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**Apprenticeship Training and Early Labor
Market Outcomes in East and West Germany**

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Apprenticeship Training and Early Labor Market Outcomes in East and West Germany

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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.

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

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1. Introduction

Youth unemployment is an important social and economic problem 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 determinants of successful labor market entry. In particular, we focus on the relevance of apprenticeships and vocational training (AVT) and investigate their association with three early labor market outcomes: unemployment and inactivity, stable fulltime employment, and wages. We study the case of Germany, which is of particular interest for three reasons: first, its 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 indirectly responsible for Germany's comparatively low rate of tertiary education (OECD 2012a). Second, Germany has an outstanding record with respect to youth unemployment, which has always been low by international comparison. Third, from the perspective of transition economics, a comparison of the East and West German experience is of special interest: although numerous studies investigate the returns to general education in former communist countries (e.g., Andr n et al. 2005, Fleisher et al. 2005, M nich et al. 2005) we know little about vocational training in transition economies. We provide this new perspective by comparing the benefits of vocational training in East and West Germany after reunification.

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 this paper is to contribute to this literature and to address important shortcomings of extant studies that Wolter and Ryan (2011) point to: first, because it is important to define clear reference groups and counterfactuals when evaluating

the returns to AVT, we focus on graduates from secondary schools who are not eligible for tertiary education. In this well defined and homogeneous sample we compare the labor market outcomes of those who attained a vocational training degree with the outcomes of those who did not. Second, because individuals are not randomly allocated to alternative training schemes, it is important to account for this potential endogeneity. Hence, we test the robustness of our key results using an instrumental variables approach. Third, one needs to choose appropriate outcome measures 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 vocational training run a lower risk of non-employment (i.e., of being unemployment or out of the labor force), have a higher chance of being in permanent fulltime employment early on, and earn higher wages than their peers who entered the labor market without investments in their 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 AVT in a period of broadly increasing educational attainment. In contrast to previous studies, we use least squares regressions with rich sets of control variables and are the first to apply instrumental variable estimations for vocational training in Germany in this literature. The results confirm the beneficial effects of AVT for early labor market outcomes, even when the overall labor market situation is dismal.

Thus, undergoing AVT after the completion of general education supports the labor market entry of young workers. Even in times of 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 in the crisis ridden economies of Europe.

2. Institutions and literature

2.1 Institutional background: education system and youth unemployment

We first sketch the German educational system and characterize the options available to high school graduates. We describe the institutional setting for those East and West German birth cohorts who completed secondary school after unification, when the same regulatory framework governed both regions of the country.¹ Finally, we point to regional youth unemployment and its development over time.

German secondary schools use an ability based track system (e.g., Heineck and Riphahn 2009). After typically 4 years in primary school pupils choose at age 10 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.² After unification, all East German states established the upper secondary schools (*Gymnasien*), but in most states lower and intermediate secondary schools were combined in one track (Riphahn and Trübswetter 2012).

Figure 1 shows that the cohort shares attaining upper secondary school degrees (*Abitur*) increased substantially in recent decades. Of the pupils leaving secondary school in

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

² In addition, comprehensive schools (*Gesamtschule*) grant degrees of either track.

2010, about 6 percent had no degree, while 21, 41, and 31 percent graduated from lower, intermediate, and upper secondary school, respectively. In East Germany the share of pupils without a degree (10 percent) and with an upper secondary school degree (36 percent) are slightly higher than in West Germany (STBA 2011).

Once pupils leave secondary school, they can choose different pathways. Those with an upper secondary school degree can take up academic studies.³ 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*).⁴ 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.⁵ 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 degrees.⁶ A third track consists of programs that meet excess demand for vocational training and improve applicants' qualifications (*Übergangssystem*/support system, 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

³ 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 public 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.

⁴ 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 substantially across occupations and regions.

⁵ Gericke et al. (2011) show that as of 2009 roughly 54 percent of all 18-21 years olds entered the dual apprenticeship system.

⁶ In addition, there is a system of civil servants' training, which is of small magnitude.

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 degrees. Most students who complete the third track continue their training with an apprenticeship (see also Franz et al. 2000). The dropout rate from AVT remains at below 20 percent is highest in the first year (AB 2012).

Figure 2.1 describes the distribution of entry cohorts across the three vocational training tracks. In 2002 and 2003 the third track covered more than forty percent of all entries to vocational training. We find regional differences with West Germans using the third track and East Germans using second track training more frequently (see **Figure 2.2**). In both regions, vocational track choice is correlated with secondary school attainment (see **Table 1**): those with lower 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.⁷ AB (2012) show that the supply-demand ratios for vocational training positions also 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). **Figure 4** shows the distribution of labor force states of 20 years olds over time and by region: the population share in education or training has increased substantially and that in employment without training declined. For most years the share of unemployed in East Germany is larger than in West Germany.

⁷ Bogai et al. (2008) and Seibert and Wesling (2012) document the commuting activity of young East Germans and its recent decline, which reflects the tightness of the East German market for training positions.

Table 2 indicates that one year after completing training about 61 and 73 percent of the East and West German graduates are in regular employment. The share of the unemployed is generally twice as high in East than 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 apprenticeship systems (e.g., Austria and Switzerland) enjoy low youth unemployment (OECD 2012b). **Table 3** presents the ratio of youth to total unemployment for selected countries; the low ratios for Germany confirm the comparatively positive situation for German youths. **Figure 5** presents East and West German youth unemployment since 1991: unemployment rates in East Germany always exceed West German levels; however, both rates came down since 2005 in spite of the recession of 2009.

2.2 Prior literature and research questions

Ryan (2001) summarizes the literature on school-to-work transitions and concludes that AVT increase employment prospects for participants. Interestingly, he suggests that societal commitment to youth employment determines the success of schemes, such as those in Japan and Germany. More recently, Wolter and Ryan (2011) summarize the empirical literature on apprenticeships and discuss four challenges for research on individual benefits from apprenticeships: (i) the precise definition of counterfactual treatments, (ii) controls for unobserved heterogeneity and self-selection, (iii) the relevance of occupation-specific factors, and (iv) the choice of relevant outcomes such as employment, unemployment, and pay. In addition, the authors point out that as most empirical studies do not consider social or private costs of apprenticeship training, they hardly offer comprehensive evaluations. The authors

emphasize two key findings: apprenticeships smooth school-to-work transitions, yet their economic returns are heterogeneous.

As a recent example of this literature, Fersterer et al. (2008) use closures of small firms in Austria to identify the causal effect of apprenticeship training. They find significant positive wage returns to additional years of apprenticeship training, which hardly differ between least squares and instrumental variable estimators. In contrast, Malamud and Pop-Eleches (2010) and Oosterbeek and Webbink (2007) find no positive wage returns; for identification they use natural experiments which extended the duration of general schooling during vocational training. McIntosh (2005) studies the returns to apprenticeship degrees in the U.K.. He uses least squares methods and finds positive returns for men but not for women.

