Knowledge Capital and Aggregate Income Differences: Development Accounting for U.S. States

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Online Appendix

Appendix A: Construction of Years of Schooling Measures by State

We compile average years of educational attainment for each U.S. state from the Integrated Public Use Microdata Series (IPUMS) data of the Minnesota Population Center (Ruggles et al. (2010)). We concentrate on the working-age population between 20 and 65 years. We also drop all respondents who are still in school at the time of the survey.

For the years 1970 to 2000, we use the 1 percent (1970) and 5 percent (1980, 1990, and 2000) random samples of the American population. The 1 percent sample has about 4 million observations, the 5 percent samples have about 13 to 14 million observations. Beginning in the year 2001, we use census data from the American Community Survey (ACS). The ACS provides annual 1 percent random population samples (with smaller sample sizes between 2001 and 2004). The approximate sample size is 3 million observations each year. Survey weights in the census and the ACS allow us to calculate measures that are representative for the U.S. population.

Until 1980, the Census reported directly the years of schooling or highest grade level completed of each individual. Beginning with the 1990 Census, the Census Bureau has changed the coding of educational categories and reports degrees (Bachelor, Master, etc.) instead. To translate the degree information into years of schooling, we use the estimates of average years of schooling of each degree provided by Jaeger (1997).[1]

Substantial differences in the labor-market performance between GED holders and standard high school graduates (Heckman, Humphries, and Mader (2011)) warrant a special treatment of GED holders. Due to the weak labor-market position of GED holders, we assign them 10 rather than 12 years of schooling.

Only the most recent survey waves identify GED holders in the Census data. We therefore estimate a constant share of GED holders among all high-school graduates from the pooled ACS 2008-2010 samples. The pooled sample is restricted for each year to get approximately the same age cohort of people aged 20-65. For example, for the year 2007, we use all people aged 21-66 in ACS 2008, 22-67 in ACS 2009, and 23-68 in 2010; for the year 1990, we use all people aged 38-83 in ACS 2008, 39-84 in ACS 2009, and 40-85 in ACS 2010. Note that 1940 is not adjusted because the GED was introduced in 1942.

[1] Some Census years only report educational categories that cover several years of schooling. For these years, we assume the same fraction for this educational category as in the closest survey with full information.

Overall, the GED adjustment affects the average years of schooling only very little, though. In 2007, for example, 15 percent of those who would have received 12 years of schooling otherwise are now assigned 10 years of schooling, reducing the mean of the average years of schooling from 12.33 to 12.27 years. Put differently, accounting for GED holders raises the mean share of those with less than 12 years of schooling from 22.6 percent to 26.7 percent.

Having computed the years of schooling of each individual *i*, the average years of schooling *S* in state *s* at time *t* is then given by combining individual years of schooling by the weighted share of individuals *i* with education level *e* in the state at the time:

$$S_{st} = \sum_e \frac{\sum_i person\ weights_{iest}}{\sum_i person\ weights_{ist}} * years\ of\ schooling_e \qquad \text{(A1)}$$

This yields the average years of schooling by state over time as shown in Figure 2.

Appendix B: Construction of Test Score Measures by State

As indicated in section 2.3 of the main text, our construction of cognitive skill measures for each U.S. state proceeds in four steps. This appendix provides methodological details on each step. First, we construct a constant measure of the mean test scores of students of each state (Appendix B.1). Second, we adjust the test scores of the working-age population of each state for interstate migration, thereby placing particular emphasis on the fact that interstate migration is selective (Appendix B.2). Third, test scores are adjusted for immigration from other countries, again with a special focus on selectivity (Appendix B.3). Fourth, we project test scores backward in time to allow for age-varying test scores in each state (Appendix B.4).

B.1 Construction of Mean State Test Scores

The National Assessment of Educational Progress (NAEP) studies the educational achievement of American students in grades four and eight in different subjects (National Center for Education Statistics (2014)). In our main analysis, we focus on the mathematics score in grade eight, on which we focus the following description. But as far as possible, we also computed test scores based on reading and grade four, as well as on a combination of subjects and grades.

Since 1990, NAEP math tests have been administered on a representative scale at the state level every two to four years for most states. By 2003, test scores are available for all states.

Adjustment of Pre-1996 Tests for Accommodation

Since 1996, NAEP allows students with disabilities and English language learners specific accommodations to facilitate test participation. The NAEP test scores before 1996 (in 1990 and 1992) did not permit such accommodation, so that they have to be adjusted in order to be on a common scale with the subsequent tests. Therefore, we rescale the pre-1996 tests as follows: For 1996, NAEP test scores and standard deviations are available for tests with and without accommodation at the national level. By subtracting the 1996 U.S. mean without accommodation from the state score and dividing by the 1996 U.S. standard deviation without accommodation, we standardize test scores to mean 0 and standard deviation of 1. By multiplying the 1996 U.S. standard deviation with accommodation and adding the 1996 U.S. mean with accommodation, we bring each test score before 1996 to the same scale as the tests that permitted accommodation.

That is, the pre-1996 waves are aligned to the post-1996 scale in the following way:

$$score_{st}^{adj} = \left(\frac{score_{st} - mean_{US,t=1996}^{same\ scale}}{sd_{US,t=1996}^{same\ scale}}\right) * sd_{US,t=1996}^{new\ scale} + mean_{US,t=1996}^{new\ scale} \qquad \text{(B1)}$$

where $score_{st}$ is the raw score (without accommodation) of state *s* at time *t*, *mean* refers to the U.S. national mean, *sd* refers to the U.S. standard deviation, *same scale* refers to scores without accommodation, and *new scale* refers to scores with accommodation.

Normalization of Scales to Base Year 2011

Next, we normalize each scale – eight-grade math, etc. – to have a mean of 500 and a standard deviation of 100 in the common base year 2011. This is done by subtracting from each test score the 2011 U.S. mean and dividing by the 2011 U.S. standard deviation and then multiplying by 100 and adding 500:

$$score_{st}^{standard} = \left(\frac{score_{st}^{adj} - mean_{US,\,t=2011}}{sd_{US,\,t=2011}}\right) * 100 + 500 \qquad \text{(B2)}$$

Regression-based Estimation of Mean State Scores by State Fixed Effects

Using the normalized scores, we estimate the average test score of each state over all test scores that are available until 2011. This is done by estimating state fixed effects in a regression with year fixed effects that take into account systematic differences over time, as well as – in estimations that combine tests across subjects and grades – grade-by-subject fixed effects that takes into account systematic differences between grades and subjects:

$$score_{sgut}^{standard} = \sum_{s=1}^{50} \alpha_s I_s + I_g * I_u + I_t + \epsilon_{sgut} \tag{B3}$$

I_s is the fixed effect of state *s* that we are interested in. I_t are time fixed effects and $I_g * I_u$ are grade-by-subject fixed effects. By leaving out the indicators that represent math, grade eight, and the year 2011, all state fixed effects refer to this subject, grade, and year. The same adjustments and estimations can also be performed for different subsamples of the population, e.g., by education category of the parents. In further analysis, we estimate average standard deviations by employing the same fixed effects regression framework.[2]

