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## Was Weber Wrong? A Human Capital Theory of Protestant Economic History

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June 2007

# **Was Weber Wrong? A Human Capital Theory of Protestant Economic History**

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## ABSTRACT

### Was Weber Wrong? A Human Capital Theory of Protestant Economic History<sup>\*</sup>

Max Weber attributed the higher economic prosperity of Protestant regions to a Protestant work ethic. We provide an alternative theory, where Protestant economies prospered because instruction in reading the Bible generated the human capital crucial to economic prosperity. County-level data from late 19<sup>th</sup>-century Prussia reveal that Protestantism was indeed associated not only with higher economic prosperity, but also with better education. We find that Protestants' higher literacy can account for the whole gap in economic prosperity. Results hold when we exploit the initial concentric dispersion of the Reformation to use distance to Wittenberg as an instrument for Protestantism.

JEL Classification: N33, Z12, I20

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<sup>\*</sup> The idea that the rise of Protestantism may have fostered human capital accumulation in Europe stems from our discussions with Paul E. Peterson, who again traces the idea back to a late-1960s University of Chicago seminar by C. Arnold Anderson and Mary Jean Bowman. We have received substantive comments during seminar presentations at Ifo Institute Munich, Aarhus Business School, ZEW Mannheim, the theology and economics faculties of the University of Munich, the University of Zurich, the Third Christmas Conference of German Expatriate Economists, WZB Berlin, the Max Planck Institute for Research in Collective Goods in Bonn, and the Universities of Florence, Rome "Tor Vergata", Harvard, Stockholm, Stanford, and UC Davis. Discussions with and comments from Andreas Ammermüller, Knut Borchardt, David Card, Andreas Diekmann, Guido Friebel, Claudia Goldin, Avner Greif, Mathias Hoffmann, Tim Lorentzen, Volker Meier, Paul Peterson, Holger Sieg, and Ulrich Woitek were very fruitful. Support has come from the Program on Education Policy and Governance of Harvard University. Erik Hornung and Martin Hofmann provided capable research assistance. We are grateful to all of them.

## I. Introduction

In the century since Max Weber [1904/05] (2001) suggested in *The Protestant Ethic and the Spirit of Capitalism* that a “Protestant ethic” was instrumental for economic progress, several interpretations have emerged how the greater economic affluence of Protestants relative to Catholics might have come about (if at all). Weber’s seminal work is considered a key founding stone of sociology, and leading mechanisms emphasized in sociological interpretations include that Protestants’ specific ethic may have induced them to work harder and to save more. To the sociological theories, we offer a simple alternative economic theory based on the standard human capital model. We suggest that Luther’s demand that all Christians should be able to read the Gospel by themselves led to increased literacy among Protestants which, incidentally, could then also be used in economic activities.

In order to test empirically which of the suggested mechanisms may be right or wrong, we go on to present county-level evidence from the very perspective that Weber had, namely Weber’s native Prussia as the main part of the German Empire in late 19<sup>th</sup> century. The evidence reveals that there is indeed a significant positive association between Protestantism and economic success. We then show that there is also a significant positive association between Protestantism and literacy. Intriguingly, after controlling for the positive effect of literacy on economic success, there remains no significant difference in economic success between Protestant and Catholic counties. Human capital can account for the whole denominational difference in economic affluence, leaving little scope for any denomination-based work ethic. Furthermore, we argue that the approximately concentric diffusion of Protestantism around Luther’s city of Wittenberg in Lutheran times allows us to identify exogenous variation in Protestantism in late 19<sup>th</sup> century. We find that even when instrumented by distance to Wittenberg, a county’s share of Protestants increases literacy, which in turn yields higher economic progressiveness. The results suggest that while religious affiliation may indeed have had economic consequences, this may have been for reasons unrelated to any ethical disposition.

It is well known that Luther opposed the Roman Catholic practice of reading out the Gospel in the scholarly language of Latin, and that he delivered the first influential translation of the Bible into his native German, for everybody to read. What is less well known today is that he also explicitly favored universal schooling, for the simple reason that people had to be literate in order to be able to read God’s Word, the Bible. In light of human capital theory, the ensuing literacy has the unintended side effect in the economic realm to increase people’s productivity and thus prosperity. In this view, religion in the form of Protestant denomination may well be associated with economic affluence, but not because of

any difference in work ethic, but rather incidentally because it furthered the creation of human capital. In the next section, we introduce this effect into a simple model of human capital.<sup>1</sup>

To study the relationship between Protestantism, education, and economic prosperity empirically, 19<sup>th</sup> century Prussia is the natural place to look at. The birthplace of Martin Luther is on 1871 Prussian territory, where the Reformation was initiated and where his doctrine diffused in its purest form. Prussia is also Max Weber's birthplace, and the situation in late 19<sup>th</sup> century is the one he had in mind when formulating his thesis. The core of Prussia is a well-defined region with rather uniform laws and institutional settings, so that empirical investigation is not hampered by institutional heterogeneity.<sup>2</sup> Prussia is also reasonably well divided between Protestants and Catholics, at roughly two thirds to one third of the population in 1871, so that no denomination constitutes just a small minority, and Prussia had a long tradition of freedom of religion. Finally, the Prussian Statistical Office collected an impressive amount of data, available at the level of 452 counties. It is generally accepted that Prussian orderliness and thoroughness yielded high-quality data even in the 19<sup>th</sup> century, which are available in archives to these days. Important for our purposes, the 1871 Prussian Census is the first instance surveying literacy of the whole population. We thus do not have to rely on data from selective samples like military recruits, which provide only a limited picture of the population at large.

The use of Prussian county data allows us to go beyond the existing empirical literature on the Weber thesis, which mostly uses cross-country variation. Iannaccone (1998) concludes that the empirical literature on the relationship between Protestantism and economic outcomes largely rejects the empirical validity of Weber's argument. In fact, studies based on cross-country data seem to show no relationship at all between Protestantism and the rise of industrial capitalism. Delacroix and Nielsen (2001) conclude that there is no clear-cut pattern in the adoption of capitalism across European countries in the 19<sup>th</sup> century with respect to the dominant religion.<sup>3</sup>

A broader context of papers studies the association between religion and economic outcomes. Quite generally, religion is an important expression of culture (Guiso, Sapienza, and Zingales 2006), and as such is viewed as a possible fundamental cause of economic growth. Thus, Barro and McCleary (2003; 2005) study the association between different religions and economic growth. In a study

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<sup>1</sup> In a closely related argument, Botticini and Eckstein (2005, 2006) suggest a human capital interpretation of Jewish history, where the ultimate root of Jewish economic prosperity as merchants lies in a centuries-old Judaic rule that required male Jews to be able to read the Torah in the synagogue, and to teach the reading of the Torah to their sons.

<sup>2</sup> While this may not hold strictly for recent Prussian annexations, we will show below that all our results hold in an analysis restricted to the core Prussian territory which had been part of Prussia for decades and even centuries.

