postdoc or a firm employee are associated with decreases in overtime work (T-tests, $p < 0.001$ each). Analogously, in Figure 2 we observe quite substantial decreases in overtime hours for the two groups who have changed their positions. The decrease (7.72 hours) is even more pronounced for those who start a job in a firm after earning a doctorate compared to new postdocs (4.14 hours).

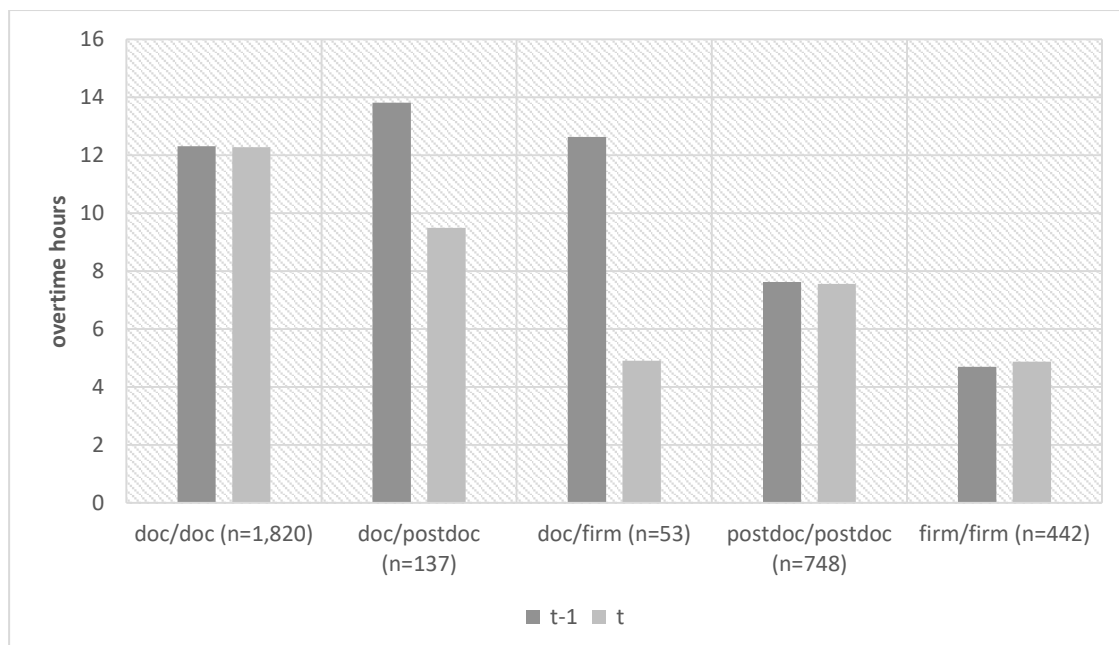


Figure 1: Overtime hours in $t-1$ and t by subgroups

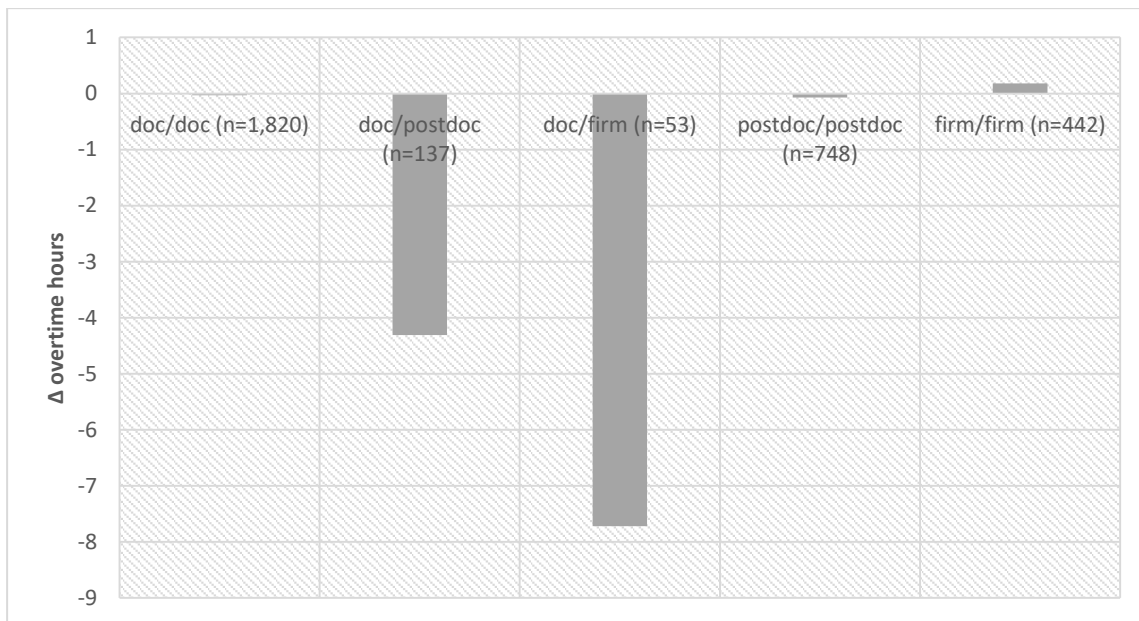


Figure 2: Change in overtime hours by subgroups

We proceed with the difference-in-differences estimations. The corresponding results are displayed in Table 5. Without controlling for further variables, the results of model (1) are in line with the aforementioned descriptive results. First, the results indicate that junior academics who face a career change in t (by either becoming a postdoc or an employee holding a doctorate) do not differ from those who remain doctoral students in the period before the change occurs. We also do not observe any changes in overtime hours over time. Both interaction terms, however, are significant. Therefore, a change in career status goes hand in hand with a decrease in the number of overtime hours.

The results are robust when controlling for the independent variables known from the cross-section analysis except of leaving out *part-time* (model 2). In model 3, we use *part-time* as an additional control. A variable which drives the differences between models 2 and 3 does indeed seem to be *part-time* employment. Whereas the difference-in-difference coefficients do not change dramatically from model 1 to model 2, the consideration of the variable *part-time* employment in model 3, however, is associated with a huge decline of the coefficients of the two interaction terms. But they still remain significant at the $p=0.006$ level for the treatment group *new firm employees* and at the $p=0.077$ level for the treatment group *new postdocs*. They are also economically meaningful. Even after controlling for various variables, we observe a decline in overtime hours after the career change. For the group of *new postdocs* the decrease in extra hours is around 2 hours after the change. Those participants who have started a job in the

