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ABSTRACT

Do Internships Pay Off? The Effects of Student Internships on Earnings

This paper studies the causal effect of student internship experience in firms on earnings later in life. We use mandatory firm internships at German universities as an instrument for doing a firm internship while attending university. Employing longitudinal data from graduate surveys, we find positive and significant earnings returns of about 6% in both OLS and IV regressions. The positive returns are particularly pronounced for individuals and areas of study that are characterized by a weak labor market orientation. The empirical findings show that graduates who completed a firm internship face a lower risk of unemployment during the first year of their careers, suggesting a smoother transition to the labor market.

JEL Classification: I23, J01, J31

Keywords: internships, skill development, higher education, labor market returns, instrumental variable

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1 Introduction

Internships have become a widespread phenomenon among university students in many countries throughout North America and Europe. Callanan and Benzing (2004), for example, argue that internships in the U.S. have become increasingly popular as a way to bridge the transition from education to work, with three out of four college students completing an internship in 2004, compared to fewer than 40% of students in 1980. In Germany, 55% of students who are currently enrolled in a university report having completed an internship during the past twelve months (Krawietz et al., 2006). By the time students finish their studies, nearly 80% report that they completed an internship while attending university (Sarcletti, 2009).

What motivates students to complete internships while enrolled at university? First and foremost, students expect internships to pay off after graduation when they enter the labor market. Indeed, when asked for their main motivation for undertaking an internship, most state the desire to get to know the work environment and gather practical work experience. Many also hope that an internship will help them to find employment later. The desire to earn money as an intern appears to be only a secondary motivator (Krawietz et al., 2006).

The surge in popularity of internships in higher education is not only a consequence of individual choices; it is also likely the result of universities emphasizing the importance of internships as part of the broader educational experience. Following the policy changes implemented as part of the Bologna Reform, graduates' employability has become a central objective of higher education across Europe (Teichler, 2011). Universities have been called upon to prepare their graduates better for the transition to work by focusing on competencies that are relevant to the job market. Internships are an effective means of building these competencies (Wolter and Banscherus, 2012, Teichler, 2011). As a consequence, many universities urge students to complete internships or even make internships an integral part of the curriculum.

Internships are believed to help students build work-relevant skills, gain specific knowledge of their future occupations, develop a clearer self-concept, and confirm or redirect individual career goals (Brooks et al., 1995). Most of the skills acquired during an internship are general and transferable (Busby, 2003). Students may further learn about their interests and preferences through internships and organize their remaining studies more efficiently by choosing courses satisfying those interests. These attributes may then translate into various favorable outcomes for the transition into the labor market and early career success, for example, shorter job search duration, lower probability of unemployment, more stable positions, better job match, and increased earnings. However, internships also produce costs due to the investment of time, effort, and sometimes even

money. Interns have to accept educational opportunity costs, and might enter the labor market later than non-interns. Considering that most internships are poorly paid or not paid at all, it is not surprising that debate has arisen about the potential downside effects of internships. One argument is that firms exploit highly qualified students as cheap workers (Wolter and Banscherus, 2012). The overall effect of internships on individual labor market outcomes is unclear, and empirical research is needed to provide a basis for sound conclusions.

Theoretically, we anticipate student internships to have positive earnings returns. Human capital theory (Becker, 1993, Mincer, 1974) predicts that the additional knowledge, skills, and competencies accumulated as an intern result in higher pay if the time spent on the internship has a higher payoff for the specific career track than the time spent studying.[1] Signaling theories argue that employers' hiring decisions are made under uncertainty since the productivity of potential workers is unknown, and that job seekers may therefore use internships and positive references provided to them upon completion of the internship to signal high ability, which may result in improved job matching and higher earnings (Spence, 1973, Akerlof, 1970, Schnedler, 2004). Screening theory predicts that firms use such signals to more accurately assess workers' hidden productivity (Stiglitz, 1975). Social capital theory (Bourdieu, 1986, Coleman, 1988) also foresees positive labor market returns of internships because of the opportunity they provide to establish relationships with co-workers and potential employers. These social ties might, according to this line of thought, lead to better jobs after graduation (Granovetter, 1995).

We use longitudinal data from graduate surveys conducted by the German Centre for Research on Higher Education and Science Studies (DZHW) to empirically investigate the earning returns to internships. To account for the endogeneity of students' decisions to undertake an internship, we employ a two-stage least squares (2SLS) approach and instrument internship completion with mandatory internships. Exogenous variation comes from the introduction and abolition of mandatory internships across university and area of study level over time.[2] The first-stage regressions suggest that the presence of mandatory internships has a large and statistically significant impact on the likelihood of acquiring internship experience during university study. In fact, university students have a 56 percentage points (80%) higher likelihood of completing a firm internship during the course of their studies if the internship is mandatory. Internship experience increases earnings by around 6%, an effect that is precisely estimated in both OLS and IV regressions. Using

[1] We suspect that this is likely, given that most students do their internships between terms or semesters and therefore do not miss class.

[2] We use the term 'area of study' to denote *Studienbereiche*, which are broadly defined areas rather than specific subjects or degree programs, for example Romance languages but not Italian, Spanish, or French. This is the term used by the German Federal Statistical Office and in our data. We use the term 'field of study' to denote a specific subject, such as Italian. The term 'study program' denotes a specific degree course, such as a master's program in Italian at a specific university.

an alternative instrument, that is the share of students reporting mandatory internships in a given university-study area-cohort cell, excluding the student's own report, we find that returns to internship are in the range of 14.6%. We interpret this as the upper bound of returns to internship experience. The positive returns are particularly pronounced for individuals and areas of study with a weak labor market orientation[3], and for humanities and social science graduates. Across other subgroups of the population, however, we do not detect heterogeneous effects.

We provide arguments and comprehensive evidence that mandatory internships are as good as randomly assigned, conditional on predetermined variables, such as area of study and university fixed effects. To support the credibility of the findings, several aspects are addressed: 1) measurement error in the instrument, 2) the risk of self-selection of students into areas of study with mandatory internships and 3) the impact of potential confounders, that is, simultaneity in the introduction of mandatory internships with other changes at the level of area of study or university. Importantly, detailed evidence from various student surveys shows that the requirement to complete an internship (or lack thereof) plays no role in students' choices of university or field of study (e.g., Hachmeister et al., 2007, Heine et al., 2009, Pryor et al., 2012). Furthermore, we analyze data from a representative internet survey conducted in Germany in 2016 that asked prospective university students and graduates in an open question about reasons for their study program choices and in another open question about reasons for their university choices. We additionally conducted a survey among first and third semester students at Universität Hamburg asking the same questions. We find no evidence that mandatory internships are relevant when choosing the university and study program, since no respondent answered that mandatory internships were important for their study choices.

The remainder of this paper is structured as follows: Section 2 gives a brief overview of the literature and the institutional setup of student internships in Germany. Section 3 describes the data, and Section 4 lays out the empirical strategy and discusses several aspects of identification. Section 5 presents the main results for the effects of internship experience on earnings and Section 6 inspects whether the effects differ for various subgroups of the population. Section 7 sheds light on labor market transitions, and Section 8 presents various robustness checks. Section 9 discusses limitations of the study and concludes.

[3]Labor market orientation is measured in two ways, first, by a graduate's self-assessment of how important labor market considerations were when choosing the study subject and second, by the occupational specificity of a graduate's area of study (see variables description in Section 3).

2 Background

2.1 Related Literature

Despite the prevalence of student internships and their importance in allowing students to explore potential career paths, the empirical literature on causal effects of internship experience remains scant. Available studies draw conclusions based on opinion polls among interns about the perceived benefits of their work experiences (Beck and Halim, 2008, Cook et al., 2004, Shoenfelt et al., 2013, Krawietz et al., 2006). Another strand of literature compares individuals with and without internship experience, but does not account for potential self-selection into conducting an internship. Some studies also report positive correlations of internships with shorter job search duration (Gault et al., 2000), higher job stability (Richards, 1984), more and better-quality job offers (Taylor, 1988), a higher chance of choosing a career-oriented job (Callanan and Benzing, 2004), and wage increases (Gault et al., 2000, Reimer and Schröder, 2006, Sarcletti, 2009).

To our knowledge, the only studies that go beyond correlations are Nunley et al. (2016) and Klein and Weiss (2011). Nunley et al. (2016) conduct a résumé-audit study in the U.S. and randomly assign three-month internship experience to fictitious job seekers. They find that applicants with internship experience receive about 14% more interview requests than applicants without such experience. The effects are larger for non-business degree holders than for business degree holders. However, the authors are not able to study wage effects due to the experimental design. Besides, as the discussion in Heckman (1998) suggests, audit studies might find high returns to internship where there are none, and no returns where the returns do exist. Audit studies are based on the implicit assumption that the distribution of unobservables is the same in both groups after creating pairs that are "identical" in paper qualifications, hence comparing their outcomes by averaging over the outcomes at all firms for the same audit pair produces an estimate for the effect of internship. Heckman (1998) shows that if the variance of skills differs between the two groups, then which group gets the callback depends also on which group has a higher variance in relevant skills. Hence, conclusions drawn from audit studies depend on the distribution of unobserved characteristics for each group and the audit standardization level. Thus, the exploration of the earning effects of internships with observational data is important to advance our understanding.

Klein and Weiss (2011) use observational data from Germany for the graduation cohort 1997. They employ matching estimation methods and find no wage effects of mandatory internships among university graduates in Germany. Our study differs from Klein and Weiss (2011) in several aspects. Contrary to their paper, we follow the graduation cohorts and use two waves to increase the sample size. This allows us to exploit the variation in mandatory internships over time, making the identification more robust. Another

important difference between our study and Klein and Weiss's study is the identified parameter: while our estimation approach identifies the local average treatment effect (LATE), the authors claim to estimate average treatment effect on the treated (ATT). The complier group in the present case are students who would have not done an internship had the internships not been mandatory. We believe that in this context the LATE is the more relevant policy parameter to identify. To explicitly compare our results to those of Klein and Weiss (2011) we replicate their study, additionally extending it to the cohort we study in this paper. We report the results in Appendix C Table C-1. Our replication shows that the differences in earning returns are rather driven by cohorts and not by the empirical approach.

2.2 Student Internships in Germany

There are two basic types of student internships: voluntary and mandatory. Whereas internships of the former type usually take place in firms or organizations outside the university setting, the latter may take place either in a firm or at the university. Students are generally free to do as many voluntary internships as they like during the course of their studies, but they have to fit these kinds of internships into their study schedule. As a result, students in Germany usually do voluntary internships during semester breaks.[4] In general, students do not earn university credit for doing voluntary internships.

In contrast, mandatory internships are mandated by study program regulations, and students earn credits for mandatory internships, that is, they have to complete an internship in order to graduate. The regulations state whether the internship has to be in a firm or at university. They further stipulate the industry and duration of the internship, and usually define learning targets. At the end of the internship, students must write a report about their tasks during the internship. To get an overview on the duration of mandatory internships, we scanned around 80 study regulations in Germany. We infer that most mandatory internships last 8-24 weeks (around two to six months). On average internships tend to be longer at universities of applied science.

Internships in firms may be either paid or unpaid. In our observation period, which was before the introduction of the general minimum wage in Germany in 2015, firms had no obligation to pay interns, irrespective of whether the internship was voluntary or mandatory. Even under the new minimum wage regulations, firms are not required to pay interns for voluntary internships shorter than three months or for mandatory internships. Nevertheless, firms and interns usually sign an internship contract stipulating the rights and obligations of both parties. Interns typically receive an internship certificate from

[4]In Germany, an academic year consists of two semesters with a summer and winter break. The exact length of the breaks varies, but the summer break is usually 12 weeks and the winter break usually 8 weeks.

firms including a performance evaluation after completion of the internship.

In this article, we are interested in the returns to internships outside of university including, for example, internships in firms and governmental and non-governmental organizations. We call internships outside of university 'firm internships' for brevity.

3 Data, Variables, and Descriptive Statistics

We use longitudinal data from the DZHW Graduate Panel, a survey of university graduates conducted by the German Centre for Research on Higher Education and Science Studies (DZHW). The DZHW Graduate Panel is described thoroughly in Rehn et al. (2011). Recent studies that have also used DZHW data are, for example, Parey and Waldinger (2011), Grave and Görlitz (2012), Freier et al. (2015). Each survey is a random sample of the student population of German universities. We employ information from three different cohorts comprising students who graduated in the years 2001, 2005, and 2009. For each cohort, an *initial survey* was conducted around one year after graduation. Around five to six years later, a *follow-up survey* was conducted. For the 2001 and 2005 cohorts, data are available for both waves, the initial and the follow-up survey. For the 2009 cohort, only the first wave is available. Figure 1 visualizes the timing of the data collection.