B.2 Adjustment for Interstate Migration

Adjusting for State of Birth

To be able to adjust the state skill measure for interstate migration, we start by computing the birthplace composition of each state from the Census data. In particular, we compute the population shares of people currently living in state *s* who were born in state *s* (“state locals”), those born in in another state *k* (“interstate migrants”), and those born in another country (“international immigrants”). Thus, the population share of individuals *i* from origin state/country *o* living in state *s* at time *t* is given by

$$population\ share_{ost} = \frac{\sum_i person\ weights_{iost}}{\sum_i person\ weights_{ist}} \tag{B4}$$

Each state is composed of individuals educated in other states. To adjust, at least partially, for the differences in schooling that these individuals brought with them to their current state of residence, we construct a series of composite test scores. The idea is that each person who is living in a state receives the test score of his home state. The baseline composite test score of state *s* at time *t* is then the weighted sum of test scores from all origin states *o* which are weighted by the fraction of people born in a particular origin *o* living in state *s* at time *t*:

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[2] Standard deviations are also adjusted to be on the same scale by $sd_{st}^{standard} = \left(\frac{sd_{st}^{adj} - sd_{US,t=2011}}{sd_{US,t=2011}}\right) * 100 + 100$.

$$score_{st}^{adj} = \sum_{o} population\ share_{ost} \times score_{o} \tag{B5}$$

Thus, each person currently living in a state is assigned the test score from the respective state of birth.

The baseline composite test score thus assigns all locals the mean test score of the state of residence which is also their state of birth, assuming that the locals have not moved during their school career to another state. Assuming that internal migrants have not left their state of birth before finishing grade eight, all internal migrants receive the mean test score of their state of birth. In this variant, the international immigrants receive the mean score of their current state of residence.

Adjusting for Selective Interstate Migration based on Educational Background

To address selective interstate migration, we compute all population shares separately by educational background. We distinguish two educational categories: Persons with (at least some) university education and persons without university education. For each state, we also construct separate test scores by the education category of the parents (some university education or not).

We then assign separate test scores by educational background *e*:

$$score_{st}^{sel} = \sum_{oe} population\ share_{oest} \times score_{oe} \tag{B6}$$

For state locals, this adjusted score replaces the average test score of the state of residence with the average test score of the state of residence by education category (university / no university). Likewise, for in-migrants it adjusts the average test scores of by education category. The assumption is that we can assign the population with a university education the test score of children with parents who have a university degree, and equivalently for those without a university education.

B.3 Adjustment for International Migration

Our adjustment for international migration combines data from international achievement tests with population shares of immigrants from different countries of origin.

International Test Score Data

We use international test score data from PISA, TIMSS, and PIRLS for international immigrants residing in one of the U.S. states.[3] As a first step, the international test data have to be rescaled onto a common scale with the national NAEP data (Hanushek, Peterson, and Woessmann (2012)). To do so, we first standardize all international test scores by subtracting from each mean score on the international scale the U.S. mean value on the international scale by subject, grade, and year and divide this difference by the U.S. standard deviation on the international scale, also by subject, grade, and year. Next, we multiply the standardized value by the U.S. standard deviation of the NAEP score by subject, grade, and year and add the U.S. mean of the NAEP score by subject, grade, and year:

$$score_{sgut}^{adj} = \left(\frac{score_{sgut} - mean_{US,gut}^{int'l}}{sd_{US,gut}^{int'l}}\right) * sd_{US,gut}^{NAEP} + mean_{US,gut}^{NAEP} \tag{B7}$$

where $score_{sgut}$ is the raw international test score of country *s* at grade g in subject *u* in year *t*.

To compute average test scores for each country, we proceed in the same way as for the national test data. The regression design takes into account systematic differences between grades, subjects, and years. The final estimate of the country average test score is then a country fixed effect:

$$score_{sgut}^{standard} = \sum_s \alpha_s I_s + I_g * I_u * I_{test} + I_t + \epsilon_{sgut} \tag{B8}$$

where I_s is the fixed effect of country *s* that we are interested in. I_t are time fixed effects and $I_g * I_u * I_{test}$ are grade times subject times survey fixed effects. The survey fixed effects indicate whether we identify grade 4 in PIRLS or grade 4 in TIMSS. Thus, they are dummy variables for TIMSS, PIRLS, and PISA. Again, the same regression can be estimated for different subsamples of the population.[4]

[3] We draw the data from the International Data Explorer (IDE) of the National Center of Education Statistics (http://nces.ed.gov/surveys/international/ide/).

[4] When estimating separate scores by the education category of the father, in PISA we use a simple average of the test scores in ISCED categories 0-4 for non-university education and ISCED categories 5a and 6 for university education. In TIMSS 1995 and 1999, we use the average of the categories until "finished secondary" for non-university education and "finished university" for university education. In the subsequent TIMSS waves, we use ISCED categories 0-4 for non-university education and ISCED categories 5a and more than 5a for university education. The IDE does not report educational background variables for PIRLS and TIMSS grade 4.

Apart from the mean test score, we also estimate the performance of the 75th and the 90th percentile of students in each country for comparison. We also estimate the standard deviation.[5]

In cases where a source country did not participate in the international achievement tests, we impute values from neighboring countries or regions. Table A5 reports the respective imputations for the main source countries of immigrants in the United States.

Population Shares of Immigrants from Different Countries of Origin

Using Census data, we next calculate the population shares of those born outside U.S. Table A5 shows the main source countries of immigrants who came to the United States over the last 70 years.

In calculating the share of immigrants from different origin countries in the birthplace composition of each state, we take into account the age of immigration. In particular, immigrants arriving in the United States before the age of 6 are assumed to have spent their school career in the U.S. school system, so they are assigned the NAEP score of their state of residence. Those who immigrated after the age of 20 are assigned the test score of their country of origin. And those who immigrated between ages 6 and 20 are assigned a weighted average of the two.

Using the population shares of immigrants from different countries of origin as in equation (B4), we then basically proceed in the same way as with the national test score data. That is, we adjust the composite test score of each state by applying the country-of-origin test scores for international immigrants.

As discussed in the paper, we do not use the average migrant test score because the skills of migrants are not random draws from the home country skill distribution. To estimate the migrant selectivity for each country, we proceed in two steps: First, for each country of origin (country subscripts omitted), we calculate the selectivity parameter for school attainment as the percentile *p* of the home country distribution from which the average immigrant to the U.S. is drawn:

$$p = s_{US}^{pri} * \frac{1}{2} s_{home}^{pri} + s_{US}^{sec} * \left(s_{home}^{pri} + \frac{1}{2} s_{home}^{sec} \right) + s_{US}^{ter} * \left(s_{home}^{pri} + s_{home}^{sec} + \frac{1}{2} s_{home}^{ter} \right) \qquad \text{(B9)}$$

where the respective educational degrees of the population are given by *pri* = primary, *sec* = secondary, and *ter* = tertiary, *s* refers to the shares of the population with the respective degrees (with $s^{pri}+ s^{sec}+ s^{ter}=1$), *home* refers to the population in the respective home country, and *US*

[5] Standard deviations are again adjusted to be on the same scale with NAEP.

refers to the immigrants from the specific home country living in the United States. Our baseline estimate uses the attainment selection parameter p to indicate where in the gap between p and perfect selectivity we find the percentile of the cognitive skill distribution for the average immigrant $(\tilde{p}_s)$. Data are taken from Docquier, Lowell, and Marfouk (2009) and refer to the year 2000. The country of origin test score is than the predicted percentile score indicated by p. For each country, we know the mean and standard deviation (as well as the 75$^{\text{th}}$ and 90$^{\text{th}}$ percentile) of the test score distribution. Assuming a normal distribution, we can calculate the corresponding test score that is adjusted for international migrant selectivity:

$$score_{sgut}^{selectivity} = invnorm(\tilde{p}_s) * sd_{sgut}^{standard} + score_{sgut}^{standard} \tag{B10}$$

where $invnorm(\tilde{p}_s)$ are draws of the *p-th* percentile from a normal (0,1) distribution, $score_{sgut}^{standard}$ is the average international test score of country s at grade g in subject u in year t, and $sd_{sgut}^{standard}$ is the corresponding standard deviation. The comparison of $score_{s}^{selectivity}$ in math, grade 8, in the year 2007, using $\tilde{p}_s = 75$ and $\tilde{p}_s = 90$, respectively, with the country-specific observed test scores at the 75$^{\text{th}}$ and 90$^{\text{th}}$ percentile, respectively, show that this prediction works well (correlations almost perfect with r = 99% in both cases).

