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Bernhard C. Dannemann

Erkan Gören

V – 408-18

April 2018

Department of Economics
University of Oldenburg, D-26111 Oldenburg

The Educational Burden of ADHD: Evidence From Student Achievement Test Scores *

Bernhard C. Dannemann†
Carl von Ossietzky University Oldenburg

Erkan Gören‡
Carl von Ossietzky University Oldenburg

This Version: April 2018

Abstract

This paper hypothesizes and empirically establishes the educational burden of the ADHD-related behavioral symptoms inattention and/or hyperactivity-impulsivity on aggregate cognitive achievement outcomes. We use a novel compilation of the 2- and 7-repeat allele variants of the human DRD4 exon III gene that candidate gene association studies have identified as an important biomarker in the etiology of childhood ADHD. The main results show a negative and statistically significant association between aggregate international student achievement test scores and the DRD4 exon III 2- and 7-repeat allele frequency measure in a cross-section of 81 countries. This finding is robust to the inclusion of additional country-specific historical, cultural, socioeconomic, biogeographic, health-related, educational, genetic, and diversity factors. Additional estimates suggest the predictive power of the country-level DRD4 exon III 2- and 7-repeat allele frequency measure on cross-country differences of estimated ADHD prevalence rates, confirming the reliability of the proposed biomarker for the measurement of ADHD-related behavioral symptoms in the general population.

Keywords: Human Capital, Cognitive Ability, Cognitive Skills, International Student Achievement Tests, Education Production Function, ADHD, DRD4 Exon III, Genetic Diversity

JEL Classification Numbers: E70, I10, I20, J24

*We would like to thank seminar participants at the Carl von Ossietzky University Oldenburg 2017 for helpful comments and suggestions. All remaining errors are our own.

†Carl von Ossietzky University Oldenburg, School of Computing Science, Business Administration, Economics, and Law (Faculty II), Institute of Economics, Building A5, 26111 Oldenburg, Germany, Tel.: +49-441-798-2625, e-mail: bernhard.dannemann@uni-oldenburg.de.

‡Carl von Ossietzky University Oldenburg, School of Computing Science, Business Administration, Economics, and Law (Faculty II), Institute of Economics, Building A5, 26111 Oldenburg, Germany, Tel.: +49-441-798-4292, e-mail: erkan.goeren@uni-oldenburg.de.

1 Introduction

The distribution of cognitive skills has been identified as a key determinant of economic and social outcomes, at both the individual and macroeconomic level. The acquisition of cognitive skills significantly predicts individual labor market outcomes, the distribution of income in society, and overall economic growth. On the individual level, increased cognitive skills manifest themselves in higher earnings and job quality, a lower risk of unemployment, and an overall improved socioeconomic status (Cawley et al., 2001; Heckman et al., 2006; Hanushek et al., 2015), among other outcomes. Additionally, evidence from country-level studies suggests that aggregate measures of cognitive skills in society are positively related to higher long-run economic growth rates (Hanushek and Kimko, 2000; Hanushek and Woessmann, 2012). Thus, uncovering the main determinants behind the acquisition of cognitive skills in society should facilitate our understanding of observed differences in standard of living across countries.

The relevant human capital literature identifies a number of possible determinants of cognitive skill outcomes, including family inputs (e.g., parental education, socioeconomic status, and time devoted to child rearing), peer inputs (e.g., social interaction with classmates and friends), schooling inputs (e.g., class size), and innate ability factors (Card, 1999; Cunha and Heckman, 2007). Although empirical studies suggest that parenting , teacher quality, and the institutional framework of the educational system may also play a role in cognitive skills (Schuetz et al., 2008; Hanushek, 1997; Ammermueller and Pischke, 2009), the operationalization and quantitative assessment of innate ability factors has received relatively little attention in the research to date (Todd and Wolpin, 2007; Cunha et al., 2010). This finding is surprising insofar as individual-level studies suggest a considerable role of innate ability factors in the total variation in individual cognitive skill outcomes (Anger and Heineck, 2010; Schuetz et al., 2013).

In this paper, we examine the possible role of childhood Attention-Deficit/Hyperactivity Disorder (ADHD) and its implications for the acquisition of cognitive skills across the life span. The bulk of evidence from molecular genetic studies suggests that childhood ADHD-related behavioral symptoms inattention and/or hyperactivity-impulsivity have a highly heritable component, thus qualifying them as an innate ability factor in the analysis of individual cognitive skill outcomes. In particular, the child's emotional capacity to pay attention to school tasks has been identified as an important determinant of individual learning success.[1] ADHD represents one of the most common childhood mental disorders with a pooled worldwide prevalence rate in the range of 5.3% to 7.2%, depending on the type of diagnostic criteria used for classification (Polanczyk et al., 2007; Thomas et al., 2015). A large number of neuropsychological studies suggest that children with the ADHD-related behavioral symptoms inattention and/or hyperactivity-impulsivity face serious difficulties in everyday social life, particularly in situations at school and at home, leading to worse educational outcomes, such as less formal schooling, poor grades, and higher school drop-out rates (Mannuzza and Klein, 2000; Bauermeister et al., 2007; Langberg et al., 2011; Birchwood and Daley, 2012). In contrast to popular belief, symptoms of childhood ADHD do not disappear upon reaching adolescence or young adulthood (Mannuzza et al., 1993; Kessler et al., 2006). Instead, the developmental disadvantages and the lack of education and socialization persist even in older ages, leading to long-term consequences for individuals with ADHD, including poor academic achievement, low-skilled occupations, higher illness-related absence from work, and a higher number of workplace accidents (Mannuzza and Klein, 2000; Barkley et al., 2006; Klein et al.,

[1] The bulk of evidence reported in Cunha and Heckman (2007) make it clear that early childhood development is critical for the acquisition of important cognitive skills and that any skill deficits can be made up only with much greater individual effort in later life.

2012).

Our empirical approach combines various data sources to quantify the educational impact of ADHD on aggregate cognitive skill outcomes in a cross-section of countries. For the construction of the main dependent variable in the empirical analysis, we use aggregated student achievement test scores from two large-scale international student achievement tests – the Programme for International Student Assessment (PISA) and the Trends in Mathematics and Science Study (TIMSS) – to approximate the average level of cognitive ability in the general population. In these studies, students in a number of countries were evaluated over a number of years. We pool the various international student achievement tests, first across students and then by waves for each of the two studies. This procedure allows the aggregate student achievement test score to be used as a measure of cognitive ability in the general population rather than in the student population. More importantly, we use the frequency of the 2- and 7-repeat allele variants of the human dopamine receptor D4 (DRD4) exon III gene that candidate gene association studies have identified as an important factor in the emergence and etiology of behavioral symptoms of inattention and/or hyperactivity-impulsivity related to childhood ADHD. This measure was constructed in the study of Gören (2017a) by matching the entire distribution of ethnic groups in the Alesina et al. (2003) ethnicity data to the DRD4 exon III population genome data in Gören (2016). We regard the resulting country-level DRD4 exon III 2- and 7-repeat allele frequency measure as a strong proxy variable for the prevalence of ADHD-related behavioral symptoms in society. Additionally, we use a large set of country-specific historical, cultural, socioeconomic, biogeographic, health-related, educational, genetic, and diversity factors to rule out endogeneity concerns in the analysis between aggregate student achievement test scores and the country-level DRD4 exon III 2- and 7-repeat allele frequency measure that might arise from the issue of omitted variables.

In a preliminary step, we report a positive and statistically significant relationship between the country-level DRD4 exon III 2- and 7-repeat allele frequency measure and estimated ADHD prevalence estimates. This finding establishes the key hypothesis proposed in this paper: that the DRD4 exon III gene is able to predict the extent of ADHD-related behavioral symptoms across countries. Considering the estimated magnitudes, the empirical analysis suggests that a one percentage point increase in the country-level DRD4 exon III 2- and 7-repeat allele frequency measure would, ceteris paribus, increase the ADHD prevalence rate in the general population by about 0.4218 percentage points. This finding is robust to the inclusion of region fixed effects, and to a full set of cultural, historical, and socioeconomic controls. Nevertheless, we refrain from using estimated ADHD prevalence rates in the empirical analysis for several reasons. First, as shown below, estimated country-specific ADHD prevalence rates are heavily confounded by study-level methodological characteristics, including ADHD diagnostic criteria, informant source for ADHD behavioral symptoms, type of population sample, whether full or partial diagnostic criteria for ADHD were met, type of ADHD measurement, and the geographical region of the study, accounting for approximately 48% of the total variation in estimated ADHD prevalence rates across individual studies. This finding casts serious doubts on the reliability of reported ADHD cases across studies and therefore countries. Second, estimated ADHD prevalence rates could be prone to population stratification bias, as the studies are not representative of their respective populations (e.g., in terms of gender, age, ethnicity, or socioeconomic status), again limiting the external validity of estimated ADHD prevalence rates in the general population. More importantly, data on estimated ADHD prevalence rates are only available for a limited sample of 42 countries, most of which can be considered as highly developed economically. This might result in inconsistent Ordinary Least Squares (OLS) estimates if the selection process underlying the inclusion of countries is endogenously determined (Wooldridge, 2010, Chapter 19).

The baseline results suggest a negative and statistically significant impact of the country-level DRD4 exon III 2- and 7-repeat allele frequency measure on aggregated student achievement test scores in a cross-section of 81 countries. This finding is consistent with the macroeconomic burden of inattention and/or hyperactivity-impulsivity as behavioral symptoms of ADHD for school learning outcomes and subsequent educational achievement. Regarding the estimated magnitude, the results suggest that a one percentage point increase of the country-level DRD4 exon III 2- and 7-repeat allele frequency measure[2] would, ceteris paribus, result in a reduction in aggregate student achievement test scores of about 3.8765 points. This effect is quite sizable as it corresponds approximately to a $(0.0388/0.6240) \times 100 \approx 6.2180$ percentage change in the standard deviation of the aggregate student achievement test score variable. It is worth mentioning that the revealed association between the aggregate student achievement test score and the country-level DRD4 exon III 2- and 7-repeat allele frequency measure is robust to the inclusion of historical, biogeographic, health-related, socioeconomic, educational, genetic, diversity, and regional factors. These model specifications effectively rule out endogeneity concerns due to unobserved country-specific heterogeneity that might be correlated with both general cognitive ability and the prevalence of ADHD related behavioral symptoms of inattention and/or hyperactivity-impulsivity in society.

We report additional sensitivity tests to examine the robustness in the association between aggregate student achievement test scores and the country-level DRD4 exon III 2- and 7-repeat allele frequency measure. In a first exercise, we test the robustness of the main findings to the inclusion of various measures of genetic, ethno-linguistic, and religious diversity, to rule out the possibility that the estimated regression coefficients associated with the country-level DRD4 exon III 2- and 7-repeat allele frequency variable captures the impact of various forms of societal diversity on general cognitive ability. Next, we report coefficient estimates based on PISA international student test score outcomes only. This specification is intended to rule out the possibility that the results might be driven by the inclusion of the TIMSS student achievement test scores in the empirical analysis. In addition, we examine heterogeneous effects of the country-level DRD4 exon III 2- and 7-repeat allele frequency measure on the distinct PISA subjects – i.e., aggregated student-level mathematics and science test score outcomes – to ensure that the main findings were not driven by the individual PISA subjects and to underline the educational burden of the ADHD-related behavioral symptoms inattention and/or hyperactivity-impulsivity on general school learning outcomes. Since the association between aggregate student achievement test scores and the country-level DRD4 exon III 2- and 7-repeat allele frequency measure only provides an indirect link to the educational burden of behavioral problems related to ADHD, we report coefficient estimates that directly employ estimated ADHD prevalence rates as the key explanatory variable. Based on a reduced sample of 37 countries, we report coefficient estimates from both simple OLS and Instrumental Variables (IV) estimation approaches to cope with simultaneity in the association between aggregate student achievement test scores and reported ADHD prevalence rates. None of these sensitivity tests alter the main conclusions substantially.

This paper is related to the literature on the main determinants behind the formation of individual cognitive abilities. The theoretical framework of this investigation is a specification of an Education Production Function (EPF) that relates individual cognitive achievement outcomes to various family, peer, schooling, and innate ability factors (Todd and Wolpin, 2003). The bulk of individual-level studies based on within-country and cross-country variation in international student achievement test scores suggest a possible role of individual characteristics (e.g., age, gender, immigration background, and

[2] Given our prior finding, this corresponds to a rise in the estimated ADHD prevalence rate of about 0.4218 percentage points.

native language), family background (e.g., parental socioeconomic status), peer inputs (e.g., social interaction with other classmates and friends), and the institutional framework of the educational system (e.g., accountability, school autonomy, and competition from private schools) on students' cognitive achievement outcomes (Fuchs and Woessmann, 2007; Ammermueller and Pischke, 2009; Schuetz et al., 2013). Besides the findings from individual-level studies on cognitive skill formation, macro-level studies based on cross-country variation in aggregated student achievement test scores point to the importance of socioeconomic (e.g., the level of economic development, the government size, and conflict incidence), institutional (e.g., rule of law, democracy, and freedom from corruption), educational (e.g., schooling expenditures), and cultural (e.g., religiosity and gender equality) aspects of international differences in cognitive ability outcomes (Rindermann, 2008; Hanushek and Kimko, 2000; Guiso et al., 2008; Stoet and Geary, 2017). However, the importance of innate ability factors has been widely neglected in the relevant human capital literature, perhaps due to problems of data availability and the difficulty of modelling and quantifying such a latent factor in an empirical analysis that encompasses a wide variety of possible dimensions (e.g., genetic heritability, child socialization, and *in utero* experiences).

There is only scant research on the importance of innate ability factors for the acquisition of cognitive skills. For example, Anger and Heineck (2010) indirectly reveal the strong predictive power of innate ability factors for various measures of students' cognitive skills through the inclusion of parental cognitive ability into the regression equation. Other studies assess the importance of various genetic controls for cross-country differences in aggregate cognitive abilities (Minkov et al., 2016; Becker and Rindermann, 2016). Although there is substantial evidence in the neuropsychological literature that early childhood development of attention and/or impulse control has a significant and long-lasting impact on a wide array of private (e.g., individual academic, labor market, and health outcomes) and social (e.g., public safety) market returns (Moffitt et al., 2011), this is the first paper – to the best of the authors' knowledge – that empirically establishes the educational burden of ADHD-related behavioral symptoms on the accumulation of human capital at the macroeconomic level. We contribute to the relevant human capital literature by explicitly identifying an important innate ability factor (i.e., the ADHD-related behavioral symptoms inattention and/or hyperactivity-impulsivity) that have been examined frequently in the neuropsychological literature but largely neglected in the literature on the main determinants of observed international differences in cognitive skill outcomes.

The remainder of this paper is organized as follows. Section 2 reviews the relevant literature on diagnosis and symptoms of ADHD-related behavioral symptoms and its implications for subsequent individual economic and social life outcomes. Section 3 provides a detailed discussion of the main country-level controls employed in the empirical analysis. Section 4 provides evidence on the reliability of the country-level DRD4 exon III 2- and 7-repeat allele frequency measure as a strong biomarker indicating the prevalence of ADHD-related behavioral symptoms in society. In addition, we show that estimated ADHD prevalence rates derived from individual ADHD studies are heavily confounded by study-level methodological characteristics, thus casting serious doubts on the external validity of estimated ADHD prevalence rates for the general population. Section 5 highlights the importance of incorporating the issue of innate ability factors into the theoretical framework of the EPF and presents the econometric methodology regarding the association between aggregate student achievement test scores and the country-level DRD4 exon III 2- and 7-repeat allele frequency measure. The main empirical results are reported in Section 6. Section 7 provides additional sensitivity tests. Finally, Section 8 concludes by summarizing the main findings.

2 Theoretical Background: ADHD and Cognitive Ability

According to the *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition (DSM-5) published by the American Psychiatric Association (2013), several different subtypes of ADHD manifest themselves across the domains of inattention, hyperactivity/impulsivity, or combinations of the two in different settings (e.g., at home, school, workplace, and other social activities). A clinical diagnosis of ADHD requires that at least six criteria (out of nine) for inattention and/or six criteria (out of nine) for hyperactivity/impulsivity that significantly interfere with childhood mental development and executive functioning persist for at least six months before the age of 12. For the inattention subtype, individuals are characterized by deficits in focusing on specific tasks, a lack of persistence, poor time management skills, and disorganization. The key diagnostic criteria for the hyperactive type are behavioral symptoms of excessive physical activity, personal disruption, and talkativeness, whereas the impulsivity type is described as making hasty, impetuous movements or decisions, in some cases with negative outcomes for themselves or their immediate environment (e.g., crossing a street without considering the traffic flow) (American Psychiatric Association, 2013). Typically, parents, teachers, or clinical personnel observe ADHD probands in the relevant contextual settings and evaluate their behavioral symptoms based on rating scales.

Reduced academic achievement and performance is by far the most researched outcome associated with the behavioral and executive functioning deficits of individuals diagnosed with ADHD. Childhood behavioral symptoms of inattention (e.g., off-task behavior in the classroom, not listening to classroom tasks, and frequent distractions), hyperactivity (e.g., excessive fidgeting and difficulty remaining seated), and impulsivity (e.g., difficulty in response inhibition) have direct implications for academic productivity (Raggi and Chronis, 2006). There exist numerous studies showing that ADHD probands have significantly lower academic performance, including (i) less formal schooling, (ii) lower final grades, (iii) higher probability of grade retention, (iv) increased use of special education services, (v) higher school drop-out rates, and (vi) lower high-school graduation and university degrees (Mannuzza and Klein, 2000; Bauermeister et al., 2007; Langberg et al., 2011; Birchwood and Daley, 2012). Although recruitment procedures (e.g., clinical vs. non-clinical community samples), investigated age groups (e.g., pre-school children, school-aged children, adolescence and adult samples), experimental design (e.g., cross-sectional vs. longitudinal cohort study), and inclusion of potential confounding factors (e.g., age, gender, socioeconomic status of parents, and presence of comorbid disorders) differ considerably across studies, the finding that ADHD symptoms significantly interfere with an individual's academic performance has been robustly demonstrated in numerous replication studies, with the core results having been synthesized and summarized in various meta-analysis and qualitative review studies (Frazier et al., 2007; Loe and Feldman, 2007; Polderman et al., 2010; Willcutt et al., 2012; Arnold et al., 2015).

Several studies have attempted to explain the negative correlation between ADHD behavioral symptoms and poor academic performance. Results showed that overall cognitive ability is significantly lower among individuals impaired by ADHD. Children diagnosed with ADHD show poor outcomes on a wide range of neuropsychological measures, including intelligence, set shifting ability, impulse control, sustained attention, working memory, processing speed, reaction time, response variability, and vigilance, with findings being more pronounced especially for the ADHD inattention-type group (Pennington et al., 1993; Frazier et al., 2004; Willcutt et al., 2012). Since overall cognitive ability appears to be of pivotal importance to an individual's problem-solving capabilities, the findings further predict poor scores on standardized tests of achievement in reading, writing, and mathematics among ADHD probands. Interestingly, the negative correlation between ADHD and the various measures of academic achievement (e.g., total mean grade and standardized test scores in reading, writing, and mathematics skills) remain relatively robust in studies accounting for the potential confounding influence of cognitive abilities, indicating that ADHD-related behavioral symptoms significantly predict academic underachievement beyond the influence of cognitive ability (Barry et al., 2002; Diamantopoulou et al., 2007; McConaughy et al., 2011). It is worth mentioning that even in representative community-based samples consisting of non-clinical participants, individuals displaying a continuum of ADHD-related symptoms perform as poorly on standard measures of academic achievement as their clinically diagnosed ADHD counterparts (Currie and Stabile, 2006; Rodriguez et al., 2007; Birchwood and Daley, 2012). The previous finding suggests that ADHD symptoms constitute a behavioral trait that is prevalent in the general population, which, depending on symptom severity, significantly interferes with future academic achievement and performance (Gray et al., 2017).

It has been reported that childhood ADHD persists significantly into adulthood (Mannuzza et al., 1993; Kessler et al., 2006). Consequently, the academic and cognitive deficits associated with behavioral symptoms of childhood ADHD have direct implications for future social, educational, occupational, and health functioning. Specifically, several prospective follow-up studies reported that childhood ADHD symptoms predict poor academic performance and occupational rank, low household income, low self-esteem, poor marital outcomes, give rise to an increase in antisocial personality and substance use disorders, social conflict with peers and family members, the propensity toward incarceration, early sexual intercourse, and the rate of sexually transmitted diseases in adulthood (Mannuzza and Klein, 2000; Barkley et al., 2006; Klein et al., 2012). Moreover, a 10-year prospective follow-up study indicates that ADHD probands had elevated risks of a wide range of adverse psychiatric disorders, including mood, anxiety, antisocial, and substance use disorders (Biederman et al., 2006). Additional studies have shown that mortality rates among ADHD probands are significantly elevated compared to normal controls, perhaps driven by the higher propensity toward risky behavior, traffic accidents , and suicide among individuals with ADHD (James et al., 2004; Olazagasti et al., 2013; Chang et al., 2014; Dalsgaard et al., 2015). In a study using Swedish national registers data, Lichtenstein et al. (2012) showed that ADHD probands had a higher risk of criminal behavior, and that pharmacological treatment results in a significant reduction in the risk of criminality. These results are in accordance with the findings that ADHD significantly worsens the quality of life in adults, including non-medical factors of satisfaction, comfort, resilience, risk avoidance, and achievement (Agarwal et al., 2012). Overall, the findings illustrate that ADHD probands face serious impairments during their life course, resulting in poor social and economic functioning and a significant reduction in their health-related quality of life and individual subjective well-being.

3 Data and Variables

In this section, we provide a detailed discussion on data construction and sources of the main dependent variable associated with the measurement of cognitive ability based on international student achievement test outcomes. Additionally, we motivate the use of the country-level DRD4 exon III 2- and 7-repeat allele frequency measure as a strong biomarker (i.e., proxy variable) for the measurement of the prevalence of ADHD-related behavioral symptoms in the general population, as evidenced by a large number of candidate gene association studies on the etiology of ADHD. In addition to the main dependent and explanatory variable, we also use a large number of country-level controls in the estimation of the EPF for two main reasons. First, the selectivity of these country-level controls is similar to the set of family, peer, and school inputs usually discussed in the empirical specification of individual EPFs. More importantly, the inclusion of a large set of country-level controls in the regression equation mitigates endogeneity concerns caused by unobserved country-specific heterogeneity that might be correlated with both international student achievement test outcomes and the distribution of the DRD4 exon III 2- and 7-repeat allele frequency measure. Thus, this kind of analysis ensures consistent estimation of the regression coefficients associated with the various input factors in the specification of the country-level EPF.

3.1 Main Dependent Variable: Student Achievement Test Scores

Generally, estimates of an EPF use some measurement of students' educational performance or outcomes for the operationalization of cognitive abilities or skills. Notable examples range from armed forces qualification tests (Heckman et al., 2006) and national or international student assessments (Hanushek and Woessmann, 2008, 2012) to international comparisons of IQ test results Lynn and Vanhanen (2002, 2006, 2011). The meaningfulness and validity of country-level IQ measures has been subject to intense scientific discussion, especially regarding their validity for the measurement of cognitive ability in the general population and issues related to data quality (Volken, 2003; Rindermann, 2007; Lynn and Meisenberg, 2010). We use student achievement test scores derived from International Student Achievement Tests (ISATs) to assess international differences in cognitive abilities for two main reasons. First, student achievement test scores are widely accepted as a measure of the overall cognitive abilities of students and/or the general population. Furthermore, it is widely agreed that student test scores share a common approach to measuring general intelligence that is comparable with IQ tests (Rindermann, 2007; Lynn and Vanhanen, 2011), with IQ being a determinant of cognitive skill formation (Lynn and Mikk, 2009). Second, ISATs are designed to be representative of the corresponding country's population and are thus suitable for measuring cognitive ability in the general population.

For the operationalization of cognitive ability, we use student performance outcomes from two large-scale scholastic assessment tests: the Programme for International Student Assessment (PISA) and Trends in Mathematics and Science Study (TIMSS). Up to the present day, six waves of the PISA study have been conducted at three-year intervals starting in 2000. The PISA study is targeted at the 15-year-old population of the participating countries, with participants varying across the different assessment waves. Despite being designed and maintained by the OECD, a large number of non-OECD member countries have participated in every wave of the study. The main concept is a cross-sectional design without any follow-up test for individual students, although national variants of PISA do exist. The OECD selects schools and students to be representative of each country's population of 15-year-olds. The second study, TIMSS, is conducted by the International Association for the Evaluation of Educational Achievement (IEA) at four-year intervals, starting in 1995, yielding a total of six waves up to the present day.[3] In contrast to PISA, TIMSS is administered to eighth-graders, which means that students are slightly younger than those in the PISA study.[4] The student sample is again chosen to be nationally representative of the respective population.

[3] Note that the IEA has also conducted prior studies, FIMS/FISS (1964/1970) and SIMS/SISS (1980,1983). However, these studies were not conducted at regular intervals and differ from today's studies in terms of test design and comparability. Thus, we do not consider these studies in the construction of the aggregate cognitive ability measure.

[4] Additional tests are conducted in the fourth grade and in the final year of secondary schooling, twelfth grade, but these are omitted from the current analysis as the age groups in these additional studies do not match those in the PISA studies.

Both ISATs are developed as paper-based student tests with questionnaires designed in the country's local language. Student test scores are calculated using item response theory (IRT) and both tests cover the subjects of mathematics and science. Reading, which is tested in the PISA study, is not part of the eighth grade questionnaire in TIMSS. By addressing a well-defined student sample and through consistent and comparable tasks, these student assessments give both broad and precise estimates of average scholastic achievement in a country. The PISA studies aim to measure real-life problem-solving skills rather than mastery of school curricula or *parrot-fashion learning* and are regarded as measures of applied ideas (Hanushek and Woessmann, 2008, 660), while TIMSS is based on shorter items that are closer to school curricula than the PISA studies and contain questions involving memorization rather than application (Rindermann, 2007, 670). All PISA studies consist of three subject domains – mathematics, science, and reading – with one of the subjects being the major and the other two being minor domains of the tests across the different waves of the assessment.

The data from both PISA and TIMSS are available for each assessment wave as student-level observations. For the macroeconomic analysis, in the first step, we aggregate student test scores to the country level using the weighted average for the subjects of mathematics and science in each ISAT and assessment wave. We employ the student probability weights provided to ensure representativity. In the second step, we calculate country-level aggregate student achievement test scores across the various assessment waves by applying the unweighted mean of the non-standardized scores rather than standardizing techniques, as suggested in Rindermann (2007).[5] The latter assumption is uncritical, as prior studies indicate that the variation in ISAT scores across the different assessment waves is driven mainly by measurement error rather than by systematic changes in student achievement test scores (Hanushek and Woessmann, 2012; Meisenberg and Woodley, 2013). In addition, both ISATs share a similar methodological background and a common scale, thus facilitating the comparability of student achievement test score outcomes across the various assessment waves.[6]

We use the aggregated country-level data on PISA and TIMSS student assessment test scores following a simple decision rule. If available, we give preference to PISA student achievement test scores over TIMSS, mostly due to the conceptual differences explained above. Accordingly, PISA scores in the domains of science and mathematics are used. As stated above, PISA reading scores, although available, are disregarded in the calculation of country-level aggregated student achievement test scores to ensure compatibility to the corresponding TIMSS data, as the latter lack observations on reading score outcomes in eighth-grade students. We employ the unweighted average of both subjects in the calculation of the country-level aggregated student achievement test scores to arrive at a broad indicator of cognitive skills in the general population.[7] In cases where PISA data are missing, the value of the corresponding TIMSS score is assigned.[8]

[5] In contrast to the proposed non-standardized approach, Hanushek and Woessmann (2008, 2012) adjust student achievement test scores in terms of level and variation to attain a score that is comparable across both countries and years.

[6] TIMSS and PISA use item-response theory to calculate plausible values for individual student achievement. Moreover, the study-level student achievement test data are calibrated to have a mean value of 500 and a standard deviation of 100 test score points across the sampled countries.

[7] In the sensitivity analysis, we show that the main findings are not driven by possible differences in characteristics of school curricula in the individual domains of mathematics and science.

[8] To ensure that the main results are not driven by this missing data replacement strategy, we include a recodification indicator for the replacements made in all model specifications to capture potential systematic differences between the two ISATs. In the empirical analysis covering 81 countries, we employ aggregated PISA student achievement test score data in 63 cases. In the remaining 18 cases, we rely on scores from TIMSS. It is worth mentioning that we find a high bivariate correlation coefficient ($Corr = 0.9066$, Number of countries = 43) between values for the two ISATs, suggesting that both tests capture general cognitive abilities in society in their own ways (Hanushek and Woessmann,

3.2 Main Explanatory Variable: DRD4 Exon III 2- and 7-Repeat Allele Frequency

Twin studies suggest that ADHD is a highly heritable psychiatric disorder, with estimated heritability rates of about 76% (Faraone et al., 2005). Evidence from brain imaging studies, pharmacological medication, and animal models provide strong support for the presence of dopamine dysregulation in the brain as the main cause in the etiology of ADHD symptoms.[9] In line with the dopamine theory of ADHD proposed by Levy (1991), initial candidate gene studies have identified a significant association of two important dopaminergic genes – the dopamine transporter gene DAT1 and the dopamine receptor gene DRD4 exon III – with ADHD (Cook et al., 1995; LaHoste et al., 1996). Although other candidate genes related to biological neurotransmission have been assessed in association with ADHD (e.g., DRD5, SLC6A4, and MAO-A)[10], DRD4 exon III polymorphism have been the candidate gene studied most extensively in case-control studies of ADHD, with a preponderance of replication studies robustly confirming the initial finding in LaHoste et al. (1996). Several meta-analytical reviews strongly confirmed the positive association between DRD4 exon III polymorphism and ADHD, indicating the importance of the human dopaminergic system for human behavioral outcomes related to locomotion, emotion, reward and cognition (Faraone et al., 2005; Bobb et al., 2006; Gizer et al., 2009; Wu et al., 2012).

The human dopamine receptor D4 gene (DRD4) consists of four encoded regions – called exons in molecular genetics – of which the third region is highly polymorphic. The primary allelic variants found in the human genome occur as a 48-base pair (48-bp) variable number of tandem repeats (VNTR) defined by the 2-repeat, 4-repeat, and 7-repeat alleles that exhibit differences in physiological functioning to dopamine releases between synaptic clefts in the brain (Van Tol et al., 1991, 1992; Lichter et al., 1993). It has been shown that the 7-repeat allele variant shows a blunted response to elevated dopamine levels relative to the ancestral 4-repeat variant. The 2-repeat allele also shows a suboptimal response to dopamine release but one that is less blunted compared to the 7-repeat variant (Asghari et al., 1995; Wang et al., 2004). It has been hypothesized that the blunted response to dopamine levels among the different DRD4 exon III allele variants might result in dopamine dysregulation between synaptic clefts in the human brain that eventually results in neuropsychological disorders such as ADHD (Swanson et al., 2007).

Although the genetic architecture of complex behavioral traits like ADHD is not fully understood, specific biomarkers might provide a reliable way to identify clinical symptoms and/or personality traits related to ADHD (Faraone and Bonvicini, 2014). The DRD4 gene is a promising candidate for this endeavor, since animal models suggest that it is mainly present in brain regions responsible for attention and response inhibition (Noaín et al., 2006). In addition, pharmacological studies suggest that DRD4 exon III 7-repeat carriers need higher doses of psychostimulant drugs such as methylphenidate compared to probands with one or two forms of the DRD4 exon III 4-repeat allele variant (McGough, 2012; Bruxel et al., 2014). This result is consistent with the aforementioned finding that the 7-repeat allele variant has a suboptimal blunted response to elevated dopamine signals compared to the ancestral 4-repeat variant.

Thus, the present study employs the DRD4 exon III 2- and 7-repeat allele variants as a strong biomarker to measure the prevalence of inattention and/or hyperactivity-impulsivity as symptoms of ADHD in society. The inclusion of the 2-repeat variant is motivated by the fact that it shows a similar blunted response to dopamine release in synaptic clefts.

2012).

[9] See Swanson et al. (2007) for a comprehensive review of the relevant molecular genetics literature.

[10] See Hawi et al. (2015) for a recent discussion of the set of genes that are candidates for the expression of the ADHD-related behavioral symptoms inattention and/or hyperactivity-impulsivity.

This issue is of particular importance among Asian populations that show very low frequencies of the 7-repeat variant but higher frequencies of the 2-repeat allele (Gören, 2016). The grouping of the DRD4 exon III 2- and 7-repeat allele variants is further supported by evidence from a candidate gene study among Chinese ADHD probands, indicating that ADHD was associated with a higher frequency of the 2-repeat variant that is comparable in magnitude to the 7-repeat frequency usually found among ADHD probands of European ancestry (Leung et al., 2005).

We use data on the prevalence of DRD4 exon III 2- and 7-repeat allele frequencies across a large number of countries. These data were constructed in Gören (2017a) by linking the Alesina et al. (2003) ethnicity data to the population genome data in Gören (2016) using information on language classifications from the *Ethnologue* database (Global Mapping International, 2010). Based on the findings from molecular genetics, we hypothesize that a higher prevalence of DRD4 exon III 2- and 7-repeat allele frequency in society is associated with a higher rate of ADHD-related behavioral symptoms.

3.3 Additional Control Variables: Biogeographic, Historical, Health-Related, Socioeconomic, Educational, Genetic, and Diversity Factors

Biogeographic Factors. We employ a basic set of biogeographic and climatic controls to examine, among other things, the impact of the soil quality, disease environment, and temperature on the accumulation of human capital in society.

