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## Apprenticeship, Vocational Training and Early Labor Market Outcomes - in East and West Germany

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# Apprenticeship, Vocational Training and Early Labor Market Outcomes – in East and West Germany

## Abstract

We study the returns to apprenticeship and vocational training for three early labor market outcomes all measured at age 25 for East and West German youths: non-employment (i.e., unemployment or out of the labor force), permanent fulltime employment, and wages. We find strong positive effects of apprenticeship and vocational training. There are no significant differences for different types of vocational training, minor differences between East and West Germany and males and females, and no significant changes in the returns over time. Instrumental variable estimations confirm the regression results. The positive returns hold up even in poor labor market situations.

JEL-Code: J400, J240, I290.

Keywords: youth unemployment, school-to-work transition, returns to education, vocational training, transition economics.

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## 1. Introduction

Failure at labor market entry and unemployment at an early age generate important social and economic problems in many countries. A broad literature confirms that the individual experience of youth unemployment foreshadows labor market opportunities over the entire life cycle (e.g., Gregg 2001). In addition, the *expectation* of a difficult labor market entry can discourage human capital investments, encourage criminal activity, and affect family formation.

In this paper, we study the association of apprenticeship and vocational education and training (AVET) with successful labor market entry. Given the lack of truly exogenous variation our focus is not on the identification of causal effects of AVET. Instead, we add to the literature by describing the correlations and heterogeneity patterns which are of independent and substantial interest. We focus on three early labor market outcomes: unemployment and inactivity, stable fulltime employment, and hourly earnings. We consider the case of Germany, which is of particular interest for three reasons: first, its apprenticeship and vocational training system has a long and rich tradition and is crucial for the qualification of the German workforce. The vocational training system is also associated with Germany's comparatively low rate of tertiary education (OECD 2012a). Second, Germany has an internationally outstanding record with respect to its low youth unemployment. Third, a comparison of the East and West German experience is of special interest from the perspective of transition economics. We provide this new perspective and compare the benefits of vocational training in East and West Germany after reunification.

Many researchers studied AVET in Germany, but only a few evaluated the returns to AVET. Instead, numerous authors discuss labor market transitions after apprenticeships (e.g., Dustmann et al. 1997, Werwatz 2002, Korpi and Mertens 2003, Euwals and Winkelmann 2004, Bougheas and Georgellis 2004, Fitzenberger and Kunze 2005, von Wachter and Bender 2006, or Göggel and Zwick 2012) or focus on youths' failure in the vocational training system (Franz

et al. 2000), or on time trends in apprenticeship transitions (Büchel 2002). Also internationally the contributions on the returns to AVET with respect to wages, the risk of non-employment, and stable full-time employment are limited. We summarize extant contributions in Table A.1.

None of the contributions on the returns to AVET with respect to wages in Germany studies evidence that is more recent than 1995; in general, these studies confirm 15 to 20 percent wage returns to AVET qualifications (e.g., Krueger and Pischke 1995, Winkelmann 1996b, Cooke 2003, Clark and Fahr 2002).<sup>1</sup> As supply and demand conditions have changed in the German labor market since the 1990s it is timely and relevant to evaluate wage returns to AVET using recent data.

Few studies have evaluated the return to AVET with respect to the unemployment risk. Winkelmann (1996a) and Buchholz and Kurz (2008) find significantly lower unemployment risks for those with vocational training compared to other more general educational degrees. Franz et al. (2000) point out that there is some heterogeneity by type of AVET and Büchel (2002) focuses on the role of secondary schooling. Both contributions focus on AVET graduates and do not compare them to those without AVET qualifications.

The return to AVET with respect to the probability of holding a stable fulltime job was addressed by Winkelmann (1996a). He evaluates the duration of first jobs and finds insignificantly higher long-run survivor rates among former apprentices than among the unskilled or among graduates from general education schemes. Winkelmann (1996b) shows that graduates from AVET programs change employers less frequently than the unskilled. Buchholz and Kurz (2008) confirm this finding.

Overall, we have little precise information on the benefits of completing AVET. We contribute to this literature by addressing this issue with respect to three labor market outcomes, by relying on more recent information, and by using large samples and rich data.

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<sup>1</sup> Ferster and Winter-Ebmer (2003) investigate returns to education for Austria in 1981-1997. Using cross-sectional data they obtain wage returns of 13-17 percent to apprenticeships and of up to 35 percent to vocational school degrees.

There are only few contributions which identify causal effects of AVET:<sup>2</sup> Oosterbeek and Webbink (2007) evaluate the wage effect of an extension of basic vocational training based on a 1975 reform in The Netherlands. Fersterer et al. (2008) identify the returns to years of completed apprenticeship training based on the failure of small Austrian firms. Using the duration of incomplete apprenticeship training as an instrument the authors estimate a wage return to a year of AVET which is slightly larger than that estimated by OLS. Malamud and Pop-Eleches (2010) exploit a 1973 reform in Romania which shortened the duration of vocational courses. The authors find no significant reform effects. Thus, none of the three studies evaluates the effect of attaining an AVET qualification and the question of the causal effect of AVET qualifications continues to be unanswered. In this paper we do not focus on the identification of causal effects, however, we offer instrumental variables results as robustness tests for our least squares evidence.

We address two additional issues. First, we investigate whether AVET can balance the labor market disadvantages of those with only lower track secondary school degrees. Büchel (2002) looks at labor market entries prior to 1992 and concludes that over time the dual education system lost the ability to compensate deficits in general education. We investigate this issue with more recent data. Second, we compare AVET returns in East and West Germany. Except for Buchholz and Kurz (2008) none of the cited studies investigated labor market entrance in East Germany after unification.<sup>3</sup> Ongoing labor market problems in East Germany may limit the opportunities of new labor market entrants and possibly attenuate the returns to human capital investments there. As the studies on labor market entry in transition economies do not address returns to vocational training (e.g., Audas et al. 2005, Bukodi 2008, Täht et al. 2008) we fill a gap in the literature.

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<sup>2</sup> Sollogoub and Ulrich (1999) compare employment and wage outcomes for youths with apprenticeship and technical school qualifications. The authors correct for selection into these vocational training paths using a Heckman correction and information on parental education as instruments.

<sup>3</sup> Krueger and Pischke (1995) look at the situation in the former GDR and compare the wage returns to education for East and West Germany around 1990.

In their survey of the apprenticeship literature Wolter and Ryan (2011, p.553) suggest that "The evidence on the economic effects of apprenticeship in individuals is still too limited to draw general conclusions." The aim of our paper is to contribute to this literature and to address important shortcomings of extant studies that Wolter and Ryan (2011) point to: first, it is important to define clear reference groups and counterfactuals when evaluating the returns to AVET. Therefore, we focus on graduates from secondary schools who are not eligible for tertiary education. In this homogeneous sample we compare the labor market outcomes of those who attained a vocational training qualification with the outcomes of those who did not. Second, individuals are allocated to different training schemes; therefore we compare the outcomes of alternative AVET programs. Third, one needs to choose appropriate outcomes where "employment, unemployment, and pay are the obvious ones for economists" (Wolter and Ryan 2011, p.551). We consider these three outcomes to comprehensively describe the relevance of vocational training for early labor market success.

Our findings suggest that vocational training generates strong positive returns on various dimensions of early labor market entry. Individuals with AVET run a lower risk of being unemployed or out of the labor force, have a higher chance of permanent fulltime employment, and earn higher wages than their peers who entered the labor market without investing in vocational skills. In contrast to prior studies (e.g., Winkelmann 1996b and Fersterer and Winter-Ebmer 2003), we do not find significant differences in returns to different types of vocational training in Germany. There are only minor differences between East and West Germany and between males and females. Also, we do not find a negative time trend in the returns to AVET in a period of increasing access to tertiary education. The results confirm the beneficial effects of AVET for early labor market outcomes, even when the overall labor market situation is dismal.

Thus, undergoing AVET after the completion of general education appears to be associated with a successful labor market entry of young workers. Even in flexible labor

markets, in regions and periods of high unemployment, and for youths with less than optimal general education outcomes, the returns to investments in vocational skills are significant and of substantial magnitude. This might be helpful evidence when deciding on measures to fight youth unemployment.

The next sections describe the institutional background of vocational training in Germany. Section 3 then describes the data and the empirical approach. Sections 4 and 5 describe the results of the OLS estimation and their heterogeneities. Section 6 shows the results of instrumental variable regressions and section 7 concludes.

## **2. Institutional background: education system and youth unemployment**

We first sketch the German educational system which is administered at the federal state level. We then characterize the options available to those high school graduates who completed secondary school after unification, when the same regulatory framework governed East and West Germany (for a summary see **Figure 1**).<sup>4</sup> Finally, we describe the youth unemployment situation in Germany.

German secondary schools use a track system (e.g., Heineck and Riphahn 2009, KMK 2013). After typically 4 years in primary school at age 10 pupils are placed in one out of three tracks. Lower secondary school (*Hauptschule*) lasts another 6 years and prepares for vocational training. Intermediate secondary school (*Realschule/Mittelschule*) also provides 6 years of instruction and typically prepares for training in white collar occupations. At upper secondary school (*Gymnasium*) education continues for an additional 8 or 9 years. The upper secondary school degree (*Abitur*) is required for university admission.<sup>5</sup> After unification, all East German states established the upper secondary schools, but in most states lower and intermediate secondary schools were combined in one track (Riphahn and Trübswetter 2012).

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<sup>4</sup> As of August 1, 1990 former East Germany adopted the West German vocational training system (Schaub and Zenke 2000).

<sup>5</sup> In addition, comprehensive schools (*Gesamtschule*) grant degrees of either track.

In recent decades, the cohort shares attaining upper secondary school degrees (*Abitur*) increased substantially. Of the pupils leaving secondary school in 2012, about 5 percent had no degree, while 18, 40, and 37 percent graduated from lower, intermediate, and upper secondary school, respectively (STBA 2013).

