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# Protestantism and Education: Reading (the Bible) and other Skills

## Abstract

During industrialization, Protestants were more literate than Catholics. This paper investigates whether this fact may be led back to the intrinsic motivation of Protestants to read the bible and whether other education motives were involved as well. We employ a historical data set from Switzerland which allows us to differentiate between different cognitive skills: reading, numeracy, essay writing and Swiss history. We develop an estimation strategy to examine whether the impact of religious denomination was particularly large with respect to reading capabilities. We find support for this hypothesis. However, Protestants' education motives went beyond reading the bible.

JEL-Code: I200.

Keywords: cognitive skills, education, reading capability, religious denomination, protestant reformation.

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# 1 Introduction

Recent research motivated by Max Weber (1905), who hypothesized that Protestants' work ethic is conducive to faster economic development, has delivered interesting novel insights. For instance, Becker and Woessmann (2009) argue that Protestant regions in late 19th century Prussia grew faster than Catholic areas due to higher literacy rates among Protestants. They provide evidence for pre-industrialization Prussia (the year 1816) that both the density of primary schools and primary school enrollment were higher in Protestant regions.<sup>1</sup> In a similar vein, Boppert et al. (2010) investigated for Switzerland the role of religion - in interaction with other sociocultural factors - on per pupil school expenditure and educational performance and show that - on average - Protestant regions were associated with higher school expenditure as well as higher educational performance.

This paper attempts to identify the educational motives of Protestants. Was there a particular emphasis of Protestants for reading capabilities, possibly to read the bible? Or were Protestants also better skilled in other fields like mathematics? Had they been motivated to develop cognitive skills in general, for instance, in order to achieve material well-being? Distinguishing several dimensions of cognitive skills is critical to answer these questions. The answers are potentially important to understand the fundamental sources of differential regional economic development. For instance, if Protestants reveal higher educational efforts not just in reading, but also in other fields, then in line with Weberian thoughts, we have indications that Protestants saw education also as being instrumental to economic success.

We employ a unique dataset from the second half of 19th century Switzerland (Woitek and Wüthrich, 2010), which allows to measure cognitive skills by conscripts' marks in the pedagogical examinations on reading, essay writing, numeracy and Swiss history. The pedagogical examinations were based on standardized tests and covered the whole male population. The data set enables us to examine in which education fields there are

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<sup>1</sup>This rules out that the emphasis on schools of Protestant regions were not merely a response to higher demand for human capital during industrialization. Rather, it may have been a result of the reformation process itself, which in Germany has been led by Martin Luther. According to Painter (1886, p. 147): "Though no complete system of popular instruction was established, the foundation for it was laid. To this great result Luther contributed more than any other man of his time; and this fact makes him the leading educational reformer of the sixteenth century."

differences in test scores between Protestant and Catholic districts and whether possible differences are more pronounced with respect to reading capabilities than for the other three fields covered by the tests. If the hypothesis is correct that bible reading was an important motivation for Protestants to acquire education, the comparatively high emphasis of Protestants on reading capabilities should materialize in high test scores for reading, relative to, say, mathematics. To our best knowledge, this is the first study of skill-specific effects of religion.

For identifying such a "Protestant reading bias" we propose a simple model of individual (effort) investment for developing different kinds of cognitive skills. The theoretical considerations provide us with a structural approach where we estimate the impact of Protestantism on reading skills while controlling for other cognitive skills, like math capability. We employ analogously to Becker and Woessmann (2009, 2010) an instrumentation strategy which relates religious denomination in a district to its distance to the centers of Protestantism in Switzerland (Zurich and Geneva) while at the same time ruling out that distance to bigger cities in general has an important direct effect on cognitive skills. Our evidence suggests that Protestants were indeed particularly motivated to develop reading skills relative to other cognitive skills. However, beyond that there is also a general Protestant bias toward education.

Studying within-country variation of cognitive skills in Switzerland at the time of industrialization is particularly appropriate for our purpose. First, Switzerland had little regional differences in institutions, typically hard to control for in cross-country studies. Second, the Reformation process in the first half of 16th century spread directly from Prussia to Switzerland. The first main reformer in the Old Confederation was Ulrich Zwingli. Zwingli began to preach ideas of reforming the Catholic church after becoming in 1519 pastor at one of the major churches in Zurich (the Grossmünster), shortly after Martin Luther published his 95 theses (October 1517). The city of Zurich converted to Protestantism in 1523, followed by the rural areas in Zurich and then by the cities of St. Gall, Schaffhausen, Basel, Bienne, Mulhouse, Berne, and Geneva (in 1536). Since 1541 the French theologian John Calvin (Jean Cauvin) gradually implemented a close connection between state and church in Geneva until his death in 1564. His predestination doctrine

was the main basis for the Weberian idea of a Protestant work ethic. It holds that Protestants are particularly motivated by material well-being in order to receive a signal of God to be chosen for salvation.

The Calvinist doctrine raises the question whether higher literacy of Protestants was merely a by-product of their motive to read the bible or if education was also perceived as instrumental for economic success. We not only find that there was a Protestant reading bias but also were Protestants better skilled in all other educational fields in our data set. These results cast severe doubt on a pure bible-reading motive of Protestants' education. Our analysis rather suggests that Protestants were also motivated, and more so than Catholics, to invest in other types of education, for instance, for economic reasons. In fact, at the end of the paper we discuss that the main reformers Luther, Zwingli and Calvin themselves had much broader educational goals than enabling the masses to read the bible.

The paper is structured as follows. Section 2 outlines a simple theoretical model from which we develop the estimation strategy. Section 3 describes the data. Empirical results are presented in section 4. Section 5 concludes and shows that the intentions of the main reformers in Switzerland and Prussia with respect to education in the 16th century went beyond reading the bible.

## 2 A Simple Model

Consider a representative individual in a district. Denote cognitive skill in reading and math by  $R$  and  $M$ , respectively. Suppose  $R$  and  $M$  are functions  $f_R$  and  $f_M$  of "effort",  $e_R$  and  $e_M$ , invested in the respective type of education. Other variables which affect educational outcomes are summarized in vector  $\mathbf{x}$ . Let  $f_R$  and  $f_M$  be given by the following linear functions:

$$R = f_R(e_R, \mathbf{x}) = a_0 + a_1 e_R + \mathbf{x}' \mathbf{a}_x, \quad a_1 > 0, \quad (1)$$

$$M = f_M(e_M, \mathbf{x}) = b_0 + b_1 e_M + \mathbf{x}' \mathbf{b}_x, \quad b_1 > 0. \quad (2)$$

Suppose the individual has preferences for both consumption ( $c$ ) and cognitive skills ( $R, M$ ), i.e., values education per se. Moreover, suppose that religious denomination affects preferences (e.g., the marginal rate of substitution between consumption and cognitive skills and/or between different cognitive skills). Let  $P$  indicate whether the individual is a Protestant ( $P = 1$ ) or not ( $P = 0$ ). Preferences are represented by the utility function  $u(c, R, M; P)$ .

Disposable income and thus consumption level  $c$  is given by a function  $F$  which may positively depend on cognitive skills ( $R, M$ ) and is decreasing in total effort invested in education,  $e = e_R + e_M$ :

$$c = F(R, M, e). \quad (3)$$

For instance, more effort allocated to education reduces the time spent to work.

Optimal effort provision towards skills ( $R, M$ ) is given by

$$(e_R^*(\mathbf{x}; P), e_M^*(\mathbf{x}; P)) \equiv \arg \max_{(e_R, e_M)} u(F(f_R(e_R, \mathbf{x}), f_M(e_M, \mathbf{x}), e_R + e_M), f_R(e_R, \mathbf{x}), f_M(e_M, \mathbf{x}); P). \quad (4)$$

Inserting a co-linear approximation of function  $e_R^*$  for reading effort  $e_R$  in (1) we obtain

$$R = \alpha_0 + \alpha_1 P + \mathbf{x}' \boldsymbol{\alpha}_x. \quad (5)$$

Similarly for math. This suggests to regress measures for different cognitive skills separately on a measure for Protestantism and other controls.