In order to assess the impact of thermal stress on cognitive abilities, we use the country's mean temperature value during the period 1960 to 1990. Investigations on paired associate learning shows that cognitive abilities are influenced by ambient temperature (Allen and Fischer, 1978), indicating that student test performance could depend on the location and average temperature of the host country. Additionally, thermal stress due to high temperatures inside buildings is found to negatively affect student achievement by decreasing cognitive performance (Mendell and Heath, 2005; Hancock and Vasmatzidis, 2003; Amasuomo and Amasuomo, 2016).

We use the percentage of inhabitants at risk of contracting malaria to assess the prevailing conditions of the disease environment and its possible implications for cognitive achievement outcomes. Despite showing a rather low case-fatality rate, malaria prevalence is described as having severe symptoms and persistent effects on cognitive development and functioning, either directly through anemia or indirectly through lost time in education due to absenteeism from school (Bleakley, 2010; Gallup and Sachs, 2001). Malaria-related school absenteeism has been found to be an important predictor of increased grade repetition rates, school failure, higher school drop-out rates, and lifelong cognitive impairments (Sachs and Malaney, 2002; Gallup and Sachs, 2001). The eradication of parasite-borne diseases has been found to be associated with significant increases in returns to schooling by raising educational quality through reduced absenteeism from school (Bleakley, 2007).

Furthermore, we consider the percentage of a country's arable land area to account for the importance of the agricultural sector in the overall economy. We hypothesize that a larger share of the workforce engaged in the primary sector is generally associated with low-skilled occupational activities (e.g., cultivation of primary crops) which might require lower investments in the accumulation of human capital. The underlying mechanisms might be comparable to the resource curse hypothesis in development economics (Sachs and Warner, 2001; Easterly and Levine, 2003), in which excessive resource extraction might result in pervasive rent-seeking activities that negatively affect the accumulation of human capital in society (Sachs and Warner, 2001; Easterly and Levine, 2003). Additional studies indicate that a larger share of agricultural workers in an economy is correlated with reduced overall cognitive performance and a lack of incentives for educational investment. It has been hypothesized that a low cultural value of and lack of esteem for education are the main driving force behind this negative relationship (Barber, 2005; Rindermann, 2007).

Historical Factors. We hypothesize that education is affected by the kind of values, norms, and beliefs promoted by religious groups. Historically, Protestant and Catholic religious leaders have promoted and discouraged a variety of socioeconomic outcomes, such as political and civic engagement but also literacy (Putnam et al., 1993; Landes, 1998; Becker and Woessmann, 2009). In addition, religiosity has been shown to affect knowledge creation, especially through bans on the teaching of specific bodies of scientific thought (e.g., evolutionary theory in public schools) and through time devoted to the practice of religion (Stoet and Geary, 2017).

Furthermore, we examine the effect of legal traditions on the formation of cognitive skills. We assume that cultural, political, and economic conditions, but also the historical development of institutions, are reflected in a country's national legal and regulatory systems (La Porta et al., 1999). The effect of legal origins on present-day economic performance is described to operate mainly through the transmission channel of education (Rostowski and Stacescu, 2006), whereby the broad ideas underlying common and civic law have influenced not only the formulation of specific rules but also the formation of human capital. Thus, the spreading of legal traditions has also affected the acquisition of education through slow-changing expectations, beliefs, modes of thought, and ideologies (La Porta et al., 2008). For instance, the French legal tradition has been described as detrimental to educational policies due to interventions into school curricula designed to promote French language and culture and to repress "deviant" ideas that might undermine the legitimacy of the central government in society (La Porta et al., 2008). In addition, socialist legal traditions have been found to significantly affect the level of and preference for education in society through repression and a lack of individual vocational freedom (Alesina and Fuchs-Schuendeln, 2007; Fuchs-Schuendeln and Masella, 2016).

Health-Related Factors. As suggested by the literature on innate abilities, *in utero* experiences, such as overall maternal health, substance abuse (e.g., alcohol, tobacco, medications, and drugs) or insufficient provision of micro-nutrients affect prenatal health and children's physical and cognitive development. Child birth weight is considered a widespread measure of perinatal health, which, for full-term birth, substantially reflects the state of prenatal development. Low birth weight (LBW) is typically defined as infant birth weight being lower than $2,500$ grams.[11] However, this definition does not explicitly enable a comparable measurement of reasons for LBW, which can either be caused by intrauterine growth restriction, i.e., low weight for gestational age (Black et al., 2013) or by an interruption of the normal intrauterine growth cycle, i.e., through preterm birth (Goldenberg et al., 2000, 2008). Despite these and further conceptual difficulties associated with LBW as an indicator of perinatal health[12], LBW has proven to be the most frequently used and readily available measure which provides valuable information about environmental and *in utero* influences during gestation and possesses a high predictive power for later health outcomes and cognitive development (Bhutta et al., 2002; Gluckman et al., 2008; Barker, 1995).

[11]See diagnosis code P07 of the World Health Organization ICD-10 criteria, which lists disorders of newborns related to short gestation and low birth weight.

[12]See Wilcox (2001) for a more detailed discussion of this issue.

Another control variable linked to the quality of the country's health system is the infant mortality rate, which is largely determined by the supply of basic medication, sanitation, and nutrition in society. A large body of literature is dedicated to the impacts of malnutrition on children's mental and physical development. Stunting and wasting, as well as lack of micro-nutrients such as iodine, zinc, or iron in early childhood are found to have dramatic effects on brain development and thereby on later cognitive abilities. Deficiency of nutrients, nutrition, and medication in early childhood are observed to cause sickness-related impairments and the failure to reach the individual's full developmental potential, resulting in reduced performance in cognitive and IQ tests, lower educational attainment, poor labor market outcomes, and the emergence of inattentive and hyperactive behavior (Grantham-McGregor et al., 2007; Chang et al., 2002; Walker et al., 2007). It has been reported that an insufficient supply of medication, nutrition, and sanitation accounts for up to 60% of early infant deaths in developing countries (Black et al., 2008; Tate et al., 2012; Kotloff et al., 2013; Esrey et al., 1991). Accordingly, we expect the infant mortality rate to act as a heavy burden on educational achievement by way of mortality, disease, disabilities, and impaired mental and physical development.

Using the same rationale, the longevity of the adult population, measured as the life expectancy at birth, is in large part determined by a country's health system and environmental health risks (Pritchett and Summers, 1996). Empirical studies and theoretical models suggest that, regardless of the educational environment, a higher life expectancy leads to increases in schooling demand, as individuals are able to draw benefits from their returns to skills for a longer working period due to a longer healthy life (Ben-Porath, 1967; Bils and Klenow, 2000; Strulik and Werner, 2016). Conversely, the expectation of early mortality reduces the incentive for educational investments and instead fosters unsustainable, reckless behavior (Lorentzen et al., 2008).

Similarly, disability-adjusted life years (DALY) lost provide a measure of the working power lost due to diseases, disabilities, and death and therefore serve as an extension to the life expectancy at birth variable. In contrast to life expectancy, educational decisions are affected not only by considerations of longevity but also by mental and physical health. Apart from that, the same mechanisms mentioned above are at work here, too, suggesting that in this case, a lower number of DALY implies increased incentives for investing in education.

Last, we consider the country's homicide rate (i.e., the number of intentional homicides per 100,000 people) as an additional health-related factor in the analysis of cognitive achievement outcomes. We hypothesize that an everyday experience of violent crime creates an unfavorable environment for educational investment due to uncertainty, and discourages learning and school effort. A higher incidence of crime is linked to distraction and the creation of criminal opportunities, with the consequence that efforts directed at socially beneficial and productive activities is reduced (Pritchett, 2001). In general, a negative relationship has been observed between violent crime and the level of education (Lochner and Moretti, 2004; Lochner, 2004). Studies show that witnessing violent crime or intentional killings significantly reduces cognitive ability and school attendance of children, as a result of stress, trauma, and fear (Brown and Velásquez, 2017; Sharkey, 2010).

Socioeconomic Factors. In this section, we discuss a set of economic environment and social value factors that might significantly predict observed differences in international student achievement outcomes.

To start with the set of economic environment factors, it has been reported that cross-country income differences are significantly correlated with differences in scholastic achievement. Richer countries tend to perform better in ISATs, suggesting that the level of economic development plays a role in determining educational achievement outcomes (Hanushek and Woessmann, 2012). The gross domestic income per person employed serves as a broad proxy for the overall standard of living in society. Additionally, economic development is closely related to infrastructure and institutional quality, suggesting that an economically more developed country might have an advantage in the accumulation of human capital. Next, we hypothesize that both the country's total fertility rate as well as the growth rate of the total population could affect cognitive ability outcomes, as they portray the familiar quality versus quantity trade-off in child rearing (Becker and Lewis, 1973). A higher quantity of children implies that family inputs into the production process (e.g., time spent on child rearing, tuition fees, and tutoring costs) have to be distributed across a large number of children, leading to reduced investment per child and, thus, to subsequently reduced educational achievement (Cunha et al., 2006).[13]

We further consider the share of government consumption to approximate the size of the country's government apparatus and its possible implications for the accumulation of human capital in society. On the one hand, a higher government consumption share is assumed to be an indicator of the country's fiscal capacity, which enables the provision of key public goods and services such as schools, libraries, and Internet access. On the other hand, these benefits are to some extent counterbalanced by possible growth-distorting government taxes and increased centralization, which have been found to significantly reduce student achievement outcomes (Falch and Fischer, 2008).

Another aspect of the economic environment in which people coexist in society is the country's degree of openness to trade. The argumentation is that countries more open to trade, and thus to international competition, might invest more in the accumulation of cognitive skills that are complementary to technological progress (Jamison et al., 2007).

In the remaining part of this section, we provide a discussion of the set of social value factors that might explain observed differences in international student achievement outcomes.

First, we consider a set of gender equality controls to account for the fact that a gender-biased cultural environment in society might have large and detrimental effects on students' test performance outcomes (Guiso et al., 2008; Fryer and Levitt, 2010). If girls are discouraged from making educational investments, their overall cognitive abilities are expected to decrease. Accordingly, a higher degree of women's emancipation has been found to be accompanied by a smaller achievement gap between boys and girls in mathematics test score outcomes (Guiso et al., 2008). To control for the role of women in the society, the share of females in the total labor force is used to proxy for the overall participation and presence of women in everyday work life. If female graduates have no access to the labor market, the main incentive for the acquisition of cognitive skills is reduced. This also applies in the case that certain occupational positions are not accessible to the women in a society. Specifically, we use the proportion of women in national parliaments as an indicator for this phenomenon of women not being able to reach higher positions, which has become known as the *glass ceiling* effect (Cotter et al., 2001).

Second, we use a set of institutional environment controls in the analysis of international aggregate student achievement outcomes. Human capital investments can turn out to be inefficient when they are not complemented by favorable political institutions. Without the provision of basic institutional structures, education might be misused for personal gain (e.g., bribery or unproductive rent-seeking activities) instead of for socially beneficial work (Pritchett, 2001).

[13]Given the observed positive association between mortality and fertility, a country's higher total fertility rate might to some extent also reflect the parent's precautionary demand for children as a means of compensating for a higher risk of child mortality in society (Lorentzen et al., 2008).

For example, it has been shown that higher decentralization improves the provision of schooling services that contribute significantly to student test score outcomes (Falch and Fischer, 2012). Thus, we hypothesize that countries with a federalist system of government might perform better in terms of student achievement test outcomes in comparison to countries with a unitary or centralized political system.[14]

The early human capital literature found the property rights of workers over their own skills to be a fundamental incentive for investments in training (Becker, 1975). Furthermore, the protection of intellectual property rights guarantees inventors the ability to reap the benefits from their inventions and thus constitutes a prerequisite for innovation activity in the economy (Helpman, 1993). We hypothesize that the establishment of property rights in a country's legislation and the enforcement thereof by the government are crucial for educational investment decisions. Planning certainty is important for balancing short-term costs (e.g., tuition fees and foregone earnings) against long-term returns to education (e.g., increased wages and profits from patents).

Freedom from corruption provides a measure of government integrity, which could affect the institutional framework of the educational system. Despite the educational sector being described as insusceptible to bribery, educational expenditures are found to be negatively affected by the presence of corruption (Mauro, 1998). Furthermore, the presence of corruption is found to significantly reduce school enrollment and student learning (Reinikka and Svensson, 2005). It has been observed that corruption is prevalent in countries with lower average rates of higher education, where high-skilled individuals are often primarily engaged in bribe-collection, perhaps due to the lack of economic opportunities (Murphy et al., 1991; Glaeser and Saks, 2006; Mocan, 2008).

Finally, we employ the number of civil conflicts to assess the detrimental influence of political instability on the accumulation of human capital in society. We hypothesize that the incidence of conflicts affects cognitive abilities through three main transmission channels. First, civil conflicts induce uncertainty due to political changes and threats against property rights and might thereby reduce individual incentives for educational investment (Ichino and Winter-Ebmer, 2004). Second, it has been reported that an environment of unrest, civil conflict, or war negatively affects the development of socio-emotional and cognitive abilities by causing stress, anxiety, and trauma (Wolff et al., 1995). Finally, the incidence of civil conflicts might divert both private and public resources from the educational sector to covering the costs of warfare, collateral damage, and scarcity of resources (Shemyakina, 2011).

Educational Factors. Previous studies suggest that international differences in access to basic schooling services or school participation rates might affect the aggregate level of cognitive ability outcomes in society (Rindermann, 2007). Besides being an important determinant in the analysis of aggregate student achievement outcomes, the inclusion of basic measures of educational attainment (i.e., the share of a country's population aged 15 and above with primary, secondary or no education) in the empirical analysis further accounts for the issue of sample selection bias in the variation of student test score outcomes across countries. Specifically, even though PISA and TIMSS are designed to be representative of the respective student populations, it is conceivable that countries with lower school enrollment rates and thus lower overall

[14] It is worth mentioning that a higher degree of decentralization might also proxy for the autonomy in educational policy decisions (e.g., school autonomy in important areas of decision-making such as budget allocation and school curricula). The interested reader is referred to Hanushek and Woessmann (2011) for a discussion of the relevant literature on the institutional structures of the educational system and possible implications for student test score outcomes.

basic educational attainment might select a non-representative sample of high-performing students with a privileged socioeconomic status. Thus, if variations in student test score outcomes were indeed subject to sample selection bias, we would expect a negative regression coefficient associated with the various educational attainment controls (Hanushek and Kimko, 2000).[15]

In order to control for the effect of formal schooling quantity on educational achievement, we consider a compound human capital index in the analysis of aggregate student test score outcomes. We assume schooling quantity to have a twofold effect on scholastic achievement. On the one hand, an increased duration of education results in a larger overall quantity of learning and implies a higher level of education, more sophisticated subject matter, as suggested by the returns-to-schooling literature, for instance, Psacharopoulos (1994). This ultimately translates into gains in cognitive abilities (Kaarsen, 2014). Therefore, more schooling should proxy for both an increased depth and breadth of education. On the other hand, average years of schooling reflect the importance of education in an economy. A high average number of schooling years is related to a high-skilled labor force and indicates a certain pressure to achieve and the relevance of particular high-skilled cognitive abilities in the production process (Rindermann, 2007). Additionally, the overall level of education in society might reflect the knowledge stock of the parent (or teacher) generation and affect the formation of cognitive skills as a direct school or family inputs.

As a further, frequently discussed input into the educational production function, we employ the student/teacher ratio (STR) as an indicator of average class size. A small class size is widely accepted as beneficial for student achievement, as it increases the amount of time a teacher can spend meeting the needs of a possibly heterogeneous group of students (Ehrenberg et al., 2001; Wright et al., 1997).[16]

In many countries, educational services are provided either by state-run public schools or by independent private schools. To assess the implications of this competition between publicly and privately provided education in a country for cognitive achievement outcomes, we consider the country's share of private enrollment in primary education. This variable serves as an indicator of individuals or parents choosing privately operated educational facilities over public institutions (Couch et al., 1993; Hsieh and Urquiola, 2006). Private schools could be chosen over public schools because private provision of educational services is more efficient, implying better individual learning outcomes (e.g., higher qualifications of teachers, better classroom equipment, and curricular differences) and higher social prestige (e.g., of graduates and academic rankings). Individuals may therefore expect a higher market return to their educational investment when after graduation from private schools (Goldhaber, 1996; De La Croix and Doepke, 2009). A second reason to choose private schools is that they may act as a substitute where publicly provided educational services are insufficient. Such choices could be driven either by the low quality of public schools (e.g., poor equipment, few or low-skilled teachers) or by a lack of school provision (e.g., no public schools in rural areas or remote districts) (Couch et al., 1993; Rouse, 1998; Chaudhary et al., 2012).

In order to assess the effect of financial inputs in the formation of cognitive ability outcomes, we consider the country's educational expenditures, measured as a share of total GDP. We hypothesize that a higher share of educational expen-

[15] This finding would be consistent with the hypothesis that aggregate student achievement test score outcomes in countries with low educational attainment might reflect the cognitive abilities of a small, elite group rather than the general population.

[16] This variable is usually perceived as a natural instrument of educational policy, mainly achieved through the hiring of more teachers (Hoxby, 2000).

ditures expresses the governmental valuation and priority of the provision of public education in society. Furthermore, additional spending on educational facilities increases the utilization of government resources for the accumulation of cognitive skills. Increased educational expenditures could entail hiring more teachers (resulting in smaller class sizes) and better quality teachers (paid higher salaries), improved classroom equipment (e.g., supplies of books and computers), reduction of tuition fees, or simply more schools (i.e., nationwide provision of educational services) available to the public (Hanushek, 1997). Through these improved learning facilities and environments, an increase in student achievement is expected.

Genetic Factors. Although it is widely acknowledged that environmental and social factors predict future cognitive performance and educational attainment, estimates from twin studies suggest that up to 58% of the variation of educational achievement is highly heritable (Shakeshaft et al., 2013). Specifically, a number of Genome-Wide Association Studies (GWAS) identified various independent genome-wide loci (typically differences in single-nucleotide polymorphisms – i.e., SNPs) that significantly predict an individual's educational attainment measured as the number of completed years of schooling (Rietveld et al., 2013; Okbay et al., 2016). Genome-wide polygenic score (GPS) analysis has been used to assess the predictive power of the relevant SNPs for various measures of educational attainment. GPS aggregate the effect of a large number of particular SNPs that are ranked according to the estimated effect sizes. For example, the estimated GPS of the most recent GWAS of educational attainment account for up to 4% of the total variance in completed years of education (Okbay et al., 2016). The predictive power of GPS of schooling years will rise further as the availability of larger sample sizes identifies additional genetic traits associated with educational attainment (Chabris et al., 2015). It is worth mentioning that derived GPS of education years correlates significantly with various measures of educational achievement in independent samples, including reading and mathematics ability and general cognitive ability (Selzam et al., 2017a,b). Furthermore, gene-based analysis has identified several genes expressed in the human brain that significantly correlate with human intelligence (Sniekers et al., 2017).

Overall, the above studies point to the importance of genetic factors for observed differences in educational and cognitive performance across individuals. Since there is a lack of data on genome-wide polygenic scores of educational years at the aggregated country level, we instead employ different measures of genetic diversity to account for the heritable nature of student achievement test score outcomes. It is worth noting that the use of various genetic diversity measures implicitly assumes that variation in student achievement test scores across countries is to some extent rooted in genetic differences across people in society. Observed differences in genetic traits across countries might either enhance or suppress the country's cognitive performance. However, theoretical and empirical models suggest that genetic diversity is associated with a larger continuum of specific human traits that might facilitate knowledge creation in society (Ashraf and Galor, 2013).

Besides using an overall measure of genetic diversity, we also consider a specific set of genetic markers that were subject to strong selection pressure in prehistoric times. In particular, we examine a possible association between genes located in the human leukocyte antigen (HLA) region and student achievement test performance. The HLA region is a cluster of more than 200 genes located on chromosome 6 that consists of three important sub-regions, referred to as class I, class II, and class III (Shiina et al., 2004). The HLA region is one of the most polymorphic regions found in the human genome, with genetic variation in the class I and class II regions providing inherent resistance to many infectious diseases.

Genetic variability in the HLA region supports the individual's immune system in the identification and elimination of intracellular pathogens. Among the possible natural selection models that could explain the extraordinary polymorphism within the HLA region, the heterozygote advantage (or overdominant selection) hypothesis has received special attention. According to this theory, heterozygote populations would more efficiently resist an array of pathogens due to a larger range of possible antigens associated with HLA heterozygosity (Doherty and Zinkernagel, 1975; Hughes and Yeager, 1998). Consistent with this hypothesis, Prugnolle et al. (2005) have shown that regional pathogen richness is positively and significantly correlated with HLA class I diversity in a worldwide sample of 61 human populations.[17] Further evidence has been provided by Cook (2015), who found a significant and positive association between HLA diversity and life expectancy prior to the international epidemiological transition in a large cross-section of countries.

In addition to health-related effects, HLA diversity has been found to be associated with language impairment, decreased cognitive ability in later life, susceptibility to psychiatric disorders (e.g., schizophrenia), and high intelligence in independent samples, even though the latter finding lacks significant evidence (Nudel et al., 2014; Payton et al., 2015; Brucato et al., 2015; Zabaneh et al., 2016). As argued above, health-related factors have a strong and significant effect on general cognitive ability, and the inclusion of HLA diversity in the empirical analysis accounts for the innate resistance of populations to many disorders. We use the country-level estimates of HLA diversity from Cook (2015) to examine its association with student achievement test scores.

Diversity Factors. Theoretical models suggest that members of diverse teams may outperform members of homogenous ones because of enhanced problem-solving capabilities (Hong and Page, 2001, 2004). On the other hand, a large number of studies in development economics point out that ethno-linguistic diversity is associated with poor socioeconomic outcomes, such as low economic growth, low provision of public goods, and a higher incidence of conflicts (Alesina et al., 2003; Desmet et al., 2012). In relation to the issue of human capital accumulation, it has been argued that educational achievement might be lower in ethnically diverse countries due to higher disagreement on issues such as school curricula and language of instruction (Easterly and Levine, 1997; Gören, 2014).

Besides being an important explanatory variable in the analysis of general cognitive ability, the inclusion of ethno-linguistic diversity further accounts for a possible source of confounding in the relationship between the key genetic controls (i.e., the DRD4 exon III 2- and 7-repeat allele frequency measure, overall genetic diversity, and HLA diversity) and cognitive achievement. For example, Ashraf and Galor (2013) argue that genetic diversity is also correlated with cultural diversity (usually measured as ethno-linguistic and/or religious diversity). More precisely, the association between the country-level $DRD4^{R2R7}$ measure and student achievement test score outcomes might simply capture the negative effect of ethno-linguistic diversity on cognitive performance rather than the issue of ADHD prevalence. To rule out this possibility, we examine the robustness of the main findings to the inclusion of various measures of ethno-linguistic and religious diversity, using the relevant country-level estimates provided by Alesina et al. (2003).

[17] Other studies reported the protective effect of HLA diversity against specific human infectious diseases, such as malaria, hepatitis B, and HIV (Hill et al., 1991; Thursz et al., 1997; Trachtenberg et al., 2003).

4 Relationship Between DRD4 Exon III and ADHD Prevalence

The aim of this section is twofold. In a first exercise, we establish the key hypothesis proposed in this paper about the strong explanatory power of the DRD4 exon III 2- and 7-repeat allele frequency measure of inattention and/or hyperactivity-impulsivity as behavioral symptoms of ADHD, as indicated by aggregated ADHD prevalence rates derived from individual ADHD studies. Second, we argue against the use of estimated ADHD prevalence rates in the empirical analysis. The reason is that these prevalence rates are heavily confounded by the issue of study-level methodological characteristics, as evidenced by a systematic meta-regression analysis of 179 individual ADHD studies conducted in 52 countries in the period 1981 to 2014. We discuss these and additional caveats associated with the use of estimated ADHD prevalence rates derived from individual ADHD studies.

4.1 Reliability of ADHD Prevalence Estimates: The Issue of Study Methodological Characteristics

ADHD prevalence estimates vary significantly across studies both between and within countries, fueling concerns about possible over- and under-diagnosis of reported ADHD cases in the general population (Charach et al., 2011; Fulton et al., 2009). A series of meta-regression studies identified that ADHD prevalence estimates are explained largely by methodological characteristics of the study, including ADHD diagnostic criteria, source of information on ADHD behavioral symptoms (i.e., child, parent, teacher, or clinician), type of population sample (i.e., community, school, or whole population), whether full or partial diagnostic criteria for ADHD were met, type of ADHD measurement (i.e., diagnostic report, interview, or symptom-only checklist), and the geographical region of the study (i.e., America, Asia, Europe, Africa, or Oceania), casting serious doubts on the reliability of reported ADHD cases across studies (Polanczyk et al., 2007, 2014; Thomas et al., 2015).

In the following, we conduct a systematic meta-regression analysis to examine the severity of study-level characteristics on estimated ADHD prevalence rates. This step of the analysis would provide information on the reliability of reported ADHD cases across studies and whether these estimates can be used to provide a valid measure of ADHD prevalence in the general population. To accomplish this task, we use a worldwide compilation of ADHD prevalence rates from 179 individual studies conducted in 52 countries during the period 1981 to 2014 (Thomas et al., 2015). The review includes studies reporting point ADHD prevalence estimates with ADHD cases identified based on the various editions of the DSM diagnostic criteria from community, schooling, or national representative survey samples. Studies reporting ADHD cases from healthy adults (i.e., age > 18) were excluded as well as studies reporting clinical intervention samples. Specifically, we estimate the following weighted meta-regression model to assess the confounding influence of study-level methodological characteristics

$$\begin{aligned} ADHD_{scrt}\sqrt{\omega_{scrt}} \quad &= \quad \beta_0\sqrt{\omega_{scrt}} + \boldsymbol{\beta}_1'\boldsymbol{\Gamma}_{scrt}\sqrt{\omega_{scrt}} + \boldsymbol{\beta}_2'\boldsymbol{\Delta}_{scrt}\sqrt{\omega_{scrt}} + \boldsymbol{\beta}_3'\boldsymbol{\Theta}_{scrt}\sqrt{\omega_{scrt}} + \beta_4 CM_{scrt}\sqrt{\omega_{scrt}} \\ &+ \quad \boldsymbol{\beta}_5'\boldsymbol{\Lambda}_{scrt}\sqrt{\omega_{scrt}} + \boldsymbol{\beta}_6'\boldsymbol{\Phi}_{scrt}\sqrt{\omega_{scrt}} + \lambda_r\sqrt{\omega_{scrt}} + \lambda_t\sqrt{\omega_{scrt}} + \upsilon_{scrt}\sqrt{\omega_{scrt}}, \qquad (1) \end{aligned}$$

where $ADHD_{scrt}$ refers to the ADHD prevalence rate of study s conducted in country c within region r at time period t. Although ADHD outcomes vary at the individual level, observations on reported cases of ADHD and control variables are only available at the aggregated study level. This requires study-level observations to be weighted according to the reported sample size ω_{scrt}, thus accounting for the possibility that the validity of reported cases of ADHD might be an increasing function of sample size. Estimating Equation (1) on study-level rather than individual observations accounts for the unexplained variation in reported cases of ADHD resulting from methodological characteristics of the study rather than individual characteristics.

We consider a full set of possible confounding methodological factors that might explain reported cases of ADHD across studies. The vector $\mathbf{\Gamma}$ includes a set of control variables indicating a possible Risk of Bias (RoB) in ADHD prevalence estimates. Specifically, each study was assessed based on eight RoB questionnaires reflecting the representativeness of sample, the sampling frame, whether individuals were randomly selected, minimum non-response bias, whether observations were directly collected from subjects, and whether data collection and construction fulfills a minimum level of measurement reliability and validity. The calculated RoB score ranges from 0 (= very high risk of bias) to 8 (= low risk of bias score). We classified studies having a very high RoB score (i.e., $0 \leq RoB \leq 1$), high RoB score (i.e., $2 \leq RoB \leq 3$), moderate RoB score (i.e., $4 \leq RoB \leq 5$), and low RoB score (i.e., $6 \leq RoB \leq 8$).

The vector $\mathbf{\Delta}$ includes a set of indicator variables that reports the various editions of the DSM diagnostic criteria (i.e., DSM-III, DSM-III-R, and DSM-IV) used to identify ADHD cases in the sample, $\mathbf{\Theta}$ refers to a set of control variables indicating the source of sampled population (i.e., schooling, community, or national representative survey sample), the variable CM indicates whether the study employs the full diagnostic criteria of the various editions of the DSM to identify ADHD cases, and $\mathbf{\Lambda}$ indicates the type of ADHD measurement (i.e., diagnostic report, interview, or symptom-only checklist).

In addition, we examine the source of information or informant (e.g., child, parent, teacher, or clinician) reporting ADHD-related symptoms, as summarized in the vector $\mathbf{\Phi}$. Most studies employ more than one informant to identify ADHD cases in the sample. We follow the relevant literature and classify studies according to an 'AND' rule that is positive if the reported ADHD case is confirmed by at least two informants (e.g., by parents and teachers) and according to an 'OR' rule that is positive if confirmed by any one informant (e.g., parent or teacher). In cases where the ADHD diagnostic assessment was supervised by clinical personnel, the study's source of information was completely coded as clinician.

The regression model further includes a full set of region fixed effects λ_r (i.e., indicator variables for North America, South America and the Caribbean, Africa, Asia, Middle East, and Europe) to account for differences in ADHD prevalence rates across regions and a set of publication year fixed effects λ_t (i.e., indicator variables for the years 1980 – 1984, 1985 – 1989,..., 2010 – 2014) to account for a possible increase in ADHD prevalence rates across time. Finally, υ_{scrt} is a study-specific error term. The method of estimation is Ordinary Least Squares (OLS) with standard errors clustered by countries to account for the likely non-independence of reported ADHD prevalence estimates within countries.

Table 1 reports the results on the association between ADHD prevalence estimates and study-level methodological characteristics. The estimates reported in column (1) examine the influence of the various RoB indicators on estimated ADHD rates. All three indicators are significantly and negatively (reference category: low RoB score) related to the study's estimated ADHD prevalence rate, with an overall R^2 of about 19%. The estimated coefficients suggest that studies lacking various criteria on, for example, representativeness, random sampling, or measurement reliability and validity tend to have lower reported ADHD prevalence estimates compared to studies with a low risk of bias assessment.

In column (2), we examine the possible confounding influence of the various editions of the DSM diagnostic manual used to identify ADHD-related symptoms in individuals. Specifically, it has been reported that estimated ADHD prevalence rates may differ substantially even within the same study, with estimated prevalence rates being higher when using DSM-IV diagnostic criteria in comparison to DSM-III-R caused by significant heterogeneity in the definition of ADHD-related subtypes (Baumgaertel et al., 1995; Wolraich et al., 1996). Consistent with this observation, the estimated results show that studies using DSM-IV diagnostic criteria report about 2.2731% higher ADHD prevalence rates than studies based on the ADHD symptom checklists in the DSM-III-R diagnostic manual.

The results presented in column (3) suggest that studies using community or nationally representative survey samples have significantly higher ADHD prevalence estimates on average relative to studies employing school samples, even though the reported association is sensitive to subsequent model specifications.

Moreover, ADHD prevalence estimates might differ as to whether studies employ full or partial diagnostic criteria for ADHD-related symptoms. Hence, in column (4), we include an indicator variable that is positive if the respective study employs the full ADHD diagnostic criteria to identify ADHD cases versus a partial diagnostic assessment. Although the corresponding estimate is not statistically significant at conventional significance levels, it turns highly significant in later model specifications, confirming its predictive power for ADHD prevalence estimates across studies.

In column (5), we investigate how the type of ADHD measurement affects ADHD prevalence rates across studies. The results robustly show that studies using a symptom-only checklist have significantly higher ADHD prevalence rates in comparison to a detailed diagnostic report in the range of 4% to 6% depending on the model specification. The inclusion of the various types of measurement controls increases the R^2 considerably from 27% in column (4) to about 38% in column (5), qualifying it as a key study-level confounding factor in ADHD prevalence estimates.

In addition, ADHD prevalence estimates might be sensitive to the informant (i.e., child, parent, teacher, and clinician) or the type of method used to combine information from multiple informants (i.e., 'AND' versus 'OR' rule) (Willcutt, 2012). According to the estimates in column (6), the results suggest that studies using children, parents, or a combination of children, parents, or teachers reporting ADHD symptoms tend to underestimate ADHD prevalence rates compared with studies using ADHD symptoms reported by a clinician. The importance of the source of information for estimated ADHD prevalence rates across studies is evidenced by an additional 10% increase of the R^2 in column (6) relative to column (5).

The previous analysis suggests that study-level methodological characteristics rather than individual factors account for approximately 48% in the variation of reported ADHD prevalence rates across studies. In the remaining two model specifications, we assess the robustness of study-level confounding factors to the presence of time and region fixed effects. In column (7), we include a full set of time fixed effects (i.e., indicator variables for each five-year period in 1980 − 1984, 1985 − 1989,..., 2010 − 2014). The inclusion of time fixed effects accounts for a possible increase in ADHD prevalence estimates caused, for example, by increased awareness of the diagnosis of ADHD-related symptoms and/or access to improved medical services for the treatment of ADHD (Polanczyk et al., 2014). Nevertheless, the results remain qualitatively unaffected by the inclusion of time fixed effects in the regression model. It is worth mentioning that the inclusion of time fixed effects further captures significant changes in DSM diagnostic criteria for ADHD over time, which would explain the insignificant coefficient of the DSM-III-R indicator variable when the regression equation includes time fixed effects. Finally, the main findings remain rather unaffected when including a full set of region fixed effects in the regression model, as shown in column (8). However, the large and significant increase of the R^2 from 50% in column (7) to about 65% in column (8) provides strong evidence that ADHD prevalence estimates vary considerably across regions, even accounting for the possible confounding influence of study-level methodological characteristics.

