Deutsches Institut für
Wirtschaftsforschung

DIW BERLIN

www.diw.de

SOEP The German Socio-Economic Panel Study

SOEPpapers

on Multidisciplinary Panel Data Research

311

Katja Coneus • Johannes Gernandt • Marianne Saam

Noncognitive skills, school achievements and educational dropout (revised version)

Berlin, July 2010

SOEPpapers on Multidisciplinary Panel Data Research
at DIW Berlin

This series presents research findings based either directly on data from the German Socio-Economic Panel Study (SOEP) or using SOEP data as part of an internationally comparable data set (e.g. CNEF, ECHP, LIS, LWS, CHER/PACO). SOEP is a truly multidisciplinary household panel study covering a wide range of social and behavioral sciences: economics, sociology, psychology, survey methodology, econometrics and applied statistics, educational science, political science, public health, behavioral genetics, demography, geography, and sport science.

The decision to publish a submission in SOEPpapers is made by a board of editors chosen by the DIW Berlin to represent the wide range of disciplines covered by SOEP. There is no external referee process and papers are either accepted or rejected without revision. Papers appear in this series as works in progress and may also appear elsewhere. They often represent preliminary studies and are circulated to encourage discussion. Citation of such a paper should account for its provisional character. A revised version may be requested from the author directly.

Any opinions expressed in this series are those of the author(s) and not those of DIW Berlin. Research disseminated by DIW Berlin may include views on public policy issues, but the institute itself takes no institutional policy positions.

The SOEPpapers are available at
http://www.diw.de/soeppapers

ISSN: 1864-6689 (online)

German Socio-Economic Panel Study (SOEP)
DIW Berlin
Mohrenstrasse 58
10117 Berlin, Germany

Contact: Uta Rahmann | urahmann@diw.de

Noncognitive skills, school achievements and educational dropout

Katja Coneus*, Johannes Gernandt†, Marianne Saam‡

Revised version
July 2010

Abstract

We analyse the determinants of dropout from secondary and vocational education in Germany using data from the Socio-Economic Panel from 2000 to 2007. In addition to the role of classical variables like family background and school achievements, we examine the effect of noncognitive skills. Both, better school grades and higher noncognitive skills reduce the risk of becoming an educational dropout. The influence of school achievements on the dropout probability tends to decrease and the influence of noncognitive skills tends to increase with age.

Keywords: noncognitive skills, school grades, secondary education, vocational training.

JEL-classification: I21; J13; J24.

Acknowledgements: We would like to thank Irene Bertschek, Andrea Mühlenweg, Friedhelm Pfeiffer, Maresa Sprietsma, Michael Ward and seminar participants at ZEW for helpful comments. Katja Coneus and Johannes Gernandt thank the Leibniz Association, Bonn, for support in the research network "Noncognitive Skills: Acquisition and Economic Consequences".

*Centre for European Economic Research (ZEW), e-mail: coneus@zew.de.
†Centre for European Economic Research (ZEW), e-mail: gernandt@zew.de.
‡Corresponding author: Centre for European Economic Research (ZEW), P.O. Box 10 34 43, D-68034 Mannheim, Germany, tel.: +49-621-1235-285, e-mail: saam@zew.de.

1 Introduction

Dropout of the secondary school-system and failed transition to professional training has been of growing concern in most industrialized countries. Not so much because dropout itself would have risen, but because the employment prospects of low-skilled young adults have considerably worsened. Germany and other countries with a dual system combining class-based and work-based training have long been relatively successful in limiting the problem of youth unemployment. However, as our data document, a considerable share of around ten percent of young adults drops out of this system. Our paper considers the determinants of educational dropout in Germany, offering three contributions: First, it develops a definition of educational dropout that is adapted to the German educational system, second, it accounts for noncognitive skills as a determinant and third, it finds evidence for age-dependent effects of school achievements and noncognitive skills on dropout status.

For the U.S., there exists a large literature on the determinants and the labour market consequences of educational dropout, which defines educational dropout as high school dropout or considers the much broader notion of disconnectedness (MaCurdy et al. (2006)). In the German context, high school dropout is not an appropriate definition and disconnectedness refers to a broader context than the context of education we are interested in. Building on an earlier analysis by Franz et al. (2000), we consider an educational dropout to be someone who has failed to complete lower secondary education or who has completed lower secondary education but failed to enter or complete a vocational degree. Since vocational education in Germany typically combines class-based and work-based training, this definition does not only reflect academic performance but also failure in the first step of labour market integration for low- and medium-skilled individuals.

In focusing on noncognitive skills, such as self-discipline and self-confidence, as a determinant, we explicitly account for an aspect that has only recently attracted attention in the economic literature and, to our knowledge, has not yet been examined in the context of educational dropout in Germany. Traditionally, studies of educational achievement or youth unemployment include parental background or previ-

ous school achievements as explanatory variables (see e.g. Dustmann (2004), Aakvik et al. (2005), and MaCurdy et al. (2006)). Evidence from research on other economic outcomes such as skill formation and school achievements (Blomeyer et al. (2009), Borghans et al. (2008), Cunha and Heckman (2008) and Duncan et al. (2007)) or unemployment and wages (Carneiro et al. (2007), Flossmann et al. (2007) and Uhlendorff (2004)) suggests that in the earlier studies of dropout, noncognitive skills represent an omitted variable. This was first noticed by Heckman and Rubinstein (2001) and confirmed in the U.S. American context by Heckman et al. (2006).

Based on representative data from the German Socio-Economic Panel (SOEP), we analyse the determinants of educational dropout in Germany in the years following the end of compulsory schooling, at ages 18 to 21. We include measures of school achievements and noncognitive skills at the age of 17 as well as information on parental background at the age of 15, which allows us to limit the problem of reverse causality. Noncognitive skills may have a direct effect on dropout risk as well as an indirect effect through a positive influence on school achievements. We are primarily interested in the direct effect. At first sight it may seem that very low school achievement observed up to the age of 17 is equivalent to the failure to obtain a school degree and thus to educational dropout. In this case, there would be no direct effect of noncognitive skills. This relation, however, does not extend to failure in apprenticeship. Moreover, there are a number of measures that allow students to earn a school degree after initial dropout, so dropout related to low school grades is not necessarily a permanent phenomenon.

