

The Economic Effects of the Protestant Reformation: Testing the Weber Hypothesis in the German Lands

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Abstract

Following Max Weber, many theories have hypothesized that Protestantism should have favored economic development. With its religious heterogeneity, the Holy Roman Empire presents an ideal testing ground for this hypothesis. Using population figures of 272 cities in the years 1300–1900, I find no effects of Protestantism on economic growth. The finding is precisely estimated, robust to the inclusion of various controls, and does not depend on data selection or small sample size. Denominational differences in fertility behavior and literacy are unlikely to be major confounding factors. Protestantism has no effect when interacted with other likely determinants of economic development. Instrumental variables estimates, considering the potential endogeneity of religious choice, are similar to the OLS results.

Keywords: Protestantism, Culture, Economic Growth, Historical Development, Germany

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1. Introduction

What is the relationship between religious beliefs, with their impact on moral reasoning and the related behavioral incentives, and economic growth? This question has been a long-standing topic of research in the social sciences. Many observers have attributed the rise of England and the Netherlands in the 17th and 18th century, as opposed to the decline of Spain and Italy, to their Protestant faith (see Braudel 1982, p. 567). Indeed, Protestantism, with its emphasis on the believers' direct relationship with and responsibility toward God, seems intuitively conducive to a modern, individualistic and rational, view of mankind. As a consequence, several theories have been put forward as to how precisely Protestantism is supposed to affect economic growth, most famously by Max Weber in his essay about the *Protestant Ethic* (Weber, 1904/05, 1930). But in fact, few empirical studies have investigated the comparative performance of Catholics and Protestants over the long run.

The present paper exploits the history of early modern Germany to assess the causal link between Protestantism and economic growth. The “natural experiment” considered here—the forced imposition of religious denominations as a consequence of the Peace of Augsburg (1555)—gave rise to substantial heterogeneity of religious denominations across the Holy Roman Empire and allows the investigation of differences in growth patterns across the Protestant and Catholic parts of the Empire. Using a dataset of cities and their population sizes, I find no positive effect of Protestantism on economic growth over the very long run (1300–1900); in fact, the growth performances of Catholic and Protestant cities are virtually indistinguishable. Throughout the regressions, the estimated impact of Protestantism on city size is small in magnitude and precisely estimated, allowing to exclude meaningful magnitudes of the effects. These findings are robust to a wide array of alternative specifications, and are confirmed by an instrumental variables strategy.

The empirical setting used here presents a series of advantages. First, the homogeneity of religious choice: almost all the territories analyzed were either entirely Protestant or entirely Catholic from the 16th century until well into the 19th century. Second, the exogeneity of religious choice: an individual's religious denomination was not freely chosen, but was the result of the choice of the local ruler (prince, duke. . .) whether to join the new religion; this choice was imposed on the subjects according to the principle *cuius regio, eius religio* (whose realm, his religion). I will also investigate the exogeneity of the ruler's religious choice and discuss to what extent it can be considered orthogonal to his territory's latent characteristics. Last, as opposed to studies about religious minorities and their economic success (e.g., the Huguenots), religious choices in early modern Germany affected the whole spectrum of the local population, and are therefore more indicative of the net (causal) effect of Protestantism on economic activity.

The purpose of this paper is to analyze the long-term economic development of Protestant and Catholic regions over six centuries (1300–1900). The long time span

considered allows to verify the presence of potential pre-existing trends and more generally to quantify the time-varying nature of the postulated treatment effects. The main dependent variable used is the size of cities, which, as argued in the following sections, provides a good proxy for the level of economic development, especially in the pre-industrial world. No other variable among those commonly used in the analysis of historical trends of well-being (real wages, body heights, quality of housing...) is available with a comparable cross-sectional breadth and temporal frequency.

Figure 1 gives an intuitive impression of the relationship between choice of denomination and average city size. To control for pre-trends across groups before the actual onset of the Reformation, I classify a city as “Protestant” in the years before 1517 if it became Protestant by 1600. A broad pattern, which I will later substantiate through regression analysis, is evident from the graph: Protestant cities are not growing differently from Catholic cities in the period after the Reformation; if anything, differences in (log) city size become less evident over time.¹

[Figure 1 about here]

Because of this temporal scope, I may not be able to test specific channels of causation to the extent that a single cross-section in time or survey data would allow to do. However, in addition to the sizes of cities and their religious affiliations that form the core of my dataset, I collect a wide variety of additional variables on city and territory characteristics from several sources: these variables comprise information about geographic characteristics, such as latitude, longitude, or presence of a navigable river; about institutional features and economic characteristics, such as the prevalent inheritance rule or the number of monasteries. With these variables, I can assess the impact of a series of confounding factors and shed light on the extent to which the effects of Protestantism are heterogeneous across cities; the potential presence of such heterogeneities can suggest the prevalence of certain channels of transmission. Finally, I try to disentangle the causality nexus between Protestantism and economic success with an instrumental variables strategy.

There are several strands of research related to this paper. First, there are cross-country studies relating Protestantism to economic outcomes in a variety of countries, such as Grier (1997), and Ekelund et al. (2006, ch. 8), or Delacroix and Nielsen (2001). While the first two find a positive association of Protestantism and economic growth, the latter paper—examining late 19th-century Europe—points to the absence of a systematic relationship. All of these studies suffer from the difficulties of interpreting cross-country correlations in a causal sense. My work expands on this by examining the same relationship within a well-defined, culturally homogeneous setting. Moreover, the present paper is novel in its use of a panel

1. Two other facts are noticeable in this graph, and will be discussed later: cities of the Protestant camp start off smaller in 1300, and are more severely hit by the Thirty Years’ War (1618-1648), as evident from the decline between 1600 and 1700.

spanning six centuries, rather than a single cross-section, to measure the long-run effects of Protestantism.

A related branch of literature uses survey data to understand the effects of Protestantism on contemporary socioeconomic outcomes: see, for example, the works by Glaeser and Glendon (1998), Guiso et al. (2003), or Spenkuch (2011). This paper can support the interpretation of contemporary findings by providing a description of the historical evolution of differences in economic outcomes across Catholics and Protestants. Moreover, this paper expands on existing work on the economic differences between Protestants and Catholics in the specific context of Germany—an analysis begun by Offenbacher (1900), whose studies provided the empirical observations Weber based his theory on, and most recently continued by Becker and Woessmann (2009). The latter paper considers a cross-section of Prussian counties in 1871 and finds a positive effect of Protestantism on economic development, which, it is argued, can be entirely attributed to differences in literacy between Protestants and Catholics. I discuss the relationship between the findings in the present paper and in the article by Becker and Woessmann (2009) in section 6.3 below.

Finally, the evidence in this paper—i.e., the absence of visible growth effects of religious denomination in the Early Modern era, in an urban setting—is consistent with a recent, theoretical literature on the “spirit of capitalism” (Doepke and Zilibotti, 2005, 2008), where it is the economic circumstances faced by the economic agents that create incentives to accumulate virtues such as patience and willingness to save, independently of the specific religious denomination.

In the following section, I expose the arguments that have been proposed to link Protestantism with economic progress, and give an introduction to the historical events in the German lands of the Holy Roman Empire covered by my analysis. In section 3, I introduce the data used in this project and discuss the use of city sizes as a proxy variable. Section 4 provides econometric evidence on differences between Catholic and Protestant parts of Germany. In section 5, I discuss the endogeneity of religious choice and how this may affect the main empirical results. Section 6 considers competing explanations for the findings. Section 7 offers a conclusion.

2. Historical background

2.1. Protestantism and economic growth: A classic hypothesis

Since the seminal work by Max Weber, various theories about the relationship between Protestantism and economic development have been proposed and discussed. Understanding through which channels Protestantism could possibly affect economic growth will help in formulating hypotheses about where and when to find its potential effects: a specific causal link might only be relevant at a certain point in time, or be valid only for a certain subset of cities.

Weber's theory was motivated by the observation that in Baden (a state of southwest Germany) Protestants earned more than Catholics, and were more likely to attend technical rather than liberal arts schools. While Protestants in Baden were mostly Lutheran, the arguments in Weber's essay revolve for the most part around Calvinism and ascetic branches of Christianity. He hypothesized that—through the doctrine of predestination—Calvinism, and the Puritan sects in particular, were successful in instilling the view that work and money-making should be seen as a vocation, an end in itself. Weber argued that this attitude was central to the initial development of modern capitalism, but also that this role of religious views would not be necessary any more in a successfully industrialized society (Weber, 1904/05, ch. 2).²

In fact, other scholars of religious doctrines have also pointed out how Calvinism, emerging in a bourgeois and urban society, was particularly favorable to the instances of business life. Ernst Troeltsch (1931, p. 644) points out Calvinists' "industrious habits, detachment from the world, and rational and utilitarian spirit," which promoted the dedication to commercial activities and the accumulation of capital. Relatedly, attitudes toward usury laws and the charging of interest have been proposed as an important channel: Calvin approved of lending money against interest in business matters (*Letter on Usury*, 1545), whereas the Catholic church reasserted the prohibition of usury in the bull *Vix pervenit* as late as 1745 (Hauser, 1927). According to these theories, one should expect positive effects of Protestantism on economic growth in Calvinist cities, and in particular in those cities with a potential for trade and commercial activity.

In the territories of the Holy Roman Empire studied in this paper Lutheranism, rather than Calvinism, was the dominant branch of Protestantism. Troeltsch (1931, pp. 554-576) discusses the Lutheran stance towards economic questions. While Luther was generally more conservative in his economic ethic than Calvin—for instance, being opposed to interest on money lending—the doctrines of Lutheranism still had momentous economic consequences: the abolition of monastic orders, of mendicancy, the reduction of Church holidays, and the secularization of church holdings all released large amounts of labor and capital and arguably could have increased output. Furthermore,

[...] the control of the Church in the sphere of economics was removed, which had brought questions like the fixing of a just price, and of usury, before the judgment seat of the confessional. All matters of that kind were now handed over to the secular authority entirely, and to Natural Law. [...] The modern tendency of the Reformers consists essentially in handing over economic matters to the territorial lords, who are obliged and entitled to increase possessions and industry for the good of the whole [...] Thus with the blessings of Lutheranism and without ecclesiastical control they entered the path of mercantilism as well as that of an absolutist social policy. (Troeltsch, 1931, p. 554 and fn. 272)

2. Weber's seminal essay has been discussed widely since its publication. Among the innumerable rebuttals, I will only cite Brentano (1916), Tawney (1926), Robertson (1933), and Samuelsson (1961).

Thus we should expect Lutheranism to increase economic activity, especially where large Church holdings are dissolved, and to promote the emergence of modern centralized states.

Other researchers have downplayed the importance of Protestantism's economic teachings, while pointing out how other elements of the Protestant religions might have fostered growth-promoting attitudes. Merton (1938) discusses how some branches of Protestantism, such as the English Puritans and the German Pietists, might have favored the rise of modern Western science. Hill (1961) also considers the actual economic teachings of Luther and Calvin marginal, and points out instead how Protestantism, by stressing individual freedom and responsibility toward God, dispensed with the Church hierarchy and thus encouraged Protestants to become more flexible and open toward new ideas. If these theories are correct, Protestantism should have favored economic growth especially in the period after the Scientific and the Industrial Revolutions.

More recently, many economists have studied the importance of trust, on the assumption that trust is a fundamental element allowing for the establishment of market exchange. Building on Putnam (1993), who claimed that hierarchical religions such as Catholicism discourage "horizontal" ties between people and hence the formation of trust, La Porta et al. (1997) show that countries with hierarchical religions perform comparatively worse on a wide range of contemporary outcomes, relating to government efficiency, civic participation, the quality of social infrastructure, and the formation of large corporations. This relationship is further examined by Guiso et al. (2003) using data from the World Values Survey: compared to Catholics, Protestants are found to be significantly more likely to trust strangers, less likely to cheat on taxes and to accept a bribe. Catholics are, perhaps surprisingly, more likely to teach thrift to their children, and to have a positive view of competition.³ These findings also suggest a beneficial effect of Protestantism, especially in an urban and commercial setting.