While many researchers study apprenticeships in Germany, few actually evaluate the returns to AVT as such.⁸ Among the few authors addressing the returns to and benefits of vocational training are Winkelmann (1996a, 1996b), Cooke (2003), and Buchholz and Kurz (2008). All use data from the German Socioeconomic Panel but focus on different periods.⁹

Cooke (2003) does not find clear and general wage benefits among those with completed apprenticeships. However, his sample combines all males aged 18-29 in either 1984 or 1994 who had completed any of the West German secondary school tracks and who may then have pursued rather different educational and labor market careers. In contrast, Winkelmann (1996b) finds wage returns to apprenticeships of 15-20 percent, and even higher returns to vocational training degrees for West German respondents in the late 1980s.

⁸ 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 2004, von Wachter and Bender 2006, Göggel and Zwick 2012) or focus on youths failing in the vocational training system (Franz et al. 2000), or on time trends in apprenticeship transitions (Büchel 2002).

⁹ Ferster and Winter-Ebmer (2003) investigate returns to education for Austria. Using cross-sectional data they obtain returns to different vocational degrees for the years 1981-1997. The wage returns to apprenticeship degrees are between 13 and 17 percent, whereas vocational schools yield rates of up to 35 percent.

The other two papers look at non-employment or the duration until a first job is found, job stability, the propensity to take up fixed-term employment, and labor market transitions. The conclusions with respect to the returns to AVT are mixed: Winkelmann (1996a) confirms smoother labor market entry for those with apprenticeship degrees compared to a mixed reference group of graduates from university, vocational schools, or secondary schools. Apprentices who were trained in large firms have the lowest risk of unemployment. Buchholz and Kurz (2008) also use heterogeneous reference groups; they analyze the duration until first employment and the risk of unemployment after a first job. Among graduates of basic schools those without vocational degrees perform worst. - Overall, we have little precise information on the benefits of completing vocational degrees. We contribute to this literature by applying more recent data, larger samples, and by addressing the endogeneity of vocational training.

Three other issues are of interest for our analysis. First, some authors investigate whether AVT in general can balance the labor market disadvantages of those with only lower track secondary schools degrees. For example, Büchel (2002) looks at labor market entries prior to 1992 and concludes that over time the dual education system lost the ability to compensate for deficits in general education. We investigate this issue with more recent data.

A second issue also concerns changes over time: as increasing population shares obtained upper secondary school qualifications, the signal value of the other secondary school and vocational degrees declined over time (see **Figure 1**), and the return to vocational training may have fallen. Also, Buchholz and Kurz (2008) expect worsening labor market entry conditions since the mid 1980s because of rising unemployment and more labor market flexibility at the expense of the young. The authors expect worse opportunities in East than in West Germany and for women compared to men. They find increasing duration until labor market entrants find a first job, a rising incidence of unemployment and fixed-term contracts, and less stable careers. We follow up on the possibly changing returns to vocational training over time and compare the outcomes for the birth cohorts 1975 through 1986.

As a third and final issue, the East-West comparison has not gathered much attention in the extant German literature on the returns to vocational training. Except for Buchholz and Kurz (2008) none of the cited studies investigated labor market entrance in East Germany after unification. In section 2.1 we illustrated that youth unemployment is higher in East than in West Germany and that the second, school-based track of vocational training is more frequent in East than in West Germany. It thus seems plausible to expect that the ongoing labor market problems in East Germany also limit the opportunities of new labor market entrants and possibly attenuate the returns to human capital investments there. Generally, the literature on labor market entry in transition economies is limited and does not address returns to vocational training (see, e.g., Audas et al. 2005, Bukodi 2008 or Täht et al. 2008). By evaluating returns to vocational training in East and West Germany we contribute to fill this gap in the literature.¹⁰

Based on this review of the literature, we address the following research questions in our analyses: what are the returns to vocational training at labor market entry; do returns vary by type of vocational training; can vocational training compensate disadvantages from secondary schooling; do returns differ between East and West Germany; are returns to vocational training falling over time; are the outcomes robust to controls for endogenous selection into vocational education.

3. Data and empirical approach

3.1 Data

We use the 2000-2011 annual waves of the German Socioeconomic Panel (SOEP), a household survey which allows us to study individual educational careers and labor market

¹⁰ Krueger and Pischke (1995) compare the 1988 labor markets in East and West Germany, i.e., before unification. In their two regional samples about 60 percent of both East and West Germans held apprenticeship degrees and the returns to the degrees were 14 percent in communist East Germany and 19 percent in the West German market economy. In their analysis of post-unification labor markets they do not present returns to vocational degrees.

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 because they completed secondary education after German unification in 1990. We consider only those who initially graduated with a degree 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).¹¹ 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 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).

We consider three labor market outcomes at age 25. (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.¹² (b) Permanent fulltime job, i.e., whether a person works fulltime and holds a job with at least one year of tenure with the same employer. (c) The wage rate of all those who are fulltime employed; we use real (2006) log hourly gross wages.

Table 4 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-

¹¹ 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.

¹² 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.

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 wages, individuals in East Germany trail their West German peers on average by 0.3 log points (2.4 vs. 2.1).

Table 4 describes our explanatory variables. Our main variables of interest are indicators for completed AVT, which we consider, both, in combination and separately. The apprenticeship indicator refers to the first track of the vocational training system. The vocational training indicator combines various formats of school based second track training. In our sample 76 percent of youths completed an AVT degree with little difference between East and West Germany.¹³ About one quarter of those with AVT degrees indicated to have a degree from the second track of vocational training.¹⁴

The other independent variables in the multivariate analyses consider individual and regional characteristics that may affect estimates of the returns to AVT. The first group comprises gender, marital status, the number of children in the household, the highest secondary schooling degree completed, migration background, an indicator for having served in military or civil service, and for tertiary education. East and West Germany differ in the secondary school degrees attained; the share of youths with lower secondary school (*Hauptschule*) as their highest secondary school degree 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 4**). Also, the share of married individuals is higher in West Germany. More East than West German youths, mostly males, report to have served in the military or have opted for civil service.

As indicators for regional disparities we consider community size and regional unemployment. More than half of East German youths reside in small towns with fewer than

¹³ Similar to Winkelmann (1996b), we refrain from using information on apprenticeship dropout because the survey yields incomplete information on this issue.

¹⁴ 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 appears to be innocuous.

