Online Appendix to Sascha O. Becker and Ludger Woessmann, "Not the Opium of the People: Income and Secularization in a Panel of Prussian Counties"

A1. Church Attendance Data

The Protestant Regional Churches of Germany conducted annual surveys of "Expressions of Churchly Life" between 1880 (with precursors) and World War II (see main text for further information). Our main indicator of church attendance is the "sacrament participation" (Hölscher (2001)), measured as the number of participations in Holy Communion divided by the number of Protestants in a church district. Counting sacrament participations is deemed relatively reliable because the established practice was to count the number of issued wafers from the number of wafers before and after the sacrament. As indicated in the main text, the possibility of multiple individual attendances, the possibility of attending Holy Communion outside the home parish, and the counting of non-confirmed children among the number of Protestants in the denominator constitute reasons why the indicator does not directly measure the actual sacrament participation of parishioners.

While the data were contemporaneously regularly published in a comparative manner at the level of the Regional Churches, Hölscher (2001)'s "Data Atlas on the Religious Geography in Protestant Germany: From the Mid-19th Century to the Second World War" for the first time brings together the district-level data, gathered from regional archives, for the geographic

coverage of modern Germany.[1] Hölscher kindly provided us with digital versions of the data as published in the Data Atlas. After assigning IDs to every church district (*Kirchenkreis*) and cross-checking the data, we combined the data into one panel dataset. In a few cases, data were reported as double years, e.g., 1892/93. Attendance numbers for double years turned out to be in the same range as those in single calendar years, so we assigned attendance numbers to the first year of a double year.

In our analysis, in order to reduce potential measurement error, we take three-year averages of church attendance around our years of analysis. However, results are equivalent when using the original year-specific data.

The church attendance data have gaps for some church districts in some years. Our main analyses in Tables 1 and 2 use an unbalanced panel of observed church attendance (using three-year averaged data). Table A5 uses a balanced panel of counties where church attendance is observed in all six waves (as is the income data).

A2. Income Data

Income data refer to income of male elementary-school teachers, the only income data we are aware of that are available as a panel at the county level over our period of investigation. Because teacher salaries were almost entirely financed from local contributions at the time, they should provide a reasonable proxy for average income in the county (cf. Schleunes (1989)). Becker and Woessmann (2009) show that across the 452 Prussian counties, log teacher income

[1] For additional background on secularization in Germany around this time, see Nipperdey (1988) and Hölscher (2005), and Pollack (2003) for the post-WW II period. In post-WW II West Germany, the share of Protestants reporting to regularly attend church service declined from 13 percent in 1952 to 8 percent in 2005 (Pollack (2006), Table 1); among Catholics, the same measure declined from 51 percent to 23 percent over the same period.

in 1886 is highly correlated with other measures of economic development such as the size of the non-agricultural sector in 1882 (correlation coefficient 0.74) and a proxy for average income constructed from data on income tax and wages of unskilled day laborers in 1900 (0.71).

The data were collected by the Prussian Statistical Office and reported at the level of administrative counties (*Kreise*). Teacher income data are available for all Prussian counties in all the years 1886, 1891, 1896, 1901, 1906, and 1911. The data are drawn from the Galloway (2007) Prussia Database and are based on the following volumes of the *Preussische Statistik*: Volume 101, pp. 2-391 (for 1886); Volume 120, part II, pp. 2-313 (for 1891); Volume 151, part II, pp. 2-315 (for 1896); Volume 176, part III, pp. 2-485 (for 1901); Volume 209, part III, pp. 2-513 (for 1906); and Volume 231, part II, pp. 2-599 (for 1911).

In several cases, county reforms led to the split of counties into smaller units over time; typically, with increasing urbanization, counties were split into urban counties (*Stadtkreise*) and rural counties (*Landkreise*). In those cases, we aggregated data in later years up to the boundaries as of earlier years. Since teacher income data are complete for all years 1886, 1891, …, 1911, this yields a balanced panel of teacher income data in constant county borders.