Finally, Becker and Woessmann (2009) have suggested a human-capital based theory of Protestant advantage. They argue that the differences in economic outcomes between Catholics and Protestants in Prussia around 1871 can be explained by differences in literacy. These differences trace back to Luther's exhortation to be able to read and interpret the Bible on one's own, which led to the establishment of elementary schools and thus to the accumulation of human capital all over Protestant territories. If literacy is important for the development of an industrial economy, but is less productivity-enhancing in the agricultural sector, we should expect the Protestants' accumulation of human capital to exert positive effects particularly during the 19th century.⁴

3. Relatedly, Blum and Dudley (2001) propose a link based on network externalities; they suggest that Protestants are less likely to defect in a game with repeated interactions (because of the absence of easy mechanisms of penance), which in turn favors the establishment of trade networks.

4. This relationship has also been put forward by Sandberg (1979) to explain Sweden's long-run growth performance. While a classic view downplayed the importance of human capital during the British

2.2. *Historical background: Protestantism in Early Modern Germany*

The political and religious situation in Germany at the time of the Reformation was peculiar within the European context and is crucial for the empirical strategy to identify the economic effects of the Protestant Reformation. There were three different phases of the spread of Protestantism across the German lands (until 1555; 1555–1624; after 1624); these phases are distinguished by the different legal context determining religious choice.⁵

Institutions and actors. The territory of the Holy Roman Empire occupied mainly the present-day central European states of Germany, Austria, Belgium, Luxembourg, the Czech Republic, Switzerland, and parts of France and Poland. The Emperor was an elected sovereign, chosen by seven princes of the Empire (the Electors).⁶ He wielded less power than other contemporary rulers, such as the King of France or the King of England; most elements of sovereignty were exercised by the princes of the Empire instead.⁷ There were hundreds of territories ruled by princes, dukes, counts, or Church dignitaries, such as prince-bishops; all of these were sovereign entities but for the largely nominal primacy of the Emperor. Some cities were “Free Imperial cities,” being directly subjected only to the suzerainty of the Emperor. Most of the other cities were located in one of the territorial lords’ territories and hence were subject to his jurisdiction, while still enjoying some degree of self-government.

Beginning of the Reformation. The sale of indulgences by the Church prompted Martin Luther, a hitherto unknown Augustinian monk and lecturer at the University of Wittenberg, to express his objections to this practice in 95 theses on October 31, 1517. He was not the first one to protest against these practices; however, he could count on a series of fortunate circumstances which would warrant success to his endeavor. Among these circumstances were the power struggles between the Emperor, the Pope, and the territorial lords; the contemporary intellectual networks; technological breakthroughs such as Gutenberg’s printing press (Rubin, 2014); and the ongoing fight against the Turks in Austria (Iyigun, 2008). At first, many, including the Pope, dismissed his action as an minor protest without consequences. Luther’s pamphlets could spread rapidly and be translated in multiple languages.

From the beginning, Protestantism exerted a major attraction on urban dwellers, both in Free Imperial cities and in cities subject to the jurisdiction of a territorial lord. Widespread literacy, the presence of humanist circles, universities, and printing

industrial revolution (see Mitch 1999), Becker et al. (2011) argue that in the case of Prussia pre-existing levels of schooling substantially accelerated industrialization in the 19th century.

5. This historical summary is based largely on Schilling (1988). Good English-language introductions to the Reformation in Germany are provided by Scribner (1994) and Dixon (2002).

6. These were the prince-bishops of Cologne, Mainz, and Trier; as well as the King of Bohemia and the Electors of Brandenburg, Saxony, and the Palatinate.

7. While in states like England and France the king was able to impose his supremacy over local lords in the late Middle Ages, in the Holy Roman Empire the opposite turned out to be true: regional lords gained power at the expense of the Emperor (North and Thomas, 1973, pp. 79-86).

presses, or the ideology of freedom intrinsic to the nature of the city are among the reasons for this phenomenon. By the end of the 1520s the vast majority of Free Imperial cities had become Protestant. Many of the cities on princely territories had also started to replace Catholic priests with Lutheran preachers, thereby putting pressure on their territorial lords who had not yet formally introduced the new faith.⁸

The princes of the Empire were more cautious in joining the bandwagon of Protestantism. They had to balance various factors: on the one hand, the Estates representing the cities and the minor nobility would often push in favor of adopting the new faith. On the other hand, princes were reluctant to unsettle the delicate balance of power between them, the Emperor, and the Church. In that first period, it was not clear whether and how the princes had the right to change the fundamentals of faith in their territories, or even to seize the Church's holdings.

The first green light toward the formal introduction of the Reformation was given at the First Diet of Speyer in 1526,⁹ when a new formula was coined: princes should behave in religious matters "as they may hope and trust to answer before God and his imperial Majesty" until the meeting of a general council of the Church. As the general council envisaged by the parties involved failed to materialize, this formula became in practice a *laissez-passer* for the official introduction of Reformation and of separate state churches in German territories.

Peace of Augsburg (1555). In the late 1540s, an attempt undertaken by Emperor Charles V to restore his authority and the Catholic faith proved short-lived. At the Imperial Diet of Augsburg in 1555, the Emperor accepted a peace treaty which included the formula known as *cuius regio, eius religio*: it gave princes the right to impose their preferred denomination upon their subjects. This policy ended 38 years of legal limbo (1517–1555), in which uncertainty had reigned as to whether princes were allowed to introduce the Reformation. Furthermore, it guaranteed 60 years of relative peace until the outbreak of the Thirty Years' War, and sanctioned the primacy of the princes over the Emperor in religious matters. Several more territories converted formally to Protestantism in this period, including some prince-bishoprics.

Peace of Westphalia (1648). The Thirty Years' War (1618–48) would hardly change the denominational split in the Empire, despite its huge toll of lost lives and destruction. The Peace of Westphalia in 1648 established retroactively January 1st, 1624 as the *normal date*: the denomination of a territory at that point in time would have to be maintained; the conversion of a prince to another faith would not entitle him any more to force his conversion upon his subjects. Some conversions of princes occurred in fact in subsequent years, mainly for political reasons. For example, the staunchly Lutheran kings of Saxony converted to Catholicism in the 18th century in the hope of obtaining the Polish crown. This choice had no effect on

8. On this topic, see the works by Ozment (1975), Dickens (1979), and Moeller (1987).

9. Imperial Diets were assemblies of all princes of the Empire which convened at irregular intervals.

the citizens of Saxony, who did not see a Catholic church in their cities until well into the 19th century.¹⁰ For the vast majority of the territories in Germany no more denominational changes took place after 1624.

In sum, this unique historical process guaranteed a remarkable degree of confessional homogeneity and continuity within territories or cities until the 19th century, when barriers to the free movement of peasants were finally removed. To show exemplarily how stable these patterns proved to be, Table 1 presents data from the (denominationally mixed) region of Westphalia, in northwest Germany. Using the results from the Prussian census of 1849, reorganized to match historical borders, the table shows how, even 50 years after the collapse of the Holy Roman Empire and after the beginnings of industrialization, most people still resided in denominationally homogeneous areas which reflected the arrangements set by the Peace of Westphalia.

[Table 1 about here]

3. Data: City sizes as a proxy for economic development

Observing the evolution of city sizes provides us with arguably one of the best measures of economic development in pre-industrial times. Cities were the centers of learning, of political administration, and of economic activity. Books were printed in cities, artisans produced their tools and goods in cities, peasants came to cities to exchange their agricultural produce. In a Malthusian world in which population growth reacts to economic conditions, or in a model with unlimited supply of labor from the countryside, improvements in urban total factor productivity should be reflected in city sizes. Hence, if Protestantism did indeed increase the productivity of urban dwellers—by providing them with a peculiar “work ethic,” by encouraging the accumulation of human capital, or by approving of modern commercial practices, for example—this should translate into larger city sizes.

Paul Bairoch (1977, 1988) and Jan de Vries (1984) were among the first scholars to illustrate the links between city sizes and economic development. A wide variety of papers in the economics and economic history literature have subsequently used their datasets of city sizes, and showed how likely determinants of long-run economic development affect the growth of cities. For example, DeLong and Shleifer (1993) find that more representative forms of government (oligarchies rather than

10. More difficult was the case of Protestant territories conquered in war or through dynastic succession by Catholic princes; most notably, this was the case of the (Rhenish) Palatinate, a Calvinist territory inherited by a Catholic line of the Wittelsbach family. In this case, it depended on the willingness of the institutions of the Empire (notably the Imperial Chamber Court, the *Reichskammergericht*) and the credibility of the other princes' threats whether the new ruler was successful in imposing his faith. In general, cities, with their degree of self-government, could avoid interferences, whereas the broad mass of people in the countryside might have been more easily converted. This motivates the use of the denomination resulting from the normal date in the empirical analysis.

autocratic princes) had a positive impact on urban growth in the medieval and early modern periods. Relatedly, Acemoglu et al. (2005) have shown that those European cities that could engage in trade relationships with the colonies across the Atlantic grew faster in the period after 1500.

In the context of the analysis conducted in this paper, two assumptions are crucial in order to make credible inferences based on city sizes. First, the Malthusian response of population to economic shocks must be comparable across Protestant and Catholic cities. It could be conceivable that Protestant cities became more productive over time, but that this increased productivity was counteracted by a shift in demographic behavior toward more restraint, such that no increase in population resulted. I discuss further below, in section 6.1, why any plausible differences in fertility behavior are unlikely to explain the absence of results. Second, migration into the cities—necessary because of high urban mortality rates—had to occur along denominational lines, with Catholics migrating into Catholic cities and vice versa. Otherwise, a dilution of the original denominational ratio would have occurred over time. In fact, all available evidence suggests that even in mixed-denomination regions, migration flows were strictly determined by the religious denomination of the target city (see François, 1982, p. 49; Rödel, 1985, p. 322).

To further validate the use of city sizes as proxy, I use the Prussian manufacturing census of the years 1816–1821, one of the earliest and most detailed comprehensive censuses of population and economic activity (Krug and Mützell, 1825), and compare city sizes with a variety of social and economic outcomes.¹¹ The results from this census are relevant because they provide evidence on the relationship between city size and economic outcomes in an epoch recent enough to have high-quality statistical data, but early enough for the cities not to be affected yet by the Industrial Revolution.

The regressions of Table 2 show that city size is strongly correlated with indicators of economic development: the supply of education (measured by the teacher-to-student ratio in elementary schools), accumulated capital (embodied by the sums insured with the local fire insurance company), indicators of economic activity (such as the tax on businesses), and with the quality of housing, as represented by the percentage of houses with stone walls (as opposed to timber) and with shingled roofs (as opposed to thatched). At the same time, city size is not clearly related with any particular branch of economic activity, as emerges from the lack of correlation with the number of looms or merchants (columns (4) and (5)). As evident from panel B, these results also hold when the sample is limited to the smaller subset of those cities in the Prussian manufacturing census that are also featured in the Bairoch et al. (1988) dataset used in the main part of this paper.

[Table 2 about here]

11. Detailed descriptions of the variables used are provided in Appendix A.1.

To test the link between Protestantism and economic development, I use the population estimates by Bairoch et al. (1988) to construct a dataset encompassing 272 cities of the former Holy Roman Empire over six centuries—this compilation includes all cities that reached the threshold of 5000 or more inhabitants in or before 1800.¹² The years considered in my panel are spaced in 100 years' intervals from 1300 to 1700, and then in fifty years' intervals from 1750 to 1850, as in Bairoch et al. (1988). In addition, I include city size data for the years 1875 and 1900, which are drawn from national statistics (*Statistik des Deutschen Reiches* for Germany; *Statistisches Jahrbuch* for Austria). The distribution of Catholic and Protestant cities in my dataset is shown in Figure 2. As can be seen, Catholic cities generally cluster in the southeastern part of the Empire, Protestant ones in the northeast, whereas in the Western half of the Empire the picture is mixed.