Once pupils leave secondary school, they can choose different pathways. Those with an upper secondary school degree can take up academic studies.<sup>6</sup> Generally, however, a transition into vocational training is most common and possible for graduates from all tracks. The German vocational training system can be described as a three track system, as well (see, e.g., Quintini et al. 2007, or Biavaschi et al. 2012).

The first track is the apprenticeship system (*Duales System*/dual system): apprenticeships last between 2 and 4 years and combine vocational 'on-the-job training' with formal education in vocational schools (*Berufsschule*).<sup>7</sup> The firm-based 'on-the-job training' has to meet formal, occupation-specific standards. Employers announce and fill open apprenticeship positions based on their business interests.<sup>8</sup>

The second track of vocational training is predominantly provided in fulltime schools without firm involvement (*Schulberufssystem*/school system). Both tracks lead to nationally recognized vocational qualifications.<sup>9</sup> Typically, choice between track one and track two education is tied to the choice of an occupation; in most cases any given occupation is taught exclusively in track one or two. The tracks differ in that first track students spend more time in firms and on-the-job whereas the second track training focuses on school based education. This implies different levels of relevant hands-on experience, occupational networks, and exposure

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<sup>6</sup> During the time of our analysis healthy young men above age 18 could face military draft or substitute service. However, by 2009 the cohort share of those in military or substitute service had dropped to roughly 3.4 percent. In earlier years the share was about three times as high (Wingerter 2011). The mandatory draft system was abolished in 2011.

<sup>7</sup> Often apprentices spend 1-2 days per week in school and 3-4 days at the firm. They earn a modest wage at the firm; the amount varies across occupations and regions.

<sup>8</sup> Gericke et al. (2011) show that as of 2009, roughly 54 percent of all 18-21 years olds entered the dual apprenticeship system.

<sup>9</sup> In addition, there is a system of civil servants' training, which is of small magnitude.

to the needs and interests of potential employers. Most importantly, second track school based training ends with students starting a job search and first track apprenticeship training ends with job offer decisions by employers. This likely affects both opportunities and behavior of trainees.

A third track consists of programs that meet excess demand for vocational training and improve applicants' qualifications but do not grant vocational degrees (*Übergangssystem* / transition program, for details see AB 2012). This track has three major tasks. It offers (i) general schooling for those not yet qualified for apprenticeships in a 'vocational preparation year' (*Berufsvorbereitungsjahr*), which can be used to complete a basic school degree. (ii) In a program called 'elementary vocational year' (*Berufsgrundbildungsjahr*) students may learn occupation-specific skills which can allow them to shorten a later apprenticeship. (iii) Finally, 'special vocational schools' (*Berufsfachschule*) prepare students for apprenticeships but do not provide formal qualifications. Most students who complete the third track continue their training with an apprenticeship (Franz et al. 2000). The dropout rate from AVET remains at below 20 percent and is highest in the first year (AB 2012).

Overall, the three-track vocational system succeeds in providing substantial population shares with vocational training degrees. BMBF (2014) discuss that the cohort share of those remaining without any vocational qualification reaches 13.5 percent among those in their 20s in 2011. The shares of those without vocational qualifications correlate with secondary school attainment and reach from 50.1 percent among those without secondary school, to 31.7 and 8.4 percent among those with lower and intermediate secondary school degrees and 5.4 percent among those graduating from upper secondary school.

**Figure 2** describes the distribution of entry cohorts across the three vocational training tracks for East and West Germany. We find regional differences with West Germans using the third track and East Germans using second track training more frequently. In both regions, vocational track choice is correlated with secondary school attainment (see **Table 1**): those with lower secondary school attainment tend to start out in the third vocational track.

In recent decades, the supply of vocational training positions often fell short of demand. **Figure 3** depicts the number of vocational training positions filled and the demand for vocational training in East and West Germany since 1992. Until 2008 demand exceeded supply in both regions. Since then demographic shifts in East Germany, where fertility had dropped by half in the early 1990s, took pressure off the system.<sup>10</sup> AB (2012) show that the supply-demand ratios for vocational training positions differ substantially by occupation. Instead of pursuing tertiary education, military or substitute service, and vocational training, high school graduates may work without training as unqualified workers, leave the labor force, or become unemployed (Riphahn 2002).<sup>11</sup>

AB (2012) report that one year after completing training about 63 and 73 percent of the East and West German AVET graduates are in regular employment (as of 2008). The share of unemployed is generally twice as high in East as in West Germany. Unemployment is particularly likely if youths in the dual system are not offered a position by their training firm: AB (2012) show that the share of youths in apprenticeship training that is offered a permanent position in the training firm increases with firm size and is lower in East than in West Germany.

By international comparison, Germany and its neighboring countries with dual apprenticeship systems (e.g., Austria and Switzerland) enjoy low youth unemployment (OECD 2012b). **Table 2** presents the ratio of youth to total unemployment for selected countries; the low ratios for Germany confirm the comparatively positive situation for German youths.

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<sup>10</sup> Bogai et al. (2008) and Seibert and Wesling (2012) document the commuting activity of young East Germans, which reflects the tightness of the East German market for training positions.

<sup>11</sup> STBA (2014, p.60, 63) report that 2.9 percent of all 15-19 year olds (as of 2012) are not in education and training but in employment. Among all 18-24 year olds 10.4 percent do not have a secondary school degree and are not in training or education (as of 2012); of these 44 percent are employed and 56 percent are not employed.

### 3. Data and Empirical Specification

We use the 2000-2011 years of the German Socioeconomic Panel (SOEP), a household survey which covers educational careers and labor market outcomes (Wagner et al. 2007). A key advantage of the SOEP is its rich set of socio-economic indicators.

We study individuals aged 25 in the years 2000-2011, i.e., born 1975-1986 in East and West Germany who completed secondary education after German unification in 1990. We consider only those who initially graduated from either *Hauptschule* (lower secondary school) or *Realschule* (intermediate secondary school); thus, we use a homogeneous sample of graduates from those two school tracks that qualify for vocational training. We omit youths with missing information on educational background or with a secondary school degree from *Gymnasium* (upper secondary school).<sup>12</sup> The latter are typically three years older at graduation than the youths in our sample and have the option to take up academic education. Therefore their career choices differ from those of the group of youths that we focus on here. After dropping 6 observations with missing values on key variables, our sample contains 1,839 individuals (1,306 in West and 533 in East Germany).

As dependent variables we consider three labor market outcomes at age 25 when both training and military and substitute service are typically completed and labor market entrants had the opportunity to establish themselves in the labor market. In particular, we consider (a) non-employment, i.e., whether an individual is currently unemployed or out of the labor force; this indicator is set to zero for those currently working or enrolled in education;<sup>13</sup> (b) holding a permanent fulltime job which describes whether a person works fulltime and holds a job with

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<sup>12</sup> To reduce the number of missing values for our education measure, we also used data from earlier survey waves to measure educational outcomes. It is possible that observations in our sample obtained higher educational degrees after their initial secondary school degree, either prior to or after completing vocational education. We account for additional degrees in our estimations.

<sup>13</sup> Note that young individuals may self-report the own employment status as being “out of the labor force” rather than “registered unemployed” as long as they are not (yet) qualified for official unemployment benefits. In both cases the individual is currently not employed, which we consider to be the relevant information here.

at least one year of tenure with the same employer; and (c) the hourly earnings of those who are fulltime employed where we use the log of real (2006) gross hourly earnings or wages, i.e., monthly earnings per hour worked.

**Table 3** describes the dependent variables in East and West Germany. For the first two dependent variables we use the full sample and for the third outcome we use only those in fulltime employment. We find clear East-West differences: the share of individuals in non-employment is eight percentage points lower in West than in East Germany (17 vs. 25 percent) and more individuals have a permanent fulltime position in West (48 percent) than in East Germany (40 percent). With respect to log real hourly earnings, individuals in East Germany trail behind their West German peers on average by 0.3 log points (2.4 vs. 2.1).

Individual labor market outcomes are affected by a number of mechanisms which we need to account for in order to quantify the relevance of AVET qualifications. These mechanisms work through labor demand and labor supply and can be addressed using regional characteristics. Our main variables of interest are two indicators for completed AVET, which we consider, both, in combination and separately: the apprenticeship indicator refers to the first track of the vocational training system, and the vocational training indicator combines various formats of school based second track vocational training. It is not possible to complete a vocational degree in the third track of the vocational training system. Individuals who start out in track three and later complete a degree in the first or second track of the vocational system are in the treatment group. Those who fail to complete a vocational degree end up in our control group which comprises all those who failed to commence or complete AVET degrees. In our sample 76 percent of the youths completed an AVET qualification with little difference between

East and West Germany.<sup>14</sup> About one quarter of those with AVET qualifications indicated to have a qualification from the second track of vocational training.<sup>15</sup>

In addition, it is important to control for those individual characteristics that may be correlated with and affect the estimates of the returns to AVET via the labor supply side.<sup>16</sup> This group of measures comprises gender, marital status, the number of children in the household, the highest secondary schooling degree completed, migration background, an indicator for past in military or civil service, and for tertiary education. As labor demand varies at the regional level this provides one reason to differentiate between East and West Germany. In addition, the two regions differ in the distribution of secondary school degrees; the share of youths with at most lower secondary school degree (*Hauptschule*) is lower in East Germany than in the West. The share of migrants, which combines first and second generation immigrants, reaches 32 percent in West and only 3 percent in East Germany (see Panel A of **Table 3**). To control for regional disparities we consider community size and regional unemployment. More than half of East German youths reside in small towns with fewer than 20,000 inhabitants compared to only 43 percent in West Germany. The mean state unemployment rate is substantially higher in East than West Germany (about 17 vs. 8 percent). Given structural heterogeneities in the education system it is important to allow for federal state fixed effects in the estimations. All models control for year fixed effects; these jointly account for the business cycle and for birth cohort differences, which cannot be separated in our cross-sectional setting. The hourly earnings equation additionally controls for tenure, industry, occupation and firm size. Panel B of **Table 3** presents descriptive statistics for covariates used in the hourly earnings regressions.