private sector after completion of their doctoral studies, however, scale back overtime hours to a greater extent (by 4 hours). The result that new firm employees decrease their extra hours after starting a job in the private sector seems quite surprising and counter-intuitive at first glance, because one could imagine that starting a job in another career system would be associated with a high work load due to the initial necessities of training and familiarization with new tasks.

Table 5: Difference-in-differences estimations of overtime hours

	(1)	(2)	(3)
t	-0.026 (0.344)	-0.006 (0.324)	0.193 (0.252)
New postdoc in t	1.501 (0.992)	1.443 (0.910)	0.977 (0.730)
t*New postdoc in t	-4.282*** (1.268)	-3.959*** (1.179)	-1.745* (0.983)
New doctorate in firm in t	0.323 (1.700)	1.355 (1.472)	1.232 (1.277)
t*New doctorate in firm	-7.697*** (1.890)	-6.424*** (1.672)	-4.110*** (1.496)
Part-time (1=yes)			13.115*** (0.275)
Job focus		-0.808*** (0.106)	-0.035 (0.085)
Managerial responsibilities (1=yes)		-0.290 (0.317)	0.764*** (0.256)
Age		-0.355*** (0.059)	-0.047 (0.052)
Male (1=yes)		-2.173*** (0.335)	-0.067 (0.259)
Child (1=yes)		-2.349*** (0.465)	-2.733*** (0.412)
Partner (1=yes)		0.312 (0.398)	0.251 (0.305)
Career goal professor		-0.130 (0.108)	0.298*** (0.086)
Career goal manager		0.420*** (0.128)	0.489*** (0.097)
Work involvement		-0.675*** (0.154)	-0.525*** (0.121)
Importance of leisure time		-2.542*** (0.153)	-2.384*** (0.120)
Intercept	12.308*** (0.240)	37.304*** (2.201)	16.205*** (1.802)
Adjusted-R ²	4,020	4,020	4,020
Observations	0.008	0.127	0.463

Notes: The table reports coefficients and robust standard errors (in parentheses). Significant results at the 10%, 5% and 1% levels are indicated by *, **, and ***.

