Luther and the Girls:
Religious Denomination and the Female Education Gap in 19ᵗʰ Century Prussia

SASCHA O. BECKER
LUDGER WOESSMANN

Luther and the Girls:
Religious Denomination and the Female Education Gap in 19th Century Prussia

Abstract

Martin Luther urged each town to have a girls' school so that girls would learn to read the Gospel, evoking a surge of building girls' schools in Protestant areas. Using county- and town-level data from the first Prussian census of 1816, we show that a larger share of Protestants decreased the gender gap in basic education. This result holds when using only the exogenous variation in Protestantism due to a county's or town's distance to Wittenberg, the birthplace of the Reformation. Similar results are found for the gender gap in literacy among the adult population in 1871.

JEL Code: I21, J16, N33, Z12.

Keywords: gender gap, education, Protestantism.

Sascha O. Becker
Department of Economics
University of Stirling
Stirling FK9 4LA
United Kingdom
sascha.becker@stir.ac.uk

Ludger Woessmann
Center for Economic Studies and Ifo
Institute for Economic Research at the
University of Munich
Poschingerstrasse 5
81679 Munich
Germany
woessmann@ifo.de

> "And would to God that every town also had a girls' school,
> in which the girls were taught the Gospel for an hour each day."
> Martin Luther (1520), *To the Christian Nobility of the German
> Nation Concerning the Improvement of the Christian Estate*.

I. Introduction

In the history of mass education, Prussia is generally considered the role model of educational reforms. Not only did it provide a decent basic education to most of its boys early on, but it had virtually reached gender parity in primary education already by the second half of the 19th century. Despite the importance of education for economic prosperity in general and for the gender gap in economic outcomes in particular, the factors that historically helped to close the female education gap are barely understood.

This paper suggests that Protestantism was a distinctive driving force in the advancement of female education in Prussia. Martin Luther explicitly urged girls, as well as boys, to be able to read the Gospel as a solely religious aim. This pledge for female reading ability helped to promote schooling for girls. We use data on school enrolment from the first Prussian Population Census in 1816 at the level of counties and towns to show that a larger share of Protestants in a county or town was indeed associated with a larger share of girls among the total school population. To our knowledge, this is the first time that these early sub-regional data are ever used in econometric analyses.

We present instrumental variable estimates where each county's and town's share of Protestants is instrumented by its distance to Wittenberg to suggest that the effect of Protestantism can be causally interpreted. The emergence of the Reformation from Luther's city of Wittenberg and its diffusion in a roughly circular fashion provides exogenous variation in Protestantism. Our results show that regions that were exogenously driven towards Protestantism by their proximity to Wittenberg were the first to reach gender parity in primary education in the early 1800s. The result that Protestantism was one factor that helped to reduce the gender gap in education in Prussia is confirmed when using county-level data on the gender gap in adult literacy in 1871. Thus, even by the time that universal public primary education had closed the gender gap in enrolment in primary education at

1

the end of the 19th century, the gender gap in literacy was lower among Protestants than among Catholics, and Protestant women had even more literacy than Catholic men.

While the motivation for our analysis is mostly historical in nature, the impact of Protestantism on the gender gap in education is still visible in international data today. Figure 1 plots the Protestant share of the population against the educational Gender Parity Index (GPI), measured as the ratio of years of education in the female and male population, for European countries in 1970.[1] Across countries, a higher share of Protestants is clearly associated with a higher GPI in years of education. All countries with a GPI under 0.88 are Catholic countries. All Protestant countries lie above this value.

Of course, such cross-country comparisons are plagued by the difficulty of disentangling the effect of religion from other possible causes of gender differences in educational attainment that may vary across countries, such as institutions and geography. By looking at sub-regional data within Prussia, this paper uses observations that are all exposed to the same institutional and legal setting. Similarly, problems of geographical variation are substantially smaller within Prussia than on a global scale, and will be dealt with by proper control variables.

Given the substantive returns to education on the labor market (cf. Card 1999; Psacharopoulos and Patrinos 2004), the difference in educational achievement between women and men has crucial consequences for gender differences in economic outcomes. In fact, education has played a major role in the evolutionary and revolutionary phases that transformed the economic role of women (Goldin 2006). In addition, female education may have substantial payoffs beyond the labor market. For example, Currie and Moretti (2003) show that mothers' education has important effects on the health of their children, suggesting that the intergenerational transmission of human capital depends on female

---

[1] The pattern is even more pronounced in a world-wide picture, but we stick to European countries in this depiction to evade worries of comparisons across culturally diverse continents. Note, however, that the relationship in Figure 1 is nonlinear and that there appears to be no relationship between the GPI and the Protestant share of the population once the latter rises above 20 percent. The GPIs were calculated using data on average years of education of both genders from Barro and Lee (2001). The population share of Protestants is from Barrett, Kurian and Johnson (2001).

Figure 1: PROTESTANTISM AND EDUCATIONAL GENDER RATIOS ACROSS EUROPE
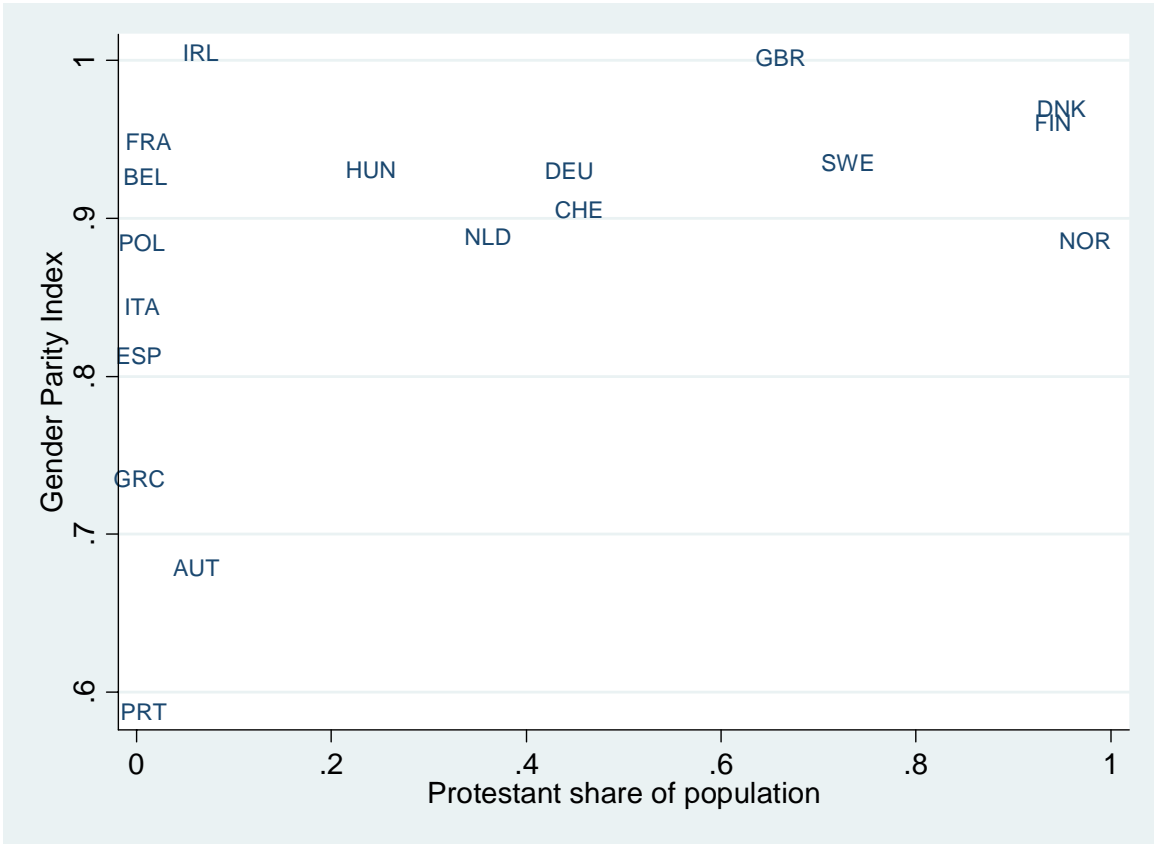
Gender Parity Index = ratio of years of education in the female population to years of education in the male population. Data refer to 1970.

education. It is thus important to understand what forces helped to overcome the historically poor participation of girls in basic education in the developed world.

Similarly, issues of gender parity in education are high on the agenda in developing countries today. Gender parity constitutes one of the "Education for All" development goals (UNESCO 2000). Only five out of 148 countries in the developing world have achieved gender parity through tertiary education (UNESCO 2006). In line with the religious factors emphasized in this paper, it seems that cultural factors play a major role in preventing gender parity in education in developing countries today (UNESCO 2003, ch. 3).

The paper is structured as follows. Section II presents an overview of Luther's and other reformers' teachings on female education and provides evidence on the practical implementation of school reforms in the decades after the Reformation. Section III presents data and empirical results on the effects of Protestantism on the gender gap in school enrolment at the level of counties and towns from the earliest Prussian Census in 1816. Section IV traces the development of the gender gap in school enrolment over the 19th century and presents evidence on the gender gap in adult literacy in 1871. Section V concludes and gives a brief outlook on the perpetuation of the denominational gender gap in Germany at higher levels of education until today.