4.2 Association Between ADHD Prevalence Estimates and DRD4 Exon III 2- and 7-Repeat Allele Frequency

The previous discussion has shown that study-level methodological rather than individual characteristics contribute significantly to reported ADHD cases, thus limiting the external validity of estimated ADHD prevalence rates for the general population. Despite these obvious limitations, we nevertheless employ ADHD prevalence rates to examine a key assumption in the present study that the proposed DRD4 exon III biomarker is significantly correlated with the extent of ADHD-related symptoms in society.

To accomplish this task, ADHD prevalence rates for each country were calculated from the corresponding study-level data, with studies having a larger sample size being assigned a higher weight in the calculation. The pooled ADHD prevalence rate across the available set of 52 countries was about 0.0686 with a standard deviation of 0.0480. To provide a direct test of the positive association between ADHD prevalence rates and the DRD4 exon III 2- and 7-repeat allele frequency measure, we estimate the following regression model in a cross-section of countries:

$$ADHD_c = \beta_0 + \beta_1 DRD4_c^{R2R7} + \boldsymbol{\beta}_2' \boldsymbol{X}_c + \boldsymbol{\beta}_3' \boldsymbol{R}_c + e_c, \tag{2}$$

where $ADHD_c$ refers to the ADHD prevalence rate of country c derived from study-level data, $DRD4_c^{R2R7}$ is the country-level DRD4 exon III 2- and 7-repeat allele frequency measure, the vector $\boldsymbol{X}_c$ is a vector of country-level control variables, $\boldsymbol{R}_c$ refers to a full set of region fixed effects, and e_c is the usual error term. The vector $\boldsymbol{X}_c$ includes a set of socioeconomic, historical, institutional, and cultural variables that might explain differences in ADHD prevalence rates across countries and to ensure that the proposed key association is not sensitive to the issue of omitted variables.

Table 2 presents OLS estimates between the ADHD prevalence rates and the DRD4 exon III 2- and 7-repeat allele frequency measure in a cross-section of 42 countries. The reduced sample size is due to missing observations of the set of country-level controls included in Equation (2). In the baseline specification presented in column (1), the regression coefficient associated with the country-level $DRD4^{R2R7}$ measure is positive and highly statistically significant at the 5% significance level conditional on a full set of region fixed effects. This result is consistent with findings from molecular genetic studies, emphasizing the importance of the human dopamine system – and especially a possible role of the DRD4 exon III gene – for ADHD-related behavioral symptoms. To the best of the authors' knowledge, this is the first study showing that this association even holds at the aggregated macro-level and among culturally distinct countries, qualifying the DRD4 exon III gene as a strong biomarker for the measurement of ADHD-related symptoms in the general population.

In column (2), we include a set of legal origin factors (i.e., indicator variables that refer to British, French, Scandinavian, German, and Socialist legal origin) to control for the institutional environment in which people live and cooperate in a given country. We hypothesize that differences in estimated ADHD prevalence rates across countries might to some extent reflect differences in the country's legal tradition. For example, the collectivist environment in socialist countries might result in a higher awareness of antisocial behavioral outcomes of ADHD-impaired individuals in comparison to countries with a British legal tradition that is relatively tolerant of individualistic self-expression. Reassuringly, the estimated regression coefficient associated with the country-level $DRD4^{R2R7}$ measure remains rather robust and precisely estimated at the 1% significance level.

In column (3), we address potential concerns in the relevant psychiatric literature arguing that variation of ADHD prevalence rates across countries might reflect differences in cultural values, norms, and beliefs regarding the recognition and treatment of ADHD related behavioral symptoms in society (Timimi and Taylor, 2004; Singh, 2008). We use a set of major religion shares (i.e., percentage of the population that is Protestant, Muslim, or Catholic) to measure differences in cultural values across countries. Again, the association between ADHD prevalence rates and the country-level $DRD4^{R2R7}$ measure remains precisely estimated even in this model specification.

Next, we consider another source of confounding factors caused by differences in standards of living across countries. Specifically, it is conceivable that estimated ADHD prevalence rates are underreported in countries that are less developed economically and overdiagnosed in countries with a higher standard of living. The possible endogeneity of estimated ADHD prevalence rates to the country's level of economic development might further reflect the impairing nature of ADHD-related behavioral symptoms in an economically more complex environment, as manifested in an increased use of prescribed ADHD medications in economically advanced countries (Scheffler et al., 2007). To account for this type of endogeneity, the results reported in column (4) includes the natural logarithm of real GDP per capita as a measure of the country's standard of living in the regression model. Although the coefficient associated with the log of real GDP per capita has the expected positive sign, it is not statistically significant at conventional significance levels. The effect of the country-level $DRD4^{R2R7}$ measure on estimated ADHD prevalence rates remains relatively strong and precisely estimated.

To examine whether differences in reported ADHD prevalence rates across countries result from differences in the country's health system, column (5) includes the mean life expectancy at birth into the regression model. The hypothesis is that a highly advanced health system – approximated by using the country's life expectancy at birth – might provide improved medical services both for the diagnosis and treatment of ADHD cases. The life expectancy variable enters insignificantly into the regression model, whereas the impact of the country-level $DRD4^{R2R7}$ measure on estimated ADHD prevalence rates remains rather robust and statistically significant at the 1% significance level.

Another concern could be that ADHD prevalence rates reflect differences in a country's educational system. For example, awareness of ADHD-related behavioral symptoms in society probably increases with the amount of time people spend in school. To rule out this possibility, the specification presented in column (6) controls for a human capital index, which enters insignificantly into the regression model. The regression coefficient associated with the country-level $DRD4^{R2R7}$ measure remains virtually unchanged to the inclusion of the human capital variable.

Finally, the remaining two model specifications presented in columns (7) and (8) are intended to account for the possibility that ADHD-impaired individuals might experience serious challenges in educational and occupational life in more mature societies that have developed complex hierarchical organizational systems in which people coexist and interact (Williams and Taylor, 2006). In modern societies, this requires a minimum of strategic self-control for an individual's economic and social well-being (Moffitt et al., 2011). To account for the concern that estimated ADHD prevalence rates might be higher in more mature societies, in column (7) we first consider a measure of early state experience between the year 1 AD and 1500 AD. This variable indicates the present-day historical experience of a country's population with early state formation and centralization during the pre-colonial era. This measure has been ancestry-adjusted to account for global migration flows across countries that has occurred since 1500 AD using data on international migration flows from the Putterman and Weil (2010) database. Second, in column (8) we control for the country's Neolithic transition timing (i.e., the number of years when the country shifted to agricultural practices up to the year 2000 AD) to account for the relative importance of sedentary practices in society. Accordingly, this variable has been ancestry-adjusted to control for large international migration flows since 1500 AD. Including these measures subsequently in the regression model leaves the main findings regarding the positive association between estimated ADHD prevalence rates and the country-level $DRD4^{R2R7}$ measure unchanged. Regarding the estimated magnitudes, the regression coefficients reported in the complete model specification of column (8) suggest that a one percentage point increase in the country-level $DRD4^{R2R7}$ measure would, ceteris paribus, increase the ADHD prevalence rate in the general population by about 0.4218 percentage points.

In summary, the results presented in Table 2 qualify the $DRD4^{R2R7}$ measure as a strong biomarker for measuring the prevalence of ADHD-related behavioral symptoms across countries. We advocate the use of the country-level $DRD4^{R2R7}$ measure over estimated ADHD prevalence rates from study-level data, since the latter variable seems to be heavily confounded by study-level methodological characteristics. Additionally, in contrast to the proposed country-level $DRD4^{R2R7}$ measure, the identification and diagnosis of ADHD cases might be sensitive to unobserved individual characteristics (e.g., age, gender, ethnic background, parents' socioeconomic status, and family structure of ADHD probands), thus limiting the external validity of estimated ADHD prevalence rates from study-level data for the general population. More importantly, data coverage of estimated ADHD prevalence rates is limited in scope for both countries and ethnic groups, thus restricting their practical value in empirical cross-country studies.

5 Education Production Function, ADHD, and Identification Approach

This section sets the theoretical framework for the analysis of the relationship between cognitive ability and the various family, peer, school, and innate ability factors. We point out that accounting for the issue of innate abilities in the empirical analysis of the EPF is crucial for consistent estimation of the regression coefficients associated with the various input factors that explain cognitive ability outcomes. We then proceed by specifying a cross-country variant of the EPF relating aggregate student achievement test scores to the country-level DRD4 exon III 2- and 7-repeat allele frequency measure – as an important innate ability factor in the specification of the EPF – that is robust to a large set of possible confounding factors arising from unobserved country-specific heterogeneity.

5.1 Education Production Function

For the theoretical foundation regarding the relationship between cognitive achievement and the prevalence of ADHD related behavioral symptoms in society, we rely on a large body of studies in the human capital literature.[18] According to Todd and Wolpin (2003), this literature can be classified into one branch examining how early childhood development (ECD) is influenced by home environment and parental inputs (Cunha and Heckman, 2007), and a second branch, where an EPF is constructed to describe the relationship between family, peers, schooling, and innate endowment inputs and the corresponding cognitive achievement outcome – for example, as measured by the results of ISATs (Hanushek and Woessmann, 2011). In the following, we discuss potential challenges associated with the estimation of EPFs in the presence of unobserved childhood innate ability factors. The motivation is that childhood behavioral symptoms, such as continued attention to school tasks, are determined by unobserved innate ability factors that significantly interfere with the child's learning success and, thus, subsequent educational and occupational achievement. We highlight the importance of the proper modelling of innate ability factors in the specification of the EPF in order to consistently estimate the

[18] See Hanushek (2002) for a review of the relevant literature.

remaining regression coefficients associated with the set of schooling, family, and peer inputs.

The EPF methodology can be applied either to evaluate policy measures as an experimental data design or to identify and interpret parameters of the production function using non-experimental data. In the present case, the latter consideration applies. Thus, we follow the methodology outlined in Hanushek (2002) and use the following general microeconomically based framework describing the key determinants of an individual's educational outcomes:

$$CAO_{sa} = f\left(\boldsymbol{F}_{sa}, \boldsymbol{P}_{sa}, \boldsymbol{S}_{sa}, \boldsymbol{A}_{s}, \upsilon_{sa}\right), \tag{3}$$

where CAO_{sa} is the individual cognitive achievement outcome of student s at age a that is determined by a general function $f(\cdot)$ consisting of a set of family inputs $\boldsymbol{F}_{sa}$, peer inputs $\boldsymbol{P}_{sa}$, school inputs $\boldsymbol{S}_{sa}$, and the child's innate ability factors $\boldsymbol{A}_{s}$ that is usually modelled as being invariant across ages (e.g., due to the child's genetic endowment). Finally, υ_{sa} is an idiosyncratic error term.

The empirical application of Equation (3) crucially hinges on the availability of the various family, peer, and school input variables. The conceptual framework developed in Todd and Wolpin (2003) indicates that in the analysis of student cognitive achievement, both current and past inputs matter, suggesting the cumulative nature of the acquisition of future cognitive skill outcomes. However, in empirical applications of the EPFs, the relevant data usually lack the longitudinal dimension of individual cognitive achievement outcomes among different ages. Up to the point at which individual cognitive ability is assessed, students receive or use a variety of educational inputs that constitute the status quo of their performance. However, prior educational investments and cognitive achievement cannot be measured retrospectively, or if at all, only by proxy variables. The estimation of the EPF is further complicated by the facts that data on the set of family, peer, and school inputs are relatively incomplete, that student achievement test scores are subject to measurement error problems, and that the data on the child's heritable (i.e., innate) endowment are usually unobserved and/or difficult to model in empirical applications.

The problem of missing data on children's innate endowments poses a serious obstacle to the estimation of general EPFs when using non-experimental observational data. The reason is that innate ability factors are important for the development of a child's mental capacity and behavior, which in turn determine the child's learning outcomes in school and subsequent educational achievement (Cunha and Heckman, 2007). The identifying assumption usually set in the consistent estimation of the EPF is that the unobserved student innate ability factor is uncorrelated with the remaining family, schools, and peer inputs.[19] However, this assumption is likely to be violated when using non-experimental observational data. For example, most childhood development studies suggest that adverse *in utero* experiences, including poor maternal health, substance abuse, and malnutrition can have severe and long-lasting implications for future childhood cognitive outcomes. Additionally, Cunha and Heckman (2007) point out that the old "nature" versus "nurture" distinction has become obsolete and has been replaced by the modern epigenetic view in which a child's cognitive ability is heavily influenced by a complex interaction between genetic endowments and susceptibility to environmental conditions. Thus, the modern epigenetic view would reject the widespread assumption in the human capital literature that innate ability factors are uncorrelated with the child's family and educational environment. In other words, family and educational

[19] For example, Hanushek and Kimko (2000) estimate a cross-country variant of the EPF shown in Equation (3) based on the restrictive assumption that average ability of students does not vary across countries or is at least orthogonal to the remaining input factors.

inputs cannot be analyzed independently of the child's innate endowment in the analysis of traditional EPFs.[20]

It is obvious that not accounting for the child's innate ability factors would result in inconsistent estimates of the various family and school input factors. The severity of the omitted variables bias in the estimation of the EPF is evidenced in a series of empirical studies analyzing the determinants in the variation of individual cognitive achievement outcomes. For example, the empirical analysis in Schuetz et al. (2013) reveals that student characteristics (e.g., age, gender, and grade outcomes), family background (e.g., parents' marital, working, and economic status), school inputs (e.g., school's location in the community, educational expenditures per student, and class size), and institutional structures of schools (e.g., private versus public school, accountability, and school autonomy) together only account for between 30 and 40 percent of the overall variation in individual student achievement test scores, indicating the importance of (unobserved) innate student-level ability factors in the estimation of EPFs. Additionally, Anger and Heineck (2010) show that the explanatory power in the analysis of child's cognitive ability increases considerably once the regression model accounts for the parent's cognitive abilities, suggesting the importance of intergenerational transmitted genetic and cultural traits in the acquisition of students' cognitive skill outcomes.

Different estimation approaches have been proposed to overcome the endogeneity problem in the estimation of EPFs depending on the availability of student-level data.[21] The most prominent approaches are fixed-effects and first-difference specifications, which effectively account for endogeneity problems in the estimation of the EPF resulting from the presence of unobserved individual level heterogeneity that is invariant across different ages and partly determined by the child's initial innate ability at birth. Unfortunately, the missing longitudinal dimension in the collection of student achievement test score outcomes prevents the application of the aforementioned model specifications for the current analysis. In addition, even if the data fulfill the necessary longitudinal dimension, we are explicitly (rather than implicitly) interested in uncovering the specific innate ability factors – particularly the ADHD-related behavioral symptoms inattention and/or hyperactivity-impulsivity – that give rise to differences in individual cognitive achievement outcomes.

5.2 Econometric Specification

We tackle the issue of endogeneity in the relationship between aggregate student achievement test scores and the various input factors by estimating a cross-country variant of Equation (3) similar to the specification proposed in Hanushek and Kimko (2000). Thus, we relate aggregate student achievement test scores to country-specific socioeconomic and educational characteristics analogous to parental and school resource variables in the specification of student-level EPFs. Specifically, the following cross-country education production function is estimated:

$$SATS_c = \beta_0 + \beta_1 DRD4_c^{R2R7} + \boldsymbol{\beta}_2' \boldsymbol{BG}_c + \boldsymbol{\beta}_3' \boldsymbol{MR}_c + \boldsymbol{\beta}_4' \boldsymbol{LO}_c + \boldsymbol{\beta}_5' \boldsymbol{Z}_c + \boldsymbol{\beta}_6' \boldsymbol{R}_c + \varepsilon_c, \tag{4}$$

where $SATS_c$ is the aggregate student achievement test score (averaged across the two subjects mathematics and science) of country c during the various assessment waves from 1995 to 2015, and $DRD4_c^{R2R7}$ refers to the country-level DRD4

[20]This assumption is also consistent with the optimizing behavior of parents, indicating that the amount of financial resources and educational investment is subject to the child's initial cognitive endowment (Becker and Lewis, 1973). Moreover, even schools use different class intervention measures that are designed to match the child's general cognitive ability (Todd and Wolpin, 2003).

[21]See Todd and Wolpin (2003) for an excellent discussion of the various approaches to estimate educational production functions and the underlying assumptions for consistent estimation of the various input factors.

exon III 2- and 7-repeat allele frequency measure of country c. In addition to the key dependent and explanatory variable, we employ a large set of country-specific controls in the regression equation to cope with endogeneity concerns in the association between aggregate cognitive achievement and the country-level DRD4 exon III 2- and 7-repeat allele frequency measure. Specifically, the baseline specification includes a full set of biogeographic $\boldsymbol{BG}_c$, major religion $\boldsymbol{MR}_c$, legal origin $\boldsymbol{LO}_c$, and region $\boldsymbol{R}_c$ effects in the education production function. We conduct a series of additional sensitivity tests to examine the robustness in the association between aggregate student achievement test scores and the country-level $DRD4^{R2R7}$ measure through the inclusion of the vector $\boldsymbol{Z}_c$, which refers to a large battery of health-related, socioeconomic, educational, genetic, and diversity factors. Finally, the variable ε_c is a stochastic error term.

It is worth noting that the empirical analysis of aggregate cognitive achievement is not confounded by the presence of overall human genetic diversity, as we explicitly account for this kind of confounding factor in the relationship between aggregate cognitive achievement and the country-level DRD4 exon III 2- and 7-repeat allele frequency measure.[22]

Theory suggests a negative sign for the regression coefficient β_1, which would indicate a negative relation between the country-level $DRD4^{R2R7}$ measure and aggregate student achievement test scores. This finding would be consistent with the educational burden of the ADHD-related behavioral symptoms inattention and/or hyperactivity-impulsivity for cognitive achievement outcomes in society.

6 Main Empirical Results

Biogeographic and Historical Factors. Table 3 presents the first results on the association between the average cognitive achievement test score variable and the country-level $DRD4^{R2R7}$ measure in a cross-section of 81 countries. The estimates presented in column (1) show the univariate relationship between both key variables conditional on a full set of region, OPEC, and TIMSS fixed effects. The latter variable accounts for possible differences in the PISA and TIMSS achievement test scores across countries. However, given the high correlation between the two achievement test scores, the estimated regression coefficient associated with the TIMSS indicator variable is statistically insignificant at conventional significance levels across the various model specifications (results not shown). The inclusion of the OPEC indicator variable accounts for the natural resource curse hypothesis, which suggests that countries with a higher amount of proven mineral resources might have poorer growth performance due to widespread corruption and rent-seeking activities that eventually undermine the individual's incentive to invest in the accumulation of human capital. More importantly, the influence of the country-level $DRD4^{R2R7}$ measure on the dependent variable is negative and highly statistically significant at the 1% significance level, consistent with the educational burden hypothesis of ADHD-related symptoms in society overall. The point estimate suggests that increasing the median value of the $DRD4^{R2R7}$ measure in the 81-country sample (i.e., Singapore = 0.2376) to the $DRD4^{R2R7}$ value in the United States (i.e., 0.2636) would, ceteris paribus, decrease the average composite cognitive skill measure by about $(0.2636 - 0.2376) \times 2.8806 \times 100 \approx 7.4896$ test score points.[23] This effect is

[22] The inclusion of overall genetic diversity in the estimation of the EPF captures the notion of international differences in average ability of students consistent with the hypothesis that a higher continuum of human traits in society might result in the emergence of those traits that bring forth individuals with high cognitive abilities (Ashraf and Galor, 2013).

[23] According to the estimates in column (8) of Table 2 this change in the value of the $DRD4^{R2R7}$ measure would correspond to a rise in the estimated ADHD prevalence rate of about $(0.2636 - 0.2376) \times 0.4218 \times 100 \approx 1.0967$ percentage points.

quite sizeable and corresponds approximately to a $(0.0749/0.6240) \times 100 \approx 12.0032$ percentage change in the standard deviation of the average student achievement test score variable.

Next, the estimates reported in columns (2) and (3) are intended to assess the potential burden of the disease environment on general cognitive ability through the inclusion of various biogeographical controls. None of these control variables enter significantly into the regression model, leaving the regression coefficient associated with the country-level $DRD4^{R2R7}$ measure qualitatively unaffected both in magnitude and statistical significance.

In column (4), we include the percentage of a country's arable land area to account for the possibility that a favorable agricultural land endowment might result in a higher level of economic activity in the agricultural sector that pays less attention to the accumulation of human capital in society. However, the point estimate of the country-level $DRD4^{R2R7}$ measure remain rather stable and highly statistically significant at the 5% significance level.

The results presented in column (5) examine the potential confounding influence of major religion effects on average student achievement test scores. Interestingly, the regression coefficient associated with the Protestant religion share enters into the regression model positively and statistically significantly at the 1% significance level, consistent with the notion of Weber's Protestant work ethic. Accordingly, the coefficient associated with the share of Catholics in the population is significant, although only at the 10% significance level, and considerably smaller in magnitude. Controlling for these rough cultural dimension controls in the empirical EPF even results in a significant increase of the estimated magnitude associated with the country-level $DRD4^{R2R7}$ measure.

Finally, the results shown in column (6) reveal that the association between the aggregate student achievement test score and the country-level $DRD4^{R2R7}$ measure is rather robust to the inclusion of a full set of legal origin factors in the regression model. Interestingly, the results show quite significantly that countries with a German legal tradition have on average higher student achievement test scores than countries with a socialist legal origin. This finding provides evidence that the institutional framework in which people coexist and cooperate significantly influences individual decisions about the accumulation of human capital over the life course. In addition, the regression coefficient associated with the shares of Protestants and Catholics in the population turns insignificant in this augmented model specification. This finding is consistent with the notion that culture shapes the institutional framework in society, and that when conditioning on the country's legal tradition, the impact of cultural factors on the accumulation of human capital becomes less pronounced (Gorodnichenko and Roland, 2017). According to this final model specification, the estimated regression coefficients suggest that increasing the country-level $DRD4^{R2R7}$ value of Singapore (i.e., 0.2376) to the level of the United States (i.e., 0.2636) would, ceteris paribus, result in a reduction of the average student achievement test score by about $(0.2636 - 0.2376) \times 3.8765 \times 100 \approx 10.0789$ points. Again, this effect is quite sizable, as it corresponds roughly to a $(0.1008/0.6240) \times 100 \approx 16.1538$ percentage change in the standard deviation of the average student achievement test score variable.

Health-Related Factors. Table 4 examines the robustness of the regression coefficient associated with the country-level $DRD4^{R2R7}$ measure to the inclusion of various health-related factors. The results presented in column (1) refer to the baseline specification reported in Table 3, column (8) and is reproduced for comparison purposes.

Column (2) includes the country's share of infants born with low birth weight. As described in greater detail above, this variable captures the general provision of health care and nutrition during pregnancy and can therefore be interpreted as the result of the newborn's *in utero* experiences. Theory suggests that negative *in utero* experiences inhibit intrauterine development and therefore result in reduced subsequent postnatal development potential (Bhutta et al., 2002; Gluckman et al., 2008). This finding is confirmed by a negative estimated regression coefficient associated with the low birth weight variable, which is statistically significant at the 5% significance level. More importantly, the estimated regression coefficient and statistical significance associated with the key country-level $DRD4^{R2R7}$ measure remain qualitatively unchanged by this model specification.

In column (3), the infant mortality rate per $1,000$ infants is included in the regression equation, which proxies for the general provision of medical services, nutrition, and sanitation for infants in society and its possible consequences for subsequent cognitive achievement outcomes. As expected, the infant mortality rate enters into the regression model with a negative and highly statistically significant regression coefficient. The estimated magnitude suggests that an average increase in infant deaths by one child per $1,000$ infants would, ceteris paribus, result in a reduction of the country-level student achievement test score by about 2.8382 points. Or to put it differently, decreasing the infant mortality rate of Uruguay (the country closest to the median infant mortality rate of 14.0308 infant deaths per $1,000$ infants in the 81-country sample) to the level of Germany (i.e., 4.4115 infant deaths per $1,000$ infants) would, ceteris paribus, increase Uruguay's student achievement test score by about $(4.4115 - 14.03808) \times (-0.0284) \times 100 \approx 27.3395$ points. Although the estimated regression coefficient associated with the country-level $DRD4^{R2R7}$ measure is slightly reduced in magnitude, it is still of the expected negative sign and remains highly statistically significant at the 1% significance level.

In model specification (4), life expectancy at birth is included in the regression equation. As predicted by life-cycle models of schooling and earnings, longevity creates incentives for investment in education as the phase of working life is longer. As predicted, the estimated regression coefficient associated with life expectancy is both positive and highly statistically significant at conventional significance levels, confirming that longevity is beneficial to educational achievement outcomes, similar to previous findings reported in other studies (Strulik and Werner, 2016). An additional expected year of life increases aggregate student achievement test scores by about 6.6526 points. In addition, the latter finding is further consistent with the notion that higher life expectancy partly reflects the quality of the country's health system and its corresponding beneficial effect on overall cognitive ability. Again, the main findings associated with the country-level $DRD4^{R2R7}$ variable remain relatively robust and precisely estimated.

Column (5) includes the disability-adjusted life years lost as an additional variable indicating the country's overall health situation (i.e., disease environment and quality of the health system). As the DALY refer not only to early death but also to expected life years lost due to illness or disability, they share the same transmission channels as the life expectancy variable, but additionally account for the burden of diseases and their implications for labor productivity. Severe diseases or disabilities decrease the expectancy of healthy life and therefore result in an increase in DALY. Again, this might discourage individuals from investing in education, but could also measure impairments caused by or occurring as a co-morbidity of ADHD. As hypothesized, the regression coefficient associated with the DALY variable enters with the expected negative sign into the regression equation and is highly statistically significant at the 1% significance level. Regarding the estimated magnitude, the coefficient estimates suggest that decreasing the value of the DALY for Latvia (i.e., $DALY = 0.4479$) to the level of Germany (i.e., $DALY = 0.3019$) would, ceteris paribus, increase aggregate student achievement test scores by about $(0.3019 - 0.4479) \times (-2.2591) \times 100 \approx 32.9829$ points. As in the previous specification, the regression coefficient associated with the country-level $DRD4^{R2R7}$ variable remains qualitatively unchanged in this model specification.

In column (6), we include a country's homicide rate (i.e., the number of intentional homicides per 100,000 inhabitants) in the regression equation. This variable proxies for the criminal environment and the overall presence of crime in daily life. Crime is thought to have a direct effect on education by creating an unfavorable environment and discouraging students from pursuing a lawful career. Additionally, the inclusion of this control variable in the regression equation accounts for an important source of confounding in the association between aggregate student achievement test scores and the country-level $DRD4^{R2R7}$ measure, as the latter might to some extent reflect the detrimental influence of criminal acts in society on general cognitive ability triggered by a higher prevalence of the ADHD-related behavioral symptoms inattention and/or hyperactivity-impulsivity. As expected, the regression coefficient associated with the homicide rate is negative and weakly statistically significant at the 10% significance level. The estimates suggest that reducing Colombia's homicide rate (42.4533) to the level of Germany (0.8200) would, all else equal, boost student achievement test scores by about $(0.8200 - 42.4533) \times (-0.0113) \times 100 \approx 47.0456$ points, which is a relatively large effect, amounting to approximately a $(0.4705/0.6240) \times 100 \approx 75.4006$ percentage change in the standard deviation of the average student achievement test score variable. Interestingly, the inclusion of the country's homicide rate in the regression equation results in a considerable increase in the estimated magnitude associated with the country-level $DRD4^{R2R7}$ measure, suggesting that the previous model specification suffered from a serious omitted variables bias problem.

In column (7), we simultaneously include all of the aforementioned health-related measures reported in model specifications (2) to (6) in the regression model. The infant mortality rate, as before, enters with a negative point estimate and remains highly statistically significant at the 1% significance level. The estimated regression coefficient for the homicide rate remains qualitatively unaltered, while the remaining coefficients associated with low birth weight, life expectancy, and DALY now turn statistically insignificant at conventional significance levels in this final model specification, perhaps due to the presence of multi-collinearity among the various health related control variables. Nevertheless, the main findings regarding the key country-level $DRD4^{R2R7}$ measure remain qualitatively unaffected even in this augmented model specification, suggesting that this variable does not unintentionally measure either of the health-related factors mentioned above, but instead provides, as intended, a valid approximation of the educational burden of the ADHD-related behavioral symptoms inattention and/or hyperactivity-impulsivity on overall cognitive ability.

Economic Environment Factors. In this section, we examine the robustness of the main findings to the inclusion of a set of economic environment controls in the regression equation. The corresponding estimates are shown in Table 5. As before, the results presented in column (1) portray the baseline model specification, as previously shown in column (8) of Table 3.

A potential concern might be that educational achievement is actually driven by socioeconomic factors and that the country-level $DRD4^{R2R7}$ variable captures international differences in economic development and knowledge creation to some extent (Gören, 2017a,b). As the main indicator of economic prosperity, we include the country's logarithm of real GDP per capita in the regression model, as shown in column (2). As expected, the regression coefficient associated with economic development enters with the expected positive sign and is highly statistically significant at the 1% significance level, consistent with the notion that economically more prosperous countries achieve higher student achievement test score outcomes, perhaps due to better-quality infrastructure. As hypothesized, the relationship between aggregate student achievement test scores and the country-level $DRD4^{R2R7}$ measure is partly confounded by the omission of GDP per capita from the regression model, as indicated by the substantial decrease in the estimated magnitude associated with the country-level $DRD4^{R2R7}$ measure. However, the regression coefficient associated with the country-level $DRD4^{R2R7}$ measure still has the expected negative sign and remains statistically significant at the 5% significance level.

Next, we examine the sensitivity of the main findings to the inclusion of the government consumption share in the regression model. Again, the assumption is that higher government spending captures to some extent the positive effect of a country's fiscal capacity to finance the provision of basic infrastructure services (e.g., kindergarten, museums, and libraries) on aggregate student achievement outcomes, but also captures growth-distorting government taxes that may discourage the accumulation of human capital in society. Thus, the estimated sign of the regression coefficient associated with the government consumption share variable would provide information as to which effect predominates. The results shown in column (3) indicate that although the government consumption share variable enters negatively into the regression model, it is statistically insignificant at conventional significance levels. More importantly, the main findings regarding the country-level $DRD4^{R2R7}$ measure remain qualitatively unchanged to this model specification.

The estimates conducted in columns (4) to (5) include the total fertility rate (i.e., the number of births per woman) and the population growth rate in the regression model. These model specifications account for the educational effect of the quality vs. quantity trade-off in child rearing and its consequences for aggregate student achievement outcomes. With more children, limited financial resources and parenting time have to be distributed across a larger number of children, thus theory would predict that lower per-child investments in education might have adverse effects on individual cognitive achievement outcomes.[24] The regression coefficient associated with the country's total fertility rate enters with the expected negative sign into the regression model and is highly statistically significant at the 1% significance level. Although the regression coefficient associated with the key country-level $DRD4^{R2R7}$ measure is reduced in magnitude, it retains the expected negative sign and remains highly statistically significant at the 1% significance level. Likewise, the regression coefficient associated with the population growth rate is negative and statistically significant at the 5% significance level, as shown in column (4). In contrast to column (3), the estimated regression coefficient associated with the country-level $DRD4^{R2R7}$ measure even increases in magnitude as compared with the baseline specification, and remains highly statistically significant at the 1% significance level.

In column (6), we account for the potential positive effect of the country's openness to international trade on aggregate student achievement test scores. It has been argued that participation in international production chains might positively affect educational achievement outcomes and thereby help to maintain a country's competitiveness in international markets (Jamison et al., 2007). Consistent with this hypothesis, the estimated regression coefficient associated with the trade openness variable enters with the expected positive sign into the regression model and is statistically significant at conventional significance levels. Reassuringly, the main results regarding the country-level $DRD4^{R2R7}$ measure remain relatively robust to the inclusion of trade openness in the regression model and precisely estimated.

The estimates reported in model specification (7) jointly include the set of economic environment factors in the regression equation. In this augmented model specification, only the regression coefficient associated with the population growth

[24] It is worth mentioning that the inclusion of these variables further accounts for an important source of confounding factors in the association between student achievement test scores and the country-level $DRD4^{R2R7}$ measure, as ADHD studies suggest that ADHD-impaired individuals have earlier sexual encounters and more frequent extramarital and/or unprotected intercourse.

rate variable remains statistically significant at the 5% significance level. Although the estimated regression coefficient associated with the country-level $DRD4^{R2R7}$ measure falls in magnitude, it still has the expected negative sign and remains highly statistically significant at the 1% significance level.

Finally, the results reported in column (8) confirm the robustness of the previous findings to the inclusion of the various health-related factors in the regression model.

Social Value Factors. In Table 6, we present coefficient estimates that account for various social value factors in the empirical analysis of aggregate student achievement test score outcomes. As in prior tables, we examine the sensitivity of the main findings regarding the country-level $DRD4^{R2R7}$ measure shown in column (2) relative to the inclusion of the set of social value controls.

In the following two model specifications, we consider various gender equality indicators to assess the impact of a gender-biased cultural environment on the accumulation of human capital in society. Specifically, the results shown in column (2) include the proportion of seats held by women in national parliaments in the regression model. Although this variable enters into the regression model with the expected positive sign, it is statistically insignificant at conventional significance levels. In addition, the estimates presented in column (3) examine the impact of the proportion of females in the total labor force on aggregate student achievement test score outcomes. Again, this variable does not enter significantly into the regression model. In both model specifications, the results regarding the key country-level $DRD4^{R2R7}$ variable remain unchanged, in terms of both the estimated magnitude and statistical significance.