There are two changes in how teacher income is reported over time. First, in 1886 and 1891, teacher income covers only direct wage payments, but not extras such as housing allowances and any other allowances. From 1896 onwards, data include all components of income. To make data consistent over time, we pre-multiply direct wage payments in 1886 and 1891 by the county-specific ratio of total income over (only) wage payments observed in 1896.

Second, in 1911, income is only reported as total income of male and female elementary-school teachers combined, whereas for all other years both genders are reported separately. In 1911, we impute income of male elementary-school teachers by pre-multiplying total income of

elementary-school teachers by the county-specific share of male teachers in total income observed in 1906.

As an alternative income measure available only in 1892 and 1901, Table A6 uses daily wages of urban male day laborers aged 16 and over, taken from the Social Security Statistics. The Prussian authorities used these day laborer wages as reference values to determine contributions to the compulsory Health Insurance System (1.5 percent of the customary wage paid to day laborers), indicating that they were considered sufficiently representative of wages in low-income households and thus constitute a useful proxy for their local standard of living. The source of the variable is Georg Neuhaus, "Die ortsüblichen Tagelöhne gewöhnlicher Tagearbeiter in Preußen 1892 und 1901," *Zeitschrift des Königlich Preussischen Statistischen Bureaus*, 44 (1904), 310-346. For additional information, see Becker and Woessmann (2009) and the ifo Prussian Economic History Database (iPEHD) described in Becker, Cinnirella, Hornung, and Woessmann (2012).

A3. Additional Data

The control variables used in Table A3 are taken from the Prussian Population Census in 1871. First used in Becker and Woessmann (2009), who provide variable definitions and detailed documentation (see also iPEHD), they are based on Königliches Statistisches Bureau, *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, 1874).

The Population Census provides data on several measures that are often used in the church attendance literature and in the income literature, such as the age structure (where, in addition to the share of the population below 10 years of age, we also use the share of the

population aged 60 and older from Galloway (2007)), gender distribution, the share of the county population that lives in urban areas, literacy, migration, and the share of Protestants in the population. Unfortunately, these cross-sectional control variables are not consistently available in the panel dimension.[2]

In the province of Hannover, county borders changed substantially between 1871 and 1886 in a fashion that prevents re-aggregation (for example, two old counties split and merged into three new counties). Counties in the province of Hannover are therefore dropped in the regression analyses in Table A3 that involve control variables from 1871.

A4. Merging the Datasets

We merge the church attendance and income data by assigning the income data, available at the level of the administrative county, to that church district (for which we have church attendance data) which contains the capital of the administrative county (same for the 1871 control variables available for administrative counties). In cases where several county capitals are located in the same district, we aggregated the county data up to the church district level (taking population-weighted averages of income data).

To make regional entities comparable over time in face of territorial changes during our period of observation, we aggregated church-district and county data up to the highest level at which consistency over time is given.

[2] Available data suggest that church membership barely changed over our period of investigation. On average across the 508 (593) Prussian counties in 1885 (1910), 65.9 (63.4) percent of inhabitants were Protestants, 32.8 (35.3) percent Catholics, 0.25 (0.43) percent other Christians, 0.99 (0.65) percent Jews, and only 0.01 (0.16) percent "adherents of other religions, with undetermined or without religious designation."

Our resulting dataset covers an unbalanced panel of 175 separate territorial entities (which we refer to as "counties") spanning 1886-1911. These counties constitute the intersection between modern Germany (for which Hölscher (2001) collected church attendance data) and Prussia at the end of the 19th century (for which Prussian census records provide income data). Due to the intersection requirement, our analysis does not cover the non-Prussian parts of modern Germany (esp. the Southern parts) and the parts of Prussia not located in modern Germany (esp. the Eastern Provinces located in modern Poland and Russia). Due to lack of church-district data, we also miss the Province of Brandenburg (except for Berlin) and Western Pomerania.

Table A1 provides descriptive statistics. Figure A1 shows a scatterplot of income and church attendance in 1911.