II. The Reformers' Urge for Female Schooling

Education of large parts of the population was unheard of before the advent of the Reformation. Standard estimates suggest that less than one percent of the German population was literate at the time of the Reformation (Engelsing 1973). Even after the Reformation, educational efforts of the Catholic Church remained hugely different in scale from the Protestant Church, especially for girls.

Luther's views contrasted strongly with this Catholic neglect of schooling of boys and girls. In what is generally viewed as his first major pamphlet that signified the breakthrough of the Reformation among the general public, *To the Christian Nobility of the German Nation Concerning the Reform of the Christian Estate*, Luther (1520) explicitly demanded not only that every town should have a boys' school, but also a girls' school: "Above all,

the foremost and most general subject of study, both in the higher and the lower schools, should be the Holy Scriptures, and for the young boys the Gospel. And would to God that every town had a girl's school also, in which the girls were taught the Gospel for an hour each day… Ought not every Christian at his ninth or tenth year to know the entire holy Gospel…?"

Luther and the other reformers not only pleaded for educational efforts of both genders, but also influenced the implementation of school reforms on the practical front. Towns and regions that joined the Reformation instituted new Church and School Ordinances to align regulations with the Protestant ideals. Those were typically authored by leading reformers. One of them, Johannes Bugenhagen, provided a basis for universal education of both boys and girls in northern Germany, where he traveled during regular extended leaves of absence from his duties as parish pastor in Wittenberg (cf. Green 1979). His Church Ordinance for the city of Braunschweig in 1528, which provided for girls to learn reading, was to set the standard for subsequent systems. In this ordinance, Bugenhagen requested that the city should have both four boys' schools and four girls' schools. In his Church Ordinance for Wittenberg, he extended the request for girls' schooling to writing and calculating.

Other leading reformers wrote schoolbooks for girls' schools. Johann Agricola's *One Hundred-and-Thirty Questions for the Young Children in the German Girls' School at Eisleben* (1527), a catechetical work for religious instruction, is considered the earliest book published explicitly for use in a school for girls (cf. Green 1979).

These efforts to promote girls' education seem to have been quite effective over the first decades after the Reformation. Since Germany was fragmented into hundreds of states, data coverage is necessarily limited to some of the bigger states. The Electorate (Kurfürstentum) of Brandenburg was one of the biggest states at the time and also the core state of what later became Prussia. Green (1979) examines documentary materials from the visitations by church officials to the local parishes and finds that in the year that the Reformation was introduced (1539), Brandenburg had 55 boys' schools and 4 girls' schools (cf. Table 1). By 1572, the year that educational reform began under the leadership of the reformer Andreas Musculus, the number had increased to 78 and 9, respectively.

Table 1: DIFFUSION OF SCHOOLS IN BRANDENBURG IN THE 16TH CENTURY

Year(s)	Number of boys' schools	Number of girls' schools
Middle Ages until 1539	55	4
1540-1572	76	9
1573-1600	100	45

Data for 102 towns in the Electorate (Kurfürstentum) of Brandenburg.
Source: Green (1979).

Remarkable progress followed 1573-1600, when the number of schools for girls increased five-fold to 45.

It seems that there was nothing similar in terms of developments in the number of girls' schools in Catholic regions. Quite to the contrary, in Bavaria, the biggest Catholic state in Germany at the time, there were still strong objections against schools in the countryside in general as late as 1614 (Gawthrop and Strauss 1984).

The supply of girls' schools is arguably only one prerequisite for an increased educational attainment of girls. In his *Sermon on Keeping Children in School*, Luther (1530, p. 526) also extended his educational postulations to every individual Christian and asked parents to send their children to school, thus also stimulating the demand for education. A likely channel for this last effect is the non-monetary benefit associated with literacy perceived by Protestants, namely the ability to read the Bible (cf. Becker and Woessmann 2009).

To the extent that, in Protestant areas, more girls' schools were built and Protestant parents followed Luther's request to send girls to schools, we would expect a narrower gender gap in education among Protestants.

III. Protestantism and the Gender Gap in Basic Education in 1816 Prussia

This section tests empirically whether Protestantism did indeed lead to a reduction in the gender gap in education, using the earliest point in time for which data across all Prussian counties and municipalities are available.

Data for 1816 Prussia

Data coverage over the 17th and 18th centuries is, unfortunately, equally scarce as in the 16th century, for which we presented exemplary evidence in the previous section. In 1805, Prussia founded its Prussian Statistical Bureau. This statistical office performed the first full-scale Population Census in 1816, collecting data on population, occupation and education which was later reported at the county and municipality level (see data appendix for details). This is thus the earliest year which lends itself to a micro-econometric analysis

of education, gender and religion, and we are not aware that anybody has used these data for micro-econometric analysis at all.

Prussia in 1816 was divided into 357 counties, 289 of which had the necessary data in 1816 to be included in the analysis. In addition, data are also reported for 172 "large and medium-sized" towns (156 with necessary data in 1816; the smallest included town had roughly 2,500 inhabitants). While these towns are also contained in the county averages of the county-level data, the town data provide additional detailed information on specific schools and other town characteristics.

In particular, the county-wide data contain only information on public primary schools. Other school types, such as private schools and secondary schools, seem to barely exist or not exist at all outside the large and medium-sized towns, and no data are reported in the county totals. By contrast, the town data contain more detailed information. These include both the distinction between public and private schools and different types of secondary schools (see below).

Basic descriptive statistics for the county and the town samples are provided in the appendix Tables A.1 and A.2. The average share of Protestants across the 289 counties is 59%, and 70% across the towns. However, in both samples, the share of Protestants varies from 0% to 100%. This stark distinction between all-Protestant and all-Catholic counties in Prussia (cf. also Figure 2) provides the interesting denominational variation within the framework of a single country that enables the analysis of this paper.[2]

In the following analysis, we first look at the county data on enrolment in public primary schools and then at the town data on enrolment in public and private primary and secondary schools.
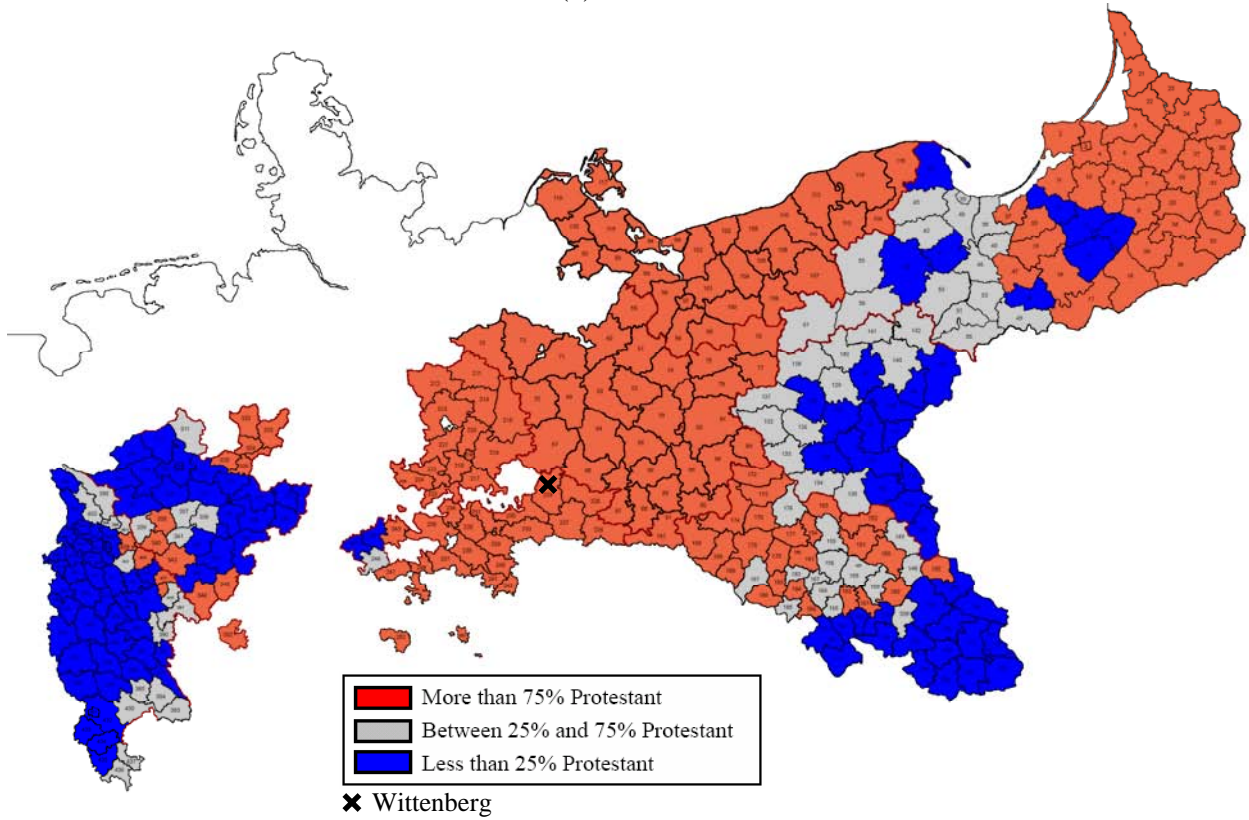
Evidence from Counties

