Schmollers Jahrbuch 131 (2011), 547 – 568
Duncker & Humblot, Berlin

Noncognitive Skills, School Achievements and Educational Dropout

By Katja Coneus, Johannes Gernandt, and Marianne Saam*

Abstract

We analyse the determinants of dropout from secondary and vocational education in Germany using data on 17- to 21-year-olds from the Socio-Economic Panel from 2000 to 2007. Beyond the role of classical variables like family background and school achievements, we examine the effect of noncognitive skills. At constant school grades, 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.

Zusammenfassung

Wir analysieren die Determinanten eines Abbruchs der schulischen und beruflichen Ausbildung in Deutschland anhand von Daten für 17- bis 21-Jährige des Sozio-ökonomischen Panels (SOEP) von 2000 bis 2007. Über klassische Einflussgrößen wie Familienhintergrund und Schulleistungen hinaus untersuchen wir den Effekt nicht-kognitiver Fähigkeiten. Bei gleichen Schulnoten verringern nicht-kognitive Fähigkeiten das Risiko, die Schule oder Ausbildung abzubrechen. Der Einfluss des Schulerfolgs auf das Risiko, Bildungsabbrecher zu sein, sinkt tendenziell mit dem Alter, während der Einfluss nicht-kognitiver Fähigkeiten steigt.

JEL Classification: I21, J13, J24

Received: July 26, 2010
Accepted: August 4, 2011

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

* This paper was written while all three authors worked at ZEW. We would like to thank two anonymous referees, Irene Bertschek, Andrea Mühlenweg, Friedhelm Pfeiffer, Maresa Sprietsma and Michael Ward 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".

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 more than 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.

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. As a measure of noncognitive skills we use the locus of control introduced by Rotter (1966) within the field of social psychology. It measures the degree to which individuals attribute events in live to consequences of own behavior.

In order to reduce unobserved heterogeneity in skills, 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, noncognitive skills measured through the locus of control turn out to have a significant effect on educational dropout between 18 and 21 even after controlling for school achievements up to the age of 17. The influence of school achievements decreases with age, while the effect of noncognitive skills increases. Especially in entering and completing apprenticeship, noncognitive skills seem to play a role even at equal school achievements.

2. Related Literature

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 as a determinant, we explicitly account for an aspect that 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 previous 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; Borgehans et al., 2008; Cunha/Heckman, 2008; and Duncan et al., 2007) or unemployment and wages (Carneiro et al., 2007; Flossmann, 2007; and Uhlendorff, 2004) suggests that in the earlier studies of dropout, noncognitive skills represent an omitted variable. This was first noticed by Heckman/Rubinstein (2001) and confirmed in the U.S. American context by Heckman et al. (2006). Closely related to our analysis is the recent work by Piatek/Pinger (2010) and by Caliendo et al. (2010). Piatek/Pinger (2010) find that the locus of control affects wages only via its influence on educational outcomes. Following the theoretical approach by Coleman/De Leire (2003), Caliendo et al. (2010) investigate the role beliefs reflected in the locus of control play in job search strategies (2010).

There has been some controversy around the interpretation of the locus of control within a model of human capital investment. The study by Coleman/De Leire (2003) examines the relationship between the locus of control and educational attainment, which is measured by graduation from high school and four year college attendance. Controlling for math abilities and parental education, they find that a one standard deviation increase in the Rotter index increases the likelihood of graduation from high school by 1.4 percentage points. At the same time the Rotter index is not a significant determinant for college attendance. They argue that the Rotter index does not reflect unobserved ability but a person's perception about the causality between his or her actions and

future economic outcomes. This hypothesis is tested using data on the high school students' expectations about their future income and skill-level of profession. The analysis confirms a pattern of expectations that is compatible with the locus of control representing beliefs rather than ability. The re-examination study by Cebi (2007) finds noncognitive skills not to be a significant predictor of educational outcomes and occupational expectation. One possible explanation for the different result are the different measures used for cognitive abilities. While Coleman and De Leire (2003) use math test scores as a measure for cognitive abilities, the study by Cebi (2007) uses the AFQT. The AFQT score incorporates a much broader set of cognitive abilities. Thus, the different results might be due to different measures of cognitive skills. In both studies, the impact of cognitive skills on educational attainment is much larger than the impact of the Rotter index. In addition, Cebi (2007) finds that the Rotter index has a significant effect on hourly wages. In the labour market, a one standard deviation increase of the Rotter index increases hourly wages by 2.1 percent. This result supports the view of the locus of control reflecting noncognitive skills that are rewarded in the labour market.