In order to reduce unobserved heterogeneity in skills and social background, we investigate the relation between school achievements, noncognitive skills and educational dropout using a probit model with a rich set of control variables, instrumental variable (IV) estimation and a panel model for siblings. While the results differ somewhat across ages and models, we find that both, school achievements and noncognitive skills have a significant effect on educational dropout between 18 and 21. The effect of school achievements decreases with age, while the effect of noncognitive skills increases. Especially in entering and completing apprenticeship

noncognitive skills such as self-confidence and persistence seem to play a role even at equal school achievements.

2 Data source and definitions

2.1 The German Socio-Economic Panel

To study the determinants of educational dropout, we use information from the youth questionnaire from the German Socio-Economic Panel (SOEP) filled in by 17-year-olds from the year 2000 on. The SOEP is a representative national longitudinal data set which surveys households and individuals (Wagner et al.; 2007). It provides information on family background, like parental education and occupation, when the respondents were 15 years old as well as on school achievements, school track and noncognitive skills. Educational dropout is observed up to the age of 25. We do not include dropout status of 17-year-olds in our econometric analysis since strong reverse causality may be present. Also, the cohorts older than 21 are excluded because the number of observations is very small. We end up with a sample of 2,542 observations on individuals aged between 18 and 21 who were first interviewed before 2006.[1]

2.2 Rotter's Locus of Control

While the economic literature traditionally recognizes the importance of cognitive skills for school and labour market success, the link between noncognitive skills and human capital accumulation has been studied only in recent years. In school, individuals who have highly pronounced noncognitive skills can e.g. be expected to be motivated when doing homework and to be less likely to skip school. In the labour market, noncognitive skills influence the willingness to work hard, being on time and being trusted (Heckman and Rubinstein; 2001). They are thus also susceptible to influence the success in entering and completing an apprenticeship.

[1]Because of changes in the youth questionnaire, we do not include the most recent waves from 2006 and 2007 for the definition of items used for our measure of noncognitive skills. We nevertheless observe some persons in these years who answered the questions in earlier waves.

In our analysis, we use Rotter's Locus of Control (Rotter index) as measure for noncognitive skills (Rotter; 1966). The concept developed in psychology identifies noncognitive skills through personality traits. It is employed to distinguish between two types of personality. Respondents are confronted with pairs of opposite statements about their personal situation or life in general. One category of statements sees luck as the determining force of success and failure. The other category sees individual skills and actions as the determining force. According to their degree of agreement with the statements, individuals can be divided into two types, externalisers and internalisers. Externalisers attribute outcomes to external circumstances, while internalisers attribute outcomes to their own control. Internalisers are considered to have stronger noncognitive skills such as motivation, interest and self-esteem.

In order to construct a Rotter index, we use 10 items from the youth questionnaire. The items are ranked on a four-point scale in the youth questionnaire and are addressed to all 17-year-olds. We sum up all items to obtain a unidimensional scale. Table 1 presents the means for all items and the overall noncognitive skill indicator (Rotter index), separately for educational dropouts and other individuals (All tables are contained in Appendix B). Additionally, we compute t-tests to examine whether these groups differ significantly with respect to noncognitive skills. The results indicate that educational dropouts have significantly lower noncognitive skills than non-dropouts (see also Figure 1, all figures are contained in Appendix A). The standard deviation of the overall distribution of the Rotter index is 3.1 points.

In addition, in 2005 the Rotter index was assessed for all adults, which include the individuals' parents. This measure covers the same items as the one in the youth questionnaire, but the scale ranges from 1 to 7 for each item. We merge the parents' noncognitive skills with the child's skills at the age of 17. In doing so we assume that the parents' noncognitive skills are relatively stable from 2000 to 2007 (see e.g. Dahl (2004) for evidence on stability of personality traits from early adulthood on).

2.3 School achievements

For measuring the individuals' academic ability, we do not observe cognitive skills in the form of IQ-tests or general academic performance tests as available e.g. in the PISA survey. Meanwhile, the data set contains information on the latest school grades obtained in mathematics and German. The grades adjusted for school track serve as a measure of school achievements in our analysis.

Students in Germany are attending three different school tracks. German children normally start school at the age of six and complete four years of primary school and five to six years of lower-level secondary school.[2] Those who want to earn a degree giving access to higher education complete three more years of upper-level secondary education. The overwhelming majority of schools are public state schools. The secondary schools are traditionally differentiated into three levels: Hauptschule, Realschule and Gymnasium. The first two cover only the lower level of secondary schooling. They are conceived to provide general education as a basis for apprenticeship training or professional schools without university status.

We generate a universal score to compare the grades in math and German across school tracks. Grades in Germany range from 1 to 6 with 1 to 4 being pass grades and 5 and 6 being fail grades. The 17-year-old individuals are asked about the last grades they received in school at the end of a semester. For some of them, these will be the final school leaving grades, others will still be in the course of pursuing a degree. To make grades comparable across school tracks, we look at conditions for admission to a higher school track in the case of good grades. To some extent, the Länder (regions) provide regulations how teachers should decide about this transfer. In general, a grade average between 2 and 3 is necessary for being recommended for a higher school track.[3] Some regulations require the grade 2 in most main subjects (math, German, first foreign language). Therefore the most plausible way to make grades comparable is to assume that 2 at the lower school track corresponds to a

[2] In some regions, primary school lasts six years and lower-level secondary school three to four.

[3] See e.g. Bayerisches Staatsministerium für Unterricht und Kultus (2008), Senatsverwaltung für Bildung, Wissenschaft und Forschung des Landes Berlin (2005) and Ministerium für Schule und Weiterbildung des Landes Nordrhein-Westfalen (2008).

pass grade (4) in the higher school track. Assuming further that the relation is linear (3 at the lower track corresponding to 5 at the higher one etc.), we obtain ten grade levels in two subjects. We generate a composite score ranging from 2 to 20. It is obtained by subtracting the sum of grades from 22 and subtracting 2 for a grade obtained in the middle school track and 4 for a grade obtained in the lowest school track. The assumptions about comparability of grades may seem to be quite strong. However, a measure of school grades confers essential information on possible determinants of educational dropout that cannot be omitted in a case where a measure of cognitive skills is not available.[4] Figure 2 shows that the grade score distribution of the dropout group is located at the left of the distribution of the non-dropouts. The mean score is 13.11 for non-dropouts and 9.80 for dropouts.