If access to education were gender-neutral, the enrolment rate of girls would reflect the gender composition among school-aged children. A descriptive look at the county-wide
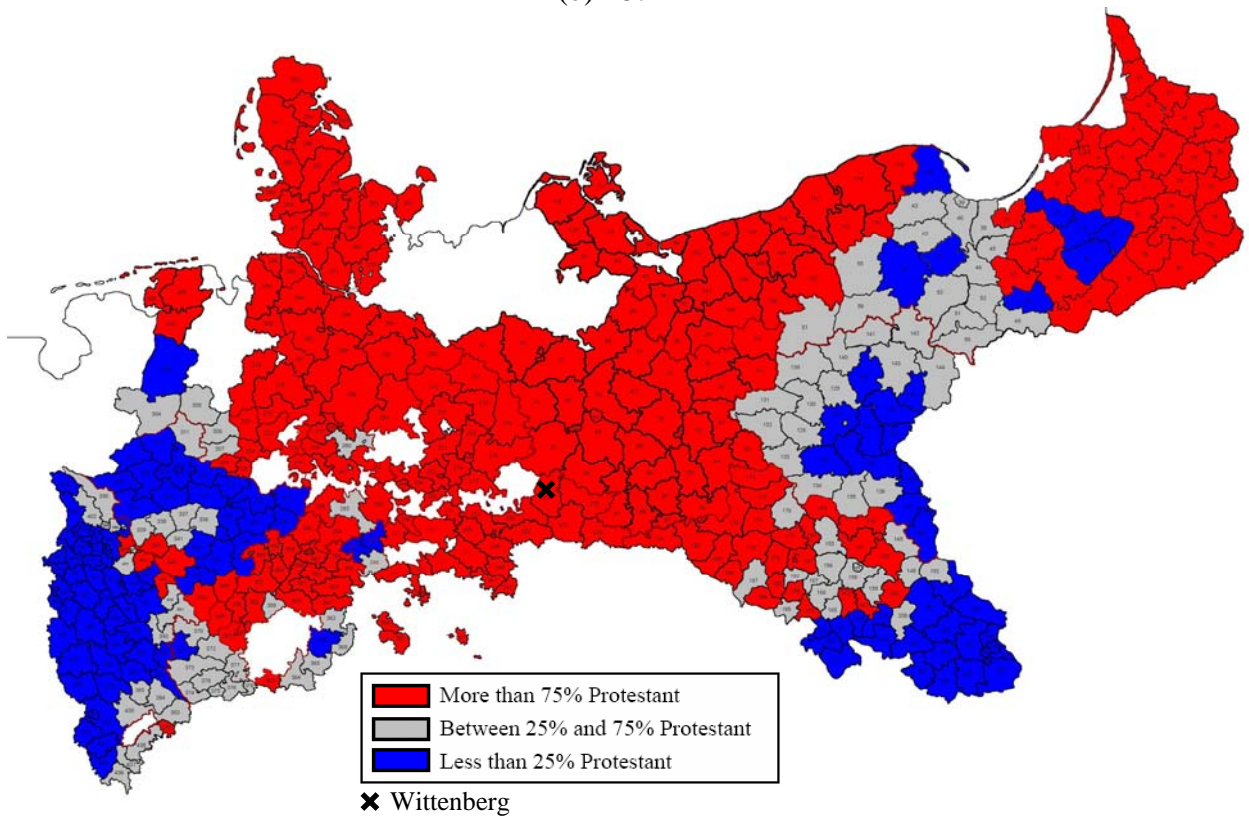
---

[2] As is evident from the figure, Prussia annexed several territories between 1816 and 1871, namely Hohenzollern-Sigmaringen, Schleswig-Holstein, the Kingdom of Hannover, Hessen-Kassel, Nassau, and the free city of Frankfurt.

Figure 2: PROTESTANTISM IN 19TH CENTURY PRUSSIA

(a) 1816

	More than 75% Protestant
	Between 25% and 75% Protestant
	Less than 25% Protestant
✖	Wittenberg

(b) 1871

	More than 75% Protestant
	Between 25% and 75% Protestant
	Less than 25% Protestant
✖	Wittenberg

data reveals that enrolment in primary schools is clearly lower for girls than for boys (cf. Table A.1). The share of girls among pupils enrolled in public primary schools is 47.3% on average across Prussian counties (compared to the share of girls in the relevant age group of 49.1%), below gender parity.

To test whether these gender differences in educational participation are less pronounced in Protestant areas, we perform simple regression analyses. Our dependent variable is the share of female pupils among all pupils in public primary school. The first column of Table 2 displays results from a bivariate regression of the share of girls in all pupils against the share of Protestants in the county. A higher fraction of Protestants is associated with a higher share of girls enrolled in primary school. The point estimate of 0.020 can be interpreted as follows: When a county goes from being all Catholic (0% Protestants) to all Protestant, the share of female pupils among all pupils in public primary school increases by two percentage points.

A demographic reason for differences in female shares in enrolment could be differences in the gender composition of school-aged children. In column (2), we control for the fractions of girls in the age group 8-14, as available in our data set. A higher fraction of girls in school age is indeed associated with a higher share of girls in primary school. However, the coefficient on Protestantism remains unaffected.

In column (3), we add geographical controls: latitude (in rad), longitude (in rad), their interaction, and the fraction of the population living in towns. The coefficient on the fraction of Protestants increases substantially, doubling to four percentage points. The negative coefficient on the fraction of the population living in towns reflects an institutional feature, as will become clear when looking at data for Prussian towns. Since, in towns, enrolment of girls is more pronounced in private primary schools (constituting 17% of primary school enrolment in towns), we expect a higher fraction of urban population in a county to lower the share of girls enrolled in public primary school.

Another reason for the gender gap to vary across counties may be the stage of development. Glewwe and Kremer (2006) argue that, at the international level, the gender gap in education closes as national income increases. At the individual level, richer families may be more inclined to send their daughters to school. Direct income measures are not

Table 2: PROTESTANTISM AND THE FEMALE ENROLMENT GAP, COUNTY TOTALS, 1816

Dependent variable:	% Girls among pupils enrolled in public primary schools				
	(1)	(2)	(3)	(4)	(5)
% Protestants	.020 (.005)***	.021 (.005)***	.040 (.006)***	.041 (.006)***	.035 (.006)***
% Girls in age group 8-14		.872 (.143)***	.461 (.150)***	.461 (.148)***	.451 (.147)***
Latitude (in rad) * 100			-.006 (.003)*	-.006 (.003)**	-.006 (.003)*
Longitude (in rad) * 100			.0002 (.009)	.008 (.009)	.010 (.009)
Latitude * Longitude * 100			-.0007 (.010)	-.010 (.010)	-.012 (.011)
% Population living in towns			-.023 (.010)**	-.013 (.011)	-.006 (.011)
Number of horses per capita				.150 (.051)***	.138 (.051)***
Number of bulls per capita				.175 (.815)	.120 (.812)
Prim. schools per 1,000 inhabitants					.005 (.002)*
Obs.	289	289	289	289	289
R^2	.046	.156	.279	.306	.315

Coefficients and standard errors from ordinary least squares (OLS) estimation.
Standard errors in parentheses: * significance at ten, ** five, *** one percent.
Data for Prussian counties from the 1816 Census; see main text for details.

available in the 1816 Prussian Census data. However, natural proxies are variables measuring agricultural productivity, in particular after controlling for the share of people living in towns. We transform the following livestock numbers at the county level to per capita numbers: number of horses, number of foals, number of bulls, number of oxen, number of cows, number of young cattle, number of sheep and number of goats. In column (4) of Table 2, we use only the number of horses and bulls per capita, but results are very similar when using all agricultural variables (with the other agricultural variables being statistically insignificant). Again, the coefficient on the share of Protestants remains unchanged.

An interesting question is whether school enrolment is mostly demand-driven or supply-driven, i.e. whether the reduced female enrolment gap is partly explained by better school supply in Protestant areas. To probe this point, we include the number of primary schools per 1,000 inhabitants as a measure of school supply in the county. Column (5) shows that including supply of primary schools slightly reduces the effect of Protestantism on the fraction of girls enrolled, from 0.041 to 0.035. The effect of the number of primary schools per 1,000 inhabitants itself on the fraction of girls enrolled is positive and significant. Taken together, this indicates that part of the enrolment effect for girls works through higher school density in Protestant areas, but that the bulk of the effect comes from the demand side. Protestant parents seem to have a higher preference for schooling of their daughters than Catholic parents.

Endogeneity of Protestantism? Using Distance to Wittenberg as an Instrument

Several historical facts suggest that the origin of denominational differences in Prussia can be viewed as an exogenous shock (cf. Becker and Woessmann 2009 for details). Most of the denominational variation across Prussia in the 19th century can be traced back to denominational choices of local rulers during the Reformation in 16th and early 17th century, mostly motivated by religious conviction and power politics vis-à-vis the Pope and the German Emperor. In addition, the increased literacy of Protestants was an unintended side effect of Luther's Gospel-reading aims, unrelated to a work ethic or any other economic thought.