The approach in (5) does not allow us, however, to compare the effects of religious denomination on different cognitive skills, like reading vs. math skills. This is because both kinds of skills are likely to be highly related to each other and differently distributed. In order to be able to identify whether Protestants were particularly motivated to develop reading skills vis-à-vis math skills (or others), we divide optimization problem (4) in two parts, finding first the optimal allocation between  $e_R$  and  $e_M$  for given total effort  $e$  and then, secondly, choosing the optimal level  $e$ . We will focus on the optimal choice in the first part to examine whether there is a "Protestant reading bias". Optimal effort choice

for given  $e$  reads

$$(\tilde{e}_R(e, \mathbf{x}; P), \tilde{e}_M(e, \mathbf{x}; P)) \equiv$$

$$\arg \max_{(e_R, e_M)} u(F(f_R(e_R, \mathbf{x}), f_M(e_M, \mathbf{x}), e), f_R(e_R, \mathbf{x}), f_M(e_M, \mathbf{x}); P) \text{ s.t. } e_R + e_M = e. \quad (6)$$

Suppose function  $\tilde{e}_M$  can be inverted such that we can write  $e = E(e_M, \mathbf{x}; P)$ . We then obtain

$$e_R = e - e_M = E(e_M, \mathbf{x}; P) - e_M. \quad (7)$$

Let us also invert the function  $M = f_M(e_M, \mathbf{x})$  in (2) to obtain

$$e_M = \frac{M - b_0 - \mathbf{x}'\mathbf{b}_x}{b_1} \equiv g(M, \mathbf{x}). \quad (8)$$

When we plug  $e_M = g(M, \mathbf{x})$  into the right-hand side of (7) and the resulting expression for  $e_R$  into  $R = f_R(e_R, \mathbf{x})$  we get

$$R = f_R(E(g(M, \mathbf{x}), \mathbf{x}; P) - g(M, \mathbf{x}), \mathbf{x}) \equiv \tilde{R}(M, P, \mathbf{x}). \quad (9)$$

For instance, consider a linear approximation of  $\tilde{e}_M$ :

$$\tilde{e}_M(e, \mathbf{x}; P) \simeq \gamma_0 + \gamma_1 e + \mathbf{x}'\boldsymbol{\gamma}_x - \theta P, \text{ i.e., } e = E(e_M, \mathbf{x}; P) = \frac{e_M - \gamma_0 - \mathbf{x}'\boldsymbol{\gamma}_x + \theta P}{\gamma_1}. \quad (10)$$

Note that, plausibly,  $\gamma_1 \in (0, 1)$ , which means that a marginal increase in total effort  $e$  raises both  $\tilde{e}_R$  and  $\tilde{e}_M$ . Moreover, and importantly, if Protestantism affects the educational effort structure  $(e_R, e_M)$  towards reading, then  $\theta > 0$ .

Using (8) and (10) in (7) and (1) we find that

$$R = \tilde{R}(M, P, \mathbf{x}) = \beta_0 + \beta_1 P + \beta_2 M + \mathbf{x}'\boldsymbol{\beta}_x, \text{ with } \beta_1 \equiv \frac{a_1 \theta}{\gamma_1}, \beta_2 \equiv \frac{a_1(1 - \gamma_1)}{b_1 \gamma_1}. \quad (11)$$

We run this type of regression to examine a possible Protestant reading bias.<sup>2</sup> Recall that

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<sup>2</sup>As the linear approximation of function  $\tilde{e}_M$  in (10) may be too crude, we also allow, in robustness checks, for an additional term  $\beta_3 P \times M$  on the right-hand side of (11) when examining the effects of Protestantism and math performance on reading performance. Results can be found in a web-appendix. They suggest that the effect of Protestantism remains stable, although  $\beta_3$  sometimes enters significantly. In principle, there may also be a non-linear effect of Protestantism on reading performance. However,

effort raises cognitive skills,  $a_1, b_1 > 0$ , and that  $\gamma_1 \in (0, 1)$ . Thus, if  $\beta_1 > 0$ , we conclude that there is an effort bias of Protestants towards reading ( $\theta > 0$ ). Moreover, we expect  $\beta_2 > 0$ .<sup>3</sup>

### 3 Data and Identification

This section describes the data employed in our empirical analysis and discusses identification issues. Data sources are provided in a web-appendix.

#### 3.1 Cognitive Skills and Some Statistics

The fraction of Protestants in a district is our main independent variable of interest (*Protestants*). Cognitive skills are measured by the results of pedagogical examinations of conscripts in the military service. The tests were compulsory for every male citizen. They were explicitly introduced by the federal state to survey the efficiency of school systems, with high priority given to comparability of results. We use three five-year averages of test scores for the periods 1875-79, 1885-89 and 1899-1903 in panel regressions with time fixed effects. There were standardized test in four subjects: reading, essay-writing, mathematics (written and oral) as well as knowledge of Swiss history and constitution. In the first five years (1875 to 1879), the grades ranged from 1 (very good) to 4 (poor), and thereafter from 1 to 5. We use the fraction of conscripts with the best grades (1-2) in the four subjects and the fraction of pupils with insufficient grades (4-5) as measures for four kinds of cognitive skills in a district.<sup>4</sup>

Reading capability,  $R$ , is measured in two ways: by the fraction of the best conscripts (*Best Reading*) and by the fraction who failed (*Failed Reading*). Similar measures apply

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since our measure for  $P$ , the share of Protestants in a district, is concentrated on zero and one, we cannot allow for such a non-linear effect due to multicollinearity. For instance, the correlation coefficient between the fraction of Protestants and its squared value is 0.982.

<sup>3</sup>The coefficients  $\beta_0$  and  $\beta_x$  are unimportant and we have no prediction. They are given by  $\beta_0 \equiv a_0 - \frac{a_1 b_0 (1 - \gamma_1)}{b_1 \gamma_1} - \frac{a_1 \gamma_0}{\gamma_1}$ ,  $\beta_x \equiv \left( \mathbf{a}_x - \frac{a_1 (1 - \gamma_1) \mathbf{b}_x}{b_1 \gamma_1} - \frac{\gamma_x}{\gamma_1} \right)$ .

<sup>4</sup>Conscripts had incentive to do well. Those with grade 4-5 in more than one subject had to take repetition courses during military service. It was also common that names and grades were published in local newspapers.



to math,  $M$ , and the other two fields, essay writing and history. Tab. 1 provides summary statistics for the pooled sample (all three time periods) of the educational performance measures and the share of Protestants. The variation in the data is remarkable. The fractions of both high-performers and low-performers in an education field range from below 5 percent to above 50 percent, even up to 86 percent. Among the best grades, the highest average and the widest variability is with respect to reading capability (*Best Reading*), with a mean fraction of high-performers equal to 40.3 percent and a standard deviation of 14.3 percent. On average, 11.5 percent of conscripts failed the reading test (*Failed Reading*). The districts where the failure rate in reading was particularly high were all Catholic.<sup>5</sup> When all educational fields are combined, the mean fraction of high-performers is 28.3 percent and that of low-performers is 21.3 percent, with standard deviation of 10.6 and 15.5 percent, respectively.

The mean fraction of Protestants averaged over all districts was 56.4 percent. However, the distribution of the share of Protestants in the data is bipolar, with peaks close to zero and one. This is reflected in the very high standard deviation of 0.41.

Tab. 2 provides correlation coefficients between the fractions of high- and low-performers in reading and math on the one hand and between cognitive skills in a district and the share of Protestants on the other hand. One sees that Protestants do better in all fields. They have more high-performers and less low-performers, with correlation coefficients between religion and skills of magnitudes between 0.22 and 0.30. The share of low-performers in reading is very strongly (albeit far from perfectly) correlated with the share of low-performers in math; an analogous pattern holds for high-performers. Moreover, also not surprisingly, the share of high-performers is negatively correlated with the share of low-performers in and across fields.

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<sup>5</sup>For instance, in the year 1870, the failure rates in reading tests ranged between 50 and 76 percent in the districts Gersau and March (canton of Schwyz), Riviera (Ticino), and Goms, Raron and Visp (Valais), in all of which the fraction of Catholics was above 97 percent.