A5. Robustness Checks

The pattern of results of the basic models presented in the paper is confirmed in a number of robustness checks. First, results are robust in the subsample of 116 counties with more than 90 percent Protestant population (Table A4), which shows that results are not affected by the fact that income refers to all teachers while church attendance refers to Protestants. Second, results are robust in a balanced sample of 89 counties with full data in all six waves (Table A5). Finally, results are robust when dropping Berlin (which has the highest income level in most waves) and when dropping the two counties with participations in Holy Communion over Protestants larger than one in 1911 (see Figure A1).

Appendix References

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Table A1
Descriptive Statistics

	Obs.	Mean	Std. Dev.	Min	Max
	(1)	(2)	(3)	(4)	(5)
Church attendance					
Pooled	898	0.47	0.28	0.06	1.48
1886	123	0.53	0.28	0.07	1.48
1891	149	0.50	0.28	0.07	1.42
1896	156	0.49	0.28	0.07	1.43
1901	162	0.48	0.29	0.07	1.40
1906	160	0.46	0.28	0.06	1.35
1911	148	0.39	0.25	0.06	1.29
Change 1886-1911	101	-0.07	0.07	-0.20	0.15
ln(teacher income)					
Pooled	1,050	7.42	0.21	6.94	8.08
1886	175	7.23	0.16	6.95	7.78
1891	175	7.27	0.16	6.94	7.91
1896	175	7.34	0.15	7.08	8.06
1901	175	7.54	0.13	7.25	8.04
1906	175	7.58	0.15	7.29	8.08
1911	175	7.58	0.12	7.39	7.99
Change 1886-1911	101	0.36	0.09	0.19	0.59
Control variables (1871)					
Share of population $<$ 10 years	100	0.24	0.02	0.19	0.28
Share of population $>$ 60 years	100	0.08	0.01	0.04	0.10
Share female	100	0.51	0.02	0.44	0.54
Share of county pop. in urban areas	100	0.31	0.19	0.06	1.00
Share literate	100	0.95	0.02	0.87	0.99
Share born in municipality	100	0.66	0.10	0.40	0.85
Share of Protestants	100	0.81	0.28	0.03	1.00

Church attendance refers to participations in Holy Communion over Protestants. Ln(teacher income) refers to log income of male elementary-school teachers.
Data sources: church attendance: Hölscher (2001) based on Sacrament Statistics; teacher income: Galloway (2007) based on Education Censuses; control variables: Becker and Woessmann (2009) based on Population Census.

Table A2
Income and Church Attendance: Year-by-Year Cross-Sections

	1886	1891	1896	1901	1906	1911
	(1)	(2)	(3)	(4)	(5)	(6)
Church attendance	-0.291	-0.334	-0.321	-0.256	-0.286	-0.309
	(0.042)***	(0.033)***	(0.034)***	(0.031)***	(0.038)***	(0.037)***
Const.	7.365	7.426	7.497	7.657	7.705	7.705
	(0.030)***	(0.022)***	(0.023)***	(0.020)***	(0.022)***	(0.020)***
Obs. = number of counties	123	149	156	162	160	148
R^2	0.308	0.384	0.381	0.314	0.321	0.376

Dependent variable: log income of male elementary-school teachers. Ordinary least squares (OLS) estimations in cross-sections of counties for respective year indicated in header. Church attendance refers to participations in Holy Communion over Protestants. Robust standard errors in parentheses: significant at the *** 1, ** 5, * 10 percent level.
Data sources: church attendance: Hölscher (2001) based on Sacrament Statistics; teacher income: Galloway (2007) based on Education Censuses.

Table A3
Income and Church Attendance, 1886

Dependent variable:	ln(teacher income)		Church attendance	
	(1)	(2)	(3)	(4)
Church attendance	-0.285	-0.183		
	(0.052)***	(0.049)***		
ln(teacher income)			-0.927	-1.000
			(0.126)***	(0.186)***
Share of population < 10 years		-0.914		-2.229
		(0.602)		(1.663)
Share of population > 60 years		-3.298		-3.424
		(1.160)***		(2.927)
Share female		-0.242		1.591
		(0.823)		(2.032)
Share of county pop. in urban areas		0.049		-0.461
		(0.085)		(0.142)***
Share literate		-0.612		-0.326
		(0.573)		(1.017)
Share born in municipality		-0.259		-0.176
		(0.126)**		(0.293)
Share of Protestants		0.009		0.077
		(0.036)		(0.090)
Fixed effects for six Provinces		yes		yes
Const.	7.377	8.906	7.209	8.501
	(0.035)***	(0.700)***	(0.920)***	(2.301)***
Obs.	100	100	100	100
R^2	0.264	0.706	0.264	0.507