20,000 inhabitants compared to only 43 percent in West Germany. The state unemployment rate is substantially higher in East than West Germany (about 17 vs. 8 percent). In addition, all estimation models control for year and federal state fixed effects.¹⁵ In the wage equation we additionally control for tenure, public sector, and firm size. Panel B of **Table 4** presents descriptive statistics for covariates used in the wage regressions.

3.2 Empirical Approach

We use linear regressions to analyze the relevance of AVT degrees for early labor market outcomes. As the coefficient estimates might be biased because of measurement error and the endogeneity of training, we additionally turn to an instrumental variables (IV) approach. Similarly, Fersterer et al. (2008) apply IV to identify the causal effect of apprenticeship training. They find little difference between least squares and IV estimates and obtain an overall wage return of about 15 percent to a completed apprenticeship in Austria.

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 15.¹⁶ 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 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 an AVT. We argue that the two indicators do not directly influence labor market outcomes at age 25 and are thus uncorrelated with the respective error terms.

¹⁵ Since we look at 25 years olds in every survey year, our year fixed effects jointly reflect calendar year and birth cohort effects.

¹⁶ 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.

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 generates 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. They suggest that father's education is a viable option to address the endogeneity problem with regard to education.

4. Results

4.1 Linear Regression Results

Tables 5.1-5.3 present the estimation results for three outcomes: being unemployed or out of the labor force, holding a stable permanent job, and real hourly log wage 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 AVT degree for the three outcomes. The coefficient is always statistically highly significant and indicates a beneficial correlation between AVT and labor market entry: the probability of being unemployed or out of the labor force at age 25 is 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 wages in fulltime employment are about 17 percent higher among those who hold a vocational training degree. The magnitude of the effect on wages 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.

Next we investigate whether the returns to apprenticeships (first track) and school based vocational training (second track) differ. We present the basically unconditional results for the two indicators in column 2. The coefficient estimates for the two training measures do not differ significantly and there is no clear order in the returns to the two degrees: school-based vocational training yields slightly larger coefficients in **Tables 5.1** and **5.3**, while apprenticeships dominate with respect to finding a permanent fulltime job (**Table 5.2**). We tested the equality of the coefficients with and without control variables and could not reject the hypothesis that the coefficients are identical (results available upon request); 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. Based on our results, we use a joint indicator of AVT for the remainder of our analysis.

The estimation results in columns 3 and 4 of **Table 5** 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 vocational training are smaller in magnitude and less precise for the East German subsample particularly in **Table 5.1**. 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 AVT both with and without control variables; these interaction terms never yielded statistically significant coefficient estimates. Therefore we conclude that AVT are associated with improved early labor market outcomes in East and West Germany.¹⁷

In columns 5 and 6 of **Table 5** we add control variables that account for potential individual and regional heterogeneities. The correlation patterns between AVT degrees and

¹⁷ We tested the hypothesis that there are different time trends in the returns to AVT in East and West Germany. This hypothesis was rejected, as well.

early labor market outcomes are now somewhat attenuated, but remain economically and statistically highly significant.¹⁸

Following Büchel (2002) we test whether completing an AVT degree can compensate labor market relevant deficits from secondary education. Columns 5 and 6 of **Table 5** show that those with only lower secondary school degrees as their highest degree do worse in the labor market compared to those with higher degrees. In column 7 we restrict the sample to those who obtained AVT degrees: all three panels of **Table 5** confirm that even in this subsample those who initially obtained only lower secondary education still have worse labor market outcomes at age 25. Thus, AVT does not generally compensate disadvantages generated by initial secondary education.

Finally, we are interested in the development of returns to AVT over time. Column 8 of **Table 5** presents the estimated coefficients of a time interaction term for AVT, which measures the heterogeneity in returns across the eleven birth cohorts in our sample. The coefficients confirm that the beneficial correlation of vocational training with labor market outcomes declined over time; however, the coefficients of the interaction terms are imprecise and small in magnitude, suggesting that those with AVT and born in 1975 had a return to training of, e.g., 6.5 (29.4) percentage points with respect to non-employment (permanent fulltime employment) compared to 2.1 (17.3) percentage points among those born in 1986. The coefficient of the time interaction effect in the wage regression is positive, small, and insignificant. Therefore, the benefit of AVT did not decline with respect wages.

4.2 Robustness and effect heterogeneity

¹⁸ Clearly, the selection into fulltime employment may bias the estimates of wage returns of AVT. In contrast to most of the literature which ignores this problem, we follow Arcidiacono et al. (2010) and Neal and Johnson (1996) to provide a non-rigorous evaluation of the selection effect: we assign observations with missing wage observations zero wages and estimate median regressions on the full sample. As in these prior studies, the coefficient estimates differ when the full sample is used. Instead of 15.8 percent as in column 6 of **Table 5.3**, we now obtain highly significant wage returns of 11 percent. This confirms the strongly beneficial association of AVT with wages.

To study heterogeneities in the returns to AVT, we provide additional tests along three dimensions. First, we compare the returns to AVT for males and females. Second, we study the labor market sensitivity of the returns to AVT, and third, we evaluate the heterogeneity of wage returns for different occupations, industries, and employer sizes.

So far, we considered gender main effects and interaction terms of marital status and gender to account for heterogeneous labor market outcomes of males and females. The estimated 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 earn higher wages than females. If we add interaction terms of gender with AVT to the specification in column 6 of **Table 5**, the resulting estimates are small and insignificant for all three dependent variables. **Table 6.1** shows separate estimates for males and females using the specification of column 6 of **Table 5**. We find small differences in the returns to AVT by gender for the first two outcome variables and a larger difference in wage returns, where female returns are about 50 percent larger than those of men. This difference is robust to adding controls for industry and occupation (results are not shown and available upon request). Overall, the beneficial correlation of AVT degrees holds for both genders.¹⁹ This confirms the evidence of Fersterer and Winter-Ebmer (2003) for Austria.²⁰

In column 6 of **Table 5** we controlled for state unemployment measured contemporaneously with the dependent variables. We now modify this approach in various respects. First, we add an interaction of the AVT indicator with an indicator for East German residence to test whether the returns differ between the East and West German labor markets which are characterized by different unemployment rates (results are available upon request). We find no significant differences in returns between the two regions. Next, we add an

¹⁹ So far, we have not considered experience in our wage regression because of the homogeneous sample construction. However, once a third order polynomial in experience is included the overall wage return to AVT drops from 0.158 to 0.134. Also, the gender difference in wage returns to AVT increases when experience is considered: the coefficient for males drops to 0.099 and the one for females declines to 0.190. Both point estimates continue to be statistically significant.