[Figure 2 about here]

Summary statistics of the variables in the dataset are reported in Table 3.¹³ The unconditional differences in means of city size show that Protestant cities start smaller than their Catholic counterparts in 1300, but later make up for this difference. This comparison, however, is problematic, due to the inclusion of additional cities as time progresses. The second and third panel of the table confirm that there are some differences across the two subsamples. In terms of their geographic characteristics (second panel), Protestant cities are more likely to be in the north of the Empire (higher latitude values) and thus closer to Atlantic ports. They are also closer to Wittenberg, the city where Martin Luther lived and taught, but not to the other centers of the Reformation, such as Geneva and Zurich. Finally, Catholic cities have a stronger presence of the Church (more monasteries as of 1517) and are more likely to be in a region with neighboring cities of different religious denomination.

[Table 3 about here]

4. City growth in Protestant and Catholic territories

4.1. Empirical framework and baseline results

To capture differentials in city growth between Protestant and Catholic cities I use a generalized differences-in-differences setup. The simplest conceivable regression equation relating the outcome of interest, city size u_{it} , to denominational affiliation

12. The potential selection bias inherent in this definition is discussed in Supplementary Appendix 1, Table A.i. The definition of the Holy Roman Empire considered here encompasses all territories that were active members of the Empire in the 16th century, and that continued to be part of it until its dissolution in 1803. It thus does not include, for example, Switzerland, the Netherlands, or Northern Italy.

13. Full descriptions and sources for the data are given in Appendix A.2.

is the following:

$$\ln(u_{it}) = \chi_i + \zeta_t + \alpha \cdot Prot_i \cdot Post1517_t + \varepsilon_{it} \quad (1)$$

In this baseline differences-in-differences setup, I allow for a full set of city fixed effects (χ_i) and year fixed effects (ζ_t). They will capture the effect of any time-invariant, city-specific characteristic, or of any period-specific shock that affects all cities, respectively. In addition to these, the interaction term between a city's religion, $Prot_i$, and an indicator for the time periods after the inception of the Reformation, $Post1517_t$, captures the effect of Protestantism on city size.¹⁴ The estimated coefficient α will reflect the average difference in log city size between Protestant and Catholic cities in the period after the beginning of the Reformation.

The treatment effects of Protestantism are, however, unlikely to be constant over the whole time period considered, from the beginning of the Reformation in 1517 until 1900. An alternative setup would model the treatment effects as a linear function of time:

$$\begin{aligned} \ln(u_{it}) = & \chi_i + \zeta_t + \alpha_{\text{post}} \cdot Prot_i \cdot Post1517_t \\ & + \alpha_{\text{posttrend}} \cdot Prot_i \cdot Post1517_t \cdot Trend_t + \varepsilon_{it} \end{aligned} \quad (2)$$

The coefficient α_{post} represents an average post-treatment difference in city size; in addition to that, $\alpha_{\text{posttrend}}$ captures any linear evolution of city size differences over time. The time trend $Trend_t$ is defined as $(t - 1517)/100$, and is hence measured in centuries.

The most flexible approach would allow the treatment effects of Protestantism to vary arbitrarily in any time period considered, by interacting the variable $Prot_i$ with a full set of dummies for every time period in the dataset (except one):

$$\ln(u_{it}) = \chi_i + \zeta_t + \sum_{\tau \in \Gamma} \alpha_{\tau} \cdot Prot_i \cdot I_{\tau} + \varepsilon_{it} \quad (3)$$

The set Γ of Protestantism/year interactions included in the regression comprises all years in the dataset after the beginning of the Reformation as well as 1300 and 1400, leaving the year 1500 as the omitted category. The counterfactual inclusion of interaction terms relating to the years 1300 and 1400 allows to control for possible pre-trends in the set of cities that would later become Protestant. The coefficients α_t can be seen as the difference in log city size between Protestant and Catholic cities,

14. As in the context of Figure 1, the variable $Prot_i$ is equal to one throughout 1300-1900 if the city became Protestant before the normal year 1624, and zero throughout if it remained Catholic. Note that the counterfactual definition of a city as "Protestant" already in the years 1300–1500 serves only the purpose of controlling for pre-trends. The variable $Prot_i$ varies over time, switching from one to zero, only for the three cities in the dataset that, after introducing the Reformation in the 16th century, switched their denomination between 1600 and 1624. For ease of exposition, I will use the notation $Prot_i$ instead of $Prot_{it}$. All regressions are substantially unchanged if I drop these switching cities from the database.

conditional on city and time fixed effects, relative to the difference in log city size in the omitted year, 1500.

The regression results can be seen in Table 4; panels A–C reflect the setups of equations 1–3, respectively.¹⁵ From the estimates in column (1), there appear to be no economic effects of Protestantism. Almost all of the coefficients are far from conventional levels of significance. In the simple differences-in-differences regression of panel A, the estimated effect suggests a minuscule and not significant difference in log city size (0.022). When analyzing how the effect of Protestantism varies over time in the fully flexible setup of panel C, three facts stand out. First, a negative effect appears in 1700: this can be attributed to the greater damage sustained by the Protestant areas during the Thirty Years’ War (1618–1648). Second, the coefficients become markedly positive, while still small in magnitude and not significant, towards the end of the 19th century. Finally, there are no indications of a pre-trend, as evidenced by the small and insignificant coefficients relating to 1300 and 1400. A test of joint significance of all post-1517 coefficients (i.e., the interactions of “Protestant” with all year dummies from 1600 onwards) rejects the null (p-value: 0.017); however, this is due largely to the one negative coefficient in 1700. When testing the joint significance of the coefficients relating to the years 1750 and later, the null is not rejected, with a p-value of 0.292.

[Table 4 about here]

As evident from the summary statistics in Table 3, cities that would later become Protestant are different from their Catholic counterparts along a wide array of characteristics. To the extent that these time-invariant characteristics (such as geographic features) have a constant effect on city size, this is captured by the city fixed effects. It is conceivable, though, that these features exert an effect on city size that varies over time; for example, distance to the Atlantic ports may be important only in the period after 1500, after the discovery of the Americas. Following a setup similar to equation (3), we can investigate this and other hypotheses by interacting time-invariant characteristics of cities, $control_i$, with a full set of time dummies:

$$\ln(u_{it}) = \chi_i + \zeta_t + \sum_{\tau \in \Gamma} \alpha_{\tau} \cdot Prot_i \cdot I_{\tau} + \sum_{\tau \in \Gamma} \beta_{\tau} \cdot control_i \cdot I_{\tau} + \varepsilon_{it} \quad (4)$$

Analogously, a full set of interactions of control variables with time dummies can be included in the regression setups of equations (1) and (2).

Column (2) reports the results of a regression including the full set of interactions of year dummies with latitude and longitude; while the estimates of these interactions (not reported) are mostly significant, the coefficients capturing the economic effects of Protestantism are mostly unchanged, being generally slightly lower in magnitude than before.

More specifically, one can consider why latitude and longitude should affect economic outcomes, and what they are proxying for. The former can be seen as

15. Across all regressions, standard errors are clustered at the level of territories.

proxying for the closeness to the Atlantic seaports. The latter is correlated with the age of a city: the further east, the younger cities are, as they were founded during the eastward movement of the Germanic populations during the 10th–13th century. In that sense, any differential growth pattern of cities located further east could be seen as convergence toward a city-specific steady state of cities starting smaller. Column (3) controls for time-varying effects of distance to the Atlantic ports and of log city size in 1300; this is a very flexible way to control for long-run convergence patterns. The results from this setup largely confirm the prior estimates in column (2). In all further regressions, I control for time-varying effects of initial city size and distance to Atlantic ports, unless otherwise noted.

All results discussed so far are based on the 272 cities that lay in the German-speaking parts of the Empire, thereby excluding 25 cities of the Empire which lay in Bohemia, Moravia, Carniola (Slovenia) and parts of Northern Italy. This is motivated by the desire to consider not only a homogeneous legal setting, but also a homogeneous cultural space, where the message of the Reformation could spread without the need for translation. Column (4) shows that the results are virtually unchanged when including the other 25 cities.

The vast majority of the territories considered in the analysis are Lutheran. If we take a more restrictive view of Weber's original hypothesis, though, a positive effect on economic development should be expected in particular from the Reformed (i.e. Calvinist¹⁶) denomination, with its view on the doctrine of predestination. If this was true, the previous regressions, which pooled Lutheran and Reformed cities under the label "Protestant," might be misleading, and the estimated coefficient biased downwards.

Only a minority of German states chose to adopt the Reformed faith over the Lutheran alternative: the Rhenish Palatinate, Hesse, and Bremen are some of the few notable examples. These territories comprise 21 cities in my dataset, as opposed to 163 Lutheran cities. Regression results in column (5) are based on a definition of "Protestant" that encompasses only these (Reformed) territories. The main finding is unchanged: there is no evidence for pre-trends, but no evidence for any substantial effect, positive or negative, after the inception of the Reformation, either.¹⁷

Column (6) investigates an alternative hypothesis: in this case, the dependent variable is not total population of a single city, but rather total urban population by territory. Based on the Bairoch et al. (1988) dataset, I aggregate the population of cities at the level of territories; the latter are defined using historical borders,

16. Perhaps confusingly, not all religious denominations that emerged from the Protestant Reformation are "Reformed;" the latter term is used to classify Calvinist or Zwinglian (as opposed to Lutheran) branches.

17. Note that in this regression the implicit comparison group for Reformed (Calvinist) cities are Lutheran and Catholic cities together. The working paper version of this paper (Cantoni, 2010, section 4.4) presents also results with separate interaction terms between a "Lutheran" indicator and time dummies; in this case, the results can be interpreted as the difference between Reformed and Catholic cities only. Results are very similar.

keeping the borders constant over the period analyzed.¹⁸ This specification controls for the extensive margin of urban growth: some territories might have become more urbanized by creating a series of new, smaller cities, rather than by continuously increasing the size of existing cities.¹⁹ The results of the estimates in column (6) are very similar to the regressions which use city size as the dependent variable. All estimated effects are very close to zero, with the only exception of a negative effect in 1700 stemming from the Thirty Years' War in the Protestant territories.

4.2. Interpreting the magnitude of estimated effects

Given the inability to reject the null hypothesis of no effect of Protestantism, it is important to determine whether this inability is due to the small power of the statistical tests applied. In fact, the sample size is comparatively large (almost 1900 observations) and the standard errors relatively small, being in the same order of magnitude as the point estimates. This makes it more likely that the estimated effects are indicative of a true absence of effects, rather than of an inability to reject the null hypothesis. To reinforce this observation, one can try to gauge the precision of the effect by considering the 95% confidence interval around the point estimates, and see which magnitudes of the effect can be safely excluded.

Figure 3 gives a visual representation of the baseline estimates of Table 4, columns (1) and (3), panel C. In both cases, the upper confidence bounds lie around 0.2–0.4, which would suggest that, conditional on the covariates, Protestant cities are at most 22–49% larger than their Catholic counterparts. A log difference of 0.2–0.4 corresponds to approximately one third of the standard deviation of log city sizes in the dataset for any of the years 1750–1900. That is, even the upper bound of the confidence interval suggests that the implied effect of Protestantism are at best minor.

[Figure 3 about here]

An alternative way to gauge the magnitude of coefficients relating to city sizes is to model explicitly how shocks to urban productivity affect city sizes. In a simple model of a Malthusian economy, population size reacts to shocks in productivity (as they could have arguably occurred through the adoption of Protestantism). The elasticity of city size with respect to productivity shocks is determined by the

18. In general, if territories changed hands or lost their independence, they would do so as a whole and would still be treated as distinct units. For example, the Duchy of Cleves was given to the Margraves of Brandenburg as a result of the Treaty of Xanten (1614); however, the Duchy of Cleves continued to exist as a legal unit afterwards, and the Margrave of Brandenburg would simply add “Duke of Cleves” to his collection of titles. Therefore, the Duchy of Cleves is considered a “territory” throughout the period considered in the dataset.