In further analysis, we use $\tilde{p}_s = p_s$ (according to equation (B9)) and $\tilde{p}_s = 90$, respectively.

B.4 Backward Projection of Time-Varying Scores

Finally, we employ two methods of age projections of historical achievement patterns, one based on extrapolation from the available NAEP data and one based on projection from state SAT scores.

Extrapolation of NAEP Trends

The skill measures developed so far assume that an average test score applies to the whole working-age population. We now aim to project developments of cognitive skills over time by state. Because test score data are not available before 1990 at the state level, we project test scores back in time, incorporating the long-term national trend which dates back to 1978 for eighth-grade math. For the projections, we do not use the 1990 value but rather start in 1992, as the very first test scores seem to differ somewhat from the subsequent trends. The basic idea of our backward projection is to use an average of the linear trend in the state test score and the observed national trend to predict the test score of the state in a given year until 1978, i.e. from 1978 to 1992.

The national NAEP series that goes back until 1978, called long-term trend NAEP, is on a slightly different scale than the state NAEP series used in the state analysis. First, as scores reported prior to 2004 are reported in a different testing format and both formats are reported for 2004, we align the prior scores by standardization equivalent to the adjustment for scores without accommodation above. Then, to make the scales comparable, we subtract from each long-term trend test score the long-term trend score in 1992 and divide by the U.S. standard deviation in 1992 from the long-term trend. We then multiply this term by the U.S. standard deviation in 1992 from the state NAEP series and add the national mean from the from the state NAEP series.

We start the projection by interpolating the available test scores linearly for each state from 1992 to 2011.[6] The projection then follows an iterative process: We assume that each test score of state *s* in *t*–1, $\tilde{T}_{s,t-1}$, is equal to the test score in *t*, T_{st}, minus a simple average of the change in the state-specific linear time trend, i.e. the slope of the time trend, and the change in the national time trend:

$$\tilde{T}_{s,t-1} = T_{st} - \frac{1}{2}\left(x_t \Delta Linear\ State\ Trend_{st} + \Delta\overline{National_t}\right) \qquad \text{(B11)}$$

where

$$\Delta Linear\ State\ Trend_{st} = Linear\ State\ Trend_{st} - Linear\ State\ Trend_{s,t-1}$$

$$\Delta\overline{National_t} = \overline{National_t} - \overline{National_{t-1}}$$

The $Linear\ State\ Trend_{st}$ is obtained from state-specific regressions of the test score on years. $\overline{National_t}$ is the long-term trend national average and available backwards until 1978.

To ensure that the (weighted) average of all state test scores is equal to the national average, we adjust the linear state trend with a time-varying constant, x_t. This adjustment factor is computed by taking the weighted sum of the test score projection on both sides and solving for x_t:

[6] A few states started representative NAEP testing later than 1992. These are Alaska, Montana, Oregon, Vermont, and Washington in 1996, Illinois, Kansas, and Nevada in 2000, and South Dakota in 2003. We project their scores back to 1992 with a simple backward projection method: $\tilde{T}_{s,t-1} = T_{st} - \frac{1}{2}\left(\Delta Linear\ State\ Trend_{st} + \Delta\overline{National_t}\right)$.

$$\overline{National_{t-1}} = \sum_{s=1}^{51} w_s \tilde{T}_{s,t-1}\,, for\ t \leq 1991\ and\ \sum_{s=1}^{51} w_s = 1$$

$$\Leftrightarrow x_t = \frac{2 * \sum_{s=1}^{51} w_s T_{st} - \overline{National_t} - \overline{National_{t-1}}}{\sum_{s=1}^{51} w_s \Delta Linear\ State\ Trend_{st}} \tag{B12}$$

The weights, w_s, are based on average daily attendance in public elementary and secondary schools by state from the Digest of Education Statistics (U.S. Department of Education (2013)). To obtain a weight for each state, we divide the average daily attendance in the state by the total national daily attendance. This measure is averaged over the time period 1978 to 1992 as the fractions are rather stable. The cross-sectional correlation between the fractions in 1978 and in 1992 is 98 percent.

This part of the extrapolation is exemplified by Figure A2, which shows both the observed data and the extrapolated state trends for two states: Massachusetts and Mississippi. Massachusetts was above the national average in 2011, but also had a steeper growth trend than the nation as a whole. As such, we shrink the extrapolated trend toward the national trend. Mississippi is different: while it also had a steeper growth trend than the nation as a whole, its scores were below the national average. Again, we shrink the extrapolation to the nationally observed trend.

The projected test score series then uses the available test score information for each state from 1992 to 2011 and the projected scores from the above iterative procedure from 1978 to 1992. Before 1978, we either assume a constant test score or a linear state trend.

The adjusted skill measure is then constructed by taking five-year averages of the projected test score series. These five year averages are then matched to the population shares of the appropriate age. To match the projected test score data, the share of people from origin *o* living in state *s* in equation (B4) is computed in five-year age intervals from the Census data, both for the state average and for the education-category subsamples. The adjusted skill measure is then derived as

$$score_{st}^{projected} = \sum_{oea} population\ share_{oeast} \times score_{oea} \tag{B13}$$

where the population shares and scores now do not only vary by state of origin *o* and educational category *e*, but also by age category *a*.

Projection from State SAT Scores

We obtained state-specific SAT scores (in math, writing, and reading) from 1972 to 2013 from the College Board. SAT scores are not representative for the total student population. But College Board also provided information on total participation (number of test takers). We calculate SAT participation rates by dividing the number of SAT participants by the total number of public high school graduates in each state. The latter is collected from various years of the Digest of Education Statistics (filling gaps by linear interpolation between available years).

Regressing the SAT score on the participation rate shows a significant negative relationship, indicating that a higher participation rate is related to a less selective sample and lower test scores. We therefore construct a series of participation-adjusted SAT scores:

$$SAT\ score_{st} = \alpha_0 + \alpha_1 participation\ rate_{st} + \lambda_s + \lambda_t + \epsilon_{st} \qquad \text{(B14)}$$

We use the estimated coefficients to predict SAT test scores with constant participation rates, where we assume that all states have the mean U.S. participation rate over the period 1972 to 2013 of 46.9 percent.