²⁰ Cooke (2003) and Winkelmann (1996b), who use German data, only consider males.

interaction term between the current state unemployment rate and AVT (see columns 1, 4, and 7 of **Table 6.2**). Not surprisingly, this yields significant coefficient estimates for the outcome 'currently unemployed or out of the labor force': the return to AVT with respect to current unemployment is significantly lower when unemployment is high, but it remains positive. The return to AVT with respect to the other two dependent variables 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 6.2**). Thus, the current labor market situation does not affect the benefits of AVT.²¹

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 AVT ten years later, at age 25 (see columns 3, 6, and 9 of **Table 6.2**). We find no significant coefficient estimate of the interaction terms in the unemployed or out of the labor force and the wage equations, but for the permanent fulltime employment outcome.²² The point estimates (see column 6 of **Table 6.2**) suggest that the beneficial effect of completed AVT at age 25 is significantly lower if the (youth) unemployment rate at age 15 was high. This surprising result may suggest a selection of youths commencing their AVT in times of high unemployment, i.e., that they are less likely to enter permanent fulltime employment compared to youth starting AVT in less difficult times. Alternatively, the long-term benefit of AVT 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 AVT positions offered: in these years firms face particular social pressure to offer AVT positions even though they may not foresee a demand for trained workers

²¹ 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 as contradictory as it seems at first glance.

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

subsequently.²³ Importantly, however, the returns to AVT degrees 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). Although we find that the wage returns to AVT vary by occupation, industry, and employer size, the coefficients of the interaction terms of AVT with occupation, industry, or employer size indicators are jointly not significantly different from zero (results available upon request).

4.3 Results of Instrumental Variables Regressions

Since selection into AVT is not random and because the unobservables affecting this choice may be correlated with early labor market outcomes, least squares regression results provide biased estimates of the causal effects of vocational training. Typical approaches to identify causal returns to vocational training use quasi or natural experiments generated by policy reforms or firm failures (Fersterer et al. 2008, Malamud and Pop-Eleches 2010, or Oosterbeek and Webbink 2007). As we cannot take advantage of similar experiments, we apply an instrumental variables approach. We assume that our two instruments are not correlated with the conditional error term in the models of our three outcome measures and that the causal effect of interest is homogeneous. If these assumptions hold, our IV estimates may be more reliable than the least squares regression coefficients and the former might be indicative of the causal effects of vocational training. We use two instruments: one indicates

²³ Ryan (2001) argued that societal commitment to youth employment is key to explain the success of the apprenticeship systems in Japan and Germany.

whether the father of the individual holds a vocational degree and the other indicates the presence of family conflicts during adolescence.²⁴

Table 7 shows the results of the full specification as in column 6 of **Table 5** using instrumental variables regressions for the three outcome variables. The two instruments are highly statistically significant in the first stage regressions for the first two outcomes, where the first stage F-statistics take on values of over 15. In the case of the wage regression the first stage F-value reaches only 5.4 which suggests that the IV estimates are most likely not reliable here. We also test the overidentifying restrictions, i.e., that the instruments are uncorrelated with the main equations' error terms: the null hypothesis is not rejected, which supports our approach. Again, the test result is weakest in the case of the wage regression. 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 those in column 6 of **Table 5** the estimates at least double in size for the first two dependent variables and jump to 0.822 in the wage regression. The IV point estimate in the non-employment equation is insignificant, the other two equations' estimates are precise. Overall, the instrumental variables approach confirms that AVT yield large beneficial effects for early labor market outcomes.

5. Conclusions

This paper studies the returns to apprenticeship and vocational training (AVT) for three dimensions of labor market entry: being unemployed or out of the labor force, being in permanent fulltime employment, and fulltime wages, all at age 25. We focus on individuals

²⁴ We evaluated the validity of a large number of potential instruments for these estimations. 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 all of them to the data for the period when the youth was aged 15, 16, or 17 years old.

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 recent evidence and addressing shortcomings of prior studies: the lack of clearly defined reference groups, the neglect of the endogeneity of the central variable, and the selection of outcome measures. In contrast to prior studies we also apply instrumental variable regression estimation to vocational training outcomes in Germany.

We estimate the returns to AVT at labor market entry, study their heterogeneity across different types of training, test whether AVT 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 AVT fall over time. Our results confirm the highly beneficial effects of AVT. 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. Instrumental variables regressions suggest that least squares results are downward biased and possibly attenuated by measurement error. The returns to AVT with respect to permanent fulltime employment and wages are robust to the contemporaneous labor market situation. We find that past unemployment affects the returns to AVT with respect to permanent fulltime employment, however, these returns are large and positive even if past unemployment was high.

It is not trivial to newly establish vocational training systems in countries where they do not yet exist. 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 AVT now, may encourage other countries to establish comprehensive vocational education systems. In addition, the return to AVT in the German

labor market with its sizeable supply of well trained workers may represent a lower bound to the return to AVT 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 AVT systems that support young school leavers in the process of labor market entry.