19. Note, however, that only 11 cities among those in my dataset were founded after 1517. Entry into the dataset occurs mainly because many cities, while already existing, are too small and have no reported population sizes for the earlier dates.

elasticity of output with respect to the reproducible factor of production, labor.²⁰ If $\beta < 1$ is the elasticity of output with respect to labor, city sizes react to shocks in urban productivity with an elasticity equal to $1/(1 - \beta)$. This implies that, for the case of $\beta = 0.5$, an increase in city size of 0.2–0.4 log points can be caused by an increase to urban productivity of about 0.1–0.2 log points, or 11–22%. Even considering the upper bound of the estimated effects on city size, the implied underlying changes in productivity appear minor.

Finally, one can compare these magnitudes to other estimates of determinants of city size. Acemoglu et al. (2005) use an analogous empirical setup to determine the effect of being located on an Atlantic port on log city size; the sample they consider are cities from the Bairoch et al. (1988) dataset located all across Europe. The corresponding point estimates for the years 1700–1850 vary between 0.7 and 1.1 (table 5, p. 560); these can be directly compared to the estimates of α_τ from regression equations 3 and 4. Thus it appears from this comparison that even the upper bound for the estimated effect of Protestantism is far from the effects that other likely determinants of growth have on city size.²¹

4.3. *Robustness: Results in subsamples, urbanization rates, heterogeneity of effects*

To investigate the robustness of these results, I first apply the regression setup described in equation (4) to a series of subsets of my data; these results can be found in Supplementary Appendix 1. The use of only a subset of the 272 cities can be motivated either on econometric or on historical grounds.

I limit the analysis to the 221 cities west of the river Elbe, as east of the Elbe stronger forms of serfdom persisted until the early 19th century, which hampered free movement of labor to the cities. I control for the population loss occurred as a consequence of the Thirty Years' War (1618–1648), and I allow for differential effects of the war across Protestant and Catholic cities. To take into account the selection/survivorship bias arising from the inclusion criterion of cities in the Bairoch et al. (1988) dataset, I consider first only the balanced sub-panel of 45 cities with recorded population data in all years, and second only those 126 cities that are large enough to feature a population estimate for 1500. I exclude the 38 Free

20. Assume, e.g., a production function of the type $Y = AL^\beta\Lambda^{1-\beta}$, where Λ is a factor of production in limited supply. There are no property rights over Λ ; real incomes are given by the average product of labor and are constant (population adjusts correspondingly to shocks in A). Alternatively, assume that Λ belongs to a landlord who pays the marginal product of labor to workers, and is otherwise extraneous to the Malthusian dynamics of the model (see Galor 2005, p. 240).

21. These point estimates can also provide a natural alternative hypothesis against which to gauge the probability of making a type II error, i.e. failing to reject the null hypothesis (of a zero effect of Protestantism) when in fact it is false. Taking the the baseline specification with controls of Table 4, column (3), the effect of Protestantism on log city size in, e.g., 1750 is 0.021 (s.e. 0.147). This implies that the probability of making a type II error at the 5% significance level, under $H_a : \beta_{1750} = 0.7$, is $0.0014 = 1 - \phi[(0.7 - (0.021 + 1.645 \cdot 0.147))/0.147]$.

Imperial cities in the dataset, which enjoyed a radically different institutional setup than the territorial states of the Empire. Based on Huppertz (1939, map I), I split the sample into territories with partible and impartible inheritance rules, as this might have arguably affected the potential for city growth. Finally, to make my results comparable with the analysis of Becker and Woessmann (2009), I limit the analysis to those cities that were part of Prussia in 1871. Across all of these specifications, the full thrust of the baseline regressions is preserved: no clear and consistent effect of Protestantism on city size can be detected, neither positive, nor negative, and the precision of the estimates allows to exclude meaningful magnitudes. Full results of these regressions are provided in Supplementary Appendix 1, Table A.i.

Motivated by the literature reviewed in section 3 and the findings of the Prussian manufacturing census of 1816–1821 (Table 2), the analysis has so far relied on city sizes as an indicator of economic development, and measured the impact of Protestantism on city sizes. However, urbanization *rates*, defined as the share of urban dwellers over total population in a region, may be a better indicator of economic development, capturing the shift of an agrarian society towards commercialization and industrialization.²² Estimating urbanization rates for periods before 1800 is problematic mostly for the absence of reliable data about total population sizes at the regional level (population censuses were first conducted, for most territories, only in the 19th century). I resort to a dataset of urbanization rates for 20 regions of Germany in the period 1700–1900; for the period before 1700, no sufficient sources for population sizes could be found.²³

The drawback of the use of urbanization rates as the dependent variable is the impossibility to control for pre-trends in the regions that would later become Protestant. At the same time, urbanization rates can provide a useful check of the patterns detected using city sizes as dependent variable. Table 5 presents results of a regression based on the setup of equation (3). The main explanatory variable is now, instead of a binary indicator of religious affiliation, the share of Protestants among the general population in each of the 20 regions according to the 1900 census.²⁴ The omitted year, in the set of interaction terms, is 1700, so that the estimated coefficients can be interpreted as the difference in urbanization rates (in percentage points) between a region that is fully Protestant and one that is fully Catholic, relative to 1700.

[Table 5 about here]

22. Urbanization rates are usually defined as the share of people living in cities above 5 000 or 10 000 inhabitants over total population. They have been recently used as indicators of economic development across countries by, among others, Acemoglu et al. (2002), Acemoglu et al. (2005), Nunn and Qian (2011), and Greif and Tabellini (2012).

23. See appendix A.3 for a description of the dataset.

24. The 1900 census results are used as they allow for precise matching with the borders of the 20 regions considered. For a subset of regions, the 1900 shares can be compared with the census results of 1820: the correlation coefficient across time is 0.98, which confirms the remarkable persistence of denominational affiliations across Germany.

The results of Table 5 confirm the findings based on city sizes as the dependent variable. Protestant regions do not feature significant deviations in their evolution of urbanization rates until 1900. The point estimates suggest a difference of at most 5.6 percentage points in favor of Protestant regions; a small effect, relative to a standard deviation of urbanization rates in the dataset of 14.8 percentage points.

As an additional robustness check, which could plausibly give hints as to which mechanisms are at work, I also analyze the potential heterogeneity of effects across subgroups of cities; these results are shown in Supplementary Appendix 3. Two potential sources of heterogeneity are discussed: first, the interaction of Protestantism with opportunities for commerce (as proxied by the presence of a river or sea port), and second, the differential strength of the Church before the Reformation (as proxied by the number of monasteries in each city). In fact, the results of Supplementary Appendix 3 lend no support to these hypotheses: the absence of effects of Protestantism does not result from considerable heterogeneity of the effects along some observable dimension.²⁵

5. Endogenous adoption of the Reformation

To understand the causal nexus between Protestantism and economic growth, we also need to shed light on the circumstances of adoption of the Reformation. For the large majority of the population in the Holy Roman Empire the new religion was imposed from above, enacting the principle of *cuius regio, eius religio*; this is even more true for the generations born after the Peace of Westphalia, whose religion had been determined by some princes' choices decades or centuries ago. However, in the 16th century rulers could have chosen to follow the new religion out of unobserved reasons that correlate with the potential for economic growth.

Two possible sorts of endogeneity are conceivable here. On the one hand, it could be that cities or territories which were already more inclined to commercial activity saw the growth-promoting potential of the Protestant Reformation and therefore chose to adopt it. For example, Ekelund et al. (2002) argue that Protestantism was more likely to be adopted in emergent, entrepreneurial societies. In that case, cities with a predisposition for economic growth would be those that became Protestant, and OLS estimates would overstate the causal effect of Protestantism. Alternatively, it could be that cities with a higher potential for economic growth around 1500 chose to remain Catholic. The Catholic Church was famed for its rent-extraction practices, but it also guaranteed a legal and cultural framework to be shared with other trading

25. Other potential sources of heterogeneity, such as the impact of the Black Death of 1348–1350, the timing of introduction of the Reformation, or the suitability of surrounding land for growing potatoes, are discussed in Supplementary Appendices 4 and 5.

partners; therefore, it could be that cities with more interest in economic activity chose the less risky alternative and remained Catholic.²⁶

An instrumental variables strategy may alleviate these concerns about endogeneity. As first suggested by Becker and Woessmann (2009), the distance to Wittenberg—the city where Martin Luther first presented his 95 theses, and where he taught at the local university—can be used as an instrument that predicts the adoption of the Reformation across German territories. Being close to Wittenberg mattered less for the spread of ideas—in fact, thanks to the recent invention of the printing press, Luther’s theses were rapidly known all over Germany within months—but rather because of geopolitical considerations (Cantoni, 2012). Introducing the Reformation was a risky venture for a territorial lord, especially in the years until 1555, for the imperial troops under Charles V could have intervened and imposed the return to the old faith. Given this threat, a territory was more likely to embrace the Reformation if its neighbors had already done so; closeness to a powerful Lutheran state, such as Saxony, could have provided easier military defense in case of military conflict. Saxony, the territory around Wittenberg, was an early adopter of Luther’s ideas, the first one to reform the Mass, the first one to establish a territorial church, the first one to perform a church visitation already in the 1520s and 30s (Dixon, 2002, p. 122).

In fact, distance to Wittenberg is a robust predictor for the eventual adoption of Protestantism across the cities and territories of the Holy Roman Empire.²⁷ The simple correlation coefficient is equal to -0.482 , indicating a clear negative relationship between distance to Wittenberg and likelihood of adoption of Protestantism. Table 6 shows results from a regression predicting the adoption of the Reformation by 1600 across the 272 cities used in this dataset; this can be seen as conceptually similar to a first-stage in a regression where “Protestantism” is the endogenous variable.²⁸ The setup is a linear probability model, with a binary dependent variable.

[Table 6 about here]

26. Weber shared the view that the Catholic Church practiced a form of control over social and economic affairs that was severe in principle, but flexible in practice: “[...] *the Reformation meant not the elimination of the Church’s control over everyday life, but rather the substitution of a new form of control for the previous one. [...] The rule of the Catholic Church, ‘punishing the heretic, but indulgent to the sinner,’ as it was in the past even more than today, is now tolerated by peoples of thoroughly modern economic character, and was borne by the richest and economically most advanced peoples on earth at about the turn of the fifteenth century.*” (Weber 1930, p. 36)

27. Distance to Wittenberg is computed as great circle distance (“as the crow flies”). Given the absence of major natural obstacles (e.g. large mountainous chains) in Germany’s physical geography, this can be taken as a reasonable approximation of actual travel time.

28. In the setup used to analyze the full panel dataset, the actual first stage will be different due to the presence of city and time fixed effects, and the interaction of “Protestantism” with year dummies. However, the strength and robustness of distance to Wittenberg as predictor of adoption of Protestantism hold as well in the IV setup.

As evident from all columns, distance to Wittenberg is a strong and robust predictor; a city that is 100km closer to Wittenberg is 14–18% more likely to become Protestant by 1600. The t-statistic on the respective coefficients is always close to or larger than 5, eliminating any concern about weak instruments. Geneva and Zurich, the cities where Calvin and Zwingli lived and taught respectively, do not seem to have exerted a similar spatial influence on the religious decisions of German states (column (2)). This is not surprising, as Lutheranism is the dominant form of Protestantism in Germany. Adding controls for latitude, longitude, or distance to the Atlantic ports and city size in 1300 does not affect the results (columns (3) and (4)). Cantoni (2012) shows that this result holds even after controlling for a large variety of economic and/or institutional covariates.