In column (4), we include a binary indicator variable for the presence of a federalist political system. As stated above, a higher degree of decentralization might be associated with a more efficient provision of public educational services (Falch and Fischer, 2012). In line with the theory, the estimated regression coefficient enters positively and statistically significantly into the regression model, although only at the 10% significance level. Again, the main findings regarding the key country-level $DRD4^{R2R7}$ variable remain qualitatively unchanged to this model specification.

In specifications (5) and (6), we include two indicators assessing the country's institutional environment. In both model specifications, the regression coefficients associated with the protection of property rights and the freedom from corruption variable, respectively, enter with the expected positive sign into the regression model. Furthermore, both regression coefficients are highly statistically significant at the 1% significance level. This result is in accordance with the findings from previous studies, consistent with the hypothesis that a favorable institutional environment facilitates the accumulation of human capital in society due to higher future market returns resulting from educational investment decisions (Reinikka and Svensson, 2005).

In column (7), we include the logarithm of the number of civil conflicts in the regression model to account for the detrimental effects of a war-prone environment on cognitive achievement outcomes. Although the estimated regression coefficient associated with the civil conflicts variable has the expected negative sign, it enters statistically insignificantly into the regression model. The main results regarding the key country-level $DRD4^{R2R7}$ measure remain qualitatively unchanged in this model specification.

In column (8), we jointly include the full set of social value factors in the regression equation. None of the social value controls included remain statistically significant in this 'horse race' specification. The point estimate regarding the country-level $DRD4^{R2R7}$ measure decreases slightly in magnitude, yet still remains statistically significant at the 1% significance level.

After including the health-related factors examined in column (7) of Table 4, the estimated regression coefficients associated with the various social value controls still remain statistically insignificant at conventional significance levels, as shown in the last column (9). Again, the estimated regression coefficient associated with the key country-level $DRD4^{R2R7}$ measure remains relatively robust and precisely estimated, even in this augmented model specification.

Educational Factors. In Table 7, we examine the predictive power of a full set of educational input factors in the regression model as the *prima facie* most obvious determinants for the accumulation of cognitive abilities. In addition, we account for an additional source of confounding in the association between student achievement test scores and the country-level $DRD4^{R2R7}$ measure, as the latter variable might to some extent reflect the adverse effect on cognitive achievement resulting from the poor educational achievement of ADHD impaired students.

In column (1) we report, again, the baseline specification previously shown in column (6) of Table 3, but this time restricted to a limited sample of 73 country observations. The reason for reducing the sample is the lack of data available on the various educational input factors for some countries in the extended 81-country sample.

In columns (2) to (4), we include various measures indicating the share of the population aged 15 and above with primary, secondary, or no educational attainment. However, none of the three measures enter significantly into the regression model. More importantly, the main results regarding the country-level $DRD4^{R2R7}$ measure remain qualitatively unchanged to these model specifications.

In column (5), we include the logarithm of the human capital index as a proxy for the overall quantity of schooling in a country in the regression model. However, the estimated regression coefficient of the human capital index is statistically insignificant, suggesting that it does not contribute to the accumulation of cognitive skills once a full set of biogeographic, historical, and region factors are accounted for in the regression equation. Again, the regression coefficient associated with the country-level $DRD4^{R2R7}$ measure remains virtually unchanged in magnitude and statistical significance, suggesting that the omission of school quantity does not significantly confound the association between aggregate student achievement test score outcomes and the country-level $DRD4^{R2R7}$ variable.

The results presented in column (6), examines the robustness of the main findings to the inclusion of the student-teacher ratio in secondary education, as a real resource measure of classroom size. The estimated regression coefficient associated with the student-teacher ratio has a negative sign but is statistically insignificant at conventional significance levels. This finding is in line with results from other studies, which have found that the student-teacher ratio is a rather poor proxy variable for schooling quality (Wright et al., 1997; Hoxby, 2000). Again, the estimated regression coefficient associated with the $DRD4^{R2R7}$ measure remains relatively robust and precisely estimated.

Next, we consider the effect of education expenditures on cognitive skills formation by including governmental expenditures on education expressed as a percentage of total GDP, as shown in model specification (7). Theory suggests that increased schooling resources lead to better learning opportunities and thus to improved educational performance. However, the educational expenditure variable enters into the regression model statistically insignificantly, consistent with the hypothesis that the influence of financial resources on the educational process is largely dependent on the timing of spending (Hanushek, 1997, 2002; Häkkinen et al., 2003). Once educational expenditures are included in the regression model, the estimated regression coefficient associated with the country-level $DRD4^{R2R7}$ decreases in magnitude but remains statistically significant at the 5% significance level.

In column (8), the share of private enrollment in primary education is included to account for the possibility that private schools might be more efficient in the provision of basic school services. Additionally, this variable might capture competition effects between the private and public school sector, with potentially positive effects on the formation of cognitive skill outcomes in society. However, the estimated regression coefficient associated with the private enrollment rate variable enters statistically insignificantly into the regression equation[25], leaving the main findings associated with the key country-level $DRD4^{R2R7}$ measure qualitatively unchanged.

Entering the set of educational input factors jointly into the regression equation, as shown in column (9), does not alter the main findings substantially. All of the included educational factors remain statistically insignificant at conventional significance levels.

In column (10), we examine the robustness of the previous findings to the inclusion of the various health-related factors, as examined in column (7) of Table 4. Upon controlling for these factors, the estimated regression coefficient associated with the country-level $DRD4^{R2R7}$ measure decreases moderately in magnitude, but still remains statistically significant at the 1% significance level. Interestingly, the estimated regression coefficient associated with the country's population share aged 15 and above with no educational attainment is positive and now turns highly statistically significant at the 1% significance level. This finding suggests that countries with lower educational attainment might select a non-representative sample of high-performing students across the various international student assessment waves.

7 Robustness Analysis

Genetic and Diversity Factors. In this part of the analysis, we examine the sensitivity of the main results to the presence of various aspects of diversity in society. Specifically, it is conceivable that the estimated regression coefficient associated with the country-level $DRD4^{R2R7}$ measure captures the potential influence of genetic, ethnic, or religious diversity on overall cognitive ability. To rule out these additional confounding factors, Table 8 presents coefficient estimates controlling for various diversity measures in the regression model. Again, column (1) presents the baseline specification and is shown for comparison purposes.

In column (2), we consider an ancestry-adjusted measure of overall genetic diversity to account for the possibility that observed differences in cognitive abilities across countries reflect differences in the genetic composition across countries to some extent. This model specification is intended to rule out the possibility that the country-level genetic $DRD4^{R2R7}$ measure simply captures the issue of overall genetic diversity on student achievement test scores. The regression coefficient associated with the ancestry-adjusted overall genetic diversity measure enters insignificantly into the regression model, leaving the regression coefficient of the country-level $DRD4^{R2R7}$ measure virtually unchanged with respect to magnitude and statistical significance.

Next, we consider a possible association between HLA heterozygosity and student achievement test performance. It has been argued that HLA diversity might affect student achievement test scores either indirectly through increased inherent resistance to many infectious diseases (e.g., malaria, hepatitis B, and HIV) or directly due to increased susceptibility to

[25] This finding is in line with the results reported in Hsieh and Urquiola (2006), who find no support for the hypothesis of rivalry induced by the provision of private schooling in society enhances educational quality.

psychological disorders (e.g., language impairment or cognitive decline in later life). In addition to the aforementioned pathway, HLA diversity might also capture regional pathogen richness and the associated detrimental impact on cognitive ability. However, the estimates reported in column (3) reveal that HLA diversity enters insignificantly into the regression model. Hence, once we have controlled for a full set of cultural, historical, and biogeographic factors, there seems to be no separate statistically significant effect of HLA diversity on student achievement test scores. This observation is further consistent with the notion that the diffusion of key medical discoveries since the global epidemiological transition have lessened the benefits of HLA heterozygote individuals on an array of possible infectious diseases (Cook, 2015). Reassuringly, the regression coefficient associated with the country-level $DRD4^{R2R7}$ measure remains rather robust and precisely estimated.

In column (4), we examine the robustness of the main findings to the inclusion of an ethno-linguistic diversity measure. Specifically, it is conceivable that the country-level $DRD4^{R2R7}$ measure merely reflects the detrimental effect of ethno-linguistic diversity on the accumulation of human capital rather than the prevalence of ADHD. Although the ethno-linguistic diversity measure enters into the regression model negatively and statistically significantly, the negative association between the country-level $DRD4^{R2R7}$ measure and general cognitive ability remains qualitatively unaffected by the potential confounding influence of ethno-linguistic diversity.

In addition, the baseline results remain largely unaffected when including a measure of religious diversity – capturing the notion of the cultural differences within a country originating from different religious values, norms, and beliefs – in the regression model, as indicated in column (5).

Finally, to account for the possible conflating influence of the various genetic and cultural controls, the estimates reported in column (6) include all variables simultaneously in the regression model. Even in this augmented model specification, the estimated regression coefficient associated with the country-level $DRD4^{R2R7}$ measure remains relatively robust and precisely estimated.

Stratified Analysis by PISA Subjects. In Table 9, we analyze whether the main results are affected by the way we constructed the main dependent variable in the analysis of international student achievement test score outcomes. As stated above, our preferred data source is the OECD PISA study, which contains, apart from reading, the subjects of mathematics and science. We replicate the main empirical results, but this time restrict the analysis to a limited sample of 63 country observations for which we have student achievement test scores from PISA only (Panel A). We therefore examine whether the main findings are driven by the inclusion of the TIMSS aggregate student achievement test scores and thus if qualitative differences in both ISATs drive the main results. Additionally, we stratify the empirical analysis by the various PISA subjects, i.e., mathematics and science (Panel B and C), to address possible concerns of subject choice affecting the main findings.

Column (1) corresponds to the bivariate baseline specification in the relationship between the various student achievement test score outcomes and the country-level $DRD4^{R2R7}$ measure, conditional on a full set of region, OPEC, biogeographic, major religion, and legal origin effects (this corresponds to the baseline model specification (6) of Table 3). Even in this reduced PISA sample of 63 countries, the estimated regression coefficient associated with the country-level $DRD4^{R2R7}$ measure is of the expected negative sign and highly statistically significant at the 1% significance level. In all panels A to C, the coefficients are slightly larger in magnitude, yet do not differ qualitatively from the main findings.

Next, in columns (2) to (4), we examine the robustness of the previous findings by subsequently including the various health-related, economic environment, and social value factors in the regression equation. None of these model specifications alter the main findings regarding the key country-level $DRD4^{R2R7}$ measure substantially. It is worth noting that in all model specifications (2) to (4), the estimated regression coefficient associated with the country-level $DRD4^{R2R7}$ measure increases in magnitude compared to the main findings based on the extended 81-country sample.

In the remaining columns (5) to (7), we restrict the empirical analysis to the reduced schooling sample, in which both PISA student achievement test scores and data on the various education input factors are available for a total number of 57 countries. In model specification (5), we again only use the basic set of region, OPEC, biogeographic, major religion, and legal origin effects in the regression model. Next, we examine the sensitivity of the main findings to the inclusion of the various education input factors, as shown in column (6). In column (7), we add the full set of health-related factors to the previous model specification. None of these model specifications alter the main findings considerably.

Overall, the stratified analysis by PISA subjects reveals that the main findings are robust to variations of the sample size (i.e., restriction to the PISA sample) and to the inclusion of a large set of additional country-specific biogeographic, historical, regional, health-related, socioeconomic, and educational factors. Across the panel specifications A to C, the influence of the country-level $DRD4^{R2R7}$ measure on aggregate student achievement test scores is of the expected negative sign and remains statistically significant at conventional significance levels.

Instrumental Variables Estimation Approach. The results discussed so far point to a negative and statistically significant effect of the country-level $DRD4^{R2R7}$ measure on general cognitive ability. Given the positive association between the DRD4 exon III 2- and 7-repeat allele frequency measure and ADHD-related behavioral symptoms, this finding is suggestive of the proposed hypothesis that ADHD prevalence might play a causal role in predicting cognitive problems. In the following, we present coefficient estimates from an Instrumental Variables (IV) estimation approach to provide a more direct test of this causal link.

Several causal pathways underlying the association between ADHD-related behavioral symptoms and academic achievement have been proposed in the relevant literature. In particular, it is conceivable that frequent frustration with educational failures might lead to decreased motivation and the emergence of behavioral problems associated with inattention, hyperactivity, and impulsivity, which in turn would result in even lower educational outcomes (Arnold, 1997). Such a simultaneous relationship between academic achievement and ADHD-related behavioral problems undermine the identification of causal inferences. Even if the underlying hypothetical model runs unidirectionally from ADHD to academic achievement, omitted variables might result in a spurious relationship between the two outcomes. For example, Hinshaw (1992) argue that the presence of common factors (e.g., language difficulties) might explain both the presence of ADHD-related symptoms and academic underachievement. Both hypothetical causal mechanisms result in endogeneity problems that can only be overcome with the use of a credible IV estimation approach.

Thus, we estimate the following regression equation regarding the association between student achievement test scores and ADHD prevalence:

$$SATS_c = \beta_0 + \beta_1 ADHD_c + \boldsymbol{\beta}_2' \boldsymbol{X}_c + \boldsymbol{\beta}_3' \boldsymbol{R}_c + e_c, \tag{5}$$

where $\boldsymbol{X}$ is a vector of country-level controls, $\boldsymbol{R}$ refers to a vector of region controls, and e is the usual error term. Again, simultaneity bias and/or the existence of common factors might blur the relationship between student achievement test scores and ADHD prevalence. To account for this source of endogeneity, we utilize a set of excluded instrumental variables that satisfy the necessary relevance and exclusion condition in a standard IV estimation approach.

In panel A of Table 10 we report coefficient estimates associated with the country-level ADHD prevalence rate. The results presented in columns (1) to (4) were derived using the OLS estimator, while columns (5) to (8) utilize the Two-Stage Least Square (2SLS) estimator of the proposed IV approach. In panel B, we report the first-stage IV diagnostic tests for under-identification and weak identification of the set of excluded instruments. Given the discussion about the possible determinants of cross-country differences in estimated ADHD prevalence rates, we employ the country-level $DRD4^{R2R7}$ measure, state history experience, and Neolithic transition timing as excluded instrumental variables.

In line with the proposed hypothetical mechanism, the results presented in columns (1) to (4) point to a negative and statistically significant association between student achievement test scores and ADHD prevalence, which is robust to the inclusion of continent and country-level controls. However, the OLS coefficient estimates regarding the ADHD prevalence rate might be biased due to the presence of simultaneity and/or omitted variables bias. Thus, columns (5) to (8) provide coefficient estimates based on the proposed IV estimation approach. Across the various model specifications, only the results reported in columns (7) and (8) show that the set of excluded instruments are relevant and excludable, as indicated by the corresponding Kleibergen and Paap (2006) *rk* LM and the Hansen J statistic, respectively. In addition, testing for weak identification of IV, the non-robust Cragg-Donald and heteroskedasticity-robust Kleibergen-Paap *rk* Wald F statistic indicates that the reported 2SLS coefficient estimate of ADHD in columns (7) and (8) has a maximum relative OLS bias of 10% and 20%, respectively.[26] Although the findings are supportive of a causal link between student achievement test scores and ADHD prevalence, they should be interpreted with caution given the relatively small number of 37 country observations.

8 Conclusion

The ADHD-related behavioral symptoms inattention and/or hyperactivity-impulsivity significantly interfere with childhood learning success and eventually lead to individual educational underachievement. In contrast to popular belief, ADHD-related behavioral symptoms persist into adolescence and adulthood with direct implications for future educational, occupational, and social life outcomes.

Although a large number of neuropsychological studies have confirmed the impairing nature of ADHD-related behavioral symptoms in daily life activities throughout the life course, no study, to the best of the authors' knowledge, has addressed the macroeconomic burden of ADHD for the accumulation of human capital in a sample of culturally distinct countries. We contribute to the relevant human capital literature on the formation of cognitive skills in society by identifying an important innate ability factor that significantly determines the child's inclination to pay attention to schooling tasks, which is regarded as an essential prerequisite for individual learning success.

In particular, we examine the relationship between international student achievement test score outcomes and a set of

[26]The critical values for assessing the weakness of IV are tabulated in Stock and Yogo (2005) for various combinations of the number of endogenous variables, instruments, and the relative size of the OLS bias. Although these values only apply to the non-robust Cragg-Donald Wald F statistic assuming the presence of *i.i.d.* errors, we follow the suggestion in Baum et al. (2007, p. 490) and apply these critical values with caution to the Kleibergen-Paap Wald F statistic, which is robust to the presence of non–*i.i.d.* errors.

specific allele variants of the human DRD4 exon III gene, which candidate gene association studies have found to be a robust biomarker in the etiology of the ADHD-related behavioral symptoms inattention and/or hyperactivity-impulsivity. The negative and statistically significant coefficient associated with the country-level DRD4 exon III 2- and 7-repeat allele frequency measure on aggregate student achievement test score outcomes is consistent with the educational burden of the ADHD-related behavioral symptoms inattention and/or hyperactivity-impulsivity on cognitive achievement outcomes. This finding is robust to the inclusion of a full set of country-specific regional, biogeographic, historical, health-related, socioeconomic, educational, genetic, and diversity factors and across various model specifications.

Several policy implications can be drawn from the findings in this paper. The psychological literature discusses a series of academic and behavioral classroom intervention measures designed to increase children's attention and motivation that may be beneficial for individual learning outcomes and for subsequent academic and occupational achievement, especially for children with ADHD-related behavioral symptoms. These intervention measures include class-wide peer tutoring, task or instructional modifications, parental involvement in completing and checking homework, and individualized academic interventions tailored to the specific needs of ADHD-impaired students at school.[27] Given that the emotional skill of impulse-control significantly predicts an individual's economic, health, and social outcomes, the teaching of such skills in early life seems of pivotal importance to avoid later disabilities, especially in an increasingly complex modern society (Moffitt et al., 2011).

[27] See Raggi and Chronis (2006) for an excellent discussion of the various intervention measures designed to improve the educational performance of ADHD-impaired children and adolescents.

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A Regression Tables

Table 1: Meta-Regression of ADHD Prevalence Estimates (Assessing Study Methodological Characteristics)

	(1) Risk of Bias Score	(2) DSM Edition	(3) Population Sample	(4) Full vs. Partial ADHD Criteria	(5) Type of ADHD Measurement	(6) Informant of ADHD	(7) Time Fixed Effects	(8) Region Fixed Effects
	Dependent Variable: Study-Level Estimated ADHD Prevalence Rate							
Reference Category: *Low Risk of Bias Score*								
Very High Risk of Bias Score	-0.0316***	-0.0358***	-0.0373***	-0.0372***	-0.0352***	-0.0349***	-0.0310***	-0.0023
	(0.0056)	(0.0043)	(0.0030)	(0.0032)	(0.0036)	(0.0030)	(0.0049)	(0.0080)
High Risk of Bias Score	-0.0345**	-0.0393***	-0.0297***	-0.0301***	-0.0202***	-0.0137***	-0.0138***	-0.0117***
	(0.0143)	(0.0142)	(0.0095)	(0.0103)	(0.0073)	(0.0044)	(0.0038)	(0.0036)
Moderate Risk of Bias Score	-0.0319***	-0.0343***	-0.0258***	-0.0256***	-0.0196***	-0.0204***	-0.0220***	-0.0166***
	(0.0088)	(0.0105)	(0.0070)	(0.0069)	(0.0069)	(0.0060)	(0.0072)	(0.0050)
Reference Category: *DSM-IV Diagnostic Criteria*								
DSM-III Diagnostic Criteria		-0.0100	-0.0051	-0.0082	-0.0112	-0.0067	-0.0083	-0.0061
		(0.0127)	(0.0119)	(0.0120)	(0.0099)	(0.0119)	(0.0171)	(0.0204)
DSM-III-R Diagnostic Criteria		-0.0227***	-0.0194***	-0.0212***	-0.0253***	-0.0209**	-0.0218	-0.0129
		(0.0083)	(0.0069)	(0.0051)	(0.0058)	(0.0079)	(0.0133)	(0.0150)
Reference Category: *Schooling Sample*								
Community Sample			0.0182*	0.0171	0.0279***	0.0159**	0.0119	0.0106
			(0.0103)	(0.0114)	(0.0102)	(0.0063)	(0.0094)	(0.0079)
Whole Population			0.0191**	0.0198**	0.0376***	0.0169	0.0138	0.0096
			(0.0081)	(0.0085)	(0.0088)	(0.0125)	(0.0103)	(0.0094)
Reference Category: *Full Diagnostic Criteria Not Met*								
Full Diagnostic Criteria Met				0.0046	0.0278***	0.0301**	0.0340***	0.0256*
				(0.0124)	(0.0100)	(0.0116)	(0.0109)	(0.0137)
Reference Category: *Diagnostic Report*								
Interview					-0.0122	-0.0149	-0.0199	-0.0130
					(0.0155)	(0.0158)	(0.0194)	(0.0199)
Symptom-only Checklist					0.0429***	0.0597***	0.0601***	0.0455***
					(0.0125)	(0.0103)	(0.0116)	(0.0091)
Unclear					0.0268	0.0523***	0.0602***	0.0480***
					(0.0193)	(0.0164)	(0.0154)	(0.0153)
Reference Category: *Clinician*								
Child						-0.0336**	-0.0319**	-0.0199
						(0.0133)	(0.0137)	(0.0189)
Parent						0.0126	0.0160	0.0041
						(0.0123)	(0.0107)	(0.0088)
Teacher						-0.0218*	-0.0232	-0.0192
						(0.0114)	(0.0163)	(0.0153)
AND Rule						-0.0504***	-0.0520***	-0.0505***
						(0.0111)	(0.0112)	(0.0130)
OR Rule						-0.0379***	-0.0406***	-0.0415***
						(0.0085)	(0.0146)	(0.0116)
Unclear						-0.0483*	-0.0513*	-0.0404**
						(0.0257)	(0.0286)	(0.0192)
Number of ADHD Studies	179	179	179	179	179	179	179	179
R^2	0.19	0.22	0.27	0.27	0.38	0.48	0.50	0.65
Time Fixed Effects	No	No	No	No	No	No	Yes	Yes
Region Fixed Effects	No	No	No	No	No	No	No	Yes

Notes: This table shows the association between estimated ADHD prevalence rates and various study-level methodological characteristics in a sample of 179 individual ADHD studies conducted in 52 countries during the years 1981 to 2014. The method of estimation refers to a weighted meta-regression model where study-level observations are weighted according to their reported sample size. *Time Fixed Effects* refer to a set of indicator variables that take a value of 1 if the respective study was published within a given five-year interval (i.e., 1980–1984, 1985–1989,..., and 2010–2014). *Region Fixed Effects* refer to a set of regional controls for individual ADHD studies conducted in North America, Latin America and the Caribbean, Africa, Asia, the Middle East, and Europe. See the main text for additional details on data construction and sources. Constant term included but not shown.
Standard errors, clustered with respect to countries, are reported in parentheses.
*: Significant at the 10% level. **: Significant at the 5% level. ***: Significant at the 1% level.

Table 2: Association Between the Country-Level ADHD Prevalence Estimate and DRD4 Exon III 2- and 7-Repeat Allele Frequency Measure

	(1) Baseline Specification	(2) Legal Origin Effects	(3) Major Religion Effects	(4) Economic Development	(5) Health System	(6) Educational System	(7) State Experience	(8) Neolithic Transition
	Dependent Variable: Country-Level ADHD Prevalence Estimate							
$DRD4^{R2R7}$	0.2197**	0.3644***	0.4188***	0.4219***	0.4226***	0.4302**	0.4339**	0.4218**
(Ethnicity-Weighted)	(0.1036)	(0.1311)	(0.1286)	(0.1509)	(0.1556)	(0.1740)	(0.1617)	(0.1654)
ln Real GDP per Capita				0.0010	-0.0001	0.0089	0.0007	0.0026
				(0.0130)	(0.0150)	(0.0178)	(0.0195)	(0.0203)
Life Expectancy					0.0002	0.0025	0.0046	0.0041
					(0.0020)	(0.0022)	(0.0030)	(0.0037)
ln Human Capital Index						-0.1210	-0.1612	-0.1582
						(0.0980)	(0.1047)	(0.1103)
ln State History 1 AD – 1500 AD							-0.0269	-0.0306
(Ancestry-Adjusted)							(0.0200)	(0.0206)
ln Agricultural Transition Timing								0.0188
(Ancestry-Adjusted)								(0.0422)
Number of Countries	42	42	42	42	42	42	42	42
R^2	0.40	0.45	0.45	0.45	0.45	0.48	0.53	0.54
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Legal Origin Effects	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Major Religion Effects	No	No	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable is the country-level ADHD prevalence estimate calculated as the weighted average across individual ADHD studies within countries, where each study-level observation is weighted according to its reported sample size. $DRD4^{R2R7}$ refers to the country-level DRD4 exon III 2- and 7-repeat allele frequency measure (ethnicity-weighted). *ln Real GDP per Capita* refers to the natural logarithm of real GDP per capita. *Life Expectancy* refers to the country's overall life expectancy at birth. *ln Human Capital Index* refers to the natural logarithm of a country's human capital index, which combines data on average years of schooling and information on the assumed rate of return to educational years adjusted for decreasing returns. *ln State History* refers to the natural logarithm of the country's experience with early state formation from 1 AD to 1500 AD (ancestry-adjusted). *ln Agricultural Transition Timing* refers to the natural logarithm of the time elapsed between when the country began practicing sedentary agriculture and the year 2000 (ancestry-adjusted). *Region Fixed Effects* refer to region controls for North America, Latin America and the Caribbean, Africa, East Asia, Central Asia, South Asia, Middle East, Europe, and Oceania. *Legal Origin Effects* refer to a set of indicator variables that take a value of 1 if the country's legal tradition is British, French, German, or Scandinavian. *Major Religion Effects* refer to a set of country-level controls indicating the share of Muslims, Catholics, and Protestants in the population (measured in percent). See the main text for additional details on data construction and sources. Constant term included but not shown.

Robust standard errors are reported in parentheses.

*: Significant at the 10% level. **: Significant at the 5% level. ***: Significant at the 1% level.

Table 3: DRD4 III 2- and 7-Repeat Allele Frequency Measure and Student Achievement Test Score (Biogeographic and Historical Factors)

	(1) Baseline Specification	(2) Absolute Latitude	(3) Climate Effects	(4) Percentage Arable Land	(5) Major Religion Effects	(6) Legal Origin Effects
	Dependent Variable: Aggregate Student Achievement Test Score					
$DRD4^{R2R7}$	-2.8806***	-2.7416**	-2.3051**	-2.2348**	-3.6139***	-3.8765***
(Ethnicity-Weighted)	(0.8839)	(1.1567)	(1.0241)	(1.0396)	(1.1089)	(1.1361)
ln Absolute Latitude		0.0312	-0.0042	0.0086	-0.0371	-0.0906
		(0.1477)	(0.1714)	(0.1744)	(0.1706)	(0.1821)
Population in Area with Malaria			-0.1244	-0.1324	-0.1358	-0.0370
			(0.2422)	(0.2458)	(0.2731)	(0.2809)
Temperature			-0.0056	-0.0045	0.0001	-0.0046
			(0.0120)	(0.0119)	(0.0125)	(0.0141)
ln Percentage Arable Land Area				-0.0120	0.0047	0.0026
				(0.0392)	(0.0419)	(0.0401)
Percentage of Protestants					0.0060***	0.0054
					(0.0022)	(0.0037)
Percentage of Catholics					0.0039*	0.0022
					(0.0020)	(0.0020)
Percentage of Muslims					-0.0008	-0.0019
					(0.0026)	(0.0027)
British Legal Origin						0.1314
						(0.1842)
French Legal Origin						0.2511
						(0.1600)
German Legal Origin						0.3861**
						(0.1754)
Scandinavian Legal Origin						0.0075
						(0.2901)
Number of Countries	81	81	81	81	81	81
R^2	0.69	0.69	0.69	0.69	0.73	0.75
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
OPEC Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
TIMSS Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable is the country-level student achievement test score outcome in the academic subjects mathematics and science. This variable has been constructed from individual student achievement test score outcomes from the PISA and TIMSS studies during the various student assessment waves in the years 1995 to 2015. $DRD4^{R2R7}$ refers to the country-level DRD4 exon III 2- and 7-repeat allele frequency measure (ethnicity-weighted). *ln Absolute Latitude* refers to the natural logarithm of the absolute value of a country's approximate centroid latitude in decimal degrees. *Population in Area with Malaria* is the share of a country's population in 1995 residing in areas with malaria falciparum. *Temperature* is the country's mean temperature value (in degrees Celsius) during the period 1960 to 1990. *ln Percentage Arable Land Area* refers to the natural logarithm of a country's percentage arable land area. *Major Religion Effects* refer to a set of country-level controls indicating the share of Muslims, Catholics, and Protestants in the population (measured in percent). *Legal Origin Effects* refer to a set of indicator variables that takes a value of 1 if the country's legal tradition is British, French, German, or Scandinavian. *Region Fixed Effects* refer to region controls for North America, Latin America and the Caribbean, Africa, East Asia, Central Asia, South Asia, Middle East, Europe, and Oceania. *OPEC Fixed Effects* refer to an indicator variable for member countries belonging to the Organization of the Petroleum Exporting Countries (OPEC). *TIMSS Fixed Effects* take a value of 1 if the student achievement test score outcome was derived from the TIMSS study and zero otherwise. See the main text for additional details on data construction and sources. Constant term included but not shown.
Robust standard errors are reported in parentheses.
*: Significant at the 10% level. **: Significant at the 5% level. ***: Significant at the 1% level.

Table 4: DRD4 III 2- and 7-Repeat Allele Frequency Measure and Student Achievement Test Score (Health-Related Factors)

	(1) Baseline Specification	(2) Low Birth Weight	(3) Infant Mortality	(4) Life Expectancy	(5) Disability-Adjusted Life-Years	(6) Homicide Rate	(7) Health-Related Factors
	Dependent Variable: Aggregate Student Achievement Test Score						
$DRD4^{R2R7}$	-3.8765***	-3.6536***	-3.3784***	-3.2673***	-3.6231***	-4.2019***	-3.6049***
(Ethnicity-Weighted)	(1.1361)	(1.1311)	(0.9943)	(1.0611)	(1.0861)	(1.1830)	(1.0217)
Low Birth Weight		-0.0452**					-0.0038
		(0.0217)					(0.0236)
Infant Mortality Rate			-0.0284***				-0.0252***
			(0.0058)				(0.0092)
Life Expectancy				0.0665***			-0.0004
				(0.0172)			(0.0300)
Disability-Adjusted Life-Years					-2.2591***		-0.3429
					(0.8223)		(0.8738)
Homicide Rate						-0.0113*	-0.0078*
						(0.0061)	(0.0041)
Number of Countries	81	81	81	81	81	81	81
R^2	0.75	0.77	0.84	0.81	0.79	0.77	0.85
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OPEC Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TIMSS Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Biogeographic Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Major Religion Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Legal Origin Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable is the country-level student achievement test score outcome in the academic subjects mathematics and science. This variable has been constructed from individual student achievement test score outcomes from the PISA and TIMSS studies during the various student assessment waves in the years 1995 to 2015. $DRD4^{R2R7}$ refers to the country-level DRD4 exon III 2- and 7-repeat allele frequency measure (ethnicity-weighted). *Low Birth Weight* refers to the share of newborns with a birth weight below 2,500 grams. *Infant Mortality Rate* refers to the number of infant deaths within one year per 1,000 live births. *Life Expectancy* refers to the country's overall life expectancy at birth. *Disability-Adjusted Life-Years* refer to the country's healthy life years lost due to disabilities, diseases, or deaths. *Homicide Rate* refers to the number of intentional homicides per 100,000 inhabitants of a country. *Region Fixed Effects* refer to region controls for North America, Latin America and the Caribbean, Africa, East Asia, Central Asia, South Asia, Middle East, Europe, and Oceania. *OPEC Fixed Effects* refer to an indicator variable for member countries belonging to the Organization of the Petroleum Exporting Countries (OPEC). *TIMSS Fixed Effects* take a value of 1 if the student achievement test score outcome was derived from the TIMSS study and zero otherwise. *Biogeographic Effects* include *ln Absolute Latitude*, *Population in Area with Malaria*, *Temperature*, and *ln Percentage Arable Land Area. Major Religion Effects* refer to a set of country-level controls indicating the share of Muslims, Catholics, and Protestants in the population (measured in percent). *Legal Origin Effects* refer to a set of indicator variables that takes a value of 1 if the country's legal tradition is British, French, German, or Scandinavian. See the main text for additional details on data construction and sources. Constant term included but not shown.
Robust standard errors are reported in parentheses.
*: Significant at the 10% level. **: Significant at the 5% level. ***: Significant at the 1% level.