In the initial survey, students were asked whether they did a mandatory and/or voluntary internship during the course of their studies. In one question, each respondent was asked whether a firm internship was mandatory; respondents could tick the item "Yes, external internships (e.g., internship at a firm)." In another question later in the survey, each respondent was asked: "Which of the following means of further education and qualification, which go beyond your professional studies, did you use during your years of study?" Respondents could tick whether they did a voluntary firm internship. We use the first question to generate the instrument $Mandatory$, which is a dummy variable that takes the value one if a respondent stated that a firm internship was mandatory and zero otherwise. We use both questions to generate the endogenous variable $Internship$, which is a dummy variable that takes the value one if a respondent did a voluntary and/or mandatory firm internship and zero otherwise.

To check the reliability of self-reports we collect information on the existence of mandatory firm internships taken from study program regulations and—despite the strict data privacy rules—we were granted the permission to merge this information to a subsample of the DZHW survey data. We received a list of study programs with more than five respondents per study program from the DZHW for the graduate cohort of 2009. For this list, we collected as many study program regulations as possible and coded whether firm internships were mandatory. Afterwards, the DZHW merged the information given

the regulations to the share of survey respondents stating that a firm internship was mandatory at the study program level.[5] Table 2 illustrates the results for study programs with and without mandatory firm internships (according to the study program regulations). The results show that the overlap of the survey responses with the study program regulations is substantial, supporting the accuracy of the survey responses.[6]

DZHW further collects information on details of graduates' university studies and their opinions about their studies. The surveys also include comprehensive demographic, socioeconomic, and educational information. In particular, the survey collects various proxy variables for students' intelligence, ability, and labor market orientation, and information on parental backgrounds. The outcome variable, gross monthly earnings, is self-reported for the job at the time of the interview and measured in euros adjusted to 2005 prices. On average, we measure earnings around three years after graduating from university.

Throughout the analysis, we mainly work with a sample comprising all available waves of the three graduate cohorts as indicated by the shaded areas in Figure 1. This sample helps to increase the precision of the estimates, which will become particularly relevant when studying heterogeneous effects in Section 6.[7] In Section 8, we also distinguish between short-term (i.e., one year after university graduation) and medium-term (i.e., five to six years after graduation) labor market effects, using sub-samples of the available data.

A typical feature of some university degrees is that they imply an obligatory second phase of education. For example, prospective teachers in Germany take a first state exam upon completing their university studies, and then have to complete 1.5 years of classroom training before taking the state exam, which then qualifies them to work as a teacher. Similar obligatory second educational phases of varying duration exist, for example, for lawyers, clerics, and medical doctors in Germany. During this period, individuals are outside the regular labor market. For this reason, we exclude all individuals from our sample who finished university with a state exam (lawyers, clerics, pharmacists, teachers, and physicians) or reported having to complete an obligatory second phase of education. Furthermore, we exclude graduates who finished university with a bachelor's degree because of small sample size issues. Graduates with bachelor's degrees were interviewed only in 2009. Moreover, bachelor's degrees imply a shorter duration of study than other university degrees (Diplom, Magister, Master) and are less accepted by employers in Germany.[8]

[5]Note that merging the regulations to both the individual-level data and survey information other than the share of respondents stating that a firm internship was mandatory is prohibited due to German data protection.

[6]A perfect overlap is not expected, because conditioning on a respondent's university starting year was not possible. Given the substantial variation in the requirement to do firm internships over time, we expect that incorporating the university starting year would increase the overlap of the survey responses with the regulations.

[7]We borrow the idea of pooling the data from Parey and Waldinger (2011).

[8]In unreported regressions we estimate the returns to internships for a larger sample comprising all these groups, and the main results are similar.

Finally, we only keep those observations that have non-missing values for all relevant variables.[9] This results in a sample size of 13,976 graduates, with 19,736 person-wave observations. 6,790 graduates are observed in both the initial and follow-up survey.

Table 1 reports summary statistics for the overall sample (column 1) and differentiated by first- and second-wave observations (columns 2 and 3) and by internship experience in firms (columns 4 and 5). The numbers in column 1 in Table 1 show that 66% of graduates did a firm internship while attending university, 41% completed a voluntary firm internship and 48% a mandatory one.[10] The average year of birth is 1977, 53% are female, nearly one in three graduates completed an apprenticeship before starting at the university, and the average final high school grade is 2.2 (on a 1–5 grade scale with 1 signifying "excellent" and 5 "failing"). Furthermore, many students come from highly educated families, with 37% of mothers and 50% of fathers having graduated from an upper secondary school. Columns 4 and 5 indicate that students who did an internship express a stronger labor market orientation in their self-assessment when asked "To what extent did labor market considerations play a role when choosing your area of study?" (on a scale 1–5 with 1 signifying "not at all" and 5 "very much"). It is important to point out that labor market orientation refers to a point in time prior to entering university and can therefore be considered to be a predetermined variable. With respect to the outcome variable—log monthly earnings—the unconditional means show that students who did an internship during the course of their studies have quite similar earnings to their fellow graduates.

Table A-1 in Appendix A reports descriptive statistics for internship experience by field of study for three broad groups: (1) science, mathematics, engineering; (2) business and economics; (3) humanities and social sciences. It shows that more than 70 percent of graduates in humanities and social sciences acquire some internship experience while studying, followed by 68 percent of business and economics graduates. Figure A-1 displays how distributed internship experience is across the universities in the sample. Similar to Table 1, we distinguish between internship experience (panel A), voluntary internship experience (panel B), and mandatory internship experience (panel C).

[9] After excluding the initial groups we end up with 23,451 observations. We lose 2,460 observations because of missing values on the dependent variable, the instrument and the internship, ending up with 20,991 observations. The rest of the loss is due to missing values in parental education, high school graduation grade, and labor market orientation. In unreported regressions we replaced the missing values with the sample average and also control for it with dummy variables. The results are very similar and are available upon request.

[10] The corresponding figures in column 5 (0.63 and 0.70) do not add up to one, because many students did more than one firm internship during their studies. Among graduates who did a firm internship, about 37% did a mandatory but no voluntary internship, about 31% did a voluntary but no mandatory internship, and about 32% did both a mandatory and a voluntary internship during studies. Unfortunately, the DZHW data do not contain any further information on the number of internships. In Appendix B, we present descriptive evidence on the number of internships during studies from the Bavarian Graduate Panel, which is a survey similar to the DZHW survey.

4 Empirical Strategy

We start by estimating the following OLS regression.

$$Log(Earnings)_{i,c,u,a,t+} = \beta_0 + \beta_1 Internship_{i,c,u,a,t} + \beta_2 GradCohort_c + \beta_3 AREA_a + \beta_4 UNI_u + X_{i,c,u,a,t}\gamma + \epsilon_{i,c,u,a,t}, \quad (1)$$

where $log(Earnings)$ is the natural logarithm of gross monthly earnings of individual i of graduation cohort c of university u and study area a at time $t+$, where $t+$ is a time point after graduation. The variable $Internship$ equals one if a student did a firm internship while attending university at time t, and zero otherwise. We further include a rich set of fixed effects: $GradCohort$ includes dummy variables for graduation cohort, $AREA$ is a 53×1 vector of area of study fixed effects and UNI is a 262×1 vector of university fixed effects to control for the potential concern that the quality and reputation of the university and/or the study program may be correlated with the availability of mandatory firm internships and graduates' labor market outcomes later in life.[11] The vector X contains individual set of controls, such as a dummy variable indicating gender (*Female*), 22×1 vector of birth year indicators, a survey wave dummy, degree type dummy and several predetermined variables that are likely good proxies for students' intelligence and ability, in particular we control for students' final high school grade (*high school grade*), whether they completed an apprenticeship before beginning university studies (*apprenticeship*), the self-reported influence of labor market aspects on their choice of what career and study subject (*labor market orientation*), as well as a full set of dummy variables for mother's and father's highest general educational degree (four groups each).[12]

However, there are several reasons why the estimated effect of returns to internships may be biased in the OLS regression. It is likely that the choice to do an internship correlates with unobserved factors such as motivation or ability, that are also correlated with earnings later in life. Hence we rely on a 2SLS framework. To estimate the effect of internship experience on earnings later in life, we instrument firm internship experience

[11] Note that for $AREA$, the data only allow us to observe the areas of study, which are referred to as *Studienbereiche* in the nomenclature of the German Federal Statistical Office, but not the exact subject (Statistisches Bundesamt, 2014). For example, we can observe whether someone studied Romance languages, but not whether the subject was French, Italian, Spanish, or Portuguese.

[12] Mincer type wage equations typically control for age and age^2 to proxy work experience. Age variables have been omitted from the baseline specification because they are likely to be outcome variables themselves. This is because internship experience might delay labor market entry due to the extra time working rather than attending university. We experimented with the inclusion of age variables and found that this leaves our results unchanged.

with the presence of mandatory firm internships. The second-stage equation is:

$$Log(Earnings)_{i,c,u,a,t+} = \beta_0 + \beta_1 \widehat{Internship}_{i,c,u,a,t} + \beta_2 GradCohort_c + \beta_3 AREA_a + \beta_4 UNI_u + X_{i,c,u,a,t}\gamma + \epsilon_{i,c,u,a,t}, \quad (2)$$

and the first-stage equation is:

$$Internship_{i,c,u,a,t} = \alpha_0 + \alpha_1 Mandatory_{i,c,u,a,t} + \alpha_2 GradCohort_c + \alpha_3 AREA_a + \alpha_4 UNI_u + X_{i,c,u,a,t}\gamma + \varepsilon_{i,c,u,a,t}, \quad (3)$$

where in the first-stage equation (3), the dichotomous variable *Mandatory* equals one if a firm internship was mandatory during the course of studies, and zero otherwise. In the second-stage equation (2) the variable *Internship* is the prediction from the estimated first-stage equation. The rest of the variables are defined as in equation (1).

4.1 Measurement Error in the Instrument

In the main specification, the instrument relies on individual survey responses on the existence of mandatory firm internships rather than on information from study program regulations. This approach might create measurement error in the instrument. Collecting all study program regulations from all universities to supplement and verify the accuracy of the survey data is, however, unfeasible for two reasons. First, the regulations are either not readily available or unavailable, especially for older graduate cohorts. Second, restrictive data privacy rules in Germany generally prohibit the access to sensitive information such as university names, implying that the DZHW data do not comprise university names. We tackle the question of how well the survey responses match the study program regulations in two ways. First, we use alternative definitions of the instrumental variable in the spirit of Ashenfelter and Krueger (1994) to provide a range for internship effects. These instruments exploit variation in the requirement to do a firm internship at the department level over time, which is a major source of variation in our data. We construct departments by creating cells for each unique combination of a respondent's university and area of study. We further calculate the proportion of students reporting a mandatory firm internship by department and graduation cohort in a leave-one-out fashion. The first and second stage regressions then take the following form:

$$Log(Earnings)_{i,c,u,a,t+} = \beta_0 + \beta_1 \widehat{Internship}_{i,c,u,a,t} + \beta_2 GradCohort_c + \beta_3 AREA_a + \beta_4 UNI_u + X_{i,c,u,a,t}\gamma + \epsilon_{i,c,u,a,t}, \quad (4)$$

and the first-stage equation is:

$$Internship_{i,c,u,a,t} = \alpha_0 + \alpha_1 \frac{1}{k-1} \sum_{j=1, j\neq i}^{k} Mandatory_{j,c,u,a,t} + \alpha_2 GradCohort_c + \alpha_3 AREA_a + \alpha_4 UNI_u + X_{i,c,u,a,t}\gamma + \varepsilon_{i,c,u,a,t}, \quad (5)$$

where the second term in equation (5) is the ratio of people reporting the existence of a mandatory internship of graduation cohort c, university u, area a at time t, excluding the individual herself. We report the results from the above equations alongside to estimation results from equations (2) and (3).

Finally, we conducted our own additional short survey among students enrolled at Universität Hamburg. We asked first and third semester bachelor students the same question on the existence of mandatory firm internships as in the DZHW survey. Because we know whether firm internships are mandatory from the study program regulations, we can evaluate the accuracy of the question asked in the DZHW survey. Note that this test is rather strict, because we survey first and third semester students in contrast to graduates as in the DZHW survey—especially first semester students might not yet be aware of the obligation to do a (firm) internship. The results show that the survey responses are reliable. Out of 282 students, about 92% answered the question correctly. This result therefore further supports the accuracy of the survey responses.