Is it reasonable to use distance to Wittenberg as an instrumental variable; i.e., are there any other reasons for which distance to Wittenberg might matter for economic growth, except through the promotion of the adoption of Protestantism? Saxony and the region around Wittenberg are unlikely candidates for the role of an economic magnet, exerting a positive (or negative) influence on the growth trajectories of its neighbors. The loss of the electoral privilege in 1547 and the division into many different lines of succession made Saxony, the territory of Martin Luther, a marginal player in the Empire’s economic and political destinies. Moreover, distance from Wittenberg does not correlate with any other geographically distributed factor—such as distance to the commercial centers of Northern Italy or Flanders, distance to Atlantic seaports, or distance to the iron ore and gold mines of the Bohemian forest—that may, in fact, have an influence on economic potential.²⁹

A regression setup taking into account the endogeneity of the decision to adopt the Reformation would be equivalent to equations (1)–(3), but where the interaction terms including $Prot_i$ are instrumented by the respective interaction terms with the instrumental variable instead. For the case of equation (3), this is conceptually equivalent to the following two-stage least squares setup:

$$\ln(u_{it}) = \chi_i + \zeta_t + \sum_{\tau \in \Gamma} \alpha_\tau \cdot \widehat{Prot_i \cdot I_\tau} + \varepsilon_{it} \quad (5)$$

$$Prot_i \cdot I_t = \zeta_i + \vartheta_t + \sum_{\tau \in \Gamma} \gamma_\tau \cdot (DistanceWittenberg)_i \cdot I_\tau + \eta_{it} \quad \forall t \in \Gamma \quad (6)$$

where ζ_i and ϑ_t are city and time fixed effects respectively.

[Table 7 about here]

Regression results using distance to Wittenberg as an instrument can be seen in Table 7; like Table 4, it is divided in three panels, corresponding to the IV analogues of regression equations (1)–(3). The first column reports the baseline results, whereas the other columns introduce control variables interacted with time dummies. As

29. Becker and Woessmann (2009) discuss the exogeneity of the Wittenberg instrument analyzing the correlation with a variety of plausible economic outcomes of the early 16th century (table 4, p. 561).

opposed to the OLS results, now all coefficients of interest in column 1 are positive; however, none of them reaches conventional levels of significance, not even jointly (p -value=0.396). This weakly positive result is further questioned by the results in columns (2)–(3), which show how the estimates are affected by allowing for time-varying effects of city characteristics: latitude, longitude, initial city size and distance to Atlantic ports. Figure 4 gives a visual representation of the IV estimates, both with and without controls; as can be generally expected, the coefficients are estimated less precisely than their OLS counterparts.

[Figure 4 about here]

Column (4) presents, analogously to Table 4, results including also the cities from outside the German-speaking areas of the Empire. The last column uses aggregate urban sizes at the level of territories as the dependent variable. Again, the results are generally larger than their OLS counterparts, but fail to reach conventional levels of significance. In both cases, one can reject a test of joint significance of all interactions after 1500.

In sum, the findings from instrumental variables regressions in Table 7 shed light on the causality nexus between Protestantism and economic growth. The estimated coefficients for the periods 1600 and onwards are generally larger than their OLS counterparts, suggesting a negative selection in the camp of Protestantism: cities with an intrinsically lower potential for economic growth—those more peripheral relatively to the economic centers of the Empire—chose to adopt the Reformation. However, there seems to be no significantly positive, causal impact of Protestantism on the growth of German cities, even when this negative selection is taken into account.

6. Competing explanations: Fertility, religious interactions, and literacy

6.1. Fertility and religious denomination

One potentially confounding factor in the analysis so far is the behavior of fertility. If, at any given level of real income, Catholics have higher fertility rates than Protestants, inferring local productivity levels from total population size could be misleading. In a Malthusian environment, the increase in population that results from higher productivity levels (stemming, e.g., from a specific “Protestant ethic”) can be offset by a contemporaneous movement to a lower fertility schedule. This is true both for urban fertility rates—if we assume that city growth is mostly attributable urban reproduction rates—and for the fertility rates of the surrounding countryside, if we assume more realistically that most of the observed city growth is due to migration from the neighboring agricultural areas.

While it is known that Protestant areas in Germany went through the fertility transition of the late 19th century earlier than their Catholic counterparts (Galloway et al., 1994; Brown and Guinnane, 2002), there is little evidence on fertility

levels (or fertility schedules) across denominations in pre-industrial Germany. Probably the most relevant study for the present context has been provided by Peter Zschunke (1984), who analyzes the fertility behavior of the population of Oppenheim, a rare tri-denominational city (Catholics, Lutherans and Calvinists) in the 17th and 18th century. Focusing on one city and being able to conduct extensive demographic reconstructions, this study can provide insights on fertility levels and their relationship to religious denominations and income or wealth.³⁰

Overall, the findings by Zschunke (1984) suggest that total marital fertility (TMFR) was indeed lower for Protestant women relative to Catholic ones (11 children for Catholic, 9 for Lutheran, and 8.9 for Calvinist women). In practice, considering also factors such as age at marriage, stopping age, and maternal mortality, these differences in TMFR resulted in an average number of children per family that was about 5–12% lower for Protestant families: 4.2 children for Catholic families, as opposed to 4.0 or 3.7 for Calvinist or Lutheran ones, respectively (p. 194).³¹ In addition, due to different practices in nursing and approaches to medicine, survival at age 10 was 5–6 out of 10 newborn babies for Protestants, 4 out of 10 for Catholics, further narrowing the fertility differential if one considers “offspring reaching adulthood” the relevant outcome.³²

In the context of a Malthusian model in which income per capita levels are, in equilibrium, determined by the intersection of a fertility schedule $B(y)$ and a mortality schedule $D(y)$, both of which possibly respond to income per capita y , these findings would suggest that Protestants had higher incomes per capita (the effect of lower fertility is, however, dampened by a lower mortality rate among Protestants). If the emergence of Protestantism brought a shift in fertility behavior toward more restraint and, at the same time, an increase in productivity (due to a better “work ethic”), the overall effect would be an absence of changes in population. Observing no changes in (relative) population would falsely lead to the conclusion that there were no productivity differences, whereas in fact Protestants had higher incomes per capita. In Supplementary Appendix 6, I discuss how, making some assumptions on the structure of the economy, it is possible to gauge how the observed differences in fertility could plausibly affect the empirical results above.

30. The data collected by Zschunke (1984) admittedly provide only actual levels of fertility, and do not attempt to provide a characterization of the entire fertility schedule, e.g. by identifying exogenous shifts to the mortality schedule.

31. Very similar conclusions are reached by another study based on micro data from a mixed-denomination village, Oberkassel in the Duchy of Berg (Hörning, 1998). There, total marital fertility between Catholic and Reformed (Zwinglian) families differed by 12% (higher among Catholics). The average number of children per woman was virtually identical: 5.22 for both denominations, over the period 1690–1810 (Hörning, 1998, Table 6).

32. Studies that reach a different conclusion and see no clear evidence for denominational patterns in fertility behavior are, e.g., Mols (1956, p. 219) and François (1991, p. 66), studying the cities of Metz and Augsburg, respectively, and the review articles by Heller-Karneth (2000) and Schröter (2006). For the rural areas, Knodel (1978) found no systematic differences in fertility levels and their trends over time across nine small Catholic and Protestant villages in Germany. McQuillan (1999), looking at Alsace, supports instead the view of more restraint among Protestants.

In the most adverse scenario, the point estimates of the effect of Protestantism on city size would have to be corrected up by 0.24 log points. Still, the effect would be far, for example, from the 0.7–1.1 log points effect of Atlantic trade (Acemoglu et al., 2005). Differences in fertility are hence plausibly only a minor confounding factor when comparing the growth performance of Catholic and Protestant cities.

6.2. Religious interactions and local spillovers

If Protestant cities were indeed endowed with a peculiar worth ethic or other advantages that translated into higher productivity, it is conceivable that other, neighboring cities would have profited from it even while remaining Catholic. The channels through which such a spillover could have occurred are potentially many: trade with Protestant cities, local dissemination of technological or commercial knowledge, spatial spread of practices and values by imitation. In this case, conventional estimates trying to detect a treatment effect of Protestantism would be biased downward because of these local spillovers.

To investigate this hypothesis, I construct a measure of “religious interaction” representing, for each city, the percentage of cities lying within a range of 100km that belong to the opposite religious denomination. This measure varies between 0% (for 65 out of 272 cities) and 100% (only one city: Erfurt). I then consider the following general setup, analogous to equation (4), but augmented by triple interaction terms:

$$\ln(u_{it}) = \chi_i + \zeta_t + \sum_{\tau \in \Gamma} \alpha_{\tau} \cdot Prot_i \cdot I_{\tau} + \sum_{\tau \in \Gamma} \beta_{\tau} \cdot control_i \cdot I_{\tau} + \sum_{\tau \in \Gamma} \gamma_{\tau} \cdot control_i \cdot Prot_i \cdot I_{\tau} + \varepsilon_{it} \quad (7)$$

In this context, the variable $control_i$ is the measure of religious interaction. The set of coefficients γ_i reports whether Protestantism affects city size differentially depending on the religious denomination of neighbors.

For ease of representation, I discuss the results of this regression graphically, by depicting the treatment effects of Protestantism for two different types of cities: cities that lie in an area with few religious interactions (0% of nearby cities having a different religion) and cities in mixed areas, defined as having half of the neighboring cities with a different religion.³³ If spillover effects were present, we would expect the growth performances of Catholic and Protestant cities in mixed areas to be very similar (leading to estimated treatment effects close to zero), and the relative performance of cities in religiously homogenous areas to be different. However, the results in Figure 5 show how similar the estimated treatment effects for Protestant cities in either surrounding are, suggesting that local spillovers are not a likely explanation for the absence of effects.

[Figure 5 about here]

33. Full regression results are reported in Supplementary Appendix 3, Table A.iii.

6.3. *Protestantism and literacy*

In an influential paper, Becker and Woessmann (2009) find a positive correlation between Protestantism and economic outcomes across Prussian counties in 1871. They argue that this finding can be explained fully by differences in literacy: Protestants, as a consequence of Martin Luther's exhortation to read the Bible on one's own, were on average more literate than Catholics. What explains the difference between the present paper and the findings of Becker and Woessmann?

At a first level, the research questions examined differ slightly. The present paper examines the long-run performance of cities, including the analysis of potential pre-trends in the period before the introduction of the Reformation; the paper by Becker and Woessmann is a single cross-section of outcomes in 1871. Whereas the analysis in this paper considers all major cities in the Holy Roman Empire, Becker and Woessmann study counties, urban and rural, in Prussia.³⁴ Yet, if one accepts the premise that city growth is an indicator of economic development, the divergence of results is surprising.

The most likely candidate for an explanation is the different setting. Most of the observations in the dataset of Becker and Woessmann refer to rural, and not urban counties. The relationships between indicators of economic development (per capita income tax revenues, average teacher's incomes, or the share of employment in manufacturing and services) and Protestantism found there are virtually absent for the subsample of urban counties.³⁵ Cities, with their varied population of artisans, traders, scholars and merchants, might have been just as cosmopolitan and open to new business practices in either a Catholic or a Protestant setting. If literacy was, even before the industrial revolution, the key ingredient for economic growth, evidence available for the period before 1800 suggests that in an urban setting literacy rates were relatively high by international standards even in Catholic cities.³⁶ This has been widely documented using signatures in marriage registries after the introduction of the Civil Code in the German territories. Looking at Koblenz, François (1977) finds very high literacy rates (near universal in the case of males); he notes that these results are comparable to the rates found in a similar Protestant city, Speyer, around the same time. Praß (1999) conducts a very detailed examination of basic literacy in the adjacent territories of Minden-Ravensburg (Protestant) and Covey-Paderborn (Catholic). In the urban centers of these territories, literacy rates are near identical, despite the overall economic

34. Note, however, that the results in this paper hold also when limiting the analysis to cities in 1871 Prussia (cf. Supplementary Appendix 1, Table A.i, column 8).

35. Supplementary Appendix 7 presents a more detailed replication of the main correlations between Protestantism and economic outcomes from Becker and Woessmann (2009), limiting the analysis to those Prussian counties that also contain a city present in the Bairoch et al. (1988) dataset. In this subsample, the correlations disappear entirely. See also Becker and Woessmann (2009), fns. 25, 41, 42, 44.