Still, there may be worries that the adoption of Protestantism may have been endogenous to pre-existing ethical, educational or economic differences. To rule out such potential remaining worries about endogeneity of the share of Protestants in a county, we employ an instrumental variable strategy that uses a particular aspect of the historical diffusion of Protestantism across the German Empire in order to restrict the variation in Protestantism used in the estimation to a part that is credibly exogenous. Reformation historians refer to the diffusion of Protestantism as resembling the propagation of a wave caused by a stone thrown into water. Luther's preaching had its most imminent effect in the area surrounding his city of Wittenberg, and there is a tendency for the impact to diminish with distance to Wittenberg. In effect, in the German Empire, Protestantism dispersed around Wittenberg in a mostly concentric pattern. As evidenced in Figure 2, it seems that the Reformation spread out from Wittenberg in all directions, but then came to a halt after some distance.

The main reasons for a roughly circular dispersion around Wittenberg may have been the costs of traveling and of information diffusion through space, and these transportation and transaction costs played a crucial role at the time. Among other things, rulers who wanted to convert their church system to Protestantism had to send priests to study the new denomination in Wittenberg. Thus, thousands of students came to Wittenberg to hear Luther's sermons and speeches, and they spread the word as preachers back in their home regions (cf. Bunkowske 1985). Given the arduousness of travel in the early 1500s, the propensity to come to Wittenberg to listen to Luther and his successors likely declined with distance to Wittenberg. The fact that the German regions spoke ever more different dialects the further distant the regions may also have contributed to a concentric pattern of the dispersion of Protestantism, both in oral and written means of dissemination, and in the dissemination both to rulers and to the population at large.

It is generally accepted that Wittenberg was an "unimportant place" (Holborn 1942, p. 133) until 1517. Therefore, distance to Wittenberg should be unrelated to a county's economic and educational state before it adopted Protestantism. However, it is hard to ascertain this rigorously across our Prussian counties because there are hardly any data on the economic or educational situation for the time of Reformation, and the 1816 Population

9

Census is explicitly the first occasion where state-wide data on school enrolment was surveyed.

But several pieces of evidence support the idea that distance to Wittenberg is unrelated to the economic and educational situation before 1517. In Becker and Woessmann (2009), we show that, in the sample of 452 Prussian counties as of 1871, distance to Wittenberg is completely insignificant in predicting the probability of being a free imperial city (measured in pre-Reformation status), considered to be centers of economic activity before the Reformation. Second, the same is true for the probability of being a free Hanseatic city, which constituted major trading hubs in pre-Lutheran times. Third, distance to Wittenberg is similarly uncorrelated with urban population density in 1500, a proxy often used for economic progressiveness before industrialization. Fourth, in terms of proxies for the educational situation before 1517, we estimate whether distance to Wittenberg predicts whether a county had a university before 1517. We also regress the year of foundation of universities in existence before 1517 on distance to Wittenberg. In both exercises, distance to Wittenberg is completely unrelated to the spread of universities before Lutheran times. Fifth, we perform the same exercise for those present-day German schools that trace back their history to pre-Reformation times. Both a dummy for the existence of and the year of foundation of those schools are unrelated to distance to Wittenberg. Sixth, the density of monasteries, guardians of learnedness in medieval times that preserved the skill of literacy and often contained substantial libraries, measured in 1517 is equally unrelated to distance to Wittenberg.

As a consequence, the geographically concentric pattern of the dispersion of the Reformation provides a means to obtain a specific variation in Protestantism that is credibly exogenous to economic and educational considerations: the variation due to distance to Wittenberg. We thus use distance to Wittenberg as an instrument for the share of Protestants in a county in 19th century Prussia.

Table 3 reports instrumental variable (IV) estimates of the effect of Protestantism on girls' share in primary school enrolment, where Protestantism is instrumented by distance to Wittenberg. As is evident from the F-statistic of the instrument in the first stage, distance to Wittenberg is a strong instrument for the share of Protestants in a county. Each 100 km

Table 3: INSTRUMENTING PROTESTANTISM BY DISTANCE TO WITTENBERG

Dependent variable:	1st stage % Protestants				2nd stage % Girls among pupils in public primary schools			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
% Protestants					.049 (.011)***	.049 (.009)***	.049 (.009)***	.046 (.012)***
Distance to Wittenberg in 100 km	-.126 (.014)***	-.190 (.015)***	-.189 (.015)***	-.156 (.015)***				
% Girls in age group 8-14	-3.284 (1.493)**	2.324 (1.273)*	2.317 (1.274)*	1.804 (1.188)	.906 (.151)***	.416 (.155)***	.417 (.153)***	.415 (.152)***
Latitude (in rad) * 100		-.091 (.034)***	-.093 (.034)***	-.052 (.033)		-.008 (.004)**	-.008 (.003)**	-.008 (.004)**
Longitude (in rad) * 100		-.567 (.108)***	-.571 (.110)***	-.399 (.105)***		-.003 (.010)	.005 (.010)	.006 (.010)
Latitude * Longitude * 100		.640 (.120)***	.645 (.122)***	.455 (.117)***		.003 (.011)	-.006 (.011)	-.008 (.011)
% Population living in towns		.120 (.090)	.137 (.095)	.298 (.092)***		-.024 (.011)**	-.015 (.011)	-.011 (.013)
Number of horses per capita			-.320 (.439)	-.610 (.411)			.155 (.051)***	.147 (.052)***
Number of bulls per capita			8.951 (7.016)	5.810 (6.544)			.100 (.821)	.066 (.816)
Prim. schools per 1,000 inhabitants				.124 (.019)***				.003 (.003)
Obs.	289	289	289	289	289	289	289	289
R^2	.228	.551	.553	.615	.069	.273	.300	.308
F statistic (instrument)	83.72	157.00	155.25	108.39				

Coefficients and standard errors from instrumental variables (IV) estimation.
Standard errors in parentheses: * significance at ten, ** five, *** one percent.
Data for Prussian counties from the 1816 Census; see main text for details.

distance to Wittenberg is associated with a Protestant share that is 13-19 percentage points lower (see columns (1)-(4)). The second stage uses only that part of the Protestant share that is due to distance to Wittenberg to predict the girls' share in primary school enrolment.

The positive effect of Protestantism on girls' share in primary school enrolment is highly robust in the IV specification. In fact, the point estimate is higher, with a difference in girls' share in primary school enrolment of 4.6-4.9 percentage points between an all-Protestant and an all-Catholic county, depending on the specification (see columns (5)-(8)). The finding that school supply has a negligible effect on girls' enrolment (column (8)) shows up also in the IV estimates.

We conclude from the data on county totals that there is an economically and statistically significant effect of Protestantism on the female enrolment gap. The result is robust across several specifications and remains stable when instrumenting the fraction of Protestants by distance the Wittenberg.

Evidence from Towns

The county-wide data are limited to information about public primary schools. The data on Prussian towns, in contrast, have information on both public and private schools and on primary as well as secondary schools. The descriptive pattern that female enrolment numbers are lower than male enrolment numbers is also visible in towns: Across the 156 towns with non-missing education data, 41.5% of pupils are female (compared to a population share of 50.5% in the relevant age group; cf. Tables 4 and A.2).[3]

Table 4 splits down the educational gender gap by type of school. The fraction of females falls with the level of schooling. While in primary schools, girls make up 46.5% of all pupils, in (lower) secondary schools, they only constitute 38.5% of pupils, and only boys attend upper-secondary schools (*Gelehrtenschulen*, i.e. Gymnasien).[4]

---

[3] There are two outliers in terms of the share of girls in the relevant age group, Rogasen (79.6%) and Hirschberg (70.4%), which also have larger shares of females in other age groups. Dropping these two outliers does not change any of our qualitative results.

[4] Only after 1900, girls were allowed to obtain the *Abitur*, the university-entry certificate (see Vogt 1997).

Table 4: THE FEMALE ENROLMENT GAP, TOWNS, 1816

School type	% girls among pupils			% private enrolm. in school type	enrolm. in school type as % of total enrolm.
	all	public	private		
Elementary school	46.5 (8.0)	43.8 (12.7)	55.1 (21.6)	16.9	73.9
Middle school	38.5 (30.9)	28.0 (27.3)	61.1 (36.2)	29.4	18.0
Gymnasium	0.0 (0.0)	–	–	–	8.1
All schools	41.5 (7.2)	–	–	–	100.0

Columns 1-3 display means (standard deviations in parentheses).
Data for 156 Prussian medium-sized and large towns from the 1816 Census; see main text for details.

In private schools, female enrolment exceeds male enrolment. The reason for higher enrolment of girls in private as opposed to public schools is that the Prussian state did not yet consider female education a public duty. Secondary schools for girls were thus mostly run privately. However, private schools constitute only a small fraction of all schools, so that on the whole, female school enrolment is clearly below gender parity.

Table 5 presents regression analyses using the town sample. The first three columns refer to primary school enrolment, the last three columns to secondary school enrolment. The number of observations is lower in the latter case because not all towns host secondary schools.