5.3 Limitations

In sum, we present some new evidence on the working hours of young academics. Due to data limitations, we are not able to explore long-term consequences in working time stemming from job transitions. It is worth mentioning, though, that working time is reduced in particular when starting a job as a doctorate holder in a firm, although individuals have to familiarize themselves with somewhat different tasks compared to tasks in academia. It would be interesting to examine the further development over a longer observation period.

Since our survey data are based on subjective reports of our respondents, potential biases associated with working time should be taken into account. This could, in particular, concern the comparison of working hours of firm employees and respondents working in academia. Contrarily to academia, working hours are often systematically registered by the employer in the private sector. Furthermore, there could be some intra-firm-specific regulations concerning the number of overtime hours, so that it is not possible for employees to accumulate too many extra hours. Thus, those participants who have started a job in the private sector could assess their working hours more precisely compared to those participants who remain within academia, where no detailed records are kept on working hours.

At first glance, one could argue that individuals can choose the number of working hours more autonomously in academia. We are not able to explicitly differentiate between involuntary and discretionary overtime. However, our results reveal that apart from working overtime, academic employees report hours mismatches, and hours mismatch is considerably correlated to overtime. Our perception is that supervisor pressure plays a smaller role than in private sector firms. Instead, junior academics are assumed to feel pressure to ensure a follow-up temporary contract or to qualify for a tenured position. Further research may address this issue in more detail. Beckers et al. (2008) show that employees who freely choose to work extra hours report being more satisfied with their jobs, having lower levels of job fatigue and to perceiving a work-family conflict to a smaller extent compared to those who do not have such discretionary room with respect to working hours.

Notwithstanding the aforementioned limitations, it has been worthwhile conducting our own survey, because general and meaningful existing data are very limited in corresponding sample size. The German Socio-Economic Panel, a representative yearly survey of people living in Germany, also asks respondents for actual, contractual and desired working hours. Although some thousands of individuals are interviewed, it is not easily possible to separate young academics, and only about 300 responding full-time employees (anywhere!) with a Master's degree in the corresponding age group in the wave for the year 2013 are captured, for instance. Overtime (mean = 5.5 hours) and working hours mismatch (mean = 6.8 hours) is somewhat lower for this broader group compared to our STEM sample of doctoral students, postdocs and firm employees holding a doctorate.

6 CONCLUSION

By using unique longitudinal survey data on the occupational situation and careers of German doctoral students and doctorate holders, we explore antecedents of overtime. Due to the longitudinal structure of our data set, following our participants' career development we also observe the adjustment processes of the working time after completing doctoral studies and starting a new position as a postdoc in academia or as a firm employee. Thus, we contribute to the existing literature by providing both new cross-sectional and longitudinal evidence on factors associated with the supply of overtime for the special group of junior academics working inside or outside of academia.

To sum up, our results reveal that overtime varies with the career stage. More precisely, doctoral students work significantly longer hours compared to postdocs and firm employees holding a doctorate. Our results also highlight that overtime is particularly relevant for doctoral students with part-time contracts. In addition, we find that more career-oriented individuals are performing more extra hours. Compared to this, individuals with family responsibilities and a stronger preference for leisure time spend significantly fewer hours at work.

Our observation regarding the positive relationship between overtime work and part-time employment deserves closer attention. Although excess work does not constitute a phenomenon which only occurs in part-time employment, it seems to affect research assistants - in particular doctoral students - to a considerable extent. The often-voiced concern about doctoral students who have 20-hour contracts but work late into the night does not seem to be a myth but rather the normal case for many doctoral students. Generally, the functions of part-time employment and the individual motives to enter this form of contract appear to be different inside and outside of academia. Part-time employment in the private sector, in particular for the highly educated group of doctoral holders serves rather as a temporary flexibility instrument which enables individuals to better combine their working and private life domains after certain life events, such as child birth. In academia, however, this does not seem to be the main reason. The lack of funding and the surplus of doctoral students in some disciplines (e.g. chemistry or life sciences) often do not leave doctoral students any choice other than to accept part-time employment. Although we are not able to prove so with our data, other studies highlight that many doctoral

students readily accept this temporary period of precarious employment (Dörre and Neis 2008). Therefore, it also has to be scrutinized for the evaluation of excess work as to what extent the excess work is conducive to career development, and also the boundaries between (partly involuntary) excessive working hours and workaholism should be explored (Clark et al. 2014).