36. In fact, this result could be a success of the Counter-Reformation movement, which through the institution of the Jesuits and other orders placed importance on the education of the youth and the pursuit of knowledge (Bossy, 1970; Reinhard, 1977).

backwardness generally ascribed to the Prince-Bishopric of Paderborn during the Ancien Regime.³⁷

My findings thus suggest that in an urban setting in the pre-industrial age—the setting where we are most likely to expect religious choice to exert impulses on the commercial and entrepreneurial spirit—Protestantism has no power to explain differentials in economic growth. In contrast, the findings of Becker and Woessmann can be seen as a test of the importance of Protestantism—and of literacy as the channel through which Protestantism works—in the context of the second industrial revolution. Differences in literacy matter in explaining the take-up of manufacturing and industrial technologies in the second half of the 19th century, in particular outside of the established urban centers (this is consistent with the arguments put forward by Sandberg, 1979 and Becker et al., 2011). Literacy was thus a form of dormant capital only in the Protestant countryside; in the cities, the productive structure made sure that both Protestant and Catholic men (to a smaller degree, also women) had an economic incentive to acquire human capital.

7. Conclusion

Max Weber, in his seminal work, proposed what might be the most famous theory about the impact of cultural factors, namely beliefs about religion and afterlife, on economic growth. Despite its renown, this theory has rarely been tested quantitatively with historical data. The evidence presented in this paper, based on urban growth data of 272 cities of the Holy Roman Empire, points consistently towards the absence of any differences in the long-run performance of Protestant and Catholic regions. This absence of differences cannot be explained by endogenous selection into Protestantism, and is unlikely to arise because of, for example, imitation of best practices and spread of values from Protestant to Catholic territories.

In light of the various theories that suggest that Protestants should be more inclined to economic activity, this result is surprising. One explanation could be that many arguments about Protestant advantage, in particular Max Weber's, are in fact based on an analysis of the doctrines of Calvinism or of minor Protestant sects, such as the Puritans, and not on the teachings of Lutheranism, the largest denomination in Germany. The analysis in this paper finds no substantial differences, either, in the economic performance of the Calvinist territories of the Holy Roman Empire as opposed to the Catholic/Lutheran ones. Still, one cannot exclude that other, minor religious groups had an ideology that was conducive to economic growth. Testing this latter hypothesis, however, is intrinsically more difficult, as sect membership is likely endogenous (more than the forced imposition of denominations at the hand of

37. Similar results are also found in Hinrichs and Winnige (2003).

a territorial lord), and because it is hard to disentangle the impact of religious beliefs from the status of belonging to a minority.

An alternative theory, namely that Protestantism (in particular, Lutheranism) encouraged literacy and thus economic development, does well in predicting the dissemination of the second industrial revolution in late 19-century Prussia (Becker and Woessmann, 2009), but may not have equal explanatory power for urban growth in the pre-industrial era. Finally, the findings are consistent with the theoretical work by Doepke and Zilibotti (2005, 2008). The economic circumstances that urban dwellers faced in the Early Modern age might have encouraged them to become literate and impart their children values such as thrift and patience, independently of the religious denomination.

While there are many reasons to expect Protestant cities and states to have been more economically dynamic during the past centuries—because of their work ethic, their attitude toward business, or their encouragement of literacy—the present paper finds that, despite their differing views on religious matters, Protestants and Catholics might not have been so different in their economic performance after all.

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Figures and Tables

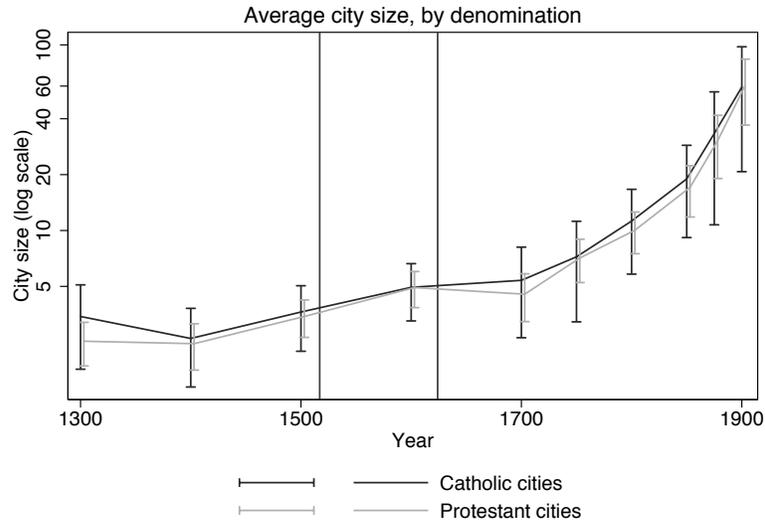


FIGURE 1. Average population of cities, by denomination. *Population figures in thousands. Vertical bars indicate the onset of the Reformation (1517) and the “normal year” set by the Peace of Westphalia (1624). Capped spikes denote 95% confidence intervals around the sample average. Population is assumed to be equal to 500 inhabitants if the actual value is missing in Bairoch et al. (1988).*

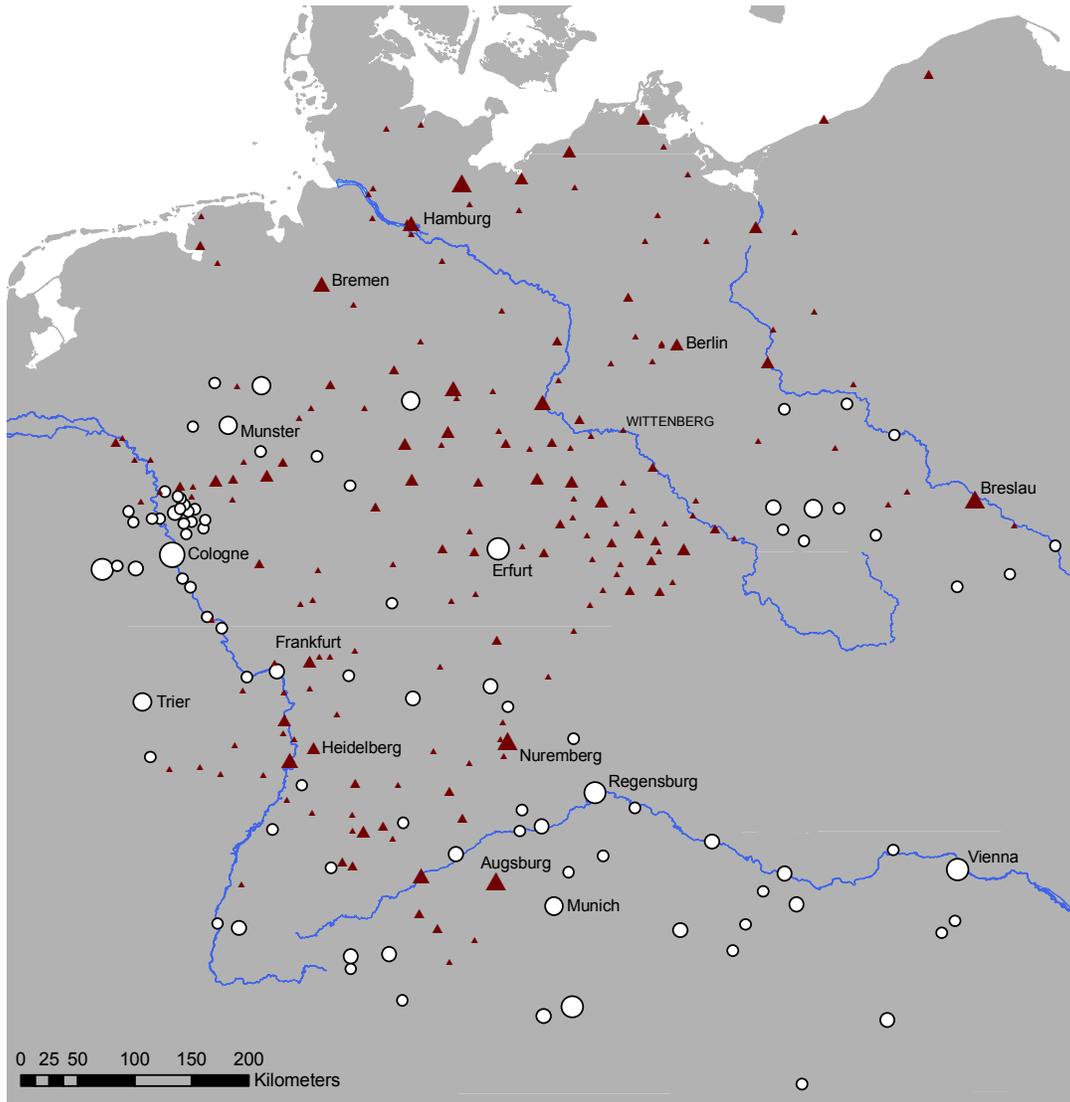


FIGURE 2. Cities in the dataset. Circles correspond to Catholic cities, triangles to Protestant cities (symbol size proportional to population in 1500). Selected cities labeled.

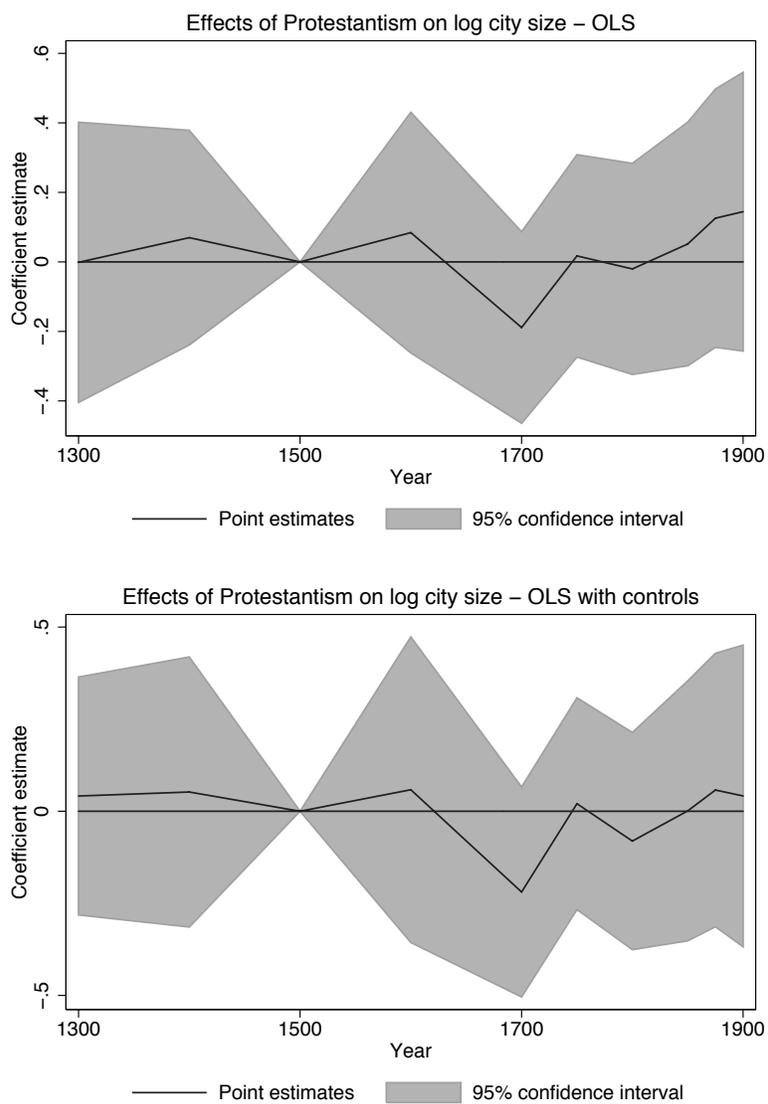


FIGURE 3. Estimated coefficients and 95% confidence intervals. Results from the baseline OLS estimates in Table 4, columns (1) and (3), panel C.