2.4 Definition of educational dropout

We define educational dropout with respect to the stages at which young people without advanced general education can fail to integrate into the labour market via the German system of general and vocational education. We generally consider those who are neither in education currently nor have completed schooling beyond the lower secondary level as educational dropouts. More precisely, a person is considered as an educational dropout if he or she:

- left school without any degree, irrespective of subsequent vocational training
- left lower-secondary school without any degree (Hauptschulabschluss, Realschulabschluss or 'mittlere Reife' obtained at Gymnasium) and is neither enrolled in vocational education nor holds a vocational degree
- is enrolled in a preparation year for vocational training (Berufsvorbereitungsjahr) or an elementary vocational year (Berufsgrundbildungsjahr)

[4]Sensitivity analysis shows that a score computed with a stronger valuation of higher school tracks, counting a very good grade (1) at the lower school track as only a passing grade (4) at the higher track does not have any substantial effect on the conclusions from our analysis. Results are available upon request.

- is pursuing a degree from lower-level secondary school and is more than two years behind the regular age for obtaining it.

The definition implies that someone who is currently in education may become a dropout if he or she leaves the educational system without a degree. We also account for the fact that some situations of school enrolment already reflect failed regular integration into the vocational training system. We count those as dropouts who are more than two years behind the regular age for obtaining a lower-level school degree and still in school as well as those in special measures preparing for vocational training. Someone who obtains a high school degree (Abitur) will by definition not be considered as an educational dropout irrespective of whether he or she completes professional training afterwards.

The majority of vocational training is provided within the dual system where apprentices work in a firm and attend vocational school part-time for two to three years. For some professions, only full-time schooling is provided. Primary and secondary school attendance is compulsory for nine to ten years, depending on the regions (Länder). In most regions, three years of part-time schooling in the dual system, or, alternatively three years of full-time general or vocational schooling, are compulsory afterwards at least until the age of 18. While some regions and some school types aim at avoiding early ability tracking, most children enter a specific track of secondary school at the age of 10. Primary school teachers recommend a school track for the child, but these recommendations are not binding everywhere.

Nowadays, a number of students completes upper-level secondary schooling at Gymnasium before entering an apprenticeship and many graduates of the lowest and even the middle school track encounter problems in entering apprenticeship at all. Special educational measures are targeted at improving these students' preparation for vocational education: the preparation year for vocational training (Berufsvorbereitungsjahr) and the elementary vocational year (Berufsgrundbildungsjahr). The preparation year for vocational training allows students who have left school without any degree to obtain the equivalent of a degree from the lowest track (Hauptschulabschluss) and to prepare for transition into the dual system. The elementary

vocational year generally requires a school degree and is offered mainly to students who were unable to enter the dual system. If the student continues education in the dual system afterwards, the elementary vocational year contributes to the fulfillment of the degree requirements of vocational school.

3 Determinants of educational dropout

3.1 Descriptive statistics

Table 2 reports descriptive statistics by dropout status. It contains sample means and standard deviations of all variables used in the estimation. Dropouts are as old as non-dropouts in the pooled sample for 18- to 21-year-olds. The overall share of dropouts is 10%. The share of persons with migration background is about ten percentage points higher for dropouts.[5] The share of females is higher for non-dropouts.

In the lower part of Table 2, we look at descriptive statistics for the family background, especially the mother's characteristics, which we use in the estimations based on this sample. While 80% of the non-dropouts lived together with both of their parents at age 15, this share is only 67% for dropouts. Information on the mother's education and occupational status also refers to characteristics when individuals were 15 years old. The overall pattern is that on average, maternal educational attainment is lower than the attainment of the offspring. In several categories of education, a clear picture emerges of mothers of non-dropouts being better educated than mothers of dropouts. The share of mothers working as a white-collar employee is nearly twice as high for non-dropouts compared to dropouts.

In order to receive an impression of the pattern of educational dropout among young adults, we consider a broader sample of 17- to 25-year-olds (containing 21,988 observations). After the age of 17, the share of dropouts rises sharply. Between the age of 18 and 25, the overall share of dropouts increases only slightly (see Figure 3). However, at the individual level, one observes nonnegligible rates of entry to the

[5] The dummy for immigration takes the value one if the individual belongs to the first or second generation of immigrants and zero otherwise.

dropout status and exit from it in the late teens and early twenties. There is the possibility of definite exit by earning the corresponding degrees. Given the German system of general and professional education, causes for entering and exiting the dropout status vary between age cohorts. For this reason, we do not attempt to model the time spells of being a dropout. Nevertheless, it is still interesting to see the evolution of entry and exit rates over age cohorts. Considering those in the sample of 17- to 25-year-olds, we observe that entry rates are almost continuously declining from the age of 18 on, while exit rates decline from the age of 19 on (see Table 3). The reason of being a dropout changes over time. At a younger age, having no school degree is the main reason to become a dropout while later failure to enter or complete a vocational degree is for nearly 90 percent of the group of dropouts responsible for this status (see Figure 4).

3.2 Empirical approach

Our goal is to assess the role school achievements and noncognitive skills play in affecting the risk of educational dropout from lower-level secondary and vocational education. While inferior school grades have an important influence on educational dropout, they do not completely predetermine it. As explained in the introduction, low noncognitive skills are expected to have both a direct and an indirect effect on educational dropout. The indirect effect occurs when low noncognitive skills lead to low school performance which in turn increases the likelihood to become a dropout. The direct effect of noncognitive skills is observed when at equal previous school achievements, those with higher noncognitive skills display better discipline in continuing school attendance, greater initiative in applying for vocational training and better performance in work-based training. In this way, noncognitive skills may affect educational dropout even when previous school achievements are constant.