4.2 Self-Selection into Study Programs with Mandatory Internships

Our identification approach crucially hinges on the assumption that individuals do not systematically select themselves into study programs with mandatory firm internships based on unobservable characteristics. Put differently, the instrument must provide variation that is exogenous given the control variables. This assumption would be violated if, for example, more ambitious students are more likely to choose study programs with mandatory firm internships, and if they are also more successful in the labor market later in life.[13]

The survey of the literature suggests that the quality and reputation of the study programs and universities (Hoyt and Brown, 1999, Parey and Waldinger, 2011) as well as proximity to one's nearest university (Spiess and Wrohlich, 2010) are likely to be the most important choice determinants. Several German national newspapers such as *Handelsblatt*, *Die Zeit*, and *Der Spiegel* regularly publish university rankings by subjects and

[13]Note that ambition would have to be an omitted variable that is not sufficiently captured by the predetermined observables such as high school grade, labor market orientation, and parents' educational background, all of which are included in the full model specification.

institutions, and this information is widely circulated. Hachmeister and Hennings (2007) report that the majority of high school students in the final year of secondary school in Germany know and consult these rankings. However, none of these published rankings include information on internships. Moreover, gathering information from university websites on whether or not internships are mandatory is rather difficult, and unlike in the U.S., German universities do not distribute brochures or college catalogs to prospective students (Hoyt and Brown, 1999). Table A-2 in Appendix A summarizes studies asking students in Germany about factors that influence their study choices. The table provides an overview of the type of survey, sample size, the relevant question on study and/or university choice, key findings, and whether a question on internships is included in the survey. Most surveys elicit students' reasons for their university choice on a 5-point Likert scale (1 = "very important"; 5 = "not important at all"). For example, the representative surveys among first-year students conducted by the DZHW ask "How important are the following reasons for your choice of study?" on aspects such as reputation of the university, accessibility of the campus from home, quality of the academic program, etc. (Heine et al., 2005, 2009). Whether an internship is mandatory−or whether universities have good connections with firms that enable students to find internships more easily during the course of their studies−was not among the items listed in the surveys. Indeed, none of the studies we have found on this topic for Germany lists mandatory internships as a relevant aspect of study choice (Hachmeister and Hennings, 2007, Hachmeister et al., 2007, Bartl and Korb, 2009, Institut für Marktforschung GmbH, 2014). Moreover, U.S. and Canadian student surveys indicate that internship availability does not play a role in students' choices (Hoyt and Brown, 1999, Canadian Undergraduate Survey Consortium, 2004, Pryor et al., 2012). These results suggests that educators, researchers, and empirical methodologists do not expect a mandatory internship to be a relevant aspect in students' choices of university or study program.

We further provide evidence from the German Internet Panel (GIP), wave 22. The GIP is a longitudinal panel survey conducted online on a bimonthly basis and is representative of the general population in Germany aged 16–75.[14] Survey participants who had already finished their studies were asked in an open question to name the three most important reasons for their university choice, and in another open question the three most important reasons for their study program choice.[15] Similarly, participants who had not (yet) started their studies were asked to name the three most important aspects that

[14]The German Internet Panel is funded by the German Research Foundation through the Collaborative Research Center 884, "Political Economy of Reforms" (SFB 884). A survey description is available in Blom et al. (2015).

[15]The open questions are "If you attended university: Retrospectively, please name the three most important aspects that were decisive for your university choice(s)," and "If you studied: Retrospectively, please name the three most important aspects that were decisive for your study program choice."

would be crucial for choosing a university and study program, respectively.[16] In total, 696 individuals responded to these questions. None of the respondents mentioned that mandatory internships offered by study programs were a factor in choosing the study program and university, and only 2 respondents (less than 0.3%) mentioned that internships completed before university helped them to choose the field of study.

In a similar vein, we conducted our own survey at the Universität Hamburg by handing out questionnaires to first and third semester students of various bachelor study programs. We surveyed students in their early bachelor studies to capture their motivations for choosing a certain study program and university as accurately as possible. The sample includes 282 students enrolled in programs both with and without mandatory firm internships according to the relevant study program regulation.[17] None of the survey participants indicated that the existence of mandatory (firm) internships was important for their choice of study program and university. Only one student indicated that a firm internship completed before studying played a role in study program choice.

Finally, we address this concern by using the DZHW data. We regress the instrument and its variations on a range of predetermined covariates. Table 3 shows that most coefficients are small in magnitude, statistically non-significant, and are not robust across different specifications in column (1)-(3), with the exception of having done an apprenticeship before starting university studies. The negative correlation with the instrument, however, is not surprising, as students who finished an apprenticeship before their studies are often exempt from doing a mandatory internship if their apprenticeships comprised field-relevant work experience. Finally, column (4) of Table 3 includes predicted earnings as a function of all observables as a dependent variable. The adjusted R-squared of the regression is virtually zero and the the estimate of the instrument itself is small in magnitude and statistically insignificant. We therefore believe that it is very unlikely that students choose their subjects and universities based on whether firm internships are mandatory. In summary, the evidence indicates that mandatory internships are not a decisive factor for students' university and study program choice.

4.3 Impact of Potential Confounders

One threat to our identification strategy are changes at the university or department levels that affect earnings and coincide with the introduction or elimination of mandatory firm internships. For example, if the introduction of mandatory firm internships coincides with improvements in career counseling, we would overestimate the earning effects of

[16] The open questions are "If you have not (yet) attended university: please name the three most important aspects that would be decisive for your university choice," and "If you have not (yet) studied: please name the three most important aspects that would be decisive for your study program choice."

[17] The sample includes four study programs with about 50–70 respondents each; while two programs require firm internships, two do not.

internships. In order to assess the influence of such potential confounders, we examine twelve different indicators of study and university quality from DZHW that may affect earnings and thereby potentially bias the main results.

The twelve indicators cover the following four areas: 1) overall quality of education, 2) educational media and infrastructure, 3) training, and 4) career counseling. Respondents can rate items in category on a five-point scale, from "very bad" (1) to "very good" (5).[18] We test whether changes in the quality indicators across cohorts coincide with the introduction and elimination of mandatory firm internships by regressing the respective indicator on the set of controls specified in equation (3). The outcome takes the value one if respondents tick a four ("good") or five ("very good") on the respective measure, and zero otherwise.

Table 4 reports the estimates for the twelve different educational outcomes. Each coefficient and standard error in parentheses comes from a different regression. Positive coefficients imply that the presence of mandatory firm internships coincides with improvements in the quality indicators. 46 out of the 48 estimated coefficients coefficients in Table 4 are close to zero and statistically non-significant at conventional levels. The only estimates that are statistically significant are for the outcome variable *Up-to-date education* in columns (1) and (3).[19] We thus believe that concurrent changes in education quality are unlikely to drive our estimates.

5 Results

Table 5 presents the OLS and IV results. Each column shows the estimated coefficients and standard errors from a different regression. The first two columns present results for the OLS regressions, and columns 3-6 show the IV estimates. The standard errors are clustered at the department level.

All regressions in Table 5 show a positive and statistically significant relationship between firm internship experience while attending university and earnings later in life. The OLS coefficients for both specifications suggest that a student who gained labor market experience through a firm internship during the course of her studies has 6% higher earnings later in life. The estimated coefficients are statistically significant at the 0.1% level.

Importantly, the IV estimates also point to a causal positive and statistically significant

[18]Figure A-2 in Appendix A displays the distribution of the twelve variables. The figure shows that there are considerable differences in how graduates evaluate the quality of their studies. For example, around 50% of the graduates rate the structure of the degree program and that the methods taught are up-to-date as good or very good (panel A). In contrast, fewer than 15% of graduates gave the same positive rating for career counseling (panel D).

[19]In unreported regressions, we also estimated logit models, which yield a very similar picture.

relationship between firm internship experience and graduates' labor market earnings. In columns (3) and (4), where we instrument internship experience with self-reported mandatory internship existence, the estimates suggest a 6.5% return to internships. When we use the instrument with the leave-one-out ratio (IV_{II}), the coefficients indicate returns of around 15%. The difference in magnitude between the two IV estimates might be partly due to measurement error in self-reported measure. Additionally, note that the second instrument assumes that there is no variation in mandatory internship requirement within a department for a given cohort, which is not always the case. Related to this, our second instrument might be capturing the internship returns to a compositionally different complier group. As the instrument is the share of students in a given department-cohort cell, it might be capturing the effect not only for individuals who did an internship because it was mandatory for them, but also for those who voluntarily choose to do so because of the high shares of internship takers. We report column (5) and (6) as an alternative specification to provide some range of the magnitude, however we prefer the more conservative estimate, that is column (4) in Table 5 is our preferred specification.

First-stage results based on equation (3) are presented in Panel B of Table 5. The estimated coefficient for the instrumental variable *Mandatory internship* is always positive and precisely estimated at the 0.1% significance level. The estimates suggest that a mandatory firm internship increases the likelihood of firm internship experience by 56 percentage points. The corresponding F-statistics of about 2,542 point toward a strong first-stage relationship. Similarly, although the F statistics for the second instrument is smaller than in column (4), it is nevertheless above the conventional threshold.

Table 5 also shows the estimated effects for other selected explanatory variables. Female graduates have around 17% lower earnings than male graduates. This estimated relationship is consistent with previous findings for Germany (Machin and Puhani, 2003, Leuze and Strauß, 2009). Moreover, the estimates for the variable *apprenticeship* reveals that graduates who completed an apprenticeship before starting their studies have around 8% higher earnings.

In our main IV approach, the identifying strategy is based on instrumenting internship experience during studies by an indicator whether an internship was mandatory. In the interpretation of the Local Average Treatment Effect (LATE) framework, this suggests that IV estimates identify an effect for compliers, i.e., students who do an internship during studies because it becomes mandatory and would not have completed any internship during the course of their studies otherwise. The subpopulation for which the effect is identified might therefore be different compared to the overall student population (Imbens and Angrist, 1994). Hence, it is important to point out that the similarity in the magnitude of the OLS and IV estimates might not necessarily be indicative of no or little selection in the OLS regressions, but the consequence of the different subpopulations for

which the effect is identified. Noncompliance in the present context would imply students dropping out of university as a result of internships becoming mandatory. In Section 8, we present descriptive evidence from administrative data from the Federal Statistical Office suggesting that students are not more or less likely to drop out of university because an internship becomes mandatory.[20] Hence, it is likely that we are close to the case of a one-sided full compliance and the IV estimates might therefore be close to the Average Treatment on the Nontreated. Heckman et al. (2006) point out that this parameter answers an interesting policy question. In the present context, the parameter is informative about the earnings gains for students who would not have done an internship and who are selected into internship at random.

The positive LATE could be driven by various, not necessarily mutually exclusive, mechanisms. For example, internship experience may help develop and/or signal job-related skills (Akerlof, 1970, Spence, 1973, Mincer, 1974, Becker, 1993). The practical job experience in firms might create job networks and social capital theory also predicts positive returns to internship experience (Granovetter, 1995). It is important to point out that we cannot disentangle the extent to which the positive internship experience are driven by human capital theory, signaling theory, and social capital theory, because these theories produce very similar predictions. Moreover, returns might differ between voluntary and mandatory internships. For example, returns of voluntary internships could be higher if students who are interested and motivated learn more from the practical experience compared to those who are forced to do an internship, but are not motivated. On the other hand, it could be that a mandatory internship makes a significant difference in case students realize the (unexpected) benefits of the practical work experience.

Is a 6% increase in earnings with internship experience a comparatively small or large effect? To answer this question, it is helpful to compare our results with the empirical literature on causal wage returns of education (Heckman et al., 2006). For the U.S., Angrist and Krueger (1991), Acemoglu and Angrist (2000) report causal wage returns to schooling of around 6–10%, and Oreopoulos (2007) estimates returns of around 13%. For Germany, the returns to schooling estimates vary between 0 and 10% (Becker and Siebern-Thomas, 2007, Pischke and Wachter, 2008, Saniter, 2012). Comparing our results with the literature, it therefore appears that the returns to internship experience are roughly comparable to the wage returns of one more year of schooling and therefore quite significant in size.[21]

[20] We cannot study the proportion of those not complying with a mandatory internship in the DZHW data, because we work with a survey of university graduates.