<sup>3</sup> In a growth model calibrated to England, Cavalcanti, Parente, and Zhao (2006) suggest that Protestantism could at best account for only slight delays in the start of industrialization.

concerned with controlling the effects of economic institutions, Acemoglu, Johnson, and Robinson (2001, p. 1388; 2005, p. 419) find no effect of religion on growth in a cross-country setting.

Any cross-country study is plagued by the difficulty of disentangling the effect of religion from other possible fundamental causes of economic prosperity that vary across countries, such as institutions and geography. By looking at regional data within Prussia, all our observations are exposed to the same institutional and legal setting. Similarly, problems of geographical variation are substantially smaller within Prussia than on a global scale, and we control for a rich set of geographical features. We can even include district fixed effects, using only variation across counties within each district. In effect, we hold institutions and geography constant and ask whether there is a role for religion in economic outcomes.<sup>4</sup>

In contrast to the cross-country findings, we do find a significant association between Protestantism and economic prosperity when using county-level variation in late 19<sup>th</sup>-century Prussia, confirming Weber's descriptive observation. But we also show that there is a strong association between Protestantism and literacy, confirming the basic tenet of our suggestion that Luther's preaching advanced education.<sup>5</sup> When Protestantism and literacy are entered jointly in a "horse race" to explain economic prosperity, the association between Protestantism and economic outcomes vanishes, and the whole effect is absorbed by a significant association between literacy and economic outcomes.<sup>6</sup> Thus, Protestantism does have no independent association with economic prosperity once differences in literacy are accounted for. The same pattern of results holds when we use density of schools rather than literacy as an alternative measure of education, showing that there is a significant role for the supply of schools in the Protestant lead. The interpretation of these findings most favorable to the Weber thesis would be that the economic role of the Protestant ethic works exclusively via human capital accumulation – a thought not explicitly contained in Weber's work.

But we argue below that for several reasons, the higher literacy of Protestant counties is exogenous to ethics, as well as to economic outcomes. Not only was literacy an unintended side effect of Luther's Gospel-reading aims, unrelated to a work ethic or any other economic thought. Also, most of the 19<sup>th</sup>-

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<sup>4</sup> In the discussion of "fundamental" causes of economic growth, the cross-country finding by Glaeser, La Porta, Lopez-de-Silanes, and Shleifer (2004) that human capital may be a more basic source of growth than institutions carries particular interest for our study.

<sup>5</sup> In a similar vein, Goldin and Katz (2002) show that in the United States in 1910-1938, areas that led in secondary education had higher shares of Protestant population.

<sup>6</sup> The finding of an important role of education is consistent with a long literature stressing the importance of human capital for historical economic development in general; cf., e.g., Easterlin (1981), Goldin (2001), Lindert (2003), and Galor (2005). Landes (1969) stresses that education was a key ingredient for the transfer of industrial leadership from Britain to Germany at the end of the 19<sup>th</sup> century. For a recent review of the vast literature on the role of human capital in modern economic growth, cf. Hanushek and Wößmann (2007).

century denominational variation can be traced back to denominational choices of local rulers during the Reformation in 16<sup>th</sup> and early 17<sup>th</sup> century, mostly motivated by religious conviction and power politics vis-à-vis the Pope and the German Emperor. Furthermore, Protestantism spread across the German Empire roughly in circles around Luther's city of Wittenberg, whose role as the origin of Protestantism was triggered by a particularly vicious example of indulgence practices.

We use the concentric diffusion of Protestantism to obtain exogenous variation in counties' shares of Protestants in a "double-IV" estimation. Using distance to Wittenberg as an instrument, we can identify an effect of Protestantism on literacy, which is then found to advance economic outcomes. In this model, identification comes from the assumption that Luther's Reformation was an exogenous event, generating a random shock that spread concentrically around Wittenberg. We provide several pieces of evidence showing that the adoption of the Reformation was indeed unrelated to the economic or educational reality of the time.

Combining the facts about the historical origin of the Protestant geographical variation with the results of our county-level estimations, we argue that the variation in literacy used in this paper is exogenous both to any work ethic and to economic outcomes. We also show that literacy had the same effect on economic outcomes in Protestant and Catholic regions, which does not allow for a role of schools in economic progress solely through their potential transmission of a differential work ethic. As a consequence, the higher economic prosperity of Protestant counties has to be viewed as a consequence of higher human capital (unintended during its adoption), but not of work ethic.

Thus, the evidence favors a human capital theory of Protestant economic prosperity over Weber's theory. The driving force of the higher economic prosperity of Protestants in late 19<sup>th</sup> century Prussia was education. Religion in the sense of an *ethical* disposition towards economic issues did *not* have a significant effect on economic outcomes. Of course, without the Reformation, Protestants would not have acquired more human capital relative to Catholics. In this sense, religion *was* important for economic success, because without intention it involved an uneven accumulation of human capital.

As a final addition, we use individual-level data from contemporary Germany to show that the same pattern between religious denomination, education, and income holds in Germany to these days. The use of contemporary data allows us to go from county-level to individual-level data and to use labor income as an individual-level measure of economic success. Protestants earn more than Catholics even in the late 1990s, but again, this can be fully traced back to their higher level of education.

On a cautionary note, we stress that there is considerable controversy about what Weber's own main hypothesis about Protestantism and the development of capitalism actually was. However, it goes undisputed that the core of his argument is that there is a difference in ethical disposition between

Protestants and Catholics which had a significant bearing on economic outcomes. Furthermore, a “common interpretation” (Delacroix and Nielsen 2001) has developed which – rightly or wrongly – interprets Weber’s thesis as the view that the rise of industrial capitalism was facilitated in Protestant regions. This is the basic relationship that we test in this paper. In this sense, the paper does not necessarily test Weber’s theory of a Protestant work ethic proper, but rather its common interpretation, namely that there is a relationship between Protestantism and economic success.

The structure of the paper is straightforward. Section II provides the theoretical foundation. Section III presents our data and empirical results. Section IV concludes.

## **II. Theory of Protestant Economic History**

This section presents two alternative theoretical approaches for understanding the history of Protestants’ relative economic progressiveness. We first discuss Weber’s thesis based on a Protestant work ethic. We then derive our alternative explanation, a simple human capital theory of Protestant economic history based on Luther’s request for literacy as a prerequisite to reading the Bible.

### **A. *Weber’s Thesis and Its Criticism***

Max Weber [1904/05] (2001) proposed the “most famous link between culture and economic development” (Acemoglu, Johnson, and Robinson 2005, p. 401), namely that the Protestant Reformation was instrumental in facilitating industrial capitalism in Western Europe. Weber [1904/05] (2001, p. 3) provides the object of his investigation in his very first sentence:

“A glance at the occupational statistics of any country of mixed religious composition brings to light with remarkable frequency a situation which has several times provoked discussion in the Catholic press and literature, and in Catholic congresses in Germany, namely, the fact that business leaders and owners of capital, as well as the higher grades of skilled labor, and even more the higher technically and commercially trained personnel of modern enterprises, are overwhelmingly Protestant.”

Actually, the descriptive observation of greater economic prosperity of Protestants seems to have been the subject of a long-running discussion, traceable at least as far back as to Menschenfreund (1773).