3. Measures of Skills and Educational Outcomes

3.1 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 the dropout status of 17-year-olds in our econometric analysis since a 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]

3.2 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 noncogni-

[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.

tive 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, to be on time and to be trustworthy (Heckman/Rubinstein, 2001). They are thus also susceptible to influence the success in entering and completing an apprenticeship.

In our analysis, we use Rotter's locus of control (Rotter index) as a measure for noncognitive skills (Rotter, 1966). The psychological concept 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, whilst internalisers attribute outcomes to their own control. Internalisers are considered to have stronger noncognitive skills such as motivation and the ability to set oneself goals and to attain them. The perceived relationship between one's own behavior and its consequences can have an influence on a variety of decisions during school and later on. In school, individuals who believe that success in school results from their own effort (internalisers) are more willing to apply themselves. Coleman/DeLeire (2003) develop a human capital model accounting explicitly for the locus of control. They argue that the locus of control influences educational decisions and outcomes through beliefs rather than through abilities. However, in reduced-form models such as the model we are able to specify with our data, these factors cannot be distinguished. We consider a strong perceived relation between own actions and consequences as a noncognitive skill that increases the individual's capacity to perform tasks required in school and vocational training (e.g. learning for a test after class or exercising effort to finish a professional task on time). It may also have a positive influence on the effort necessary to apply for an apprenticeship. Someone who has little belief in what he can affect will not only anticipate lower monetary returns to education but lower immediate incentive to effort (e.g. in the form of anticipated better grades when learning more or higher chances of finding an apprenticeship when sending out more applications). In a typical model of human capital investment, the locus of control would have two effects on educational outcomes. Firstly, externalisers have higher opportunity costs of effort in school since they perceive a stronger dependence between their effort and educational success. In our approach, this will be considered as an indirect effect operating through school grades. Secondly, the locus of control can have a direct effect through the decision to stay in school and the behaviour necessary for the successful transition to apprenticeship and its completion.

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. 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). The standard deviation of the overall distribution of the Rotter index is 3.1 points.

Tabelle 1

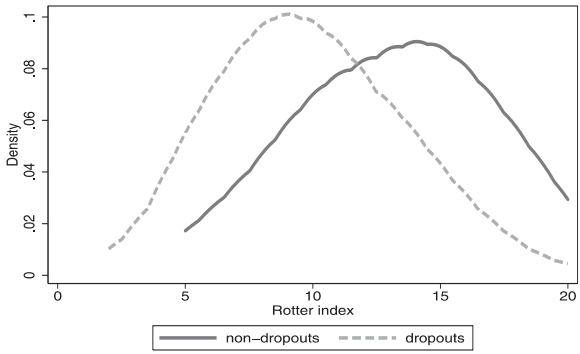
Mean values Rotter's Locus of Control

Statement	Dropout	Non-dropout	*t*-value
I decide the way my life is run	3.47	3.52	1.35
Compared to others, I haven't attained what I deserve	2.78	3.12	7.26
What you achieve in life is mainly a matter of fate or luck	2.60	2.82	4.44
Experience that others determine my life	2.24	2.40	3.22
In case of difficulties doubts about own abilities	2.66	2.94	5.67
Little control over life	3.45	3.54	–0.35
One has to work hard to achieve success	2.51	2.76	5.19
Possibilities limited by social conditions	2.18	2.35	3.76
Abilities are more important than effort	1.97	2.03	1.27
Social and political activities influence social conditions	2.91	3.15	4.97
Locus of Control (all statements)	26.76	28.51	8.98
Observations	279	2,254	

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.

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).



Source: SOEP 2000–2007. Own calculation.