Table 1: Summary statistics

Variable	Mean	S. D.	Min.	Max.
Best Reading	.4029031	.1432474	.0427046	.8618654
Best Essay	.2468622	.1044783	.0200803	.7508855
Best Math	.2994142	.1167105	.0462633	.7260921
Best History	.1820285	.0859801	.0167598	.5301062
Failed Reading	.1151478	.1193597	0	.5589623
Failed Essay	.2146129	.1731524	.007874	.759434
Failed Math	.1882927	.136435	.011811	.6556604
Failed History	.333545	.2156219	.0145631	.8564669
Protestants	.5635065	.4124564	0	.9993389
Best Grade (all topics)	.282802	.1056755	.0453737	.7172373
Failed (all topics)	.2128996	.1553381	.0133495	.6963444

**Notes:** Summary statistics of the pooled sample.

Table 2: Correlation

Variable	Protestants	Best Reading	Best Math	Failed Reading	Failed Math
Protestants	1.0000				
Best Reading	0.2797*	1.0000			
Best Math	0.2964*	0.8419*	1.0000		
Failed Reading	-0.2297*	-0.5811*	-0.4702*	1.0000	
Failed Math	-0.2243*	-0.5557*	-0.5998*	0.8961*	1.0000

**Notes:** \* significant at the one percentage level.

## 3.2 Other Controls

We control for the economic, geographical and sociocultural environment of a district by a large set of controls suggested in the literature.<sup>6</sup> The stage of economic development is captured by the proportion of population employed in the primary sector (*Primary*) and by population density in logs (*Density*). Thereby, we address the potential concern that our results are driven by a different demand for education in Protestant and Catholic districts. We also control for the altitude above sea level in logs of the main town of a district (*Altitude*) as a measure of a district's remoteness. Moreover, we include dummy variables for the majority language in a district (*French, Italian, Romanic*, i.e., German language is the omitted category), since language may be related to religion and may affect attitudes towards schooling. Finally, we account for the ratio of children (below 16 years old) to total population (*Children*). We want to rule out that our results are driven by a correlation between religious denomination and fertility, with the number of children being negatively related to their skills (labelled "quality-quantity trade-off" in fertility choice models). For instance, it could be the case that Catholics have more children and therefore put less emphasis on education.

In some regressions we also employ various measures of primary school inputs at the district level, which have been suggested by the literature on educational production. This helps us to examine whether possible effects of religious denomination work through regional differences in school organization and public school finance. The data were collected for a prize-winning contribution to the World Exhibition in Vienna in 1873 and follow-ups in National Exhibitions. School inputs are aggregated by districts. They cover the years 1871/72 (156 observations), 1881/82 (168 observations) and 1894/95 (169 observations). We allow school inputs in 1871/72 to affect results of the pedagogical examinations in the period 1875-79, and inputs in 1881/82 and 1894/95 to affect outcomes in 1885-89 and 1899-1903, respectively. We use total annual real public school expenditure per pupil in logs (*Expenditure*), the real capital stock per pupil in logs (*Capital*), the pupil-teacher ratio (*Class Size*), and the number of school weeks (*Weeks*). Moreover, we control for the number of school days per year a pupil is absent from school in logs (*Absenteeism*).

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<sup>6</sup>For a more detailed description of the control variables, see Boppart et al. (2010).

This measure can be interpreted as a measure for the degree of utilization of the supply of school services. We also account for characteristics of teachers: the fraction of clerical teachers which either belongs to a religious order or works in a parish (*Clerics*), the fraction of teachers who do not possess vocational education from university, teacher training seminars or grammar schools (*Poor Training*), the fraction of teachers older than 40 years (*Age*), the fraction of teachers with more than 20 years of service (*Length of Service*), and the fraction of female teachers (*Female*).

### 3.3 Identification Strategy

We address the concern that OLS estimates (with time fixed effects) of the impact of Protestantism on cognitive skills may not represent causal effects. For instance, when we run regression (5) it could be possible that (average) unobserved ability to acquire education in a district determined, at the time of Reformation, whether a district became Protestant or remained Roman Catholic and then ability was transmitted from generation to generation. In this case, the coefficient on religion would be biased in an OLS estimation. As argued in Boppart et al. (2010), the Reformation process in Switzerland could be viewed as a truly exogenous event. Furthermore, with regard to regression (11) endogeneity seems to be less of a concern.  $\beta_1$  would be biased if Protestantism is correlated with an unobserved variable which affects the reading bias. We control in our estimations for many socio-cultural characteristics as well as for school inputs and absenteeism. Hence, such an unobserved variable is not easy to think of.

Nevertheless, we follow an instrumental variable strategy which is similar in spirit to Becker and Woessmann (2009) for Prussia (who used the distance to Wittenberg as instrument for Protestantism). In Switzerland the Reformation began in the city of Zurich under church leader Zwingli and then spread to the canton of Zurich before reaching other cities. In the Francophone part, after Geneva adopted Protestantism, the influential figure was Calvin who made Protestantism popular in the West of Switzerland. We therefore take the shorter (log) distance of the main town of a district to one of the two cities Zurich and Geneva as instrument for the share of Protestants in a district. The distances are calculated using historical sources to be able to measure the actual length of routes

between the main town of a district and Zurich/Geneva.

With regard to regression (5), one potential problem with instrumenting Protestantism in that way could be that ability was generally more concentrated closer to cities. In this case the identifying assumption, that the distance to Zurich/Geneva is uncorrelated with unobserved variables which affect human capital formation, would be violated. To address the concern that there is such a "city-bias" we additionally control for the (shortest) log distance to one of the six big cities (Zurich, Geneva, St. Gallen, Basel, Berne, Lucerne) in the IV regressions. Then, the identifying assumption is fulfilled as long as unobserved characteristics (as ability) are uncorrelated to the distance to Zurich and Geneva for given proximity to the next big city, population density and altitude. We provide first stage results for our IV estimates in appendix.

## 4 Empirical Results

We first present the estimation results for all four fields separated (regression (5)), before coming to the question if there was a Protestant reading bias (regression (11)).

### 4.1 Protestantism and Different Skills

In this subsection we show the results from regressing our measures for cognitive skills in reading, numeracy, essay writing and history separately on the share of Protestants and other controls. We allow for time fixed effects to take into account the panel data structure. Tab. 3 presents the regression results when the share of high-performers in one of the four subjects is the dependent variable. We control for the stage of development (*Primary*, *Density*), geography (*Log Altitude*), family structure (*Children*) and majority language.

In all non-IV estimations (columns (1)-(4)), the effect of Protestantism is significant at the one percent level. Column (1) shows that, on average, a fully Protestant district has a 10.6 percentage points higher fraction of high-performers in reading than a fully Catholic district (coefficient  $\alpha_1$  in equation (5)). The effects on math and essay writing skills are somewhat lower, the one on history much lower. The ranking of the sizes of effects corresponds to the average share of high-performers (highest in reading and lowest

Table 3: Effect of Protestantism on the share with best grade

	Reading	Essay	Math	History	Reading	Essay	Math	History
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Protestants	0.106*** (0.013)	0.079*** (0.010)	0.091*** (0.013)	0.037*** (0.010)	0.182*** (0.068)	0.111** (0.046)	0.192*** (0.070)	0.093* (0.049)
Children	-1.465*** (0.154)	-1.201*** (0.137)	-1.403*** (0.158)	-1.046*** (0.124)	-1.593*** (0.299)	-1.159*** (0.190)	-1.711*** (0.314)	-1.163*** (0.205)
Primary	-0.231*** (0.070)	-0.241*** (0.058)	-0.063 (0.073)	-0.118** (0.053)	-0.177** (0.083)	-0.225*** (0.065)	0.004 (0.085)	-0.085 (0.063)
Romanic	0.001 (0.028)	0.015 (0.019)	0.002 (0.030)	-0.029 (0.020)	-0.019 (0.027)	-0.011 (0.019)	-0.029 (0.026)	-0.058*** (0.021)
Italian	0.051** (0.024)	0.051*** (0.018)	-0.022 (0.020)	-0.036** (0.015)	0.084** (0.037)	0.042 (0.026)	0.006 (0.035)	-0.041 (0.027)
French	-0.023** (0.010)	-0.003 (0.008)	0.004 (0.011)	0.004 (0.009)	-0.019 (0.013)	-0.004 (0.010)	0.004 (0.013)	0.001 (0.010)
Log Altitude	-0.030 (0.020)	-0.005 (0.018)	-0.013 (0.019)	-0.010 (0.019)	-0.049** (0.023)	-0.033** (0.016)	-0.042** (0.020)	-0.044*** (0.015)
Log Density	0.027*** (0.007)	0.026*** (0.007)	0.017** (0.008)	0.011 (0.007)	0.005 (0.014)	0.009 (0.009)	-0.005 (0.014)	-0.006 (0.010)
Log Next City					-0.009 (0.010)	0.010 (0.007)	-0.001 (0.011)	0.011 (0.008)
Obs.	493	493	493	493	475	475	475	475
R <sup>2</sup>	0.673	0.687	0.581	0.567	0.602	0.622	0.451	0.485
IV	no	no	no	no	yes	yes	yes	yes

**Notes:** Clustered standard errors in parenthesis. \*\*\* significant at, or below, 1 percent, \*\* significant at, or below, 5 percent, \* significant at, or below, 10 percent.

in history; see Tab. 1) and it is not possible to identify a motivational bias towards certain skills from these results. Columns (5)-(8) show IV-results for the same regression equations. As typically the case with instrumentation, standard errors increase such that the coefficient on Protestantism sometimes becomes less significant. However, the magnitudes of the Protestant impact even increase substantially.