Results are broadly similar to the county sample. Column (1) shows OLS estimates for a specification that includes the same geographic control variables as for the county data. Instead of the agricultural controls, which are not available in the town data, we use other indicators measuring the stage of economic development of the towns: the fraction of houses that have massive walls (as opposed to timbered or wooden walls), the number of businesses per capita, the number of looms per capita and the number of retailers per capita.

The coefficient on the fraction of Protestants is significantly positive at 4 percent and thus in the same range as in the regression on the sample of county totals. Similar to the regression on county totals, we find a small reduction of the direct effect of Protestantism on girls' enrolment share when controlling for the number of primary schools per 1,000 inhabitants (not reported).

Using the Wittenberg instrument again, the coefficient estimate on the fraction of Protestants nearly doubles and stays statistically significant. Similar to the county totals regressions, the part of the variation in the fraction of Protestants that we can arguably attribute to the exogenous spread of the reformation yields stronger effects on the share of girls among pupils.

When looking at secondary school enrolment in columns (4)-(6), the point estimates for the effect of Protestantism on the female enrolment share are even larger, albeit statistically insignificant. This may be attributed to the considerably smaller number of observations in the town data compared to the county data set.

Table 5: Protestantism and the Female Enrolment Gap, Towns, 1816

	Primary schools			Secondary schools		
	OLS	IV		OLS	IV	
		1st stage	2nd stage		1st stage	2nd stage
Dependent variable:	% Girls among pupils (1)	% Protestants (2)	% Girls among pupils (3)	% Girls among pupils (4)	% Protestants (5)	% Girls among pupils (6)
% Protestants	.041 (.020)**		.079 (.034)**	.097 (.061)		.159 (.105)
Distance to Wittenberg in 100 km		-.187 (.020)***			-.171 (.021)***	
% Girls in age group 8-14	.202 (.156)	-.598 (.498)	.213 (.159)	-.228 (.420)	-.595 (.489)	-.203 (.423)
Latitude (in rad) * 100	-.019 (.012)	-.120 (.045)***	-.024 (.012)*	-.002 (.032)	-.125 (.046)***	-.008 (.034)
Longitude (in rad) * 100	-.027 (.035)	-.642 (.144)***	-.036 (.036)	.007 (.099)	-.636 (.151)***	-.004 (.100)
Latitude * Longitude * 100	.029 (.039)	.712 (.160)***	.039 (.040)	-.003 (.110)	.709 (.167)***	.009 (.111)
% Buildings w/ massive walls	-.012 (.025)	-.057 (.081)	-.002 (.026)	.044 (.075)	-.051 (.089)	.059 (.078)
Businesses per capita	.059 (.118)	.603 (.384)	.067 (.119)	-.681 (.361)*	-.116 (.428)	-.618 (.372)*
Looms per capita	-.011 (.070)	.378 (.220)*	-.023 (.071)	.130 (.186)	.377 (.215)*	.109 (.189)
Retailers per capita	-.592 (.651)	-1.878 (2.072)	-.566 (.659)	4.138 (1.805)**	-.865 (2.109)	4.094 (1.813)**
Obs.	156	156	156	141	141	141
R^2	.108	.534	.087	.100	.506	.093
F statistic (instrument)		90.06			67.40	

Coefficients and standard errors from ordinary least squares (OLS) and instrumental variables (IV) estimation.
Standard errors in parentheses: * significance at ten, ** five, *** one percent.
Data for Prussian medium-sized and large towns from the 1816 Census; see main text for details.

It is instructive to control for school supply when estimating the effect of Protestantism on girls' enrolment in secondary schools. In contrast to primary schools, there are separate middle schools for boys and girls. We can thus control for the number of boys' and girls' middle schools and upper-secondary *Gymnasien* per 1,000 inhabitants. The point estimate of the direct effect of Protestantism goes down to 0.02, whereas there is a strong positive effect of the number of girls' middle schools on girls' enrolment in these schools (detailed results available from the authors upon request). When regressing the number of girls' middle schools per 1,000 inhabitants on the fraction of Protestants, there is a strong positive association. Given the fact that the vast majority of girls' middle schools are privately run, whereas boys' middle schools are publicly run, there seems to be more private initiative to operate girls' middle schools in Protestant areas.

It has been argued that girls' middle schools originally catered to relatively well-off families eager to demarcate themselves from the lower classes and endow their daughters with the knowledge and competences required for their future social positions as bourgeois married women. The issue of professional training did not arise, as women of a certain rank were not expected to work (Küpper 1987, p. 181-184). It thus appears that girls' participation in secondary education at the time was largely demand driven. While throughout most of the 19th century, the Prussian state authorities remained passive with regard to female education beyond the primary level, the emerging bourgeoisie did attach value to promoting their daughters' education. Hence, we should expect a positive association between female education in secondary education and the prevalence of bourgeois elements in the population. This is precisely what we observe. When regressing the share of girls enrolled in secondary schools (both public and private) on religion as well as a number of demographic and economic controls, religion turns out to be statistically insignificant, whereas the number of retailers per capita is positively and highly significantly correlated with women's participation (cf. Table 5).

We read the 1816 results as evidence of significant denominational differences in the gender education gap in primary and lower-secondary education (although the latter does not reach standard levels of statistical significance): School enrolment of girls is higher in Protestant areas.

IV. The Evolution of the Gender Gap over the 19th Century

This section documents how the educational gender gap evolved between 1822 and 1864 and then estimates whether Protestantism had an effect on the gender gap in literacy among the adult population in 1871.

### *The Evolution of Educational Gender Ratios from 1822 to 1864*

Between 1822 and 1864, the Prussian Statistical Office published school enrolment statistics only at the level of provinces or districts (Regierungsbezirke; see Preussische Statistik 1889, p. 1). Figure 3 shows the evolution of the Gender Parity Index (GPI) of primary and secondary school enrolment in 1822-1864. In primary education, the GPI starts from about 0.92 and reaches 0.98 at the end of the period. In 1864, 1.43 million boys and 1.40 million girls are enrolled in primary school. After 1864, the regular publication of school enrolment numbers was discontinued and only taken up again in 1886. Using data from the 1886 Education Census, we can show that the closing of the gender enrolment gap is virtually complete. In Prussia as a whole, in 1886, 2,422,044 boys and 2,416,203 girls are enrolled in primary school. Girls thus make up 49.94% of pupils in primary school.

In secondary schools, however, the gender gap persists over the whole period 1822-1864. The straight line depicts enrolment in public secondary school, whereas the dotted line includes private secondary schools (not included in the school statistics before 1858). Even including the private schools, the GPI in secondary education stands at only 0.57 in 1864. The absolute numbers of secondary enrolment are also telling. In 1864, only 131,430 boys and 74,761 girls are enrolled, compared to the 1.43 million boys and 1.40 million girls enrolled in primary school, showing the limited nature of secondary school enrolment in Prussia in the middle of the 19th century.

In sum, whereas the educational gender gap in primary school enrolment observed in 1816 closes over the century due to compulsory schooling regulations, it persists in secondary schooling.