But the particular feature of Weber’s main thesis is that it is the specific *ethic* of Protestantism which affected economic outcomes. Weber argued that the Reformation introduced the crucial notion of the “calling” (“Beruf”), with the current use of the word originating in Luther’s translation of the Bible. The notion of the calling carries the suggestion of a religious conception, the sanctification of labor to a task set by God. This notion, according to Weber, created a particular Protestant work ethic, which – in contrast to the Catholic ideal of surpassing worldly morality in monastic asceticism – valued

the fulfillment of worldly duties as the highest moral achievement.<sup>7</sup> According to Weber [1904/05] (2001, p. 40), “The only way of living acceptably to God was ... solely through the fulfillment of the obligations imposed upon the individual by his position in the world. That was his calling.” Weber explicitly traces this central notion back to Luther, while later it was most rigorously developed in certain Protestant communities, such as Calvinism, Puritanism, Methodism, and Baptism.<sup>8</sup>

The Protestant work ethic approved the accumulation of wealth and thus, according to Weber’s argument, provided the moral foundation for capitalist industrialization. Although success in a calling was not seen as a means to please God – which, according to Luther’s *Doctrine of Justification*,<sup>9</sup> was beyond human capability and solely depended on God’s grace – it became regarded as a sign of being among the select group that God will save from damnation (cf. Giddens’ introduction to Weber 2001). Thus, Weber provides an ethics-based theory for economic development.

The exact interpretation and precise mechanisms of the Weber thesis remain hotly debated. There are literally libraries full of books interpreting and discussing his work. One mechanism traced back to Weber’s work is that the work ethic drives Protestants to simply work harder. Another mechanism is that their belief system compels them to save more in order to defer gratification, which transforms into investments and thus higher productivity in the longer run.<sup>10</sup> There is also a lot of controversy whether Weber was trying to explain economic disparities existent at his time, or whether he was just trying to explain the initial origin of capitalism. Because more than a hundred years of exegesis have proven futile in settling these issues, we resort to aiming our analysis at what has been called the “Common Interpretation” (Delacroix and Nielsen 2001) of the *Protestant Ethic* which has taken a life of its own, namely the simple emphasis of a “connection between Protestantism and economic progress” (Coleman’s 1959 introduction to Samuelson [1957] 1993) in general.

Given its fundamental importance, Weber’s thesis has witnessed a stream of criticism that has not stopped for a century. Among others, he was criticized as misinterpreting Protestant doctrine, Catholic doctrine, and the development of specific forms of “capitalism” (see Giddens’ introduction to Weber 2001 for a summary). Many casual observers also felt unconvinced by the idea that denominational differences indeed materialize in substantially different work ethics, at least in within-German

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<sup>7</sup> Although Weber does not explicitly use the term “work ethic” (“Berufsethik”) in his 1904/05 work, his association of the Protestant ethic with the “calling” conveys this meaning, and he extensively uses the term “work ethic” in later works.

<sup>8</sup> In Prussia, there were only two major Protestant fractions, Lutherans and Reformists, whose distinction was dropped in official statistics when they were merged into the Protestant Church in Prussia (Evangelische Kirche in Preußen) in 1817.

<sup>9</sup> This central doctrine of Luther’s theological considerations, which declared that man himself could do nothing and that everything is bestowed by God’s grace, in itself creates some uneasiness towards the Weber thesis that it should be particularly the Protestants whose ethic drives them to higher worldly objectives than Catholics.

<sup>10</sup> Merton (1936) stressed the importance of Protestantism for the development of science.

comparisons where denominational affiliations hardly reflect deliberate personal choices but rather follow regional patterns. Yet, by surviving for more than a hundred years, the Weber thesis has shown remarkable resilience against its numerous critics.

Whatever the exegetic merits of Weber's thesis, our interest is a purely empirical one, investigating the real-world validity of the argument. And it is worth noting that this empirical interest does not distinguish us from Weber [1904/05] (2001, p. xl),<sup>11</sup> who explicitly viewed his work as "thoroughly matter-of-fact analyses of studies which are strictly empirical in their intention". However, to date we are not aware of a thorough empirical analysis of the Weber thesis at the sub-national level.<sup>12</sup>

Although – as Weber's introductory sentence already shows – Weber based his thesis explicitly on within-country comparisons, the most influential empirical evidence to date is cross-country. The previous cross-country research seems to refute even "Weber's stylized account of European economic history, demonstrating that ... economic progress was uncorrelated with religion" (Iannaccone 1998, p. 1475). In a thorough study of the historical cross-country pattern in 19<sup>th</sup>-century Europe, Delacroix and Nielsen (2001, p. 509) conclude that Weber's purported link between Protestantism and economic outcome is a "myth", "derived largely from selected anecdotal evidence".<sup>13</sup> However – as even Delacroix and Nielsen (2001, pp. 544-545) duly concede – there are substantial limitations to the use of cross-national data because of substantial regional heterogeneity in religious denomination and economic development, and even more because cross-country comparisons are notoriously plagued by the difficulty of netting out the effects of other fundamental causes of economic development, such as institutions and geography (cf. Acemoglu, Johnson, and Robinson 2005).

At least, common perceptions of systematic denominational differences in economic backwardness within Germany stand in contrast to the cross-country pattern. Weber [1904/05] (2001) himself refers to regular public discussions at the "Katholikentag", regular official meetings of Catholic laymen in Germany (the "Catholic congresses" cited above), on the general public feeling that Catholics were economically disadvantaged relative to Protestants at his time. The very same discussions of Catholic backwardness reemerged at the "Katholikentag" meetings and in the Catholic press in the 1950s and

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<sup>11</sup> Authors' own translation from the German original; the existing English translation ("these thoroughly serious studies") misses Weber's main statement in this case.

<sup>12</sup> The only explicit evidence that Weber put forward is Offenbacher's (1900) descriptive exposition for the region of Baden, but even this piece of evidence has been shown to have substantial flaws (cf. Becker 1997).

<sup>13</sup> Early critics of the Weber thesis had already pointed out historical inconsistencies in the argument, arguing that most capitalist institutions preceded the Reformation (Tawney 1926), that early leaders of the Reformation were very much uninterested in or even hostile to economic issues and ignorant of the working of capitalist institutions (Samuelson [1957] 1993), and that several selective regional examples of economic development went counter to the Weber thesis (cf. also Iannaccone 1998 and the additional references cited therein).

1960s (e.g., Herder-Korrespondenz 1954; Erlinghagen 1965), suggesting that the Weber observation was indeed viewed as an important stylized fact in Germany both in the late 19<sup>th</sup> century and in the mid 20<sup>th</sup> century. But a thorough sub-national empirical analysis is still missing.

### ***B. Luther's Educational Postulations***

It is a highly acclaimed fact that Martin Luther was the first to translate the Bible from its original into German. To spread God's Word, he urged for a move away from the scholarly language of Latin, so that the Word could be understood by everyone. What is less well known is that Luther also very explicitly urged for an expansion of education (cf. Rupp 1996a, 1996b, 1998). Quite obviously, if one wants to read the Bible, one must be able to read. Very early on, in what is generally viewed his first major pamphlet that signified the breakthrough of the Reformation among the general public, *To the Christian Nobility of the German Nation Concerning the Reform of the Christian Estate*, Luther (1520, pp. 461-462) explicitly demanded that every town should have both a boys' and a girls' school where every child should learn to read the Holy Scriptures, in particular the Gospel.