Figure 1: Rotter index for 17-year-olds

3.3 School Achievements

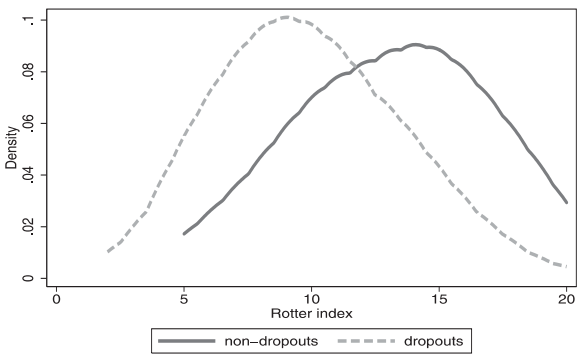
For measuring the individuals' academic ability, we do not observe cognitive skills in the form of IQ-tests or general academic performance tests as available e.g. in the PISA survey. Meanwhile, the data set contains information on the latest school grades obtained in mathematics and German. The grades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

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

of good grades. To some extent, the Länder (regions) provide regulations on how teachers should decide about this transfer. In general, a grade average between 2 and 3 is necessary for being recommended to enter 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 a grade 2 at the lower school track corresponds to a 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 the 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 13.16 for non-dropouts and 9.89 for dropouts.



Source: SOEP 2000–2007. Own calculation.

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

[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).

[4] Sensitivity analysis introducing the dummies for mean school grades, school tracks and interactions lead to little change in the probit regression presented subsequently in Table 5. But given the large number of additional variables it becomes difficult to compute the covariance-matrix. Results are available from the authors upon request.

3.4 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 general schooling or vocational training beyond the lower secondary level as educational dropouts. Since we observe individuals aged 18 to 21, the status of having dropped out may be transitory for a number among them. The most obvious reason is that someone who initially fails to secure an apprenticeship may do so later. It is also possible that someone drops out of one apprenticeship to enter another at a later stage, or that someone returns to secondary school after having left without a degree. More precisely, a person is considered as an educational dropout if he or she:

(1) left school without any degree, irrespective of subsequent vocational training

(2) left lower-secondary school (grade 10 or below) with a degree (Hauptschulabschluss, Realschulabschluss or 'mittlere Reife' obtained at Gymnasium) or reports holding a degree of the category 'other degree', and is neither enrolled in vocational education nor holds a vocational degree.

(3) is enrolled in a preparation year for vocational training (Berufsvorbereitungsjahr) or an elementary vocational year (Berufsgrundbildungsjahr)

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

Since the survey offers the category 'other' in the variable indicating the school degree but the German school system does not offer any other regular degrees, we checked empirically whether this corresponds to higher or lower educational achievement than the Hauptschulabschluss or Realschulabschluss. As a very high share of those reporting this kind of degree turned out to fulfill all other criteria of being a dropout (the share of holders of a Hauptschulabschluss being dropouts is lower), we included this category of reported degrees in case (2). In point (3) and (4) we 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. This definition implies that we do not consider as dropouts:

- those who are currently enrolled in school or training, except those under (3)
- those who have obtained a degree from upper-secondary schooling (finishing grade 12 or 13), granting access to higher education (Abitur or Fachhochschulreife).

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 an 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 the 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.

4. Determinants of Educational Dropout

4.1 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 about as old as non-dropouts in the pooled sample for 18- to 21-year-olds. The overall share of dropouts is 11 %. 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

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

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.

Tabelle 2

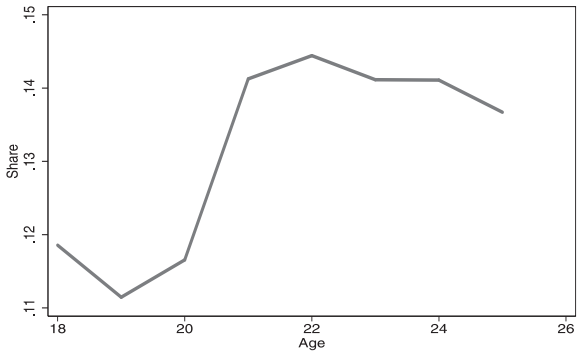
Descriptive statistics by dropout status

	Non-Dropout		Dropout	
Share	0.89		0.11	
West German share	0.70	(0.46)	0.67	(0.47)
Female Share	0.52	(0.50)	0.41	(0.49)
Age	19.10	(1.02)	19.17	(1.08)
Migration background	0.17	(0.38)	0.27	(0.44)
Rotter index	28.51	(3.01)	26.76	(3.44)
Grade score	13.16	(3.56)	9.89	(3.38)
Rotter index, mother	45.11	(7.25)	42.33	(7.15)
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	0.16	(0.36)	0.05	(0.22)
No training qualifcation	0.13	(0.33)	0.29	(0.45)
Apprenticeship degree	0.63	(0.48)	0.63	(0.49)
Higher apprenticeship degree	0.06	(0.23)	0.01	(0.12)
University degree	0.19	(0.39)	0.08	(0.27)
Not working	0.22	(0.42)	0.41	(0.49)
Blue-collar worker	0.21	(0.41)	0.30	(0.46)
White-collar worker	0.43	(0.50)	0.24	(0.43)
Self-employed	0.08	(0.27)	0.04	(0.20)
Civil-servant	0.06	(0.23)	0.01	(0.09)
Observations	2,254		279	

Note: Standard deviation in parentheses.