Table 5: DRD4 III 2- and 7-Repeat Allele Frequency Measure and Student Achievement Test Score (Economic Environment Factors)

	(1) Baseline Specification	(2) GDP per Capita	(3) Government Consumption	(4) Fertility Rate	(5) Population Growth	(6) Trade Openness	(7) Economic Environment	(8) Health-Related Factors
	Dependent Variable: Aggregate Student Achievement Test Score							
$DRD4^{R2R7}$	-3.8765***	-2.5740**	-3.7060***	-3.0536***	-4.0503***	-3.6383***	-2.7301***	-3.1287***
(Ethnicity-Weighted)	(1.1361)	(1.1515)	(1.1811)	(0.9907)	(1.1203)	(1.0032)	(0.9876)	(0.9881)
ln GDP per Capita		0.3374***					0.1418	0.0707
		(0.1194)					(0.1869)	(0.2036)
Government Consumption			-1.1979				-1.0378	-0.7169
(Percentage of GDP)			(1.4911)				(1.5954)	(1.5266)
Total Fertility Rate				-0.3834***			-0.1978	-0.1089
				(0.1018)			(0.1354)	(0.1303)
Population Growth					-0.1540**		-0.1515**	-0.0965
					(0.0618)		(0.0570)	(0.0651)
Trade Openness						0.0024*	0.0020	0.0011
(Percentage of GDP)						(0.0013)	(0.0014)	(0.0012)
Number of Countries	81	81	81	81	81	81	81	81
R^2	0.75	0.79	0.76	0.80	0.77	0.77	0.83	0.86
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OPEC Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TIMSS Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Biogeographic Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Major Religion Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Legal Origin Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Health-Related Effects	No	No	No	No	No	No	No	Yes

Notes: The dependent variable is the country-level student achievement test score outcome in the academic subjects mathematics and science. This variable has been constructed from individual student achievement test score outcomes from the PISA and TIMSS studies during the various student assessment waves in the years 1995 to 2015. $DRD4^{R2R7}$ refers to the country-level DRD4 exon III 2- and 7-repeat allele frequency measure (ethnicity-weighted). *ln Real GDP per Capita* refers to the natural logarithm of real GDP per capita. *Government Consumption* refers to the share of government consumption measured in percentage of total GDP. *Total Fertility Rate* refers to the country's average number of children expected to be born to a woman over her entire life course. *Population Growth* refers to the country's average population growth rate (measured in percent). *Trade Openness* refers to the country's amount of exports and imports over total GDP (measured in percent). *Region Fixed Effects* refer to region controls for North America, Latin America and the Caribbean, Africa, East Asia, Central Asia, South Asia, Middle East, Europe, and Oceania. *OPEC Fixed Effects* refer to an indicator variable for member countries belonging to the Organization of the Petroleum Exporting Countries (OPEC). *TIMSS Fixed Effects* take a value of 1 if the student achievement test score outcome was derived from the TIMSS study and zero otherwise. *Biogeographic Effects* include *ln Absolute Latitude*, *Population in Area with Malaria*, *Temperature*, and *ln Percentage Arable Land Area*. *Major Religion Effects* refer to a set of country-level controls indicating the share of Muslims, Catholics, and Protestants in the population (measured in percent). *Legal Origin Effects* refer to a set of indicator variables that takes a value of 1 if the country's legal tradition is British, French, German or Scandinavian. *Health-Related Effects* include *Low Birth Weight*, *Infant Mortality Rate*, *Life Expectancy*, *Disability-Adjusted Life-Years*, and *Homicide Rate*. See the main text for additional details on data construction and sources. Constant term included but not shown.

Robust standard errors are reported in parentheses.

*: Significant at the 10% level. **: Significant at the 5% level. ***: Significant at the 1% level.

Table 6: DRD4 III 2- and 7-Repeat Allele Frequency Measure and Student Achievement Test Score (Social Value Factors)

	(1) Baseline Specification	(2) Female Political Empowerment	(3) Female Economic Empowerment	(4) Government Structure	(5) Property Rights Protection	(6) Freedom from Corruption	(7) Number of Civil Conflicts	(8) Social Value Factors	(9) Health-Related Factors
	Dependent Variable: Aggregate Student Achievement Test Score								
$DRD4^{R2R7}$	-3.8765***	-3.9575***	-3.8367***	-3.9037***	-3.4152***	-3.2612***	-3.5968***	-3.4752***	-3.6959***
(Ethnicity-Weighted)	(1.1361)	(1.1526)	(1.1686)	(1.1238)	(1.0941)	(1.0320)	(1.1388)	(1.0236)	(1.0802)
Women in Parliament		0.0027						0.0047	0.0045
(Proportion of Seats)		(0.0095)						(0.0076)	(0.0067)
Female Economic Participation			-0.0054					-0.0091	0.0084
(Share of Labor Force)			(0.0121)					(0.0106)	(0.0145)
Federalist Political System				0.1749*				0.1554*	0.0695
				(0.0908)				(0.0910)	(0.0771)
Property Rights Protection					0.0129***			0.0065	0.0061
(0 = low to 100 = high)					(0.0036)			(0.0068)	(0.0067)
Freedom from Corruption						0.0148***		0.0106	0.0031
(0 = low to 100 = high)						(0.0039)		(0.0070)	(0.0062)
ln Number of Civil Conflicts							-0.0175	0.0108	0.0129
							(0.0185)	(0.0177)	(0.0171)
Number of Countries	81	81	81	81	81	81	81	81	81
R^2	0.75	0.75	0.75	0.76	0.80	0.80	0.76	0.82	0.86
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OPEC Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TIMSS Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Biogeographic Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Major Religion Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Legal Origin Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Health-Related Effects	No	No	No	No	No	No	No	No	Yes

Notes: The dependent variable is the country-level student achievement test score outcome in the academic subjects mathematics and science. This variable has been constructed from individual student achievement test score outcomes from the PISA and TIMSS studies during the various student assessment waves in the years 1995 to 2015. $DRD4^{R2R7}$ refers to the country-level DRD4 exon III 2- and 7-repeat allele frequency measure (ethnicity-weighted). *Women in Parliament* refers to the proportion of seats held by women in national parliaments. *Female Economic Participation* refers to the percentage of women in the total labor force. *Federal Political System* refers to an indicator variable for a federalist government system. *Property Rights Protection* refers to an index of governmental and legislative efforts to protect private property. *Freedom from Corruption* refers to the country's freedom from corruption index. *ln Number of Civil Conflicts* refers to the country's average number of internal (i.e., civil) conflict events. *Region Fixed Effects* refer to region controls for North America, Latin America and the Caribbean, Africa, East Asia, Central Asia, South Asia, Middle East, Europe, and Oceania. *OPEC Fixed Effects* refer to an indicator variable for member countries belonging to the Organization of the Petroleum Exporting Countries (OPEC). *TIMSS Fixed Effects* take a value of 1 if the student achievement test score outcome was derived from the TIMSS study and zero otherwise. *Biogeographic Effects* include *ln Absolute Latitude*, *Population in Area with Malaria*, *Temperature*, and *ln Percentage Arable Land Area*. *Major Religion Effects* refer to a set of country-level controls indicating the share of Muslims, Catholics, and Protestants in the population (measured in percent). *Legal Origin Effects* refer to a set of indicator variables that takes a value of 1 if the country's legal tradition is British, French, German, or Scandinavian. *Health-Related Effects* include *Low Birth Weight*, *Infant Mortality Rate*, *Life Expectancy*, *Disability-Adjusted Life-Years*, and *Homicide Rate*. See the main text for additional details on data construction and sources. Constant term included but not shown.
Robust standard errors are reported in parentheses.
*: Significant at the 10% level. **: Significant at the 5% level. ***: Significant at the 1% level.

Table 7: DRD4 III 2- and 7-Repeat Allele Frequency Measure and Student Achievement Test Scores (Educational Factors)

	(1) Baseline Specification	(2) No Education	(3) Primary Education	(4) Secondary Education	(5) Human Capital	(6) Student-Teacher Ratio	(7) Educational Expenditures	(8) Private Enrollment	(9) Educational Factors	(10) Health-Related Factors
	Dependent Variable: Aggregate Student Achievement Test Score									
$DRD4^{R2R7}$	-3.5286***	-3.5475***	-3.4669***	-3.4787***	-3.5627***	-3.5658***	-3.3426**	-3.5305***	-3.4990**	-3.0533***
(Ethnicity-Weighted)	(1.2096)	(1.2597)	(1.2178)	(1.1835)	(1.2114)	(1.2415)	(1.2725)	(1.2237)	(1.3584)	(1.0223)
No Education		0.0016							0.0156	0.0318***
(Percentage of Population)		(0.0080)							(0.0105)	(0.0098)
Primary Education			0.0025						0.0085	0.0087
(Percentage of Population)			(0.0058)						(0.0069)	(0.0065)
Secondary Education				-0.0024					-0.0002	0.0085
(Percentage of Population)				(0.0069)					(0.0091)	(0.0087)
ln Human Capital Index					0.1486				1.0904	-0.2441
					(0.6533)				(0.7833)	(0.6422)
Student-Teacher Ratio						-0.0077			0.0035	0.0082
(Secondary Education)						(0.0142)			(0.0146)	(0.0114)
Educational Expenditures							0.0821		0.1036	0.0839
							(0.0803)		(0.0922)	(0.0610)
Private Enrollment Rate								0.0003	0.0003	0.0012
(Primary Education, in Percent)								(0.0031)	(0.0032)	(0.0045)
Number of Countries	73	73	73	73	73	73	73	73	73	73
R^2	0.78	0.78	0.78	0.78	0.78	0.78	0.79	0.78	0.79	0.91
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OPEC Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
TIMSS Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Biogeographic Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Major Religion Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Legal Origin Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Health-Related Effects	No	No	No	No	No	No	No	No	No	Yes

Notes: The dependent variable is the country-level student achievement test score outcome in the academic subjects mathematics and science. This variable has been constructed from individual student achievement test score outcomes from the PISA and TIMSS studies during the various student assessment waves in the years 1995 to 2015. $DRD4^{R2R7}$ refers to the country-level DRD4 exon III 2- and 7-repeat allele frequency measure (ethnicity-weighted). *No Education* refers to the country's percentage of population aged 15 and above with no educational attainment. *Primary Education* refers to the country's percentage of population aged 15 and above with primary educational attainment. *Secondary Education* refers to the country's percentage of population aged 15 and above with secondary educational attainment. *ln Human Capital Index* refers to the natural logarithm of a country's human capital index, which combines data on average years of schooling and information *Student-Teacher Ratio* refers to the average classroom size in secondary education, i.e., the number of students per trained teacher. *Educational Expenditures* refer to the country's percentage of GDP devoted to educational services. *Private Enrollment Rate* refers to the country's share of privately enrolled students in primary education. *Region Fixed Effects* refer to region controls for North America, Latin America and the Caribbean, Africa, East Asia, Central Asia, South Asia, Middle East, Europe, and Oceania. *OPEC Fixed Effects* refer to an indicator variable for member countries belonging to the Organization of the Petroleum Exporting Countries (OPEC). *TIMSS Fixed Effects* take a value of 1 if the student achievement test score outcome was derived from the TIMSS study and zero otherwise. *Biogeographic Effects* include *ln Absolute Latitude*, *Population in Area with Malaria*, *Temperature*, and *ln Percentage Arable Land Area*. *Major Religion Effects* refer to a set of country-level controls indicating the share of Muslims, Catholics, and Protestants in the population (measured in percent). *Legal Origin Effects* refer to a set of indicator variables that takes a value of 1 if the country's legal tradition is British, French, German, or Scandinavian. *Health-Related Effects* include *Low Birth Weight*, *Infant Mortality Rate*, *Life Expectancy*, *Disability-Adjusted Life-Years*, and *Homicide Rate*. See the main text for additional details on data construction and sources. Constant term included but not shown.

Robust standard errors are reported in parentheses.

*: Significant at the 10% level. **: Significant at the 5% level. ***: Significant at the 1% level.

Table 8: DRD4 III 2- and 7-Repeat Allele Frequency Measure and Student Achievement Test Score (Genetic and Diversity Factors)

	(1) Baseline Specification	(2) Genetic Diversity	(3) HLA Genetic Diversity	(4) Ethnic Diversity	(5) Religious Diversity	(6) Genetic and Diversity Factors
	Dependent Variable: Aggregate Student Achievement Test Score					
$DRD4^{R2R7}$	-3.8765***	-4.4028***	-3.8706***	-3.4633***	-3.8991***	-3.9026***
(Ethnicity-Weighted)	(1.1361)	(1.1370)	(1.2064)	(1.1519)	(1.1233)	(1.1942)
Predicted Genetic Diversity		-4.9385				-5.9396
(Ancestry-Adjusted)		(3.8201)				(5.1445)
HLA Diversity			0.0572			2.4985
(Ethnicity-Weighted)			(3.3450)			(4.9590)
Ethnic Diversity				-0.4882*		-0.4554
				(0.2498)		(0.2730)
Religious Diversity					0.0523	0.0811
					(0.2368)	(0.2323)
Number of Countries	81	81	81	81	81	81
R^2	0.75	0.76	0.75	0.77	0.75	0.78
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
OPEC Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
TIMSS Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Biogeographic Effects	Yes	Yes	Yes	Yes	Yes	Yes
Major Religion Effects	Yes	Yes	Yes	Yes	Yes	Yes
Legal Origin Effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variable is the country-level student achievement test score outcome in the academic subjects mathematics and science. This variable has been constructed from individual student achievement test score outcomes from the PISA and TIMSS studies during the various student assessment waves in the years 1995 to 2015. $DRD4^{R2R7}$ refers to the country-level DRD4 exon III 2- and 7-repeat allele frequency measure (ethnicity-weighted). *Predicted Genetic Diversity* refers to a country-level measure of overall genetic diversity (ancestry-adjusted). *HLA Diversity* refers to a country-level measure of genetic diversity associated with a set of genes located in the HLA region (ethnicity-weighted). *Ethnic Diversity* refers to a country-level measure of ethno-linguistic diversity. *Religious Diversity* refers to a country-level measure of religious diversity. *Region Fixed Effects* refer to region controls for North America, Latin America and the Caribbean, Africa, East Asia, Central Asia, South Asia, Middle East, Europe, and Oceania. *OPEC Fixed Effects* refer to an indicator variable for member countries belonging to the Organization of the Petroleum Exporting Countries (OPEC). *TIMSS Fixed Effects* take a value of 1 if the student achievement test score outcome was derived from the TIMSS study and zero otherwise. *Biogeographic Effects* include *ln Absolute Latitude*, *Population in Area with Malaria*, *Temperature*, and *ln Percentage Arable Land Area*. *Major Religion Effects* refer to a set of country-level controls indicating the share of Muslims, Catholics, and Protestants in the population (measured in percent). *Legal Origin Effects* refer to a set of indicator variables that takes a value of 1 if the country's legal tradition is British, French, German or Scandinavian. *Health-Related Effects* include *Low Birth Weight*, *Infant Mortality Rate*, *Life Expectancy*, *Disability-Adjusted Life-Years*, and *Homicide Rate*. See the main text for additional details on data construction and sources. Constant term included but not shown.

Robust standard errors are reported in parentheses.

*: Significant at the 10% level. **: Significant at the 5% level. ***: Significant at the 1% level.

Table 9: DRD4 III 2- and 7-Repeat Allele Frequency Measure and Student Achievement Test Score (Stratified Analysis According to PISA Subjects)

	(1) Baseline Specification	(2) Health-Related Factors	(3) Economic Environment	(4) Social Value Factors	(5) Schooling Sample	(6) Educational Factors	(7) Health-Related Factors
	Panel A – *Dependent Variable: Aggregate PISA Student Achievement Test Score*						
$DRD4^{R2R7}$	-4.2957***	-5.8645***	-5.9801***	-6.1522***	-4.1031***	-3.9787***	-6.5177**
(Ethnicity-Weighted)	(1.1115)	(1.8266)	(1.7623)	(1.5758)	(1.2278)	(1.3475)	(2.3417)
Number of Countries	63	63	63	63	57	57	57
R^2	0.83	0.88	0.91	0.92	0.84	0.85	0.92
	Panel B – *Dependent Variable: Aggregate PISA Student Achievement Mathematics Score*						
$DRD4^{R2R7}$	-4.0803***	-6.0946***	-6.0408***	-6.4830***	-3.7640***	-3.7785**	-7.0899***
(Ethnicity-Weighted)	(1.1956)	(1.8999)	(1.6885)	(1.6363)	(1.3167)	(1.4983)	(2.2092)
Number of Countries	63	63	63	63	57	57	57
R^2	0.80	0.85	0.90	0.91	0.84	0.85	0.92
	Panel C – *Dependent Variable: Aggregate PISA Student Achievement Science Score*						
$DRD4^{R2R7}$	-4.0774***	-5.8312***	-6.1372***	-6.0382***	-3.9233***	-3.6014**	-6.2710**
(Ethnicity-Weighted)	(1.1537)	(1.8128)	(1.8795)	(1.5921)	(1.2086)	(1.3198)	(2.3373)
Number of Countries	63	63	63	63	57	57	57
R^2	0.82	0.88	0.90	0.92	0.83	0.84	0.91
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OPEC Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Biogeographic Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Major Religion Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Legal Origin Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Health-Related Effects	No	Yes	Yes	Yes	No	No	Yes
Economic Environment Effects	No	No	Yes	No	No	No	No
Social Value Effects	No	No	No	Yes	No	No	No
Educational Effects	No	No	No	No	No	Yes	Yes

Notes: The dependent variable is the country-level student achievement test score outcome in the academic subjects mathematics and science. This variable has been constructed from individual student achievement test score outcomes from the PISA and TIMSS studies during the various student assessment waves in the years 1995 to 2015. $DRD4^{R2R7}$ refers to the country-level DRD4 exon III 2- and 7-repeat allele frequency measure (ethnicity-weighted). *Predicted Genetic Diversity* refers to a country-level measure of overall genetic diversity (ancestry-adjusted). *HLA Diversity* refers to a country-level measure of genetic diversity associated with a set of genes located in the HLA region (ethnicity-weighted). *Ethnic Diversity* refers to a country-level measure of ethno-linguistic diversity. *Religious Diversity* refers to a country-level measure of religious diversity. *Region Fixed Effects* refer to region controls for North America, Latin America and the Caribbean, Africa, East Asia, Central Asia, South Asia, Middle East, Europe, and Oceania. *OPEC Fixed Effects* refer to an indicator variable for member countries belonging to the Organization of the Petroleum Exporting Countries (OPEC). *TIMSS Fixed Effects* take a value of 1 if the student achievement test score outcome was derived from the TIMSS study and zero otherwise. *Biogeographic Effects* include *ln Absolute Latitude*, *Population in Area with Malaria*, *Temperature*, and *ln Percentage Arable Land Area*. *Major Religion Effects* refer to a set of country-level controls indicating the share of Muslims, Catholics, and Protestants in the population (measured in percent). *Legal Origin Effects* refer to a set of indicator variables that takes a value of 1 if the country's legal tradition is British, French, German, or Scandinavian. *Health-Related Effects* include *Low Birth Weight*, *Infant Mortality Rate*, *Life Expectancy*, *Disability-Adjusted Life-Years*, and *Homicide Rate*. *Economic Environment Effects* include *ln Real GDP per Capita*, *Government Consumption*, *Total Fertility Rate*, *Population Growth*, and *Trade Openness*. *Social Value Effects* include *Women in Parliament*, *Female Economic Participation*, *Federal Political System*, *Property Rights Protection*, *Freedom from Corruption*, and *ln Number of Civil Conflicts*. *Educational Effects* include *No Education*, *Primary Education*, *Secondary Education*, *ln Human Capital Index*, *Student-Teacher Ratio*, *Educational Expenditures*, and *Private Enrollment Rate*. See the main text for additional details on data construction and sources. Constant term included but not shown.

Robust standard errors are reported in parentheses.

*: Significant at the 10% level. **: Significant at the 5% level. ***: Significant at the 1% level.

Table 10: ADHD Prevalence Rate and Student Achievement Test Score (Instrumental Variables Estimation Approach)

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Estimator	OLS	OLS	OLS	OLS	2SLS	2SLS	2SLS	2SLS
TIMSS Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Continent Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
Country Controls	No	No	Yes	Yes	No	No	Yes	Yes
Panel A – *Dependent Variable: Aggregate Student Achievement Test Score*								
ADHD Prevalence Rate	-6.4754***	-4.9478***	-3.7442**	-4.0975***	-6.3282***	-9.3471***	-5.2160***	-5.8155***
	(1.3327)	(1.5553)	(1.3645)	(1.2962)	(2.3765)	(2.9513)	(1.5008)	(1.3908)
Number of Countries	37	37	37	37	37	37	37	37
Partial R^2	0.31	0.26	0.70	0.72	0.31	0.05	0.69	0.70
Panel B – *First Stage IV Diagnostics: Testing for Underidentification and Weak Identification of IV*								
Instrumented Variable					*ADHD* Prevalence Rate	*ADHD* Prevalence Rate	*ADHD* Prevalence Rate	*ADHD* Prevalence Rate
Excluded Instruments					$DRD4^{R2R7}$ State History Neolithic Transition	$DRD4^{R2R7}$ State History Neolithic Transition	$DRD4^{R2R7}$ State History Neolithic Transition	$DRD4^{R2R7}$ State History Neolithic Transition
Kleibergen-Paap rk LM Statistic					4.0819	3.0741	10.6780	11.7508
$p-value$					0.2528	0.3803	0.0136	0.0083
Hansen J Statistic					1.2362	1.5281	3.2706	1.2119
$p-value$					0.5390	0.4658	0.1949	0.5456
Cragg-Donald Wald F Statistic					4.7868	5.3750	9.0107	8.0292
H_0: Maximum relative OLS bias > 10% ($p-value$)					0.7399	0.6589	0.2104	0.3061
H_0: Maximum relative OLS bias > 20% ($p-value$)					0.2789	0.2057	0.0204	0.0405
H_0: Maximum relative OLS bias > 30% ($p-value$)					0.1250	0.0826	0.0044	0.0103
Kleibergen-Paap rk Wald F Statistic					2.9290	6.2063	6.0950	6.5389
H_0: Maximum relative OLS bias > 10% ($p-value$)					0.9334	0.5403	0.5562	0.4936
H_0: Maximum relative OLS bias > 20% ($p-value$)					0.6110	0.1288	0.1374	0.1056
H_0: Maximum relative OLS bias > 30% ($p-value$)					0.3916	0.0445	0.0485	0.0345

Notes: This table reports coefficient estimates from an instrument variables (IV) estimation approach on the association between student achievement test scores and the country-level ADHD prevalence rate. The results presented in columns (1) to (4) refers to the baseline OLS estimates. Columns (5) to (8) reports the corresponding 2SLS estimates. All specifications assess the sensitivity of the main findings to the inclusion of TIMSS fixed effects, columns (1) and (5), continent fixed effects, columns (2) and (6), a set of country controls, columns (3) and (7), and to the inclusion of continent fixed effects and country controls, columns (4) and (8). *TIMSS Fixed Effects* take a value of 1 if the student achievement test scores were derived from the TIMSS study and zero otherwise. *Continent Fixed Effects* refer to continent dummies for the Americas, Africa, Asia, and Europe. *Country Controls* refer to a set of *Biogeographical Effects* (i.e., ln absolute latitude, share of the population living in area with malaria, and percentage of arable land area), *Legal Origin Effects* (i.e., dummy variables for British, French, German or Scandinavian legal origin), and *Major Religion Effects* (i.e., percentage of Muslims, Catholics, and Protestants in the population). See the main text for additional details on data construction and sources.

Panel A reports the regression coefficient associated with the country-level ADHD prevalence rate across the various model specifications. For the 2SLS estimates, the ADHD prevalence rate is treated as endogenous and instrumented using a set of excluded instrumental variables (i.e., the country-level $DRD4^{R2R7}$ measure, *ln State History Experience*, and *ln Agricultural Transition Timing*). *Panel B* reports the first stage IV diagnostics regarding underidentification and weak identification of IV in the 2SLS estimates. The critical values for assessing the weakness of IV are tabulated in Stock and Yogo (2005) for various combinations regarding the number of endogenous variables, instruments, and the relative size of the OLS bias. Even though these values only apply to the non-robust Cragg-Donald Wald F statistic assuming the presence of *i.i.d.* errors, we follow the suggestion in Baum et al. (2007, p. 490) and apply these critical values with caution to the Kleibergen-Paap Wald F statistic which is robust to the presence of non–*i.i.d.* errors.

The Partial R^2 refers to the model's R^2 after partialling out the TIMSS and continent fixed effects, respectively, from the regression model. Robust standard errors are reported in parentheses.

*: Significant at the 10% level. **: Significant at the 5% level. ***: Significant at the 1% level.

B Descriptive Statistics

Table 11: Summary Statistics for the ADHD Meta-Regression Sample

Variable	N	Mean	SD	Minimum	Maximum
ADHD Prevalence Rate	179	0.0730	0.0527	0.0020	0.3450
Risk of Bias Score: Very High ($0 \leq RoB \leq 1$)	179	0.0168	0.1287	0	1
Risk of Bias Score: High ($2 \leq RoB \leq 3$)	179	0.2291	0.4214	0	1
Risk of Bias Score: Moderate ($4 \leq RoB \leq 5$)	179	0.5754	0.4957	0	1
Risk of Bias Score: Low ($6 \leq RoB \leq 8$)	179	0.1788	0.3842	0	1
DSM-III Diagnostic Criteria	179	0.0559	0.2303	0	1
DSM-III-R Diagnostic Criteria	179	0.1285	0.3356	0	1
DSM-IV Diagnostic Criteria	179	0.8156	0.3889	0	1
Population Sample: Community	179	0.1676	0.3746	0	1
Population Sample: School	179	0.7374	0.4413	0	1
Population Sample: Whole Population	179	0.0950	0.2940	0	1
Full Diagnostic Criteria Met: Yes	179	0.4190	0.4948	0	1
Type of ADHD Measurement: Interview	179	0.4358	0.4972	0	1
Type of ADHD Measurement: Diagnostic Report	179	0.1285	0.3356	0	1
Type of ADHD Measurement: Symptom-only Checklist	179	0.3966	0.4906	0	1
Type of ADHD Measurement: Unclear	179	0.0391	0.1944	0	1
Informant of ADHD: Child	179	0.0447	0.2072	0	1
Informant of ADHD: Parent	179	0.2570	0.4382	0	1
Informant of ADHD: Teacher	179	0.2123	0.4101	0	1
Informant of ADHD: And Rule	179	0.1006	0.3016	0	1
Informant of ADHD: Or Rule	179	0.0670	0.2508	0	1
Informant of ADHD: Unclear	179	0.0168	0.1287	0	1
Informant of ADHD: Clinician	179	0.3017	0.4603	0	1
Five-Year Indicator: 1980 to 1984	179	0.0112	0.1054	0	1
Five-Year Indicator: 1985 to 1989	179	0.0279	0.1652	0	1
Five-Year Indicator: 1990 to 1994	179	0.0615	0.2408	0	1
Five-Year Indicator: 1995 to 1999	179	0.1341	0.3417	0	1
Five-Year Indicator: 2000 to 2004	179	0.1508	0.3589	0	1
Five-Year Indicator: 2005 to 2009	179	0.3631	0.4823	0	1
Five-Year Indicator: 2010 to 2014	179	0.2514	0.4350	0	1
Region Dummy: Latin America and Caribbean	179	0.1285	0.3356	0	1
Region Dummy: North America	179	0.1955	0.3977	0	1
Region Dummy: Africa	179	0.0447	0.2072	0	1
Region Dummy: East Asia	179	0.1229	0.3292	0	1
Region Dummy: Central Asia	179	0.0168	0.1287	0	1
Region Dummy: South Asia	179	0.0335	0.1805	0	1
Region Dummy: Middle East	179	0.1453	0.3533	0	1
Region Dummy: Europe	179	0.2793	0.4499	0	1
Region Dummy: Oceania	179	0.0335	0.1805	0	1

Table 12: Pairwise Correlations for the ADHD Meta-Regression Sample

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) *ADHD* Prevalence Rate	1.0000																	
(2) Risk of Bias Score: Very High ($0 \leq RoB \leq 1$)	-0.0659	1.0000																
(3) Risk of Bias Score: High ($2 \leq RoB \leq 3$)	0.0914	-0.0712	1.0000															
(4) Risk of Bias Score: Moderate ($4 \leq RoB \leq 5$)	-0.0771	-0.1520	-0.6345	1.0000														
(5) Risk of Bias Score: Low ($6 \leq RoB \leq 8$)	0.0212	-0.0609	-0.2543	-0.5432	1.0000													
(6) DSM-III Diagnostic Criteria	-0.0790	-0.0318	-0.1326	0.1597	-0.0500	1.0000												
(7) DSM-III-R Diagnostic Criteria	-0.1853	0.0799	-0.1298	-0.0079	0.1258	-0.0934	1.0000											
(8) DSM-IV Diagnostic Criteria	0.2067	-0.0502	0.1906	-0.0878	-0.0790	-0.5117	-0.8076	1.0000										
(9) Population Sample: Community	-0.1535	-0.0586	-0.0310	0.0526	-0.0142	0.0211	0.1406	-0.1338	1.0000									
(10) Population Sample: School	0.1825	-0.0210	0.0835	-0.0245	-0.0529	-0.0207	-0.1123	0.1092	-0.7520	1.0000								
(11) Population Sample: Whole Population	-0.0784	0.1061	-0.0859	-0.0302	0.0975	0.0042	-0.0105	0.0066	-0.1454	-0.5429	1.0000							
(12) Full Diagnostic Criteria Met: Yes	-0.0601	-0.1109	0.0491	0.0422	-0.0712	0.1878	0.1476	-0.2387	0.1949	-0.0851	-0.1206	1.0000						
(13) Type of ADHD Measurement: Interview	-0.1070	-0.1147	0.0572	0.0255	-0.0572	0.1787	0.1339	-0.2214	0.2391	-0.1669	-0.0541	0.9207	1.0000					
(14) Type of ADHD Measurement: Diagnostic Report	-0.0990	0.0799	-0.0107	-0.0079	-0.0049	-0.0934	-0.0975	0.1395	0.0065	-0.3020	0.4451	-0.3261	-0.3374	1.0000				
(15) Type of ADHD Measurement: Symptom-only Checklist	0.1931	0.0721	-0.0615	-0.0197	0.0688	-0.1475	-0.0724	0.1499	-0.2109	0.3281	-0.2237	-0.6423	-0.7125	-0.3113	1.0000			
(16) Type of ADHD Measurement: Unclear	-0.0428	-0.0263	0.0272	-0.0016	-0.0189	0.0764	0.0087	-0.0527	-0.0905	0.1204	-0.0654	-0.1713	-0.1773	-0.0775	-0.1636	1.0000		
(17) Informant of ADHD: Child	-0.1062	-0.0282	-0.1179	0.0764	0.0402	-0.0526	0.0785	-0.0366	0.0477	0.0062	-0.0701	0.0355	0.0826	-0.0831	-0.0096	-0.0436	1.0000	
(18) Informant of ADHD: Parent	0.0069	0.0228	0.0445	-0.0121	-0.0408	-0.0874	-0.1494	0.1807	0.1811	-0.4045	0.3764	-0.2921	-0.2332	0.5001	-0.0587	-0.1186	-0.1272	1.0000
(19) Informant of ADHD: Teacher	0.1235	0.0386	-0.0554	-0.0239	0.0787	-0.0073	0.0864	-0.0703	-0.2329	0.3098	-0.1682	-0.4132	-0.4287	-0.0360	0.4169	0.1067	-0.1123	-0.3053
(20) Informant of ADHD: And Rule	-0.0601	0.1011	-0.0496	0.0241	-0.0106	-0.0813	-0.0729	0.1111	-0.1003	0.1151	-0.0450	-0.1710	-0.2564	-0.1284	0.3364	0.0284	-0.0723	-0.1966
(21) Informant of ADHD: Or Rule	-0.0358	-0.0350	0.0134	-0.0409	0.0498	0.1293	-0.1029	0.0122	0.0591	-0.0939	0.0656	-0.0013	-0.0103	-0.1029	0.0110	0.1764	-0.0580	-0.1576
(22) Informant of ADHD: Unclear	0.0224	-0.0170	0.1360	-0.0639	-0.0609	-0.0318	0.0799	-0.0502	-0.0586	0.0779	-0.0423	-0.0227	-0.0270	-0.0501	-0.0169	0.1982	-0.0282	-0.0768
(23) Informant of ADHD: Clinician	-0.0161	-0.0858	0.0472	0.0228	-0.0525	0.1051	0.1114	-0.1583	0.0635	0.0603	-0.1714	0.7493	0.7479	-0.2524	-0.5329	-0.1326	-0.1422	-0.3865
(24) Five-Year Indicator: 1980 to 1984	-0.0879	-0.0139	-0.0579	0.0913	-0.0496	0.4370	-0.0408	-0.2236	-0.0477	0.0634	-0.0344	0.0175	0.0138	-0.0408	-0.0862	0.2527	-0.0230	-0.0625
(25) Five-Year Indicator: 1985 to 1989	-0.0695	-0.0221	-0.0924	0.0770	0.0094	0.6969	-0.0651	-0.3566	0.0147	-0.0529	0.0607	0.1996	0.1929	-0.0651	-0.1374	-0.0342	-0.0367	-0.0997
(26) Five-Year Indicator: 1990 to 1994	-0.1303	0.1478	-0.0288	-0.0626	0.0627	-0.0622	0.6664	-0.5382	0.0097	0.0470	-0.0829	0.0184	0.0097	-0.0287	0.0303	-0.0516	0.0572	-0.0973
(27) Five-Year Indicator: 1995 to 1999	-0.0368	-0.0514	-0.0974	0.0395	0.0732	0.0471	0.3389	-0.3203	0.0429	-0.0260	-0.0156	0.0314	0.0179	-0.1511	0.0831	0.0052	-0.0851	-0.1189
(28) Five-Year Indicator: 2000 to 2004	0.0347	-0.0550	0.0303	0.0778	-0.1152	-0.0346	-0.1152	0.1199	0.0616	-0.0323	-0.0300	0.0217	0.1018	0.0248	-0.1184	-0.0045	-0.0156	0.0379
(29) Five-Year Indicator: 2005 to 2009	0.0408	-0.0081	0.0584	-0.0330	-0.0188	-0.1837	-0.2552	0.3290	-0.0900	0.1074	-0.0465	-0.0055	-0.0544	-0.0122	0.0289	0.0874	0.0616	0.0610
(30) Five-Year Indicator: 2010 to 2014	0.0749	0.0247	0.0519	-0.0754	0.0321	-0.1410	-0.2225	0.2755	0.0158	-0.0932	0.1198	-0.1267	-0.1197	0.1623	0.0566	-0.1169	-0.0007	0.1013
(31) Region Dummy: Latin America and Caribbean	0.1574	-0.0501	0.1483	-0.0417	-0.0920	-0.0934	-0.1474	0.1826	0.0065	0.0015	-0.0105	0.1476	0.1339	-0.1474	-0.0042	-0.0775	-0.0831	-0.0730
(32) Region Dummy: North America	0.0063	0.0454	-0.1346	-0.0325	0.1744	0.0641	0.1474	-0.1652	0.1559	-0.3140	0.2727	-0.1332	-0.1208	0.4421	-0.1406	-0.0995	-0.0385	0.2581
(33) Region Dummy: Africa	-0.0642	-0.0282	-0.1179	0.1311	-0.0304	-0.0526	-0.0831	0.1028	-0.0247	0.0676	-0.0701	0.0355	-0.0810	-0.0831	0.1562	-0.0436	-0.0468	-0.0653
(34) Region Dummy: East Asia	-0.1419	0.0837	0.0794	-0.0571	-0.0414	0.0571	0.0597	-0.0853	-0.0769	0.1460	-0.1213	0.2339	0.2201	-0.0929	-0.1644	0.0123	-0.0810	-0.0255
(35) Region Dummy: Central Asia	0.0075	-0.0170	0.0324	0.0241	-0.0609	-0.0318	-0.0501	0.0621	-0.0586	0.0779	-0.0423	-0.0227	-0.0270	-0.0501	-0.0169	0.1982	-0.0282	-0.0768
(36) Region Dummy: South Asia	-0.0272	-0.0243	-0.0276	0.0344	-0.0059	0.2250	-0.0715	-0.0715	-0.0005	0.0406	-0.0603	0.0306	0.0241	-0.0715	-0.0241	0.1225	0.1099	-0.0385
(37) Region Dummy: Middle East	0.3462	-0.0538	0.0394	-0.1271	0.1387	-0.1003	-0.1109	0.1551	-0.1425	0.2100	-0.1335	-0.0609	-0.0745	-0.1583	0.1843	-0.0014	0.0643	-0.1336
(38) Region Dummy: Europe	-0.2071	0.0157	-0.0134	0.0813	-0.0955	-0.0430	0.0958	-0.0572	-0.0127	0.0036	0.0107	-0.1249	-0.0700	-0.0530	0.0806	0.0671	0.1064	-0.0242
(39) Region Dummy: Oceania	-0.1137	-0.0243	-0.0276	0.0972	-0.0869	0.0898	0.0212	-0.0715	0.1657	-0.1710	0.0455	-0.0323	0.0241	0.1140	-0.0876	-0.0376	-0.0403	0.1036