[21] Note, however, that the local average treatment effects are estimated for different groups. The literature on causal returns to schooling estimates returns for individuals with low levels of schooling who are forced to acquiring more education because of an increase in compulsory years of schooling. In this study, we estimate earnings returns of internship experience for university graduates and it is important to point out that different instruments are likely to define different parameters (Heckman et al., 2006).

6 Heterogeneous Effects

This section studies whether subgroups of the population benefit differently from firm internships. In addition to the results of separate models for each subgroup, we also report the relevant p-values from interacted models for both the OLS and IV approaches in Table 6.

Panel A reports the impact of internship experience in firms separately for men and women. Differences in returns to internship experience may show similarities to, for example, differences in college degree returns, which are higher for women than for men (Jacobson et al., 2005, Jepsen et al., 2014).

Panel B investigates whether effects vary by parental education. The sample is split into two groups by whether one of the parents has an upper secondary school degree. This split is based on the idea that students with highly educated parents could benefit from their parents' social networks, irrespective of their own labor market experience. Hence, a firm internship might be more rewarding for students without such intergenerational networks.

In panel C, separate effects are estimated for graduates by their final high school grade, since students with good and very good grades are likely to have other unobservable characteristics (e.g., high motivation, intelligence, social skills) that might make them benefit more from a firm internship than students with lower grades. Further, due to their abilities, they might be more likely to participate in a firm internship of high quality and prestige, an aspect that we cannot observe.

Panel D analyzes the heterogeneity of internship experience across students' labor market orientation. Students for whom labor market aspects played a critical role in their choice of what to study might be more ambitious and motivated during their internships than students with a weaker labor market orientation, potentially leading to higher returns. Alternatively, firm internships might be particularly beneficial for students who have not given much thought to labor market aspects: internship experience in firms might help them to gain a clearer self-concept and develop better career plans.

Panel E separately reports returns to internship experience for areas of study with a *strong* or *weak* labor market orientation. Following Sarcletti (2009), areas of study have a *strong* labor market orientation if they lead to a particular profession. Examples are medicine and architecture, because nearly all medical students become doctors and most architecture students later work as architects. In contrast, areas of study with a *weak* labor market orientation do not necessarily lead to a particular profession. These areas teach more general skills that qualify graduates for a wide range of jobs. Examples are history, philosophy, and languages.[22] Finally, panel F separately shows the impact of firm

[22]See Table A-3 in Appendix A for a complete classification of areas of study into weak and strong labor market orientation.

internships by field of study for three groups: (1) science, mathematics, engineering; (2) business and economics; (3) humanities and social sciences.

The estimates in panels A, B, and C in Table 6 do not point toward heterogeneous effects of internship experience in firms by gender, parental background, or high school performance. In contrast, the point estimates in panels D and E suggest that firm internships are particularly beneficial for students with lower levels of labor market orientation. For example, the IV estimates in panel D suggest returns of around 12% for students whose labor market aspects did not play an important role in their choice of what to study compared to only 2% for those who took labor market aspects strongly into consideration. The difference of 10 percentage points is statistically significant at the 5% level, as indicated by the p-value of 0.017 from the interacted model. In line with this finding, the estimates in panel E also point toward higher returns of internship experience in firms for graduates in areas of study with a weak labor market orientation, with the difference being statistically significant at the 10% level (p-value of 0.08 from the interacted model). The heterogeneous effects by field of study in panel F are also consistent with those in panels D and E. The estimates suggest that graduates in the humanities and social sciences (without economics) have higher firm internship earnings returns compared to those who studied science, mathematics, engineering, business, or economics.

We conclude that those who benefit most from internship experience in firms are individuals with a weaker labor market orientation and those who study subjects with a weaker labor market orientation. One explanation for this heterogeneity of effects is that firm internships help students to develop a better understanding of their future occupation and a clearer concept of their own preferences. Moreover, for graduates in subjects with a weak labor market orientation, firm internships can help to establish contacts with potential employers, which may facilitate the screening of candidates when the subject itself is not a strong signal.[23]

7 Transition to the Labor Market

This section examines how internship experience in firms affects the transition to the labor market, specifically during the first years after university graduation. We use calendar information in the surveys to construct binary activity indicators for every month during the first five years after graduation. Monthly information is available for employment, unemployment, and full-time employment. We use these indicators as additional outcome measures to study transitions to the labor market after graduating from univer-

[23] In unreported regressions, we also distinguished between students who graduated from a university versus a university of applied sciences. Studies at universities of applied sciences are more practically oriented, and the effect of internship experience in firms might therefore differ by the type of university degree. The regression results did not point toward heterogeneous effects.

sity. Figure 2 graphically displays the estimated coefficients of internship experience in firms for these activities from OLS and IV regressions. The vertical bars represent the 95% confidence intervals. Panel A in Figure 2 displays the effects of internship experience in firms on the probability to be employed. While there are no statistically significant effects during the first two years, later years exhibit positive coefficients, though only significant at the 5% level during the third year. Panel B reports estimates on the likelihood to be unemployed. The graph reveals that internship experience in firms decreases the risk of being unemployed during the first year. However, in later years, this effect levels off to nearly zero and becomes statistically non-significant in most regressions. Panel C in Figure 2 shows the results for being in full-time employment. This indicator is only defined for employed individuals in the respective month. The graph shows a higher propensity to be in full-time employment in most months, with statistically significant point estimates mainly between 20 and 35 months after entering the labor market.

Given that firm internships reduce the risk of unemployment in the short term, the question is how much of the internship earnings return can be attributed to the reduction in the risk of unemployment? To analyze this question, we include the unemployment duration after graduation measured in months as a covariate in the full IV specification. The earnings effect of a firm internship declines from around 6% to 4.6%.[24] The decline in the point estimate is consistent with the negative wage effects found in the unemployment scarring literature, which finds that a one-month unemployment spell decreases wages, on average, by about 1% (e.g., Arulampalam, 2001, Gregg and Tominey, 2005, Gangl, 2006, Mroz and Savage, 2006). Further, the results in Figure 2 are also in line with recent work by Nunley et al. (2017) who find in a résumé audit study that internship experience obtained while studying mitigates the negative effect of underemployment on employment prospects of college graduates in the United States.

Overall, the findings in Figure 2 suggest that firm internships raise earnings by helping graduates to find their first job faster with a higher chance of being full-time employed. Moreover, including unemployment duration as a covariate in the regression suggests that firm internships work partly by reducing unemployment, but that the earnings effect is not entirely the result of increased job experience.

8 Robustness Checks

In this section, we present sensitivity checks. Table 7 reports the results of sensitivity analyses based on the full model specification similar to the regressions in Table 5, columns (2) and (4). First we present the estimates with an alternative definition of the

[24]The internship effect remains statistically significant at the 5% level in the full IV specification; unemployment duration is statistically significant at the 0.1% level.

instrumental variable, that is the threshold 70/30. The 70/30 threshold defines cells as having mandatory firm internships if more than 70% of all graduates report that a firm internship was mandatory, and zero if less than 30% report that its mandatory. Note that this approach involves some measurement error as we only observe departments and not students' actual study regulations, which would be more precise. The IV estimate in panel A is positive and significant, albeit it is nearly three times larger than the estimate from our preferred specification.

In panel B, we consider that certain departments might differ in educational quality, connections to firms, or degree of support provided to students in finding high-quality jobs. To control for these potential differences, panel B in Table 7 reports the estimates when controlling for a maximum set of 1,494 department fixed effects (i.e., dummy variables for unique combinations of university and area of study). These fixed effects are added to the full model specification, which already comprises area of study and university fixed effects. Hence, there might be the risk that this model is over-specified. It turns out that the coefficient for internship experience in firms decreases, suggesting positive returns of around 4–5%.[25]

In panel C of Table 7, we present estimated results for the models only with department fixed effects (excluding area of study and university fixed effects), therefore exploiting the variation within departments (i.e., the variation through timing) without the potential problem of over-fitting. Similar to the point estimates in panel B, the estimates suggest positive earnings returns of internship experience during the course of studies of 4–5%.

There might be differences in labor market returns for the same area of study across the applied science or full universities. For example, a degree in economics might differ in terms of quality or labor market returns between universities and universities of applied sciences. To address this concern, the regressions in panel D additionally include fixed effects for interactions between area of study and type of university. Reassuringly, the estimates do not change much.

There is also the risk that the returns on internship experience in firms are confounded by other forms of practical work experience. For example, 48% of graduates report paid employment during the course of their studies that was related to their degree. Moreover, the requirement to complete a firm internship might affect whether students seek other forms of work experience that might be substitutes or complements for firm internships. The regressions in panel E of Table 7 include a dummy variable for whether graduates worked during the course of their studies. The point estimates for internship experience in firms remain largely unaffected, pointing towards positive internship returns of around 6%.

[25]Note that the model specification including department fixed effects is not our preferred one because statistical power declines, which would render the analysis of heterogeneous effects in Section 6 infeasible.

Sample attrition might be a problem, as only 34% of individuals participating in the initial survey were also interviewed in the follow-up survey. To address this concern, panel F restricts the analysis to earnings information from the initial survey, that is, earnings measured one year after graduation. Panel G restricts the analysis to earnings information from the follow-up survey, that is, earnings measured five to six years after graduation. The IV estimates in both panels point toward positive effects of internship experience in firms on earnings of around 6%. We therefore argue that the main findings are unlikely to be biased by selected sample attrition, and we note that the differences in earnings in the short and medium term are not very large (1.1-1.5 percentage points). This is conceivable if one factors in that a poor labor market start could result in lasting disadvantage for college graduates. For example, Franz et al. (1997) find that, in Germany, individuals experiencing unemployment directly after apprenticeship receive lower wages later in life, and a range of papers shows that labor market entry conditions matter for earning and employment prospects (Altonji et al., 2016, Lange et al., 2013, Raaum and Røed, 2006).

To explore whether the estimated returns to internship might be driven by outliers, we winsorize earnings at the 1% level. The point estimates in panel H of Table 7 remain very stable. In unreported regressions, we also winsorized the top and bottom 0.5% of log(earnings) and also estimated level models including zero earnings. The results are in line with the main findings and are available upon request.

Finally, we examine the potential problem of selected attrition. First, in unreported regressions, we estimated linear probability and probit models on graduates' likelihood of participating in the second wave. We found no empirical evidence of differences in attrition rates between those with and without an internship experience. Second, to investigate whether mandatory internships affect the probability to graduate, we obtain additional data from the Federal Statistical Office of Germany. The administrative data contains the number of students in incoming cohorts of 2003, 2004 and 2005 for 70 departments for which we also collect information from the university websites whether at the time internship was mandatory in the department. We also obtain data on the number of students graduating in 2007-2011 for the same departments. Unfortunately, we do not know precisely when the graduating students started their studies, hence in Table 8 we present three different approaches of matching the starting cohorts to graduation cohorts. We test whether the proportion of graduates, calculated as the number of graduates divided by the number of incoming students, is statistically different between departments with a mandatory internships and departments without one. Panel A of Table 8 presents the average proportion of graduates and the p-value of the difference for each of the three incoming cohorts matched with the number of graduates after ten semesters, which is the regular study duration. The proportion of graduates is similar between the two

columns and the p-value of the difference is well above 10%. Panel B repeats the same exercise, however matches each incoming cohort to the number of graduates after 12 semesters. Again the differences is statistically not different from each other. Finally, panel C calculates the proportion of graduates by aggregating over all cohorts. Namely, we divide the aggregate number of students who graduate in years 2007-2011 by the aggregate number of incoming students in 2003, 2004, and 2005. The mean differences are statistically not different from each other. We conclude that the presence of a mandatory internship does not change the graduation rate per se.

9 Conclusions

This study provides causal evidence of the effects of student internships in firms on earnings and transition to the labor market of university graduates. The estimates from instrumental variable regressions suggest that work experience gained through student internships in firms increases earnings by around 6% in the short and medium term. The empirical findings further suggest that graduates who completed a firm internship face a lower risk of unemployment during the first year of their careers. The positive returns are similar in magnitude for female and male graduates. There is also no empirical evidence of heterogeneous effects by students' socio-economic background and ability, proxied by their parents' educational attainment and students' average final secondary school grade, respectively. However, we do find significant differences in effects of internship experience with respect to the labor market orientation of students and the areas of study. The highest returns are estimated for a weak labor market orientation, and humanities and social sciences, which is in line with the notion of internships serving as a means of vocational exploration and screening.