Examining how Protestantism affects the fraction of low-performers gives rise to similar conclusions. According to Tab. 4, Protestantism is clearly associated with lower failure rates in all four fields, reducing them by almost 10 percentage points in the non-IV estimates. In the IV regressions, again, not only standard errors but also estimated coefficients on Protestantism increase substantially, such that significance levels remain at the one percent level.

Regarding other control variables, all regressions show that the fraction of children in a district has a highly significant and negative effect on cognitive skills, consistent with the well-known notion of a quality-quantity trade-off. A more advanced stage of development (lower agricultural labor share and higher population density) tends to positively affect the share of high-performers but has little effect on low-performers. Altitude tends to be adversely related to skills. The majority language often has no clear effect. However, reading and writing performance tends to be better when Italian is majority language.

In Tab. 3 and 4 we did not control for school inputs. Tab. 5 and 6 suggest that the main results remain fairly robust to the inclusion of inputs in public schools. Hence, a substantial part of the effect of Protestantism on educational performance seems to work through "effort", rather than school inputs and absenteeism. The sizes of effects of Protestantism drop somewhat in the IV estimations compared to Tab. 3 and 4, now being closer to the non-IV estimates. Higher school expenditure is significantly related to cognitive skills in non-IV estimates (except in history), but not in the IV regressions.<sup>7</sup> In contrast, higher class size significantly reduces cognitive skills in all four education fields, including in the IV regressions. Higher absenteeism from school enters in the expected fashion in all fields except in reading, where it has no effect. This indicates that learning

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<sup>7</sup>Given that we control for school capital, class size and teacher characteristics, the effect of school expenditure may best be interpreted as the effect of higher (unobserved) salary of teachers (see Boppart et al., 2010).

Table 4: Effect of Protestantism on the share failed

	Reading	Essay	Math	History	Reading	Essay	Math	History
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Protestants	-0.082*** (0.008)	-0.097*** (0.010)	-0.098*** (0.013)	-0.097*** (0.015)	-0.153*** (0.048)	-0.143*** (0.050)	-0.278*** (0.091)	-0.301*** (0.106)
Children	0.508*** (0.097)	0.634*** (0.122)	0.986*** (0.145)	1.238*** (0.170)	0.744*** (0.211)	0.755*** (0.224)	1.682*** (0.428)	1.983*** (0.481)
Primary	0.055 (0.048)	0.030 (0.060)	-0.072 (0.077)	-0.121 (0.094)	-0.001 (0.054)	-0.010 (0.064)	-0.197* (0.106)	-0.264** (0.125)
Romanic	-0.004 (0.014)	-0.002 (0.021)	-0.008 (0.022)	0.073** (0.029)	0.002 (0.022)	0.006 (0.028)	0.034 (0.040)	0.132*** (0.042)
Italian	-0.009 (0.017)	-0.041* (0.021)	0.035 (0.024)	0.101*** (0.023)	-0.056** (0.026)	-0.067** (0.030)	-0.040 (0.046)	0.037 (0.054)
French	0.017** (0.007)	0.010 (0.008)	0.005 (0.011)	-0.018 (0.015)	0.012 (0.008)	0.007 (0.009)	0.007 (0.015)	-0.012 (0.020)
Log Altitude	0.025** (0.012)	0.034** (0.015)	0.037** (0.017)	0.052** (0.022)	0.026 (0.016)	0.038** (0.017)	0.055* (0.028)	0.088** (0.034)
Log Density	-0.007* (0.004)	-0.015*** (0.005)	-0.010 (0.006)	-0.012 (0.007)	0.004 (0.010)	-0.006 (0.010)	0.017 (0.017)	0.022 (0.021)
Log Next City					0.018** (0.007)	0.009 (0.008)	0.017 (0.014)	0.006 (0.017)
Obs.	493	493	493	493	475	475	475	475
R <sup>2</sup>	0.722	0.852	0.653	0.848	0.688	0.847	0.438	0.740
IV	no	no	no	no	yes	yes	yes	yes

**Notes:** Clustered standard errors in parenthesis. \*\*\* significant at, or below, 1 percent, \*\* significant at, or below, 5 percent, \* significant at, or below, 10 percent.



Table 5: Effect of Protestantism on the share with best grade

	Reading	Essay	Math	History	Reading	Essay	Math	History
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Protestants	0.097*** (0.014)	0.068*** (0.010)	0.093*** (0.013)	0.042*** (0.010)	0.169*** (0.064)	0.091** (0.043)	0.138** (0.067)	0.042 (0.046)
Children	-1.138*** (0.157)	-0.875*** (0.132)	-0.765*** (0.146)	-0.683*** (0.118)	-1.211*** (0.207)	-0.746*** (0.148)	-0.795*** (0.244)	-0.580*** (0.147)
Primary	-0.129* (0.073)	-0.216*** (0.057)	-0.032 (0.077)	-0.125** (0.053)	-0.098 (0.076)	-0.200*** (0.052)	-0.008 (0.077)	-0.110** (0.052)
Romanic	-0.026 (0.025)	-0.025 (0.020)	-0.040 (0.027)	-0.054** (0.021)	-0.047* (0.025)	-0.041** (0.019)	-0.052* (0.029)	-0.060*** (0.022)
Italian	0.064*** (0.023)	0.045** (0.018)	0.045** (0.020)	-0.021 (0.020)	0.100** (0.044)	0.050* (0.027)	0.064 (0.041)	-0.035 (0.031)
French	-0.033** (0.015)	-0.002 (0.011)	0.042*** (0.014)	0.018 (0.012)	-0.017 (0.020)	0.004 (0.013)	0.052*** (0.019)	0.017 (0.015)
Log Altitude	-0.009 (0.016)	0.001 (0.014)	0.009 (0.015)	0.002 (0.016)	-0.024 (0.023)	-0.020 (0.013)	-0.009 (0.019)	-0.019 (0.013)
Log Density	0.034*** (0.007)	0.030*** (0.006)	0.032*** (0.007)	0.018*** (0.007)	0.029*** (0.010)	0.016*** (0.006)	0.025*** (0.009)	0.008 (0.006)
Log Absenteeism	0.001 (0.008)	-0.019*** (0.006)	-0.025*** (0.007)	-0.031*** (0.006)	-0.002 (0.010)	-0.020*** (0.006)	-0.027*** (0.008)	-0.029*** (0.007)
Week	-0.001 (0.001)	-0.002** (0.001)	-0.001 (0.001)	-0.000 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	0.001 (0.001)
Class Size	-0.052** (0.021)	-0.038** (0.016)	-0.065*** (0.021)	-0.044*** (0.016)	-0.053** (0.024)	-0.033** (0.015)	-0.063*** (0.022)	-0.035** (0.016)
Capital	0.025** (0.010)	0.026*** (0.007)	0.026*** (0.008)	0.022*** (0.006)	0.024** (0.011)	0.026*** (0.007)	0.027*** (0.009)	0.023*** (0.006)
Poor Training	-0.022 (0.020)	0.005 (0.015)	-0.034 (0.022)	-0.024 (0.017)	-0.007 (0.023)	0.009 (0.017)	-0.027 (0.026)	-0.026 (0.019)
Female Teachers	-0.028 (0.038)	-0.005 (0.027)	-0.149*** (0.038)	-0.012 (0.030)	-0.082 (0.054)	-0.034 (0.035)	-0.179*** (0.050)	-0.017 (0.039)
Clerics	0.128*** (0.045)	0.019 (0.033)	0.179*** (0.047)	0.071* (0.038)	0.205*** (0.075)	0.037 (0.049)	0.216*** (0.072)	0.063 (0.058)
Length of Service	0.183** (0.082)	0.040 (0.055)	0.091 (0.076)	0.101* (0.054)	0.166 (0.102)	0.051 (0.062)	0.077 (0.091)	0.122* (0.062)
Age	-0.223*** (0.084)	-0.046 (0.053)	-0.127* (0.074)	-0.076 (0.053)	-0.244*** (0.089)	-0.084 (0.052)	-0.143* (0.076)	-0.111** (0.053)
Expenditure	0.048*** (0.016)	0.034*** (0.013)	0.032** (0.015)	0.010 (0.013)	0.022 (0.027)	0.024 (0.019)	0.010 (0.028)	0.004 (0.021)
Log Next City					-0.003 (0.011)	0.008 (0.007)	-0.000 (0.012)	0.013 (0.008)
Obs.	493	493	493	493	475	475	475	475
R <sup>2</sup>	0.716	0.740	0.658	0.636	0.663	0.694	0.621	0.617
IV	no	no	no	no	yes	yes	yes	yes

**Notes:** Clustered standard errors in parenthesis. \*\*\* significant at, or below, 1 percent, \*\* significant at, or below, 5 percent, \* significant at, or below, 10 percent.