Table 12: continued

Variable	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)
(1) *ADHD* Prevalence Rate																					
(2) Risk of Bias Score: Very High ($0 \leq RoB \leq 1$)																					
(3) Risk of Bias Score: High ($2 \leq RoB \leq 3$)																					
(4) Risk of Bias Score: Moderate ($4 \leq RoB \leq 5$)																					
(5) Risk of Bias Score: Low ($6 \leq RoB \leq 8$)																					
(6) DSM-III Diagnostic Criteria																					
(7) DSM-III-R Diagnostic Criteria																					
(8) DSM-IV Diagnostic Criteria																					
(9) Population Sample: Community																					
(10) Population Sample: School																					
(11) Population Sample: Whole Population																					
(12) Full Diagnostic Criteria Met: Yes																					
(13) Type of ADHD Measurement: Interview																					
(14) Type of ADHD Measurement: Diagnostic Report																					
(15) Type of ADHD Measurement: Symptom-only Checklist																					
(16) Type of ADHD Measurement: Unclear																					
(17) Informant of ADHD: Child																					
(18) Informant of ADHD: Parent																					
(19) Informant of ADHD: Teacher	1.0000																				
(20) Informant of ADHD: And Rule	-0.1736	1.0000																			
(21) Informant of ADHD: Or Rule	-0.1392	-0.0896	1.0000																		
(22) Informant of ADHD: Unclear	-0.0678	-0.0437	-0.0350	1.0000																	
(23) Informant of ADHD: Clinician	-0.3412	-0.2198	-0.1762	-0.0858	1.0000																
(24) Five-Year Indicator: 1980 to 1984	0.0748	-0.0355	-0.0285	-0.0139	0.0459	1.0000															
(25) Five-Year Indicator: 1985 to 1989	-0.0880	-0.0567	0.2257	-0.0221	0.1102	-0.0180	1.0000														
(26) Five-Year Indicator: 1990 to 1994	0.1516	-0.0856	-0.0686	0.1478	-0.0161	-0.0272	-0.0434	1.0000													
(27) Five-Year Indicator: 1995 to 1999	0.1165	-0.0225	-0.0399	-0.0514	0.0986	-0.0418	-0.0667	-0.1007	1.0000												
(28) Five-Year Indicator: 2000 to 2004	-0.0661	0.0148	0.1367	-0.0550	-0.0389	-0.0448	-0.0714	-0.1078	-0.1658	1.0000											
(29) Five-Year Indicator: 2005 to 2009	0.0057	-0.0207	-0.0166	-0.0081	-0.0660	-0.0803	-0.1280	-0.1932	-0.2971	-0.3182	1.0000										
(30) Five-Year Indicator: 2010 to 2014	-0.1119	0.1060	-0.1038	0.0247	-0.0161	-0.0616	-0.0982	-0.1483	-0.2280	-0.2442	-0.4376	1.0000									
(31) Region Dummy: Latin America and Caribbean	-0.1177	0.1492	0.0306	-0.0501	0.1114	-0.0408	-0.0651	-0.0983	-0.0531	0.2113	0.0225	-0.0686	1.0000								
(32) Region Dummy: North America	-0.0148	-0.1180	-0.0195	-0.0644	-0.1092	-0.0524	0.0874	0.1085	-0.0286	0.1858	-0.1965	0.0065	-0.1893	1.0000							
(33) Region Dummy: Africa	0.0861	0.1974	-0.0580	-0.0282	-0.0833	-0.0230	-0.0367	-0.0553	-0.0058	-0.0156	0.0616	-0.0007	-0.0831	-0.1066	1.0000						
(34) Region Dummy: East Asia	-0.1527	-0.0686	0.0357	0.0837	0.1988	-0.0398	0.0398	0.1168	-0.0474	-0.0627	0.0712	-0.0600	-0.1437	-0.1846	-0.0810	1.0000					
(35) Region Dummy: Central Asia	-0.0678	0.1011	0.1390	-0.0170	0.0090	-0.0139	-0.0221	-0.0334	-0.0514	0.0666	-0.0986	0.1250	-0.0501	-0.0644	-0.0282	-0.0489	1.0000				
(36) Region Dummy: South Asia	-0.0208	0.0409	-0.0499	-0.0243	0.0128	0.2755	0.1568	-0.0477	-0.0733	-0.0785	0.0530	-0.0364	-0.0715	-0.0918	-0.0403	-0.0697	-0.0243	1.0000			
(37) Region Dummy: Middle East	0.0962	0.0203	0.0797	0.0697	-0.0637	-0.0438	-0.0699	-0.0395	-0.0691	-0.1294	0.0514	0.1631	-0.1583	-0.2032	-0.0892	-0.1543	-0.0538	-0.0768	1.0000		
(38) Region Dummy: Europe	0.1640	-0.1254	-0.1171	0.0157	-0.0294	0.0523	-0.1055	-0.0556	0.1935	-0.1580	0.0736	-0.0451	-0.2391	-0.3069	-0.1347	-0.2331	-0.0813	-0.1159	-0.2566	1.0000	
(39) Region Dummy: Oceania	-0.0967	0.0409	0.0742	-0.0243	-0.0548	-0.0198	0.1568	0.0816	0.0178	0.0082	-0.0761	-0.0364	-0.0715	-0.0918	-0.0403	-0.0697	-0.0243	-0.0347	-0.0768	-0.1159	1.0000

Table 13: Summary Statistics for the ADHD and $DRD4^{R2R7}$ Country Sample

Variable	N	Mean	SD	Minimum	Maximum
$ADHD$ Prevalence Rate	42	0.0625	0.0368	0.0066	0.1647
$DRD4^{R2R7}$	42	0.2291	0.0508	0.1134	0.3473
Legal Origin: British	42	0.3095	0.4679	0	1
Legal Origin: French	42	0.4524	0.5038	0	1
Legal Origin: German	42	0.0952	0.2971	0	1
Legal Origin: Scandinavian	42	0.0952	0.2971	0	1
Legal Origin: Socialist	42	0.0476	0.2155	0	1
Major Religion Share: Protestantism	42	17.5595	27.9005	0	97.8000
Major Religion Share: Catholicism	42	28.7952	36.9618	0	96.9000
Major Religion Share: Islam	42	21.1886	37.3047	0	99.4000
ln Real GDP per Capita	42	9.6824	0.9373	6.7218	11.1580
Life Expectancy	42	72.8356	7.3760	47.5213	80.3303
ln Human Capital Index	42	0.9174	0.2778	0.1495	1.2631
ln State History 1 AD - 1500 AD	42	-1.2456	0.4751	-2.6539	-0.6198
ln Agricultural Transition Timing	42	8.7044	0.3158	7.9137	9.1874
Region Dummy: Latin America and Caribbean	42	0.1429	0.3542	0	1
Region Dummy: North America	42	0.0476	0.2155	0	1
Region Dummy: Africa	42	0.1190	0.3278	0	1
Region Dummy: East Asia	42	0.1190	0.3278	0	1
Region Dummy: Central Asia	42	0.0238	0.1543	0	1
Region Dummy: South Asia	42	0.0238	0.1543	0	1
Region Dummy: Middle East	42	0.1429	0.3542	0	1
Region Dummy: Europe	42	0.3333	0.4771	0	1
Region Dummy: Oceania	42	0.0476	0.2155	0	1

Table 14: Pairwise Correlations for the ADHD and $DRD4^{R2R7}$ Country Sample

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
(1) $ADHD$ Prevalence Rate	1.0000																							
(2) $DRD4^{R2R7}$	0.1942	1.0000																						
(3) Legal Origin: British	-0.1706	0.2089	1.0000																					
(4) Legal Origin: French	0.3274	-0.0329	-0.6085	1.0000																				
(5) Legal Origin: German	-0.1410	-0.1606	-0.2172	-0.2949	1.0000																			
(6) Legal Origin: Scandinavian	-0.0626	-0.0062	-0.2172	-0.2949	-0.1053	1.0000																		
(7) Legal Origin: Socialist	-0.1143	-0.1467	-0.1497	-0.2032	-0.0725	-0.0725	1.0000																	
(8) Major Religion Share: Protestantism	-0.1444	0.1870	-0.0235	-0.4669	0.0955	0.8364	-0.1424	1.0000																
(9) Major Religion Share: Catholicism	0.2134	0.6223	-0.1521	0.3926	-0.0508	-0.2505	-0.1720	-0.2068	1.0000															
(10) Major Religion Share: Islam	0.2162	-0.6021	-0.1444	0.3904	-0.1858	-0.1856	-0.0870	-0.3376	-0.4188	1.0000														
(11) ln Real GDP per Capita	-0.0845	0.1352	0.0430	-0.2535	0.2099	0.2629	-0.1524	0.3905	0.0717	-0.1944	1.0000													
(12) Life Expectancy	-0.0983	0.2070	-0.1055	-0.1209	0.2227	0.2222	-0.1016	0.2607	0.2221	-0.3688	0.8354	1.0000												
(13) ln Human Capital Index	-0.2380	0.3205	0.1150	-0.4820	0.3377	0.2903	0.0114	0.4942	0.1248	-0.5868	0.8190	0.8341	1.0000											
(14) ln State History 1 AD - 1500 AD	-0.2530	-0.2427	0.0595	0.0515	0.2686	-0.2974	-0.2099	-0.2526	-0.1225	0.1812	-0.0436	0.1312	-0.0904	1.0000										
(15) ln Agricultural Transition Timing	0.1011	-0.2537	-0.1217	0.2700	-0.0877	-0.2370	0.0808	-0.3541	-0.0802	0.3293	0.1691	0.3220	-0.0083	0.4579	1.0000									
(16) Region Dummy: Latin America and Caribbean	0.4326	0.4863	-0.2733	0.4492	-0.1325	-0.1325	-0.0913	-0.2250	0.6861	-0.2258	-0.2168	-0.0381	-0.1355	-0.2956	-0.1552	1.0000								
(17) Region Dummy: North America	-0.0251	0.1465	0.3340	-0.2032	-0.0725	-0.0725	-0.0500	0.1544	0.0582	-0.1243	0.2048	0.1444	0.2680	0.0554	0.0104	-0.0913	1.0000							
(18) Region Dummy: Africa	-0.0812	-0.2067	0.0719	0.1090	-0.1193	-0.1193	-0.0822	-0.0773	-0.2425	0.3051	-0.5728	-0.6918	-0.5605	-0.0204	-0.4958	-0.1501	-0.0822	1.0000						
(19) Region Dummy: East Asia	-0.2302	-0.1959	0.0719	-0.3341	0.3817	-0.1193	0.2630	-0.1787	-0.2641	-0.1978	-0.0351	0.1278	0.0644	0.3272	0.0460	-0.1501	-0.0822	-0.1351	1.0000					
(20) Region Dummy: Central Asia	0.0543	-0.2890	-0.1046	0.1718	-0.0507	-0.0507	-0.0349	-0.0995	-0.1227	0.3305	-0.0519	-0.1020	-0.1483	0.1147	0.2348	-0.0638	-0.0349	-0.0574	-0.0574	1.0000				
(21) Region Dummy: South Asia	-0.0747	-0.1092	0.2333	-0.1419	-0.0507	-0.0507	-0.0349	-0.0932	-0.1176	-0.0406	-0.3292	-0.2471	-0.2310	0.0832	0.1704	-0.0638	-0.0349	-0.0574	-0.0574	-0.0244	1.0000			
(22) Region Dummy: Middle East	0.3107	-0.3879	0.0210	0.1758	-0.1325	-0.1325	-0.0913	-0.2568	-0.3102	0.6662	0.1303	-0.0530	-0.2418	0.0668	0.4718	-0.1667	-0.0913	-0.1501	-0.1501	-0.0638	-0.0638	1.0000		
(23) Region Dummy: Europe	-0.2655	0.1708	-0.2549	-0.1353	0.1147	0.4588	0.0791	0.4780	0.1333	-0.3804	0.4500	0.4298	0.5165	-0.1590	-0.0191	-0.2887	-0.1581	-0.2599	-0.2599	-0.1104	-0.1104	-0.2887	1.0000	
(24) Region Dummy: Oceania	-0.1205	0.2109	0.3340	-0.2032	-0.0725	-0.0725	-0.0500	0.1066	-0.0284	-0.1279	0.1386	0.1615	0.2347	0.0644	-0.0946	-0.0913	-0.0500	-0.0822	-0.0822	-0.0349	-0.0349	-0.0913	-0.1581	1.0000

Table 15: Summary Statistics for the 81-Country Sample

Variable	N	Mean	SD	Minimum	Maximum
$SATS$	81	4.4252	0.6240	2.9675	5.5807
Indicator: TIMSS	81	0.2222	0.4183	0	1
$DRD4^{R2R7}$	81	0.2323	0.0660	0.0980	0.4583
ln Absolute Latitude	81	3.3822	0.7434	0.3124	4.1589
Population in Area with Malaria	81	0.1115	0.2592	0	1
Temperature	81	14.4297	8.5190	-7.9294	27.2440
ln Percentage Arable Land Area	81	2.3522	1.1883	-2.3010	4.0291
Major Religion Share: Protestantism	81	11.6901	22.4612	0	97.8000
Major Religion Share: Catholicism	81	34.0333	38.3069	0	96.9000
Major Religion Share: Islam	81	21.1746	35.2328	0	99.4000
Legal Origin: British	81	0.1852	0.3909	0	1
Legal Origin: French	81	0.4321	0.4985	0	1
Legal Origin: German	81	0.0617	0.2422	0	1
Legal Origin: Scandinavian	81	0.0494	0.2180	0	1
Legal Origin: Socialist	81	0.2716	0.4476	0	1
Low Birth Weight	81	8.0984	2.8299	4.1000	18.6333
Infant Mortality Rate	81	17.1026	13.3284	3.1615	60.9462
Life Expectancy	81	72.3863	5.0010	57.4585	80.3303
Disability-Adjusted Life-Years	81	0.3272	0.1156	0.1793	0.9579
Homicide Rate	81	6.5526	11.3658	0.4333	65.3867
ln GDP per Capita	81	9.4649	0.8080	7.7414	11.1580
Government Consumption	81	0.1973	0.0597	0.0743	0.3407
Total Fertility Rate	81	2.4207	1.0354	1.3262	5.2726
Population Growth	81	1.0896	1.2494	-1.2606	6.7407
Trade Openness	81	83.5695	47.3345	21.1660	356.3131
Women in Parliament	81	16.9584	9.6070	0	44.1650
Female Economic Participation	81	39.1951	9.5224	13.7139	48.8440
Government Structure: Federalist	81	0.2963	0.4595	0	1
Property Rights Protection	81	57.4621	22.6865	10	91.7500
Freedom from Corruption	81	50.4475	22.4963	18.4200	94.7350
ln Number of Civil Conflicts	81	-2.2126	3.2428	-4.6052	4.2197
Predicted Genetic Diversity	81	0.7242	0.0234	0.6434	0.7563
HLA Genetic Diversity	81	0.3248	0.0168	0.2649	0.3529
Ethnic Diversity	81	0.3547	0.2175	0.0020	0.7517
Religious Diversity	81	0.4127	0.2381	0.0035	0.8603
Region Dummy: Latin America and Caribbean	81	0.1605	0.3694	0	1
Region Dummy: North America	81	0.0247	0.1561	0	1
Region Dummy: Africa	81	0.0988	0.3002	0	1
Region Dummy: East Asia	81	0.1111	0.3162	0	1
Region Dummy: Central Asia	81	0.0741	0.2635	0	1
Region Dummy: Middle East	81	0.0988	0.3002	0	1
Region Dummy: Europe	81	0.4074	0.4944	0	1
Region Dummy: Oceania	81	0.0247	0.1561	0	1
OPEC Dummy	81	0.0741	0.2635	0	1

Table 16: Pairwise Correlations for the 81-Country Sample

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
(1) *SATS*	1.0000																					
(2) Indicator: TIMSS	-0.3720	1.0000																				
(3) $DRD4^{R2R7}$	-0.0548	-0.1570	1.0000																			
(4) ln Absolute Latitude	0.4022	-0.0910	-0.4613	1.0000																		
(5) Population in Area with Malaria	-0.3478	0.3418	0.4592	-0.4955	1.0000																	
(6) Temperature	-0.5591	0.2844	0.3243	-0.7692	0.5137	1.0000																
(7) ln Percentage Arable Land Area	0.2473	-0.2536	0.1380	0.3379	-0.1636	-0.2808	1.0000															
(8) Major Religion Share: Protestantism	0.3578	-0.1393	0.0939	0.2720	-0.1198	-0.3761	0.0273	1.0000														
(9) Major Religion Share: Catholicism	-0.0046	-0.2165	0.4824	-0.1206	0.0446	0.1043	0.1773	-0.1945	1.0000													
(10) Major Religion Share: Islam	-0.4169	0.3067	-0.4261	-0.0726	0.0642	0.3064	-0.3463	-0.2910	-0.4868	1.0000												
(11) Legal Origin: British	0.0374	0.1274	0.1521	-0.2747	0.0864	0.1764	-0.1811	0.1227	-0.1616	-0.0936	1.0000											
(12) Legal Origin: French	-0.4058	0.0733	0.1861	-0.2538	0.1744	0.4827	-0.1282	-0.3529	0.4051	0.2975	-0.4158	1.0000										
(13) Legal Origin: German	0.3247	-0.1371	-0.0391	0.1335	-0.1110	-0.1617	0.1006	0.1166	0.0147	-0.1538	-0.1223	-0.2237	1.0000									
(14) Legal Origin: Scandinavian	0.2424	-0.1218	-0.0146	0.2244	-0.0987	-0.3061	-0.0333	0.7855	-0.2002	-0.1372	-0.1087	-0.1988	-0.0585	1.0000								
(15) Legal Origin: Socialist	0.1256	-0.0593	-0.3118	0.3411	-0.1616	-0.4551	0.2627	-0.1599	-0.2204	-0.0996	-0.2911	-0.5326	-0.1566	-0.1392	1.0000							
(16) Low Birth Weight	-0.5509	0.3893	0.1446	-0.4504	0.3878	0.6046	-0.0878	-0.2642	0.0317	0.2486	0.2269	0.3255	-0.1339	-0.2744	-0.3545	1.0000						
(17) Infant Mortality Rate	-0.7660	0.4345	-0.0950	-0.3022	0.3915	0.3495	-0.1543	-0.2491	-0.2044	0.3644	0.0222	0.1212	-0.2482	-0.2294	0.0917	0.5351	1.0000					
(18) Life Expectancy	0.7030	-0.5296	0.0677	0.2949	-0.4016	-0.3168	0.1647	0.2225	0.2177	-0.2900	-0.0619	-0.0297	0.2763	0.2495	-0.1838	-0.5040	-0.8996	1.0000				
(19) Disability-Adjusted Life-Years	-0.2938	0.2993	-0.0382	0.0451	0.1832	-0.0779	0.0669	0.1003	-0.1568	-0.1525	0.1611	-0.2747	-0.1384	-0.0663	0.2724	0.2341	0.5700	-0.7234	1.0000			
(20) Homicide Rate	-0.4679	0.2705	0.1991	-0.3470	0.2848	0.3210	-0.0832	-0.0817	0.3287	-0.1644	0.0283	0.2063	-0.1327	-0.1090	-0.1296	0.3156	0.3551	-0.4101	0.2196	1.0000		
(21) ln GDP per Capita	0.6312	-0.4026	-0.0747	0.3193	-0.4570	-0.3149	-0.0877	0.3836	0.0689	-0.1807	0.1907	-0.1662	0.2628	0.2747	-0.2575	-0.3249	-0.7494	0.7170	-0.3692	-0.3582	1.0000	
(22) Government Consumption	-0.0521	0.1322	-0.4609	0.3621	-0.2450	-0.3176	0.0618	-0.1081	-0.3955	0.2557	-0.2656	-0.2250	-0.2820	-0.0122	0.6411	-0.2190	0.1190	-0.2424	0.2616	-0.2036	-0.2838	1.0000
(23) Total Fertility Rate	-0.7303	0.5597	0.0244	-0.4087	0.5663	0.6173	-0.5188	-0.2187	-0.1120	0.5732	0.0963	0.4175	-0.2383	-0.1453	-0.3494	0.5400	0.6431	-0.5993	0.1454	0.3141	-0.5054	-0.0360
(24) Population Growth	-0.4875	0.2939	0.0370	-0.4738	0.3834	0.6380	-0.6279	-0.1824	-0.0702	0.5551	0.1996	0.4417	-0.1295	-0.1173	-0.5390	0.4523	0.3048	-0.2286	-0.1648	0.1581	-0.0484	-0.2544
(25) Trade Openness	0.2172	-0.0602	-0.0005	-0.2603	-0.0338	0.0555	-0.0983	-0.0554	-0.0491	-0.0112	0.1510	-0.1757	-0.0947	-0.0568	0.1427	-0.0189	-0.1852	0.1082	-0.0897	-0.1305	0.1565	0.1175
(26) Women in Parliament	0.3842	-0.3461	0.3197	0.2407	-0.1663	-0.3497	0.2736	0.6274	0.2606	-0.5125	-0.0151	-0.1782	0.1083	0.5362	-0.1081	-0.2947	-0.3432	0.3920	-0.0581	-0.0236	0.3122	-0.2462
(27) Female Economic Participation	0.4448	-0.3100	0.1991	0.2164	-0.1365	-0.5260	0.4267	0.3430	0.1415	-0.7822	0.1096	-0.5940	0.1024	0.1914	0.4172	-0.3186	-0.1656	0.1360	0.3296	-0.0336	0.1109	-0.0398
(28) Government Structure: Federalist	0.3089	-0.1517	0.0963	0.1129	-0.1949	-0.2203	0.1211	0.0189	0.1369	-0.2902	0.1779	-0.1294	0.1706	-0.0231	-0.0923	-0.1413	-0.3596	0.3223	-0.1170	-0.0861	0.2861	-0.1743
(29) Property Rights Protection	0.6028	-0.3092	0.1380	0.1809	-0.2919	-0.2611	-0.0333	0.5294	0.1497	-0.3746	0.3568	-0.1662	0.3164	0.3170	-0.4521	-0.1685	-0.6055	0.5866	-0.2233	-0.2334	0.7533	-0.3826
(30) Freedom from Corruption	0.6144	-0.2851	0.1117	0.1979	-0.3000	-0.2708	-0.1212	0.6041	0.0862	-0.2981	0.3183	-0.1840	0.2717	0.4251	-0.4271	-0.2736	-0.6275	0.6423	-0.2818	-0.2879	0.7928	-0.3630
(31) ln Number of Civil Conflicts	-0.4313	0.2331	0.1520	-0.2870	0.2707	0.2706	0.1127	-0.2473	-0.0916	0.3013	0.0124	0.2157	-0.1904	-0.1692	-0.0656	0.3443	0.4455	-0.4604	0.1974	0.1921	-0.4757	0.0698
(32) Predicted Genetic Diversity	0.0718	0.1049	-0.5937	0.5394	-0.3914	-0.2868	0.1261	0.0825	-0.4022	0.3486	0.0006	-0.2056	-0.0947	0.0543	0.2532	-0.0716	-0.0283	-0.0038	0.1938	-0.3934	0.2015	0.4338
(33) HLA Genetic Diversity	0.4179	-0.1324	-0.3001	0.5325	-0.5023	-0.3956	0.1170	0.2960	0.0080	-0.0156	0.0489	-0.1027	0.1099	0.1848	-0.0778	-0.2830	-0.4229	0.4524	-0.1028	-0.3315	0.5491	0.0026
(34) Ethnic Diversity	-0.4308	0.1265	0.1128	-0.3364	0.2059	0.2344	-0.2261	-0.1668	-0.0905	0.2394	0.1438	0.0958	-0.2262	-0.2865	0.0297	0.2059	0.3633	-0.4193	0.2051	0.1758	-0.2216	0.1007
(35) Religious Diversity	0.1845	-0.0073	0.0290	-0.0223	-0.0703	-0.1156	0.0895	0.1712	-0.1420	-0.2915	0.3769	-0.4621	0.1772	-0.1747	0.1746	-0.0483	-0.1003	0.0181	0.2090	-0.0249	0.1223	0.0553
(36) Region Dummy: Latin America and Caribbean	-0.3920	-0.0719	0.3273	-0.4207	0.1287	0.3713	-0.1384	-0.1598	0.5874	-0.2533	-0.1219	0.4334	-0.1121	-0.0997	-0.2670	0.1650	0.1493	-0.0952	-0.1171	0.6204	-0.2510	-0.3501
(37) Region Dummy: North America	0.1669	-0.0850	0.0719	0.1042	-0.0689	-0.2844	-0.0091	0.1776	0.0178	-0.0930	0.3338	-0.1388	-0.0408	-0.0363	-0.0972	-0.0593	-0.1306	0.1651	-0.0792	-0.0424	0.2112	-0.1676
(38) Region Dummy: Africa	-0.4092	0.3207	-0.1061	-0.1059	0.0790	0.2823	-0.0745	-0.0015	-0.2191	0.2880	0.1618	0.1289	-0.0849	-0.0755	-0.2021	0.4005	0.5116	-0.5031	0.4647	0.0394	-0.2782	-0.0284
(39) Region Dummy: East Asia	0.1297	0.0000	0.2352	-0.4532	0.3733	0.2261	-0.0975	-0.1392	-0.2097	-0.0783	0.1348	-0.1498	0.2358	-0.0806	-0.0393	0.1287	0.0634	-0.0806	-0.0941	-0.0990	-0.1680	-0.1656
(40) Region Dummy: Central Asia	-0.1529	-0.0378	-0.4375	0.1329	-0.0904	-0.2159	0.0656	-0.1439	-0.2478	0.2606	-0.1348	-0.1516	-0.0725	-0.0645	0.3572	0.0187	0.3599	-0.2153	0.1051	-0.0179	-0.2223	0.2224
(41) Region Dummy: Middle East	-0.2317	0.3207	-0.2985	-0.0109	0.1116	0.2846	-0.4326	-0.1684	-0.2494	0.6307	-0.0513	0.2960	-0.0849	-0.0755	-0.2021	0.1076	0.0078	-0.0542	-0.2411	-0.0857	0.0512	0.2539
(42) Region Dummy: Europe	0.5655	-0.2619	0.0274	0.5630	-0.3589	-0.5718	0.4660	0.2894	0.1193	-0.3978	-0.2012	-0.3175	0.1005	0.2749	0.3410	-0.4718	-0.5743	0.4659	0.0153	-0.3254	0.4352	0.1937
(43) Region Dummy: Oceania	0.1972	-0.0850	0.1070	0.0264	-0.0689	0.0332	-0.0773	0.1355	-0.0413	-0.0958	0.3338	-0.1388	-0.0408	-0.0363	-0.0972	-0.1060	-0.1387	0.1829	-0.1090	-0.0749	0.1568	-0.0913
(44) OPEC Dummy	-0.2368	0.1890	-0.0496	-0.1304	0.0504	0.3169	-0.3295	-0.1357	-0.2446	0.5381	-0.0135	0.2291	-0.0725	-0.0645	-0.1727	0.0175	0.1235	-0.1295	-0.1585	-0.0734	0.1127	0.0251

Table 16: continued

Variable	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)	(42)	(43)	(44)
(1) $SATS$																						
(2) Indicator: TIMSS																						
(3) $DRD4^{R2R7}$																						
(4) ln Absolute Latitude																						
(5) Population in Area with Malaria																						
(6) Temperature																						
(7) ln Percentage Arable Land Area																						
(8) Major Religion Share: Protestantism																						
(9) Major Religion Share: Catholicism																						
(10) Major Religion Share: Islam																						
(11) Legal Origin: British																						
(12) Legal Origin: French																						
(13) Legal Origin: German																						
(14) Legal Origin: Scandinavian																						
(15) Legal Origin: Socialist																						
(16) Low Birth Weight																						
(17) Infant Mortality Rate																						
(18) Life Expectancy																						
(19) Disability-Adjusted Life-Years																						
(20) Homicide Rate																						
(21) ln GDP per Capita																						
(22) Government Consumption																						
(23) Total Fertility Rate	1.0000																					
(24) Population Growth	0.7693	1.0000																				
(25) Trade Openness	-0.1410	0.0642	1.0000																			
(26) Women in Parliament	-0.4114	-0.3641	-0.0282	1.0000																		
(27) Female Economic Participation	-0.6775	-0.7180	0.0591	0.4947	1.0000																	
(28) Government Structure: Federalist	-0.3389	-0.2252	-0.2252	0.1306	0.2165	1.0000																
(29) Property Rights Protection	-0.3742	-0.0723	0.1737	0.4184	0.2557	0.2860	1.0000															
(30) Freedom from Corruption	-0.3425	-0.0076	0.2042	0.5075	0.2125	0.1975	0.9274	1.0000														
(31) ln Number of Civil Conflicts	0.2729	0.0810	-0.2369	-0.2166	-0.2459	-0.1352	-0.4839	-0.4968	1.0000													
(32) Predicted Genetic Diversity	-0.0979	-0.1235	0.0209	-0.1118	-0.1289	-0.0384	-0.0324	0.0145	-0.1202	1.0000												
(33) HLA Genetic Diversity	-0.3211	-0.1966	0.0022	0.3343	0.0607	0.1247	0.4125	0.5048	-0.3773	0.6426	1.0000											
(34) Ethnic Diversity	0.2901	0.2720	0.1129	-0.2339	-0.1648	-0.1197	-0.3152	-0.2866	0.3091	-0.0500	-0.3006	1.0000										
(35) Religious Diversity	-0.2798	-0.2469	0.0738	0.0825	0.3883	0.2100	0.1558	0.1262	-0.1168	0.0985	0.1063	0.1334	1.0000									
(36) Region Dummy: Latin America and Caribbean	0.2108	0.1415	-0.2008	0.0573	-0.0604	0.1582	-0.1342	-0.1925	0.0669	-0.5688	-0.3793	0.1046	-0.1421	1.0000								
(37) Region Dummy: North America	-0.0960	-0.0072	-0.1392	0.0259	0.1104	0.2452	0.2229	0.2255	-0.1181	-0.0112	0.1714	0.1815	0.2335	-0.0696	1.0000							
(38) Region Dummy: Africa	0.3855	0.2154	-0.0636	-0.1179	-0.2398	-0.2148	-0.0995	-0.0922	0.2513	0.2199	0.0315	0.0972	-0.0323	-0.1447	-0.0527	1.0000						
(39) Region Dummy: East Asia	0.0365	0.1299	0.2420	-0.1317	0.0879	-0.0574	-0.0357	-0.0714	0.0946	-0.4885	-0.4183	0.0017	0.0058	-0.1546	-0.0563	-0.1170	1.0000					
(40) Region Dummy: Central Asia	-0.0424	-0.1594	-0.0197	-0.1736	0.1287	-0.1835	-0.2678	-0.3050	0.0887	0.1642	-0.1074	0.0673	0.0333	-0.1237	-0.0450	-0.0936	-0.1000	1.0000				
(41) Region Dummy: Middle East	0.5203	0.6099	-0.0076	-0.4509	-0.7493	-0.2148	-0.1824	-0.1145	0.0287	0.2898	0.0281	0.2141	-0.1001	-0.1447	-0.0527	-0.1096	-0.1170	-0.0936	1.0000			
(42) Region Dummy: Europe	-0.6543	-0.6075	0.1313	0.4197	0.4567	0.1773	0.2922	0.3185	-0.2532	0.3578	0.4841	-0.3359	0.0056	-0.3625	-0.1319	-0.2745	-0.2932	-0.2345	-0.2745	1.0000		
(43) Region Dummy: Oceania	-0.0748	0.0153	-0.1215	0.1629	0.0928	0.0710	0.2358	0.2780	-0.1181	-0.0444	0.1065	-0.0808	0.2712	-0.0696	-0.0253	-0.0527	-0.0563	-0.0450	-0.0527	-0.1319	1.0000	
(44) OPEC Dummy	0.3369	0.4722	-0.0879	-0.3322	-0.5607	-0.1835	-0.1852	-0.0972	0.1364	0.0912	-0.0603	0.2619	-0.2434	-0.1237	-0.0450	0.0644	0.0500	-0.0800	0.5384	-0.2345	-0.0450	1.0000