Luther's call to teach everyone in order for them to be able to read God's Word by themselves is the key feature for our alternative theory of the relative economic affluence of Protestants, because – as a mere coincidence – the literacy that was created also had a significant use in the economic sphere. It should be stressed, though, that Luther never had an economic use in mind. The increased education of Protestants was purely religiously motivated in its instrumental function for the dissemination of the Gospel; instruction, learning, education, and scientific engagement did not carry a value of their own for Luther (Rupp 1998, p. 173). Thus, Rupp (1996b, p. 618) states quite clearly that “Luther's prime concern in this area was the creation of elementary schools for the people as a means of providing all Christians with access to the word of God, as contained in the Bible”.<sup>14</sup>

This relates both to the authority of a book, the Bible, for Protestantism and to Luther's general theological tenet of the universal priesthood of all believers. As Pelikan (2005, p. 171) put it:

“The teaching of the New Testament, Luther insisted, was meant to be read and to be obeyed not only by the religious professional but by the artisan at his job and the mother at her household duties. That is part of what he meant by ‘the universal priesthood of believers’ and was one reason that he devoted himself to producing a translation of the Bible which spoke to the people in their own language.”

Rather than relying on injunctions by specifically ordained priests, ceremonial exercises, and sacerdotal imagery, each Christian was urged to read the sacred text for himself or herself. This required

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<sup>14</sup> Woodberry (2004) uses a similar argument to show that Protestant (rather than Catholic) missionaries were central in expanding mass education in the colonial world.

breaching the clerics' privilege of education in favor of universal basic education – a demand truly revolutionary for the time (Rupp 1996b). Rupp (1998, p. 172) summarizes the basic line of reasoning:

“because the divine revelation had quasi materialized itself in the Holy Scripture, each Christian, each Protestant believer was indispensably referred to getting to know and reading this scripture. But this, in turn, made it necessary that everybody could indeed read this scripture – and this, of course, had corresponding efforts of education in schools, which had still to be established, as its precondition...”

The next step in our argument is that such educational expansion was useful beyond religion, in our case for economic productivity. As Rupp (1996b, p. 613) points out,

“Such a call for the launching of educational efforts, motivated at first by religious considerations, naturally released other potentialities beyond the strictly religious sphere: because of its inherent formal structures, the work of education, once begun, was no longer tied exclusively to religion but could also develop naturally in other areas. This was a fact of exceptional importance to the history of Protestantism. In this way, Protestantism became an educational factor of the first order. Since Luther's day and right up to the present, it has produced countless poets and thinkers, scientists and philosophers who have left their mark upon the life of the intellect, and not only in Germany.”

The linguistic and methodical skills created by the teaching of God's Word – reading, understanding, and knowing the Word, including its exegetical comprehension – are disposable in relation to other tasks that go beyond the religious realm (Rupp 1996a, p. 38). But these alternative uses of the acquired education are purely unintentional and of no value to Luther and his Reformist circles. Economic or even capitalist aspects were not a key issue in the Reformation, a fact that Weber [1904/05] (2001, pp. 48-49) was also well aware of: “We have continuously to deal with aspects of the Reformation which must appear to the truly religious consciousness as incidental and even superficial.”

It is well accepted in the study of German educational history that the Reformation was of exceptional importance for the development of the German school system. Thus, Flitner [1941] (1954, pp. 33-43) names Luther and the Reformation as one of four “sources” of elementary schooling, and Spranger (1949, pp. 15-17) counts the Reformation's religious teaching of children as one of the three “roots” of the German elementary school (see also Reble 2002, pp. 81-94).<sup>15</sup> It is thus no surprise that Luther's closest collaborator in the Reformation, Philipp Melanchthon, early on in his career was bestowed the honorary title of *Praeceptor Germaniae*, teacher of the Germans (cf. Rupp 1996b).<sup>16</sup>

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<sup>15</sup> In the post-Luther era of the Counter-Reformation, it was particularly the Jesuits who tried to advance education also among the Catholic population. However, as our evidence below shows, this was far less encompassing than the Protestant urge for education.

<sup>16</sup> However, whereas Luther's main concern was with the literacy taught in elementary schooling, Melanchthon was most concerned with advanced schools and universities (Rupp 1996b).

Luther addressed his educational demands at two different addressees. First, as is most evident in a 1524 pamphlet, he pressured the Protestant rulers to build and maintain schools. Second, most evident in a 1530 sermon, he demanded from each individual, especially the parents, to put emphasis on education and to send children to school.

In his pamphlet *To the Councilmen of All Cities in Germany That They Establish and Maintain Christian Schools*, Luther (1524) assigned the duty of operating schools to the rulers and territorial authorities. If parents did not take care of schools, Luther argued, it would be the duty of the rulers to incur the effort and cost of running schools. He explicitly puts the blame for the lack of educated people on the authorities. In his practical implementation of educational reforms, Melanchthon also made the authorities responsible for organizing the new education system (cf. Rupp 1996b).

But in his *Sermon on Keeping Children in School*, Luther (1530, p. 526) also extended his educational postulations to every individual Christian:

“I see that the common people are dismissive to maintaining the schools and that they withdraw their children from instruction altogether and turn solely to the care for food and bellies, and besides they either will not or cannot consider what a horrible and un-Christian thing they are doing and what great and murderous harm they are doing everywhere in so serving the devil.”

Thus, in line with the universal priesthood of all believers, all Christians are called to ensure that their children receive a decent education.

### ***C. A Human Capital Theory of Protestant Economic History***

The supreme importance of education for economic prosperity receives particular emphasis in the economics profession since the emergence of the theory of human capital in the early 1960s. The key idea of this theory is that education is an investment which yields higher labor-market earnings because it increases productivity. Given Luther’s educational postulations discussed in the previous section, this reasoning provides a simple alternative theory for the historical economic success of Protestant regions: Protestants acquired more schooling than Catholics for religious reasons, and as a side effect, this higher schooling then transformed into higher economic prosperity.

We can depict the central features of this argument in a very simple model. Consider a utility function that adds non-monetary religious benefits  $r$ , differentiated by denomination  $d$ , to a standard human capital model, e.g. Card’s (1995) simplified version of the Becker (1967) model:

$$U(y, S) = \log(y(S)) + r_d(S) - h(S) \quad (1)$$

where  $y(S)$  denotes average annual earnings with  $S$  years of schooling measuring the benefits of schooling in terms of (labor) earnings, and  $h$  is an increasing convex function measuring the monetary and non-monetary costs of schooling.  $r_d(S)$  captures the non-monetary benefit associated with literacy stressed above, namely the ability to read the Bible.