Figure 3: GENDER PARITY INDEX OF SCHOOL ENROLMENT, 1822-1864

(a) Primary School
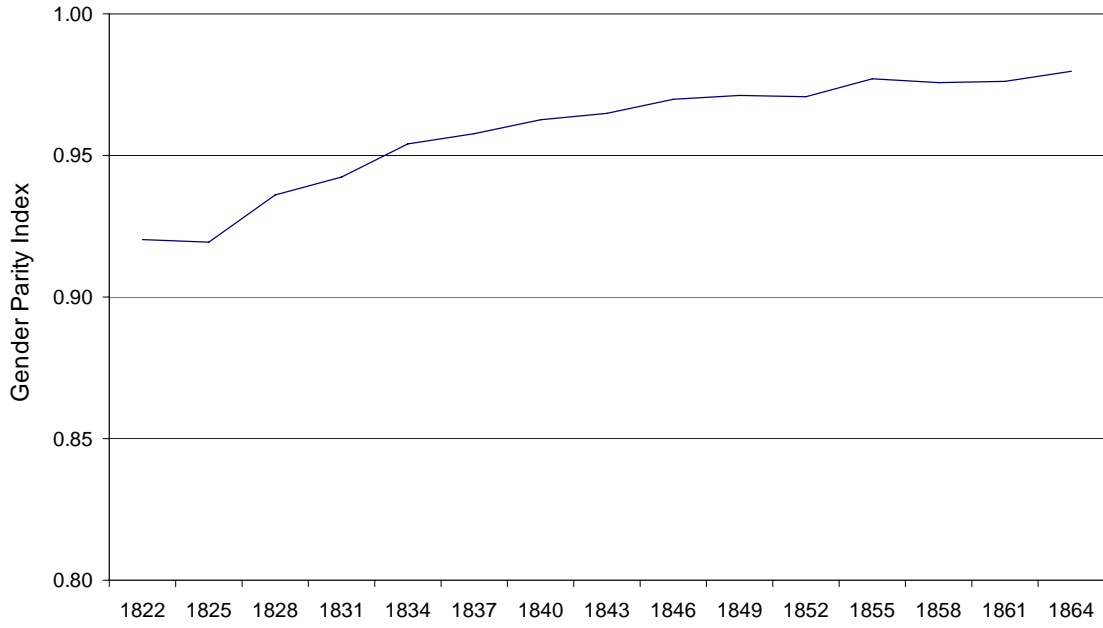
(b) Secondary School
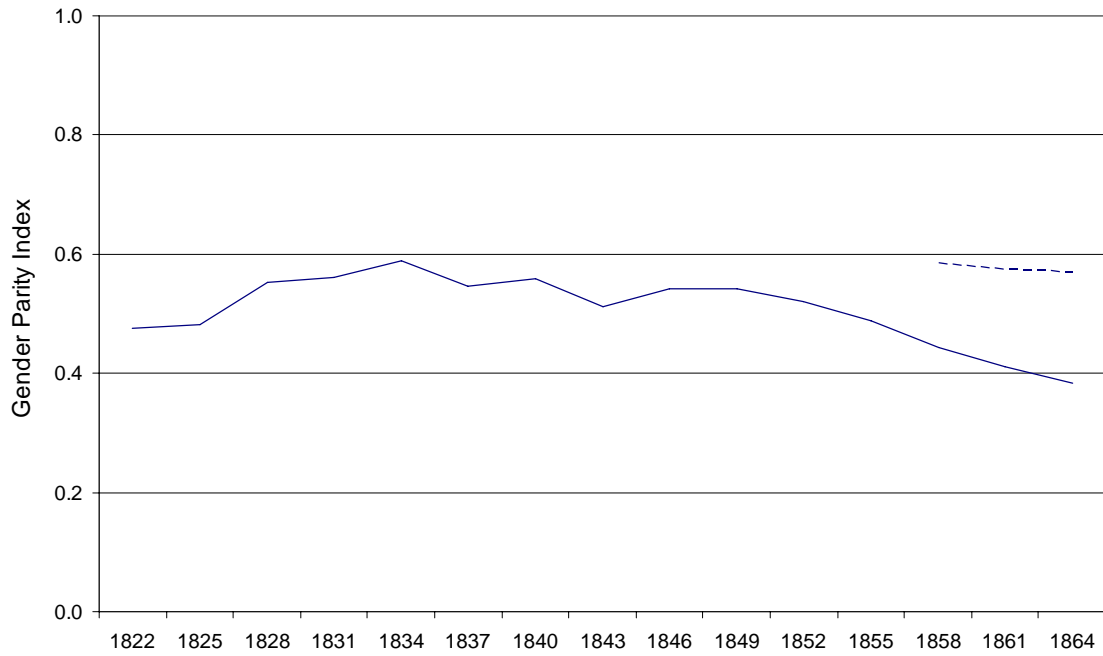
Straight line: public schools; dotted line: public and private schools.

Evidence of Denominational Effects on Gender Ratios in Literacy in 1871

The Prussian Population Census in 1871 collected data on literacy for all household members. The 1871 Population Census is explicitly the very first census ever to survey literacy in Prussia. Literacy is measured as the ability to read and write among the population aged 10 years or older. As an outcome measure, it captures whether the learning of basic skills in primary education was successful.

Although young girls had virtually caught up with boys in terms of primary school enrolment by 1871, there are still significant differences in literacy in the adult population. As the Prussia-wide cross-tabulations of literacy by gender and denomination of Table 6 show, Protestant women had even higher literacy than Catholic men. The numbers imply that the GPI of literacy rates, i.e. the literacy rate of females divided by the literacy rate of males, is larger for Protestants (94.9) than for Catholics (92.6).

An interesting exception to the general pattern can be observed in predominantly Protestant regions. When looking at literacy rates in counties with more than 80% Protestants, Catholic women in Protestant areas seem to profit from the better school supply.[5] Although they do not reach the level of the Protestant women there, they nearly reach the level of Catholic men.

Regression analysis allows us to analyze the gender education gap more closely and to control for demographic and geographic factors that might influence it (Table 7). The result that a larger share of Protestants reduced the gender gap in literacy is very robust in the different specifications. The specification of column (1) contains a set of demographic control variables derived from the 1871 Population Census. They include age structure, gender, native population, household and county size, and recent population growth, which is included to capture possible effects of the Franco-Prussian war of 1870/71. In column (2), we add geographic control variables: latitude and longitude of the county capitals and their interaction, as well as the fraction of the population in the county that lives in towns.

---

[5] Becker and Woessmann (2009) show that, similar to the results for 1816 presented above, Protestant areas have a higher school density also in the second half of the 19th century. In 1886, the fraction of pupils with distance to school of more than 3 kilometers is significantly lower in Protestant areas; see data appendix for details on the 1886 Education Census.

Table 6: LITERACY RATES BY DENOMINATION AND GENDER, 1871

	Males	Females
all Prussian counties		
Protestants	93.36	88.72
Catholics	84.75	78.48
counties with >80% Protestants		
Protestants	93.79	89.23
Catholics	88.35	87.95

% Literate among those aged ≥ 10.
Data for Prussian counties from the 1871 Population Census; see main text for details.

Table 7: Protestantism and the Female Literacy Gap, 1871

	OLS				IV
	(1)	(2)	(3)	(4)	(5)
% Protestants	.008 (.001)***	.009 (.001)***	.007 (.001)***	.007 (.001)***	.006 (.003)**
% Missing education info	.021 (.038)	.019 (.037)	.020 (.038)	.025 (.037)	.025 (.039)
% Age below 10	-.162 (.019)***	-.139 (.020)***	-.157 (.019)***	-.143 (.019)***	-.162 (.019)***
% Jews	-.174 (.034)***	-.193 (.035)***	-.174 (.033)***	-.188 (.033)***	-.185 (.038)***
% Females	-.105 (.036)***	-.012 (.040)	-.075 (.037)**	-.059 (.037)	-.109 (.036)***
% Born in municipality	.028 (.004)***	.005 (.006)	.024 (.004)***	.025 (.004)***	.026 (.006)***
% Of Prussian origin	-.064 (.021)***	-.032 (.022)	-.060 (.021)***	-.063 (.021)***	-.067 (.022)***
Average household size	-.019 (.151)	.044 (.161)	.095 (.155)	.055 (.150)	-.074 (.174)
ln(Population size)	-.137 (.103)	-.052 (.103)	-.192 (.105)*	-.200 (.103)*	-.134 (.104)
Popul. growth 1867-1871 (in %)	.016 (.011)	.005 (.012)	-.0009 (.013)	.006 (.011)	.012 (.013)
Geographic controls		yes			
% of labor force in manu and serv			.011 (.004)***		
ln(Per capita income)				1.071 (.292)***	
Obs.	452	452	452	452	452
R^2	.556	.587	.564	.570	.554

Dependent variable: fraction of females among the literate.
Standard errors in parentheses: * significance at ten, ** five, *** one percent.
Column 5 uses distance to Wittenberg as an instrument for the fraction of Protestants in county.
Data for Prussian counties from the 1871 Population Census and the 1882 Occupation Census; see main text and appendix for details.
Further controls: % Blind, % Deaf-mute, % Insane.

To control for the stage of economic development, we use two measures: the fraction of workers in manufacturing and services (column (3))[6] and per capita income (column (4)), proxied by the per capita income of primary school teachers.[7] Using teacher income as a proxy may actually "over-adjust" for income to the extent that better paid teachers may be directly responsible for higher literacy rates.

The results across all specifications clearly show that the gender literacy gap significantly decreases with an increasing share of Protestants in the population. To judge the size of the effect, note that the dependent variable, the fraction of females among the literate, varies between 43.8% and 49.9% across the 452 Prussian counties as of 1871 (cf. Table A.3). The first decile is at 46.7% and the ninth decile is at 49.6%. A point estimate of 0.007 thus corresponds to the following thought experiment: If a county went from an all Catholic to an all Protestant population, the fraction of females among the literate would increase by two-thirds of a percentage point, which is quite sizeable, considering the relatively small variance in the outcome.

In column (5), we again use distance to Wittenberg as an instrument for the fraction of Protestants in a county. The point estimate on the fraction of Protestants drops slightly to 0.006 and remains clearly significant. We conclude that, in 1871, Protestantism narrows the gender literacy gap. The smaller adult gender literacy gap in Protestant areas may indeed be the direct consequence of better access to primary schools for Protestant women in earlier decades, as evidenced by our 1816 results above.

V. Conclusions and Outlook

This paper traces the development of female education in what is generally viewed as the role model of educational reforms, Prussia, over the 19th century. We suggest that Protestantism helped to reduce the gender gap in basic education, because Martin Luther urged each town to have a girls' school so that girls would learn to read the Gospel.

---

[6] Occupation measures stem from the 1882 Occupation Census; see data appendix for details.

[7] Income of primary school teachers was reported in the 1886 Education Census; see data appendix for details.

Sporadic evidence from the time of the Reformation confirms that the Reformation did indeed lead to a surge in the building of girls' schools in Protestant areas.

Our empirical analysis uses the exogenous variation in Protestantism stemming from a county's or town's distance to Wittenberg to show that Protestantism led to a decrease in the gender gap in basic education in 1816 as well as in the gender gap in adult literacy in 1871. The evidence reveals that there was a response to Luther's postulation of female education by Protestant authorities and – in the case of middle schools – private entities to build girls' schools and by Protestant parents to send their girls to school. Together, this helped to reduce the gender gap in educational enrolment in early 19th century Prussia and in literacy in late 19th century.