The participation-adjusted SAT scores allow us to predict state NAEP scores before 1992. To do so, we first regress the eighth-grade math test scores in NAEP on the participation-adjusted SAT scores by state for the years since 1992 where both test scores series are available:

$$NAEP\ score_t = \beta_0 + \beta_1 SAT\ score_t^{adjusted} + \epsilon_t \qquad \text{(B15)}$$

Because the SAT is taken around high school graduation, in these regressions we lag the SAT test scores by four years to capture almost the same cohorts as in NAEP. The regressions show that the participation-adjusted SAT score and the NAEP score move together over time in almost all states.[7]

With the estimated coefficients, we can then construct predicted NAEP test scores for each state for the years 1968 to 1991. Applying the same algorithm for the projection of test scores by age as before, we construct new aggregate test scores for each state and year by using the predicted NAEP test scores based on the SAT data.

[7] Exceptions are Kansas, Nevada, and South Dakota, which are also the states that start relatively late in NAEP, thereby impeding the prediction of a reliable connection between NAEP and SAT. For these states, we use the U.S. average coefficient.

Additional Appendix Tables

Table A2: Selectivity of Migrant Sending Countries

Country	School-attainment selectivity		Country	School-attainment selectivity	
	Adjusted	Unadjusted	Adjusted	Adjusted	Unadjusted
Niger	1.000	0.990	Egypt	0.982	0.867
Congo, Dem. Rep.	0.998	0.959	Nepal	0.982	0.865
Gambia, The	0.998	0.96	Pakistan	0.981	0.861
Kenya	0.998	0.956	Suriname	0.981	0.863
Lesotho	0.998	0.956	Tunisia	0.981	0.861
Tanzania	0.998	0.952	Afghanistan	0.980	0.857
Cameroon	0.997	0.947	Kiribati	0.980	0.858
Cote d'Ivoire	0.997	0.946	Maldives	0.980	0.858
Madagascar	0.997	0.945	Mauritius	0.980	0.858
Malawi	0.997	0.949	Tuvalu	0.980	0.858
Mongolia	0.997	0.948	Sri Lanka	0.979	0.855
Uganda	0.997	0.946	Bahrain	0.978	0.852
Zambia	0.997	0.943	Iran	0.978	0.853
Nigeria	0.996	0.936	Qatar	0.978	0.853
Zimbabwe	0.995	0.930	Saudi Arabia	0.978	0.852
Mauritania	0.994	0.921	United Arab Emirates	0.978	0.853
Palau	0.994	0.921	Singapore	0.977	0.850
Burkina Faso	0.993	0.917	Bangladesh	0.976	0.845
Sao Tome and Principe	0.992	0.908	Senegal	0.976	0.845
Chad	0.991	0.903	Eritrea	0.974	0.840
Mozambique	0.991	0.904	Kuwait	0.974	0.839
Guinea	0.990	0.898	Liechtenstein	0.974	0.838
Guinea-Bissau	0.990	0.902	Switzerland	0.972	0.833
Liberia	0.990	0.898	Burma (Myanmar)	0.971	0.828
Mali	0.990	0.901	Bhutan	0.970	0.828
Rwanda	0.990	0.902	Taiwan	0.970	0.827
Ethiopia	0.989	0.895	Angola	0.969	0.823
India	0.989	0.897	Congo, Rep. of the	0.969	0.823
Indonesia	0.989	0.894	Venezuela	0.969	0.825
Namibia	0.989	0.893	Equatorial Guinea	0.968	0.822
Burundi	0.988	0.891	Benin	0.967	0.819
Macedonia	0.988	0.893	Libya	0.967	0.817
Papua New Guinea	0.988	0.891	Brazil	0.966	0.816
Sierra Leone	0.988	0.891	Turkey	0.966	0.817
Botswana	0.987	0.887	Seychelles	0.965	0.812
Central African Rep.	0.987	0.885	Djibouti	0.964	0.809
Brunei	0.986	0.883	Monaco	0.963	0.808
Comoros	0.986	0.880	Palestinian Territory	0.963	0.809
Sudan	0.986	0.883	Thailand	0.962	0.806
Ghana	0.985	0.877	Bolivia	0.956	0.791
Algeria	0.984	0.872	Malaysia	0.956	0.790
Togo	0.984	0.875	France	0.954	0.785
Andorra	0.983	0.870	Swaziland	0.954	0.785
Gabon	0.983	0.871	Georgia	0.953	0.784
Morocco	0.983	0.869	San Marino	0.952	0.780
South Africa	0.983	0.870	Vatican	0.951	0.778

(continued on next page)

Table A2 (continued)

Country	School-attainment selectivity		Country	School-attainment selectivity	
	Adjusted	Unadjusted	Adjusted	Adjusted	Unadjusted
Paraguay	0.951	0.779	Austria	0.912	0.704
Lebanon	0.949	0.775	Serbia and Montenegro	0.912	0.704
Belize	0.948	0.771	Slovakia	0.912	0.703
China, Hong Kong SAR	0.947	0.769	Saint Vincent	0.911	0.702
China, Macao SAR	0.947	0.769	Bahamas, The	0.910	0.700
Somalia	0.946	0.767	Nicaragua	0.910	0.699
Haiti	0.945	0.765	Romania	0.909	0.699
Azerbaijan	0.944	0.763	Costa Rica	0.908	0.697
Spain	0.944	0.764	Vanuatu	0.907	0.694
Philippines	0.943	0.760	Australia	0.906	0.693
Latvia	0.941	0.758	Czech Republic	0.906	0.693
Uzbekistan	0.940	0.755	Cyprus	0.905	0.692
Grenada	0.939	0.754	Israel	0.905	0.693
Bulgaria	0.938	0.750	Oman	0.905	0.692
United Kingdom	0.938	0.752	Peru	0.905	0.692
Vietnam	0.938	0.750	Antigua and Barbuda	0.904	0.690
Japan	0.936	0.747	Armenia	0.903	0.688
Micronesia	0.936	0.746	Korea	0.902	0.688
Marshall Islands	0.935	0.746	Albania	0.901	0.685
Kazakhstan	0.933	0.742	Saint Kitts and Nevis	0.899	0.682
Panama	0.933	0.741	Dominica	0.898	0.68
Colombia	0.932	0.738	Uruguay	0.898	0.681
Estonia	0.932	0.739	Luxembourg	0.894	0.674
Denmark	0.931	0.737	Norway	0.894	0.674
New Zealand	0.930	0.736	Saint Lucia	0.893	0.673
Trinidad and Tobago	0.930	0.736	Cambodia	0.892	0.671
Sweden	0.929	0.733	Fiji	0.892	0.671
Belgium	0.928	0.731	Cape Verde	0.890	0.668
China	0.928	0.732	Bosnia and Herzegovina	0.889	0.666
Belarus	0.927	0.729	Malta	0.885	0.660
Chile	0.927	0.730	Poland	0.885	0.661
Kyrgyzstan	0.927	0.729	Croatia	0.884	0.660
Hungary	0.926	0.728	Barbados	0.88	0.653
Tajikistan	0.926	0.728	Ireland	0.879	0.652
Turkmenistan	0.926	0.729	Tonga	0.879	0.652
Finland	0.925	0.725	Honduras	0.876	0.647
Jamaica	0.925	0.725	Germany	0.872	0.643
Netherlands	0.923	0.723	Laos	0.867	0.636
Argentina	0.922	0.721	Ecuador	0.865	0.632
Lithuania	0.921	0.719	Portugal	0.865	0.633
Ukraine	0.919	0.716	Italy	0.863	0.629
Moldova	0.918	0.714	Greece	0.850	0.613
Syria	0.918	0.713	Slovenia	0.850	0.613
Russia	0.917	0.712	Guatemala	0.847	0.609
Guyana	0.916	0.709	Dominican Republic	0.843	0.604
Samoa	0.916	0.710	Cuba	0.836	0.595
Iceland	0.914	0.708	El Salvador	0.827	0.584
Iraq	0.914	0.707	Canada	0.774	0.525
Jordan	0.914	0.707	Mexico	0.710	0.461
Yemen	0.913	0.704	Puerto Rico	0.500	0.500