Assume that individuals choose schooling  $S$  to maximize utility  $U$ . Using the same  $y$  and  $h$  functions across denominations, maximization yields a first-order condition that equates marginal benefits to marginal costs:

$$\frac{y'(S)}{y(S)} + r'_d(S) = h'(S) \quad (2)$$

We follow Card (1995) in making the model operational through linearity assumptions:

$$\frac{y'(S)}{y(S)} = a_i - k_1 S \quad (3a)$$

$$h'(S) = b_i + k_2 S - m_d \quad (3b)$$

$$r'_d(S) = l_d \quad (3c)$$

where  $k_1, k_2 \geq 0$  and subscripts  $i$  denote person-specific intercepts.

Equations (3b) and (3c) contain the two main points of our model extension. The first one is the reduction in costs of schooling  $m_d$  to the individual, which we add to the standard formulation of equation (3b). The idea is that because of the demands to build and maintain schools that Luther addressed at the regional rulers (see Luther's 1524 pamphlet, discussed above), the costs of schooling may be lower for individuals in Protestant regions than in Catholic regions. Therefore, the marginal costs of schooling will show heterogeneity across denominations  $d$ , just like the monetary costs and benefits show heterogeneity across individuals  $i$  in the Card model.

There are three aspects to this reduction in individual marginal costs of schooling. First, due to the higher prevalence of public schools in Protestant regions, the commuting costs to schools will be lower. Second, depending on the incidence of the ruler's financing of the costs of schools, part or all of the financial burden may not have to be carried by the individual in terms of taxes, but may come, e.g., from reduced spending on amenities for the ruler and his protégées. Third, independent of the behavior of the regional ruler, one may also think of Luther's educational postulations as inducing Protestants to view learning as less of a strain and more of an enjoyment. In sum, the marginal costs of schooling will be lower for individuals living in Protestant relative to Catholic regions:

$$m_{prot} > m_{cath} \quad (4a)$$

The second main point of our model extension is that the non-monetary religious benefits  $r$ , which we add to the model, also show heterogeneity across denominations  $d$ , as depicted in equation (3c).<sup>17</sup> Following the discussion of Luther's 1530 sermon above, we can assume that the individual marginal religious benefit of schooling will be higher for Protestants than for Catholics:

$$r'_{prot}(S) > r'_{cath}(S) \quad \Leftrightarrow \quad l_{prot} > l_{cath} \quad (4b)$$

Presumably,  $l_{cath}=0$ , because Catholic doctrine had it that individuals should rely on their priests to teach them the Word of God, which is anyways to be read in Latin only. By contrast, Luther's postulations mean that Protestants receive a positive religious (non-monetary) benefit from being literate,  $l_{prot}>0$ , because this allows them to read the Word of God themselves, in particular after Luther had provided the German translation of the Bible. In essence, this structure means that even though the marginal monetary benefits to education may be the same across denominations, marginal total benefits to human capital investment are higher for Protestants.

With equations (2)-(4), the optimal level of schooling is given by

$$S^* = \frac{l_d + m_d + a_i - b_i}{k_1 + k_2} \quad (5)$$

It follows directly from (4) and (5) that in optimum, average education will be higher for Protestants than for Catholics:

$$S^*_{prot} > S^*_{cath} \quad (6a)$$

and, with the basic human capital idea of a positive marginal returns to education  $y'(S)>0$ , that average income will be higher for Protestants than for Catholics:

$$y^*_{prot} > y^*_{cath} \quad (6b)$$

The latter is a simple side effect emanating from the fact that due to their lower costs and higher non-monetary benefits of literacy, Protestants will choose a higher level of education, which then also translates into higher productivity and earnings in the market.

This equilibrium is illustrated in Figure 1. First, religion shifts the marginal benefit curve. The religious benefits to education shift the Protestant total marginal benefits to schooling upwards, so that

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<sup>17</sup> Adding individual heterogeneity in the religious benefits on top of the denominational heterogeneity would not change or add to the main point of our model.

they reach a higher optimal level of schooling. Second, religion also shifts the marginal cost curve. Marginal costs of schooling are lower for individuals living in Protestant regions, further increasing the equilibrium level of schooling chosen in Protestant regions. As depicted in Figure 1, these shifts may mean that optimal years of schooling jump beyond the level necessary to reach literacy (say, 4 or 5 years) for the average Protestant relative to the average Catholic.

### **III. Evidence on Protestantism, Education, and Economic Outcomes**

This section provides an empirical analysis of the associations between Protestantism, literacy, and economic progressiveness in late 19<sup>th</sup>-century Prussia, using variation across the 452 Prussian counties. To our knowledge, this is the first thorough empirical analysis of the Weber thesis at the sub-national level, in particular in Weber's native Prussia. After a brief presentation of the data, the section presents the basic results and tests for robustness to geographical controls. We then discuss several historical facts that suggest that the historical origin of denominational differences in literacy in Prussia can be viewed as an exogenous shock. The concentric dispersion of Protestantism around Luther's city of Wittenberg allows us to use distance to Wittenberg as an instrument to yield exogenous variation in Protestantism, which we exploit in a three-stage least-squares estimation. In additional analyses, we test for robustness to the exclusion of Prussian annexations and to migration, exploit data on students' distance to school to evaluate the role of the supply of schools, and estimate to what extent the role of schools may have been to transmit denominational ethics. The section closes with a brief look at the patterns of Protestantism, education, and earnings in contemporary German micro data.

#### ***A. Data and Descriptive Statistics from 19<sup>th</sup> Century Prussia***

Prussia in the late 19<sup>th</sup> century is the obvious place to analyze the relationships of interest, using sub-national data. First, 19<sup>th</sup> century Prussia has the birthplace of the Reformation at its center. Luther proclaimed his 95 Theses in Wittenberg, and the Prussian territory conserved Protestantism in its purest form. Second, Prussia is Max Weber's birthplace, and his views were shaped by what he observed across Germany. Third, Prussia had rather uniform laws and institutional frameworks, with the possible exception of recent annexations (dealt with below). Fourth, Prussia was well divided between Protestants and Catholics, with Protestants constituting roughly two thirds and Catholics roughly one third of the total population, so that no denomination was an extreme minority. This differs from the more lopsided denominational distributions of most other countries. What is more, Prussia was exceptional in granting freedom of religion to each individual as early as in the mid-18<sup>th</sup> century. Frederick the Great, the enlightened monarch of Prussia, had famously declared in 1740 that in his

country, everybody may find his salvation in his own way.<sup>18</sup> Fifth, with a population of about 24.6 million in 1871, Prussia was one of the largest European countries and accounted for 60 percent of the inhabitants of the German Empire. Sixth, Prussian proverbial orderliness and thoroughness yielded high-quality data at the county level in the second half of the 19<sup>th</sup> century.

We thus build our database on Protestantism, literacy, and economic outcomes in 19<sup>th</sup>-century Prussia from census material collected by the Prussian Statistical Office in the 1870s and 1880s, available at the county level. Our data cover all 452 Prussian counties (*Kreise*) at the time, divided into 35 districts (*Regierungsbezirke*) and 11 provinces (*Provinzen*). We use data from the 1871 Population Census, the 1882 Occupation Census, and the 1886 Education Census; see Appendix A for details.