Our result of a significant causal effect of Protestantism on the female education gap adds to the literature on the historical relevance of religious factors in education outcomes (e.g., Botticini and Eckstein 2005, 2007; Becker and Woessmann 2009) by highlighting the gender dimension. Given the religious norm stressed in Botticini and Eckstein's important work that literacy transmitted from father to son in Judaism, this dimension may well be an important difference in the otherwise similar inheritance of religion-led educational advancement in Jewish and Protestant history.[8]

The growing evidence that women's education is instrumental for important economic and non-economic outcomes beyond its own sake – e.g., for the economic role of women (Goldin 2006) and for the health of children (Currie and Moretti 2003) – provides additional relevance for the finding that women's education is affected by historical causes of religious denomination.

While the motivation of this study is mostly historical in nature, the result may have wider relevance for the developing world today. In terms of UNESCO's "Education for All" development goals (UNESCO 2000) that emphasize gender parity, our evidence suggests that cultural factors may constitute a relevant factor hindering equal access to education for both genders, as in the case of Catholics in 19th century Prussia. This enforces

---

[8] While this paper concentrates on Luther's role in advancing female (and male) human capital accumulation in general, it is an unfortunate legacy of Luther's embarrassing late writings on Jews that they are partly responsible for the expulsion of Jews, leading to a serious loss of human capital.

the importance of strict enforcement of compulsory schooling to ensure gender parity in those countries where women are traditionally disadvantaged.

This is in line with the Prussian experience, where we show that compulsory schooling regulations managed to close the educational gender gap in primary education over the course of the 19th century. However, it is interesting to note that the pattern of effects of religious denomination on the gender gap in primary school enrolment and adult literacy observed in 19th century Prussia continues in secondary and tertiary education in the 20th and 21st century. For instance, in the first year when women were admitted to university in Prussia in 1908, there were more than eight times as many female students of Protestant denomination than of Catholic denomination (359 vs. 43; see Preussische Statistik 1910, p. 71), compared to a proportion of roughly two to one in the total female population. Protestant women stayed ahead of Catholic women in West Germany even after World War II. In 1951/52, 59% of female university students were Protestant, clearly exceeding their population share of 52%. For male students, the denominational difference was less pronounced, with 56% of male students being Protestant (see Herder-Korrespondenz 1954). Even in contemporary Germany, according to data from the German Socioeconomic Panel, Protestant women continue to stay ahead of Catholic women in educational attainment. It is an interesting topic for future research to establish how the Protestant lead in female education perpetuated across the education levels.

References

Barrett, David B., George T. Kurian, Todd M. Johnson (2001). *World Christian Encyclopedia*. 2nd edition. Oxford: Oxford University Press.

Barro, Robert J., Jong-Wha Lee (2001). International Data on Educational Attainment: Updates and Implications. *Oxford Economic Papers* 53 (3): 541-563.

Becker, Sascha O., Ludger Woessmann (2009). Was Weber Wrong? A Human Capital Theory of Protestant Economic History. *Quarterly Journal of Economics* 124: forthcoming.

Botticini, Maristella, Zvi Eckstein (2005). Jewish Occupational Selection: Education, Restrictions, or Minorities? *Journal of Economic History* 65 (4): 922-948.

Botticini, Maristella, Zvi Eckstein (2007). From Farmers to Merchants, Conversions and Diaspora: Human Capital and Jewish History. *Journal of the European Economic Association* 5 (5): 885-926.

Bunkowske, Eugene W. (1985). Was Luther a Missionary? *Concordia Theological Quarterly* 49 (2-3): 161-179.

Card, David (1999). The Causal Effect of Education on Earnings. In: Orley Ashenfelter, David Card (eds.), *Handbook of Labor Economics*, vol. 3A, pp. 1801-1863. Amsterdam: North-Holland.

Currie, Janet, Enrico Moretti (2003). Mother's Education and the Intergenerational Transmission of Human Capital: Evidence from College Openings. *Quarterly Journal of Economics* 118 (4): 1495-1532.

Engelsing, Rolf (1973). *Analphabetentum und Lektüre: Zur Sozialgeschichte des Lesens in Deutschland zwischen feudaler und industrieller Gesellschaft*. Metzler.

Galloway, Patrick R., Eugene A. Hammel, Ronald D. Lee (1994). Fertility Decline in Prussia, 1875-1910: A Pooled Cross-Section Time Series Analysis. *Population Studies* 48 (1): 135-158.

Gawthrop, Richard, Gerald Strauss (1984). Protestantism and Literacy in Early Modern Germany. *Past and Present* 104: 31-55.

Glewwe, Paul, Michael Kremer (2006). Schools, Teachers, and Education Outcomes in Developing Countries. In: Eric A. Hanushek, Finis Welch (eds.), *Handbook of the Economics of Education*, vol. 2, ch. 16. Amsterdam: North-Holland.

Goldin, Claudia (2006). The Quiet Revolution That Transformed Women's Employment, Education, and Family. *American Economic Review* 96 (2): 1-21.

Green, Lowell (1979). The Education of Women in the Reformation. *History of Education Quarterly* 19 (1): 93-116.

Herder-Korrespondenz (1954). Meldungen aus der katholischen Welt: Eine Konfessions-statistik der westdeutschen Studentenschaft. *Herder-Korrespondenz* 1954 (9): 99-101.

Holborn, Louise W. (1942). Printing and the Growth of a Protestant Movement in Germany from 1517 to 1524. *Church History* 11 (2): 123-137.

Küpper, Erika (1987). Die höheren Mädchenschulen. In: Karl-Ernst Jeismann, Peter Lundgreen (eds.), *Handbuch der deutschen Bildungsgeschichte*, vol. 3, ch. 4. Munich: C.H. Beck.

Luther, Martin (1520). An den christlichen Adel deutscher Nation von des christlichen Standes Besserung. (To the Christian Nobility of the German Nation Concerning the Improvement of the Christian Estate.) In: *Dr. Martin Luthers Werke: Kritische Gesamtausgabe*. Vol. 6, pp. 381-469, 1888, Weimar.

Luther, Martin (1530). Eine Predigt, daß man Kinder zur Schule halten solle. (A Sermon on Keeping Children in School.) In: *Dr. Martin Luthers Werke: Kritische Gesamtausgabe*. Vol. 30, Part 2, pp. 522-588, 1909, Weimar.

Psacharopoulos, George, Harry A. Patrinos (2004). Returns to Investment in Education: A Further Update. *Education Economics* 12 (2): 111-134.

Schleunes, K.A. (1989). *Schooling and Society: The Politics of Education in Prussia and Bavaria 1750-1900*. London: St. Martin's Press.

UNESCO (2000). *The Dakar Framework for Action – Education for All: Meeting Our Collective Commitments*. Paris: United Nations Educational, Scientific and Cultural Organization.

UNESCO (2003). *Gender and Education for All - The Leap to Equality - EFA Global Monitoring Report 2003/4.* Paris: United Nations Educational, Scientific and Cultural Organization.

UNESCO (2006). *Strong Foundations: Early Childhood Care and Education – EFA Global Monitoring Report 2007*. Paris: United Nations Educational, Scientific and Cultural Organization.

Vogt, Annette (1997). Elsa Neumann - erste Promovendin an der Berliner Uni. *Berlinische Monatsschrift* 8: 27-32.

Appendix: Data Sources

Demographers have found county-level data for 19th century Prussia to be a unique source of highest-quality data for analyses at a disaggregate level (cf. Galloway, Hammel, and Lee 1994). We have compiled the county-level data as well as municipality-level data from respective archives.

1816 Population Census

1816 is the earliest year for which the Prussian Statistical Office, founded in 1805, collected detailed data at the county and municipality level. It is thus the earliest year which lends itself to a micro-econometric analysis of education, gender and religion. To our knowledge, these data have not been used for econometric analyses before. The 1816 data refer to 172 large and medium-sized[9] towns and 357 counties[10] in Prussia.

The town data provide information on the number of schools, teachers and students of the following school types: public primary schools (*Öffentliche Elementarschulen*), private primary schools (*Privat-Elementarschulen*), public (lower) secondary schools (*Öffentliche Buerger- oder Mittelschulen für Söhne und Töchter*) for boys and girls, private secondary schools (*Private Bürger- oder Mittelschulen für Söhne und Töchter*), as well as upper-secondary schools (*Gelehrte Schulen*). For all school types, we have gender-specific enrolment numbers. In contrast, the county data report only on public primary schools (*Öffentliche Elementarschulen*).

The source of the 1816 Population Census data is Mützell (1825).

School Enrolment Statistics, 1822-1864

Between 1822 and 1864, the Prussian Statistical Office published school enrolment statistics at the province or district (*Regierungsbezirk*) level only. Those are reviewed in Engel (1869).

---

[9] The Prussian statistical office does not explicitly state what the threshold is for being classified as a medium-sized town, but the smallest town (Jülich) had 2,470 inhabitants in 1816.

[10] Data on the 357 Prussian counties includes the 172 towns mentioned above.