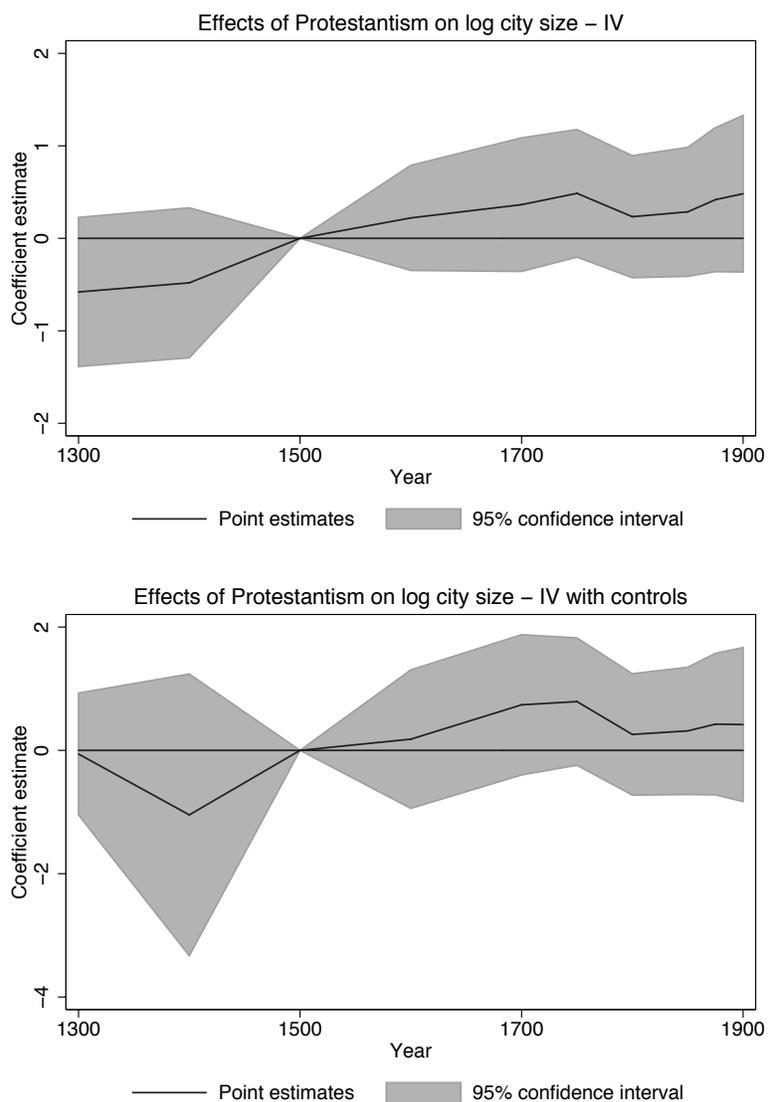


FIGURE 4. Estimated coefficients and 95% confidence intervals. Results from the baseline IV estimates in Table 7, columns (1) and (3), panel C.

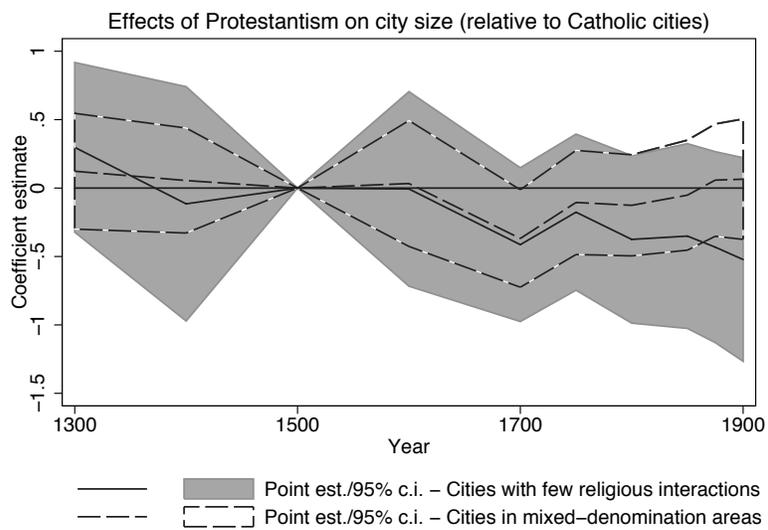


FIGURE 5. Heterogeneity of estimated effects and 95% confidence intervals: Religious interactions. Results from the OLS estimates of equation (7), section 6.2.

TABLE 1. Homogeneity of religious affiliation after 1624

| Territory | Population (1849) | Religion (after 1624) | % Prot. (1849) | % Cath. (1849) |
|--|----------------------|--------------------------|-------------------|-------------------|
| Prince-Bishopric of Münster | 329 081 | Cat | 4.3 | 94.9 |
| Duchy of Westphalia | 191 425 | Cat | 8.7 | 90.0 |
| Prince-Bishoprics of Paderborn and Corvey Abbey | 160 404 | Cat | 4.7 | 92.9 |
| Vest Recklinghausen | 46 940 | Cat | 1.3 | 98.2 |
| County of Mark | 305 182 | Pro | 78.1 | 21.0 |
| Principality of Minden and County of Ravensberg | 260 096 | Pro | 97.2 | 2.1 |
| Principality of Siegen | 44 885 | Pro | 82.3 | 17.5 |
| Counties of Wittgenstein-Berleburg and W.-Hohenstein | 21 463 | Pro | 94.1 | 3.9 |
| Free Imperial city of Dortmund | 10 515 | Pro | 71.1 | 27.1 |
| Lippstadt | 4 845 | Pro | 40.5 | 58.0 |
| Counties of Tecklenburg and Lingen | 42 123 | Pro / Cat | 55.8 | 43.6 |

Source: Reekers (1964).

TABLE 2. City size and economic outcomes, Prussia 1821

| Dependent Variable | Teacher-to-student ratio | Fire Insurance p.c. | Business Tax p.c. | Looms p.c. | Merchants p.c. | % Houses with stonework | % Houses with shingled roofs |
|--|------------------------------|-------------------------------|------------------------------|-----------------------------|---------------------------|------------------------------|------------------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| <i>Panel A: All cities in the Prussian manufacturing census of 1816–1821</i> | | | | | | | |
| ln(City size) | 0.380*** [0.127] 0.211 | 19.226*** [2.413] 0.260 | 0.153*** [0.023] 0.619 | -0.041 [0.259] -0.013 | 0.078 [0.054] 0.060 | 0.093*** [0.027] 0.220 | 0.082*** [0.027] 0.176 |
| Observations | 157 | 999 | 66 | 168 | 941 | 162 | 162 |
| R-squared | 0.044 | 0.068 | 0.383 | 0.000 | 0.004 | 0.048 | 0.031 |
| <i>Panel B: Subset of cities also present in the Bairoch et al. (1988) dataset</i> | | | | | | | |
| ln(City size) | 0.341** [0.150] 0.226 | 22.289** [9.641] 0.271 | 0.117*** [0.032] 0.509 | 0.096 [0.348] 0.026 | 0.147 [0.116] 0.115 | 0.082** [0.035] 0.181 | 0.022 [0.030] 0.062 |
| Observations | 83 | 100 | 29 | 90 | 98 | 87 | 87 |
| R-squared | 0.051 | 0.073 | 0.259 | 0.001 | 0.013 | 0.033 | 0.004 |

*: Significant at 10%; **: 5%; ***: 1%. Robust standard errors in brackets. Standardized beta coefficient in italics. A constant term is included in all regressions. Source: Krug and Mützell (1825). Variable definitions: see Appendix A.1.

TABLE 3. Summary statistics

| | N. Obs. | Mean | Std.dev. | Catholic cities | Protestant cities | Difference |
|----------------------------|---------|-------|----------|-----------------|-------------------|------------|
| City size in 1300 | 80 | 8400 | 8577 | 11167 | 7214 | 3952 |
| City size in 1500 | 126 | 6984 | 7183 | 8529 | 6413 | 2116 |
| City size in 1800 | 268 | 10584 | 20868 | 11244 | 10250 | 995 |
| City size in 1900 | 271 | 60216 | 169798 | 59227 | 60708 | -1482 |
| Latitude | 272 | 50.82 | 1.69 | 49.94 | 51.22 | -1.28*** |
| Longitude | 272 | 10.64 | 2.77 | 10.40 | 10.76 | -0.36 |
| Distance to Atlantic ports | 272 | 335.9 | 166.5 | 422.1 | 295.4 | 126.7*** |
| Distance to Wittenberg | 272 | 285.0 | 147.9 | 383.9 | 238.5 | 145.4*** |
| Distance to Geneva | 272 | 458.2 | 185.5 | 409.0 | 481.4 | -72.4*** |
| Distance to Zurich | 272 | 641.5 | 191.2 | 582.6 | 669.1 | -86.5*** |
| River/Port | 272 | 0.360 | 0.481 | 0.310 | 0.384 | -0.073 |
| Number of monasteries p.c. | 272 | 1.134 | 1.859 | 1.562 | 0.932 | 0.630** |
| Religious interaction | 272 | 0.272 | 0.255 | 0.411 | 0.206 | 0.205*** |

*: Difference significant at 10%; **: 5%; ***: 1%. P-values based on t-tests of differences in means, allowing for unequal variances. Variable definitions: see Appendix A.2. Distances measured in km.

TABLE 4. OLS estimation

| Dependent Variable | ln(City size) | | | | | ln(Urban pop. in a territory) |
|--|-------------------|--------------------|-------------------|--------------------|-------------------|----------------------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| <i>Panel A: Differences-in-Differences</i> | | | | | | |
| Protestant × Post1517 | 0.022 [0.152] | -0.042 [0.153] | -0.035 [0.146] | 0.002 [0.148] | 0.094 [0.261] | -0.077 [0.225] |
| <i>Panel B: Structured setup</i> | | | | | | |
| Protestant × Post1517 | -0.127 [0.184] | -0.112 [0.173] | -0.107 [0.222] | -0.106 [0.225] | 0.074 [0.389] | -0.182 [0.175] |
| Protestant × Post1517 × Trend | 0.054 [0.078] | 0.025 [0.088] | 0.026 [0.099] | 0.039 [0.100] | 0.007 [0.091] | 0.038 [0.073] |
| p-value for joint significance Protestant | 0.761 | 0.769 | 0.860 | 0.895 | 0.928 | 0.568 |
| <i>Panel C: Fully flexible setup</i> | | | | | | |
| Protestant × Year 1300 | -0.001 [0.206] | -0.015 [0.185] | 0.041 [0.165] | -0.015 [0.168] | -0.052 [0.501] | -0.015 [0.238] |
| Protestant × Year 1400 | 0.070 [0.158] | 0.009 [0.172] | 0.052 [0.187] | 0.035 [0.186] | 0.144 [0.231] | 0.091 [0.172] |
| Protestant × Year 1600 | 0.084 [0.177] | 0.003 [0.175] | 0.058 [0.212] | 0.065 [0.212] | 0.131 [0.257] | -0.030 [0.152] |
| Protestant × Year 1700 | -0.189 [0.141] | -0.237* [0.128] | -0.219 [0.145] | -0.256* [0.150] | -0.002 [0.279] | -0.288 [0.174] |
| Protestant × Year 1750 | 0.017 [0.149] | 0.014 [0.132] | 0.021 [0.147] | 0.035 [0.146] | 0.227 [0.264] | 0.013 [0.200] |
| Protestant × Year 1800 | -0.020 [0.155] | -0.110 [0.148] | -0.081 [0.150] | -0.044 [0.153] | 0.140 [0.249] | -0.114 [0.210] |
| Protestant × Year 1850 | 0.052 [0.179] | -0.039 [0.185] | 0.001 [0.180] | 0.025 [0.180] | 0.096 [0.226] | -0.035 [0.221] |
| Protestant × Year 1875 | 0.126 [0.190] | 0.008 [0.188] | 0.058 [0.189] | 0.079 [0.188] | 0.100 [0.227] | -0.034 [0.231] |
| Protestant × Year 1900 | 0.144 [0.205] | 0.011 [0.201] | 0.042 [0.209] | 0.072 [0.207] | 0.174 [0.234] | 0.040 [0.243] |
| p-value for joint significance Protestant | 0.017 | 0.045 | 0.013 | 0.008 | 0.121 | 0.059 |
| p-value for joint significance Latitude | | 0.010 | | | | |
| p-value for joint significance Longitude | | 0.002 | | | | |
| p-value for joint significance Dist. to Atlantic | | | 0.029 | 0.002 | 0.086 | 0.245 |
| p-value for joint significance City size in 1300 | | | 0.000 | 0.000 | 0.000 | 0.012 |
| Controls Latitude | N | Y | N | N | N | N |
| Controls Longitude | N | Y | N | N | N | N |
| Controls Distance to Atlantic ports | N | N | Y | Y | Y | Y |
| Controls City size in 1300 | N | N | Y | Y | Y | Y |
| Sample including all cities of the HRE | N | N | N | Y | N | N |
| Only Reformed (Calvinist) defined as Protestant | N | N | N | N | Y | N |
| Observations | 1876 | 1876 | 1876 | 1990 | 1876 | 986 |
| Number of cities/territories | 272 | 272 | 272 | 297 | 272 | 128 |

*: Significant at 10%; **: 5%; ***: 1%. All regressions contain a full set of city and year fixed effects. Control variables are entered as a full set of control × year dummy interactions in all three panels. P-values refer to a joint test significance of all coefficients relating to the post-Reformation period (interactions of respective variable with year dummies, 1600 and onwards) and are reported only for the setup of Panel C. Robust standard errors, clustered by territory, in brackets.