Additional Appendix Tables

Table A2: Selectivity of Migrant Sending Countries

Country	School-attainment selectivity		Country	School-attainment selectivity	
	Adjusted	Unadjusted		Adjusted	Unadjusted
Mongolia	0.997	0.948	England	0.938	0.752
Indonesia	0.989	0.894	Scotland	0.938	0.752
Macedonia	0.988	0.893	United Kingdom	0.938	0.752
Botswana	0.987	0.887	American Samoa	0.936	0.746
Ghana	0.985	0.877	Guam	0.936	0.746
Southern Africa	0.985	0.878	Japan	0.936	0.747
Africa	0.984	0.872	Overseas Territories	0.936	0.746
Algeria	0.984	0.872	U.S. Virgin Islands	0.936	0.746
Morocco	0.983	0.869	Israel/Palestine	0.934	0.751
South Africa	0.983	0.870	Kazakhstan	0.933	0.742
Egypt	0.982	0.867	Panama	0.933	0.741
Northern Africa	0.982	0.867	Colombia	0.932	0.738
Tunisia	0.981	0.861	Estonia	0.932	0.739
Bahrain	0.978	0.852	Baltic States	0.931	0.738
Iran	0.978	0.853	Denmark	0.931	0.737
Qatar	0.978	0.853	New Zealand	0.930	0.736
Saudi Arabia	0.978	0.852	Trinidad and Tobago	0.930	0.736
United Arab Emirates	0.978	0.853	Sweden	0.929	0.733
Singapore	0.977	0.850	Western Europe	0.929	0.741
Kuwait	0.974	0.839	Belgium	0.928	0.731
Liechtenstein	0.974	0.838	Former USSR without Russia	0.928	0.734
Switzerland	0.972	0.833	Chile	0.927	0.730
Taiwan (Chinese Taipei)	0.970	0.827	Former USSR	0.927	0.731
Southeast Asia + Iran	0.968	0.825	Kyrgyzstan	0.927	0.729
Brazil	0.966	0.816	Hungary	0.926	0.728
Turkey	0.966	0.817	Finland	0.925	0.725
Southeast Asia	0.965	0.820	South America	0.925	0.730
Palestinian Nat'l Auth.	0.963	0.809	Total Average	0.925	0.744
Thailand	0.962	0.806	Netherlands	0.923	0.723
Malaysia	0.956	0.790	Argentina	0.922	0.721
Asia	0.955	0.798	Lithuania	0.921	0.719
Middle East	0.955	0.798	Northern Europe	0.921	0.720
France	0.954	0.785	Ukraine	0.919	0.716
Georgia	0.953	0.784	Moldova	0.918	0.714
East Asia	0.950	0.791	Oceania	0.918	0.715
Lebanon	0.949	0.775	Syrian Arab Republic	0.918	0.713
Hong Kong	0.947	0.769	Europe	0.914	0.714
Macao-China	0.947	0.769	Iceland	0.914	0.708
Azerbaijan	0.944	0.763	Jordan	0.914	0.707
Spain	0.944	0.764	Antarctica	0.913	0.706
Philippines	0.943	0.760	Austria	0.912	0.704
Latvia	0.941	0.758	Montenegro	0.912	0.704
Bulgaria	0.938	0.750	Serbia	0.912	0.704

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Table A2 (continued)

Country	School-attainment selectivity		Country	School-attainment selectivity	
	Adjusted	Unadjusted		Adjusted	Unadjusted
Slovak Rep.	0.912	0.703	Central America	0.891	0.677
Czechoslovakia	0.909	0.698	Bosnia and Herzegovina	0.889	0.666
Romania	0.909	0.699	Malta	0.885	0.660
Eastern Europe	0.907	0.698	Poland	0.885	0.661
Australia	0.906	0.693	Croatia	0.884	0.66
Czech Rep.	0.906	0.693	Ireland	0.879	0.652
Yugoslavia	0.906	0.707	Honduras	0.876	0.647
Cyprus	0.905	0.692	Germany	0.872	0.643
Oman	0.905	0.692	Portugal	0.865	0.633
Peru	0.905	0.692	Italy	0.863	0.629
Armenia	0.903	0.688	Greece	0.850	0.613
Korea, Rep.	0.902	0.688	El Salvador	0.827	0.584
Albania	0.901	0.685	Canada	0.774	0.525
Southern Europe	0.899	0.697	North America	0.774	0.525
Uruguay	0.898	0.681	Mexico	0.710	0.461
Luxembourg	0.894	0.674	Puerto Rico	0.500	0.500
Norway	0.894	0.674			

Table A3: Summary Statistics

	Obs.	Mean	Std. dev.	Min.	Max.
Real GDP per capita, 2007	47	41,218	6,388	29,302	59,251
Years of schooling, 2007	47	13.11	0.35	12.52	13.74
Test scores:					
Baseline: local average adjusted for interstate migrants	47	499.9	15.98	460.4	527.7
+ Adjustment of locals by education category	47	494.4	15.46	454.9	521.3
+ Adjustment of interstate migrants by education category	47	493.9	15.80	453.1	522.0
+ Adjustment of international migrants scores by selectivity	47	497.7	15.57	454.8	524.7
Age adjustment with extrapolation of NAEP trends by education category	47	442.4	22.04	381.9	476.5
Age adjustment with projection from SAT scores	47	407.2	27.52	321.5	456.6
Growth rate of real GDP per capita, 1970-2007	47	2.24	0.31	1.56	2.89
Change in years of schooling, 1970-2007	47	2.02	0.45	0.78	2.86
Estimated annual change in test scores, 1968-2011	47	3.17	1.21	1.17	6.77

Notes: See sections 2.2, 2.3, and 3.1 for details on the data. Test scores refer to eighth-grade math. Locals are all persons who report a state of birth equal to the current state of residence. Interstate migrants report another state of birth than state of residence. International migrants report another country of birth than the United States. “By education category” indicates that individuals with/without university education are assigned the test scores of children of parents with/without university education.