Ordinary least squares (OLS) estimation in cross-section of counties in 1886. Ln(teacher income) refers to log income of male elementary-school teachers. Church attendance refers to participations in Holy Communion over Protestants. Control variables refer to the year 1871. Robust standard errors in parentheses: significant at the *** 1, ** 5, * 10 percent level.
Data sources: church attendance: Hölscher (2001) based on Sacrament Statistics; teacher income: Galloway (2007) based on Education Censuses; control variables: Becker and Woessmann (2009) based on Population Census.

Table A4
Restriction to Counties with at least 90 Percent Protestants

Dependent variable:	ln(teacher income)					Church attendance
	Cross-section (time fixed effects)	Time-series (county fixed effects)	First difference 1886-1911	Two-way fixed effects		
	(1)	(2)	(3)	(4)	(5)	(6)
Church attendance	-0.224 (0.029)***	-1.610 (0.255)***	-0.003 (0.130)	0.109 (0.089)	0.104 (0.080)	
Church attendance $(t-5)$					-0.010 (0.088)	
ln(teacher income)						0.025 (0.031)
ln(teacher income) $(t-5)$						0.043 (0.040)
Time fixed effects	yes	no	no	yes	yes	yes
County fixed effects	no	yes	no	yes	yes	yes
Const.	7.294 (0.020)***	8.195 (0.127)***	0.364 (0.014)***	7.495 (0.041)***	7.165 (0.049)***	0.024 (0.404)
Obs.	620	620	71	620	495	536
Number of counties	116	116	71	116	113	116
R^2 (within)	0.755	0.160	0.000	0.901	0.907	0.386

Unbalanced panel of counties observed every five years in 1886-1911. Sample restricted to counties with a share of Protestants in the population of at least 90 percent in 1885. Dependent variable in col. 1-5: log income of male elementary-school teachers; in col. 6: participations in Holy Communion over Protestants. In col. 3, dependent variable and independent variable refer to the change between 1886 and 1911. Standard errors (clustered by county) in parentheses: significant at the *** 1, ** 5, * 10 percent level.
Data sources: church attendance: Hölscher (2001) based on Sacrament Statistics; teacher income: Galloway (2007) based on Education Censuses.

Table A5
Balanced Panel of Counties with Observed Data in All Waves

Dependent variable:	ln(teacher income)					Church attendance
	Cross-section (time fixed effects)	Time-series (county fixed effects)	First difference 1886-1911	Two-way fixed effects		
	(1)	(2)	(3)	(4)	(5)	(6)
Church attendance	-0.281 (0.043)***	-2.271 (0.294)***	-0.024 (0.131)	0.076 (0.099)	-0.081 (0.132)	
Church attendance $(t-5)$					0.125 (0.140)	
ln(teacher income)						-0.002 (0.034)
ln(teacher income) $(t-5)$						0.006 (0.039)
Time fixed effects	yes	no	no	yes	yes	yes
County fixed effects	no	yes	no	yes	yes	yes
Const.	7.373 (0.030)***	8.486 (0.141)***	0.355 (0.014)***	7.194 (0.050)***	7.542 (0.057)***	0.402 (0.416)
Obs.	534	534	89	534	445	445
Number of counties	89	89	89	89	89	89
R^2 (within)	0.689	0.298	0.0004	0.914	0.904	0.476