The 1871 Population Census provides data on religious affiliation and literacy, as well as a set of standard demographic variables such as gender and age. The descriptive statistics, reported in Table 1, reveal that the average share of Protestants in a county was 64.2 percent, against 34.5 percent Catholics (the remaining shares being Jews at 1.1 percent and other Christian denominations at 0.2 percent). There are two things to note. First, both Protestants and Catholics are not just a small minority, but constitute a sizeable fraction of the Prussian population. Second, there is substantial variation across counties, essentially ranging from zero to 100 percent Protestants or Catholics, which provides the variation for our empirical analysis. In fact, more than 75 (60) percent of the counties have a share of at least 80 (90) percent of either Protestants or Catholics.

The 1871 census is explicitly the very first census ever to survey literacy in Prussia.<sup>19</sup> Literacy is measured as the ability to read and write among the population aged 10 years or older. As a measure of educational outcome, literacy may be a more informative measure of accumulated human capital than standard enrollment data, which may partly capture years in school that did not lead to effective educational outcomes. Average literacy across the counties was as high as 87.5 percent (Table 1).<sup>20</sup> This mirrors the fact that Prussia was well-known and much-admired for its primary education system in the second half of the 19<sup>th</sup> century, which is often viewed as a key feature responsible for the fact that Germany took over industrial leadership from Britain (cf. Landes 1969, pp. 339-348). Still, there is substantial cross-county variation in the literate share of the population, ranging from 37.4 to 99.3 percent, and 16 percent of the counties had more than one quarter of their adult population illiterate.

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<sup>18</sup> “... hier mus ein jeder nach Seiner Façon Selich werden.” Frederick also wrote that “all religions are equal and good...” A unique feature in 18<sup>th</sup> century, a Protestant and a Catholic church stood next to each other in the *Forum Fridericianum* at the origin of the central boulevard “Unter den Linden” in Berlin.

<sup>19</sup> Other parts of the German Empire did not survey literacy in the 1871 census.

<sup>20</sup> This made West German regions those with the highest literacy of Western Europe at the time (Tabellini 2005).

Data from the 1886 Education Census show that the vast majority of students (95.5 percent) went to schools affiliated with a single religious denomination. Most children attended a school of their own denomination, but schools were open to children from other denominations. While schools were denominationally affiliated, funding was mostly independent of official church sources. Nearly half of the average funding for teaching staff came from local public authorities, 16.7 percent from school fees, and slightly above 10 percent each from endowment funds, trusts, and needs-based central government grants. Thus, local communities and authorities could develop and maintain significant educational differences along denominational lines.

Our main indicators of economic progressiveness are measures of the sectoral structure, derived from the 1882 Occupation Census. The average share of the labor force in non-agriculture is 33.9 percent (27.7 percent in manufacturing and 6.3 percent in the service sector). The shares are somewhat higher when restricting the analysis to the male labor force (Table 1). As an alternative measure of economic development, we also use an income proxy derived from the 1886 Education Census. This measure refers to the average annual income of male elementary school teachers, which has been used as a proxy for income in general (e.g., Lee, Galloway, and Hammel 1994). In 19<sup>th</sup>-century Prussia, teacher salaries were almost entirely financed from local contributions and therefore reflect the overall income in the county (cf. Schleunes 1989). The correlation between the teacher income measure and the size of the non-agricultural sector is 0.74. The downsides of the income measure for our purposes are that teacher salaries may be affected by how much education is valued in a county, and that there may be reverse causality from teacher income to literacy, giving rise to problems of endogeneity. Also, the nominal income measure may be affected by differences in price levels across counties. However, the Balassa-Samuelson hypothesis suggests that prices are higher in economically advanced areas (Balassa 1964; Samuelson 1964), so that nominal income differences may still provide a good proxy for economic affluence. Given its shortcomings, we use the income measure only as a robustness check for results based on the sectoral measures; our main qualitative results turn out to be perfectly robust across the different measures.

The demographic control variables from the 1871 Population Census include age structure, gender, native population, household and county size, and recent population growth (Table 1). We routinely include population growth between 1867 and 1871 as a control variable to capture possible effects of the Franco-Prussian war of 1870/71. While the impact of the war on Prussian territory was very low in general, the death toll of the Prussian army was relatively low (40,000 soldiers), and there was nearly a year between the end of the war in January and the census in December, the control variable for recent population growth may capture any remaining differential migration or death toll across counties.

Figures 2-4 provide a rough impression of the geographical distribution of the main variables across the 452 counties. Figure 2 reveals a mostly concentric pattern of the diffusion of Protestantism with Wittenberg at the center. Protestant diffusion came to a halt in the western provinces (Rhineland and Westphalia) and in the eastern parts which were predominantly Polish speaking.<sup>21</sup> As a general tendency, the predominantly Protestant regions in the center of Prussia are also economically more successful (Figures 3a and 3b). Another center of economic progressiveness is the western Ruhr area with its mineral resources. In line with the diffusion of Protestantism, literacy rates are highest in the Protestant heartland in the center of Prussia and lowest in the western and eastern counties (Figure 4).

### ***B. Protestantism, Education, and Economic Outcomes in 19<sup>th</sup> Century Prussia: Basic Results***

This section estimates the central associations in this paper. First, we test the main prediction of the Weber thesis, whether Protestant counties were economically more advanced. Second, we estimate the validity of our alternative explanation, whether Protestant counties showed higher literacy. Third, we calculate to what extent differences in literacy by religion can account for the economic differences and run a “horse race” between Protestantism and literacy in accounting for economic outcomes.

In this section, we keep the assumption that the spread of Protestantism was exogenous to prior economic progressiveness, and – given our argument above that the additional literacy of Protestants was an unintended by-product of Luther’s urge to read the Bible – we take denominational differences in literacy as exogenous to both work ethic and economic outcomes. Given these assumptions, we can estimate the mentioned associations by ordinary least squares. In the sections below, we will probe these assumptions in instrumental variable specifications and other robustness specifications.

We start by establishing the link between Protestantism and economic outcomes, in order to provide empirical support for the common interpretation of the Weber thesis. Thus, we regress economic outcomes  $Y$  of the 452 Prussian counties on the share of Protestants  $PROT$  in the county, as well as a set of control variables  $X$ :

$$Y = \alpha_1 + \beta_1 PROT + X\gamma_1 + \varepsilon_1 \quad (7)$$

The vector of mostly demographic control variables includes the share of Jews and females in the county, the share of the county population below 10 years of age, born in the specific municipality, and of Prussian origin, shares of the population with physical or mental disabilities (blind, death-mute, and

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<sup>21</sup> Note that the diffusion of Protestantism was intimately related to Luther’s German language Bible translation and his German language texts. It is thus no surprise that the Reformation was less successful in the Polish speaking districts. The German-speaking districts of Königsberg and Gumbinnen in the far east of Prussia, however, have been an integral part of the Prussian mainland for centuries and are again predominantly Protestant.

insane), average household size, size of the county, and population growth over the four preceding years (to control for potential effects of the Franco-Prussian war).