The findings are confirmed by several robustness checks, and we provide comprehensive evidence showing that mandatory firm internships are likely to be exogenous. Due to data limitations, however, we cannot estimate longer-term effects as individuals' earnings are not observed 10–20 years after graduating from university. Further, we have no information on the size, sector, and reputation of the firm or institution at which the internship took place, and we can only present first suggestive evidence on the relevance of potential mechanisms. Hence, whether the returns vary by internship quality, firm characteristics, and on the extent and relevance of various possible mechanisms is left for future research. Despite these caveats, to the best of our knowledge, this is the first study aiming at estimating causal earnings returns to internship experience in firms. As such, this study complements the large empirical literature on the returns of schooling by estimating local average treatment effects of job experience among highly educated individuals.

The present findings are of interest to university students, policy makers, and educators alike. There is a growing debate in recent decades over the contradictory expectations placed on institutions of higher education: on the one hand, they are expected to incorporate labor market demands into their study curricula. On the other hand, they are expected to guarantee freedom and independence in academic research and teaching. Our study suggests that university education combined with practical learning—through firm internships—might be one way of bringing these two aspects [freedom of academic research "versus" demands of firms] together.

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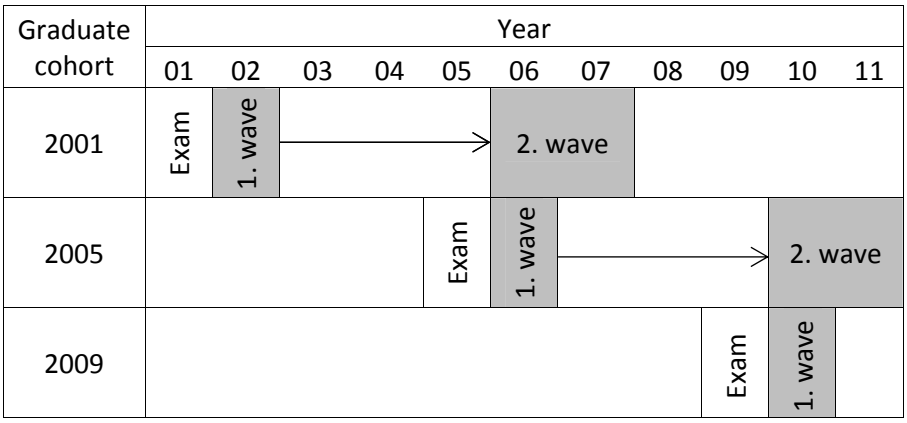
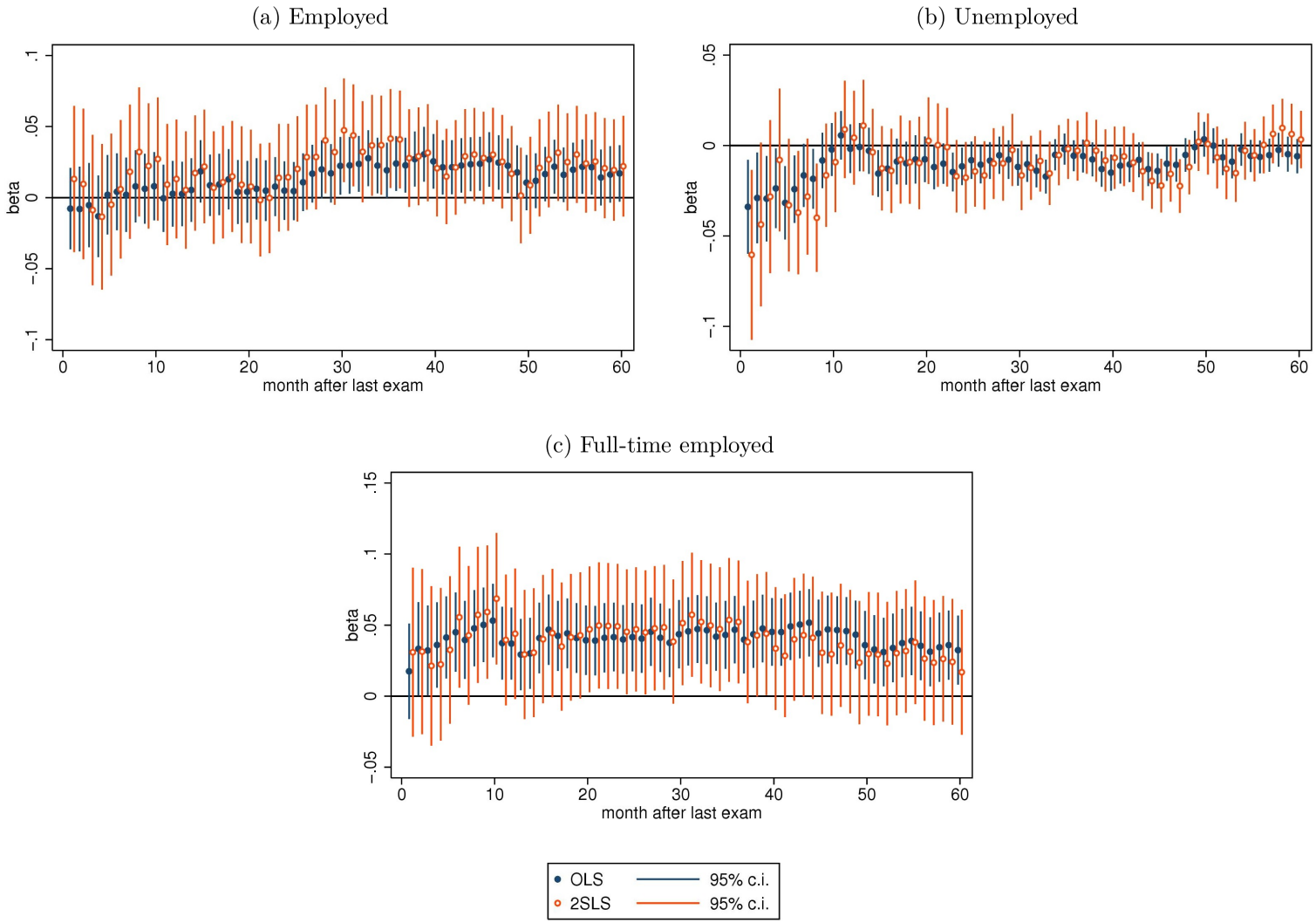
Figures and Tables

Figure 1: DZHW Panel Survey of Graduates



Note: Adopted from Rehn et al. (2011), p. 367. This study employs data from graduate surveys conducted by the DZHW. It includes random samples of university graduates who passed their last exam in 2001, 2005, or 2009. For the cohorts 2001 and 2005, we utilize an *initial survey* one year after graduation (first wave) and a *follow-up survey* about five to six years after graduation (second wave). For the cohort 2009, only the first wave is available. For the analysis, we use a pooled sample. It comprises all second-wave observations of the cohorts 2001 and 2005 and all first-wave observations of 2001, 2005, and 2009.

Figure 2: Transmission variables over time



Note: Estimates are from OLS and 2SLS regressions (IV_I) for the effect of internship experience on binary variables indicating monthly status activity. Each circle represents the coefficient for one particular month. The vertical bars are the 95% confidence intervals. All models control for gender, year of birth FE, area of study FE, university FE, degree type FE, high school degree type mother and father FE, apprenticeship, high school grade, degree of labor market orientation and a dummy for the 2nd wave. *Data:* DZHW Graduate Panel.

Table 1: Sample means

	All	1 year after graduation	5–6 years after graduation	Internship	
				No	Yes
	(1)	(2)	(3)	(4)	(5)
Panel A. Explanatory variables					
Internship	0.66	0.66	0.67	0.00	1.00
Voluntary internship	0.41	0.41	0.41	0.00	0.63
Mandatory internship	0.48	0.48	0.48	0.00	0.70
Paid employment during studies	0.48	0.48	0.48	0.43	0.51
Year of birth	1977	1977	1976	1976	1977
Female	0.53	0.53	0.54	0.48	0.56
Apprenticeship	0.30	0.30	0.31	0.42	0.24
High school grade	2.23	2.24	2.22	2.26	2.22
Labor market orientation[a]	2.91	2.92	2.88	2.81	2.95
University of applied sciences	0.41	0.41	0.40	0.59	0.31
Mother has upper secondary school degree	0.37	0.38	0.36	0.32	0.40
— intermediate —	0.36	0.36	0.35	0.36	0.35
— lower —	0.26	0.25	0.28	0.31	0.24
— no —	0.01	0.01	0.01	0.01	0.01
Father has upper secondary school degree	0.50	0.51	0.50	0.44	0.54
— intermediate —	0.23	0.23	0.23	0.26	0.22
— lower —	0.25	0.25	0.27	0.29	0.23
— no —	0.01	0.01	0.01	0.01	0.01
Panel B. Outcome variable					
Log earnings	7.71	7.54	8.05	7.72	7.71
Employed	0.81	0.78	0.86	0.82	0.80
Unemployed	0.03	0.03	0.02	0.03	0.03
Full-time employed	0.70	0.65	0.79	0.70	0.69
Share of observations in 2nd wave	0.34	0.00	1.00	0.34	0.35
Number of individuals	13,976	12,946	6,790	4,720	9,256
Number of observations	19,736	12,946	6,790	6,631	13,105

Note: Column (1) presents variable means for the estimation sample according to Figure 1. Column (2) only includes observations from the first wave (1 year after graduation). Column (3) only includes observations from the second wave (5–6 years after graduation). Columns (4) and (5) divide the sample by treatment status. [a] The variable "labor market orientation" measures how important labor market aspects were with respect to study choice, measured on a five-point scale with 1 indicating "unimportant" and 5 "very important". *Data:* DZHW Graduate Panel.

Table 2: Survey responses and study program regulations

Share (%) of respondents stating that a firm internship is mandatory	Study program regulation: firm internship			
	Not mandatory (n=20)		Mandatory (n=17)	
	Share (%)	Cumulative (%)	Share (%)	Cumulative (%)
(1)	(2)	(3)	(4)	(5)
0	50.00	50.00	5.88	5.88
1–19	35.00	85.00	5.88	11.76
20–39	10.00	95.00	0.00	11.76
40–59	5.00	100.00	5.88	17.65
60–79	0.00	100.00	23.53	41.18
80–99	0.00	100.00	29.41	70.59
100	0.00	100.00	29.41	100.00

Note: The table combines responses on the existence of mandatory firm internships from the DZHW survey with information on the existence of mandatory firm internships gathered from study program regulations for a subsample of 37 study programs for the graduate cohort of 2009. The analysis includes study programs with more than 5 responses in the survey. Columns (2)–(5) show the relative and cumulative shares of survey respondents stating that a firm internship was mandatory per study program in percent (i.e., study program is the statistical unit). Columns (2) and (3) show the results for study programs where a firm internship was mandatory according to the study program regulation, and columns (4) and (5) show the results for study programs where it was not mandatory.

Table 3: Mandatory internships and individual characteristics

	Self-reported	Leave-one-out Ratio	Threshold 70/30	Predicted Earnings
	(1)	(2)	(3)	(4)
Female	0.002	0.010^{+}	0.011	
	(0.009)	(0.006)	(0.009)	
Share of observations in 2nd wave	0.000	0.001	0.002	
	(0.004)	(0.002)	(0.002)	
Apprenticeship	−0.060***	−0.003	−0.017^{+}	
	(0.011)	(0.007)	(0.009)	
Mother has upper sec. high school degree	0.010	0.003	0.006	
	(0.009)	(0.004)	(0.006)	
Father has upper sec. high school degree	0.021**	0.006	0.012*	
	(0.008)	(0.004)	(0.006)	
High school grade	0.007	−0.009*	−0.010^{+}	
	(0.007)	(0.004)	(0.006)	
Labor market orientation	0.011***	0.002	0.002	
	(0.003)	(0.002)	(0.003)	
Mandatory Internship				0.005
				(0.020)
Cohort FE	Yes	Yes	Yes	
Birth year FE	Yes	Yes	Yes	
Area of study FE	Yes	Yes	Yes	
Degree type FE	Yes	Yes	Yes	
University FE	Yes	Yes	Yes	
Number of observations	19736	19271	13859	19736
Adj. R2	0.347	0.611	0.724	0.000

Note: The estimates in columns (1)-(3) are from regressions of the respective instrument on the covariates. In column (4) the outcome is the predicted earnings. Standard errors (in parentheses) are clustered at the department level. $^{+}$ p<0.10, * p<0.05, ** p<0.01, *** p<0.001. *Data:* DZHW Graduate Panel.