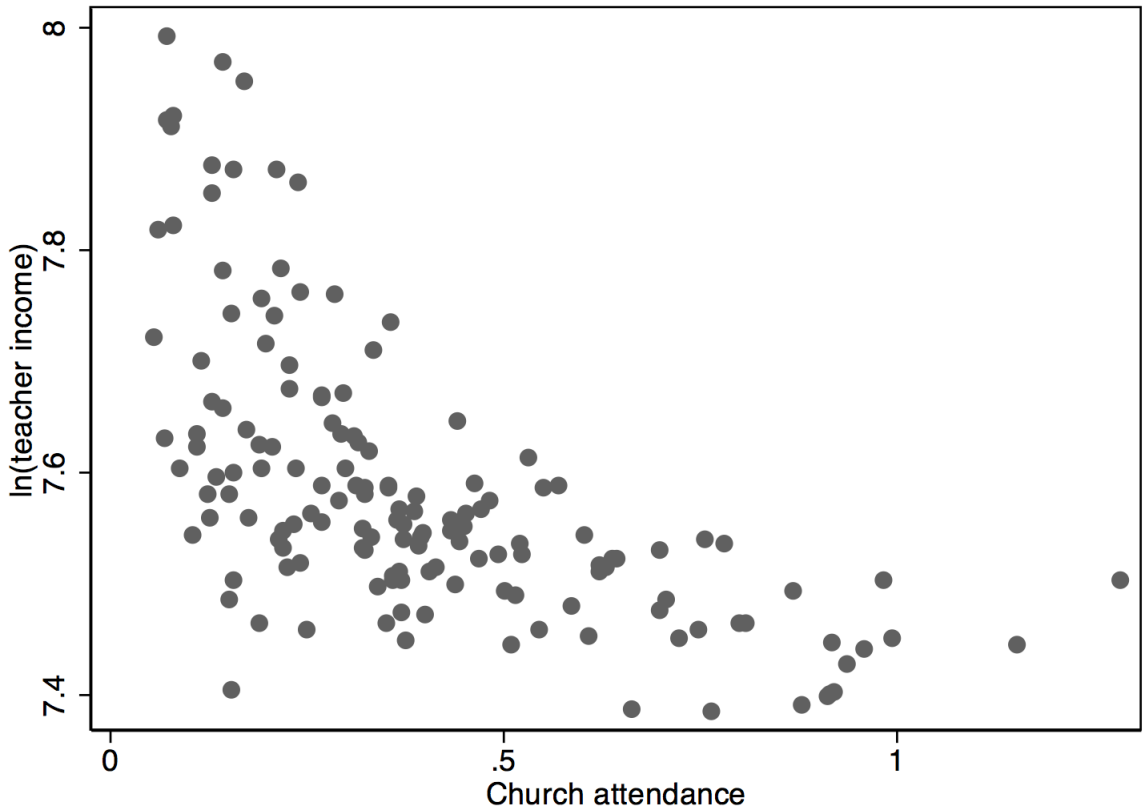
Balanced panel of counties observed every five years in 1886-1911. Dependent variable in col. 1-5: log income of male elementary-school teachers; in col. 6: participations in Holy Communion over Protestants. In col. 3, dependent variable and independent variable refer to the change between 1886 and 1911. Standard errors (clustered by county) in parentheses: significant at the *** 1, ** 5, * 10 percent level.
Data sources: church attendance: Hölscher (2001) based on Sacrament Statistics; teacher income: Galloway (2007) based on Education Censuses.

Table A6
Alternative Income Measure: Wages of Day Laborers in 1892 and 1901

Dependent variable:	ln(day laborer wages)				
	Cross-section (time fixed effects)	Time-series (county fixed effects)	First difference 1892-1901	Two-way fixed effects	
	(1)	(2)	(3)	(4)	(5)
Church attendance	-0.309 (0.035)***	-1.547 (0.662)**	-0.131 (0.208)	-0.131 (0.208)	-0.164 (0.233)
Church attendance $(t-5)$					0.224 (0.226)
Time fixed effects	yes	no	no	yes	yes
County fixed effects	no	yes	no	yes	yes
Const.	0.707 (0.024)***	1.363 (0.313)***	0.146 (0.009)***	0.619 (0.1)***	0.515 (0.101)***
Obs.	244	244	113	244	216
Number of counties	131	131	113	131	126
R^2	0.399	0.138	0.003	0.753	0.796