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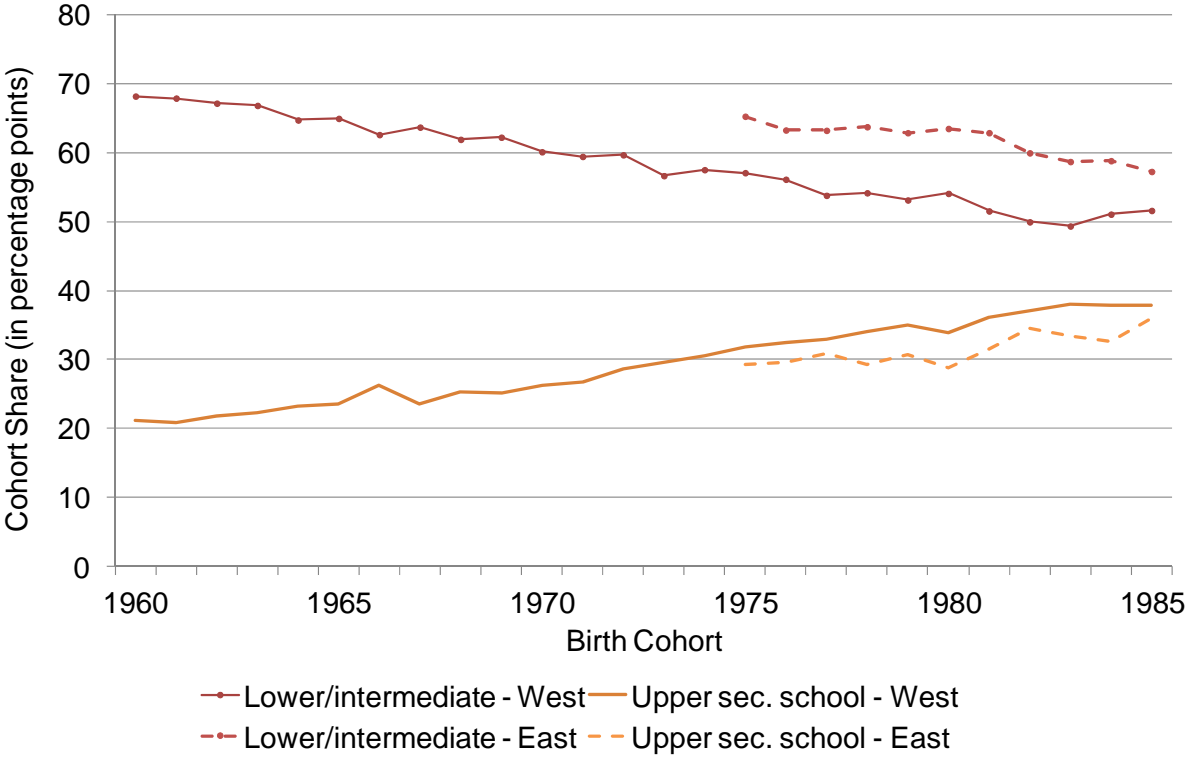
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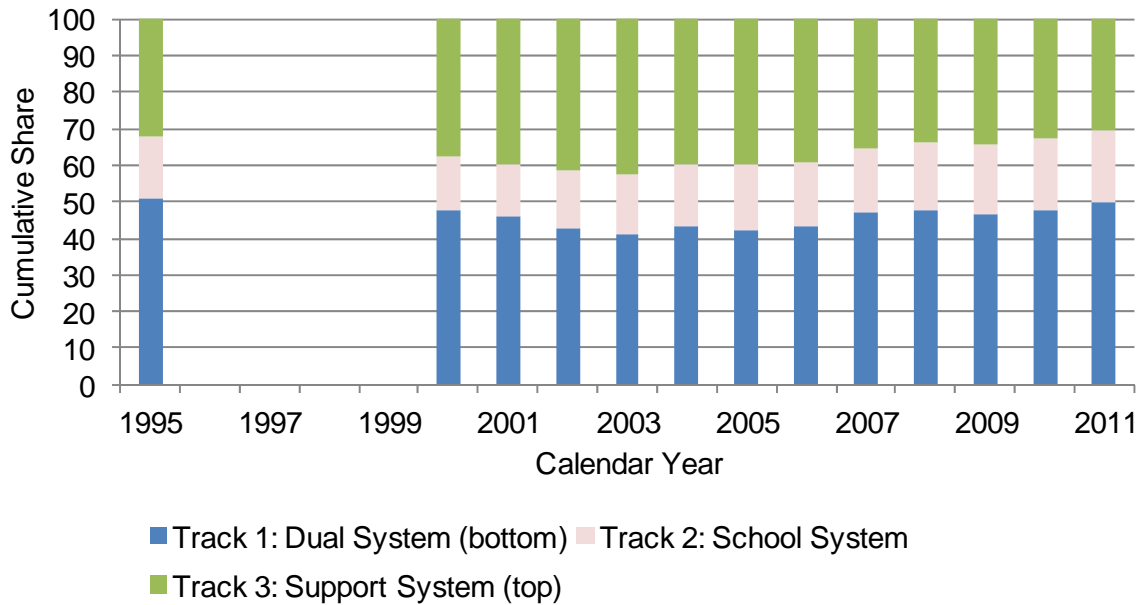
Figure 1 Secondary school educational attainment in East and West over time



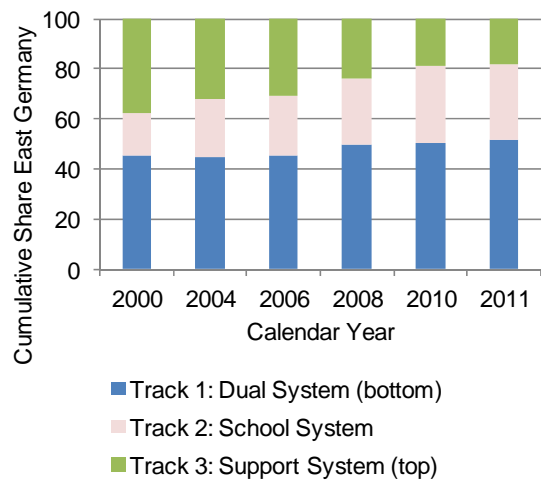
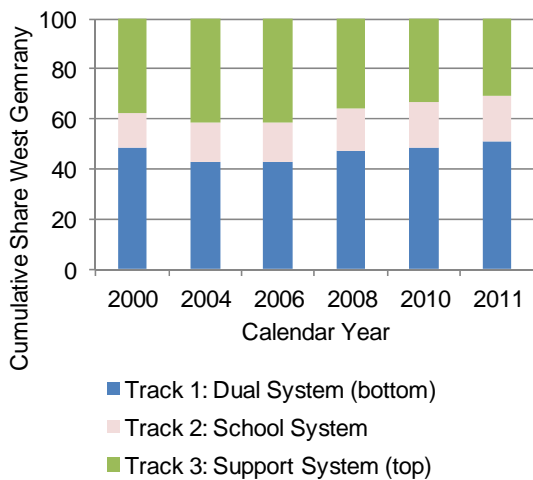
Source: German Mikrozensus 2007, own calculations.

Figure 2 Entries to Vocational Training by Track and Year

2.1 Germany



2.2 West and East Germany in selected years

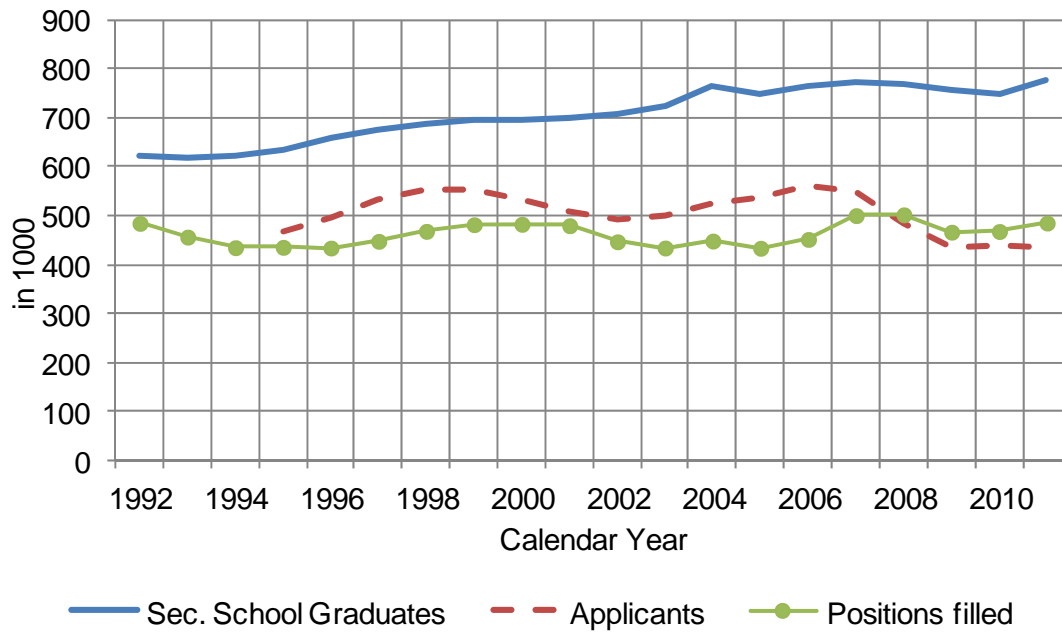


Note: Information for the years prior to 1995 and 1996-1999 is not available.