Table A4: Main Data by State

	Real GDP per capita 2007	Years of schooling 2007	Test scores: Average NAEP score	Baseline score	Adjusted for selective migration	Projection by NAEP trends	Projection from SAT scores
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Alabama	33,506	12.74	461.1	469.0	464.1	400.2	372.8
Alaska	61,877	13.15	504.8	501.9	506.3	453.5	414.4
Arizona	39,712	12.76	487.7	493.5	493.1	445.7	414.7
Arkansas	32,338	12.59	475.0	481.8	475.9	409.9	385.7
California	48,777	12.74	472.3	478.5	497.9	459.2	434.6
Colorado	47,735	13.47	513.6	506.4	505.4	454.2	416.1
Connecticut	59,251	13.65	515.0	511.5	508.6	459.5	423.9
Delaware	64,604	13.15	497.2	499.9	497.8	430.6	390.0
Florida	39,153	13.00	483.5	491.5	489.5	436.6	402.0
Georgia	40,389	12.93	481.5	485.6	484.4	425.4	396.3
Hawaii	46,022	13.42	470.8	478.2	501.8	453.7	416.4
Idaho	34,079	13.09	512.2	504.8	499.5	448.2	419.1
Illinois	46,646	13.24	498.6	498.7	501.4	456.2	416.0
Indiana	38,777	12.95	511.0	506.8	498.9	436.2	403.7
Iowa	42,242	13.20	521.7	517.5	510.4	476.5	456.1
Kansas	40,943	13.28	520.2	512.2	507.7	458.9	420.9
Kentucky	33,412	12.64	489.2	492.1	484.8	420.8	381.2
Louisiana	44,778	12.53	462.9	467.7	463.4	383.3	345.7
Maine	34,944	13.27	518.9	516.0	508.8	456.9	429.9
Maryland	45,469	13.55	501.9	492.4	494.9	432.5	395.4
Massachusetts	51,781	13.74	530.5	524.0	524.7	460.3	399.2
Michigan	36,532	13.17	499.0	498.6	494.8	442.4	411.6
Minnesota	45,987	13.55	534.8	527.7	524.3	476.2	439.8
Mississippi	29,727	12.53	450.8	460.4	454.8	381.9	321.5
Missouri	37,395	13.09	501.6	500.6	496.1	445.3	412.4
Montana	34,372	13.26	528.5	516.5	509.7	452.3	434.8
Nebraska	43,525	13.33	517.1	513.8	507.7	463.2	445.2
Nevada	48,392	12.62	477.2	486.9	490.8	443.9	416.6
New Hampshire	41,668	13.58	524.0	520.0	515.9	454.6	404.8

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Table A4 (continued)

	Real GDP per capita 2007	Years of schooling 2007	Test scores: Average NAEP score	Baseline score	Adjusted for selective migration	Projection by NAEP trends	Projection from SAT scores
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
New Jersey	51,337	13.48	519.0	513.9	516.5	465.5	433.2
New Mexico	35,313	12.71	468.2	480.9	480.0	428.4	403.3
New York	53,165	13.27	497.8	498.4	508.8	460.1	426.4
North Carolina	41,123	12.98	497.3	497.1	492.3	416.1	358.3
North Dakota	41,329	13.47	531.8	527.0	520.3	472.8	456.6
Ohio	38,389	13.13	510.2	506.8	500.8	432.5	394.4
Oklahoma	36,504	12.84	488.5	491.4	486.2	437.8	412.4
Oregon	42,422	13.18	511.0	503.1	503.9	450.7	420.1
Pennsylvania	39,951	13.21	509.2	507.7	501.5	444.3	406.7
Rhode Island	42,274	13.05	489.4	495.8	495.5	445.4	411.0
South Carolina	33,539	12.85	490.5	492.7	486.8	414.8	354.5
South Dakota	41,649	13.12	521.6	518.6	508.7	460.5	427.1
Tennessee	37,068	12.74	475.8	482.1	477.3	415.5	374.3
Texas	45,502	12.52	502.7	499.8	496.8	438.1	400.2
Utah	39,464	13.26	506.5	502.9	497.2	454.7	434.7
Vermont	36,445	13.63	525.2	517.1	511.7	447.5	400.1
Virginia	47,501	13.44	508.3	501.8	501.6	441.0	402.6
Washington	47,553	13.37	513.8	506.8	514.2	460.2	391.5
West Virginia	29,302	12.53	475.7	483.0	472.8	411.9	380.2
Wisconsin	39,841	13.28	521.1	516.5	509.5	463.1	433.3
Wyoming	59,558	13.22	514.1	509.4	504.9	452.2	423.6

Notes: (1) Real GDP per capita in 2005 U.S. dollars. (2) Mean years of completed schooling, 2007. (3) Estimated average eighth-grade math NAEP score from 1992 to 2011, obtained from a regression of NAEP test scores on time and state fixed effects; see Appendix B.1. (4) Baseline: local average adjusted for interstate migrants by average test score of their state of birth. (5) Baseline + adjustment of locals by education category + adjustment of interstate migrants by education category + adjustment of international migrants by selectivity. (6) Age adjustment with extrapolation of NAEP trends by education category; see Appendix B.4. (7) Age adjustment with projection from SAT scores; see Appendix B.4.

Table A5: Main Source Countries

Country of Birth	Total Census Observations, 1940-2010	Share of all immigrants (in percent)	Imputation of international test scores
Mexico	1,054,264	24.14	
Philippines	192,335	4.40	
Puerto Rico	184,529	4.22	NAEP
Germany	138,950	3.18	
India	136,515	3.13	Southeast Asia: Indonesia, Malaysia, Philippines, Singapore, Thailand + Iran
Canada	136,424	3.12	
Cuba	115,914	2.65	Central America: El Salvador, Panama, Honduras, Trinidad&Tobago
China	115,670	2.65	East Asia: Shanghai-China, Hong Kong, Macao-China, Mongolia, Taiwan (Chinese Taipei), Japan, Korea, Rep.
Vietnam	111,037	2.54	Southeast Asia: Indonesia, Malaysia, Philippines, Singapore, Thailand
Italy	102,190	2.34	
El Salvador	93,766	2.15	
Korea	87,184	2.00	South Korea
England	81,712	1.87	
USA, Unknown State	72,212	1.65	NAEP
Poland	71,464	1.64	
Dominican Republic	67,583	1.55	Central America
Japan	62,327	1.43	
Jamaica	58,633	1.34	Central America
Colombia	57,598	1.32	
Guatemala	55,451	1.27	Central America
Abroad, ns	52,545	1.20	Total Average
Other USSR/Russia	44,915	1.03	USSR: Russia, Moldova, Ukraine, Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan
Taiwan	40,817	0.93	
Haiti	40,287	0.92	Central America
West Germany	36,231	0.83	Germany
Iran	34,117	0.78	
Ecuador	32,475	0.74	South America: Argentina, Brazil, Chile, Colombia, Peru, Uruguay
Peru	32,047	0.73	
Portugal	31,728	0.73	
Honduras	31,141	0.71	
Ireland	30,295	0.69	
Greece	29,979	0.69	
France	28,703	0.66	
Brazil	25,754	0.59	
United Kingdom	25,565	0.59	
Hong Kong	25,324	0.58	
Nicaragua	23,920	0.55	Central America
Pakistan	23,123	0.53	Southeast Asia + Iran
Guyana/British Guiana	22,425	0.51	South America
Laos	21,998	0.50	Southeast Asia
Trinidad and Tobago	21,731	0.50	

Notes: Main source countries/regions of immigrants living in the United States. Only countries with a share of the total immigrant inflow of at least 0.5 percent. Averages over all available Census years. Imputation: Countries/ region by which test scores are imputed in cases without international test score data. Source: Authors' calculations based on Ruggles et al. (2010).