School achievements and noncognitive skills are likely to depend on the person's genetic endowment, unobserved skills and family and social environment. The major advantage of our sample is that it contains measures of academic achievements and noncognitive skills of both the young women and men and their mothers[6], so we are

[6]Fathers have a higher number of missings because they are more frequently not living in the

able to control for part of this endogeneity. We follow three empirical approaches to deal with the endogeneity issue: a probit estimation including a rich set of control variables (section 3.3), an instrumental variable estimation (section 3.4) and a panel estimation with unobserved family effects (section 3.5).

The basic model estimates the relation between the dropout status of individual i at a certain age t, only including the measures for school achievements and noncognitive skills, ac_i and n_i:

$$Prob(dropout_{it}) = f(\alpha + \beta_{act} ac_i + \beta_{nt} n_i). \tag{1}$$

In order to reduce unobserved heterogeneity, which is likely to affect the estimates of β_{ac} and β_n, we then include measures of the mother's noncognitive skills n_m (individual i's mother being index by m), of her academic and professional achievement ac_m and other covariates x_i to the model:

$$Prob(dropout_{it}) = f(\alpha + \beta_{act} ac_i + \beta_{nt} n_i + \gamma_{act} ac_m + \gamma_{nt} n_m + \gamma_{xt} x_i). \tag{2}$$

In the instrumental variable model, we reestimate equation (2) using instruments $\mathbf{z_i}$ for school achievements with $cov(ac_i, \mathbf{z}_i) \neq 0$ and assumed to satisfy uncorrelatedness with the error term u_i, $E[u_i|\mathbf{z}_i] = 0$. Since the efficiency loss associated with instrumental variable estimation prevents identification of effects for individual age cohorts, we estimate the model using the pooled sample, including interaction effects between age and skill measures.

An alternative to instrumental variables when tackling the problem of causal inference is to study the educational dropout status of siblings ($i \in \{1, 2, 3\}$) in the family j at age t. The general panel model is

$$P(dropout_{ijt}) = f(family_j + \beta_{act} ac_{ij} + \beta_{nt} n_{ij} + \delta t). \tag{3}$$

If family background represents the unobserved variable affecting dropout status and has an identical effect on siblings, including family effects, $family_j$ will recover an asymptotically unbiased estimate under suitable assumptions about their distribution. We model family effects as correlated random effects depending on the

households. Sensitivity analysis shows that the variables for the father have no additional effect. Results are available upon request.

mean school achievement and mean Rotter index of siblings. Observing siblings in general instead of twins, we consider a more representative sample of individuals, but we risk to obtain biased estimates because of differences in genetic endowment and changes in family conditions between births. Because of limited data availability, we apply the panel estimation to a pooled sample with repeated observations for some individuals. We consider a specification with identical effects for all ages and with interaction terms of school achievement and noncognitive skills with age.

We observe the Rotter index as a measure of noncognitive skills and the last school grades obtained as a measure of academic performance at the age of 17. Dropout status is observed in this and up to seven subsequent periods, but because of severe reverse causality at the age of 17 and small sample sizes in the oldest cohorts, we limit our econometric analysis to cohorts aged 18 to 21. Since the explanatory variables do not vary over time, we estimate models for single cohorts or pooled samples rather than dynamic panel models.

3.3 Probit models

In the basic probit model, regressing dropout status on school grades and the Rotter index only, we observe that the average effect of school grades on the probability to be a dropout declines with age while the effect of the Rotter index increases (see Table 4). This is the main result of our paper. While magnitudes will change to some extent in subsequent specifications, this general tendency can be shown to be robust.

Introducing the full set of covariates reduces the effect of school grades on the probability of being a dropout by a fifth to a half (see Table 5). The effect of the Rotter index is only slightly reduced for some cohorts. The effect of the mother's Rotter index is virtually zero. The pattern of effects over the ages remains the same. We interpret this pattern as reflecting the different stages of failure in transition from school to completed vocational training. At the age of 17, the share of dropouts is still low (see Figure 3), since some that will eventually not obtain their school degree have not yet failed. At the age of 18, the share of dropouts increases sharply,

reflecting dropout of school and failed transition into apprenticeship immediately after obtaining a degree. Both plausibly depend on school grades. At ages 19 to 21, the overall share of dropouts does not change much, but the share of those that have completed a school degree but have failed to enter or complete an apprenticeship rises. During this stage, noncognitive skills seem to play an increasingly important role.[7]

In sum, the effects of school achievements are reduced somewhat when controlling for the mother's skills and other variables, while the effects of noncognitive skills do not change much. With regard to their magnitude, we consider the estimates for single cohorts aged 18 to 20 as most reliable. For 21-year-olds, the sample is particularly small and the marginal effects of the Rotter index and the dummy for migration background change notably. For the 18- to 20-year-olds, the effect of a one point higher grade score on the dropout probability ranges between 0.8 and 2.3 percentage points. An individual whose grade score is one standard deviation higher (3.7 points) has on average a probability to be an educational dropout that is between 3.0 and 8.5 percentage points lower. Lying just below 4 points, the standard deviation roughly corresponds to having good grades instead of passing grades in the two subjects considered or to obtaining the same grades at the next higher school track. In the same cohorts, the average marginal effect of a one point increase in the Rotter index on the probability to be a dropout lies between 0.7 and 1.2 percentage points. This implies that a standard deviation difference in noncognitive skills (3.1 points) is related to a dropout probability that is 2.2 to 3.7 percentage points lower.

3.4 Instrumental variable models

School achievements and dropout status may be subject to correlated unobserved effects, even after controlling for the background variables included in the probit regression. In this case, academic performance measured by school grades is endogenous and depends on the same unobserved effects that influence educational dropout.

[7] The sample used here is not balanced over cohorts, but using a smaller balanced sample recovers a similar pattern of effects with higher standard errors. Results available upon request.