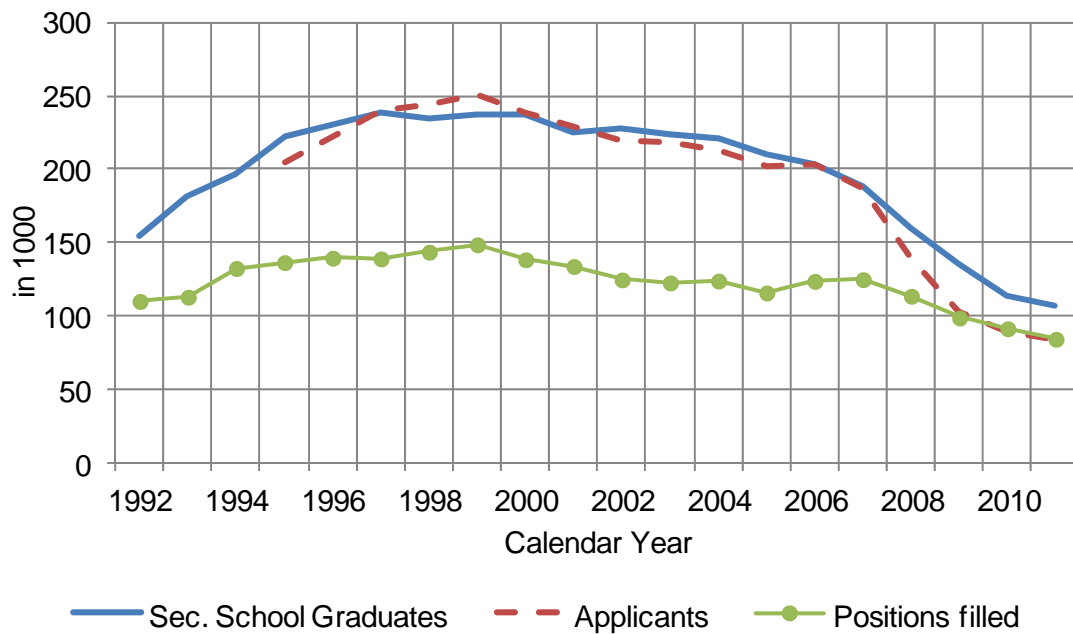
Source: Konsortium Bildungsberichterstattung (2006), AB (2010, 2012).