Table A6: Development Accounting Results for Different Years

Test score specification	Year	Total knowledge capital		Test scores		Years of schooling	
Baseline: local average adjusted for interstate migrants	2007	0.150***	(0.045)	0.057**	(0.025)	0.093***	(0.023)
	2000	0.149***	(0.047)	0.061**	(0.026)	0.088***	(0.024)
	1990	0.127***	(0.048)	0.031	(0.029)	0.096***	(0.023)
	1980	0.155**	(0.078)	0.024	(0.038)	0.131***	(0.044)
	1970	0.179***	(0.060)	0.028	(0.033)	0.151***	(0.032)
+ Adjustment of locals by education category	2007	0.159***	(0.043)	0.066***	(0.024)	0.093***	(0.023)
	2000	0.157***	(0.046)	0.069***	(0.025)	0.088***	(0.024)
	1990	0.138***	(0.046)	0.042	(0.027)	0.096***	(0.023)
	1980	0.181**	(0.076)	0.050	(0.035)	0.131***	(0.044)
	1970	0.198***	(0.059)	0.047	(0.031)	0.151***	(0.032)
+ Adjustment of interstate migrants by education category	2007	0.169***	(0.043)	0.076***	(0.024)	0.093***	(0.023)
	2000	0.165***	(0.047)	0.077***	(0.025)	0.088***	(0.024)
	1990	0.145***	(0.046)	0.049*	(0.026)	0.096***	(0.023)
	1980	0.178**	(0.075)	0.047	(0.034)	0.131***	(0.044)
	1970	0.186***	(0.057)	0.035	(0.029)	0.151***	(0.032)
+ Adjustment of international migrants by selectivity	2007	0.190***	(0.041)	0.097***	(0.022)	0.093***	(0.023)
	2000	0.180***	(0.045)	0.092***	(0.024)	0.088***	(0.024)
	1990	0.169***	(0.043)	0.073***	(0.023)	0.096***	(0.023)
	1980	0.195**	(0.076)	0.064*	(0.034)	0.131***	(0.044)
	1970	0.203***	(0.056)	0.052*	(0.028)	0.151***	(0.032)

Notes: Development accounting results (covariance measure) for 47 U.S. states with different test score specifications. Test scores refer to eighth-grade math. Locals are all persons who report a state of birth equal to the current state of residence. Interstate migrants report another state of birth than state of residence. International migrants report another country of birth than the United States. "By education category" indicates that individuals with/without university education are assigned the test scores of children of parents with/without university education. Calculations assume a return of w=0.17 per standard deviation in test scores and a return of r=0.08 per year of schooling. Bootstrapped standard errors in parentheses with 1,000 replications. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A7: Five-State Measure: Alternative Numbers of Top and Bottom States

	Total knowledge capital	Test scores	Years of schooling
Five-state measure	0.306	0.186	0.120
Three-state measure	0.307	0.170	0.137
Seven-state measure	0.261	0.164	0.097

Notes: Development accounting results (five-state measure) for 47 U.S. states with different numbers of countries used at the top and bottom of the state distribution. Test score specification adjusts locals and interstate migrants by age-education category based on extrapolation of NAEP trends by education category and international migrants by selectivity. Test scores refer to eighth-grade math. Calculations assume a return of w=0.17 per standard deviation in test scores and a return of r=0.08 per year of schooling.

Table A8: Growth Accounting by State, 1970-2007

	Average annual growth rate of real GDP per capita (percent)	Absolute change in years of schooling	Estimated annual change in test scores	Average annual growth rate accounted for by			Percent of total growth		
				Total knowledge capital	Test scores	Years of schooling	Total knowledge capital	Test scores	Years of schooling
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Alabama	2.35	2.65	2.77	0.70	0.31	0.38	29.6	13.4	16.3
Arizona	2.03	1.60	2.71	0.54	0.31	0.23	26.5	15.1	11.4
Arkansas	2.39	2.50	2.85	0.68	0.32	0.36	28.5	13.5	15.0
California	2.14	1.01	2.22	0.40	0.25	0.15	18.5	11.8	6.8
Colorado	2.58	1.57	3.38	0.61	0.38	0.23	23.6	14.8	8.8
Connecticut	2.79	2.25	2.77	0.64	0.31	0.32	22.9	11.3	11.6
Florida	2.16	1.98	3.93	0.73	0.45	0.29	33.9	20.6	13.2
Georgia	2.44	2.66	2.90	0.71	0.33	0.38	29.2	13.5	15.7
Hawaii	1.63	1.96	3.28	0.65	0.37	0.28	40.2	22.9	17.4
Idaho	2.02	1.53	2.08	0.46	0.24	0.22	22.6	11.7	10.9
Illinois	2.03	2.03	3.36	0.67	0.38	0.29	33.1	18.7	14.4
Indiana	2.01	1.85	3.28	0.64	0.37	0.27	31.8	18.5	13.3
Iowa	2.32	1.64	1.17	0.37	0.13	0.24	15.9	5.7	10.2
Kansas	2.43	1.63	3.10	0.59	0.35	0.23	24.1	14.4	9.6
Kentucky	1.86	2.62	3.64	0.79	0.41	0.38	42.6	22.2	20.3
Louisiana	2.41	2.33	4.30	0.82	0.49	0.34	34.2	20.3	14.0
Maine	2.20	2.20	1.63	0.50	0.18	0.32	22.8	8.4	14.4
Maryland	2.41	2.32	3.94	0.78	0.45	0.33	32.5	18.6	13.9
Massachusetts	2.56	2.21	5.47	0.94	0.62	0.32	36.7	24.2	12.5
Michigan	1.56	1.97	2.74	0.59	0.31	0.28	38.1	19.9	18.2
Minnesota	2.37	1.96	2.88	0.61	0.33	0.28	25.6	13.7	11.9
Mississippi	2.36	2.46	5.16	0.94	0.58	0.35	39.7	24.8	15.0
Missouri	1.89	2.10	2.56	0.59	0.29	0.30	31.3	15.3	16.0
Montana	2.10	1.68	1.42	0.40	0.16	0.24	19.2	7.7	11.5
Nebraska	2.42	1.67	1.54	0.42	0.17	0.24	17.1	7.2	10.0
Nevada	1.69	0.78	3.12	0.47	0.35	0.11	27.6	21.0	6.7
New Hampshire	2.56	2.16	2.85	0.64	0.32	0.31	24.8	12.6	12.2
New Jersey	2.41	2.25	3.41	0.71	0.39	0.32	29.5	16.1	13.5