Noncognitive skills measured by the Rotter index are not considered to be an endogenous variable in the IV model for two reasons: First, school achievements depend more heavily on a number of external factors such as school quality and teachers' subjective judgement than the Rotter index. Second, we have tried to assess the relation of the Rotter index to observed and unobserved variables of our model and find little statistical support for endogeneity. Regressing the Rotter index on measures of family background gives insignificant results except for the mother's Rotter index. In probit models, however, the effect of the mother's Rotter index disappears if the person's own Rotter index is included. Introducing additional variables such as conflict with parents, parents looking after school achievements and class repetition into the probit models leads only to small changes in the coefficient of the Rotter index. Including additional variables to further control for unobserved heterogeneity therefore does not seem to affect the influence of noncognitive skills on dropout status.[8]

Usually, the instruments that find the strongest argumentative support result from natural experiments or institutional regulations affecting otherwise similar populations in different ways. In this analysis, we are not able to recur to such an instrumental variable for school grades. Therefore, the results have to be read with a caveat in mind. The first instrument we consider is the school recommendation after primary school. The variable in the data set indicates whether a person obtained a recommendation for one of the three secondary school tracks or did not obtain any recommendation. How binding these recommendations are varies across regions and years. We define a dummy variable that takes the value 1 if someone obtained a recommendation to enter Hauptschule, the lowest track, and zero, if he obtained another or no recommendation. Out of those who obtained a recommendation for Hauptschule, 74% attended it up to leaving school or were still attending it at the age of 17. Of those who did not obtain this recommendation, 16% attended Hauptschule as a final school. We argue that once two individuals have attained equal school achievement, the recommendation for Hauptschule does not have any

[8] Results available upon request.

independent effect on the probability of being a dropout. As a second instrument for school achievement, we consider the response to the question whether the person has ever had 'differences in opinion' about school performance with his or her parents. Certainly, this dummy variable is not causing lower school grades, but it is correlated with them, while it is unlikely to be related to dropout risk except through school grades.[9]

In order to explicitly allow for the nonlinearity of the model explaining educational dropout, one would have to resort to structural modeling placing strong restrictions on the error term or to computationally more demanding nonlinear IV methods. Since the linear probability model usually yields a good approximation for the average marginal effects on a binary variable, an ordinary linear model and a linear instrumental variables model using GMM are estimated for the pooled sample, first with constant effects of school achievements and noncognitive skills, then including interactions with age. As instruments we add school recommendation and 'differences in opinion' with parents interacted with age.

The average effect of school grades on dropout status rises in absolute value in the IV estimation (see Table 6). Including interaction with age shows on the other hand a slightly steeper decline. The average effect of the Rotter index is somewhat reduced in the IV estimation, the increase with age remaining the same. If school grades were positively correlated with unobserved ability that reduces the risk of being a dropout, one would expect that the coefficient declines in absolute value if the bias is reduced. But unobserved factors rising dropout risk may be dominated by other aspects such as low manual skills, an instable personal situation or being in a location with poor labour market conditions. These may matter more for people with intermediate academic performance than for people with low academic performance. The latter may have a very high dropout risk anyway and additional adverse factors may not make things much worse. The effect of unobserved adverse conditions may be stronger for individuals with intermediate academic performance.

[9] The first stage regression of the score of school achievements and other exogenous variables (not shown here) yields coefficients of the instruments significant at the 1% and an F-statistic of 84.46 supporting the relevance of the instruments.

So holding the effect of these conditions constant would eliminate a downward bias in the absolute value of the coefficients for school grades. Accounting for endogeneity through IV estimation raises the average effect of a grade score that is one standard deviation (3.7 points) higher on the probability to be a dropout from 5.6 percentage points to 10.7 percentage points.

3.5 Models with unobserved family effects for siblings

We consider a model with correlated random effects (CRE) estimating mean and age-dependent effects for a pooled sample including 862 observations. In the linear case this model is equivalent to the fixed-effects model. Here we estimate a nonlinear model. Since the sample is small and not fully representative, we regard the results as sensitivity checks of the estimates obtained in the previous regressions rather than as reliable alternative estimates.

In the CRE probit specification without age effects, both school grades and the Rotter index have a significant effect on the probability of being a dropout (see Table 7). The coefficients are lower than in the probit and IV specifications. In the specification introducing interactions with age, only the main effect of school grades is significant. However, the interaction of the Rotter index with age is close to significance at the 10% level. Family effects are significant for mean school grades, while they are insignificant for the Rotter index. Overall, the results support the hypothesis that both individual school grades and noncognitive skills observed at the age of 17 have an effect on dropout status at ages 18 to 21. The signs of the effects interacted with age are also confirmed, although the standard errors are quite large.

4 Conclusion

We have investigated the determinants of being an educational dropout in the years during which young people in Germany at the lower end of the educational distribution should typically make the transition from school to vocational training and eventually to the labour market. To analyse this issue, we have developed a notion

of educational dropout that covers both the general and the vocational track of the German educational system. The first main result of this paper is that noncognitive skills reduce the risk of being an educational dropout even after controlling for school achievements and family background. This result remains robust in an IV model with endogenous school grades and a panel model with correlated random effects for siblings. The second main result is that the effect of noncognitive skills increases with age. A possible reason is that successful integration and completion of the system of vocational training between the age of 19 and 21 depends more on noncognitive skills than completing school and entering this system immediately after school.

Across specifications, magnitudes of the negative effect of an increase in noncognitive skills by one standard deviation on dropout probability concentrate in the range between 2 and 4 percentage points. An increase in the score of school achievements by one standard deviation is related to a reduction in dropout probability between 3 and 8 percentage points in models that do not account for the endogeneity of grades. An instrumental variable estimation finds a higher average effect of nearly 11 percentage points. Our results show that in addition to school achievements, noncognitive skills play a role in the successful transition from school to the system of vocational training in Germany. The effect appears to be the more important, the older the individuals are. With further data becoming available, it should be possible to extend this analysis to larger samples and older cohorts as well as to a more direct investigation of the interplay between the formation of cognitive skills, noncognitive skills and school achievements.

References

Aakvik, A., Salvanes, K. G. and Vaage, K. (2005). Educational Attainment and Family Background, *German Economic Review* **6**(3): 377–394.