Source: SOEP 2000 – 2007. Own calculation.

In order to get an impression of the pattern of educational dropout among young adults, we consider a broader sample of 18- to 25-year-olds observed with one time-lag (containing 14,718 observations). The share of dropouts rises from around 12 percent to 14 percent after the age of 20 (see Figure 3).



Source: SOEP 2000 – 2007. Own calculation.

Figure 3: Distribution of educational dropouts over age cohorts

At the individual level, one observes nonnegligible rates of entry to the 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. Exit may be just temporary if someone goes back to school or enters an apprenticeship and then drops out again. 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 interesting to see the evolution of entry and exit rates over age cohorts. Considering those in the sample of 18- to 25-year-olds, we observe that entry rates are almost continuously declining from the age of 18 on. The exit rates decline from the age of 19 on, but slightly faster (see Table 3).

Tabelle 3

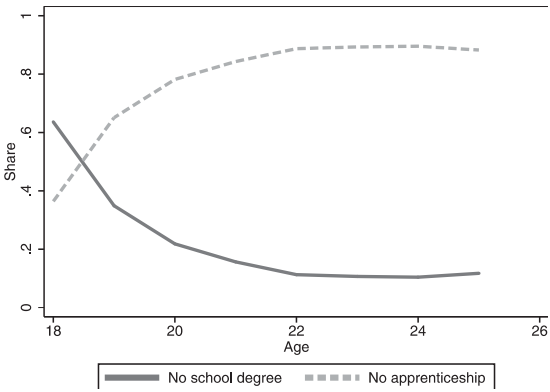
Dropout status

Age	Stayed non-dropout	Stayed dropout	Exit dropout	Entry dropout
18	84.1	3.5	4.0	8.4
19	83.2	5.3	5.7	5.8
20	84.3	7.2	4.0	4.4
21	83.1	9.6	2.7	4.6
22	83.5	10.8	2.0	3.6
23	84.6	11.8	1.3	2.2
24	84.9	12.8	1.0	1.3
25	85.7	12.8	0.6	0.9

Note: Shares in percent.

Source: SOEP 2000 – 2007. Own calculation.

The reason of being a dropout changes over time. At the age of 18, 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).



Note: Shares in percent.

Source: SOEP 2000 – 2007. Own calculation.

Figure 4: Reason for dropouts status over age cohorts

4.2 Empirical Approach

Our goal is to assess the role 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, given 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 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, an instrumental variable estimation and a panel estimation with correlated random family effects.

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:

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

As additional covariates we include gender, having a migration background, living with both parents up to the age of 15 and living in West Germany. Girls are generally expected to be less at risk of educational dropout whereas those with a migration background are expected to experience a higher risk. In eastern Germany, transition to apprenticeship might be more difficult. Not growing up with both parents might represent a destabilizing situation during childhood or youth. Controlling for these covariates may still not solve the problem of school grades depending on unobserved skills. Therefore we apply an instrumental variable estimation to the pooled sample. In order to explicitly allow for the nonlinearity of the model explaining educational dropout, one would have to resort to parametric 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.

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 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

[6] Fathers have a higher number of missings because they are more frequently not living in the households. So we did not use data on their education and skills.

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 in the estimation sample who did not obtain this recommendation, 15 % attended Hauptschule as a final school. Once two individuals have attained equal school achievement, the recommendation for Hauptschule is considered not to have any independent effect on the probability of being a dropout. We expect the instrument z_i to be correlated with school achievements, $cov(ac_i, z_i \neq 0)$, and uncorrelated with the error term u_i, $E[u_i|z_i] = 0$. The first stage regression of the score of school achievements and other exogenous variables (not shown here) yields a highly significant coefficient for school recommendation at the 1% and an F-statistic of 129 supporting the relevance of the instrument. Since the efficiency loss associated with instrumental variable estimation prevents the identification of effects for individual age cohorts, we estimate the model using the pooled sample for 18 to 21-year-olds.