As the results in Table 2 show, counties with larger shares of Protestants exhibit an advanced degree of economic progressiveness, consistently across the different measures. The estimates suggest that on average, an all-Protestant county has a non-agricultural share of its total labor force that is 3.5 percentage points larger than an all-Catholic county. The estimate for the male labor force is higher, at 4.9 percentage points, combining a manufacturing sector that is 2.9 percentage points larger and a service sector that is 2.0 percentage points larger. Viewed against the average share of the non-agricultural sector in male employment of 40.0 percent, the average conditional difference in economic progressiveness between Protestants and Catholics appear modest, but economically non-negligible and statistically significant. Similarly, the income proxy increases significantly with the share of Protestants in a county, with an all-Protestant county having 6.3 percent higher income than an all-Catholic county.

In sum, the significant positive association between Protestantism and the different measures of economic progressiveness validates the empirical content of the common interpretation of the Weber thesis. In contrast to the existing cross-county work (cf. Delacroix and Nielsen 2001), which may be hampered by the effects of institutional differences across countries, our sub-national analysis from Prussia confirms the basic underlying association purported by the Weber thesis.

Next, we test the basic prediction of our main argument, that Protestants have higher literacy than Catholics. That is, we test equation (6a) of our human capital model by regressing the share of literates *LIT* in a county's population aged 10 and older on the share of Protestants *PROT* in the county:

$$LIT = \alpha_2 + \beta_2 PROT + X\gamma_2 + \varepsilon_2 \quad (8)$$

where the vector of control variables *X* now additionally includes the share of the population with missing information on literacy (which is the case for only 1.7 percent on average, cf. Table 1).<sup>22</sup>

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<sup>22</sup> Given that the dependent variable in this model is clustered near the right-censored value of 100 percent, the linear model might be inadequate and suffer from heteroscedasticity. We therefore also estimated the model on a logit-transformed dependent variable and with heteroscedasticity-consistent weighted least squares, yielding the same qualitative results (available from the authors). Furthermore, while the supply-side point of our theoretical model – that costs of schooling may be lower in Protestant regions – requires a model specified on aggregate data, the demand-side point – that Protestants may get additional non-monetary benefits from literacy – raises the issue of ecological inferences of individual associations from aggregate data (cf. Robinson 1950). However, special tables in the 1871 Population Census on literacy rates by religious denomination within each county show that Protestants are indeed more literate than Catholics, ruling out an ecological fallacy. Unfortunately, the other variables are not reported in a break-down by religious denomination, so that our lowest possible unit of analysis is the county. Our individual-level analyses of contemporary German data in Section III.G. below also confirm the association at the individual level. And as Robinson (1950) has already shown, the difference between ecological and individual inference will usually be lower the more the variables are clustered within regions, and our variables – especially Protestantism – are very highly clustered in Prussian counties (cf. Table 1). We will provide further discussion of the distinction between supply-side regional effects and demand-side individual effects in section III.F. below.

As the results in Table 3 reveal, there is indeed a significant association between Protestantism and literacy. On average, an all-Protestant county has a literacy rate 9.9 percentage points higher than an all-Catholic county. Viewed against an average literacy of 87.5 percent, this is a substantial difference across religious denominations. As the data from the Population Census are available separately for urban municipalities and for rural areas in each county (see Appendix A for details), we can estimate this association separately for rural and urban areas. While the association is statistically significant in both sub-populations, it is more pronounced in rural areas, as might be expected with average literacy rates in urban municipalities as high as 91.0 percent (cf. Table A2 in the appendix).

Finally, we assess to what extent the higher literacy of Protestant counties can account for their advanced economic outcomes. The main tenet of our human capital theory of Protestant economic history is that Protestantism affected economic outcomes via human capital accumulation. We proceed in two steps. First, we estimate the association between literacy and economic outcomes and calculate to what extent this can account for the denominational difference in economic outcomes. Second, we run a “horse race” between Protestantism and literacy in regressions explaining economic outcomes.

As the first four columns of Table 4 reveal, there is a substantial association between a county’s share of literate people and the different measures of economic progressiveness, without conditioning on the share of Protestants.<sup>23</sup> For every 10-percentage-point increase in the literacy rate, the size of the non-agricultural sector is 4.6 percentage points larger (3.6 manufacturing plus 1.1 services) and income is 6.4 percent higher. Combining these estimates with the observation that the average literacy rate in all-Protestant counties is 10 percentage points larger than in all-Catholic counties (cf. Table 3), it turns out that Protestants’ higher literacy can account for roughly the whole gap in economic outcomes between the two denominations. Remember from Table 2 that the non-agricultural sector of an all-Protestant county is 3.5 percentage points larger than that of an all-Catholic county (2.1 manufacturing plus 1.4 services) and income is 6.3 percent higher. In fact, the extent of economic progressiveness of Protestant counties attributable to their higher literacy is slightly larger than their actual progressiveness, at least in terms of the size of the manufacturing sector, which may be due to the fact that the basic specification does not yet include controls for economic geography (see below).

To provide a more thorough analysis of the relative importance of literacy and other traits of Protestant counties in determining their superior economic outcomes, we perform a “horse race” between the share of Protestants and literates in explaining economic outcomes:

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<sup>23</sup> Note that the coefficient on the indicator of missing information on literacy is never statistically significant in these specifications, diluting worries that missing literacy information may have first-order effects on the presented results.

$$Y = \alpha_3 + \beta_3 PROT + \chi_3 LIT + X\gamma_3 + \varepsilon_3 \quad (9)$$

As the last four columns of Table 4 reveal, the coefficient on literacy is virtually unaffected by the inclusion of the share of Protestants, retaining its large and significant effect.<sup>24</sup> By contrast, the coefficient on the share of Protestants drops to virtually zero. By including the share of literates in the county, the share of Protestants loses all the quantitative or statistical significance in accounting for economic progressiveness that it had without conditioning for literacy (cf. Table 2). This is true for all four measures of economic outcomes, as well as for the three sectoral shares measured for the male labor force (not reported). Note that the magnitude of the standard errors of the coefficient on Protestantism stays the same after including literacy. That is, the coefficient is as precisely estimated as before; only its size changes to about zero in each specification.<sup>25</sup>

The results reveal that after conditioning on the effect of literacy, there is no difference whatsoever in economic outcomes between Protestant and Catholic counties. Protestantism has no independent effect on economic outcomes beyond literacy. This leaves little room for substantive economic differences stemming solely from differences in work ethic, in that Protestants provided more effort, strived more for economic success, were thriftier, or had a more efficient approach to working life. The *whole* economic lead of Protestant counties can be attributed to their higher human capital.

### C. *Robustness to Geographical Influences*

The fact that we exploit regional variation within a country means that we condition on a uniform framework of common laws and institutional settings. However, a potential threat to our specification so far comes from another possible “fundamental” cause of economic growth, geography. While geographical differences may not be as dramatic within Prussia as across countries, they may still exert economic effects across Prussian counties. We therefore test the robustness of our results against including several geographical control variables (see Table 1 above for descriptive statistics). Since our results were not sensitive to the particular measure of economic outcome, we concentrate the remaining analyses on the share of the total work force in non-agriculture as economic outcome.