Bayerisches Staatsministerium für Unterricht und Kultus (2008). Volksschulordnung - VSO.

Blomeyer, D., Coneus, K., Laucht, M. and Pfeiffer, F. (2009). Initial Risk Matrix, Home Resources, Ability Development and Children's Achievement, *Journal of the European Economic Association, Papers and Proceedings* **7**(2-3): 1–11.

Borghans, L., Duckworth, A. L., Heckman, J. and ter Weel, B. (2008). The Economics and Psychology of Personality, *Journal of Human Resources* **43**(4): 972–1059.

Carneiro, P., Crawford, C. and Goodman, A. (2007). The Impact of Early Cognitive and Non-Cognitive Skills on Later Outcomes, *Working paper, Centre for Economics of Education* .

Cunha, J. and Heckman, J. (2008). Formulation, Identifying and Estimating the Technology of Cognitive and Noncognitive Skill Formation, *Journal of Human Resources* **43**(4): 738–782.

Dahl, R. E. (2004). *Adolescent Brain Development: A Period of Vulnerabilities and Opportunities*, in R. E. Dahl and L. P. Spear. eds., *Annals of the New York Academy of Sciences*, New York Academy of Sciences.

Duncan, G. J., Claessens, A., Huston, A. C., Pagani, L. S., Engel, M., Sexton, H., Dowsett, C. J., Magnuson, K., Klebanov, P., Feinstein, L., Brooks-Gunn, J. and Duckworth, K. (2007). School Readiness and Later Achievement, *Developmental Psychology* **43**(6): 1428–1446.

Dustmann, C. (2004). Parental Background, Secondary School Track Choice, and Wages, *Oxford Economic Papers* **56**(2): 209–230.

Flossmann, A. L., Piatek, R. and Wichert, L. (2007). Going Beyond Returns to Education: The Role of Noncognitive Skills on Wages in Germany, *University of Konstanz, Unpublished Paper* .

Franz, W., Inkmann, J., Pohlmeier, W. and Zimmermann, V. (2000). *Young and Out in Germany. On Youths' Chances of Labor Market Entrance in Germany.*, in D. Blanchflower and R. B. Freeman, eds.,*Youth Unemployment and Joblessness in Advanced Countries*, Chicago Press.

Heckman, J. J. and Rubinstein, Y. (2001). The Importance of Noncognitive Skills. Lessons from the GED Testing Program, *American Economic Review* **91**: 145–149.

Heckman, J. J., Stixrud, J. and Urzua, S. (2006). The Effects of Cognitive and Noncognitive Abilities on Labor Market Outcomes and Social Behavior, *Journal of Labor Economics* **24**: 661–700.

MaCurdy, T., Keaton, B. and Nagavarapu, S. S. (2006). Profiling the Plight of Disconnected Youth in America, *Working Paper* .

Ministerium für Schule und Weiterbildung des Landes Nordrhein-Westfalen (2008). Ausbildungs- und Prüfungsordnung Sekundarstufe I .

Rotter, J. (1966). Generalized Expectancies for Internal versus External Control of Reinforcement, *Psychological Monographs, 80* .

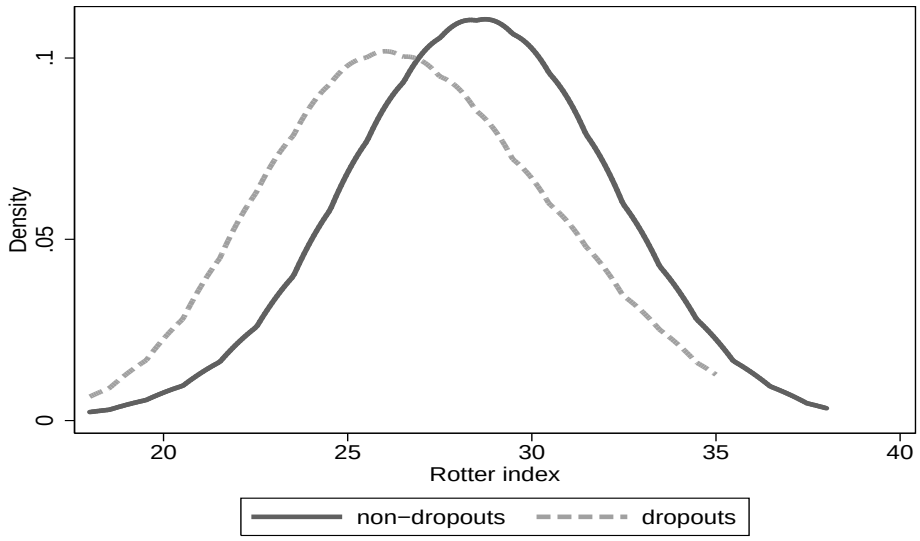
Senatsverwaltung für Bildung, Wissenschaft und Forschung des Landes Berlin (2005). Verordnung über die Schularten und Bildungsgänge der Sekundarstufe I .

Uhlendorff, A. (2004). Der Einfluss von Persönlichkeitseigenschaften und sozialen Ressourcen auf die Arbeitslosigkeitsdauer, *Kölner Zeitschrift für Soziologie und Sozialpsychologie* **56**(2): 279–303.

Wagner, G. G., Frick, J. and Schupp, J. (2007). The German Socio-Economic Panel Study (SOEP)- Scope, Evolution and Enhancements, *Schmollers Jahrbuch* **127**(1): 139–169.