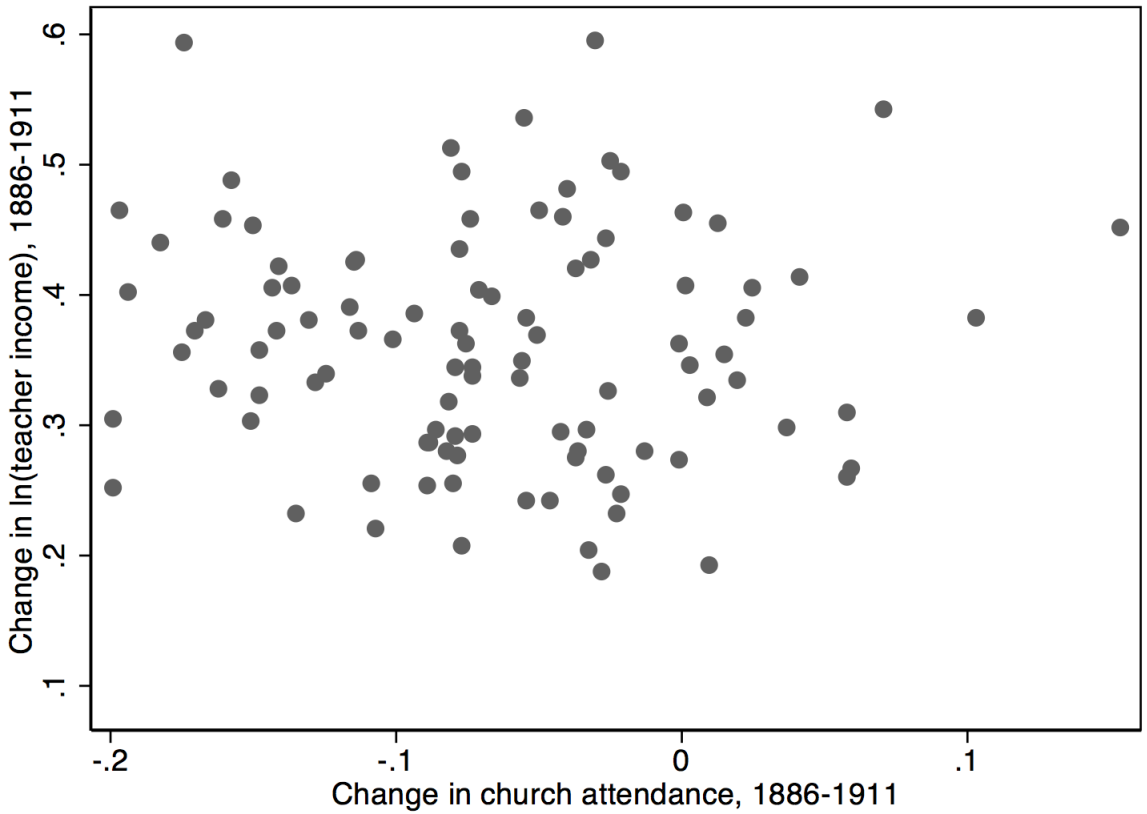
Unbalanced panel of counties observed in 1892 and 1901. Dependent variable: log daily wages of urban male day laborers aged 16 and over. Church attendance refers to participations in Holy Communion over Protestants. In col. 3, dependent variable and independent variable refer to the change between 1892 and 1901. Standard errors (clustered by county) in parentheses: significant at the *** 1, ** 5, * 10 percent level.
Data sources: church attendance: Hölscher (2001) based on Sacrament Statistics; day laborer wages: Becker and Woessmann (2009) based on Social Security Statistics.

Figure A1
Income and Church Attendance, 1911



Note: Ln(teacher income) refers to log income of male elementary-school teachers. Church attendance refers to participations in Holy Communion over Protestants.
Data sources: church attendance: Hölscher (2001) based on Sacrament Statistics; teacher income: Galloway (2007) based on Education Census.

Figure A2
Change in Income and in Church Attendance, 1886-1911



Note: Ln(teacher income) refers to log income of male elementary-school teachers. Church attendance refers to participations in Holy Communion over Protestants.
Data sources: church attendance: Hölscher (2001) based on Sacrament Statistics; teacher income: Galloway (2007) based on Education Census.