Table 6: Effect of Protestantism on the share who failed

	Reading	Essay	Math	History	Reading	Essay	Math	History
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Protestants	-0.070*** (0.009)	-0.079*** (0.011)	-0.095*** (0.014)	-0.105*** (0.018)	-0.132*** (0.048)	-0.115** (0.050)	-0.197*** (0.075)	-0.209** (0.084)
Children	0.171 (0.105)	0.237** (0.115)	0.313** (0.151)	0.616*** (0.172)	0.324** (0.163)	0.272 (0.174)	0.590** (0.264)	0.848*** (0.293)
Primary	-0.024 (0.053)	-0.034 (0.062)	-0.082 (0.077)	-0.107 (0.094)	-0.053 (0.055)	-0.063 (0.062)	-0.123 (0.084)	-0.159 (0.105)
Romanic	0.007 (0.016)	0.033 (0.024)	0.015 (0.023)	0.094*** (0.029)	0.017 (0.025)	0.040 (0.030)	0.035 (0.037)	0.117*** (0.038)
Italian	-0.053** (0.021)	-0.051** (0.023)	-0.041* (0.023)	0.055** (0.026)	-0.093** (0.038)	-0.077** (0.037)	-0.096* (0.051)	0.010 (0.054)
French	0.006 (0.011)	0.016 (0.013)	-0.029* (0.015)	-0.045** (0.017)	-0.007 (0.015)	0.008 (0.015)	-0.049** (0.022)	-0.063** (0.025)
Log Altitude	-0.001 (0.012)	0.010 (0.014)	0.004 (0.016)	0.024 (0.017)	-0.000 (0.017)	0.009 (0.016)	0.014 (0.023)	0.049** (0.023)
Log Density	-0.014*** (0.005)	-0.019*** (0.006)	-0.020*** (0.007)	-0.021** (0.008)	-0.016*** (0.006)	-0.019*** (0.007)	-0.022** (0.009)	-0.017 (0.012)
Log Absenteeism	-0.005 (0.007)	0.007 (0.008)	0.029*** (0.009)	0.051*** (0.011)	-0.001 (0.008)	0.011 (0.009)	0.035*** (0.011)	0.055*** (0.013)
Week	0.000 (0.001)	-0.000 (0.001)	-0.001 (0.001)	-0.002* (0.001)	0.001 (0.001)	-0.000 (0.001)	-0.000 (0.001)	-0.002 (0.001)
Class Size	0.034** (0.015)	0.062*** (0.019)	0.073*** (0.021)	0.065*** (0.023)	0.039** (0.018)	0.063*** (0.021)	0.078*** (0.026)	0.067** (0.027)
Capital	-0.016** (0.008)	-0.026*** (0.008)	-0.017* (0.010)	-0.023** (0.011)	-0.017** (0.008)	-0.028*** (0.008)	-0.017 (0.011)	-0.024** (0.012)
Poor Training	-0.003 (0.019)	-0.007 (0.019)	0.107*** (0.028)	0.058** (0.027)	-0.017 (0.022)	-0.015 (0.022)	0.088** (0.035)	0.037 (0.034)
Female Teachers	0.085*** (0.031)	0.039 (0.036)	0.124*** (0.043)	0.045 (0.046)	0.120*** (0.046)	0.061 (0.050)	0.180*** (0.064)	0.101 (0.066)
Clerics	-0.123*** (0.036)	-0.049 (0.043)	-0.163*** (0.050)	-0.120** (0.055)	-0.188*** (0.057)	-0.086 (0.066)	-0.267*** (0.085)	-0.217** (0.091)
Length of Service	-0.251*** (0.076)	-0.169** (0.081)	-0.167* (0.090)	-0.210** (0.087)	-0.213** (0.087)	-0.154* (0.091)	-0.104 (0.111)	-0.156 (0.112)
Age	0.234*** (0.075)	0.161* (0.082)	0.186** (0.093)	0.176** (0.087)	0.219*** (0.079)	0.160* (0.084)	0.165* (0.099)	0.173* (0.095)
Expenditure	-0.032** (0.013)	-0.033** (0.014)	-0.033** (0.014)	-0.014 (0.017)	-0.013 (0.022)	-0.023 (0.022)	-0.001 (0.030)	0.026 (0.035)
Log Next City					0.011 (0.008)	0.006 (0.009)	0.013 (0.013)	0.006 (0.014)
Obs.	493	493	493	493	475	475	475	475
R <sup>2</sup>	0.760	0.874	0.714	0.874	0.745	0.876	0.669	0.858
IV	no	no	no	no	yes	yes	yes	yes

**Notes:** Clustered standard errors in parenthesis. \*\*\* significant at, or below, 1 percent, \*\* significant at, or below, 5 percent, \* significant at, or below, 10 percent.

effort at home, including that of parents, is particularly important to develop reading skills.

## 4.2 Protestant Reading Bias

Tab. 7 shows the results when regressing (11), i.e. the share of high-performers in reading on Protestantism and on the fraction of high-performers in math, essay writing and history, respectively, in order to identify whether there is a reading bias of Protestants vis-à-vis other skills. The results show that indeed,  $\beta_1 > 0$  (the coefficient on Protestantism) and as expected also  $\beta_2 > 0$  (the coefficient on skill different to reading) hold in an estimation of equation (11). Columns (1)-(3) are non-IV estimations where we hold the fraction of high-performers in math constant. The coefficients of interest ( $\beta_1, \beta_2$ ) seem to be quite robust to the inclusion of more control variables.

Column (3) suggests that a (purely) Protestant district has 3.1 percentage points more high-performers than a (purely) Catholic district ( $\beta_1 = 0.031$ ), given that both kinds of districts have the same fraction of high-performers in math. Column (4) provides IV estimates when all controls are included with again math skill held constant. Coefficient  $\beta_1$  more than doubles to 0.082, suggesting an even higher Protestant reading bias. Again, significance declines in the IV estimation, as standard errors are substantially enlarged by instrumentation. Moreover, as expected, math performance and reading performance are highly related ( $\beta_2 > 0$ ).

Columns (5)-(6) and (7)-(8) present analogous results when holding fixed the share of high-performers in essay writing and history, respectively, rather than in math. The Protestant reading bias is similar with a given fraction of high-performers in essay writing compared to columns (3) and (4). It is about twice as high when instead controlling for the fraction of high-performers in history. In this case, the Protestant reading bias not only increases in the IV regression but also stays significant at the one percent level. Column (8) suggests that a Protestant district has 14.2 percentage points more high-performers in reading than a Catholic district when holding constant the fraction of high-performers in history. The size of the effect is as high as about one standard deviation in the dependent variable (see Tab. 1).