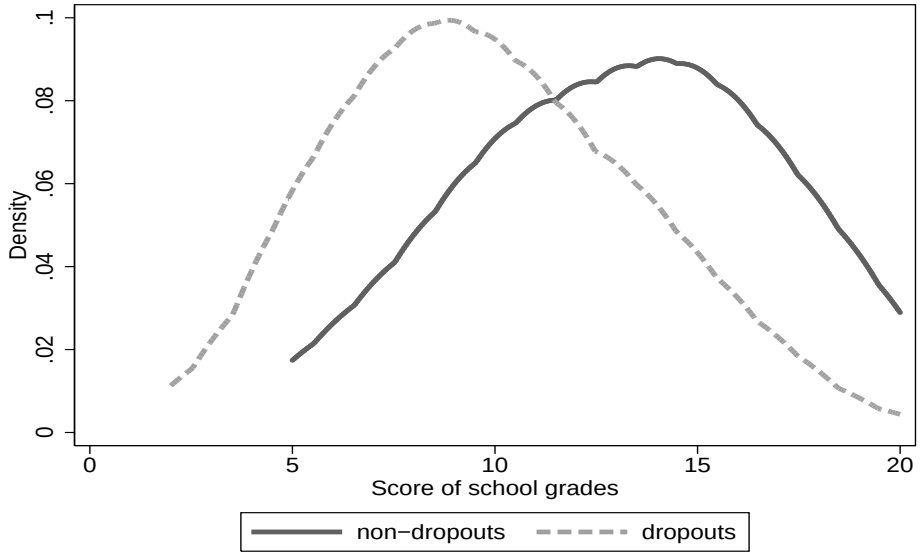
A Figures

Figure 1: Locus of Control for 17-year-olds



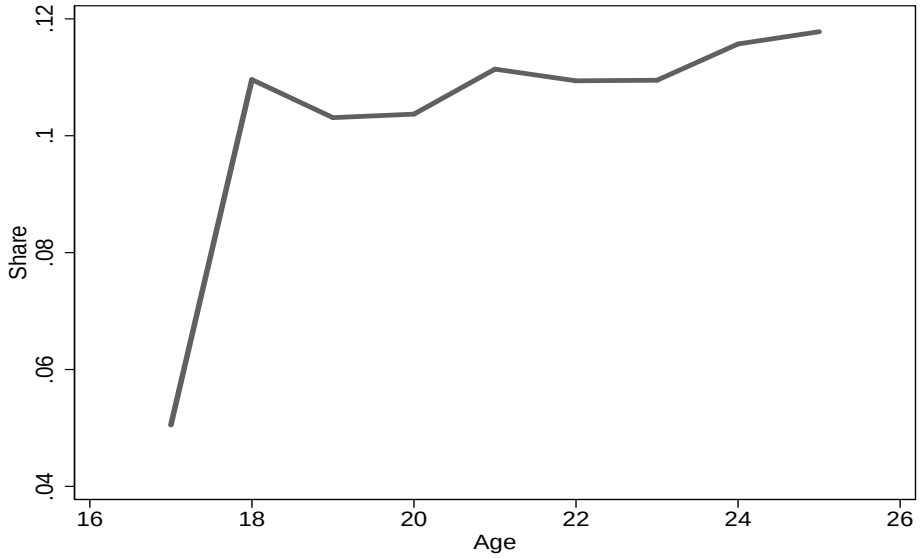
Source: SOEP 2000-2007. Own calculation.

Figure 2: Distribution of the score of school grades for 17-year-olds



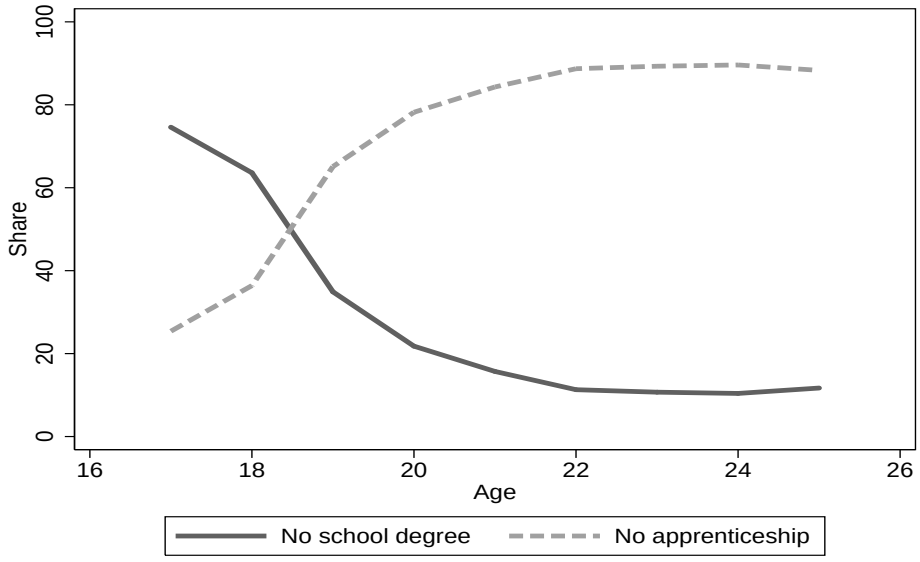
Source: SOEP 2000-2007. Own calculation.

Figure 3: Distribution of educational dropouts over age cohorts



Source: SOEP 2000-2007. Own calculation.

Figure 4: Reason for dropout status over age cohorts



Note: Shares in percent.
Source: SOEP 2000-2007. Own calculation.

B Tables

Table 1: Mean values Rotter's Locus of Control

Statement	Dropout	Non-dropout	t-value
I decide the way my life is run	3.49	3.52	0.71
Compared to others, I haven't attained what I deserve	2.79	3.12	6.61
What you achieve in life is mainly a matter of fate or luck	2.56	2.82	5.11
Experience that others determine my life	2.28	2.39	2.02
In case of difficulties doubts about own abilities	2.62	2.94	6.22
Little control over life	3.47	3.53	-0.87
One has to work hard to achieve success	2.48	2.75	5.44
Possibilities limited by social conditions	2.14	2.35	4.36
Abilities are more important than effort	1.93	2.03	2.18
Social and political activities influence social conditions	2.91	3.15	4.84
Locus of Control (all statements)	26.67	28.50	8.98
Observations	250	2,292	

Notes: The scale ranges from 10 to 40. High levels indicate strong noncognitive skills (internalisers), low levels indicate weak noncognitive skills (externalisers).
Source: SOEP 2000-2007. Own calculation.