1871 Population Census

The second point in time for which we have detailed county-level education data is 1871. The 1871 Population Census is explicitly the very first census ever to survey literacy in Prussia.[11] Literacy is measured as the ability to read and write among the population aged 10 years or older. As a measure of educational outcome, literacy may be a more informative measure of accumulated human capital than standard enrollment data, which may partly capture years in school that did not lead to effective educational outcomes. The 1871 Population Census also provides data on a host of demographic variables. The source of the 1871 Population Census data is Preussische Statistik (1874).

1882 Occupation Census

The 1882 Occupation Census collected information on employment and self-employment across two-digit sectors. We calculate the share of the labor force working in the manufacturing sector and in the service sector, using the classification provided by the Prussian Statistical Office to classify the two sectors. The manufacturing sector (sector B in the 1882 classification) includes mining, construction, and manufacture of metals, machinery, equipment, chemicals, textiles, paper, leather, food products, and wood. The service sector (sector C in the 1882 classification) includes trade business, insurance, transport, lodging, and restaurants. Note that the service sector C does not include servants and housemaids, nor does it include those working in the public administration and the military. The source of the 1882 Occupation Census data is Preussische Statistik (1884/85, Vol. 76b, pp. 232-695 and Vol. 76c, p. 239).

1886 Education Census

The 1886 Education Census collected information mainly on pupil enrolment in primary schools. It also contains county-level data on the share of pupils who had a distance to school of more than three kilometers, as well as on the average annual income of full-time male primary school teachers in a county. Given that teacher incomes were

---

[11] Other parts of the German Empire did not survey literacy in the 1871 census.

almost entirely financed from local contributions, they provide a reasonable proxy for the average income of the county (cf. Schleunes 1989). The source of the 1886 Education Census data is Preussische Statistik (1889, pp. 2-391).

1908 University Census

The 1908 University Census collected information on student enrolment in the winter semester 1908/09 in all Prussian universities. 1908 was the year women were admitted to university. The source of the 1908 University Census data is Preussische Statistik (1910).

Data References

Engel, Ernst (1869). Beiträge zur Geschichte und Statistik des Unterrichts, insbesondere des Volksschul-Unterrichts, im preussischen Staate. Zeitschrift der königlich preussischen statistischen Bureaus vol. 9, pp. 99-152.

Mützell (1825). Neues Topographisch-statistisch-geographisches Wörterbuch des Preussischen *Staats.* Halle: Karl August Kümmel, 1825.

Preussische Statistik (1874), *Die Gemeinden und Gutsbezirke des Preussischen Staates und ihre Bevölkerung: Nach den Urmaterialien der allgemeinen Volkszählung vom 1. December 1871*, Berlin: Verlag des Königlichen Statistischen Bureaus.

Preussische Statistik (1884/85). Die Ergebnisse der Berufsstatistik vom 5. Juni 1882 im preussischen Staat, Preussische Statistik vol. 76, Berlin: Verlag des Königlichen Statistischen Bureaus.

Preussische Statistik (1889). Das gesammte Volkschulwesen im Preußischen Staate im Jahre 1886, Preussische Statistik vol. 101, Berlin: Verlag des Königlichen Statistischen Bureaus.

Preussische Statistik (1910). Statistik der Preußischen Landesuniversitäten, Studienjahr Ostern 1908/09, *Preussische Statistik* vol. 223, Berlin: Verlag des Königlichen Statistischen Landesamts.

Table A.1: DESCRIPTIVE STATISTICS: PRUSSIAN COUNTIES, 1816

	Mean	StdDev	Min	Max
	(1)	(2)	(3)	(4)
% Girls among public prim. school pupils	47.13	3.77	23.04	57.57
% Protestants	59.30	40.72	.00	99.96
% Girls in age group 8-14	49.13	1.42	44.67	53.93
Latitude (in rad) * 100	90.96	2.45	85.93	97.24
Longitude (in rad) * 100	23.81	8.61	10.52	39.40
% Population living in towns	11.56	19.58	.00	100.00
Number of horses per capita	.10	.06	.00	.35
Number of foals per capita	.02	.02	.00	.11
Number of bulls per capita	.005	.003	.00	.03
Number of oxen per capita	.07	.06	.00	.25
Number of cows per capita	.22	.07	.00	.60
Number of young cattle per capita	.12	.06	.00	.49
Number of sheep per capita	.87	.66	.00	3.10
Number of goats per capita	.02	.02	.00	.12
Number of pigs per capita	.15	.10	.00	.44
Prim. schools per 1,000 inhabitants	1.97	.94	.00	4.86
Distance to Wittenberg in km	340.12	164.43	.00	731.46

Number of observations: 289.
Data for Prussian counties from the 1816 Census.

Table A.2: DESCRIPTIVE STATISTICS: PRUSSIAN TOWNS, 1816

	Mean	StdDev	Min	Max
	(1)	(2)	(3)	(4)
% Girls among prim. school pupils	46.50	8.05	12.20	69.70
% Girls among second. school pupils	21.65	21.14	.00	100.00
% Protestants	69.53	35.39	.11	100.00
% Girls in age group 8-14	50.45	4.05	42.28	79.64
Latitude (in rad) * 100	90.77	2.21	85.93	97.24
Longitude (in rad) * 100	22.37	7.53	10.52	38.75
% Buildings w/ massive walls	23.85	27.88	.00	100.00
Businesses per capita	.19	.06	.07	.45
Looms per capita	.03	.09	.00	1.04
Retailers per capita	.02	.01	.003	.06
Distance to Wittenberg in km	290.24	151.43	30.15	708.50

Number of observations: 156.
Data for Prussian medium-sized and large towns from the 1816 Census.

Table A.3: Descriptive Statistics: Prussian Counties, 1871

	Mean	StdDev	Min	Max
	(1)	(2)	(3)	(4)
% Females among the literate	48.45	1.16	43.82	49.89
% Protestants	64.18	37.83	.26	99.89
% Missing education info	1.69	1.10	.00	6.72
% Age below 10	24.71	2.48	15.33	29.87
% Jews	1.14	1.33	.00	12.87
% Females	51.00	1.51	43.97	54.63
% Born in municipality	58.97	12.39	32.01	87.23
% Of Prussian origin	99.07	1.97	74.22	100.00
Average household size	4.79	.34	3.83	5.86
ln(Population size)	10.80	.41	9.36	13.62
Popul. growth 1867-1871 (in %)	1.60	4.93	-7.76	33.83
% Blind	.09	.03	.03	.24
% Deaf-mute	.10	.05	.02	.42
% Dumb	.23	.17	.02	1.56
Distance to Wittenberg in km	326.19	148.77	.00	731.46

Number of observations: 452.
Data for Prussian counties from the 1871 Population Census; see main text and appendix for details.

CESifo Working Paper Series

for full list see www.cesifo-group.org/wp
(address: Poschingerstr. 5, 81679 Munich, Germany, office@cesifo.de)

_____

2367 Ximing Wu, Andreas Savvides and Thanasis Stengos, The Global Joint Distribution of Income and Health, August 2008

2368 Alejandro Donado and Klaus Wälde, Trade Unions Go Global!, August 2008

2369 Hans Gersbach and Hans Haller, Exit and Power in General Equilibrium, August 2008

2370 Jan P.A.M. Jacobs and Jan-Egbert Sturm, The Information Content of KOF Indicators on Swiss Current Account Data Revisions, August 2008

2371 Oliver Hülsewig, Johannes Mayr and Timo Wollmershäuser, Forecasting Euro Area Real GDP: Optimal Pooling of Information, August 2008

2372 Tigran Poghosyan and Jakob de Haan, Determinants of Cross-Border Bank Acquisitions in Transition Economies: A Latent Class Analysis, August 2008

2373 David Anthoff and Richard S.J. Tol, On International Equity Weights and National Decision Making on Climate Change, August 2008

2374 Florian Englmaier and Arno Schmöller, Reserve Price Formation in Online Auctions, August 2008

2375 Karl Farmer, Birgit Friedl and Andreas Rainer, Effects of Unilateral Climate Policy on Terms of Trade, Capital Accumulation, and Welfare in a World Economy, August 2008

2376 Monika Bütler, Stefan Staubli and Maria Grazia Zito, The Role of the Annuity's Value on the Decision (Not) to Annuitize: Evidence from a Large Policy Change, August 2008

2377 Inmaculada Martínez-Zarzoso, The Impact of Urbanization on CO_2 Emissions: Evidence from Developing Countries, August 2008

2378 Brian Roberson and Dmitriy Kvasov, The Non-Constant-Sum Colonel Blotto Game, August 2008

2379 Ian Dew-Becker, How Much Sunlight Does it Take to Disinfect a Boardroom? A Short History of Executive Compensation Regulation, August 2008

2380 Cécile Aubert, Oliver Falck and Stephan Heblich, Subsidizing National Champions: An Evolutionary Perspective, August 2008

2381 Sebastian Buhai, Miguel Portela, Coen Teulings and Aico van Vuuren, Returns to Tenure or Seniority?, August 2008

2382 Erkki Koskela and Jan König, Flexible Outsourcing, Profit Sharing and Equilibrium Unemployment, August 2008

2383 Torberg Falch and Justina AV Fischer, Does a Generous Welfare State Crowd out Student Achievement? Panel Data Evidence from International Student Tests, September 2008