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

3.1 West Germany

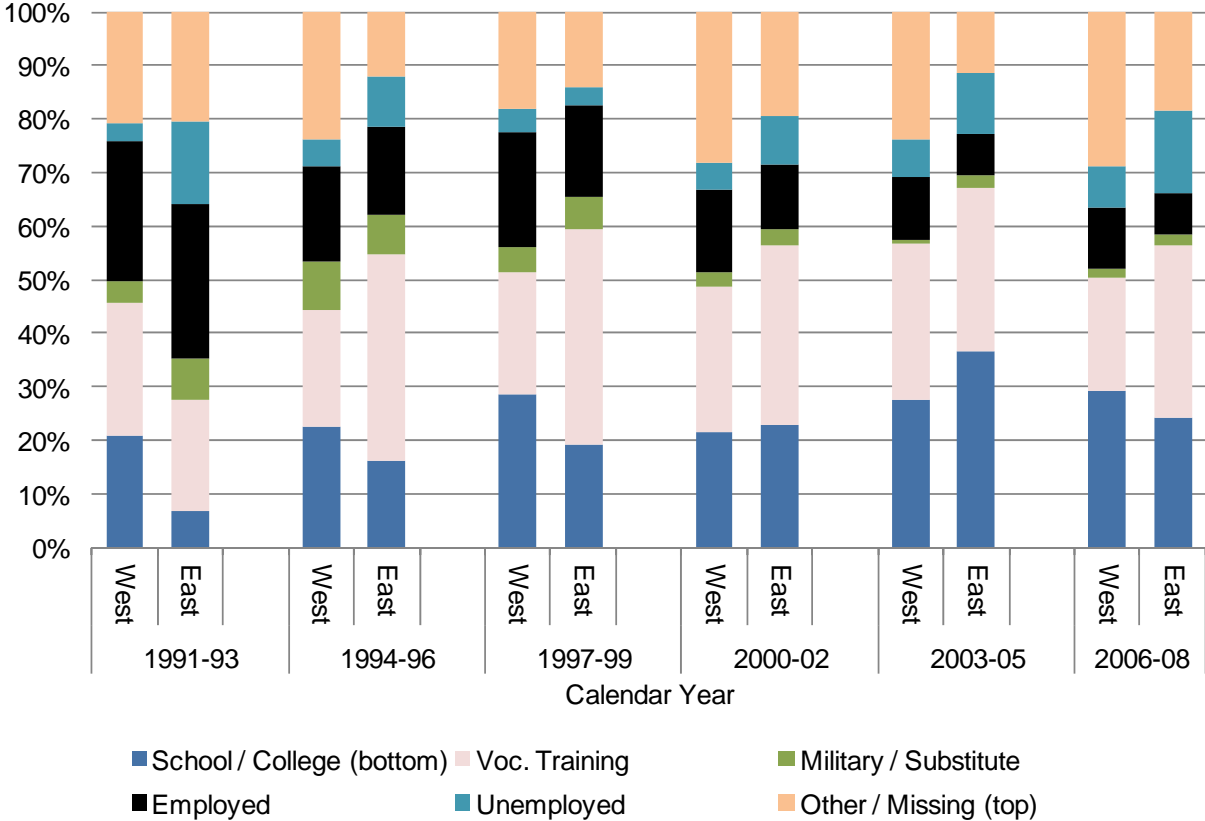


3.2 East Germany



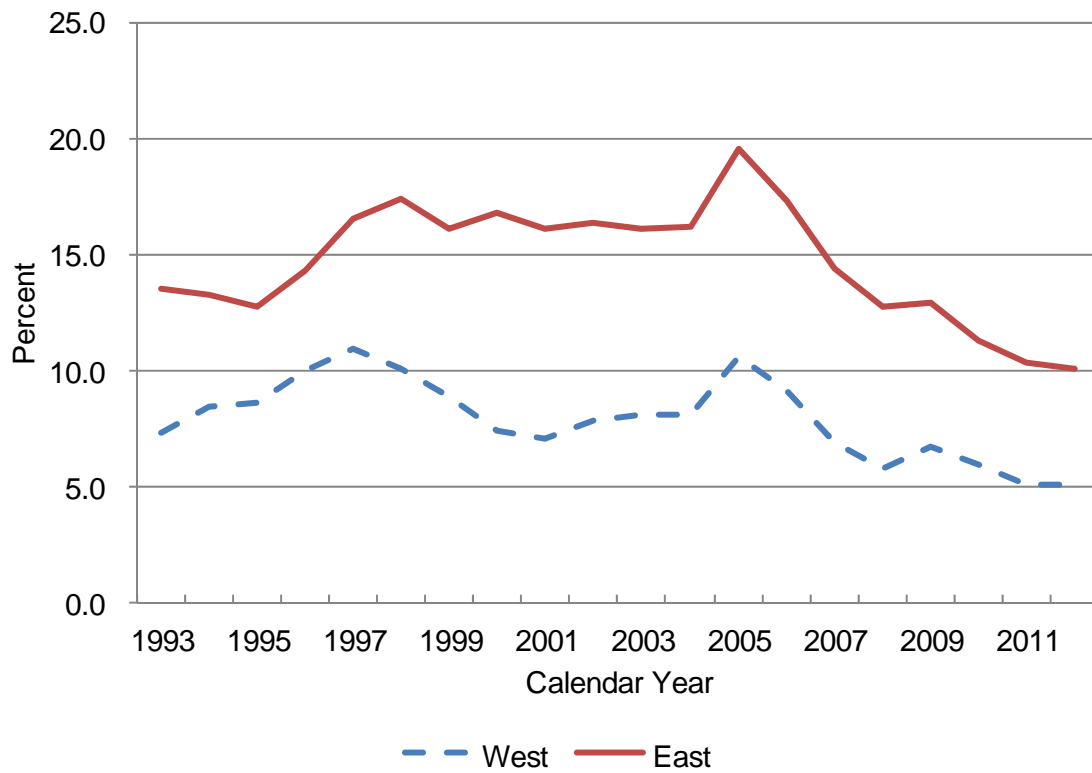
Source: Seibert and Wesling (2012) and sources cited there.

Figure 4 Labor force status of 20 years olds in East and West Germany over time



Source: SOEP (1990-2009), weighted data.

Figure 5 Youth unemployment rates in East and West Germany (age 15-25)



Source: Federal Unemployment Office.

Table 1 Vocational track choice by secondary education and region

	Vocational			Total
	Track 1	Track 2	Track 3	
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 support system. 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 Labor force status of vocational training graduates by time since graduation in 2006 and 2008 by region

Months after Training	All	Full-time / Part-time employment	Minor employment	Unemployed	Unknown
West 2006					
1	100	65.7	4.6	24.3	5.4
12	100	73.3	4.3	9.7	12.7
36	100	70.2	5.6	8.0	16.2
East 2006					
1	100	47.6	5.5	42.6	4.4
12	100	60.9	4.1	20.9	14.1
36	100	62.3	5.3	16.9	15.5
West 2008					
1	100	72.9	3.7	16.8	6.7
12	100	72.9	4.5	8.9	13.8
East 2008					
1	100	57.7	4.6	32.3	5.4
12	100	63.4	3.9	17.7	14.9

Source: AB (2012, Tab. E5-4A and Tab E5-11web).

Table 3 Total and youth unemployment across countries and over time

	1990			2000			2010		
	Total	Youth	Ratio	Total	Youth	Ratio	Total	Youth	Ratio
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
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	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 are based on 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.

Source: OECD, stats.oecd.org/Index.aspx [last access Jan. 2, 2012]

Table 4 Descriptive Statistics: Dependent and Explanatory Variables by Region

Dependent (DV) and explanatory Variables	West Germany		East Germany		Germany	
	Mean	SD	Mean	SD	Mean	SD
Panel A	N:	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
Panel B	N:	710		255		965
DV: Log gross hourly wage, 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
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 wage regressions.

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

Table 5 Estimation Results: Least Squares for three Outcomes

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

	All (1)	All (2)	West (3)	East (4)	All (5)	All (6)	Training (7)	All (8)
Apprent. & Voc.Training	-0.119*** (0.024)	-	-0.135*** (0.028)	-0.053 (0.049)	-0.042** (0.022)	-0.042** (0.022)	-	-0.065 (0.043)
Track 1: Apprenticeship	-	-0.112*** (0.025)	-	-	-	-	-	-
Track 2: Vocational Training	-	-0.141*** (0.030)	-	-	-	-	-	-
Lower Sec. School (Highest)	-	-	-	-	0.116*** (0.020)	0.115*** (0.020)	-	0.115*** (0.020)
Lower Sec. School (First)	-	-	-	-	-	-	0.082*** (0.021)	-
Apprent. & Voc.Train. * Time	-	-	-	-	-	-	-	0.004 (0.006)
Individual Characteristics	no	no	no	no	yes	yes	yes	yes
Regional Characteristics	no	no	no	no	no	yes	yes	yes
Year and State FE	yes	yes	yes	yes	yes	yes	yes	yes
Number of observations	1839	1839	1306	533	1839	1839	1392	1839
R-squared	0.040	0.041	0.044	0.061	0.273	0.273	0.264	0.273

5.2 Outcome: Permanent fulltime employment (0/1)

	All (1)	All (2)	West (3)	East (4)	All (5)	All (6)	Training (7)	All (8)
Apprent. & Voc.Training	0.291*** (0.025)	-	0.311*** (0.029)	0.232*** (0.047)	0.228*** (0.025)	0.227*** (0.025)	-	0.294*** (0.048)
Track 1: Apprenticeship	-	0.300*** (0.026)	-	-	-	-	-	-
Track 2: Vocational Training	-	0.259*** (0.034)	-	-	-	-	-	-
Lower Sec. School (Highest)	-	-	-	-	-0.067*** (0.024)	-0.071*** (0.024)	-	-0.069*** (0.024)
Lower Sec. School (First)	-	-	-	-	-	-	-0.069** (0.028)	-
Apprent. & Voc.Train. * Time	-	-	-	-	-	-	-	-0.011 (0.007)
Individual Characteristics	no	no	no	no	yes	yes	yes	yes
Regional Characteristics	no	no	no	no	no	yes	yes	yes
Year and State FE	yes	yes	yes	yes	yes	yes	yes	yes
Number of observations	1839	1839	1306	533	1839	1839	1392	1839
R-squared	0.095	0.096	0.101	0.093	0.186	0.189	0.172	0.190