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<sup>14</sup> Similar to Winkelmann (1996b), we refrain from using information on apprenticeship dropout because the survey yields incomplete information on this issue.

<sup>15</sup> Our data do not allow us to identify the third track of vocational training. However, as the third track typically leads to first or the second track training this is innocuous.

<sup>16</sup> Ideally one would study the returns to AVET as a function of the characteristics of the training firm (e.g., industry or firm size) if the AVET degree was obtained as an apprenticeship in the dual system. However, as we use individual data that is gathered at age 25 this information is not generally available. In addition, we would not be able to characterize those who obtained their degree in the secondary track of vocational training.

#### 4. OLS Results

We use OLS to analyze the relevance of AVET qualifications for early labor market outcomes. **Tables 4.1-4.3** present the estimation results for three outcomes: being unemployed or out of the labor force, holding a stable permanent fulltime job, and real hourly log hourly earnings in fulltime employment, all at age 25. In all estimations we condition on federal state and year fixed effects and present robust standard errors.

Column 1 shows the raw returns to an AVET qualification for the three outcomes. The coefficient is always highly significant and indicates a beneficial correlation between AVET and labor market entry: the probability of being unemployed or out of the labor force at age 25 is about 12 percentage points lower among those with training, the probability of permanent fulltime employment at age 25 is higher by about 30 percentage points, and hourly earnings in fulltime employment are about 17 percent higher among those who hold a vocational training qualification. The magnitude of the effect on hourly earnings is consistent with previous findings; Winkelmann (1996b) reports wage returns of 15-20 percent and Fersterer and Winter-Ebmer (2003) obtain wage returns of 13-17 percent to apprenticeships in Germany and Austria, respectively. Once we consider controls for covariates in column 2 the estimates decline somewhat in magnitude but remain statistically significant (see column 2 in **Table 4**).<sup>17</sup>

Next, we investigate whether the returns to apprenticeships (first track) and school based vocational training (second track) differ.<sup>18</sup> Column 3 shows the coefficient estimates for the two training measures. Clearly, the comparative results for the two routes may be affected by uncontrolled occupation-specific effects. However, we find no clear order in the returns to the two qualifications: school-based vocational training yields larger coefficients in **Tables 4.1** and **4.3**,

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<sup>17</sup> The covariates controlling for individual characteristics are always jointly statistically significant. Year and state fixed effects are significant in most cases. In the hourly earnings equation the controls for firm size, occupation, and industry are also group-wise statistically significantly different from zero.

<sup>18</sup> Since apprenticeship training and school based vocational training typically prepare for different occupations a comparison of the returns to these pathways contains occupation-specific effects.

while apprenticeships dominate with respect to holding a permanent fulltime job (**Table 4.2**). Tests based on regressions with and without control variables do not reject the hypothesis that the two coefficients are identical.<sup>19</sup> This finding differs from Winkelmann (1996b) and Fersterer and Winter-Ebmer (2003) who find substantial variation in the wage returns to different types of vocational training. Winkelmann (1996b) used SOEP data from 1984-1990 for male West German workers without age restrictions. Fersterer and Winter-Ebmer (2003) study Austrian data from 1981-1997. Both differentiate various types of vocational training. In contrast, we combine males and females, use recent data, and consider outcomes from East and West Germany where patterns of vocational training provision differ. When we restricted our sample to males from West Germany the identity of the two coefficient estimates could still not be rejected. Winkelmann's sample had on average 21 years of experience and thus attained vocational degrees in the 1960s. Therefore, the difference between his and our findings may result from life-cycle phenomena if differences in returns to training types realize only later in life. Alternatively, the differences in returns across degrees may have vanished in recent decades. Based on our results, we use a joint AVET indicator for the remainder of our analysis.

The estimation results in columns 4 and 5 of **Table 4** address possible differences between the returns to vocational training in East and in West Germany. Such differences could result, e.g., from heterogeneous training institutions and labor market conditions (cf. section 2). The regressions for the regional subsamples show different results: the returns to AVET are smaller in magnitude and less statistically significant for the East German subsample particularly in **Table 4.1**. The signs of the point estimates, however, do not differ between East and West. In estimations on the full sample (not shown to save space), we added regional interaction terms of AVET; these interaction terms never yielded statistically significant

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<sup>19</sup> When testing the identity of the two coefficients in the specification with all controls, the p-values are 0.0689, 0.3029, and 0.2671 for the three outcomes, respectively.

coefficient estimates. Therefore, we conclude that AVET is associated with improved early labor market outcomes in both East and West Germany.<sup>20</sup>

Following Büchel (2002) and using more recent data we test whether completing an AVET qualification compensates labor market effects of deficits from secondary education. Büchel (2002) found that for those who completed the apprenticeship between 1948 and 1974, low secondary education outcomes did not affect post apprenticeship labor market opportunities. He concluded that generally the AVET qualification balanced prior disadvantages. However, this was no longer true for individuals who completed the apprenticeship 1975-1992. In our data, AVET qualifications were obtained between about 1994 and 2011. Column 6 of **Table 4** shows that those with only lower secondary school degrees as their highest degree do worse in the labor market compared to those with higher degrees; this difference is not significant in the hourly earnings equation. In column 7 we restrict the sample to those who obtained AVET qualifications: all three panels of **Table 4** confirm that even in this subsample those who initially obtained only lower secondary education still have worse labor market outcomes at age 25. Thus, AVET does not compensate disadvantages generated by initial secondary education. We thus confirm Büchel's (2002) results for more recent years.

## 5 Robustness and effect heterogeneity

We explore heterogeneities in the returns to AVET along three dimensions: first, we compare the returns to AVET for males and females, second, we study the labor market sensitivity of the returns to AVET, and third, we compare hourly earnings returns across occupations, industries, and firm sizes.

So far, we considered gender main effects and interaction terms of marital status and gender to account for different labor market outcomes of males and females. The estimated

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<sup>20</sup> Additionally, we rejected the hypothesis that the returns to AVET changed over time (results available upon request). We also did not find different time trends in the returns to AVET in East and West Germany.

coefficients (not presented to save space) generally indicate that at age 25 males are less likely to be unemployed or out of the labor force, more likely to be permanent fulltime employed and that they earn higher hourly earnings than females. If we add interaction terms of gender with AVET to the model the resulting estimates are small and insignificant for all three outcomes. **Table 5.1** shows separate estimates for male and female samples using the specification of column 6 of **Table 4**: we find small differences in the returns to AVET by gender for the first two outcomes and a larger difference in hourly earnings returns, where female returns are more than 50 percent larger than those of men; the latter are no longer statistically significant. Overall, the beneficial correlation of AVET qualifications holds for both genders confirming Fersterer and Winter-Ebmer (2003) for Austria; prior German studies such as Cooke (2003) and Winkelmann (1996b) only considered males.

In column 6 of **Table 4** we controlled for state unemployment measured contemporaneously with the dependent variables. We already found that there are no significant differences in returns to AVET between East and West Germany, two regions with different unemployment rates. We now study the role of the labor market in greater detail. First, we add an interaction term of the current state unemployment rate and AVET (see columns 1, 4, and 7 of **Table 5.2**). Not surprisingly, this yields significant coefficient estimates for the outcome 'currently unemployed or out of the labor force': the return to AVET with respect to current unemployment is significantly lower when unemployment is high, but it remains positive. The return to AVET with respect to the other two outcomes does not vary by current unemployment. The result also holds when we use the current *youth* unemployment rate, measured for ages 15-25 (see columns 2, 5, and 8 of **Table 5.2**). Thus, the current labor market situation does not affect the benefits of AVET.<sup>21</sup>

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<sup>21</sup> Interestingly, this finding differs from those of Ammermueller et al. (2009). They conclude that unemployment affects returns to years of education. The authors consider *net* hourly income for employees aged 25-60 in firms with at least 10 employees. As the returns for highly skilled workers and those in the upper quantiles of the wage distribution appear to respond strongest to unemployment and as their sample considers older workers the results may not be contradictory.

Next, we test whether the labor market situation at the time when the training decision was taken, e.g., at age 15 of the youth, is correlated with the returns to AVET ten years later, at age 25 (see columns 3, 6, and 9 of **Table 5.2**). We find no significant coefficient estimate of the interaction terms in the unemployed or out of the labor force and the hourly earnings equations, but for the permanent fulltime employment outcome.<sup>22</sup> The point estimates (see column 6 of **Table 5.2**) suggest that the beneficial effect of completed AVET at age 25 is significantly lower if the (youth) unemployment rate at age 15 was high.<sup>23</sup> This surprising result may suggest a selection of youths commencing their AVET in times of high unemployment, i.e., that they are less likely to enter permanent fulltime employment compared to youth starting AVET in less difficult times. Alternatively, the long-term benefit of AVET in terms of permanent fulltime employment outcomes may be smaller when the labor market is tight early in life. This interpretation is plausible as in times of tight labor markets firms may reduce the average quality of the AVET positions offered: in these years firms face particular social pressure to offer AVET positions even though they may not expect a subsequent demand for trained workers.<sup>24</sup> Importantly, however, the returns to AVET qualifications in terms of permanent fulltime employment outcomes at age 25 are positive, large, and highly significant even for those who started in bad labor market situations.

Finally, we follow previous studies on German apprenticeships and test whether returns to vocational training are heterogeneous across employers and occupations (e.g., Göggel and Zwick 2012). The interaction terms of AVET with occupation, industry, or employer size indicators are not jointly significant (results available upon request).