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 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 model with correlated random effects (CRE) estimating mean and age-dependent effects of the Rotter index and school grades on dropout status. In this model the unobserved family effects are not completely random but conditional on the family average of the Rotter index and school grades. With regard to the underlying economic hypothesis, this approach is closer in spirit to fixed effects models than to the pure random effects models. It represents an alternative to the former when estimating nonlinear models (see Cameron and Trivedi (2008) p. 719).

Our main interest lies in the effect of the Rotter index on educational dropout holding school achievements up to the age of 17 constant. We observe the Rot-

ter 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. One may be concerned about poor school grades observed up to the age of 17 leading to dropout per definition. Those not holding a school degree represent the smaller fraction of the observed educational dropouts. Thus the problem would not occur for a large number of observations. Moreover, it is generally possible to return to school (e.g. in evening class) after not obtaining a degree, so the relation between bad grades up to the age of 17 and remaining a dropout at ages 18 to 21 does not exist per definition.

4.3 Results

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 of being a dropout declines with age while the effect of the Rotter index tends to increase (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.

Tabelle 4

Probit estimation educational dropout

	18 years	**19 years**	**20 years**	**21 years**
Grade score	–0.027***	–0.017***	–0.018***	–0.016***
	(0.003)	(0.003)	(0.003)	(0.005)
Rotter index	–0.007*	–0.011**	–0.013***	–0.021***
	(0.003)	(0.003)	(0.004)	(0.006)
Pseudo-R^2	0.20	0.1	0.11	0.11
Sample size	908	772	533	320

Notes: Average marginal effects. Standard errors are in parentheses: ***signifcant at 1%, **at 5% and *10% level.

Source: SOEP 2000 – 2007. Own calculation.

Introducing the full set of covariates reduces the effect of school grades on the probability of being a dropout by a fifth to around half (see Table 5). The effect of the Rotter index does not change much. 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 18, around 60 % of all dropouts do not hold a school degree or are in schooling situations that indicate some kind of failure. The remaining 40 % hold a school degree but have not managed to enter into vocational training after leaving school. Both situations plausibly depend on school grades. At ages 19 to 21, the overall share of dropouts increases only slightly, but the share of those that have completed a school degree but have failed to enter or complete an apprenticeship rises up to more than 80 %. During this stage, noncognitive skills seem to play an increasingly important role.[7]

Tabelle 5

Probit estimation educational dropout, with control variables

	18 years	**19 years**	**20 years**	**21 years**
Grade score	–0.023***	–0.011***	–0.011***	–0.008
	(0.003)	(0.003)	(0.004)	(0.006)
Rotter index	–0.006*	–0.009***	–0.012***	–0.021***
	(0.003)	(0.003)	(0.005)	(0.006)
Rotter index mothe	0.001	0.000	0.001	0.001
	(0.001)	(0.001)	(0.002)	(0.002)
Female	0.007	–0.027	–0.043	–0.031
	(0.020)	(0.020)	(0.028)	(0.037)
Family together	–0.036	–0.029	–0.021	-0.031
	(0.024)	(0.026)	(0.036)	(0.048)
Migration background	0.081**	0.01	–0.02	–0.099***
	(0.031)	(0.028)	(0.034	(0.037)
Education mother	yes	yes	yes	yes
Occupation mother	yes	yes	yes	yes
West	yes	yes	yes	yes
Pseudo-R^2	0.27	0.18	0.15	0.22
Sample size	908	772	533	320

Notes: Average marginal efects. Standard errors are in parentheses: ***signifcant at 1%, **at 5% and *10% level.

Source: SOEP 2000 – 2007. Own calculation.

[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. Additionally we conducted sensitivity analysis splitting up the dropouts into those holding no school degree and those holding a school degree. In the latter case, the observed age pattern persists although the effects are slightly reduced. For those without any school degree the number of observations at ages 20 and 21 is too small to make comparison over age cohorts meaningful. Results available upon request.

The effects of school achievements are reduced 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. The average marginal effect of a one point increase in the Rotter index on the probability to be a dropout lies between 0.6 and 1.2 percentage points for these cohorts. This implies that a standard deviation difference in noncognitive skills (3.1 points) is related to a dropout probability that is 1.9 to 3.7 percentage points lower at constant school grades. The effect of the grade score itself on dropout probability ranges between 1.1 and 2.3 percentage points per grade point. An individual whose grade score is one standard deviation higher (3.7 points) has on average a probability of being a dropout that is between 4 and 8.5 percentage points lower. Noncognitive skills make a smaller difference in dropout probability than school achievements but comparing the magnitudes the influence is not negligible.