5.3 Outcome: Log real hourly gross wages

	All (1)	All (2)	West (3)	East (4)	All (5)	All (6)	Training (7)	All (8)
Apprent. & Voc.Training	0.165*** (0.045)	-	0.177*** (0.053)	0.138 (0.085)	0.158*** (0.042)	0.158*** (0.042)	-	0.138* (0.081)
Track 1: Apprenticeship	-	0.162*** (0.046)	-	-	-	-	-	-
Track 2: Vocational Training	-	0.177*** (0.048)	-	-	-	-	-	-
Lower Sec. School (Highest)	-	-	-	-	-0.021 (0.025)	-0.022 (0.025)	-	-0.022 (0.024)
Lower Sec. School (First)	-	-	-	-	-	-	-0.037 (0.023)	-
Apprent. & Voc.Train. * Time	-	-	-	-	-	-	-	0.003 (0.015)
Individual Characteristics	no	no	no	no	yes	yes	yes	yes
Regional Characteristics	no	no	no	no	no	yes	yes	yes
Year and State FE	yes	yes	yes	yes	yes	yes	yes	yes
Number of observations	965	965	710	255	965	965	824	965
R-squared	0.232	0.232	0.136	0.135	0.363	0.363	0.384	0.363

Note: Standard errors are heteroscedasticity robust. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent level. Individual characteristics comprise an indicator 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, married, served in the military or substitute civil service, and in the wage equation additionally public sector employment, public sector information missing, a third order polynomial in tenure, 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 6 Estimation Results: Least Squares for three Outcomes - Heterogeneities

6.1 Results by gender

	Unemployed or OLF		Perm. Fulltime Employm.		Log wage	
	Male (1)	Female (2)	Male (3)	Female (4)	Male (5)	Female (6)
Apprent. & Voc.Training	-0.043 (0.029)	-0.033 (0.033)	0.223*** (0.038)	0.238*** (0.033)	0.133** (0.056)	0.199*** (0.054)
Lower Sec. School (Highest)	0.109*** (0.025)	0.124*** (0.034)	-0.054 (0.035)	-0.085** (0.034)	0.014 (0.031)	-0.108*** (0.039)
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	0.387	0.427

6.2 Results considering state unemployment interactions

	Unemployed or OLF			Perm. Fulltime Employm.			Log Wage		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Apprent. & Voc.Training	-0.146*** (0.055)	-0.138*** (0.053)	-0.131** (0.058)	0.291*** (0.062)	0.274*** (0.060)	0.369*** (0.066)	0.153 (0.111)	0.139 (0.112)	0.167* (0.090)
Lower Sec. School (Highest)	0.117*** (0.020)	0.117*** (0.020)	0.117*** (0.020)	-0.072*** (0.024)	-0.072*** (0.024)	-0.069*** (0.024)	-0.022 (0.025)	-0.022 (0.025)	-0.018 (0.025)
Unemploym.rate in t (U)	-0.014 (0.011)	-	-	0.003 (0.013)	-	-	0.003 (0.015)	-	-
Apprent. & Voc.Train. * U	0.010** (0.005)	-	-	-0.006 (0.005)	-	-	0.000 (0.009)	-	-
Youth unemp. in t (YU)	-	-0.023* (0.012)	-	-	0.003 (0.015)	-	-	-0.003 (0.016)	-
Apprent. & Voc.Train. * YU	-	0.010* (0.005)	-	-	-0.005 (0.006)	-	-	0.002 (0.010)	-
Youth unemp. in t-10 (YU15)	-	-	-0.005 (0.010)	-	-	0.022* (0.012)	-	-	0.008 (0.013)
Apprent. & Voc.Train. * YU15	-	-	0.009 (0.005)	-	-	-0.014** (0.006)	-	-	-0.001 (0.008)
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	1788	1839	1839	1788	965	965	929
R-squared	0.275	0.276	0.276	0.190	0.189	0.189	0.363	0.363	0.363

Note: See **Table 5**. 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 7 Estimation Results: IV-Approach for three Outcomes

	Unemployed or out of labor force	Permanent full employed	Log wage
Apprent. & Voc.Training (0/1)	-0.182 (0.149)	0.566*** (0.213)	0.822** (0.376)
Male (0/1)	0.010 (0.021)	0.062** (0.031)	0.108*** (0.041)
Married (0/1)	0.125*** (0.031)	-0.116*** (0.036)	0.053 (0.052)
Married * Male (0/1)	-0.129*** (0.049)	0.158** (0.070)	0.020 (0.085)
Number of children in household	0.262*** (0.024)	-0.167*** (0.029)	0.036 (0.060)
Number of children in household * Male	-0.262*** (0.032)	0.100** (0.043)	-0.058 (0.071)
Served in military/civil service (0/1)	-0.001 (0.022)	-0.100*** (0.033)	0.001 (0.037)
Migration background (0/1)	0.009 (0.023)	0.015 (0.032)	-0.001 (0.031)
Tertiary education degree (0/1)	-0.076 (0.081)	0.053 (0.120)	0.384** (0.158)
Highest degree Hauptschule (0/1)	0.098*** (0.027)	-0.030 (0.036)	0.044 (0.048)
Community size < 20,000 (0/1)	0.010 (0.020)	0.032 (0.028)	0.012 (0.031)
Community size > 100,000 (0/1)	0.001 (0.024)	-0.035 (0.033)	-0.021 (0.038)
State-level unemployment rate	-0.005 (0.010)	-0.004 (0.013)	-0.002 (0.016)
Enterprise 20-199 employees (0/1)	-	-	0.077** (0.032)
Enterprise 200-1999 employees (0/1)	-	-	0.235*** (0.036)
Enterprise >2000 employees (0/1)	-	-	0.289*** (0.043)
Enterprise empl. info missing (0/1)	-	-	-0.043 (0.099)
Public sector (0/1)	-	-	-0.083** (0.033)
Public sector info missing (0/1)	-	-	0.015 (0.105)
Tenure	-	-	0.059 (0.043)
Tenure ²	-	-	-0.010 (0.010)
Tenure ³	-	-	0.001 (0.001)
Year and State FE	yes	yes	yes
Number of observations	1839	1839	965
Test H ₀ : instrument uncorrelated with vocational training (underidentification)			
1st stage: F-value (p-value)	15.84 (0.000)	15.84 (0.000)	5.44 (0.004)
Test H ₀ : instrument correctly excluded (overidentification)			
Hansen's J statistic (p-value)	0.143 (0.705)	0.143 (0.705)	1.83 (0.176)

Note: See **Table 5**.**Source:** SOEP (2000-2011), own calculations.