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<sup>22</sup> This holds, both, for aggregate and youth unemployment rates at the time when the individual was aged 15, 16, or 17 of the youth.

<sup>23</sup> This confirms evidence that finds no causal effect of paternal unemployment during an offspring's youth on later own unemployment of the youth (Mäder et al. 2015).

<sup>24</sup> Ryan (2001) argued that societal commitment to youth employment is key to explain the success of the apprenticeship systems in Japan and Germany.

## 6 Instrumental Variables Regressions

The coefficient estimates discussed so far reflect the association of AVET qualifications with early labor market outcomes. These may differ from causal effects of education due to measurement error, individual heterogeneity in returns, and the endogeneity of training outcomes which results if AVET is affected by the same unobservables as labor market outcomes. A priori, the direction of potential biases in the OLS estimates is unclear: the mechanisms of measurement error, individual heterogeneity in qualification effects, and endogeneity may cause OLS coefficients to be under- or overestimated. In order to test the robustness of our findings we additionally apply an instrumental variables (IV) estimator. The only other study approaching returns to AVET in an IV context appears to be Fersterer et al. (2008). They identify the causal effect of apprenticeships using information on failing firms and find little difference between least squares and IV estimates; they obtain an overall wage return of about 15 percent to a completed apprenticeship in Austria. Comparable IV evidence for Germany is not available.

Because we do not have information on failing firms in our data, we use two alternative instruments: the first indicates whether a person's father completed vocational training and the second informs on whether the individual encountered conflicts with the father at age 15.<sup>25</sup> We expect both variables to be correlated with the individual decision to complete vocational training: on the one hand, parental knowledge about the vocational system may support a child's efforts; on the other hand, the desire to become more independent during puberty and to achieve control over one's future in a situation of domestic conflict may have an independent positive effect on the propensity to complete AVET.<sup>26</sup> We argue that the two indicators do not directly influence labor market outcomes at age 25 and are thus uncorrelated with the respective error

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<sup>25</sup> The survey question asked "How often do you have arguments with your father?"; we coded the answers 'very often', 'often', and 'occasionally' as 1 and the answers 'rarely' or 'never' as 0.

<sup>26</sup> The unconditional correlation of paternal AVET degree with youth AVET degree is 0.1254, i.e., it is positive and statistically significant at the one percent level. The unconditional correlation of family conflict at age 15 with youth AVET is 0.093 and also statistically significant at the one percent level.

terms. The IV estimates then identify the causal effect of vocational training for those whose training outcome is affected by the instruments.

Family background information, such as parental education is commonly used as an instrument in the analysis of returns to education. Card (1999) concludes that it may generate an upward bias in wage regressions. In contrast, Ichino and Winter-Ebmer (1999) present estimates based on parental education as a *lower* bound of the true effect and find estimates three times as high with their other instrument. We draw on recent findings by Hoogerheide et al. (2012) who show that even if the instrument does not completely meet the exogeneity assumption the resulting bias may be small. These authors suggest that father's education is a viable option to address the endogeneity problem with regard to education.<sup>27</sup> Our second instrument, whether the youth encountered conflicts with the father at age 15 is new to this literature.

**Table 6** shows the results of applying instrumental variables regressions to the model in column 6 of **Table 4** for our three outcome variables. Generally standard errors are much higher in the IV models. The two instruments are highly statistically significant in the first stage regression which is relevant for the first two outcomes. The first stage F-statistics take on values of over 15 (see bottom of **Table 6**). In the case of the hourly earnings regression which uses a smaller sample the first stage F-value is only 4.97 which suggests that the IV estimates may not be reliable here. At the bottom of **Table 6** we present the coefficient estimates of the instruments in the first stage regressions: they confirm a positive association of the instruments with the propensity to complete AVET. We also test – acknowledging the low power of the test – the overidentifying restriction that the instruments are uncorrelated with the main equations' error

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<sup>27</sup> We evaluated the validity of numerous potential instruments; however, none of the following variables met the requirements: paternal tertiary education, maternal vocational and tertiary education, state level cohort share of upper secondary school graduates, state level supply/demand ratio of vocational training positions, (relative) graduate cohort size, and the state youth unemployment rate. We matched these to the data for the period when the youth was aged 15, 16, or 17 years. Unfortunately, the data does not provide sufficient information on cognitive or non-cognitive skills which would permit direct controls for unobserved ability.

terms: the null hypothesis is not rejected, which supports our approach (see bottom rows of **Table 6**). Substantively, the estimates confirm our prior findings and yield patterns that are typical in the literature comparing IV and OLS results (see, e.g., Göggel and Zwick 2012, or Ichino and Winter-Ebmer 1999): the IV coefficients confirm the direction of the least squares results, but are larger in magnitude. Compared to the results shown in column 6 of **Table 4** the estimates at least double in size for the first two dependent variables and jump to 0.764 in the hourly earnings regression. This agrees with the literature that discusses OLS results as downward biased and lower bounds to true effects (see Arkes 2010 for a survey and Blackburn and Neumark 1995 for a critique). The IV point estimate in the non-employment equation is insignificant; the other two equations' estimates are significant. Overall, our IV results confirm that AVET yield large beneficial effects for early labor market outcomes.<sup>28</sup>

## 7. Conclusions

This paper studies the returns to apprenticeship and vocational education and training (AVET) for three dimensions of labor market entry: being unemployed or out of the labor force, being in permanent fulltime employment, and fulltime hourly earnings, all at age 25. We focus on individuals who initially graduated from lower or intermediate secondary school. While many policy-oriented contributions assert the beneficial effects of vocational training after secondary education, there are only few and mostly dated contributions devoted to testing and establishing such returns (e.g., Winkelmann 1996b, Cooke 2003). We contribute to the literature by providing new evidence on recent data and addressing shortcomings of prior studies such as the lack of clearly defined reference groups or the selection of outcome

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<sup>28</sup> We tested the robustness of our IV results by modifying the set of instruments, e.g., only using paternal vocational training, only using conflict at age 15, using paternal vocational training plus conflict at age 15 coded in 5 categories instead of one indicator, adding the number of siblings, or parental ages at birth to the original instruments. As the coefficient estimates across these different specifications are quite similar even the IV results, which serve as a robustness test of the positive OLS estimates, appear to be robust to alternative identification strategies.

measures. In addition, we show results of instrumental variable estimations for vocational training outcomes in Germany.

We describe the returns to AVET, study their heterogeneity across different types of training, test whether AVET can compensate disadvantages from low secondary school attainment, investigate differences between the West German market economy with low unemployment and the East German transition economy, and investigate whether the returns to AVET fall over time. Our central result is that AVET yield highly beneficial effects on early labor market outcomes. We do not find significant differences in the returns to different types of vocational training, only minor differences between East and West and between males and females, and no significant decline in the returns to training over time. The returns to AVET with respect to permanent fulltime employment and hourly earnings are robust to the contemporaneous labor market situation. We find that past unemployment reduces the returns to AVET with respect to permanent fulltime employment; however, even if past unemployment was high, the returns to AVET are large and significantly positive. Instrumental variables regressions confirm the results and generate even higher returns to AVET which confirms the patterns in prior studies.

It is not trivial to newly establish vocational training systems in countries where they do not yet exist and where they are not an element of employers' manpower planning. However, the positive experience of the East German transition economy, which adjusted to the West German vocational training system after unification in 1990 and generates positive returns to AVET now, may encourage other countries to move towards comprehensive vocational education systems. In addition, the return to AVET in the German labor market with its sizeable supply of well trained workers may represent a lower bound to the return that AVET may generate in countries where the workforce is less broadly trained. Our findings support the view that low youth unemployment may be a result of the general provision of AVET systems that support young school leavers in the process of labor market entry. In flexible labor markets, in

regions and periods of high unemployment, and for youths with less than optimal general education outcomes, the returns to investments in vocational skills are significant and of substantial magnitude. This might be helpful evidence when deciding on measures to fight youth unemployment.