Table 17: Summary Statistics for the 73-Country Sample

Variable	N	Mean	SD	Minimum	Maximum
$SATS$	73	4.4443	0.6393	2.9675	5.5807
Indicator: TIMSS	73	0.2192	0.4166	0	1
$DRD4^{R2R7}$	73	0.2360	0.0665	0.0980	0.4583
ln Absolute Latitude	73	3.3604	0.7757	0.3124	4.1589
Population in Area with Malaria	73	0.1119	0.2559	0	1
Temperature	73	14.4781	8.7231	-7.9294	27.2440
ln Percentage Arable Land Area	73	2.3723	1.1032	-0.5777	4.0291
Major Religion Share: Protestantism	73	12.4863	23.4060	0	97.8000
Major Religion Share: Catholicism	73	36.5671	39.2930	0	96.9000
Major Religion Share: Islam	73	19.2184	34.5871	0	99.4000
Legal Origin: British	73	0.1918	0.3964	0	1
Legal Origin: French	73	0.4521	0.5011	0	1
Legal Origin: German	73	0.0685	0.2543	0	1
Legal Origin: Scandinavian	73	0.0548	0.2292	0	1
Legal Origin: Socialist	73	0.2329	0.4256	0	1
Low Birth Weight	73	8.1661	2.8880	4.1000	18.6333
Infant Mortality Rate	73	16.7928	13.2230	3.1615	60.9462
Life Expectancy	73	72.4116	5.1666	57.4585	80.3303
Disability-Adjusted Life-Years	73	0.3288	0.1205	0.1793	0.9579
Homicide Rate	73	6.9954	11.8844	0.4333	65.3867
ln GDP per Capita	73	9.4895	0.8251	7.7414	11.1580
Government Consumption	73	0.1922	0.0580	0.0743	0.3407
Total Fertility Rate	73	2.4360	1.0178	1.3262	5.1311
Population Growth	73	1.1204	1.2016	-1.2167	6.7407
Trade Openness	73	83.9198	49.5013	21.1660	356.3131
Women in Parliament	73	17.4489	9.6758	0	44.1650
Female Economic Participation	73	39.3555	9.3171	13.7139	48.8440
Government Structure: Federalist	73	0.3014	0.4620	0	1
Property Rights Protection	73	59.3927	21.9252	10	91.7500
Freedom from Corruption	73	51.8108	22.1564	18.4200	94.735
ln Number of Civil Conflicts	73	-2.4176	3.2445	-4.6052	4.2197
No Education	73	14.536	15.9471	0.2229	67.1353
Primary Education	73	33.4813	13.9370	5.1631	66.7962
Secondary Education	73	38.6610	14.4345	12.4997	68.8693
ln Human Capital Index	73	0.9419	0.2143	0.3958	1.2631
Student-Teacher Ratio	73	16.1612	5.6989	8.8166	33.6070
Educational Expenditures	73	4.4710	1.1693	1.5938	7.1392
Private Enrollment Rate	73	10.9734	13.8670	0.2273	71.9354
Predicted Genetic Diversity	73	0.7226	0.0240	0.6434	0.7563
HLA Genetic Diversity	73	0.3244	0.0175	0.2649	0.3529
Ethnic Diversity	73	0.3552	0.2211	0.0020	0.7517
Religious Diversity	73	0.3936	0.2357	0.0035	0.8603
Region Dummy: Latin America and Caribbean	73	0.1781	0.3852	0	1
Region Dummy: North America	73	0.0274	0.1644	0	1
Region Dummy: Africa	73	0.1096	0.3145	0	1
Region Dummy: East Asia	73	0.1233	0.3310	0	1
Region Dummy: Central Asia	73	0.0548	0.2292	0	1
Region Dummy: Middle East	73	0.0822	0.2766	0	1
Region Dummy: Europe	73	0.4110	0.4954	0	1
Region Dummy: Oceania	73	0.0137	0.1170	0	1
OPEC Dummy	73	0.0822	0.2766	0	1

Table 18: Pairwise Correlations for the 73-Country Sample

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
(1) *SATS*	1.0000																								
(2) Indicator: TIMSS	-0.4118	1.0000																							
(3) $DRD4^{R2R7}$	-0.1115	-0.1823	1.0000																						
(4) ln Absolute Latitude	0.4318	-0.0851	-0.4715	1.0000																					
(5) Population in Area with Malaria	-0.3687	0.3015	0.5288	-0.5015	1.0000																				
(6) Temperature	-0.6099	0.2761	0.3418	-0.7717	0.4949	1.0000																			
(7) ln Percentage Arable Land Area	0.2790	-0.1928	0.1364	0.3391	-0.0076	-0.2171	1.0000																		
(8) Major Religion Share: Protestantism	0.3404	-0.1399	0.0618	0.2911	-0.1211	-0.4024	0.0225	1.0000																	
(9) Major Religion Share: Catholicism	-0.0362	-0.2250	0.4715	-0.1038	0.0610	0.0994	0.1875	-0.2313	1.0000																
(10) Major Religion Share: Islam	-0.4173	0.2857	-0.3896	-0.0798	-0.0072	0.3077	-0.3107	-0.2769	-0.4853	1.0000															
(11) Legal Origin: British	-0.0166	0.1625	0.1190	-0.2708	0.1105	0.1582	-0.2056	0.0946	-0.2003	-0.0555	1.0000														
(12) Legal Origin: French	-0.4273	0.0510	0.2025	-0.2361	0.1242	0.4732	-0.0570	-0.3790	0.3998	0.3114	-0.4425	1.0000													
(13) Legal Origin: German	0.3271	-0.1437	-0.0563	0.1430	-0.1193	-0.1686	0.1096	0.1091	-0.0024	-0.1503	-0.1321	-0.2463	1.0000												
(14) Legal Origin: Scandinavian	0.2428	-0.1276	-0.0288	0.2341	-0.1060	-0.3174	-0.0423	0.7886	-0.2219	-0.1340	-0.1173	-0.2187	-0.0653	1.0000											
(15) Legal Origin: Socialist	0.1924	-0.0569	-0.3001	0.3186	-0.1208	-0.4330	0.2159	-0.1317	-0.1633	-0.1530	-0.2684	-0.5004	-0.1494	-0.1327	1.0000										
(16) Low Birth Weight	-0.5790	0.4422	0.1837	-0.4540	0.3941	0.6185	-0.0710	-0.2783	0.0215	0.2373	0.2503	0.3112	-0.1452	-0.2899	-0.3566	1.0000									
(17) Infant Mortality Rate	-0.7990	0.5263	-0.0174	-0.3434	0.4606	0.4118	-0.2232	-0.2414	-0.1871	0.3426	0.0681	0.1637	-0.2583	-0.2387	0.0266	0.5399	1.0000								
(18) Life Expectancy	0.7068	-0.5665	0.0292	0.3116	-0.4208	-0.3470	0.1884	0.2104	0.2077	-0.2700	-0.1108	-0.0314	0.2816	0.2541	-0.1650	-0.5056	-0.9156	1.0000							
(19) Disability-Adjusted Life-Years	-0.2993	0.3456	-0.0368	0.0361	0.2289	-0.0528	0.0174	0.1038	-0.1661	-0.1451	0.1865	-0.2773	-0.1439	-0.0703	0.2766	0.2375	0.5868	-0.7319	1.0000						
(20) Homicide Rate	-0.4919	0.2994	0.1934	-0.3446	0.3131	0.3369	-0.1104	-0.0947	0.3157	-0.1511	0.0266	0.2034	-0.1445	-0.1192	-0.1138	0.3214	0.3853	-0.4225	0.2159	1.0000					
(21) ln GDP per Capita	0.6318	-0.4446	-0.1200	0.3633	-0.5460	-0.3860	-0.0333	0.3725	0.0456	-0.1842	0.1499	-0.2103	0.2641	0.2771	-0.1991	-0.3673	-0.7800	0.7285	-0.3650	-0.3781	1.0000				
(22) Government Consumption	0.0027	0.1365	-0.4572	0.3477	-0.2317	-0.2961	0.0053	-0.0668	-0.3827	0.2436	-0.2245	-0.2137	-0.2833	0.0079	0.6258	-0.1986	0.0989	-0.2446	0.2788	-0.1951	-0.2231	1.0000			
(23) Total Fertility Rate	-0.7898	0.5674	0.0492	-0.4028	0.5098	0.6048	-0.4408	-0.2324	-0.1263	0.5798	0.1194	0.3749	-0.2606	-0.1598	-0.3109	0.5455	0.7429	-0.6389	0.1873	0.3393	-0.6081	0.0229	1.0000		
(24) Population Growth	-0.5540	0.3000	0.0551	-0.4745	0.3282	0.6223	-0.6056	-0.2120	-0.1068	0.5722	0.2061	0.3944	-0.1494	-0.1352	-0.4944	0.4346	0.3695	-0.2565	-0.1445	0.1736	-0.1304	-0.2131	0.7559	1.0000	
(25) Trade Openness	0.2429	-0.0826	0.0106	-0.2668	-0.0455	0.0666	-0.1108	-0.0469	-0.0492	-0.0328	0.1877	-0.1968	-0.0978	-0.0591	0.1471	-0.0210	-0.2102	0.1276	-0.0952	-0.1360	0.1813	0.1052	-0.1617	0.0720	1.0000
(26) Women in Parliament	0.3658	-0.3560	0.2808	0.2592	-0.1311	-0.3609	0.2441	0.6302	0.2454	-0.5045	-0.0639	-0.1563	0.1000	0.5505	-0.1126	-0.2980	-0.3509	0.3919	-0.0670	-0.0407	0.3142	-0.2272	-0.4008	-0.3761	-0.0207
(27) Female Economic Participation	0.4606	-0.2820	0.2039	0.2096	-0.0465	-0.5175	0.3606	0.3561	0.1556	-0.8290	0.0965	-0.5689	0.1060	0.2026	0.4076	-0.3310	-0.2350	0.1509	0.3222	-0.0471	0.1483	-0.0404	-0.6591	-0.7132	0.0771
(28) Government Structure: Federalist	0.2688	-0.2036	0.0458	0.1259	-0.1927	-0.2501	0.1297	-0.0077	0.1228	-0.2874	0.1350	-0.1167	0.1765	-0.0270	-0.0793	-0.1120	-0.3388	0.3001	-0.1069	-0.0896	0.2843	-0.1773	-0.3440	-0.2382	-0.2237
(29) Property Rights Protection	0.6075	-0.3322	0.0792	0.2515	-0.3736	-0.3555	0.0226	0.5258	0.0962	-0.3640	0.3093	-0.2378	0.3223	0.3254	-0.3759	-0.2198	-0.6366	0.6065	-0.2282	-0.2863	0.7483	-0.2794	-0.4888	-0.1766	0.2189
(30) Freedom from Corruption	0.6109	-0.3324	0.0501	0.2590	-0.3938	-0.3624	-0.0616	0.6058	0.0462	-0.2939	0.2691	-0.2387	0.2751	0.4413	-0.3716	-0.3168	-0.6427	0.6584	-0.2792	-0.3267	0.7829	-0.2738	-0.4482	-0.0899	0.2454
(31) ln Number of Civil Conflicts	-0.4204	0.2771	0.2260	-0.3485	0.3672	0.3528	0.0465	-0.2254	-0.0552	0.3157	0.0704	0.2838	-0.1841	-0.1635	-0.2017	0.4033	0.4474	-0.4707	0.1907	0.2208	-0.4376	-0.0521	0.3779	0.1845	-0.2655
(32) No Education	-0.6018	0.4537	-0.0697	-0.3460	0.2608	0.6115	-0.3062	-0.2983	-0.2511	0.7632	0.0018	0.4750	-0.1635	-0.2050	-0.3529	0.4454	0.5874	-0.4932	0.1060	0.1163	-0.4128	-0.0080	0.7429	0.6694	-0.0999
(33) Primary Education	-0.0686	-0.2461	0.4014	-0.3281	0.2868	0.3663	0.2268	-0.1198	0.3793	-0.2891	-0.0538	0.2586	-0.0771	0.0254	-0.2220	0.1564	-0.0901	0.1067	-0.2056	0.2768	-0.1599	-0.3050	-0.0648	-0.0785	-0.0191
(34) Secondary Education	0.4548	-0.1600	-0.2595	0.4776	-0.3909	-0.6924	0.1073	0.2426	-0.0438	-0.3952	-0.0171	-0.5992	0.1755	0.0931	0.5665	-0.4502	-0.3028	0.2063	0.1571	-0.2713	0.3495	0.3003	-0.5224	-0.5212	0.1791
(35) ln Human Capital Index	0.6999	-0.4606	-0.0677	0.4935	-0.4115	-0.7481	0.2275	0.4324	0.0411	-0.5780	0.0384	-0.6032	0.3120	0.2501	0.3535	-0.5320	-0.6360	0.5493	-0.0704	-0.3564	0.5880	0.1049	-0.7378	-0.5944	0.1233
(36) Student-Teacher Ratio	-0.4439	0.3070	0.2224	-0.5008	0.4409	0.5331	-0.1044	-0.2371	0.0659	0.1304	0.1347	0.3066	0.0071	-0.2471	-0.3577	0.5634	0.4782	-0.4311	0.0197	0.4300	-0.5226	-0.3012	0.5097	0.3932	-0.0732
(37) Educational Expenditures	0.2463	0.0510	-0.1464	0.2907	-0.1065	-0.2975	-0.0966	0.5181	-0.2551	0.0626	0.2136	-0.3857	-0.0012	0.4155	0.0323	-0.3271	-0.1412	0.1098	0.0981	-0.2167	0.2102	0.2159	-0.0254	-0.0606	0.0532
(38) Private Enrollment Rate	-0.1877	-0.1051	0.1380	-0.2272	-0.0356	0.3226	-0.2088	-0.1215	0.2208	0.0555	0.0540	0.3873	-0.1578	-0.0926	-0.3622	0.2470	-0.0225	0.0559	-0.1793	0.1091	0.1332	-0.1554	0.1201	0.3232	0.0166
(39) Predicted Genetic Diversity	0.1134	0.1179	-0.5896	0.5345	-0.4171	-0.2858	0.1368	0.1177	-0.3793	0.3455	0.0331	-0.1992	-0.0788	0.0730	0.2115	-0.0615	-0.0573	0.0079	0.2021	-0.3840	0.2535	0.3981	-0.0892	-0.1101	0.0198
(40) HLA Genetic Diversity	0.4178	-0.1458	-0.3340	0.5444	-0.5410	-0.4281	0.1431	0.2982	0.0136	-0.0133	0.0243	-0.0985	0.1180	0.1933	-0.0812	-0.2850	-0.4269	0.4455	-0.0916	-0.3256	0.5559	0.0055	-0.3420	-0.2288	0.0162
(41) Ethnic Diversity	-0.4425	0.0836	0.1114	-0.3610	0.2093	0.2733	-0.2566	-0.1619	-0.0800	0.2604	0.1953	0.1196	-0.2361	-0.2986	-0.0208	0.2606	0.4165	-0.4298	0.2137	0.1829	-0.2065	0.0741	0.3249	0.3613	0.0956
(42) Religious Diversity	0.2105	-0.0062	0.0660	-0.0426	-0.0478	-0.1286	0.1151	0.2026	-0.1226	-0.3590	0.3963	-0.4881	0.2116	-0.1669	0.1691	-0.0053	-0.0986	-0.0107	0.2532	0.0013	0.1538	-0.0215	-0.2838	-0.2682	0.0907
(43) Region Dummy: Latin America and Caribbean	-0.4216	-0.0735	0.3201	-0.4163	0.1382	0.3837	-0.1673	-0.1793	0.5798	-0.2483	-0.1358	0.4405	-0.1262	-0.1121	-0.2565	0.1613	0.1713	-0.1004	-0.1256	0.6146	-0.2759	-0.3431	0.2214	0.1447	-0.2079
(44) Region Dummy: North America	0.1669	-0.0889	0.0660	0.1101	-0.0739	-0.2941	-0.0135	0.1741	0.0075	-0.0905	0.3445	-0.1524	-0.0455	-0.0404	-0.0925	-0.0653	-0.1350	0.1678	-0.0823	-0.0491	0.2132	-0.1674	-0.1056	-0.0123	-0.1417
(45) Region Dummy: Africa	-0.4341	0.3442	-0.1314	-0.0977	0.0844	0.2904	-0.0915	-0.0136	-0.2493	0.3311	0.1633	0.1219	-0.0951	-0.0845	-0.1933	0.4078	0.5552	-0.5182	0.4683	0.0268	-0.2994	-0.0000	0.4106	0.2285	-0.0669
(46) Region Dummy: East Asia	0.1231	0.0028	0.2268	-0.4504	0.4009	0.2323	-0.1184	-0.1547	-0.2413	-0.0633	0.1348	-0.1732	0.2282	-0.0903	-0.0095	0.1250	0.0767	-0.0847	-0.1006	-0.1146	-0.1859	-0.1479	0.0337	0.1337	0.2430
(47) Region Dummy: Central Asia	-0.1243	0.0179	-0.3894	0.1168	-0.0645	-0.2023	0.0404	-0.1242	-0.2208	0.2442	-0.1173	-0.0977	-0.0653	-0.0580	0.2946	0.0107	0.2619	-0.1890	0.0975	-0.0063	-0.1843	0.1864	0.0011	-0.1051	-0.0335
(48) Region Dummy: Middle East	-0.2132	0.3237	-0.2850	0.0087	0.0093	0.2561	-0.3640	-0.1573	-0.2721	0.6556	-0.0191	0.2293	-0.0811	-0.0721	-0.1649	0.0841	0.0298	-0.0559	-0.2367	-0.0749	0.0457	0.2734	0.4874	0.5946	-0.0193
(49) Region Dummy: Europe	0.6093	-0.3079	-0.0200	0.5785	-0.3676	-0.5788	0.4724	0.3084	0.1330	-0.4081	-0.1947	-0.3111	0.1042	0.2883	0.3303	-0.4756	-0.6073	0.4989	0.0001	-0.3434	0.4969	0.1870	-0.6815	-0.6241	0.1296
(50) Region Dummy: Oceania	0.1397	-0.0624	0.0859	0.0540	-0.0519	-0.0466	-0.0680	0.1288	-0.0540	-0.0659	0.2419	-0.1070	-0.0320	-0.0284	-0.0649	-0.0952	-0.0956	0.1171	-0.0773	-0.0588	0.0886	-0.0198	-0.0485	-0.0090	-0.0616
(51) OPEC Dummy	-0.2537	0.2031	-0.0689	-0.1239	0.0537	0.3260	-0.3812	-0.1481	-0.2719	0.5973	-0.0191	0.2293	-0.0811	-0.0721	-0.1649	0.0111	0.1389	-0.1342	-0.1647	-0.0855	0.1078	0.0538	0.3583	0.5121	-0.0911

Table 18: continued

Variable	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)	(42)	(43)	(44)	(45)	(46)	(47)	(48)	(49)	(50)	(51)
(1) *SATS*																										
(2) Indicator: TIMSS																										
(3) $DRD4^{R2R7}$																										
(4) ln Absolute Latitude																										
(5) Population in Area with Malaria																										
(6) Temperature																										
(7) ln Percentage Arable Land Area																										
(8) Major Religion Share: Protestantism																										
(9) Major Religion Share: Catholicism																										
(10) Major Religion Share: Islam																										
(11) Legal Origin: British																										
(12) Legal Origin: French																										
(13) Legal Origin: German																										
(14) Legal Origin: Scandinavian																										
(15) Legal Origin: Socialist																										
(16) Low Birth Weight																										
(17) Infant Mortality Rate																										
(18) Life Expectancy																										
(19) Disability-Adjusted Life-Years																										
(20) Homicide Rate																										
(21) ln GDP per Capita																										
(22) Government Consumption																										
(23) Total Fertility Rate																										
(24) Population Growth																										
(25) Trade Openness																										
(26) Women in Parliament	1.0000																									
(27) Female Economic Participation	0.4803	1.0000																								
(28) Government Structure: Federalist	0.0903	0.2154	1.0000																							
(29) Property Rights Protection	0.4160	0.3009	0.2854	1.0000																						
(30) Freedom from Corruption	0.5141	0.2557	0.1702	0.9254	1.0000																					
(31) ln Number of Civil Conflicts	-0.2009	-0.3054	-0.1225	-0.4242	-0.4388	1.0000																				
(32) No Education	-0.4849	-0.7559	-0.3587	-0.4110	-0.3520	0.4622	1.0000																			
(33) Primary Education	0.2468	0.0991	0.0833	-0.0591	-0.1018	0.0963	-0.1866	1.0000																		
(34) Secondary Education	0.1812	0.5456	0.1628	0.2806	0.2502	-0.4788	-0.6313	-0.5239	1.0000																	
(35) ln Human Capital Index	0.4236	0.6554	0.3486	0.5486	0.5192	-0.4927	-0.8503	-0.2206	0.7840	1.0000																
(36) Student-Teacher Ratio	-0.1985	-0.3242	-0.2176	-0.2851	-0.3287	0.4685	0.3901	0.2298	-0.4968	-0.5633	1.0000															
(37) Educational Expenditures	0.3258	0.0704	-0.0009	0.2828	0.4122	-0.1732	-0.0424	-0.2855	0.2387	0.1918	-0.2770	1.0000														
(38) Private Enrollment Rate	-0.0208	-0.2284	0.1256	0.1838	0.1018	-0.0056	0.1158	0.1184	-0.1766	-0.1380	0.1100	-0.2165	1.0000													
(39) Predicted Genetic Diversity	-0.0732	-0.1271	-0.0158	0.0511	0.0884	-0.1967	0.1138	-0.4020	0.2980	0.1126	-0.4277	0.2494	-0.0832	1.0000												
(40) HLA Genetic Diversity	0.3463	0.0748	0.1052	0.4457	0.5281	-0.3937	-0.1777	-0.2243	0.3100	0.3353	-0.4911	0.3932	-0.0805	0.6620	1.0000											
(41) Ethnic Diversity	-0.2580	-0.1849	-0.1336	-0.3083	-0.2919	0.3190	0.2907	-0.1130	-0.1338	-0.2553	0.1476	-0.1078	0.3076	-0.0545	-0.2999	1.0000										
(42) Religious Diversity	0.1183	0.4659	0.2013	0.2307	0.1818	-0.1865	-0.3577	-0.1645	0.4125	0.4298	-0.0176	0.1066	0.0124	0.0525	0.0856	0.1631	1.0000									
(43) Region Dummy: Latin America and Caribbean	0.0368	-0.0738	0.1625	-0.1892	-0.2370	0.1008	-0.0157	0.4689	-0.3364	-0.2516	0.3220	-0.3591	0.3464	-0.5589	-0.3777	0.1085	-0.1148	1.0000								
(44) Region Dummy: North America	0.0185	0.1162	0.2555	0.2286	0.2313	-0.1139	-0.1443	-0.2915	0.1628	0.2401	-0.0154	0.1710	-0.0385	0.0003	0.1778	0.1881	0.2627	-0.0781	1.0000							
(45) Region Dummy: Africa	-0.1421	-0.2660	-0.2304	-0.1403	-0.1210	0.2887	0.6010	-0.2320	-0.2229	-0.4791	0.2858	0.2473	-0.0601	0.2524	0.0402	0.1006	-0.0059	-0.1633	-0.0589	1.0000						
(46) Region Dummy: East Asia	-0.1579	0.0888	-0.0647	-0.0725	-0.1001	0.1242	-0.0050	0.1914	-0.1492	-0.0792	0.3642	-0.1514	-0.1022	-0.4799	-0.4181	0.0009	0.0369	-0.1746	-0.0629	-0.1316	1.0000					
(47) Region Dummy: Central Asia	-0.1539	0.0582	-0.1581	-0.2285	-0.2636	-0.0110	-0.0698	-0.1246	0.1863	0.0561	-0.1018	-0.2115	-0.1697	0.1355	-0.0825	0.0874	-0.0193	-0.1121	-0.0404	-0.0845	-0.0903	1.0000				
(48) Region Dummy: Middle East	-0.4001	-0.7155	-0.1965	-0.1948	-0.1153	0.0315	0.4551	-0.2235	-0.2261	-0.3190	0.0024	0.0222	0.2401	0.2876	0.0209	0.2853	-0.1818	-0.1393	-0.0502	-0.1050	-0.1122	-0.0721	1.0000			
(49) Region Dummy: Europe	0.4184	0.4823	0.1795	0.3818	0.3842	-0.3005	-0.5149	-0.0621	0.5077	0.5941	-0.6188	0.2285	-0.1964	0.3864	0.5094	-0.4162	0.0420	-0.3888	-0.1402	-0.2930	-0.3132	-0.2011	-0.2500	1.0000		
(50) Region Dummy: Oceania	0.1573	0.0785	-0.0774	0.1751	0.2260	-0.0800	-0.1058	-0.0168	-0.0799	0.1318	-0.0233	0.0998	-0.0393	-0.0621	0.0245	0.0224	0.2102	-0.0549	-0.0198	-0.0413	-0.0442	-0.0284	-0.0353	-0.0984	1.0000	
(51) OPEC Dummy	-0.3645	-0.6119	-0.1965	-0.2294	-0.1230	0.1634	0.4881	-0.1819	-0.2649	-0.3766	-0.0194	-0.0117	0.1734	0.1154	-0.0545	0.2721	-0.2358	-0.1393	-0.0502	0.0547	0.0395	-0.0721	0.6368	-0.2500	-0.0353	1.0000

Table 19: Summary Statistics for the PISA Country Sample

Variable	N	Mean	SD	Minimum	Maximum
$SATS$: PISA Mathematics and Science Score	63	4.5485	0.5988	3.2333	5.5807
$SATS$: PISA Mathematics Score	63	4.5256	0.6079	3.2073	5.6661
$SATS$: PISA Science Score	63	4.5837	0.5851	3.2574	5.4935
$DRD4^{R2R7}$	63	0.2378	0.0617	0.1076	0.4583
ln Absolute Latitude	63	3.4181	0.8004	0.3124	4.1589
Population in Area with Malaria	63	0.0645	0.1807	0	0.9539
Temperature	63	13.1427	8.3394	-7.9294	26.9546
ln Percentage Arable Land Area	63	2.5123	0.9404	0.1131	3.9845
Major Religion Share: Protestantism	63	13.3524	24.5111	0	97.8000
Major Religion Share: Catholicism	63	38.4397	38.4874	0	96.9000
Major Religion Share: Islam	63	15.434	29.9561	0	99.4000
Legal Origin: British	63	0.1587	0.3684	0	1
Legal Origin: French	63	0.4127	0.4963	0	1
Legal Origin: German	63	0.0794	0.2725	0	1
Legal Origin: Scandinavian	63	0.0635	0.2458	0	1
Legal Origin: Socialist	63	0.2857	0.4554	0	1
Low Birth Weight	63	7.5131	2.2285	4.1000	14.1429
Infant Mortality Rate	63	14.0261	11.0949	3.1615	53.1154
Life Expectancy	63	73.7934	3.8593	65.0924	80.3303
Disability-Adjusted Life-Years	63	0.3089	0.0678	0.1793	0.5602
Homicide Rate	63	4.9193	7.2414	0.4333	42.4533
ln GDP per Capita	63	9.6377	0.7070	7.7625	11.1580
Government Consumption	63	0.1931	0.0584	0.0743	0.3407
Total Fertility Rate	63	2.1129	0.7404	1.3262	4.8534
Population Growth	63	0.8945	1.1698	-1.2606	6.7407
Trade Openness	63	85.0844	52.4673	21.1660	356.3131
Women in Parliament	63	18.7248	9.4059	0	44.1650
Female Economic Participation	63	40.7632	7.9675	14.5475	48.6768
Government Structure: Federalist	63	0.3333	0.4752	0	1
Property Rights Protection	63	61.1878	22.7514	11.4286	91.7500
Freedom from Corruption	63	53.8541	23.3216	20.075	94.7350
ln Number of Civil Conflicts	63	-2.6142	3.0438	-4.6052	3.5838
Predicted Genetic Diversity	63	0.7229	0.0226	0.6434	0.7518
HLA Genetic Diversity	63	0.3260	0.0179	0.2649	0.3529
Ethnic Diversity	63	0.3401	0.2171	0.0020	0.7456
Religious Diversity	63	0.4136	0.2350	0.0049	0.8241
Region Dummy: Latin America and Caribbean	63	0.1746	0.3827	0	1
Region Dummy: North America	63	0.0317	0.1767	0	1
Region Dummy: Africa	63	0.0476	0.2147	0	1
Region Dummy: East Asia	63	0.1111	0.3168	0	1
Region Dummy: Central Asia	63	0.0794	0.2725	0	1
Region Dummy: Middle East	63	0.0476	0.2147	0	1
Region Dummy: Europe	63	0.4762	0.5034	0	1
Region Dummy: Oceania	63	0.0317	0.1767	0	1
OPEC Dummy	63	0.0476	0.2147	0	1