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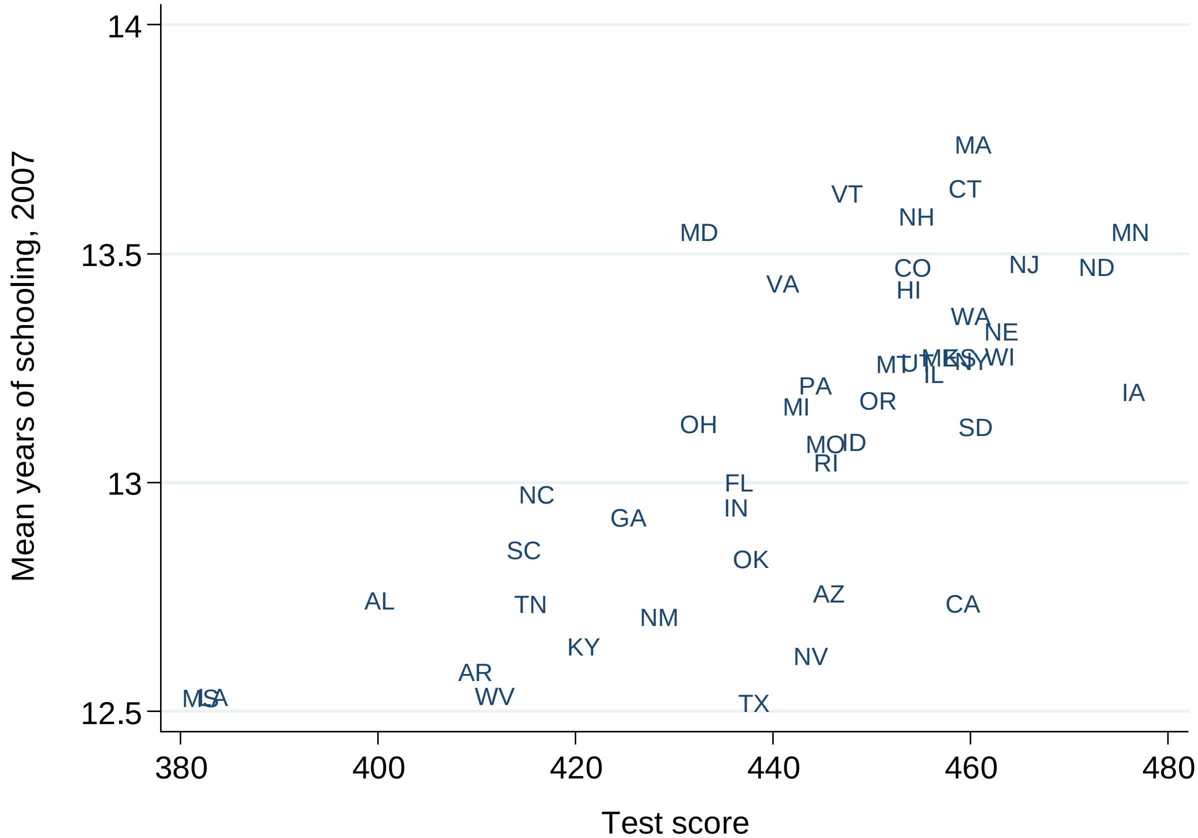
Table A8 (continued)

	Average annual growth rate of real GDP per capita (percent)	Absolute change in years of schooling	Estimated annual change in test scores	Average annual growth rate accounted for by			Percent of total growth		
				Total know-ledge capital	Test scores	Years of schooling	Total know-ledge capital	Test scores	Years of schooling
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
New Mexico	2.01	1.71	1.86	0.46	0.21	0.25	22.7	10.5	12.3
New York	2.12	2.05	3.49	0.69	0.40	0.30	32.6	18.7	13.9
North Carolina	2.30	2.76	6.06	1.08	0.69	0.40	47.2	29.9	17.3
North Dakota	2.86	2.38	1.46	0.51	0.17	0.34	17.7	5.8	12.0
Ohio	1.80	1.92	3.86	0.71	0.44	0.28	39.7	24.3	15.4
Oklahoma	2.26	1.71	1.93	0.47	0.22	0.25	20.6	9.7	10.9
Oregon	2.31	1.58	2.13	0.47	0.24	0.23	20.3	10.4	9.8
Pennsylvania	2.04	2.20	3.24	0.68	0.37	0.32	33.5	18.0	15.5
Rhode Island	2.32	2.19	2.67	0.62	0.30	0.32	26.6	13.1	13.6
South Carolina	2.30	2.86	5.35	1.02	0.61	0.41	44.2	26.4	17.9
South Dakota	2.89	1.89	2.94	0.61	0.33	0.27	20.9	11.5	9.4
Tennessee	2.29	2.52	3.59	0.77	0.41	0.36	33.7	17.8	15.9
Texas	2.48	1.85	4.43	0.77	0.50	0.27	30.9	20.2	10.7
Utah	2.41	1.22	1.93	0.39	0.22	0.18	16.4	9.1	7.3
Vermont	2.00	2.19	4.02	0.77	0.46	0.32	38.5	22.8	15.8
Virginia	2.69	2.66	3.74	0.81	0.42	0.38	30.0	15.8	14.3
Washington	2.24	1.48	6.77	0.98	0.77	0.21	43.8	34.3	9.5
West Virginia	1.67	2.33	2.88	0.66	0.33	0.34	39.6	19.5	20.1
Wisconsin	2.17	1.94	2.26	0.54	0.26	0.28	24.7	11.8	12.9

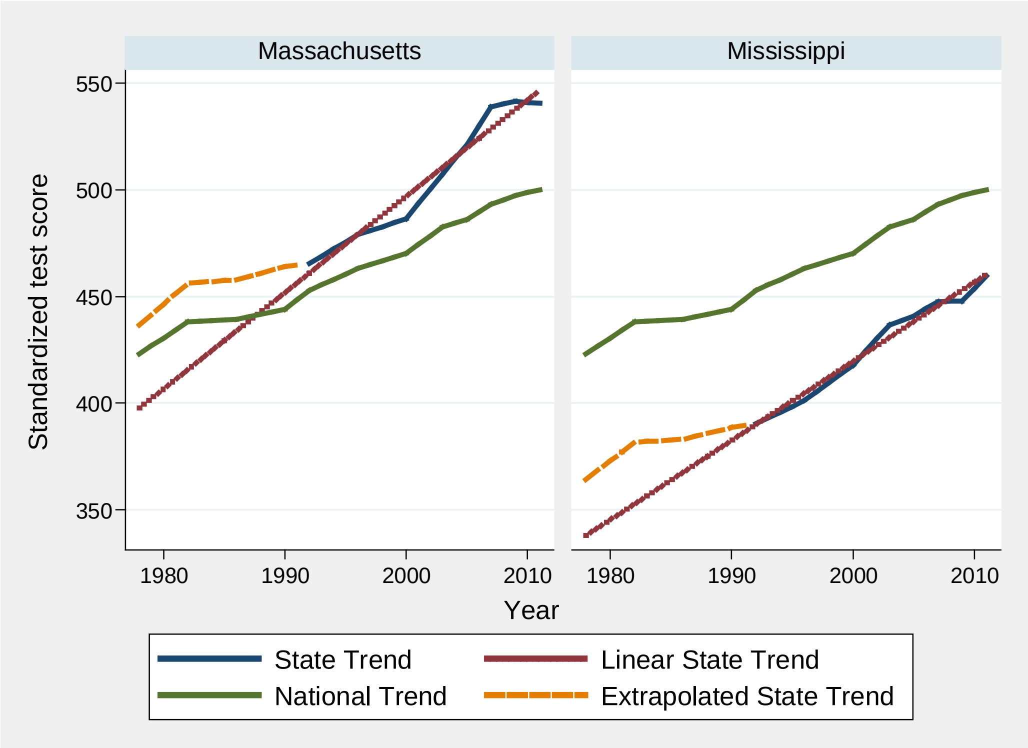
Notes: Estimated annual change in test scores: in percent of a standard deviation, obtained from a regression of test scores (NAEP scores projected based on participation-corrected SAT scores as derived in section 2.3.4) on years for each state, 1968-2011.

Figure A1: Cognitive Skills and Years of Schooling across U.S. States, 2007



Notes: Scatterplot of cognitive skill measure (adjusted for selective interstate and for international migration by selectivity) and average years of schooling of the working-age population across U.S. states, 2007. Source: Authors' calculations based on data from Ruggles et al. (2010) and National Center for Education Statistics (2014).

Figure A2: Projection of Test Scores for Massachusetts and Mississippi



Notes: NAEP test score in eighth-grade math. Source: Authors' calculations based on data from National Center for Education Statistics (2014).