TABLE 5. Urbanization rates

| Dependent Variable | Urbanization rate (%) |
|---|-----------------------|
| | (1) |
| Share Protestant × Year 1750 | 3.687 [4.081] |
| Share Protestant × Year 1800 | 2.300 [4.475] |
| Share Protestant × Year 1850 | 5.634 [3.924] |
| Share Protestant × Year 1875 | 3.791 [6.209] |
| Share Protestant × Year 1900 | -1.645 [9.244] |
| Observations | 115 |
| R-squared | 0.852 |
| Number of regions | 20 |
| p-value for joint significance Protestant | 0.361 |

*: Significant at 10%; **: 5%; ***, 1%. Regression contains a full set of territory and year fixed effects. P-value refers to a joint test significance of all the interaction terms with "Share Protestant". Robust standard errors, clustered by territory, in brackets.

TABLE 6. Determinants of adoption of Protestantism

| Dependent Variable | City Protestant in 1600 | | | |
|----------------------------|-------------------------|----------------------|----------------------|----------------------|
| | (1) | (2) | (3) | (4) |
| Distance to Wittenberg | -0.158*** [0.029] | -0.179*** [0.036] | -0.183*** [0.032] | -0.140*** [0.037] |
| Distance to Geneva | | 0.058 [0.170] | | |
| Distance to Zurich | | -0.100 [0.162] | | |
| Latitude | | | 0.007 [0.032] | |
| Longitude | | | -0.031 [0.024] | |
| ln(City size in 1300) | | | | -0.047 [0.034] |
| Distance to Atlantic ports | | | | -0.001 [0.024] |
| Constant | 1.068*** [0.078] | 1.216*** [0.452] | 1.121 [1.700] | 1.174*** [0.081] |
| Observations | 272 | 272 | 272 | 272 |
| R-squared | 0.230 | 0.254 | 0.256 | 0.253 |

*: Significant at 10%; **: 5%; ***, 1%. Linear probability model (OLS estimation). Robust standard errors, clustered by territory, in brackets.

TABLE 7. Instrumental variables estimates

| Dependent Variable | ln(City size) | | | | ln(Urban pop. in a territory) |
|--|-------------------|-------------------|-------------------|-------------------|----------------------------------|
| | (1) | (2) | (3) | (4) | (5) |
| <i>Panel A: Differences-in-Differences</i> | | | | | |
| Protestant × Post1517 | 0.621* [0.361] | 0.075 [0.408] | 0.636 [0.520] | 0.611 [0.567] | 1.009 [0.792] |
| <i>Panel B: Structured setup</i> | | | | | |
| Protestant × Post1517 | 0.468 [0.372] | -0.110 [0.388] | 0.642 [0.528] | 0.681 [0.573] | 0.970 [0.862] |
| Protestant × Post1517 × trend | 0.054 [0.145] | 0.065 [0.150] | -0.002 [0.240] | -0.024 [0.256] | 0.014 [0.313] |
| p-value for joint significance Protestant | 0.182 | 0.908 | 0.273 | 0.337 | 0.368 |
| <i>Panel C: Fully flexible setup</i> | | | | | |
| Protestant × Year 1300 | -0.580 [0.411] | -0.335 [0.532] | -0.059 [0.504] | -0.067 [0.587] | -1.133 [0.746] |
| Protestant × Year 1400 | -0.481 [0.414] | -0.614 [0.491] | -1.046 [1.166] | -1.038 [1.245] | -1.228 [0.981] |
| Protestant × Year 1600 | 0.221 [0.290] | -0.461 [0.446] | 0.182 [0.573] | 0.176 [0.583] | -0.109 [0.696] |
| Protestant × Year 1700 | 0.364 [0.369] | -0.224 [0.484] | 0.739 [0.580] | 0.902 [0.702] | 0.497 [0.704] |
| Protestant × Year 1750 | 0.486 [0.352] | 0.213 [0.470] | 0.791 [0.527] | 0.772 [0.543] | 0.871 [0.691] |
| Protestant × Year 1800 | 0.234 [0.337] | -0.253 [0.490] | 0.259 [0.502] | 0.138 [0.527] | 0.328 [0.743] |
| Protestant × Year 1850 | 0.286 [0.356] | -0.213 [0.479] | 0.316 [0.527] | 0.276 [0.548] | 0.358 [0.765] |
| Protestant × Year 1875 | 0.418 [0.397] | -0.195 [0.518] | 0.426 [0.586] | 0.390 [0.616] | 0.219 [0.833] |
| Protestant × Year 1900 | 0.482 [0.432] | -0.035 [0.568] | 0.419 [0.637] | 0.378 [0.676] | 0.340 [0.908] |
| p-value for joint significance Protestant | 0.396 | 0.010 | 0.614 | 0.593 | 0.250 |
| p-value for joint significance Latitude | | 0.001 | | | |
| p-value for joint significance Longitude | | 0.002 | | | |
| p-value for joint significance Dist. to Atlantic | | | 0.184 | 0.165 | 0.156 |
| p-value for joint significance City size in 1300 | | | 0.000 | 0.000 | 0.016 |
| <i>Instrument</i> | | | | | |
| <i>Distance to Wittenberg</i> | | | | | |
| Sample including all cities of the HRE | N | N | N | Y | N |
| Controls Latitude | N | Y | N | N | N |
| Controls Longitude | N | Y | N | N | N |
| Controls Dist. to Atlantic | N | N | Y | Y | Y |
| Controls City size in 1300 | N | N | Y | Y | Y |
| Observations | 1876 | 1876 | 1876 | 1990 | 986 |
| Number of cities/territories | 272 | 272 | 272 | 297 | 128 |

*: Significant at 10%; **: 5%; ***: 1%. All regressions contain a full set of city and year fixed effects. Control variables are entered as a full set of control × year dummy interactions in all three panels. P-values refer to a joint test significance of all coefficients relating to the post-Reformation period (interactions of respective variable with year dummies, 1600 and onwards) and are reported only for the setup of Panel C. Robust standard errors, clustered by territory, in brackets.

Appendix: Data description

A.1. Krug and Mützell data (Table 2)

| Variable | Description |
|------------------------------|--|
| Business tax p.c. | Tax revenue from business enterprises (<i>Gewerbsteuer</i>) per inhabitant, 1821 (in <i>Thaler</i>) |
| Fire insurance p.c. | Total value of buildings insured by the local fire insurance company (<i>Feuersozietät</i>) per inhabitant, 1821 (in <i>Thaler</i>) |
| % Houses with stonework | Buildings with masonry outer walls (as opposed to half-timbered or timber) as percentage of total buildings, 1816 |
| % Houses with shingled roofs | Buildings with shingled (metal, stone or clay shingles) roofs (as opposed to wooden shingles or thatched) as percentage of total buildings, 1816 |
| Looms p.c. | Number of looms in 1819 per inhabitant (population figures: 1816) |
| Merchants p.c. | Number of merchants (<i>mit kaufmännischen Rechten</i>), grocers, and peddlers in 1819 per inhabitant (population figures: 1816) |
| Teacher-to-student ratio | Number of teachers per student in private and public elementary schools, 1816 |

Source (for all variables): Krug and Mützell (1825)

A.2. City sizes panel dataset (Tables 3, 4, 6, 7)

| Variable | Description and source |
|----------------------------|---|
| City size | Population of a city. Missing values are not imputed, unless otherwise noted. Source: Bairoch et al. (1988) for the years until 1850. Official statistics (German Empire: <i>Statistik des Deutschen Reiches</i> , various vols.; Austria-Hungary: <i>Statistisches Jahrbuch, herausgegeben von der K. K. Statistischen Central-Commission</i> , various vols.) for the years after 1850. |
| City size in 1300 | Population of a city. Source: Bairoch et al. (1988). Note: this variable is used as a control variable in several regressions. In this case, if there is no population figure available for 1300, city size is assumed to equal 500. |
| Distance to Atlantic ports | Minimum great circle distance of a city to the Atlantic seaports of either Hamburg or Bremen, measured in 100's of km. Source: own calculations. |
| Distance to Geneva | Great circle distance of a city to Geneva, measured in 100's of km. Source: own calculations. |
| Distance to Wittenberg | Great circle distance of a city to Wittenberg, measured in 100's of km. Source: own calculations. |
| Distance to Zurich | Great circle distance of a city to Zurich, measured in 100's of km. Source: own calculations. |

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| Variable | Description and source |
|---------------------------------|--|
| Latitude | Latitude of the city in degrees. Source: Wikipedia. |
| Longitude | Longitude of the city in degrees. Source: Wikipedia. |
| Number of monasteries p.c. | Number of monasteries (not belonging to mendicant orders) in existence around 1517 within 5km from the city center (great circle distance), divided by total population in 1500 (in 1000's). If there is no population figure available for 1500, city size is assumed to equal 500. Source: Jürgensmeier and Schwerdtfeger (2005-2008). |
| Protestant | Binary, 1 if Protestantism is the only or dominant religious denomination in a territory, as resulting from the normal year 1624. Sources: Schindling and Ziegler (1993) and Keyser (1939-1974). For years prior to 1600, "Protestantism" is coded as 1 in city i if i was Protestant in 1600. |
| Religious interaction | Share of cities located within 100km (great circle distance) that have the opposite religious denomination (Catholic if Protestant, and vice versa), as resulting from the normal year 1624. Source: own calculations. |
| River/Port | Location on a navigable river or sea port. Source: Kunz (1999). |
| Trend | Linear time trend, starting in 1517. Measured in centuries. |
| Urban population in a territory | Total population of all cities listed in Bairoch et al. (1988) belonging to a given territory; definition of a "territory" is discussed on page 14, footnote 18 and is time-invariant. Missing values are not imputed. |

A.3. Urbanization rates panel dataset (Table 5)

This dataset is largely based on the data used in Acemoglu et al. (2011); details on the construction of the data can be found in the online appendix to the cited paper. The 20 regions considered in this dataset are: Baden, the Bavarian Palatinate, Brandenburg, Brunswick, Bavaria ("Altbayern"), Hessen-Darmstadt (incl. Nassau), Hessen-Kassel, Hanover (incl. Bremen), Mecklenburg-Schwerin, Minden, Mark, Oldenburg, Pomerania, Rhineland, Saxony (Kingdom), Saxony (Prov-ince), Silesia, Schleswig-Holstein (incl. Lübeck), Westphalia (excl. Mark and Minden), Württemberg.

| Variable | Description and source |
|------------------|---|
| Share Protestant | Share of Protestants over total population. Source: German population census, 1900 (Statistik des Deutschen Reichs. Neue Folge, Band 150: "Die Volkszählung am 1. Dezember 1900") |

Continued on next page

| Variable | Description and source |
|-------------------|--|
| Urbanization rate | Share of population living in cities above 5000 inhabitants. Source: City sizes are from Bairoch et al. (1988). Total population of regions is based on own estimates from a variety of sources; refer to Acemoglu et al. (2011), online appendix. |