Table 7: Dependent variable: share with best grade in reading

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Protestants	0.024** (0.010)	0.041*** (0.008)	0.031*** (0.009)	0.082* (0.045)	0.030*** (0.009)	0.084 (0.051)	0.067*** (0.010)	0.142*** (0.053)
Best Grade Math	0.896*** (0.044)	0.708*** (0.039)	0.713*** (0.045)	0.632*** (0.076)				
Best Grade Essay					0.987*** (0.054)	0.939*** (0.105)		
Best Grade History							0.710*** (0.069)	0.647*** (0.091)
Children		-0.471*** (0.108)	-0.593*** (0.107)	-0.708*** (0.165)	-0.274** (0.116)	-0.510** (0.200)	-0.653*** (0.138)	-0.836*** (0.203)
Primary		-0.187*** (0.044)	-0.106** (0.045)	-0.093** (0.047)	0.084 (0.052)	0.090 (0.059)	-0.040 (0.058)	-0.027 (0.063)
Romanic		-0.000 (0.012)	0.002 (0.014)	-0.014 (0.016)	-0.001 (0.013)	-0.008 (0.018)	0.012 (0.018)	-0.007 (0.022)
Italian		0.066*** (0.015)	0.032* (0.017)	0.060** (0.029)	0.020 (0.017)	0.053 (0.034)	0.079*** (0.023)	0.123*** (0.039)
French		-0.026*** (0.006)	-0.062*** (0.009)	-0.050*** (0.014)	-0.031*** (0.010)	-0.021 (0.014)	-0.045*** (0.012)	-0.028 (0.018)
Log Altitude		-0.021 (0.013)	-0.015 (0.013)	-0.019 (0.016)	-0.010 (0.013)	-0.006 (0.017)	-0.011 (0.017)	-0.012 (0.021)
Log Density		0.015*** (0.004)	0.011** (0.005)	0.013* (0.007)	0.004 (0.006)	0.014** (0.007)	0.021*** (0.007)	0.023*** (0.008)
Log Absenteeism			0.019*** (0.006)	0.015* (0.007)	0.020*** (0.006)	0.017** (0.008)	0.024*** (0.007)	0.016* (0.009)
Week			-0.001 (0.001)	-0.001 (0.001)	0.001 (0.001)	-0.000 (0.001)	-0.001 (0.001)	-0.002* (0.001)
Class Size			-0.005 (0.015)	-0.014 (0.018)	-0.014 (0.012)	-0.023 (0.016)	-0.021 (0.016)	-0.031 (0.020)
Capital			0.006 (0.007)	0.007 (0.008)	-0.001 (0.008)	-0.001 (0.009)	0.009 (0.009)	0.009 (0.010)
Poor Training			0.003 (0.020)	0.010 (0.019)	-0.027* (0.016)	-0.015 (0.018)	-0.005 (0.021)	0.010 (0.021)
Female Teachers			0.078*** (0.024)	0.031 (0.040)	-0.023 (0.026)	-0.050 (0.037)	-0.020 (0.033)	-0.071 (0.046)
Clerics			0.000 (0.032)	0.068 (0.060)	0.109*** (0.033)	0.170*** (0.052)	0.078** (0.039)	0.163** (0.068)
Length of Service			0.118* (0.060)	0.117* (0.070)	0.144** (0.056)	0.118* (0.067)	0.112 (0.068)	0.087 (0.081)
Age			-0.132** (0.061)	-0.153** (0.064)	-0.177*** (0.056)	-0.164*** (0.061)	-0.169** (0.071)	-0.172** (0.075)
Expenditure			0.025** (0.011)	0.016 (0.017)	0.014 (0.010)	0.000 (0.016)	0.041*** (0.012)	0.020 (0.020)
Log Next City				-0.003 (0.006)		-0.010 (0.007)		-0.011 (0.008)
Obs.	493	493	493	475	493	475	493	475
R <sup>2</sup>	0.745	0.812	0.832	0.802	0.851	0.825	0.782	0.737
IV	no	no	no	yes	no	yes	no	yes

**Notes:** Clustered standard errors in parenthesis. \*\*\* significant at, or below, 1 percent, \*\* significant at, or below, 5 percent, \* significant at, or below, 10 percent.

Tab. 8 presents the results for low-performers. It confirms the Protestant reading bias. Switching from a Catholic to a Protestant district reduces the fraction of low-performers by about 2 percentage points for a given fraction of low-performers in math (columns (3) and (4)). The coefficients of Protestantism are not significant in the IV estimates (columns (4), (6), (8)). However, again, their increased magnitudes suggest a higher Protestant reading bias than the non-IV estimates. The magnitude of  $\beta_1$  is generally smaller than for the high-performers in Tab. 8. This is understandable in the light of the low failure rates in reading tests. As seen in Tab. 1, on average, only 11.5 percent failed the test compared to a fraction of high-performers in reading of 40.2 percent.

Again, we also find that  $\beta_2 > 0$ . Moreover, both Tab. 7 and 8 show that there is also evidence for a positive "language reading bias" in Italian-speaking districts and often a negative one in Francophone districts (relative to German-speaking ones). But clearly, this could also reflect language specific difficulties of reading. Tab. 7 also suggests an adverse reading bias from more children. The fraction of children has no clear effect, however, on the share of low-performers in reading, holding other skills constant (Tab. 8). If anything, a higher stage of development produces a positive reading bias. Particularly, higher population density seems to improve reading skills when holding fixed other skills. Altitude does not matter. But teacher characteristics sometimes do. A higher fraction of teachers with more than 20 years of service generally improves reading skills for given other skills. The fraction of older teachers (above age 40), however, when holding fixed teachers' experience, seem to produce an opposite bias away from reading skills. Higher absenteeism, by contrast, gives rise to a positive reading bias. Again, consistent with Tab. 5 and 6, this suggests that participation in school is more important for other fields than reading. School capital does not seem to matter. Finally, if anything, public expenditure per pupil give rise to a rather weak reading bias. As average spending is higher in Protestant districts (see Boppart et al., 2010), this suggests that the Protestant reading bias mainly comes from effort choices of parents or children outside school, rather than reflecting the use of public expenditure for primary schools.

Table 8: Dependent variable: share failed in reading

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Protestants	-0.029*** (0.006)	-0.028*** (0.006)	-0.017** (0.008)	-0.025 (0.034)	-0.015** (0.008)	-0.061 (0.037)	-0.027*** (0.009)	-0.052 (0.041)
Failed Math	0.565*** (0.033)	0.554*** (0.033)	0.564*** (0.034)	0.547*** (0.058)				
Failed Essay					0.694*** (0.036)	0.619*** (0.073)		
Failed History							0.417*** (0.031)	0.385*** (0.063)
Children		-0.038 (0.067)	-0.005 (0.074)	0.001 (0.111)	0.006 (0.074)	0.156 (0.105)	-0.086 (0.090)	-0.003 (0.136)
Primary		0.095*** (0.031)	0.022 (0.036)	0.015 (0.036)	-0.000 (0.034)	-0.014 (0.037)	0.021 (0.043)	0.009 (0.042)
Romanic		-0.000 (0.009)	-0.001 (0.011)	-0.002 (0.013)	-0.016 (0.011)	-0.008 (0.014)	-0.032* (0.019)	-0.028 (0.022)
Italian		-0.029*** (0.011)	-0.030** (0.015)	-0.040 (0.024)	-0.017 (0.012)	-0.045* (0.027)	-0.076*** (0.020)	-0.097*** (0.030)
French		0.014*** (0.004)	0.023*** (0.006)	0.019** (0.010)	-0.005 (0.007)	-0.012 (0.010)	0.025*** (0.009)	0.017 (0.014)
Log Altitude		0.005 (0.008)	-0.003 (0.008)	-0.008 (0.009)	-0.008 (0.007)	-0.006 (0.011)	-0.011 (0.012)	-0.019 (0.014)
Log Density		-0.002 (0.003)	-0.002 (0.003)	-0.004 (0.004)	-0.000 (0.003)	-0.005 (0.004)	-0.005 (0.004)	-0.010** (0.004)
Log Absenteeism			-0.022*** (0.005)	-0.020*** (0.005)	-0.010*** (0.004)	-0.007 (0.005)	-0.027*** (0.007)	-0.022*** (0.008)
Week			0.001** (0.000)	0.001** (0.000)	0.000 (0.000)	0.001* (0.001)	0.001** (0.001)	0.002*** (0.001)
Class Size			-0.007 (0.009)	-0.004 (0.011)	-0.009 (0.009)	-0.000 (0.012)	0.007 (0.012)	0.013 (0.014)
Capital			-0.006 (0.005)	-0.007 (0.006)	0.002 (0.005)	0.000 (0.006)	-0.006 (0.006)	-0.007 (0.006)
Poor Training			-0.063*** (0.018)	-0.065*** (0.018)	0.002 (0.013)	-0.007 (0.016)	-0.027 (0.016)	-0.031* (0.017)
Female Teachers			0.015 (0.018)	0.022 (0.031)	0.057*** (0.017)	0.082*** (0.029)	0.066*** (0.024)	0.081** (0.037)
Clerics			-0.031 (0.024)	-0.042 (0.045)	-0.088*** (0.019)	-0.135*** (0.039)	-0.072** (0.028)	-0.104** (0.049)
Length of Service			-0.157*** (0.045)	-0.156*** (0.049)	-0.133*** (0.045)	-0.117** (0.050)	-0.163*** (0.057)	-0.153** (0.060)
Age			0.130*** (0.044)	0.129*** (0.046)	0.123*** (0.044)	0.120** (0.049)	0.161*** (0.053)	0.152*** (0.056)
Expenditure			-0.013 (0.009)	-0.013 (0.014)	-0.009 (0.008)	0.001 (0.014)	-0.026** (0.010)	-0.023 (0.017)
Log Next City				0.004 (0.005)		0.007 (0.005)		0.009 (0.006)
Obs.	493	493	493	475	493	475	493	475
R <sup>2</sup>	0.850	0.861	0.879	0.880	0.888	0.877	0.831	0.833
IV	no	no	no	yes	no	yes	no	yes

**Notes:** Clustered standard errors in parenthesis. \*\*\* significant at, or below, 1 percent, \*\* significant at, or below, 5 percent, \* significant at, or below, 10 percent.