In IV estimation, the average effect of school grades on dropout status rises in absolute value compared to the probit estimation while the effect of noncognitive skills decreases (see Table 6). However, the confidence intervals for the effect of school grades overlap and the 'difference-in-Sargan' statistic[8] does not clearly support their endogeneity. Our preferred specification remains the probit model with the full set of covariates.

We finally consider the model with correlated random effects (CRE) estimating mean and age-dependent effects for a pooled sample including 862 observations. 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, the Rotter index has a significant effect on the probability of being a dropout (see Table 7). The coefficient is at the lower bound of those found in the Probit and IV specifications. In the model introducing interactions with age, the main effects of school grades and the Rotter index are both significant. The age-dependent effects have the same sign as in the probit model. The interaction effect for school grades is significant and the one for the Rotter index 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.

[8] *C*-statistic reported in Stata.

Tabelle 6

IV estimation educational dropout

	OLS	IV GMM
Grade score	–0.016***	–0.028***
	(0.003)	(0.010)
Rotter index	–0.011***	–0.008***
	(0.003)	(0.003)
Age	0.002	0.001
	(0.006)	(0.006)
Female	–0.01	–0.005
	(0.017)	(0.019)
Family together	–0.034	–0.021
	(0.024)	(0.026)
Migration background	0.015	0.018
	(0.027)	(0.027)
Education mother	yes	yes
Occupation mother	yes	yes
West	yes	yes
R^2	0.12	0.11
p-value *C*-statistic exogeneity		0.22
Number of observations	2,479	2,479

Notes: Standard errors are in parentheses, clustered for individuals: ***signifcant at 1%, **at 5% and *10% level.

Source: SOEP 2000 – 2007. Own calculation.

Tabelle 7

Estimation educational dropout with siblings sample, CRE

		with age efects
Grade score	–0.003	-0.007**
	(0.003)	(0.004)
Grade score*age	x	0.003***
	x	(0.001)
Rotter index	–0.006***	-0.004*
	(0.002)	(0.002)
Rotter index*age	x	-0.002
	x	(0.001)
Age	0.001	0.015
	(0.005)	(0.029)
Mean grade score of the family	–0.017***	–0.017***
	(0.005)	(0.005)
Mean Rotter index of the family	0.002	0.002
	(0.002)	(0.002)
χ^2	40.6	41.00
Sample size	857	857

Notes: Average marginal effects. Standard errors are in parentheses, bootstrapped with 1000 replications, clustered for household and person: ***signifcant at 1%, **at 5% and *10% level.

Source: SOEP 2000 – 2007. Own calculation.

5. Conclusion

We have investigated the effect of noncognitive skills on 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 of 2 to 4 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. This effect appears to be getting more important, as individuals get older. 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. / *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. / *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. / *ter Weel*, B. (2008): The Economics and Psychology of Personality, Journal of Human Resources 43(4), 972 – 1059.

Caliendo, M. / *Cobb-Clark*, D. / *Uhlendorff*, A. (2010): Locus of Control and Job Search Strategies, IZA Discussion Paper 4750.

Cameron, A. C / *Trivedi*, P. K. (2008): Applied Microeconometrics Using Stata, Stata Press Press, College Station (TX).

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

Cebi, M. (2007): Locus of Control and Human Capital Revisited, Journal of Human Resources 42(4), 919 – 931.

Coleman, M. / *DeLeire*, T. (2003): An Economic Model of Locus of Control and the Human Capital Investment Decision, Journal of Human Resources 38(3), 701 – 721.

Cunha, J. / *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 / 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. / *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. / *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. / *Zimmermann*, V. (2000): Young and Out in Germany. On Youths' Chances of Labor Market Entrance in Germany, in: D. Blanchflower / R. B. Freeman (eds.), Youth Unemployment and Joblessness in Advanced Countries.

Heckman, J. J. / *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. / *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. / *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.

Piatek, R. / *Pinger*, P. (2010): Maintaining (Locus of control? assessing the stability and impact of noncognitive skills over the life-cycle, ZEW Discussion Paper 10-093.

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. / *Schupp*, J. (2007): The German Socio-Economic Panel Study (SOEP) – Scope, Evolution and Enhancements, Schmollers Jahrbuch / Journal of Applied Social Science Studies 127(1), 139 – 169.