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Effects of age at school entry (ASE) on the development of non-cognitive skills: Evidence from psychometric data

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ABSTRACT

We identify effects of age at school entry (ASE) on the development of child temperament. Our analysis is based on psychometric measures from a longitudinal cohort study of children in the Rhine-Neckar region in central Germany. In children with a higher ASE due to a birthday late in the year, we find more favorable outcomes with respect to several temperamental dimensions: these children are more persistent and less often hyperactive. The findings are robust if we control for the respective temperamental dimension before entering school. We also show that the ASE effect on persistence is stable over time by comparing the children at age eight and age eleven, after the children have entered Germany's segregated secondary-school tracks. At age eleven, we additionally find significant ASE effects on adaptability to change. Overall, the results point to a high degree of malleability in the considered non-cognitive skills after school entrance. By contrast, we do not find a significant effect of ASE on cognitive skills as measured by IQ.

1. Introduction

Parents are interested in how educational institutions affect their child's development, for schooling may impact not only cognitive skills but also various dimensions of personal growth. In this paper, we examine how school enrollment at a relatively young age in relation to age-based cut-off dates for school entry affects the development of non-cognitive skills. Economists have observed that cognitive skills are especially malleable in early childhood, before children enter school, and that non-cognitive skills seem to be also malleable in the later childhood years (e.g. Cunha, Heckman, Lochner, & Masterov, 2006). This paper provides evidence on the malleability of children's non-cognitive skills after school entry. To assess non-cognitive skills, we draw on measurements of child temperament at age 4.5, 8 and 11.[4] Psychologists consider child temperament to be an open system, developing over time in the context of experiences (cf. Rothbart & Bates, 1998).[5] Therefore, one would expect that experiences made in school affect the development of temperamental traits. Additionally, we observe child IQ results as a measure of cognitive skills.

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[4] Temperament is defined as constitutionally based (i.e. rooting on a biological basis of genetic inheritance, maturation and experience) individual differences in emotional, motor and attentional reactivity and self-regulation and includes differences in basic psychological processes constituting the affective, activational and attentional core of personality and its development (Rothbart & Bates, 1998).

[5] This is true even if temperamental traits are to some extent stable over time and situations (cf. Buss & Plomin, 1975).

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There is ample evidence in the existing literature that, at least in the short-run, a relatively younger age at school entry (ASE) negatively impacts child educational outcomes (e.g. Bedard & Dhuey, 2006; Fredriksson & Öckert, 2005; Mühlenweg & Puhani, 2010). Recent studies have also gone beyond examining traditional school outcomes like test scores and educational attainment: Dhuey and Lipscomb (2010), for example, provide evidence that relatively younger students in the US are more often classified as having learning disabilities than older students. Similarly, Elder and Lubotsky (2009), Evans, Morrill, and Parente (2010) and Elder (2011) report that relatively younger students are more often classified as having Attention Deficit Disorder (ADD) or Attention Deficit Hyperactivity Disorder (ADHD).

Other recent studies have focused on social outcomes: using data from 17 countries, Mühlenweg (2010) shows that relatively young students within a given grade are more often victims of school violence. Similarly, for the US, Dhuey and Lipscomb (2008) report that students who enter school at a relatively old age due to their birth dates are significantly more likely to hold a high school leadership position than relatively younger students. Based on Norwegian data, Black, Devereux, and Salvanes (2008) show that younger school entrants have a higher probability of teenage pregnancy. We are not aware of previous studies observing ASE effects on the development of non-cognitive skills.

In this paper we draw on a unique panel database from the Rhine-Neckar region in central Germany that contains psychometric information on child temperament. We use children's assigned age at school entry (AASE) as an instrument to identify the age at school entry (ASE) effects, as this is the standard used in the above-mentioned empirical literature. Assigned age at school entry is solely determined by date of birth and by the cut-off date. The panel structure of the data also allows us to control for children's temperament prior to school entrance (at age 4.5), and thereby check the robustness of our results. We show that children entering school at a relatively young age because of school entry-age regulations are significantly less persistent and more irritable. At age 8, they have a higher risk of being hyperactive (this effect on hyperactivity is smaller in size and no longer statistically significant at age 11). At age 11, we find that young school entrants are significantly less adaptive to change. ASE exerts no significant impact on IQ, which is consistent with the view of a lower malleability of cognitive skills after early childhood. Our findings are robust if we control for the respective temperamental dimension prior to school entrance.

The paper proceeds as follows: Section 2 explains the identification strategy in order to estimate ASE effects. Section 3 details the database, its psychometric measures and presents summary statistics. Section 4 presents and discusses the results from the instrumental variable estimation and several robustness checks. Section 5 concludes.

2. Identification strategy

Causal analysis of the effects of ASE is hampered by the fact that a child's development prior to entering school might influence *when* enrollment occurs. If the school entry of children with developmental problems tends to be delayed to the following year, they will be the oldest in the class upon enrollment. As a result, if we found a negative correlation between higher age at school entry and the dimensions of child temperament, this would not allow us to conclude that ASE has negative effects on temperament. Such a negative correlation could rather imply that entering school later did not improve a child's initial problems; children who enroll later because of developmental problems may simply still have problems when observed later on. We are thus faced with a case of potential reverse causality. ASE might be endogenous to the outcomes of interest.

In order to identify the causal effects of age at school entry, in our main identification strategy we draw on the official ASE rule which was instituted in West Germany in the late 1980s. The rule states that children should enter school in the year they turn six if they are born between January and June.[6] Those born between July and December should enter a year later. About 81% of children in our sample entered school according to the official rule. 10% entered school when they were a year older than the recommended age and 9% entered a year younger.

According to the ASE rule, a major source of variation in ASE is variation in birth date. Also, this part of the variation may be considered to be exogenous to the outcome variables. We use this exogenous source of variation in the ASE in order to identify causal effects.[7] First, we regress each of the different dimensions of temperament on the assigned ASE.[8] A positive coefficient on some of the dimensions of temperament would indicate that entering school relatively old due to a birth date after the cut-off has a positive effect on temperament. Since this reduced-form estimation is calculated based on the sample of all children and not all children comply with the ASE rule, this effect may be considered a net effect of being born after the cut-off date. If everyone were forced to comply with the ASE rule, the effect of being born late in the year would potentially be higher.

In a second step, we use instrumental variable estimation in order to identify a causal effect of age at school entry. To this end, the recommended ASE is taken as an

[6] School officially begins in Germany with the first grade; unlike the US kindergarten (known in Germany as "Vorschule") is not considered the first year of school and is not mandatory.

[7] The instrument has previously been criticized, and may be invalid if (1) parents deliberately time births in order to make their children enter school at a specific age; or (2) if date of birth has a direct effect on the outcomes of interest. However, based on data from the U.S., Dickert-Conlin and Elder (2010) recently provided evidence against the deliberate timing of childbirth with respect to the cut-off date. Additionally, they show that the incidence of a birth date before a cut-off date is not related to mothers' characteristics and early child outcomes. We also conducted several robustness checks to address this concern. In particular, we ran a placebo regression of ASE on the temperamental outcomes before school entrance (at age 4.5). None of the ASE coefficients were significant in this regression (detailed results are available upon request from the authors).

[8] We have also tried an alternative specification where we use an indicator variable for being born after the cut-off date as the regressor. All the presented results are robust if we proceed this way. This is essentially a version of the evidence from Table 2.