## 5 Discussion and Conclusion

Becker and Woessmann (2009) argue that higher literacy rates among Protestants reflected their motivation to read the Holy Scriptures, particularly the New Testament. In fact, the Reformation process was primarily motivated by the dissatisfaction of Catholics about doctrines and malpractices like the sale of indulgence, selling and buying clerical offices, the authority of the Pope and mandatory celibacy of priests. The Protestant movement may thus be perceived as an attempt to focus on the contents of the bible and thereby limit abuses of power of the Catholic church. Thus, general knowledge of the Gospel by the masses may have been viewed by reformers as being conducive to sustain the Protestant movement.

Our results strongly suggest that Protestants put particular emphasis on reading capabilities, consistent with their motivation to read the bible. However, as we argue in the following, one should be cautious to conclude that higher literacy of Protestants "was an unintended side effect of Luther's exhortation that everyone be able to read the Gospel" (Becker and Woessmann, 2009, p. 581). In fact, the main reformers in Switzerland and Germany followed several educational goals. These could have particularly materialized in good reading skills but also in other fields like math, consistent with our evidence.

Interestingly, the Swiss reformation which was initiated in the early 1520s in Zurich by Zwingli in the German speaking part of the Confederation had many similarities with the one initiated by Luther in Prussia. Zwingli preached and took action against mendicants and the mercenary service, challenging Lenten fasting, the veneration of saints and clerical celibacy (Gordon, 2002).<sup>8</sup> Moreover, importantly for our education context, Kemp (1901, p. 164) points out that:

"In 1523 he wrote in Latin what, almost beyond a doubt, was the first Protestant treatise on education. It was entitled *The Christian Education of Youth*".

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<sup>8</sup>The reformation process met huge resistance from some cantons of the Old Confederation in Switzerland, leading to the two wars of Kappel in 1529 and 1531 between the Protestant and the Catholic cantons. Zwingli died on the battlefield on October 11, 1531, two days after the Catholic cantons declared war on Zurich.

There, Zwingli (1523, pp. 67-69) explicitly referred to the need of the youth to be taught to read the bible:

"[...] the Gospel should be taught most diligently and, as much as may be, in all its purity. [...] the youth should, in consequence of this, order well and adorn beautifully his own heart. [...] He cannot order his mind and prepare his heart better, however, than by engaging in the study of the Word of God, day and night."

However, what is less recognized is that Zwingli was heavily concerned with promoting education beyond the goal to enable masses to read the bible. In fact, he even mentioned mathematics. Kemp (1901, p. 165) summarizes Zwingli's treatise on education as follows:

"He outlined a course on Scriptural study [...] He advocated the study of objects in nature, regarding the beautiful structure of the world and the harmonious arrangement of its parts as revelations of wisdom, skill, and loving providence of God. He proposed also the study of the classics and Hebrew, and with them the study of arithmetic, surveying, and music."

In the Francophone part of Switzerland, the main reformer was the French theologian Calvin. Weber (1905) has argued that Calvin's doctrine about predestination of salvation helped Protestants to develop a work ethic, although in a subtle manner. Whereas in Roman Catholicism individual behavior can affect salvation, Calvinism would hold that economic success may be a signal of God of being appointed to salvation. Calvin was not only a theology professor and preacher, but during his time in Geneva also a church-ruler<sup>9</sup> and superintendent of schools (Schaff, 1892). Similar to Luther and Zwingli, he emphasized the need for universal education, "for every person to be adequately equipped to 'rightly divide' God's Word" (Armstrong, 1992). Moreover, in 1559 he founded a fast-growing university in Geneva for religious education and the training of pastors. Whereas Zwingli provided an intellectual stimulus for education among Protestants, Calvin was

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<sup>9</sup>Although Calvin's church organization had democratic elements, he also instituted a rigid inspection of household conduct. Many recreational activities as well as blasphemy and ribaldry were forbidden. Nonconformists were persecuted and even sentenced to death.



able to implement education policies which "made Geneva to the 'education center' of Francophone Protestantism" (Higman, 2010).

In sum, the concern for education of Zwingli and Calvin clearly went beyond promoting reading capabilities, although bible reading was an important concern. Interestingly, the same applies to Luther. On the one hand, also Luther (1520) supported the goal to enable reading the bible:

"Above all, in schools of all kinds the chief and most common lesson should be the Scriptures, and for young boys the Gospel; and would to God each town had also a girls' school, in which girls might be taught the Gospel for an hour daily, either in German or Latin!"<sup>10</sup>

On the other hand, Luther emphasized the role of education for shaping society:

"In support for his plea for schools Luther clearly and vigorously set forth a number of arguments. The first was based on a moral value of education. He claimed that neither reason nor Christian love could suffer any part of the population to grow up undisciplined, and thus become [...] sources of destruction to the community. The public school plan [...] included secondary schools with courses in Latin, Greek, Hebrew, history, and mathematics. [...] His general argument for these secondary schools was the relation of education to prosperity. 'A city's prosperity', he declared, 'does not consist alone in the accumulation of treasure, in strong walls, beautiful houses, many weapons and equipments; but its greatest wealth, its health and power, does consist in [...] sensible, honest, and well-disciplined citizens'." (Kemp, 1901, p.168f.)

In a similar vein, Ornstein and Levine (2008) argue that Luther saw education as instrumental for developing character traits of children. Moreover, the authors also see economic motives behind Luther's emphasis of education:

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<sup>10</sup>Becker and Woessmann (2008) show that Protestantism mitigates the gender gap in education, which may be associated with Luther's concern for the education of girls.

"Luther recognized education as an important ally of religious reformation. He saw church, state, family, and school as crucial reform agencies. Believing that the family had a key role in forming children's character and behavior, Luther encouraged family bible reading and prayer. He also wanted parents to make sure that children had vocational training so that they could support themselves as adults and become productive citizens." (Ornstein and Levine, 2008, p.86)

In sum, Protestant reformers not only emphasized education based on reading the bible but also recognized that education was instrumental to the goals to live in a civil society and to be successful in a more material sense. The reformer's broad intentions with respect to education fit well into the presented econometric evidence. We have shown that, besides a positive Protestant reading bias, Protestants had developed higher cognitive skills in all education fields at the time of industrialization. This indicates that Protestants must have been more aware than Catholics that educational investment pays off economically, in addition to enabling them to read the bible.

## Appendix

Tab. 9 presents first-stage results for our IV estimates employed in Tab. 3-8. As expected, the share of Protestants is the higher, the closer a district lies to a center of Protestantism at the time of Reformation (Zurich/Geneva). Interestingly, given the shorter (log) distance to Zurich and Geneva, the (log) distance to the next bigger city (*Log Next City*) is positively related to Protestantism. Protestantism is thus not a general "city-phenomenon" but indeed seems to be related to the home of Zwingli and Calvin. One also sees that the number of children was higher in Protestant regions. Regarding school inputs, there were less clerical teachers, more female teachers, and more absenteeism in Protestant regions.<sup>11</sup>

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<sup>11</sup>That absenteeism is positively related to Protestantism does not necessarily mean that Protestants were attending school less frequently. It may also be explained by the behavior of Protestant teachers who may have documented absenteeism more accurately.