Table 4: Estimates of introducing mandatory internships on quality indicators

	Self-reported	Leave-one-out Ratio	Threshold 70/30
	(1)	(2)	(3)
Overall quality of education:			
Structure of the study program	−0.005	−0.018	−0.012
	(0.011)	(0.021)	(0.022)
State-of-the-art methods taught	0.001	0.013	−0.004
	(0.011)	(0.021)	(0.021)
Up-to-date education[a]	0.024*	0.032	0.036+
	(0.011)	(0.020)	(0.020)
Educational media and infrastructure:			
Availability of literature in the library	−0.009	0.009	0.000
	(0.011)	(0.021)	(0.022)
Access to IT services (internet, databases)	0.004	0.015	0.009
	(0.010)	(0.018)	(0.018)
Use of electronic communication devices	0.015	−0.024	0.014
	(0.012)	(0.022)	(0.022)
Training:			
Oral presentation training	0.004	0.021	0.017
	(0.011)	(0.023)	(0.022)
Writing skills training	0.000	−0.002	0.030
	(0.011)	(0.020)	(0.020)
Training in foreign languages[b]	0.005	0.013	0.002
	(0.009)	(0.018)	(0.017)
Career Counseling:			
Help in finding a job and starting a career	0.002	−0.021	−0.006
	(0.008)	(0.014)	(0.013)
Availability of career counseling	0.009	0.004	0.006
	(0.009)	(0.017)	(0.017)
Provision of career orientation events	−0.004	−0.003	−0.010
	(0.008)	(0.014)	(0.013)
Number of observations	18,220	17,789	12,782

Note: Estimates are from OLS regressions based on different definitions of the instrument. Standard errors (in parentheses) are clustered at the department level. All models control for gender, year of birth FE, area of study FE, university FE, degree type FE, high school degree type mother and father FE, apprenticeship, high school grade, degree of labor market orientation and a dummy for the 2nd wave. [a] The variable measures the actuality of education with respect to current job requirements. [b] The variable measures subject- or job-specific training in foreign languages. Note that departments in which 40–60% (or 30–70%) of graduates say that an internship was mandatory are excluded from the regressions, resulting in smaller sample sizes in columns (3) and (4). $^{+}$ p<0.10, * p<0.05, ** p<0.01, *** p<0.001. *Data:* DZHW Graduate Panel.

Table 5: The effect of student internship experience on log earnings

	OLS		IV_I: Self-reported		IV_{II}: Leave-one-out	
	Base	Full	Base	Full	Base	Full
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: OLS and second stage						
Internship	0.061***	0.061***	0.065***	0.065***	0.158*	0.146+
	(0.011)	(0.011)	(0.020)	(0.019)	(0.081)	(0.080)
Female	−0.165***	−0.170***	−0.165***	−0.170***	−0.169***	−0.175***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Apprenticeship		0.077***		0.077***		0.086***
		(0.013)		(0.013)		(0.016)
High school grade		−0.030***		−0.030***		−0.030***
		(0.009)		(0.009)		(0.009)
Labor market orientation		0.037***		0.037***		0.035***
		(0.004)		(0.004)		(0.005)
Panel B: First stage						
Mandatory internship			0.566***	0.560***	0.288***	0.284***
			(0.011)	(0.011)	(0.022)	(0.022)
F-statistic[a]			2,602	2,542	174	171
Adjusted R^2			0.460	0.466	0.244	0.257
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Wave FE	Yes	Yes	Yes	Yes	Yes	Yes
Birth year FE	Yes	Yes	Yes	Yes	Yes	Yes
Area of study FE	Yes	Yes	Yes	Yes	Yes	Yes
Degree type FE	Yes	Yes	Yes	Yes	Yes	Yes
University FE	Yes	Yes	Yes	Yes	Yes	Yes
Parental schooling FE	No	Yes	No	Yes	No	Yes
Adjusted R^2	0.326	0.332	0.325	0.332	0.322	0.329
Number of observations	19,736	19,736	19,736	19,736	19,271	19,271

Note: In Panel A the dependent variable is $log(earnings)$. In Panel B the dependent variable is equal to one if a graduate completed an internship during the course of studies, and zero otherwise. Standard errors (in parentheses) are clustered at the department level. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001. *Data:* DZHW Graduate Panel. [a] Relates to the instrument variable "Mandatory internship" The dichotomous variable "Apprenticeship" is equal to one for graduates who completed apprenticeship training before entering university, and zero otherwise. The variable high school grade is measured on a 1–5 grade scale with 1 signifying "excellent" and 5 "failing". The variable "labor market orientation" measures how important labor market aspects were with respect to study choice, measured on a five-point scale with 1 indicating "unimportant" and 5 "very important".

Table 6: Heterogeneous effects

	OLS	IV_I	Number of observations
Panel A: Gender			
Women	0.075***	0.057+	10,523
	(0.017)	(0.031)	
Men	0.052***	0.079***	9,213
	(0.014)	(0.023)	
P-value of interaction (internship×women)	0.190	0.871	19,736
Panel B: Parental background			
Parents with 'high' levels of schooling	0.067***	0.071*	11,294
	(0.016)	(0.029)	
Parents with 'low' levels of schooling	0.045**	0.041	8,442
	(0.015)	(0.027)	
P-value of interaction (internship×highly educated parents)	0.330	0.253	19,736
Panel C: High school performance			
High school grade ≥ median	0.052***	0.043+	12,051
	(0.013)	(0.023)	
High school grade < median	0.070***	0.118**	7,685
	(0.019)	(0.038)	
P-value of interaction (internship×high grade)	0.100	0.068	19,736
Panel D: Labor market orientation of student			
LM orientation < median	0.070***	0.116***	7,351
	(0.018)	(0.032)	
LM orientation ≥ median	0.048***	0.018	12,385
	(0.014)	(0.025)	
P-value of interaction (internship×weak LM orientation)	0.050	0.017	19,736
Panel E: Labor market orientation of study subject [a]			
Strong LM orientation	0.049***	0.049**	14,743
	(0.011)	(0.018)	
Weak LM orientation	0.101**	0.139+	4,993
	(0.036)	(0.072)	
P-value of interaction (internship×weak LM orientation)	0.080	0.080	19,736
Panel F: Field of study subject			
Science, Mathematics, Engineering	0.050***	0.056**	10,125
	(0.014)	(0.020)	
Business and Economics	0.058**	0.040	3,921
	(0.021)	(0.047)	
Humanities and Social Sciences	0.085**	0.111*	5,445
	(0.030)	(0.056)	
P-value of interaction (internship×BE)	0.170	0.525	19,491[b]
P-value of interaction (internship×HSS)	0.086	0.086	

Note: All models control for gender, year of birth FE, area of study FE, university FE, degree type FE, high school degree type mother and father FE, apprenticeship, high school grade, degree of labor market orientation and a dummy for the 2nd wave. [a] See Table A-3 in Appendix A for a classification of areas of studies into weak and strong labor market orientation. [b] 245 observations are outside of the study field categorization. Standard errors (in parentheses) are clustered at the department level. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001. *Data:* DZHW Graduate Panel.

Table 7: Robustness: Specification and sample selection

	OLS	IV_I	Number of observations
Panel A: 70/30 Instrument			
Internship	0.066***	0.164*	13,859
	(0.014)	(0.066)	
Panel B: Adding department fixed effects			
Internship	0.056***	0.043*	19,736
	(0.012)	(0.022)	
Panel C: Only department fixed effects			
Internship	0.056***	0.044*	19,736
	(0.012)	(0.022)	
Panel D: Area of study, university type, and interaction fixed effects			
Internship	0.057***	0.051+	19,736
	(0.011)	(0.028)	
Panel E: Employed during studies			
Internship	0.055***	0.062**	19,700
	(0.011)	(0.020)	
Panel F: Short-term earnings			
Internship	0.058***	0.069**	12,946
	(0.014)	(0.025)	
Panel G: Medium-term earnings			
Internship	0.063***	0.058*	6,790
	(0.014)	(0.024)	
Panel H: Winsorized earnings			
Internship	0.058***	0.062***	19,736
	(0.010)	(0.019)	

Note: All models control for gender, year of birth FE, area of study FE, university FE, degree type FE, high school degree type mother and father FE, apprenticeship, high school grade, degree of labor market orientation and a dummy for the 2nd wave. Exceptions: The regression in panel B omits area of study FE and university FE. Likewise, panel C omits area of study FE and the dummy indicating the university type due to the newly introduced interaction fixed effects between the two. Panel F uses earnings information only from the initial survey conducted around one year after graduation. Panel G uses earnings information only from the follow-up survey conducted around 5–6 years after graduation. Panel H winsorizes earnings at 1% level. Standard errors (in parentheses) are clustered at the department level. $^{+}$ p<0.10, * p<0.05, ** p<0.01, *** p<0.001. *Data:* DZHW Graduate Panel.

Table 8: The proportion of graduates by mandatory internship presence

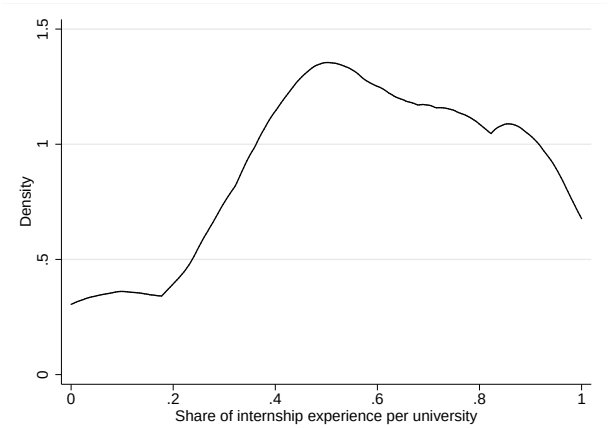
	Average proportion of graduates		
	Not mandatory	Mandatory	p-value of the difference
	Panel A: After 10 semesters		
Incoming cohort 2003	0.536	0.648	0.215
Incoming cohort 2004	0.641	0.688	0.565
Incoming cohort 2005	1.038	0.748	0.375
	Panel B: After 12 semesters		
Incoming cohort 2003	0.590	0.660	0.443
Incoming cohort 2004	0.564	0.602	0.614
Incoming cohort 2005	0.859	0.638	0.286
	Panel C: Aggregated over all cohorts		
All cohorts	0.857	0.934	0.443
Number of departments	45	25	

Note: The table compares the proportion of graduates from departments with mandatory internships to the ones graduating from departments without mandatory internships. In Panel A the proportion of graduates is calculated by dividing the number of graduates after ten semesters from the respective starting date by the number of incoming students. In Panel B the enumerator is the number of graduates after 12 semesters. In Panel C the enumerator is the aggregate number of graduates in years 2007-2011, and the denominator is the aggregate number of incoming students in 2003, 2004, and 2005. *Source*: Federal Statistical Office.