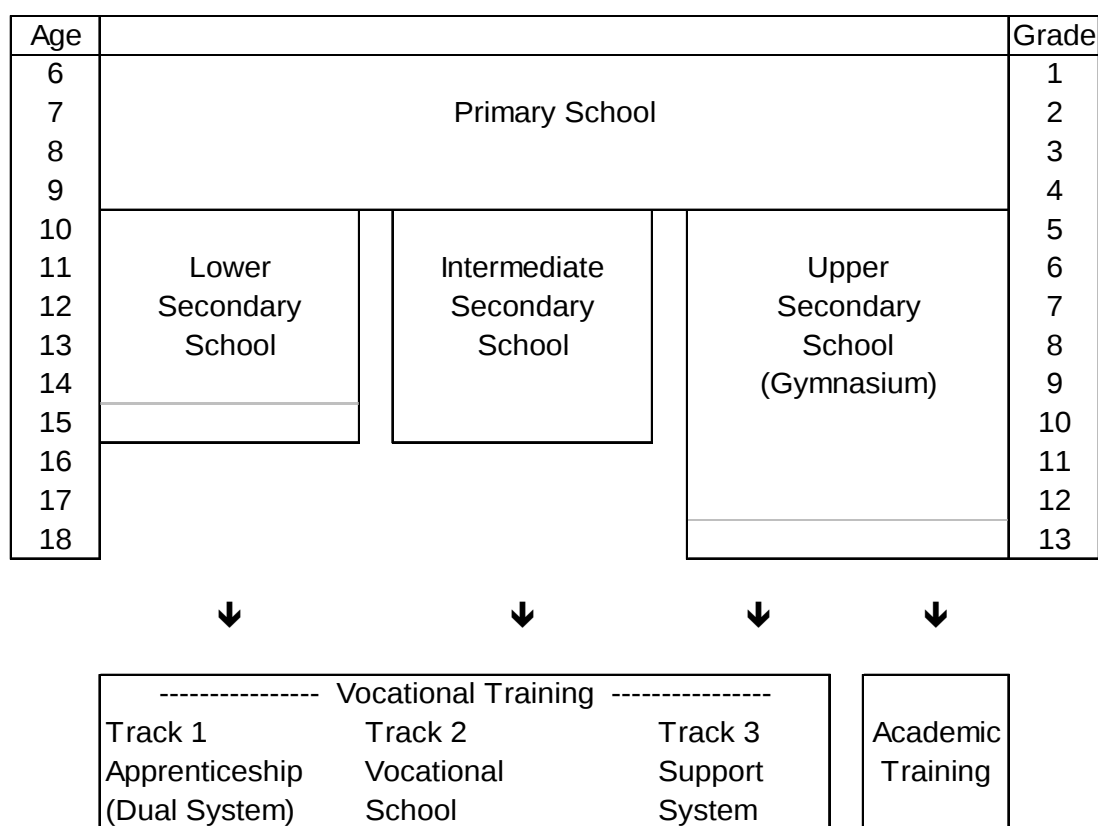
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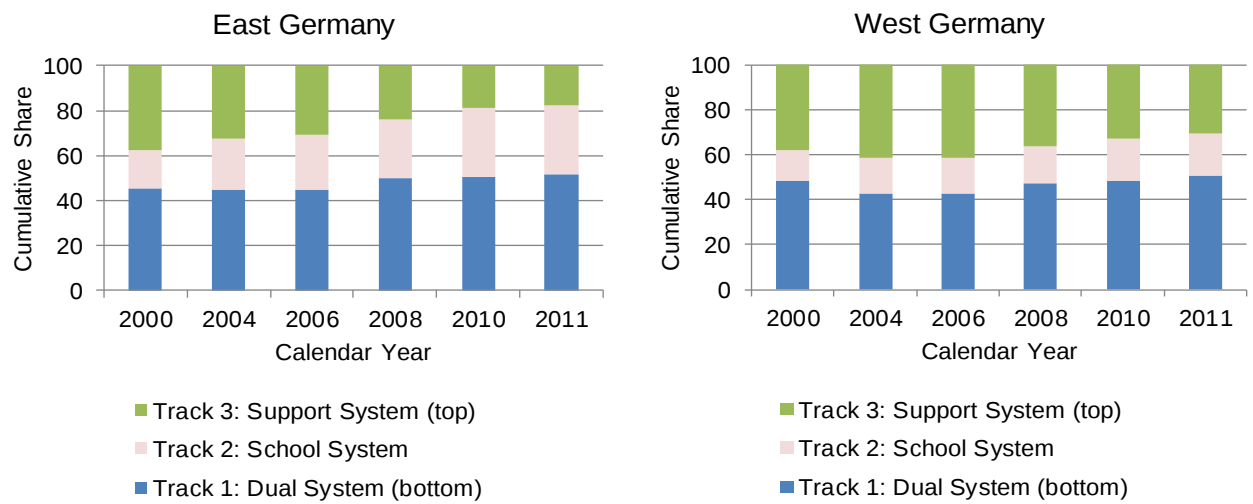
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**Figure 1** Schematic Representation of the German Education System



**Note:** This is a simplified representation of general patterns. Only those, who graduated from upper secondary school can proceed to academic training. The vocational training options are available for all who completed secondary school. For further details and precise definitions see KMK (2014).

**Figure 2** Entries to Vocational Training by Track and Year

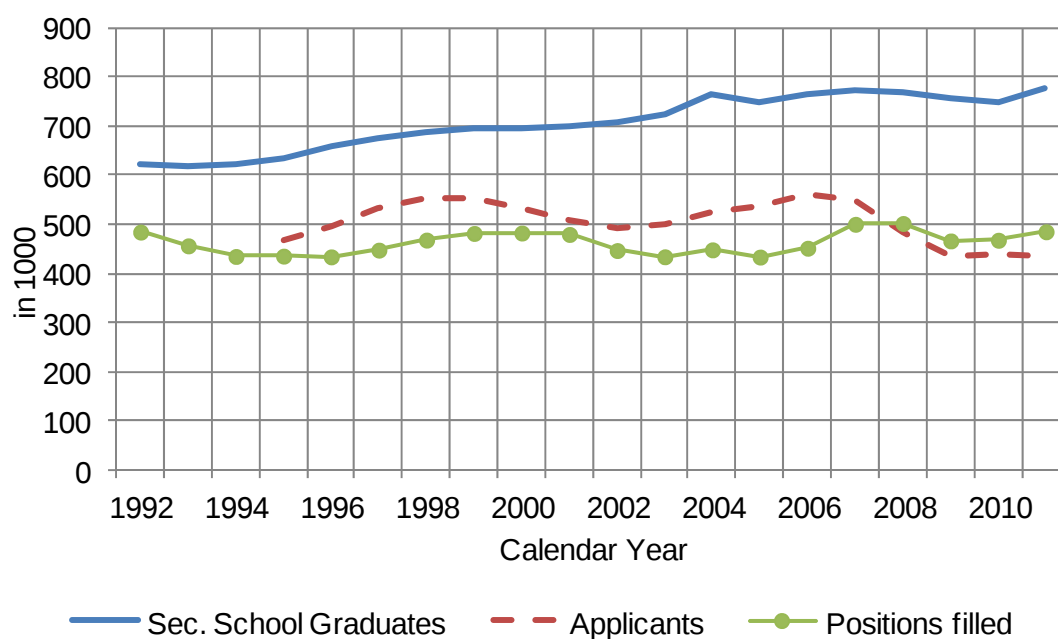


**Note:** Information for the years prior to 1995 and 1996-1999 is not available.

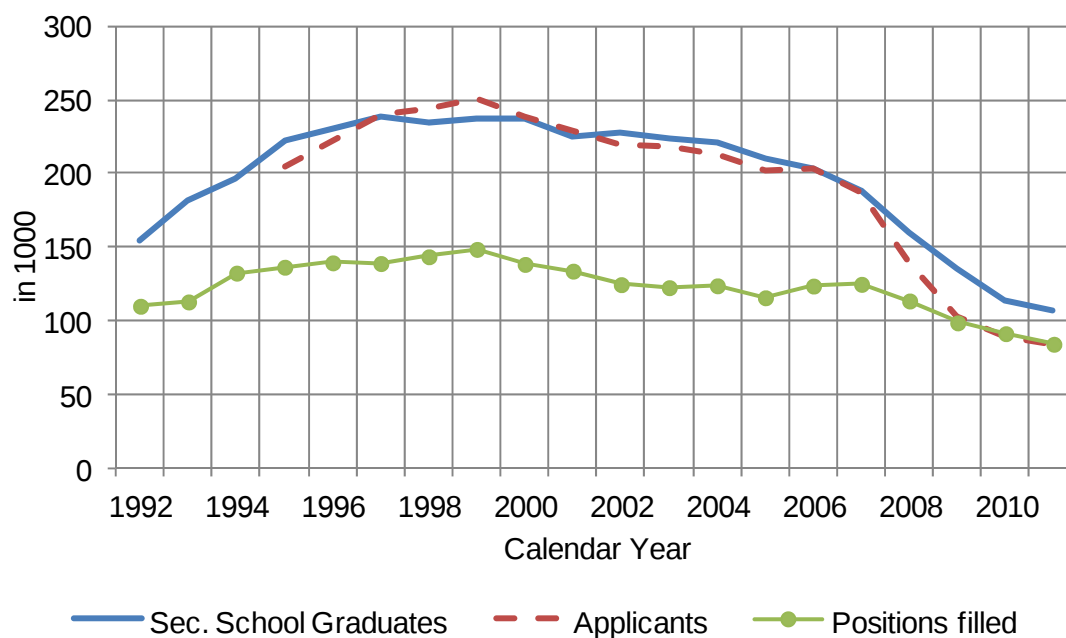
**Source:** Konsortium Bildungsberichterstattung (2006), AB (2010, 2012).

**Figure 3** Vocational training positions: demand and supply in East and West Germany

### 3.1 West Germany



### 3.2 East Germany



**Source:** Seibert and Wesling (2012) and sources cited there.

**Table 1** Vocational track choice by secondary education and region

|                                      | Vocational |         |         |       |
|--------------------------------------|------------|---------|---------|-------|
|                                      | Track 1    | Track 2 | Track 3 | Total |
| West Germany                         |            |         |         |       |
| No secondary school degree           | 26.0       | 0.7     | 73.3    | 100.0 |
| Lower secondary school degree        | 40.1       | 9.8     | 50.1    | 100.0 |
| Intermediate secondary school degree | 52.5       | 26.6    | 20.9    | 100.0 |
| Upper secondary school degree        | 68.9       | 27.3    | 3.9     | 100.0 |
| East Germany                         |            |         |         |       |
| No secondary school degree           | 28.0       | 0.1     | 71.9    | 100.0 |
| Lower secondary school degree        | 53.7       | 18.2    | 28.1    | 100.0 |
| Intermediate secondary school degree | 51.2       | 43.1    | 5.7     | 100.0 |
| Upper secondary school degree        | 60.6       | 38.3    | 1.1     | 100.0 |

**Note:** Vocational track 1 refers to the apprenticeship system, track 2 is the school based vocational training and track 3 refers to the public transition program. The data on East and West Germany refer to the area states, i.e., the city states of Berlin, Hamburg and Bremen are not included in these data.