As a further avenue for research, it may be interesting to follow doctoral part-time employed students over a longer period and to elaborate whether they manage to get out of precarious employment after completion of their doctoral studies and whether they manage to reduce the gap between actual and contractual hours.

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Appendix

Table A1: Estimations of overtime including interaction effects

	(1)	(2)
<i>Reference: Doctoral students</i>		
Postdoc (1=yes)	-1.962*** (0.486)	-0.398 (0.476)
Employee holding a doctorate (1=yes)	-3.418*** (0.559)	-1.427*** (0.525)
Postdoc*part-time		-10.731*** (1.237)
Employee holding a doctorate*part-time		-13.472*** (1.221)
Part-time (1=yes)	12.010*** (0.446)	13.865*** (0.461)
Job focus	-0.297** (0.117)	-0.170 (0.114)
Managerial responsibilities (1=yes)	1.474*** (0.349)	1.339*** (0.344)
Age	0.020 (0.057)	0.020 (0.055)
Male (1=yes)	-0.924** (0.383)	0.188 (0.342)
Child (1=yes)	-7.260*** (0.774)	-2.351*** (0.453)
Male*Child	6.844*** (0.883)	
Partner (1=yes)	-0.766* (0.461)	-0.535 (0.453)
Career goal professor	0.253** (0.115)	0.289*** (0.111)
Career goal manager	0.354*** (0.126)	0.316** (0.124)
Work involvement	-0.249 (0.172)	-0.209 (0.168)
Importance of leisure time	-2.682*** (0.171)	-2.651*** (0.166)
Intercept	7.054*** (1.966)	5.030*** (1.897)
Observations	1,984	1,984
Adjusted-R ²	0.460	0.481

Notes: The table reports coefficients and robust standard errors (in parentheses). Significant results at the 10%, 5% and 1% levels are indicated by *, **, and ***.

Table A2: OLS estimations of overtime hours by career stage – with fixed-term employment

	Postdocs		Firm employees holding a doctorate	
	(3)	(4)	(5)	(6)
<i>Job characteristics</i>				
Part-time (1=yes)	3.019** (1.330)	3.759*** (1.266)	-0.960 (1.114)	-1.016 (1.195)
Fixed-term employment (1=yes)	0.569 (1.109)	-0.181 (1.023)	2.609* (1.350)	2.634** (1.183)
Job focus	-0.604*** (0.226)	-0.473** (0.202)	0.661 (0.465)	0.500 (0.419)
Managerial responsibilities (1=yes)	2.837*** (0.711)	1.701** (0.694)	1.485 (0.909)	1.071 (0.872)
<i>Socio-demographics</i>				
Age [in years]	0.013 (0.086)	-0.061 (0.087)	0.092 (0.174)	0.115 (0.158)
Male (1=yes)	1.471** (0.744)	1.259* (0.678)	-0.185 (0.704)	-0.724 (0.668)
Child (1=yes)	-1.605** (0.727)	-1.675** (0.655)	-0.589 (0.951)	-0.716 (0.900)
Partner (1=yes)	-0.394 (1.053)	0.345 (0.956)	-0.035 (1.066)	-0.263 (0.889)
<i>Career orientation</i>				
Career goal professor		0.560*** (0.196)		0.249 (0.262)
Career goal manager		0.248 (0.229)		0.148 (0.273)
Work involvement		-0.114 (0.337)		-0.037 (0.335)
Importance of leisure time		-2.763*** (0.330)		-1.852*** (0.387)
Intercept	6.338* (3.818)	5.963 (3.946)	-2.384 (7.430)	-2.619 (6.803)
Observations	472	472	223	223
Adjusted-R ²	0.065	0.242	0.041	0.142

Notes: The table reports coefficients and robust standard errors (in parentheses). Significant results at the 10%, 5% and 1% levels are indicated by *, **, and ***.

Due to missing values, n=6 observations were deleted for the group of postdocs and n=2 for the group of firm employees holding a doctorate.

Table A3: Overtime and hours mismatch

	Whole Sample (n=1,984)	Doctoral students (n=1,281)	Postdocs (n=478)	Firm employees (n=225)
Overtime	10.41	12.57	7.23	4.89
Hours mismatch (= Actual working hours – preferred working hours)	6.76	7.04	6.73	5.19
Correlation of overtime and hours mismatch	0.45***	0.43***	0.57***	0.56***

Notes: Significant results for correlations at the 1% level are indicated by ***.