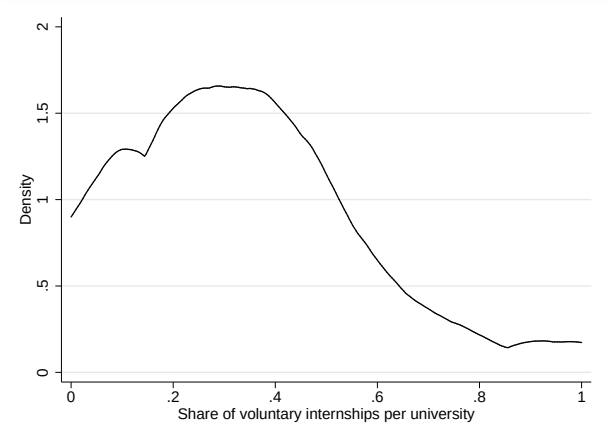
Appendix A: Additional Figures and Tables (For Online Publication)

Figure A-1: Distribution of internship experience across universities

(a) Internships



(b) Voluntary internships



(c) Mandatory internships

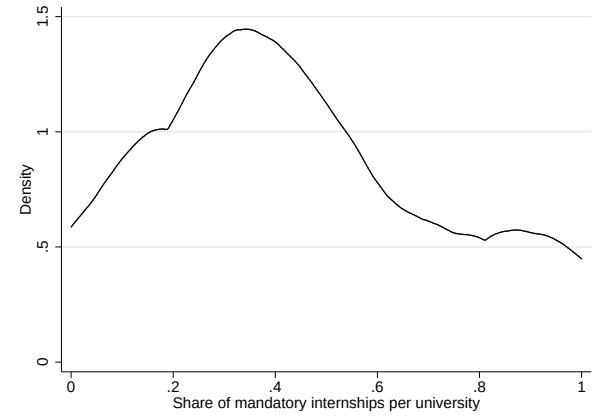
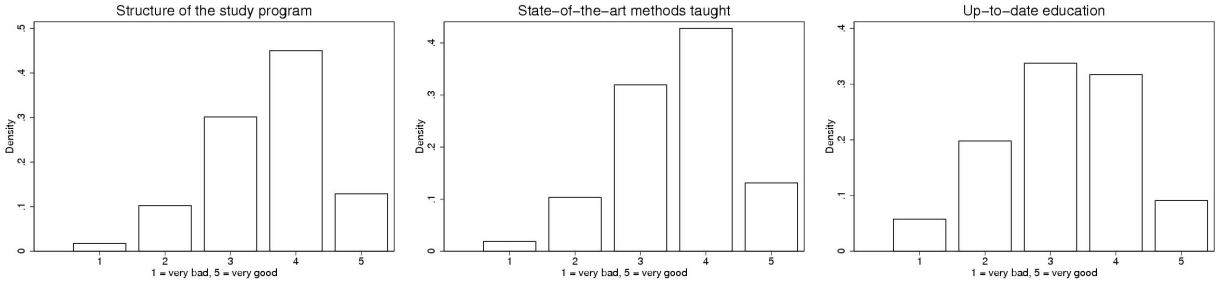
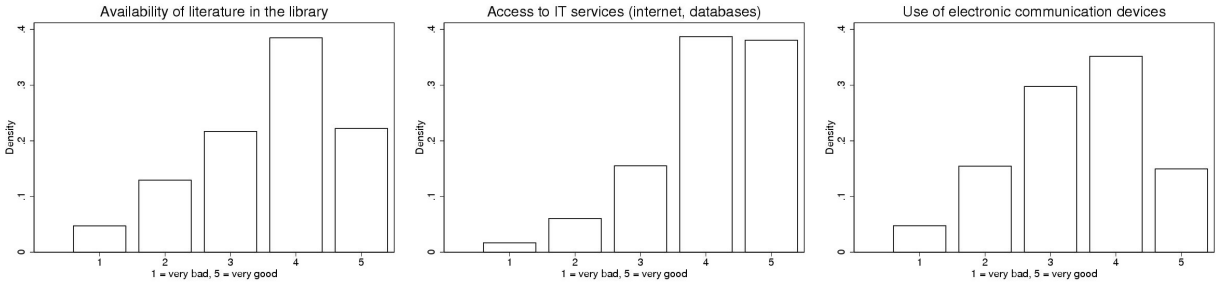


Figure A-2: Students' evaluation of study related aspects

(a) Overall Quality of Education



(b) Educational Media and Infrastructure



(c) Training

(d) Career Counseling

Note: The corresponding questionnaire item reads "How do you evaluate the following aspects of your completed studies?" Respondents are then asked to answer on a scale from 1 ("very bad") to 5 ("very good"). Data is taken from the first wave ($n = 12,964$). *Data:* DZHW Graduate Panel.

Table A-1: Internships by field of study subject

	Science, mathematics, engineering	Business and economics	Humanities and social sciences
Internship	0.62	0.68	0.74
Voluntary internship	0.33	0.51	0.51
Mandatory internship	0.50	0.40	0.50

Table A-2: Overview of survey evidence on students' reasons for the choice of university and study program in Germany

Author(s)	Survey and sample	Question	Type of question	Main results	Question on internship?
Heine et al. (2005)	Representative survey of first-year students in Germany in the winter term 2004/05; 8,200 students.	How important are the following reasons for your choice of study?	5-point Likert scale (1 very important; 5 not important) on 20 different potential reasons/aspects with respect to the university and city.	Percent who answer that it is (very) important (1 & 2 on the scale): • Interest in content (91%) • Affinity/Ability (88%) • Many occupational choices later on (67%) • To be able to work independently (64%)	No
Hachmeister and Hennings (2007)	Survey of students in the middle of their studies.	How important were the following aspects for the choice of your university?	6-point Likert scale (1 very important; 6 not important at all).	Percent who answer that it is (very) important (1 & 2 on the scale): • To study preferred field of study (66%) • Good reputation of the university and professors (59%) • Proximity to home (58%) • Interesting city (51%)	No
Hachmeister and Hennings (2007); Hachmeister et al. (2007)	Survey among high school students in final grade; around 3,600 pupils.	How important were the following aspects for the choice of your university?	4-point Likert scale (1 applies very much; 4 does not apply at all).	Percent who answer that it is (very) important (1 & 2 on the scale): • Interest in content (100%) • Good facilities (90%) • Atmosphere in the city (89%) • Services for students (82%)	No
Bartl and Korb (2009)	Online survey among first-year students at the Martin-Luther University Halle-Wittenberg in the winter term 2008/09; around 800 students.	How important were the following reasons in your choosing this university?	5-point Likert scale (1 very important; 5 not important).	Average value of the 5-point scale: • Interest in content (1.79) • No need to pay tuition fees (1.96) • Good life conditions (2.23) • Proximity to home (2.27) • University has a good reputation (2.48)	No
Heine et al. (2009)	Representative survey among first-year students in Germany in the winter term 2007/08; 8,342 students.	How important are the following reasons for your choice of study?	5-point Likert scale (1 very important; 5 not important) on different reasons/aspects with respect to the university and city.	Percent who answer that it is (very) important (1 & 2 on the scale): • Interest in study program content (83%) • Proximity to home (66%) • Good reputation of the university (60%) • Good facilities (54%)	No
Institut für Marktforschung GmbH (2014)	Representative online survey in 2013 among young people aged 16-24 who aim at studying at university; 500 individuals.	What is the most important aspect in the choice of the university?	5-point Likert scale (1 very important; 5 not important) on long list of aspects.	Percent who answer that it is very important (1 on the scale): • I do not want to be away too far from home (29%) • I will choose the university with the best study program (28%) • I want to live in a city that also has good recreational opportunities (23%) • I will choose a university with a good reputation (13%)	No

Table A-3: Classification of areas of study into strong and weak labor market orientation

Strong LM orientation	Weak LM orientation
administrative studies	ancient/classic philology, modern Greek
agricultural sciences	area studies
architecture and interior design	arts, general art history
biology	catholic theology/religious education
chemical science	composition and design
civil engineering	cultural studies/cultural sciences
computer science	English studies, American studies
dentistry/dental medicine	extra-European linguistic and cultural studies
economics	film studies
electrical engineering	fine arts
engineering management	comparative literary and linguistic sciences
food and beverage technology	general cultural studies
forestry, forest and wood management	general economic and social science
general engineering	general linguistics and philology
geomatic/geospatial engineering	geography
geosciences (without geography)	German philology and studies
health-care science	history
human medicine	library science, documentation, communication
jurisprudence/law	music, musicology
landscape conservation, - architecture	education
mathematics, natural sciences	performing arts, theater studies
mechanical engineering, process engineering	philosophy
mining and metallurgy	political sciences
nautical science / navigation	protestant theology/religious education
pharmacy	psychology
physics, astronomy	Romance philology and studies
social pedagogy	Slavic, Baltic, Finno-Ugrian studies
spatial planning	social sciences
teletraffic engineering	special education
trophology, nutritional and domestic science	sport science
veterinary medicine	

Note: Based on Sarcletti (2009).

Appendix B: Internship Characteristics (For Online Publication)

The analysis thus far relies on data from the DZHW Graduate Panel. Although the DZHW data contain a plethora of information, one of the data's drawbacks is the lack of information on internship characteristics. We therefore supplement our analysis by using data from the Bavarian Graduate Panel (BAP), which is a survey of university graduates (similar to the DZHW Graduate Panel) in the German federal state of Bavaria.[26] Similar to our main analysis, we include survey information gathered one and five years after graduation and pool information from the graduation cohorts 2003/04 and 2005/06.

The BAP has several assets. First, it contains detailed information on internship experiences, which enables us to descriptively analyze internship characteristics. Second, the similar survey structures of the DZHW Graduate Panel and the BAP enable us to replicate our main results to a certain degree. Third, the BAP offers information on the field of study rather than area of study (e.g., one category for Italian instead of only one category for Romance languages).

Despite these advantages, the BAP has several shortcomings compared to the DZHW Graduate Panel for our analysis. First, the BAP only comprises information on graduates from Bavaria, which is only one of the 16 federal states in Germany. Because Bavaria has one of the strongest economies and labor markets in Germany, the BAP data might not be representative of Germany at large. Second, the BAP dataset is only about half the size of the DZHW Graduate Panel's—the smaller sample renders most of our previous instrumental variable analysis infeasible with respect to statistical power. Third, the wording of the questions on the existence of mandatory internships differs between the two surveys: while the DZHW Graduate Panel explicitly asks for mandatory internships *in firms*, the BAP does not. Fourth, the data do not include a university indicator; instead, we include indicators for the interaction of university type and study subject.

According to the BAP, students do, on average, 2.3 internships during the course of their university studies. Table B-1 shows further descriptive statistics on the first and last internship during studies.[27] It shows that the duration of an internship is, on average, about 4 months, and that mandatory internships are longer than voluntary internships. Moreover, the first internship usually takes place in the third or fourth semester, and the last internship between the sixth and eighth semester.[28] The respondents were further asked to evaluate the first and last internship during their studies with respect to several dimensions. Notably, students evaluate mandatory internships to be more helpful than

[26] Detailed information on the BAP surveys is available at `http://www.bap.ihf.bayern.de`.

[27] The information is available only for the cohort 2003/04.

[28] Thus, the first internship usually takes place at the end of the second year of university and the last internship in the fourth year.

voluntary internships in giving them guidance on how to organize their studies. The table also indicates that students benefit more from mandatory internships in terms of job knowledge and skills.

Internships completed during the course of university study are a commonly used job search method. Figure B-1 displays the share of graduates in the 2003/04 cohort who used a particular job search method to find their first job. Furthermore, the figure shows, conditional on having used a particular method, the share of graduates who assessed this particular method to be beneficial. The most common search methods are job advertisements, speculative applications, and contacts from jobs during studies. Contacts from internships during studies rank fifth—40% of graduates have used this job search channel. Moreover, more than 70% of graduates who used internships during their university studies as a job search method indicate having benefited from contacts acquired during that internship. Thus, a large share of university graduates make use of contacts from internships and find this channel to be a useful job search method.

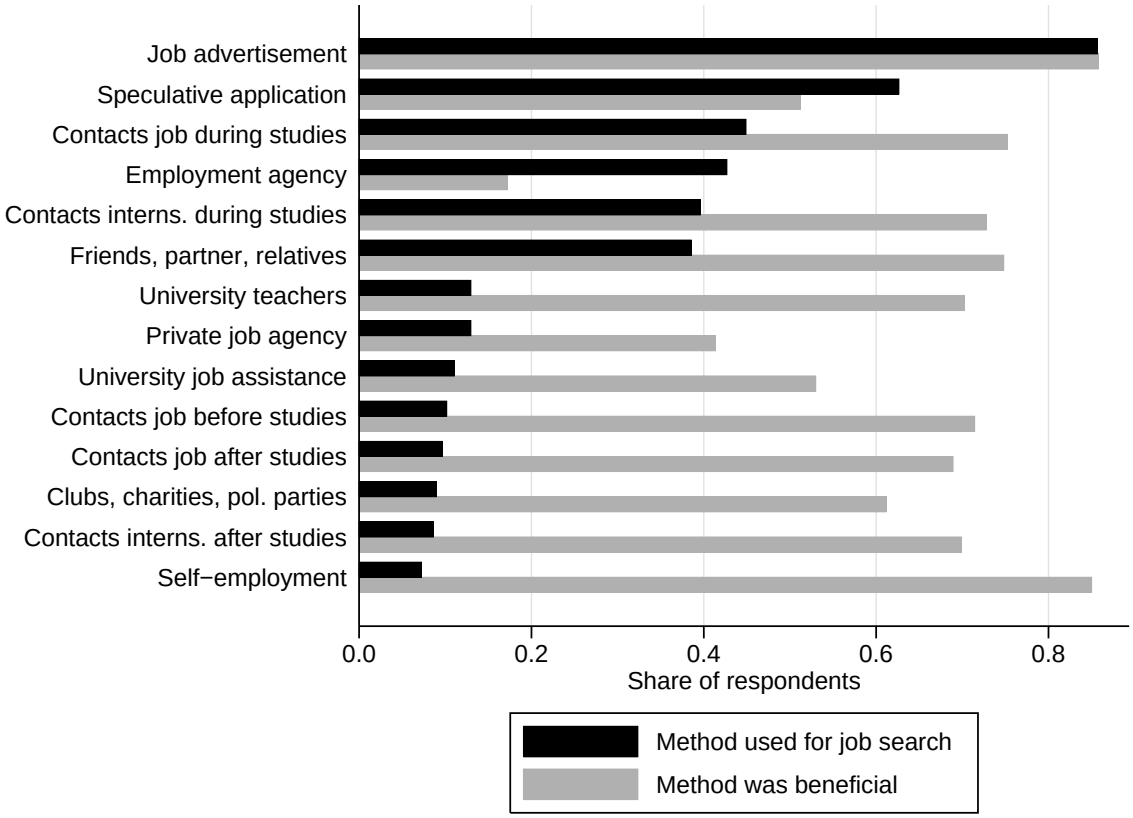
As previously mentioned, participants in the BAP were asked whether internships during studies were mandatory; however, they were not asked whether internships *in firms* were mandatory. Nonetheless, Tables B-2, B-3, and B-4 in Appendix A show that the OLS and IV point estimates are quite similar to those of the main analysis. In Table B-2, the OLS coefficient of the internship indicator of the full model is 0.042 and statistically significant at the 1% level. The estimate implies that doing an internship while attending university increases earnings after graduation by 4.3%, thus the effect is about 2 percentage points lower than in the main analysis. The lower effect size is likely due to the lower importance of internships in the Bavarian labor market, which exhibits more or less full employment (in contrast to other federal states). Moreover, the coefficients of the covariates have the same sign as in the main analysis.