Table 9: first stage regressions

	(1) Table 3 and 4	(2) Table 5 and 6	(3) Table 7	(4) Table 8
Distance to ZH/GE	-0.164*** (0.060)	-0.161*** (0.056)	-0.129** (0.052)	-0.122** (0.054)
Log Next City	0.119*** (0.042)	0.149*** (0.038)	0.120*** (0.036)	0.128*** (0.036)
Children	5.305*** (0.926)	4.018*** (0.848)	4.361*** (0.778)	3.768*** (0.784)
Primary	-0.614 (0.384)	-0.297 (0.381)	-0.227 (0.353)	-0.378 (0.354)
Romanic	0.309* (0.181)	0.217 (0.172)	0.248* (0.141)	0.207 (0.165)
Italian	-0.266* (0.140)	-0.391** (0.157)	-0.405*** (0.149)	-0.414*** (0.152)
French	0.031 (0.066)	-0.168** (0.075)	-0.210*** (0.071)	-0.187*** (0.070)
Log Altitude	0.189* (0.113)	0.222** (0.108)	0.191* (0.097)	0.185* (0.100)
Log Density	0.158*** (0.040)	0.015 (0.042)	-0.024 (0.038)	-0.016 (0.037)
Log Absenteeism		0.091** (0.040)	0.111*** (0.035)	0.112*** (0.035)
Week		0.002 (0.005)	0.003 (0.004)	0.001 (0.004)
Class Size		0.029 (0.094)	0.113 (0.086)	0.119 (0.088)
Capital		0.015 (0.053)	-0.027 (0.049)	-0.009 (0.047)
Poor Training		-0.151 (0.100)	-0.082 (0.099)	-0.005 (0.100)
Female Teachers		0.464** (0.204)	0.630*** (0.195)	0.574*** (0.193)
Clerics		-0.946*** (0.205)	-1.068*** (0.188)	-1.045*** (0.188)
Length of Service		0.676** (0.291)	0.431* (0.254)	0.382 (0.276)
Age		-0.238 (0.307)	0.015 (0.261)	0.024 (0.279)
Expenditure		0.286*** (0.080)	0.215*** (0.072)	0.215*** (0.073)
Best Grade Math			1.437*** (0.225)	
Failed Math				-1.236*** (0.195)
Obs.	475	475	475	475
R <sup>2</sup>	0.311	0.535	0.598	0.587

**Notes:** Clustered standard errors in parenthesis. \*\*\* significant at, or below, 1 percent, \*\* significant at, or below, 5 percent, \* significant at, or below, 10 percent.

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## Web-Appendix

### "Protestantism and Education: Reading (the Bible) and Other Skills" (not intended for publication)

In this web-appendix we provide supplementary information on the data and further econometric analysis which demonstrates robustness of the results.

#### Data sources:

- *Pedagogical examinations*: Statistisches Bureau des eidgenössischen Departement des Innern, *Schweizerische Statistik*, Lieferungen 27 (1876), 34 (1877), 36 (1878), 38 (1879), 61 (1885), 64 (1886), 67 (1886), 71 (1888), 75 (1889), 120 (1899), 124 (1900), 129 (1901), 134 (1901), 138 (1903).
- *School inputs*:
  - Grob, J.K. (1883). Statistik über das Unterrichtswesen in der Schweiz im Jahr 1881, Zürich: Schabelitz.
  - Huber, A. (1897). Schweizerische Schulstatistik 1894/95, Zürich: Buchdruckerei des Schweizerischen Grütlivereins.
  - Kinkelin, H. (1875). Statistik des Unterrichtswesens in der Schweiz im Jahre 1871, Zweiter Theil, Statistik der Primarschulen und Ergänzungen zum ersten Theil, Basel, Genf, Lyon: H. Georg's Verlag.
- *Distance to Zurich, Geneva, Basel, Berne, Lucerne*: Bundesamt für Landestopographie (2003): Topographische Karte der Schweiz (Dufour Map), CD Rom (first publication: 1845-1865); Bundesinventar der historischen Verkehrswege der Schweiz (<http://www.ivs.admin.ch/>).
- *Altitude*: Vogt, A. (1896). Ein vitalstatistisches Nivellement der 182 Bezirke der Schweiz. *Zeitschrift für Schweizerische Statistik* 32, 364–368.
- *Census information*: Statistisches Bureau des eidgenössischen Departement des Innern, *Schweizerische Statistik*.

- Primary sector share, population density: Lieferungen 28 (1876), 59 (1884), 97 (1894).
- Catholic share, majority language: Lieferungen 15 (1872), 51 (1891), 84 (1892).
- Ratio of children (aged 0-15): Lieferungen 20 (1874), 56 (1883), 88 (1892).

For more detailed background information on the data, particularly data quality and historical context, see Woitek and Wüthrich (2010) and Boppart et al. (2010). (See References in the main paper.)

**Further results:**

In Tab. 10 and 11 we add an interaction between Protestantism and math skills ( $P \times M$ ) to the estimation of reading bias regression (11) for high-performers and low-performers, respectively. This accounts for the possibility that a linear approximation of function  $\tilde{e}_M$  in (10) may be too crude. We therefore look at robustness of results when allowing for a non-linear specification. In order to be better able to interpret the results, we subtract the mean of the fraction of high- and low-performers in math to construct variable  $M$  (Best Grade Math, Failed Math). Columns (1)-(3) of Tab. 10 are directly comparable to columns (1)-(3) of Tab. 7; the same applies for Tab. 11 which is comparable to Tab. 8. Given an average math performance ( $M = 0$ ), the effects of Protestantism ( $\beta_1$  in (11)) on reading performance are almost identical to the results without interaction terms. Interaction terms are sometimes significant, particularly for low-performers. The Protestant reading bias as measured by the fraction of low-performers is higher, the better math skills. The opposite seems to hold, however, when we look at high-performers. Regarding other controls, the conclusions remain roughly similar to Tab. 7 and 8.

Table 10: Dependent variable: share with best grade in reading (with interaction)

	(1)	(2)	(3)
Protestants	0.023 ** (0.011)	0.038 *** (0.008)	0.030 *** (0.009)
Best Grade Math (mean subtracted)	0.928 *** (0.064)	0.795 *** (0.047)	0.769 *** (0.054)
Best Grade Math·Protestants	-0.060 (0.078)	-0.182 *** (0.065)	-0.114* (0.068)
Children		-0.517 *** (0.115)	-0.621 *** (0.112)
Primary		-0.190 *** (0.043)	-0.112 ** (0.045)
Romanic		0.001 (0.011)	0.004 (0.013)
Italian		0.068 *** (0.014)	0.033* (0.017)
French		-0.025 *** (0.006)	-0.061 *** (0.009)
Log Altitude		-0.024* (0.012)	-0.018 (0.012)
Log Density		0.014 *** (0.004)	0.011 ** (0.005)
Log Absenteeism			0.018 *** (0.006)
Week			-0.000 (0.001)
Class Size			-0.004 (0.015)
Capital			0.007 (0.007)
Poor Training			0.004 (0.019)
Female Teachers			0.082 *** (0.023)
Clerics			-0.004 (0.032)
Length of Service			0.114* (0.062)
Age			-0.126 ** (0.062)
Expenditure			0.023 ** (0.011)
Obs.	493	493	493
R <sup>2</sup>	0.745	0.815	0.833

**Notes:** Clustered standard errors in parenthesis. \*\*\* significant at, or below, 1 percent, \*\* significant at, or below, 5 percent, \* significant at, or below, 10 percent. Best Grade Math and its interaction is mean subtracted.



Table 11: Dependent variable: share failed in reading (with interaction)

	(1)	(2)	(3)
Protestants	-0.025 *** (0.006)	-0.027 *** (0.006)	-0.016 ** (0.008)
Failed Math (mean subtracted)	0.709 *** (0.030)	0.692 *** (0.029)	0.685 *** (0.031)
Failed math·Protestants	-0.315 *** (0.034)	-0.335 *** (0.035)	-0.308 *** (0.037)
Children		0.020 (0.063)	0.034 (0.073)
Primary		0.091 *** (0.029)	0.021 (0.032)
Romanic		-0.005 (0.009)	-0.010 (0.011)
Italian		-0.034 *** (0.011)	-0.040 ** (0.016)
French		0.009 ** (0.004)	0.017 *** (0.006)
Log Altitude		0.015* (0.009)	0.003 (0.008)
Log Density		-0.002 (0.003)	-0.002 (0.003)
Log Absenteeism			-0.019 *** (0.005)
Week			0.000 (0.000)
Class Size			-0.012 (0.009)
Capital			-0.011 ** (0.005)
Poor Training			-0.035 ** (0.017)
Female Teachers			-0.000 (0.018)
Clerics			-0.012 (0.023)
Length of Service			-0.129 *** (0.044)
Age			0.103 ** (0.041)
Expenditure			-0.007 (0.008)
Obs.	493	493	493
R <sup>2</sup>	0.872	0.885	0.897

**Notes:** Clustered standard errors in parenthesis. \*\*\* significant at, or below, 1 percent, \*\* significant at, or below, 5 percent, \* significant at, or below, 10 percent. Failed Math and its interaction is mean subtracted.