**Source:** AB (2012, p.104).

**Table 2** Total and youth unemployment across countries and over time

|             | 1990  |       |       | 2000  |       |       | 2010  |       |       |
|-------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|             | Total | Youth | Ratio | Total | Youth | Ratio | Total | Youth | Ratio |
| Austria     | -     | -     | -     | 3,6   | 5,2   | 1,44  | 4,5   | 8,8   | 1,96  |
| France      | 9,4   | 19,8  | 2,11  | 10,3  | 20,6  | 2,00  | 9,4   | 22,9  | 2,44  |
| Germany     | 4,9   | 4,5   | 0,92  | 7,8   | 8,4   | 1,08  | 7,2   | 9,7   | 1,35  |
| Italy       | 11,5  | 31,5  | 2,74  | 10,6  | 29,7  | 2,80  | 8,5   | 27,9  | 3,28  |
| Netherlands | 7,4   | 11,1  | 1,50  | 3,1   | 6,1   | 1,97  | 4,5   | 8,7   | 1,93  |
| Switzerland | -     | -     | -     | 2,7   | 5,0   | 1,85  | 4,7   | 7,9   | 1,68  |
| UK          | 6,8   | 10,1  | 1,49  | 5,5   | 11,7  | 2,13  | 7,9   | 19,3  | 2,44  |
| USA         | 5,7   | 11,2  | 1,96  | 4,0   | 9,3   | 2,33  | 9,8   | 18,4  | 1,88  |
| EU (21)     | 8,4   | 16,3  | 1,94  | 9,2   | 17,7  | 1,92  | 9,7   | 20,5  | 2,11  |
| OECD        | 6,3   | 12,7  | 2,02  | 6,3   | 12,1  | 1,92  | 8,5   | 16,7  | 1,96  |

**Note:** "Total" reflects the unemployment rate among 15-64 year olds and "Youth" indicates the unemployment rate among 15-24 year olds. Both rates use the definition of the International Labor Office. "Ratio" calculates the ratio of youth in overall unemployment and indicates the relative unemployment incidence for young workers. Figures for 1990 cover only West Germany. Figures for Austria and Switzerland in 1990 are not available.

**Source:** OECD, [stats.oecd.org/Index.aspx](http://stats.oecd.org/Index.aspx) [last access Sept. 11, 2014]

**Table 3** Descriptive Statistics: Dependent and Explanatory Variables by Region

| Dependent (DV) and<br>explanatory Variables   | West Germany |      | East Germany |      | Germany |      |
|-----------------------------------------------|--------------|------|--------------|------|---------|------|
|                                               | Mean         | SD   | Mean         | SD   | Mean    | SD   |
| <b>Panel A</b>                                | <b>N:</b>    | 1306 | 533          |      | 1839    |      |
| DV: Unemployed/out of labor force             | 0,17         | 0,38 | 0,25         | 0,43 | 0,20    | 0,40 |
| DV: Permanent fulltime employed               | 0,48         | 0,50 | 0,40         | 0,49 | 0,46    | 0,50 |
| First sec. School degree: Hauptschule (0/1)   | 0,41         | 0,49 | 0,24         | 0,43 | 0,36    | 0,48 |
| Highest sec. school degree: Hauptschule (0/1) | 0,37         | 0,48 | 0,20         | 0,40 | 0,32    | 0,47 |
| Apprent. & Voc. training degree (0/1)         | 0,74         | 0,44 | 0,79         | 0,41 | 0,76    | 0,43 |
| Track 1: Apprenticeship degree (0/1)          | 0,57         | 0,49 | 0,57         | 0,50 | 0,57    | 0,49 |
| Track 2: Voc. training degree (0/1)           | 0,17         | 0,38 | 0,22         | 0,41 | 0,18    | 0,39 |
| Tertiary education degree (0/1)               | 0,03         | 0,16 | 0,02         | 0,14 | 0,02    | 0,15 |
| Male (0/1)                                    | 0,49         | 0,50 | 0,53         | 0,50 | 0,50    | 0,50 |
| Number of children in household               | 0,38         | 0,71 | 0,36         | 0,63 | 0,37    | 0,69 |
| Migration background (0/1)                    | 0,32         | 0,47 | 0,03         | 0,18 | 0,24    | 0,43 |
| Married (0/1)                                 | 0,27         | 0,44 | 0,12         | 0,32 | 0,22    | 0,42 |
| Served in military/civil service (0/1)        | 0,21         | 0,41 | 0,30         | 0,46 | 0,23    | 0,42 |
| Community size < 20,000 (0/1)                 | 0,43         | 0,50 | 0,53         | 0,50 | 0,46    | 0,50 |
| Community size 20,000-100,000 (0/1)           | 0,32         | 0,47 | 0,20         | 0,40 | 0,29    | 0,45 |
| Community size > 100,000 (0/1)                | 0,25         | 0,43 | 0,27         | 0,44 | 0,26    | 0,44 |
| State-level unemployment rate                 | 8,49         | 2,33 | 17,65        | 2,92 | 11,14   | 4,86 |
| Father vocational training degree (0/1)       | 0,62         | 0,49 | 0,77         | 0,42 | 0,66    | 0,47 |
| Argument with father at age 15 (0/1)          | 0,23         | 0,42 | 0,21         | 0,41 | 0,22    | 0,42 |
| <b>Panel B</b>                                | <b>N:</b>    | 710  | 255          |      | 965     |      |
| DV: Log gross hourly earnings, 2006 prices    | 2,37         | 0,36 | 2,06         | 0,36 | 2,29    | 0,38 |
| First sec. School degree: Hauptschule (0/1)   | 0,40         | 0,49 | 0,19         | 0,39 | 0,34    | 0,47 |
| Highest sec. school degree: Hauptschule (0/1) | 0,34         | 0,48 | 0,15         | 0,36 | 0,29    | 0,46 |
| Apprent. & Voc. training degree (0/1)         | 0,85         | 0,36 | 0,87         | 0,33 | 0,85    | 0,35 |
| Track 1: Apprenticeship degree (0/1)          | 0,65         | 0,48 | 0,65         | 0,48 | 0,65    | 0,48 |
| Track 2: Voc. training degree (0/1)           | 0,19         | 0,39 | 0,22         | 0,42 | 0,20    | 0,40 |
| Tertiary education degree (0/1)               | 0,03         | 0,16 | 0,01         | 0,09 | 0,02    | 0,15 |
| Male (0/1)                                    | 0,56         | 0,50 | 0,60         | 0,49 | 0,57    | 0,50 |
| Number of children in household               | 0,21         | 0,51 | 0,19         | 0,43 | 0,20    | 0,49 |
| Migration background (0/1)                    | 0,31         | 0,46 | 0,02         | 0,15 | 0,23    | 0,42 |
| Married (0/1)                                 | 0,20         | 0,40 | 0,10         | 0,30 | 0,17    | 0,38 |
| Served in military/civil service (0/1)        | 0,21         | 0,40 | 0,33         | 0,47 | 0,24    | 0,43 |
| Public sector (0/1)                           | 0,18         | 0,38 | 0,17         | 0,38 | 0,18    | 0,38 |
| Public sector info missing (0/1)              | 0,04         | 0,20 | 0,07         | 0,26 | 0,05    | 0,22 |
| Tenure                                        | 3,61         | 2,60 | 3,50         | 2,79 | 3,58    | 2,65 |
| Enterprise <20 employees (0/1)                | 0,28         | 0,45 | 0,31         | 0,46 | 0,29    | 0,45 |
| Enterprise 20-199 employees (0/1)             | 0,29         | 0,45 | 0,36         | 0,48 | 0,31    | 0,46 |
| Enterprise 200-1999 employees (0/1)           | 0,17         | 0,38 | 0,11         | 0,32 | 0,16    | 0,37 |
| Enterprise >2000 employees (0/1)              | 0,21         | 0,41 | 0,12         | 0,33 | 0,19    | 0,39 |
| Enterprise empl. info missing (0/1)           | 0,05         | 0,21 | 0,09         | 0,28 | 0,06    | 0,23 |

| <b>Panel B (continued)</b>              | <b>N:</b> | 710  |      | 255   |      | 965   |      |
|-----------------------------------------|-----------|------|------|-------|------|-------|------|
| Occupation ISCO 1 or 2 (0/1)            |           | 0,05 | 0,22 | 0,05  | 0,22 | 0,04  | 0,20 |
| Occupation ISCO 3 or 4 (0/1)            |           | 0,35 | 0,48 | 0,38  | 0,48 | 0,29  | 0,45 |
| Occupation ISCO 5 or 6 (0/1)            |           | 0,16 | 0,36 | 0,16  | 0,37 | 0,15  | 0,36 |
| Occupation ISCO 7 (0/1)                 |           | 0,25 | 0,43 | 0,24  | 0,42 | 0,29  | 0,45 |
| Occupation ISCO 8 or 9 (0/1)            |           | 0,12 | 0,33 | 0,12  | 0,32 | 0,15  | 0,35 |
| Occupation ISCO 0 or missing (0/1)      |           | 0,07 | 0,25 | 0,06  | 0,24 | 0,09  | 0,28 |
| Sector NACE A, B, C (0/1)               |           | 0,01 | 0,12 | 0,01  | 0,12 | 0,02  | 0,12 |
| Sector NACE D (0/1)                     |           | 0,25 | 0,44 | 0,27  | 0,44 | 0,22  | 0,42 |
| Sector NACE F (0/1)                     |           | 0,08 | 0,28 | 0,07  | 0,25 | 0,13  | 0,34 |
| Sector NACE G, I (0/1)                  |           | 0,19 | 0,39 | 0,20  | 0,40 | 0,17  | 0,38 |
| Sector NACE J, K (0/1)                  |           | 0,09 | 0,29 | 0,10  | 0,30 | 0,07  | 0,25 |
| Sector NACE L, M, N, O (0/1)            |           | 0,24 | 0,43 | 0,24  | 0,43 | 0,24  | 0,43 |
| Sector NACE other (0/1)                 |           | 0,03 | 0,17 | 0,03  | 0,16 | 0,04  | 0,18 |
| Sector NACE undefined/missing (0/1)     |           | 0,09 | 0,29 | 0,08  | 0,27 | 0,12  | 0,32 |
| Community size < 20,000 (0/1)           |           | 0,43 | 0,50 | 0,60  | 0,49 | 0,48  | 0,50 |
| Community size 20,000-100,000 (0/1)     |           | 0,33 | 0,47 | 0,18  | 0,38 | 0,29  | 0,45 |
| Community size > 100,000 (0/1)          |           | 0,24 | 0,43 | 0,22  | 0,41 | 0,23  | 0,42 |
| State-level unemployment rate           |           | 8,42 | 2,32 | 17,64 | 2,96 | 10,86 | 4,78 |
| Father vocational training degree (0/1) |           | 0,66 | 0,47 | 0,79  | 0,41 | 0,69  | 0,46 |
| Argument with father at age 15 (0/1)    |           | 0,24 | 0,43 | 0,23  | 0,42 | 0,24  | 0,43 |

**Note:** Panel A presents descriptive statistics for the samples used in the regression of 'unemployment or out of the labor force' and of 'permanent fulltime employment'; Panel B provides descriptive statistics for the samples and covariates used in the hourly earnings regressions.