The IV results in columns (3) and (4) are based on an instrument that takes the value one if a student indicates having done at least one mandatory internship while attending university, and takes the value zero otherwise. The point estimates are somewhat lower and statistically non-significant. The non-significance is not surprising given the much smaller sample size. The low point estimates, however, warrant discussion. They are likely due to the kind of mandatory internships that the instrument captures. Instead of solely measuring internships in firms, the instrument is likely to also pick up internships at university to a certain degree. The smaller coefficient is nonetheless informative, because it points to a positive return of internships in general, but also highlights the additional value of completing an internship in a firm.

For the graduation cohort 2003/04, information is available on whether the intern's performance was assessed at the firm and/or university where the internship was completed. We use this information to redefine the instrument by assuming that interns who

were assessed at a university but not at a firm did not complete a firm internship, that is, we assign internships that are unlikely to be a firm internship a zero in the instrument. Columns (5) and (6) show the results of this alternative instrument definition: the point estimates—although statistically non-significant—are larger and similar to the OLS results with a point estimate of 0.047 in the full model. Moreover, Table B-3 shows that the first-stage relationship between the instrument and internship experience during studies is almost identical to the main analysis; and Table B-4 indicates that internships have larger earnings returns in areas of study with lower labor market orientation. Overall, the results of the BAP confirm the results of the DZHW Graduate Panel.

Figure B-1: Job search methods



Note: Respondents of the cohort 2003 who had already found their first job by the time of the first survey wave were asked which methods they used to find their first job ($n = 2,258$). Respondents could give multiple answers. The black bars indicate the share of respondents who used a particular search method. Conditional on having used a method, the gray bars show the share of respondents who found that this method was useful. *Data:* Bavarian Graduate Panel.

Table B-1: Internship characteristics and perceived benefits

	Internship	Voluntary	Mandatory	p-value
	(1)	(2)	(3)	(4)
First internship during studies				
Duration (in months)	3.9	2.9	4.3	0.000
In/after which semester[a]?	3.6	4.2	3.5	0.000
Internship benefits[b]				
Guidance for organizing studies	3.2	3.0	3.3	0.000
Better notion of job content	3.8	3.8	3.8	0.782
Job knowledge and skills	3.6	3.5	3.7	0.001
Soft skills	3.4	3.4	3.3	0.495
Making contacts for job entry	2.8	2.9	2.8	0.158
Number of observations	2,395	578	1,817	2,395
Last internship during studies				
Duration (in months)	4.3	3.4	4.7	0.000
In/after which semester[a]?	6.7	7.7	6.2	0.000
Internship benefits[b]				
Guidance for organizing studies	3.4	3.1	3.6	0.000
Better notion of job content	4.3	4.3	4.3	0.889
Job knowledge and skills	4.1	4.0	4.1	0.155
Soft skills	3.9	3.9	3.9	0.832
Making contacts for job entry	3.4	3.4	3.4	0.807
Number of observations	1,718	576	1,142	1,718

Note: [a] In Germany, an academic year consists of two semesters. [b] The items are measured on a scale from 1 'not useful at all' to 5 'very useful'. Column 4 reports the p-values of two-sample t-tests comparing voluntary and mandatory internships. *Data:* Bavarian Graduate Panel.

Table B-2: The effect of student internship experience on log earnings

	OLS		IV		IV firm	
	Base	Full	Base	Full	Base	Full
	(1)	(2)	(3)	(4)	(5)	(6)
Internship	0.040**	0.042**	0.020	0.028	0.033	0.047
	(0.014)	(0.014)	(0.020)	(0.020)	(0.044)	(0.044)
Female	−0.096***	−0.101***	−0.096***	−0.101***	−0.081***	−0.087***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.022)	(0.022)
University of applied sciences	−0.097	−0.113	−0.095	−0.111	−0.008	−0.098
	(0.080)	(0.081)	(0.080)	(0.080)	(0.155)	(0.156)
Apprenticeship		0.073***		0.073***		0.100***
		(0.012)		(0.012)		(0.023)
High school grade		−0.014		−0.014+		−0.002
		(0.008)		(0.008)		(0.016)
Labor market orientation		0.009*		0.009*		0.016*
		(0.004)		(0.004)		(0.007)
Cohort FE	Yes	Yes	Yes	Yes	No	No
Wave FE	Yes	Yes	Yes	Yes	Yes	Yes
Birth year FE	Yes	Yes	Yes	Yes	Yes	Yes
Area of study FE	Yes	Yes	Yes	Yes	Yes	Yes
Degree type FE	Yes	Yes	Yes	Yes	Yes	Yes
Uni type*study area FE	Yes	Yes	Yes	Yes	Yes	Yes
Parental job qual. FE	No	Yes	No	Yes	No	Yes
Adjusted R2	0.285	0.287	0.284	0.287	0.220	0.225
Number of observations	11,603	11,603	11,603	11,603	4,494	4,494

Note: The dependent variable is log(earnings). Standard errors (in parentheses) are clustered at the individual level. $^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. *Data:* Bavarian Graduate Panel.

Table B-3: First-stage results

	IV		IV firm	
	Base	Full	Base	Full
	(1)	(2)	(3)	(4)
Mandatory internship	0.592***	0.591***	0.525***	0.525***
	(0.012)	(0.011)	(0.021)	(0.021)
Female	0.026**	0.025**	0.016	0.015
	(0.008)	(0.008)	(0.014)	(0.014)
University of applied sciences	−0.063	−0.053	−0.018	−0.020
	(0.072)	(0.073)	(0.102)	(0.105)
Apprenticeship		0.008		0.000
		(0.008)		(0.013)
High school grade		−0.012*		−0.013
		(0.006)		(0.010)
Labor market orientation		0.002		0.002
		(0.003)		(0.004)
Cohort FE	Yes	Yes	No	No
Wave FE	Yes	Yes	Yes	Yes
Birth year FE	Yes	Yes	Yes	Yes
Area of study FE	Yes	Yes	Yes	Yes
Degree type FE	Yes	Yes	Yes	Yes
Uni type*study area FE	Yes	Yes	Yes	Yes
Parental job qual. FE	No	Yes	No	Yes
F-statistic[a]	2,664	2,659	618	617
Partial correlation coefficient	0.410	0.407	0.313	0.310
Adjusted R2	0.536	0.537	0.478	0.479
Number of observations	11,603	11,603	4,494	4,494

Note: The dependent variable is equal to one if a graduate completed an internship during the course of studies, and zero otherwise. Standard errors (in parentheses) are clustered at the individual level. [a] Relates to the instrument variable "Mandatory internship". $^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. *Data:* Bavarian Graduate Panel.

Table B-4: Heterogeneous effects

	OLS	IV	Number of observations
Panel A: Labor market orientation of study subject			
Strong LM orientation	0.033*	0.030	10,068
	(0.014)	(0.020)	
Weak LM orientation	0.106*	0.052	1,535
	(0.047)	(0.138)	
P-value of interaction	0.156	0.906	11,603
Panel B: Field of study [a]			
Science, mathematics, engineering	0.019	0.008	5,012
	(0.016)	(0.020)	
Business and economics	0.064*	0.056	4,098
	(0.029)	(0.046)	
Humanities and social sciences	0.082*	0.074	2,473
	(0.035)	(0.066)	
P-value of interaction (internship × BE)	0.196	0.509	11,583
P-value of interaction (internship × HSS)	0.144	0.377	

Note: All models control for gender, year of birth FE, area of study FE, Uni type-study area FE, degree type FE, university type, job qualification mother and father FE, apprenticeship, high school grade, degree of labor market orientation and a dummy for the 2nd wave. [a] See Table A-3 in Appendix A for a classification of areas of studies into weak and strong labor market orientation. 20 observations are outside of the study field categorization. $^{+}$ p<0.10, * p<0.05, ** p<0.01, *** p<0.001. *Data:* Bavarian Graduate Panel.

Appendix C: Replication of Klein and Weiss (2011)

In this section, we replicate the results from Klein and Weiss (2011) and extend their estimation strategy to additional waves. KW use data from the DZHW 1997 graduation cohort to asses the effect of mandatory internships on earnings five years after graduation. After sample restrictions similar to the ones in the present study, the authors end up with a sample of 1,971 observations. They focus on compulsory internships and use propensity score matching methods to reduce the potential bias naive OLS estimator might generate. They match on characteristics of the study program and on individual characteristics to estimate the propensity to be in a study program with a mandatory internship. The authors estimate an average treatment effect of -0.039 with a z-value of -1.58, implying negative but statistically insignificant returns to mandatory internships. In Table C-1 in column (1) we replicate their findings. We report both unmatched OLS results as well as the estimated average treatment effect on the treated (ATT) after matching. Our sample is somewhat larger than KW's sample; nevertheless we get point estimates very close to theirs. In column (2), we again use the 1997 graduation cohort and propensity score matching methods similar to Klein and Weiss (2011), but this time we use as matching characteristics the variables we use in the present study. We show that the variable choice is not changing the results qualitatively. In column (3)-(5) we extend the sample to 2001, 2005, 2009 graduation cohorts, and in column (6) we pool these cohorts. The results clearly show that the experience of the 1997 graduation cohort is unique, as for all the other cohorts we get positive returns to internship, and in the full sample the effect is also statistically significant at 5% level.

Table C-1: Mandatory Internships and Log Hourly Wages

Graduate Cohort	1997		2001	2005	2009	2001-2009
	Klein and Weiss					
	(1)	(2)	(3)	(4)	(5)	(6)
OLS (unmatched)	-0.047*	-0.040*	0.025	0.010	0.066*	0.027*
	(0.018)	(0.018)	(0.016)	(0.016)	(0.028)	(0.010)
ATT (prop. score matching)	-0.041	-0.034	0.040	0.045	0.080	0.054*
	(0.031)	(0.025)	(0.030)	(0.029)	(0.056)	(0.020)
Number of observations	2,089	2,046	7,229	8,826	2,639	19,415

Notes: The first column replicates the estimates of Klein and Weiss (2011), Table 3, column 3, page 982, using the same sample selection criteria and the same explanatory variables. KW report a point estimate of -0.039 [z-value$=-1.58$]. Column (2) uses the same sample selection criteria as in Klein and Weiss (2011) and similar explanatory variables as in our main specification (see Table 6, column 2), with the exception of university FE, because they are not included in the standard data format. Columns (3)-(6) report OLS and propensity score matching estimates for the different graduate cohorts, using our preferred specification (see Table 6, column 2). Estimates in columns (3)-(5) do not control for cohort and wave FE. Bootstrapped standard errors in parantheses. $^{+}$ p<0.10, * p<0.05, ** p<0.01.