Table 20: Pairwise Correlations for the PISA Country Sample

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
(1) *SATS*: PISA Mathematics and Science Score	1.0000																					
(2) *SATS*: PISA Mathematics Score	0.9914	1.0000																				
(3) *SATS*: PISA Science Score	0.9907	0.9698	1.0000																			
(4) $DRD4^{R2R7}$	0.0126	-0.0104	0.0594	1.0000																		
(5) ln Absolute Latitude	0.3451	0.3468	0.3306	-0.4418	1.0000																	
(6) Population in Area with Malaria	-0.1713	-0.1951	-0.1455	0.5522	-0.5199	1.0000																
(7) Temperature	-0.4723	-0.4823	-0.4523	0.3355	-0.7875	0.4778	1.0000															
(8) ln Percentage Arable Land Area	0.2502	0.2653	0.2192	-0.0482	0.4773	-0.0584	-0.2613	1.0000														
(9) Major Religion Share: Protestantism	0.4502	0.4453	0.4418	0.0436	0.3125	-0.1725	-0.4272	-0.0155	1.0000													
(10) Major Religion Share: Catholicism	-0.0284	-0.0215	0.0025	0.3472	-0.0706	-0.0376	0.1300	0.0602	-0.2650	1.0000												
(11) Major Religion Share: Islam	-0.4991	-0.4801	-0.5245	-0.4050	-0.1065	0.0066	0.2191	-0.2543	-0.2650	-0.4651	1.0000											
(12) Legal Origin: British	0.2460	0.2233	0.2409	0.2197	-0.2815	0.0609	0.1168	-0.1979	0.0637	-0.1222	-0.1084	1.0000										
(13) Legal Origin: French	-0.4643	-0.4672	-0.4298	0.1856	-0.2489	0.0963	0.4775	-0.1436	-0.3493	0.4479	0.2069	-0.3641	1.0000									
(14) Legal Origin: German	0.3271	0.3401	0.3091	-0.0744	0.1289	-0.1056	-0.1438	0.0953	0.1025	-0.0171	-0.1507	-0.1275	-0.2461	1.0000								
(15) Legal Origin: Scandinavian	0.2351	0.2392	0.2242	-0.0413	0.2268	-0.0936	-0.3174	-0.0928	0.8060	-0.2581	-0.1344	-0.1131	-0.2183	-0.0764	1.0000							
(16) Legal Origin: Socialist	-0.0156	-0.0040	-0.0324	-0.3132	0.2995	-0.0405	-0.3576	0.3096	-0.1672	-0.2397	0.0248	-0.2747	-0.5302	-0.1857	-0.1647	1.0000						
(17) Low Birth Weight	-0.4246	-0.3997	-0.4449	0.0492	-0.4689	0.1842	0.5742	-0.0182	-0.4000	0.0409	0.3108	0.1273	0.3623	-0.1173	-0.3299	-0.2496	1.0000					
(18) Infant Mortality Rate	-0.7581	-0.7181	-0.7892	-0.1313	-0.2732	0.3218	0.3282	-0.0871	-0.3841	-0.1964	0.5808	-0.2071	0.1924	-0.2599	-0.2426	0.2443	0.4326	1.0000				
(19) Life Expectancy	0.6645	0.6439	0.6716	0.0882	0.2795	-0.3045	-0.2573	0.0205	0.3726	0.2089	-0.4713	0.1857	-0.0663	0.3027	0.2743	-0.4071	-0.3977	-0.8526	1.0000			
(20) Disability-Adjusted Life-Years	-0.1194	-0.1092	-0.1296	-0.1961	0.2923	-0.0340	-0.3629	0.3592	-0.0331	-0.2042	0.0082	-0.2397	-0.2746	-0.1904	-0.0583	0.6386	0.0125	0.3606	-0.6150	1.0000		
(21) Homicide Rate	-0.4916	-0.5008	-0.4733	0.0373	-0.4351	0.2664	0.3736	-0.2923	-0.1675	0.2860	-0.0608	-0.0138	0.2505	-0.1722	-0.1366	-0.0851	0.3114	0.3889	-0.4294	0.1378	1.0000	
(22) ln GDP per Capita	0.6717	0.6748	0.6598	-0.0562	0.3265	-0.4810	-0.3557	0.0024	0.4611	0.1045	-0.3076	0.2697	-0.1661	0.2721	0.2952	-0.3593	-0.2387	-0.7784	0.7599	-0.3184	-0.2999	1.0000
(23) Government Consumption	-0.1663	-0.1665	-0.1756	-0.4296	0.3354	-0.2360	-0.2853	0.1551	-0.0719	-0.3677	0.3088	-0.2580	-0.2315	-0.3091	0.0046	0.6435	-0.0940	0.2038	-0.3631	0.5325	-0.1760	-0.3174
(24) Total Fertility Rate	-0.7153	-0.7310	-0.6821	0.0872	-0.4209	0.3318	0.5700	-0.5015	-0.2726	-0.0447	0.6125	-0.0592	0.4968	-0.2591	-0.1233	-0.2718	0.4032	0.5918	-0.4546	-0.2229	0.3281	-0.5220
(25) Population Growth	-0.3941	-0.3928	-0.3771	0.0910	-0.4805	0.2301	0.5812	-0.5984	-0.1976	-0.0058	0.5311	0.1225	0.4608	-0.1092	-0.0997	-0.4821	0.3723	0.2070	-0.0498	-0.5606	0.1767	-0.0215
(26) Trade Openness	0.1947	0.2211	0.1663	0.0033	-0.3049	-0.0161	0.1162	-0.0970	-0.0591	-0.0675	0.0654	0.1844	-0.1529	-0.1065	-0.0662	0.1170	0.0708	-0.1618	0.0619	-0.1338	-0.1910	0.1255
(27) Women in Parliament	0.4314	0.4290	0.4229	0.2274	0.2755	-0.1059	-0.3228	0.1192	0.6343	0.1534	-0.4279	-0.0304	-0.1501	0.0713	0.5775	-0.1662	-0.4079	-0.3880	0.4707	-0.1269	-0.1993	0.3546
(28) Female Economic Participation	0.5220	0.5428	0.4940	0.1163	0.2820	-0.0241	-0.5227	0.3944	0.3354	0.0358	-0.6615	0.1203	-0.6082	0.0821	0.2101	0.4031	-0.3723	-0.2320	0.1595	0.4004	-0.1148	0.1545
(29) Government Structure: Federalist	0.2140	0.1925	0.2411	0.1191	0.0528	-0.1003	-0.1426	-0.0139	0.0155	0.1641	-0.2836	0.2457	-0.0456	0.1661	-0.0460	-0.2236	0.0228	-0.2694	0.2379	-0.0797	0.0437	0.2727
(30) Property Rights Protection	0.7061	0.6975	0.7096	0.1127	0.2181	-0.3523	-0.3028	-0.0041	0.5463	0.1113	-0.3772	0.3886	-0.1454	0.3134	0.3188	-0.5155	-0.2163	-0.7533	0.7273	-0.4160	-0.3193	0.8062
(31) Freedom from Corruption	0.6962	0.6840	0.6991	0.1154	0.2159	-0.3399	-0.2975	-0.1019	0.6206	0.0646	-0.3311	0.3481	-0.1673	0.2573	0.4309	-0.4859	-0.3140	-0.7591	0.8074	-0.4877	-0.3780	0.8308
(32) ln Number of Civil Conflicts	-0.4260	-0.4193	-0.4353	0.1248	-0.3118	0.3739	0.2600	-0.0717	-0.2926	-0.1164	0.3318	0.0656	0.1622	-0.1936	-0.1717	-0.0213	0.2828	0.4760	-0.4952	0.2270	0.2723	-0.3972
(33) Predicted Genetic Diversity	0.0842	0.0883	0.0494	-0.5608	0.5921	-0.5490	-0.3908	0.3564	0.1000	-0.2460	0.2670	-0.1392	-0.1805	-0.0956	0.0797	0.3235	-0.0676	-0.0818	0.0425	0.3079	-0.2569	0.2200
(34) HLA Genetic Diversity	0.4293	0.4185	0.4026	-0.2699	0.5189	-0.5891	-0.4170	0.2213	0.3043	0.1024	-0.1083	0.0357	-0.0734	0.0986	0.1808	-0.1055	-0.3043	-0.4776	0.5373	-0.0870	-0.3130	0.5723
(35) Ethnic Diversity	-0.4633	-0.4601	-0.4482	0.2149	-0.4042	0.2965	0.2725	-0.3202	-0.2358	0.0014	0.2074	0.1590	0.1207	-0.2399	-0.3107	0.0512	0.3475	0.3996	-0.4565	0.1382	0.4245	-0.2686
(36) Religious Diversity	0.2976	0.3019	0.2622	-0.0391	-0.0071	-0.1720	-0.1666	0.0915	0.1121	-0.1649	-0.2879	0.3875	-0.4769	0.2047	-0.2036	0.1936	-0.0308	-0.1653	0.1209	0.0666	-0.0495	0.1392
(37) Region Dummy: Latin America and Caribbean	-0.4861	-0.4914	-0.4521	0.2643	-0.4321	0.1691	0.4413	-0.3414	-0.1822	0.5393	-0.2227	-0.0854	0.4637	-0.1350	-0.1198	-0.2909	0.2913	0.2721	-0.2161	-0.1431	0.7025	-0.2968
(38) Region Dummy: North America	0.1607	0.1470	0.1648	0.0715	0.1021	-0.0651	-0.3030	-0.0442	0.1731	-0.0007	-0.0898	0.4169	-0.1518	-0.0532	-0.0471	-0.1145	-0.0379	-0.1283	0.1773	-0.1045	-0.0348	0.2305
(39) Region Dummy: Africa	-0.2481	-0.2578	-0.2456	-0.1528	-0.0362	-0.0804	0.2282	0.0270	-0.1200	-0.1630	0.4229	-0.0971	0.2667	-0.0657	-0.0582	-0.1414	0.1200	0.1981	-0.2032	-0.0718	-0.0862	-0.1504
(40) Region Dummy: East Asia	0.1630	0.1553	0.1564	0.2683	-0.5346	0.5638	0.3708	-0.1026	-0.1478	-0.3308	0.0120	0.2611	-0.1938	0.2699	-0.0921	-0.1118	0.1087	0.0187	-0.0557	-0.1957	-0.1563	-0.1714
(41) Region Dummy: Central Asia	-0.2885	-0.2394	-0.3487	-0.5102	0.1181	-0.0483	-0.1866	0.0273	-0.1564	-0.2893	0.4810	-0.1275	-0.1268	-0.0862	-0.0764	0.3343	0.1180	0.5798	-0.4315	0.3097	0.0649	-0.3133
(42) Region Dummy: Middle East	-0.2507	-0.2534	-0.2413	-0.2253	-0.0057	-0.0804	0.1947	-0.3294	-0.1160	-0.1488	0.4427	-0.0971	0.2667	-0.0657	-0.0582	-0.1414	0.2257	0.0393	-0.0162	-0.1932	-0.0174	-0.0045
(43) Region Dummy: Europe	0.5103	0.5098	0.5138	0.0025	0.5760	-0.3429	-0.5652	0.5037	0.3107	0.1118	-0.4034	-0.2402	-0.2828	0.0728	0.2731	0.3116	-0.4507	-0.5398	0.3927	0.2710	-0.3818	0.4321
(44) Region Dummy: Oceania	0.1967	0.1765	0.1992	0.1142	0.0197	-0.0651	0.0668	-0.1424	0.1292	-0.0678	-0.0934	0.4169	-0.1518	-0.0532	-0.0471	-0.1145	-0.1055	-0.1393	0.2037	-0.1625	-0.0928	0.1597
(45) OPEC Dummy	-0.3001	-0.3066	-0.2830	0.1265	-0.1947	0.1700	0.3257	-0.3059	-0.1053	-0.2165	0.4730	-0.0971	0.2667	-0.0657	-0.0582	-0.1414	0.0779	0.2582	-0.2184	-0.0757	-0.0607	-0.0203

Table 20: continued

Variable	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)	(41)	(42)	(43)	(44)	(45)
(1) $SATS$: PISA Mathematics and Science Score																							
(2) $SATS$: PISA Mathematics Score																							
(3) $SATS$: PISA Science Score																							
(4) $DRD4^{R2R7}$																							
(5) ln Absolute Latitude																							
(6) Population in Area with Malaria																							
(7) Temperature																							
(8) ln Percentage Arable Land Area																							
(9) Major Religion Share: Protestantism																							
(10) Major Religion Share: Catholicism																							
(11) Major Religion Share: Islam																							
(12) Legal Origin: British																							
(13) Legal Origin: French																							
(14) Legal Origin: German																							
(15) Legal Origin: Scandinavian																							
(16) Legal Origin: Socialist																							
(17) Low Birth Weight																							
(18) Infant Mortality Rate																							
(19) Life Expectancy																							
(20) Disability-Adjusted Life-Years																							
(21) Homicide Rate																							
(22) ln GDP per Capita																							
(23) Government Consumption	1.0000																						
(24) Total Fertility Rate	0.0016	1.0000																					
(25) Population Growth	-0.2444	0.7301	1.0000																				
(26) Trade Openness	0.1242	-0.1113	0.1178	1.0000																			
(27) Women in Parliament	-0.2243	-0.3368	-0.2997	-0.0476	1.0000																		
(28) Female Economic Participation	-0.0317	-0.7343	-0.7538	-0.0106	0.4375	1.0000																	
(29) Government Structure: Federalist	-0.2562	-0.1782	-0.0964	-0.3110	0.0876	0.1274	1.0000																
(30) Property Rights Protection	-0.3542	-0.4278	-0.0771	0.1454	0.4177	0.1920	0.3169	1.0000															
(31) Freedom from Corruption	-0.3532	-0.3810	0.0050	0.1848	0.5375	0.1893	0.1985	0.9277	1.0000														
(32) ln Number of Civil Conflicts	0.0620	0.2822	0.0960	-0.1795	-0.2930	-0.2516	-0.1284	-0.4259	-0.4591	1.0000													
(33) Predicted Genetic Diversity	0.4593	-0.2365	-0.2288	0.0466	-0.0029	-0.0386	-0.0774	-0.0073	0.0222	-0.1855	1.0000												
(34) HLA Genetic Diversity	-0.0312	-0.3772	-0.2162	-0.0135	0.3874	0.1192	0.0881	0.4288	0.5066	-0.4147	0.6586	1.0000											
(35) Ethnic Diversity	0.0479	0.3787	0.3023	0.1693	-0.2868	-0.1790	-0.1225	-0.2878	-0.3014	0.2657	-0.2012	-0.3934	1.0000										
(36) Religious Diversity	0.0448	-0.3977	-0.2825	0.0678	0.0126	0.3759	0.1964	0.1621	0.1190	-0.1686	0.0382	0.1077	0.0245	1.0000									
(37) Region Dummy: Latin America and Caribbean	-0.3465	0.3982	0.2287	-0.2292	-0.0102	-0.1546	0.2070	-0.1906	-0.2355	0.1180	-0.5137	-0.3625	0.2248	-0.1392	1.0000								
(38) Region Dummy: North America	-0.1822	-0.0771	0.0216	-0.1484	-0.0042	0.1145	0.2561	0.2235	0.2213	-0.1194	-0.0027	0.1710	0.2196	0.2690	-0.0833	1.0000							
(39) Region Dummy: Africa	0.0472	0.2627	0.1214	0.0148	-0.1083	-0.4425	-0.1581	-0.1109	-0.0853	0.1596	0.1259	0.0137	-0.0616	-0.1864	-0.1028	-0.0405	1.0000						
(40) Region Dummy: East Asia	-0.2461	0.0378	0.1670	0.2603	-0.2080	0.0295	-0.0357	-0.0389	-0.0632	0.1092	-0.5000	-0.4276	0.0503	0.1015	-0.1626	-0.0640	-0.0791	1.0000					
(41) Region Dummy: Central Asia	0.2277	0.0985	-0.0732	-0.0227	-0.2230	0.0836	-0.2076	-0.3389	-0.3578	0.2035	0.1799	-0.1193	0.1660	0.0296	-0.1350	-0.0532	-0.0657	-0.1038	1.0000				
(42) Region Dummy: Middle East	0.3098	0.4692	0.6239	0.0627	-0.3803	-0.6565	-0.1581	-0.1107	-0.0868	0.0060	0.2551	0.0149	0.1555	-0.0932	-0.1028	-0.0405	-0.0500	-0.0791	-0.0657	1.0000			
(43) Region Dummy: Europe	0.2395	-0.6496	-0.5819	0.0875	0.4146	0.4505	-0.0000	0.2852	0.3101	-0.2553	0.4610	0.5012	-0.3814	-0.0591	-0.4385	-0.1726	-0.2132	-0.3371	-0.2799	-0.2132	1.0000		
(44) Region Dummy: Oceania	-0.0932	-0.0433	0.0490	-0.1302	0.1554	0.0905	0.0640	0.2382	0.2791	-0.1194	-0.0420	0.1017	-0.0800	0.3126	-0.0833	-0.0328	-0.0405	-0.0640	-0.0532	-0.0405	-0.1726	1.0000	
(45) OPEC Dummy	0.0030	0.4147	0.4982	-0.0758	-0.2579	-0.5221	-0.1581	-0.1829	-0.1007	0.2378	-0.0192	-0.0970	0.2768	-0.2887	-0.1028	-0.0405	0.3000	0.1581	-0.0657	0.3000	-0.2132	-0.0405	1.0000

C Data Description and Sources

Dependent Variable

Aggregate Student Achievement Test Score Outcome. This variable refers to the country-level aggregate student achievement test score outcome during the years 1995 to 2015. The variable is constructed based on International Student Achievement Tests (ISATs) of the various PISA (i.e., PISA 2000, 2003, 2006, 2009, 2012, and 2015) and TIMSS (i.e., TIMSS 1995, 1999, 2003, 2007, 2011, and 2015) assessment waves.

The first step in the construction of this variable involves the aggregation of individual student-level test score outcomes by country and wave, respectively, for the main academic subjects mathematics and science. It is worth mentioning that we disregard the construction of reading achievement test score outcomes, as this subject is only available in the PISA but not TIMSS assessment waves. The aggregation is performed on behalf of the provided population weights in both ISATs in order to maintain representativity of aggregated student achievement test score outcomes in the general population. This procedure yields an aggregate value for average student achievement for each combination of the ISAT, assessment wave, and academic subject. Then, we calculate country-level averages of the mathematics and science test score outcomes across the available set of PISA and TIMSS assessment waves, as proposed by Rindermann (2008).

Once country-level averages of student test score outcomes across the main subjects mathematics and science have been constructed, we take the unweighted mean of both values to arrive at a combined student achievement test score outcome. If available, we give preference to the aggregate PISA test score outcome. In order to increase the sample size, we use the aggregate TIMSS test score outcome in cases with missing country-level PISA test score observations. To avoid a possible bias through systematic differences between scores in the two international student achievement tests, we include a re-codification indicator that equals 1 if the respective test score outcome originates from TIMSS and zero otherwise throughout the empirical analysis.

The corresponding data on international student achievement test score outcomes of PISA and TIMSS are freely available online at http://www.oecd.org/pisa/ and https://timssandpirls.bc.edu/, respectively.

Genetic Variables

DRD4 Exon III 2- and 7-Repeat Allele Frequency. This variable refers to the country-level DRD4 exon III 2- and 7-repeat allele frequency measure. The construction of this variable is based on population genome data of DRD4 exon III allele frequencies across a worldwide sample of 120 populations in 59 countries. The raw data have been compiled by Gören (2016) from an extensive list of individual molecular genetic, population, and candidate gene studies of DRD4 exon III polymorphism. Since contemporary countries are generally comprised of various ethnic groups on at least some of which population genome data of DRD4 exon III allele frequencies have not yet been compiled, a matching scheme is needed for assigning ethnic groups to the population genome data in Gören (2016). The methodology developed in Gören (2017a) assigns the entire distribution of ethnic groups in the Alesina et al. (2003) ethnicity data to the population genome data in Gören (2016) based on the historical relationship between ethno-linguistic groups, as provided by the *Ethnologue* database (Global Mapping International, 2010). In cases where the Alesina et al. (2003) ethnicity data refers to universal ethnic groups (e.g., 'black' or 'white') or to groups of mixed ancestry (e.g., 'Mestizo' or 'Amerindian'), the corresponding genetic composition of DRD4 exon III allele frequencies were derived through combinations of population genome data in Gören (2016). After successful completion of the matching procedure, the ethnic-specific DRD4 exon III 2- and 7-repeat allele frequency measures were aggregated to the country level using the corresponding shares of ethnic groups within a particular country as the weighting scheme. See Gören (2017a) for additional details on data construction and sources.

Genetic Diversity. This variable refers to a country-level measure of overall genetic diversity. The calculation of this variable is based on the predictive power of migratory distance from East Africa on between-population genetic diversity (expressed as expected heterozygosity). This association has been uncovered by Ramachandran et al. (2005) based on a sample of 53 indigenous populations from the Human Genome Diversity Cell Line Panel from the Human Genome Diversity Project-Centre d'Etude du Polymorphisme Humain (HGDP-CEPH) (Cann et al., 2002). This finding is in strong support of a serial founder effect since the pre-historic exodus of anatomically modern humans originating from East Africa – i.e., Addis Ababa, Ethiopia (9N, 38E) – and subsequently inhabiting the entire world through five intermediate land-restricted migration routes, i.e., Cairo, Egypt (30N, 31E), Istanbul, Turkey (41N, 28E), Phnom Penh, Cambodia (11N, 104E), Anadyr, Russia (64N, 177E), and Prince Rupert, Canada (54N, 130W). The argumentation is that populations further away from the cradle of humanity – i.e., Addis Ababa, Ethiopia (9N, 38E) – show a concomitant decrease in their level of genetic diversity, which is in line with the hypothesis that subsequent founder populations only carry with them a fraction of their parents' genetic composition.

The empirical evidence regarding a serial founder effect uncovered in Ramachandran et al. (2005) were used by Ashraf and Galor (2013) in the construction of their country-level genetic diversity measure. To accomplish this task, Ashraf and Galor (2013) first construct the migratory distance from East Africa to the country's modern capital city, restricting the pre-historic migration routes through the aforementioned five intermediate way points. In the second step, the country-level *expected heterozygosity* estimate were inferred from the regression coefficient associated with migratory distance from East Africa in the original 53 HGDP-CEPH population sample. Given the fact that contemporary countries have undergone large population movements since the post-Columbian period (i.e., 1500 AD), Ashraf and Galor (2013) propose the use of an ancestry-adjusted version of the country-level genetic diversity measure. This variable refers to a weighted estimate of the various country-level genetic diversity measures, where the weights correspond to the shares of a country's contemporary population that can trace their ancestry back to countries prior to the post-Columbian era (i.e., prior to the year 1500 AD). See Ashraf and Galor (2013) for additional details on data construction and sources.

HLA Genetic Diversity. This variable refers to a country-level genetic diversity measure (expressed as *expected heterozygosity*) associated with a set of genes located in the human leukocyte antigen (HLA) region. The construction of this variable is based on population genome data for 156 single-nucleotide polymorphisms (SNPs) within 19 HLA genes in a sample of 51 distinct populations, as provided by the Allele Frequency Database (ALFRED) (Rajeevan et al., 2012). Next, the distribution of the relevant ethnolinguistic groups within countries in the Alesina et al. (2003) ethnicity data were matched to the set of 51 populations for which HLA heterozygosity data have been provided by ALFRED. This matching procedure employs the historical relationship between ethnic groups, as indicated by the *Ethnologue* database (Global Mapping International, 2010). It is worth mentioning that the HLA genetic composition of additional ethnic groups (e.g., black or mestizo) were constructed through combinations of HLA population genome data. Then, the ethnic-specific HLA *expected heterozygosity* measures were aggregated to the country level using the corresponding ethnic population shares as the weighting scheme. See Cook (2015) for additional details on data construction and sources.

Diversity Variables

Ethnic Diversity. This variable refers to a country-level measure of ethno-linguistic diversity, calculated using a slight variation of the Herfindahl-Hirschman concentration index based on population shares of the various ethno-linguistic groups within a particular country. This index is restricted to the unit interval, expressing the probability that two randomly selected individuals within a particular country will belong to entirely different ethnic groups. Thus, higher values of this index would indicate a more ethnically diverse country. See Alesina et al. (2003) for additional details on data construction and sources.

Religious Diversity. This variable refers to a country-level measure of religious diversity, calculated using a slight variation of the Herfindahl-Hirschman concentration index based on population shares of the various religious groups within a particular country.

This index is restricted to the unit interval, expressing the probability that two randomly selected individuals within a particular country will belong to entirely different religious groups. Thus, higher values of this index would indicate a country with greater religious diversity. See Alesina et al. (2003) for additional details on data construction and sources.

Biogeographic Variables

Absolute Latitude. This variable refers to the country's approximate centroid absolute latitude in decimal degrees. This variable is part of *The Center for International Development* research datasets at Harvard University. The corresponding data are available online at http://www.cid.harvard.edu/ciddata/ciddata.html.

Population in Area with Malaria. This variable refers to the share of a country's population residing in areas subject to malaria falciparum. The variable combines historical maps of malaria prevalence with data on the distribution of the world's population in the year 1994. The values range from 0 (no malaria prevalence) to 100 (high malaria prevalence). This variable is part of *The Center for International Development* research datasets at Harvard University. The corresponding data are available online at http://www.cid.harvard.edu/ciddata/ciddata.html.

Temperature. This variable refers to the country's mean temperature value (in Degree Celsius) during the period 1960 to 1990. The raw data are constructed using the G-ECON database with a spatial resolution of 1 decimal degree latitude $\times$ longitude from monthly temperature observations during the period 1960 to 1990 provided by the Climatic Research Unit database at the University of East Anglia. See Nordhaus (2006); New et al. (2002) for additional details on data construction and sources. The corresponding country-level temperature values across 1 decimal degree grid cells within the country's national borders have been constructed by Ashraf and Galor (2013).

Percentage Arable Land Area. This variable measures the percentage of a country's arable land area that meets the criteria of the Food and Agricultural Organization of the United Nations (FAO), which are defined as followed: "Arable land refers to land under temporary crops (double cropped areas are counted only once), temporary meadows for mowing or pasture, land under market and kitchen gardens and land temporarily fallow (less than five years). The abandoned land resulting from shifting cultivation is not included". This variable is part of the World Bank's *World Development Indicators* database. The corresponding data are available online at http://data.worldbank.org/.

Region Fixed Effects. This variable refers to a set of indicator variables that equals 1 if the respective country is located in one of the main regional classifications according to the definition of the World Bank (i.e., North America, Central and South America, Sub-Saharan Africa, East Asia, Central Asia, South Asia, Middle East, Europe, or Oceania) and zero otherwise.

Historical Variables

Legal Origin Effects. This variable refers to a vector of indicator variables that equals 1 if the respective country's legal origin is British, French, German, Scandinavian, or Socialist and zero otherwise. The corresponding data are available from the La Porta et al. (1999) study.

Major Religion Effects. This variable refers to the set of a country's major religion shares for Protestants, Catholics, and Muslims (as percentage of population in 1980). The residual indicates the membership to any other – or no religion at all. The corresponding data are available from the La Porta et al. (1999) study.

Agricultural Transition Timing. This variable refers to the time elapsed between when the country began practicing sedentary agriculture and the year 2000. See Putterman (2008) for additional details regarding data construction and sources. This variable has been ancestry-adjusted to correct for international migration flows since the year 1500 AD based on the World Migration Matrix data, as reported by Putterman and Weil (2010).

State History. This variable measures the experience of present-day countries with early state formation. The data for the ancestry-adjusted measure of state history from 1 AD to 1500 AD is constructed as follows: The data on state history, as discussed in Chanda and Putterman (2007), begin in 1 AD and continue in half-century intervals until the year 1500 AD. When constructing the index, more weights are assigned to most recent half-centuries of state experiences, and earlier half-centuries are discounted by 5 % (e.g., $\frac{1}{[1.05]}, \frac{1}{[1.05]^2}$, etc.).
This measure is then normalized to be in the range of 0 (the lowest possible experience of early state formation) and 1 (the highest possible experience with early state formation) for ease of interpretation. Finally, an ancestry-adjusted measure of early state formation for each country is constructed based on post-1500 AD international migration flows data, as reported by Putterman and Weil (2010).

Health Variables

Percentage of Low Birth Weight. This variable refers to the percentage of new-born babies with a birth weight of less than $2,500$ grams. According to the World Health Organization International Classification of Diseases criteria, this threshold denotes abnormally low weight at birth as a result of being born too soon or of slow growth, i.e., being too small for gestational age. The data are downloaded from the World Bank's *Health Nutrition and Population Statistics* database and were originally gathered as part of the UNICEF State of the World's Children reports. The data are available online at http://data.worldbank.org/.

Infant Mortality Rate. This variable measures the number of infant deaths for both sexes in the first year after birth per $1,000$ live births. The data are provided as part of the World Bank's *World Development Indicators* database and are gathered by the UN Inter-agency Group for Child Mortality Estimation, relying largely on vital registration systems and/or estimations based on censuses and surveys. See http://www.childmortality.org/ for additional details on data construction and sources. The corresponding data are available online at http://data.worldbank.org/.

Life Expectancy. This variable refers to the years of life expectancy at birth for both sexes. This measure can be interpreted as the years an individual can be expected to live if the life conditions or mortality remain unchanged. It provides a summary of mortality patterns throughout all age groups in a given year. This variable is part of the World Bank's *World Development Indicators* database. The corresponding data are available online at http://data.worldbank.org/.

Disability-Adjusted Life-Years. This variable is used to quantify the burden of disease from mortality and morbidity and corresponds to the years of healthy life lost. According to the World Health Organization, the sum of disability adjusted life years (DALY) can be interpreted as the gap between an ideal health situation (no diseases and disability) and the actual health status. For details on the calculation of the variable see the project website, (http://www.who.int/healthinfo/global_burden_disease/metrics_daly/en/). The data are available from the World Health Organization data repository at http://www.who.int/gho/database/en/.

Homicide Rate. This variable measures the country's number of intentional homicides per 100,000 people. The data are provided by the United Nations Office on Drugs and Crime (UNODC) and was gathered between 2000 and 2015 as supplied by the respective member countries. Homicide is defined by the UNODC as "[...] unlawful death purposefully inflicted on a person by another person. Data on intentional homicide should also include serious assault leading to death and death as a result of a terrorist attack. It should exclude attempted homicide, manslaughter, death due to legal intervention, justifiable homicide in self-defence and death due to armed conflict". For additional details on data construction and sources, see the corresponding website at https://data.unodc.org/.

Economic Environment Variables

GDP per Capita. This variable refers to the purchasing power parity (PPP) adjusted output-side real GDP per capita (expressed in 2011 USD). It is calculated using the output-side real GDP at chained PPPs divided by population size. Both variables are part of the Penn World Tables database, Version 9.0. See Feenstra et al. (2015) for additional details on data construction and sources. The corresponding data are freely available online at https://www.rug.nl/ggdc/productivity/pwt/.

Government Consumption. This variable refers to the country's the share of government consumption in percentage of total GDP (expressed in 2011 USD). This variable is part of the Penn World Tables database, Version 9.0. See Feenstra et al. (2015) for additional details on data construction and sources. The corresponding data are freely available online at https://www.rug.nl/ggdc/productivity/pwt/.

Fertility Rate. This variable refers to a country's total number of children born to women throughout the entire life course. As defined by the United Nations, the total rate of fertility represents the number of children expected to be born to a woman until the end of her childbearing years, using age-specific fertility rates for the population and the corresponding year. This variable is part of the World Bank's *World Development Indicators* database. The corresponding data are available online at http://data.worldbank.org/.

Population Growth. This variable refers to the country's average annual population growth rate in percent. This variable is constructed using the country's population size, which is part of the Penn World Tables database, Version 9.0. See Feenstra et al. (2015) for additional details on data construction and sources. The corresponding data are freely available online at https://www.rug.nl/ggdc/productivity/pwt/.

Trade Openness. This variable refers to the sum of exports and imports of goods and services over total GDP (measured in % of GDP). This variable is part of the World Bank's *World Development Indicators* database. The corresponding data are available online from the *Quality of Government* (QoG) database (Dahlberg et al., 2018).

Social Value Variables

Women in Parliament. This variable refers to the proportion of seats held by women in single or lower chambers in national parliaments (as percentage of total seats). This variable is part of the World Bank's *World Development Indicators* database. The corresponding data are available online at http://data.worldbank.org/.

Female Economic Participation. This variable refers to the country's share of female population aged 15 and above of the total labour force. This variable is part of the World Bank's *World Development Indicators* database. The corresponding data are available online at http://data.worldbank.org/.

Federalist Political System. This variable refers to an indicator variable that equals 1 if the respective country is classified as having a federalist political system and zero otherwise. It is based on a categorical variable taken from the *Institutions and Elections Programme* (IAEP), indicating whether a country's governmental structure is a federalist system, unitary system or a confederation. See Wig et al. (2015) for additional details on data construction and sources. The corresponding data are available online at https://havardhegre.net/iaep/.

Property Rights Protection. This variable refers to a country's degree of property rights protection. The relevant metric ranges from 0 = low to 100 = high. This variable is part of the Heritage Foundation database at https://www.heritage.org/index/property-rights. The corresponding data are available online from the *Quality of Government* (QoG) database (Dahlberg et al., 2018).

Freedom from Corruption. This variable refers to Transparency International's Corruption Perception Index (CPI), indicating the country's level of freedom from corruption. The relevant metric ranges from 0 = low to 100 = high. This variable is part of the Heritage Foundation database at https://www.heritage.org/index/freedom-from-corruption. The corresponding data are available online from the *Quality of Government* (QoG) database (Dahlberg et al., 2018).

Number of Civil Conflicts. This variable refers to the number of internal armed conflicts. This variable has been constructed from the UCDP/PRIO Armed Conflict database. The corresponding data are available online at http://ucdp.uu.se/downloads/.

Educational Variables

Share of Educational Attainment. This vector refers to a set of controls indicating the share of a country's population aged 15 and above with no, primary, or secondary educational attainment. See Barro and Lee (2013) for additional details on data construction and sources. The corresponding data are available online at http://www.barrolee.com/.

Human Capital Index. This variable refers to a human capital index. This index has been constructed from the Penn World Tables database, Version 9.0, by combining data on average years of schooling, as presented by Barro and Lee (2013); Cohen and Soto (2007); Cohen and Leker (2014), and the expected returns to education, as compiled by Psacharopoulos (1994). The latter accounts for possible diminishing returns to schooling quantity. This way, a lower return is assigned to higher education, as measured by threshold values for primary ($s \leq 4$), secondary ($4 < s \leq 8$) and tertiary ($s > 8$) schooling. See Feenstra et al. (2015) for additional details on data construction and sources. The corresponding data are available online at https://www.rug.nl/ggdc/productivity/pwt/.

Student-Teacher Ratio. This variable refers to the country's average class size, i.e., the ratio of the number of students to the number of trained teachers in secondary schooling. This variable is part of the World Bank's *World Development Indicators* database. The corresponding data are available online at http://data.worldbank.org/.

Private Enrollment Rate. This variable refers to the share of pupils enrolled in privately organized educational facilities in primary education. This variable is part of the World Bank's *World Development Indicators* database. The corresponding data are available online at http://data.worldbank.org/.

Educational Expenditure. This variable refers to the country's percentage of GDP devoted to educational services. This variable is part of the World Bank's *World Development Indicators* database. The corresponding data are available online at http://data.worldbank.org/.

ADHD Study-Level Methodological Variables

The following study-level methodological characteristics are taken from or are constructed based on information in the meta-analysis on estimated ADHD prevalence rates compiled by Thomas et al. (2015). See the main text for additional details on data construction and sources.

ADHD Prevalence Estimate. This variable refers to estimated ADHD prevalence rates (measured as the share of individuals diagnosed with ADHD) across individual ADHD studies or countries, respectively.

Risk of Bias Effects. This variable refers to a set of indicators for a possible Risk of Bias (RoB) in estimated ADHD prevalence rates. Specifically, each individual ADHD study was evaluated according to eight RoB questionnaires regarding the representativeness of the sample, the sampling frame, whether individuals were randomly selected, minimum non-response bias, whether observations were directly collected from subjects, and whether data collection and construction fulfills a minimum of measurement reliability and validity. The calculated RoB score ranges from 0 (= very high risk of bias) to 8 (= low risk of bias score). Given the RoB score, each individual ADHD study was classified as having a very high RoB score (i.e., $0 \leq RoB \leq 1$), high RoB score (i.e., $2 \leq RoB \leq 3$), moderate RoB score (i.e., $4 \leq RoB \leq 5$), or low RoB score (i.e., $6 \leq RoB \leq 8$).

DSM Diagnostic Criteria Effects. This variable refers to a set of indicators for the DSM diagnostic criteria used in the respective study. Each indicator is assigned the value of 1 if the diagnostic criterion used for the prevalence estimate is DSM-III, DSM-III-R, or DSM-IV, respectively, and zero otherwise.

Population Sample Type. This variable refers to a set of indicators for the source of the sampled population. Each indicator is assigned the value of 1 if the sampled population originates from a schooling, community, or national representative survey sample, respectively.

Full Diagnostic Criteria Met. This indicator variable takes on the value of 1 if the full diagnostic criteria of the various editions of the DSM in the assessment of individual ADHD cases are met and zero otherwise.

Type of ADHD Measurement. This variable refers to a set of indicator variables for the type of ADHD measurement. Each indicator is set to 1 if diagnosed ADHD cases are measured using a diagnostic report, an interview, or a symptom-only checklist, respectively.

Informant of ADHD. This variable refers to a set of indicator variables for the type of informant reporting ADHD-related symptoms in probands. This comprises indicators for the reported ADHD cases being confirmed by child, parent, teacher, or clinician.

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