**Source:** SOEP (2000-2011), own calculations.

**Table 4** Estimation Results: Least Squares for three Outcomes

## 4.1 Outcome: Unemployed or out of the labor force (0/1)

|                              | All<br>(1)           | All<br>(2)           | All<br>(3)           | West<br>(4)          | East<br>(5)       | All<br>(6)          | Training<br>(7)     |
|------------------------------|----------------------|----------------------|----------------------|----------------------|-------------------|---------------------|---------------------|
| Apprent. & Voc.Training      | -0.119***<br>(0.024) | -0.057***<br>(0.022) | -                    | -0.069***<br>(0.025) | -0.007<br>(0.048) | -0.042**<br>(0.022) | -                   |
| Track 1: Apprenticeship      | -                    | -                    | -0.048**<br>(0.022)  | -                    | -                 | -                   | -                   |
| Track 2: Vocational Training | -                    | -                    | -0.087***<br>(0.027) | -                    | -                 | -                   | -                   |
| Lower Sec. School (Highest)  | -                    | -                    | -                    | -                    | -                 | 0.115***<br>(0.020) | -                   |
| Lower Sec. School (First)    | -                    | -                    | -                    | -                    | -                 | -                   | 0.082***<br>(0.021) |
| Individual Characteristics   | no                   | yes                  | yes                  | yes                  | yes               | yes                 | yes                 |
| Regional Characteristics     | no                   | yes                  | yes                  | yes                  | yes               | yes                 | yes                 |
| Year and State FE            | yes                  | yes                  | yes                  | yes                  | yes               | yes                 | yes                 |
| Number of observations       | 1839                 | 1839                 | 1839                 | 1306                 | 533               | 1839                | 1392                |
| R-squared                    | 0.040                | 0.258                | 0.259                | 0.325                | 0.172             | 0.273               | 0.264               |

## 4.2 Outcome: Permanent fulltime employment (0/1)

|                              | All<br>(1)          | All<br>(2)          | All<br>(3)          | West<br>(4)         | East<br>(5)         | All<br>(6)           | Training<br>(7)     |
|------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|----------------------|---------------------|
| Apprent. & Voc.Training      | 0.291***<br>(0.025) | 0.236***<br>(0.025) | -                   | 0.248***<br>(0.029) | 0.217***<br>(0.050) | 0.227***<br>(0.025)  | -                   |
| Track 1: Apprenticeship      | -                   | -                   | 0.243***<br>(0.026) | -                   | -                   | -                    | -                   |
| Track 2: Vocational Training | -                   | -                   | 0.212***<br>(0.034) | -                   | -                   | -                    | -                   |
| Lower Sec. School (Highest)  | -                   | -                   | -                   | -                   | -                   | -0.071***<br>(0.024) | -                   |
| Lower Sec. School (First)    | -                   | -                   | -                   | -                   | -                   | -                    | -0.069**<br>(0.028) |
| Individual Characteristics   | no                  | yes                 | yes                 | yes                 | yes                 | yes                  | yes                 |
| Regional Characteristics     | no                  | yes                 | yes                 | yes                 | yes                 | yes                  | yes                 |
| Year and State FE            | yes                 | yes                 | yes                 | yes                 | yes                 | yes                  | yes                 |
| Number of observations       | 1839                | 1839                | 1839                | 1306                | 533                 | 1839                 | 1392                |
| R-squared                    | 0.095               | 0.185               | 0.186               | 0.198               | 0.194               | 0.189                | 0.172               |

### 4.3 Outcome: Log real hourly gross earnings

|                              | All<br>(1)          | All<br>(2)          | All<br>(3)          | West<br>(4)         | East<br>(5)      | All<br>(6)          | Training<br>(7)   |
|------------------------------|---------------------|---------------------|---------------------|---------------------|------------------|---------------------|-------------------|
| Apprent. & Voc.Training      | 0.165***<br>(0.045) | 0.120***<br>(0.041) | -                   | 0.138***<br>(0.051) | 0.066<br>(0.069) | 0.119***<br>(0.042) | -                 |
| Track 1: Apprenticeship      | -                   | -                   | 0.114***<br>(0.042) | -                   | -                | -                   | -                 |
| Track 2: Vocational Training | -                   | -                   | 0.142***<br>(0.044) | -                   | -                | -                   | -                 |
| Lower Sec. School (Highest)  | -                   | -                   | -                   | -                   | -                | -0.011<br>(0.023)   | -                 |
| Lower Sec. School (First)    | -                   | -                   | -                   | -                   | -                | -                   | -0.020<br>(0.024) |
| Individual Characteristics   | no                  | yes                 | yes                 | yes                 | yes              | yes                 | yes               |
| Regional Characteristics     | no                  | yes                 | yes                 | yes                 | yes              | yes                 | yes               |
| Year and State FE            | yes                 | yes                 | yes                 | yes                 | yes              | yes                 | yes               |
| Number of observations       | 965                 | 965                 | 965                 | 710                 | 255              | 965                 | 824               |
| R-squared                    | 0.232               | 0.418               | 0.419               | 0.355               | 0.401            | 0.418               | 0.443             |

**Note:** Standard errors are heteroscedasticity robust. \*\*\*, \*\*, and \* indicate statistical significance at the 1, 5, and 10 percent level. Individual characteristics comprise indicators for tertiary education, gender, number of children in the household, married, interaction of gender with number of children in the household, interaction of gender with married, migration background, served in the military or substitute civil service, and in the hourly earnings equation additionally public sector employment, public sector information missing, a third order polynomial in tenure, five occupation indicators, seven industry indicators, and four indicators for firm size. Regional characteristics comprise two indicators for community size and the state level unemployment rate.

**Source:** SOEP (2000-2011), own calculations.

**Table 5** Estimation Results: Least Squares for three Outcomes - Heterogeneities**5.1 Results by gender**

|                             | Unemployed or OLF   |                     | Perm. Fulltime Employm. |                     | Log Hourly Earnings |                     |
|-----------------------------|---------------------|---------------------|-------------------------|---------------------|---------------------|---------------------|
|                             | Male<br>(1)         | Female<br>(2)       | Male<br>(3)             | Female<br>(4)       | Male<br>(5)         | Female<br>(6)       |
| Apprent. & Voc.Training     | -0.043<br>(0.029)   | -0.033<br>(0.033)   | 0.223***<br>(0.038)     | 0.238***<br>(0.033) | 0.090<br>(0.057)    | 0.159***<br>(0.054) |
| Lower Sec. School (Highest) | 0.109***<br>(0.025) | 0.124***<br>(0.034) | -0.054<br>(0.035)       | -0.085**<br>(0.034) | 0.003<br>(0.029)    | -0.043<br>(0.040)   |
| Individual Characteristics  | yes                 | yes                 | yes                     | yes                 | yes                 | yes                 |
| Regional Characteristics    | yes                 | yes                 | yes                     | yes                 | yes                 | yes                 |
| Year and State FE           | yes                 | yes                 | yes                     | yes                 | yes                 | yes                 |
| Number of observations      | 926                 | 913                 | 926                     | 913                 | 552                 | 413                 |
| R-squared                   | 0.101               | 0.360               | 0.115                   | 0.266               | 0.435               | 0.481               |

**5.2 Results considering state unemployment interactions**

|                             | Unemployed or OLF    |                      |                     | Perm. Fulltime Employm. |                      |                      | Log Hourly Earnings |                   |                   |
|-----------------------------|----------------------|----------------------|---------------------|-------------------------|----------------------|----------------------|---------------------|-------------------|-------------------|
|                             | (1)                  | (2)                  | (3)                 | (4)                     | (5)                  | (6)                  | (7)                 | (8)               | (9)               |
| Apprent. & Voc.Training     | -0.146***<br>(0.055) | -0.138***<br>(0.053) | -0.140**<br>(0.068) | 0.291***<br>(0.062)     | 0.274***<br>(0.060)  | 0.353***<br>(0.076)  | 0.093<br>(0.108)    | 0.076<br>(0.111)  | 0.123<br>(0.121)  |
| Lower Sec. School (Highest) | 0.117***<br>(0.020)  | 0.117***<br>(0.020)  | 0.120***<br>(0.022) | -0.072***<br>(0.024)    | -0.072***<br>(0.024) | -0.081***<br>(0.026) | -0.010<br>(0.023)   | -0.010<br>(0.023) | 0.004<br>(0.026)  |
| Unemploym.rate in t (U)     | -0.014<br>(0.011)    | -                    | -                   | 0.003<br>(0.013)        | -                    | -                    | 0.002<br>(0.014)    | -                 | -                 |
| Apprent. & Voc.Train.* U    | 0.010**<br>(0.005)   | -                    | -                   | -0.006<br>(0.005)       | -                    | -                    | 0.002<br>(0.008)    | -                 | -                 |
| Youth unemp. in t (YU)      | -                    | -0.023*<br>(0.012)   | -                   | -                       | 0.003<br>(0.015)     | -                    | -                   | -0.003<br>(0.016) | -                 |
| Apprent. & Voc.Train.* YU   | -                    | 0.010*<br>(0.005)    | -                   | -                       | -0.005<br>(0.006)    | -                    | -                   | 0.005<br>(0.010)  | -                 |
| Youth unemp. in t-10 (YU15) | -                    | -                    | -0.015<br>(0.013)   | -                       | -                    | 0.026*<br>(0.015)    | -                   | -                 | 0.002<br>(0.019)  |
| Apprent. & Voc.Train.* YU15 | -                    | -                    | 0.013<br>(0.008)    | -                       | -                    | -0.019**<br>(0.009)  | -                   | -                 | -0.003<br>(0.012) |
| Individual Characteristics  | yes                  | yes                  | yes                 | yes                     | yes                  | yes                  | yes                 | yes               | yes               |
| Regional Characteristics    | yes                  | yes                  | yes                 | yes                     | yes                  | yes                  | yes                 | yes               | yes               |
| Year and State FE           | yes                  | yes                  | yes                 | yes                     | yes                  | yes                  | yes                 | yes               | yes               |
| Number of observations      | 1839                 | 1839                 | 1528                | 1839                    | 1839                 | 1528                 | 965                 | 965               | 788               |
| R-squared                   | 0.275                | 0.276                | 0.275               | 0.190                   | 0.189                | 0.182                | 0.418               | 0.419             | 0.415             |