Table 2: Descriptive statistics by dropout status

	Non-Dropout		Dropout	
Share	0.90		0.10	
West German share	0.70	(0.46)	0.68	(0.47)
Female Share	0.52	(0.50)	0.40	(0.49)
Age	19.11	(1.03)	19.11	(1.08)
Migration background	0.17	(0.38)	0.28	(0.45)
Rotter index	28.50	(3.04)	26.67	(3.30)
Grade score	13.12	(3.56)	9.80	(3.44)
Rotter index, mother	45.07	(7.28)	42.37	(6.95)
Family lives together	0.80	(0.40)	0.67	(0.47)
Education and occupational status of the mother				
Low or no school degree	0.41	(0.49)	0.72	(0.45)
Medium school degree	0.43	(0.50)	0.23	(0.42)
High school degree	0.15	(0.36)	0.05	(0.22)
No training qualification	0.13	(0.34)	0.27	(0.44)
Apprenticeship degree	0.62	(0.48)	0.64	(0.48)
Higher apprenticeship degree	0.05	(0.23)	0.02	(0.13)
University degree	0.19	(0.39)	0.08	(0.27)
Not working	0.23	(0.42)	0.42	(0.49)
Blue-collar worker	0.21	(0.41)	0.30	(0.46)
White-collar worker	0.43	(0.50)	0.22	(0.42)
Self-employed	0.08	(0.26)	0.05	(0.22)
Civil-servant	0.06	(0.23)	0.01	(0.09)
Observations	2,292		250	

Note: Standard deviation in parentheses.
Source: SOEP 2000-2007. Own calculation.

Table 3: Dropout status

Age	Stayed non-dropout	Stayed dropout	Exit dropout	Entry dropout
18	85.8	2.6	2.9	8.6
19	84.5	4.6	5.5	5.4
20	85.7	5.8	4.2	4.2
21	85.2	7.1	2.9	4.8
22	85.9	8.2	2.3	3.6
23	86.5	8.9	1.7	2.9
24	87.1	10.2	1.1	1.6
25	87.7	10.5	0.7	1.1

Note: Shares in percent.
Source: SOEP 2000-2007. Own calculation.

Table 4: Probit estimation educational dropout

	18 years	**19 years**	**20 years**	**21 years**
Grade score	-0.027***	-0.015***	-0.014***	-0.013***
	(0.003)	(0.003)	(0.004)	(0.005)
Rotter index	-0.008***	-0.010***	-0.012***	-0.021***
	(0.003)	(0.003)	(0.004)	(0.005)
Pseudo-R^2	0.22	0.11	0.10	0.13
Sample size	908	772	535	327

Notes: Average marginal effects. Standard errors are in parentheses: ***significant at 1%, **at 5% and *10% level.
Source: SOEP 2000- 2007. Own calculation.

Table 5: Probit estimation educational dropout, with control variables

	18 years	**19 years**	**20 years**	**21 years**
Grade score	-0.023**	-0.010***	-0.008**	-0.006
	(0.003)	(0.003)	(0.004)	(0.005)
Rotter index	-0.007**	-0.008**	-0.012***	-0.023***
	(0.003)	(0.003)	(0.004)	(0.005)
Rotter index mother	0.000	0.000	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.002)
Female	0.009	-0.027	-0.049*	-0.040
	(0.019)	(0.019)	(0.026)	(0.033)
Family together	-0.054**	-0.023	-0.005	-0.024
	(0.024)	(0.024)	(0.032)	(0.042)
Migration background	0.078**	-0.014	-0.001	-0.072**
	(0.031)	(0.027)	(0.034)	(0.036)
Education mother	yes	yes	yes	yes
West	yes	yes	yes	yes
Pseudo-R^2	0.27	0.17	0.14	0.25
Sample size	908	772	535	327

Notes: Average marginal effects. Standard errors are in parentheses: ***significant at 1%, **at 5% and *10% level.
Source: SOEP 2000-2007. Own calculation.

Table 6: IV estimation educational dropout

	OLS	OLS with age effect	IV GMM	IV GMM with age effect
Grade score	-0.015***	-0.021***	-0.029***	-0.037***
	(0.003)	(0.008)	(0.003)	(0.008)
Grade score*age	x	0.006**	x	0.008*
	x	(0.002)	x	(0.005)
Rotter index	-0.011***	-0.007**	-0.008***	0.004
	(0.003)	(0.003)	(0.003)	(0.003)
Rotter*age	x	-0.004**	x	-0.004*
	x	(0.002)	x	(0.002)
Age	-0.004	0.033	-0.005	0.010
	(0.005)	0.059	(0.006)	(0.061)
Female	-0.021	-0.022	-0.004	-0.006
	(0.016)	(0.016)	(0.017)	(0.017)
Family together	-0.033	-0.035	-0.17	-0.021
	(0.023)	(0.023)	(0.023)	(0.023)
Migration background	0.021	0.019	0.025	0.024
	(0.026)	(0.025)	(0.026)	(0.026)
Education mother	yes	yes	yes	yes
West	yes	yes	yes	yes
R^2	0.1141	0.12	0.0922	0.0988
p-value C statistic exogeneity				
grade score			0.049	0.061
grade score*age				0.325
p-value Hansen's J overid.			0.980	0.829
Number of observations	2,487	2,487	2,487	2,487

Notes: Standard errors are in parentheses, clustered for individuals: ***significant at 1%, **at 5% and *10% level.
Source: SOEP 2000-2007. Own calculation.

Table 7: Estimation educational dropout with siblings sample, CRE

		with age effects
Grade score	-0.006*	-0.010***
	(0.003)	(0.004)
Grade score*age	x	0.003
	x	(0.002)
Rotter index	-0.005**	-0.003
	(0.002)	(0.002)
Rotter index*age	x	-0.002
	x	(0.001)
Age	0.001	0.015
	(0.004)	(0.027)
Mean grade score of the family	-0.014***	-0.014***
	(0.004)	(0.004)
Mean Rotter index of the family	0.002	0.002
	(0.002)	(0.002)
Chi^2	38.01	38.92
Sample size	862	862

Notes: Average marginal effects. Standard errors are in parentheses, bootstrapped with 1000 replications, clustered for household and person: ***significant at 1%, **at 5% and *10% level.
Source: SOEP 2000-2007. Own calculation.