**Note:** The results are based on specification of column 6 in **Table 4**. We lose a few observations when controlling for state youth unemployment at age 15 because the unemployment rates are not available for the oldest three cohorts in East Germany prior to 1993. The explanatory variable label 'in t' refers to a contemporaneous unemployment measure, the label 'in t-10' indicates that the unemployment rate was measured ten years earlier at age 15 of the individual.

**Source:** SOEP (2000-2011), own calculations.

**Table 6** Estimation Results: IV-Approach for three Outcomes

|                                                                                              | Unemployed or<br>out of labor force | Permanent<br>full employed | Log hourly<br>earnings |
|----------------------------------------------------------------------------------------------|-------------------------------------|----------------------------|------------------------|
| Apprent. & Voc.Training (0/1)                                                                | -0.182<br>(0.149)                   | 0.566***<br>(0.213)        | 0.764**<br>(0.370)     |
| Male (0/1)                                                                                   | 0.010<br>(0.021)                    | 0.062**<br>(0.031)         | 0.089**<br>(0.043)     |
| Married (0/1)                                                                                | 0.125***<br>(0.031)                 | -0.116***<br>(0.036)       | 0.063<br>(0.049)       |
| Married * Male (0/1)                                                                         | -0.129***<br>(0.049)                | 0.158**<br>(0.070)         | 0.016<br>(0.079)       |
| Number of children in household                                                              | 0.262***<br>(0.024)                 | -0.167***<br>(0.029)       | 0.022<br>(0.057)       |
| Number of children in household * Male                                                       | -0.262***<br>(0.032)                | 0.100**<br>(0.043)         | -0.049<br>(0.067)      |
| Served in military/civil service (0/1)                                                       | -0.001<br>(0.022)                   | -0.100***<br>(0.033)       | -0.001<br>(0.035)      |
| Migration background (0/1)                                                                   | 0.009<br>(0.023)                    | 0.015<br>(0.032)           | -0.000<br>(0.030)      |
| Tertiary education degree (0/1)                                                              | -0.076<br>(0.081)                   | 0.053<br>(0.120)           | 0.317**<br>(0.148)     |
| Highest degree lower sec. school (0/1)                                                       | 0.098***<br>(0.027)                 | -0.030<br>(0.036)          | 0.046<br>(0.044)       |
| Community size < 20,000 (0/1)                                                                | 0.010<br>(0.020)                    | 0.032<br>(0.028)           | 0.005<br>(0.029)       |
| Community size > 100,000 (0/1)                                                               | 0.001<br>(0.024)                    | -0.035<br>(0.033)          | -0.025<br>(0.036)      |
| State-level unemployment rate                                                                | -0.005<br>(0.010)                   | -0.004<br>(0.013)          | -0.001<br>(0.015)      |
| Year and State FE                                                                            | yes                                 | yes                        | yes                    |
| Number of observations                                                                       | 1839                                | 1839                       | 965                    |
| First stage coefficient estimates                                                            |                                     |                            |                        |
| Father with AVT                                                                              | 0.0846***<br>(0.0225)               | 0.0846***<br>(0.0225)      | 0.03003<br>(0.0258)    |
| Conflict with father                                                                         | 0.0842***<br>(0.0217)               | 0.0842***<br>(0.0217)      | 0.07008***<br>(0.0253) |
| Test H <sub>0</sub> : instrument uncorrelated with vocational training (underidentification) |                                     |                            |                        |
| 1st stage: F-value (p-value)                                                                 | 15.84 (0.000)                       | 15.84 (0.000)              | 4.97 (0.007)           |
| Test H <sub>0</sub> : instrument correctly excluded (overidentification)                     |                                     |                            |                        |
| Hansen's J statistic (p-value)                                                               | 0.143 (0.705)                       | 0.143 (0.705)              | 1.73 (0.188)           |

**Note:** See **Table 4**; we use the specification of column 6. The specification for log hourly earnings additionally controls for firm size, public sector employment, tenure, occupation and industry indicators. Constant terms are not presented. The first stage models in columns 1 and 2 are identical. The model differs in column three with respect to sample size and model specification.

**Source:** SOEP (2000-2011), own calculations.

**Appendix Table A.1** Prior Literature

| Author(s)               | Publ. Year | Country | Data                                  | Method             | Training Indicator                                                                | Dependent Variable                                                                                                  | Effect                                                                                             |
|-------------------------|------------|---------|---------------------------------------|--------------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| Krueger / Pischke       | 1995       | Germany | SOEP (1988-91)                        | OLS                | Apprenticeship (set of education indicators)                                      | W - log monthly earnings                                                                                            | 15-23 % compared to no voc. training                                                               |
| Winkelmann              | 1996a      | Germany | SOEP (1984-90)                        | Probit, cross-tab  | Apprenticeship graduates vs. graduates from univ., full-time voc. or sec. schools | U - unemployed before first FT job<br>FT - job stability                                                            | sign. negative<br>insign. higher                                                                   |
| Winkelmann              | 1996b      | Germany | SOEP (1984-90)                        | OLS, Poisson       | 4 Types of voc. training (incl. apprenticeships), 2 types of tertiary training    | W - log monthly earnings<br>FT - no. of employer changes                                                            | varies by type of voc. training (15-20 %)<br>reduced by voc. training                              |
| Franz et al.            | 2000       | Germany | SOEP (1984-92);<br>if voc. training   | Prop. hazard       | 4 Types of voc. training (incl. apprenticeships)                                  | U - time until job after voc. training                                                                              | varies by type of vocat. training                                                                  |
| Büchel                  | 2002       | Germany | BIBB/IAB 1991/92;<br>if voc. training | Biv. probit        | 3 cohorts with completed apprenticeships since 1948                               | U - no unemployment at entry, job in occupation                                                                     | sec. schooling matters since 1975                                                                  |
| Clark / Fahr            | 2002       | Germany | IABS 1984-95                          | OLS                | Apprentices vs. non-apprentices with first employment spell before age 20.        | W - earnings within occupation                                                                                      | 15-19 % for degree (2.75 yrs)<br>higher for apprent. and Abitur holders, interactions              |
| Cooke                   | 2003       | Germany | SOEP (1984, 1994)                     | OLS                | in training vs. appr. degree vs. other voc. training                              | W - log wages                                                                                                       |                                                                                                    |
| Fersterer / Winter-Ebm. | 2003       | Austria | Mikrozensus (1981-97)                 | OLS, Quantile Reg. | Apprenticeship vs. voc. school vs. sec. school types vs. university               | W - log hourly wages                                                                                                | apprent./voc.school: 12-17/29-38% relative to compuls.school                                       |
| McIntosh                | 2005       | UK      | LFS (1996-2002)                       | OLS                | completed trade apprenticeship vs. other voc. qualifications                      | W - log hourly wage                                                                                                 | 7 and 0 % return for men and women                                                                 |
| Oosterbeek / Webbink    | 2007       | NL      | Wage structure survey 1995            | DID - OLS          | reform extended duration of voc. training                                         | W - log hourly wage                                                                                                 | no sign. effect of extension of general education                                                  |
| Buchholz / Kurz         | 2008       | Germany | SOEP (1984-02)                        | Exp. hazard, logit | voc. qualification vs. sec. or tert. degree                                       | FT - duration until first employment<br>FT - first job fixed-term contract<br>U - risk of unemploy. after first job | depends on sec school degree<br>less likely if voc. qualification<br>lower with voc. qualification |
| Fersterer et al.        | 2008       | Austria | Admin data (75-98)                    | IV - 2SLS          | duration of apprenticeship, IV=firm failure                                       | W - log annual wage                                                                                                 | IV > OLS, about 3-4 % p.a.                                                                         |
| Malamud / Pop-Eleches   | 2010       | Romania | Census 1992, 2002, hh. surveys 95-00  | OLS and RDD        | vocational vs. general education (reform)                                         | W - log family income, log wage<br>U - unemployed, nonemployed                                                      | insignificant<br>insignificant                                                                     |
| Picchio / Staffolani    | 2013       | Italy   | Admin data (09-12)                    | Logit              | contract: apprentice vs. fixed term                                               | FT - transition to perm. job<br>FT - transit. to perm. job in given firm                                            | sign. higher for apprentices<br>sign. higher for apprentices                                       |

Note: W represents wage, U represents unemployment, and FT represents stable full-time employment