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<sup>24</sup> Since the literacy measure is significantly clustered near 100 percent, the estimates might be strongly driven by variation among observations that are close to universal literacy. However, our results are robust to restricting the analysis to the sub-sample of 315 counties with literacy rates below 95 percent, to the 158 counties with literacy rates below 90 percent, and even to the 73 counties with literacy rates below 75 percent.

<sup>25</sup> The qualitative results are unaffected by the inclusion of certain control variables which are correlated with Protestantism, such as the population share aged below 10 and average household size. Even when literacy and Protestantism are entered alone, literacy shows a significant positive association with the four measures of economic outcomes, while Protestantism does not; in the case of manufacturing (and the combined non-agricultural sector), the negative coefficient on the share of Protestants even gets significant.

We first add a set of geographic variables to capture several dimensions of county location. To account for periphery, we include distance of the county capital to the Prussian capital of Berlin (measured as the greater circle distance). Longitude (measured in rad) is a measure of the North-South location of a county, included as a proxy for distance to the North and Baltic Seas at the northern boundary of Prussia. Latitude measures the East-West location and traces out the westward expansion of Prussia over the centuries. We also include the interaction of latitude and longitude. Finally, we include a dummy for counties located in Poland today, serving as a proxy for Slavic languages.

All our substantive previous results presented in Tables 2-4 – the association between Protestantism and economic outcomes, the association between Protestantism and literacy, and the association between literacy and economic outcomes without and with conditioning on Protestantism – are robust to the inclusion of the geographic controls (Tables 5-7). In the regressions with the economic outcome as dependent variable, only latitude, longitude, and their interaction enter statistically significantly, while distance to Berlin and the Poland dummy are insignificant.

Next, we add the fraction of the work force employed in mining to control for the effects of the availability of natural resources. Several authors (e.g., Delacroix and Nielsen 2001) have argued that the Ruhr area in the west of Prussia was economically thriving because of the mining industry, and despite the Catholic dominance. While the mining variable enters significantly positive in all models, our main associations again remain robust, at a slightly reduced magnitude.

Another worry about geographical robustness is the variation between rural and urban areas, as economic development might have gained ground mostly in urban areas. From the Population Census, we know the share of Protestants separately for urban and rural areas in each county (where a population size of 2,000 is used to classify municipalities into urban and rural). As reported in Table A2 in the appendix, on average the share of Protestants is virtually identical in municipalities and in rural areas (64.6 and 64.7 percent, respectively). There is no tendency for Protestants or Catholics to live predominantly in urban (or rural) areas. Consequently, it does not come as a surprise that our results are robust to the inclusion of the fraction of the county population living in urban municipalities. While the share of urban population enters significantly positive in all models, the point estimates on our coefficients of interest are again slightly reduced, but remain highly significant.<sup>26</sup>

Our final and most demanding geographic robustness check consists in including a whole set of 35 district dummies. Thereby, we exclude all the variation that exists across districts and exploit only the

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<sup>26</sup> We estimated two additional specifications to control for urbanity. First, we used a binary indicator of urbanity that was equal to one when more than 50% of the county population lived in urban municipalities. Second, we dropped urban counties from the regression sample. Both exercises yielded very similar results.

within-district variation. To the extent that there is unobserved regional heterogeneity, district dummies should be able to capture most of its substance. While the point estimates of the coefficients on Protestantism are again reduced by inclusion of the district dummies in Tables 5 and 6, they remain statistically significant. Results of our key specification in Table 7 are virtually unaffected by the inclusion of district dummies.

We conclude that all our qualitative results are robust to controlling for a variety of geographical influences: Economic outcomes and literacy are both significantly higher in Protestant counties, but Protestantism has no significant association with economic outcomes beyond the one due to literacy.

#### ***D. The Historical Origin of Denominational Differences in Literacy as Exogenous Shock***

The evidence presented thus far shows that Protestant regions were economically more advanced than Catholic regions only insofar as they had higher literacy rates. Religious denomination had no association with economic outcomes independent of the association that can be traced back to differences in literacy. In itself, this is an intriguing descriptive finding: The fact that Protestant regions were economically more successful in late 19<sup>th</sup>-century Prussia – purported by Weber and shown by our data – can be fully accounted for by a positive association between literacy and economic success, so that there is no room for additional explanations of economic success based on Protestantism, in particular based on a specific Protestant work ethic.

Considering only the results so far without further discussion, the possible interpretation most favorable to the Weber thesis would be that the work ethic stressed by Weber works exclusively through the accumulation of human capital. One might argue that a Protestant ethic led Protestants to invest more in their human capital in order to be economically more successful. Such an interpretation would be consistent in particular with the interpretation of the Weber thesis which argues that the Protestant ethic led to higher thrift, which translated into investments and thus higher long-run economic prosperity. Of course, this is definitely *not* the specific kind of interpretation that Weber had in mind; there is no mention of any argument close to the human capital idea in his work. But at least, such an interpretation would be related in spirit to Weber's ethical interpretation.

However, we argue that such an interpretation is not consistent with several historical facts. As discussed in detail above, Luther's call for literacy was in no way intended to foster economic goals. Quite to the contrary, Luther was at least as far from pursuing economic goals as his Catholic opponents. Instead, we argued that the economic effects of increased literacy were an unintended by-product of his call for everyone to be able to read the Gospel. Thus, the increased literacy among Protestants was unrelated to any work ethic or other thought from the ethical or economic sphere.

There are several further reasons to consider literacy as exogenous to the relationship considered by Weber, i.e. both to ethical considerations and to economic outcomes. First, the main features of denominational orientation across German regions were already determined at the time of Reformation in the 16<sup>th</sup> and early 17<sup>th</sup> century. In related work (Becker and Wößmann, in progress), we provide evidence for a strong intertemporal stability of regional denominational affiliations in Germany over more than 400 years. Thus, the overwhelming part of the denominational variation in late 19<sup>th</sup> century had nothing to do with decisions made at the time, but had been given for at least 200 years. In Germany, religion is not only an individual cultural aspect that can be viewed as mostly invariant over an individual's lifetime as in any other country (Guiso, Sapienza, and Zingales 2006), but even more, it is a regional aspect that hardly changed for several centuries.

Second, what is more, even at the time of denominational choice in the 16<sup>th</sup> and early 17<sup>th</sup> century, it was not the personal ancestors of the citizens in our data who made the choices, but rather the local and regional princes, dukes, and rulers of the many small princedoms, fiefdoms, and imperial cities that constituted the fragmented German empire at the time of Reformation. The Imperial Diet held 1555 in Augsburg had adopted the principle “*Cuius regio, eius religio*” (“Whose rule, his religion”). Thus, even at the time of Reformation, it was not individual citizens who could make deliberate denominational choices, but they were forced to accept their respective sovereign's denomination.

Third, it is generally accepted that the princes' choices at the time were mostly driven by reasons of power politics, following or seceding from the Pope as a worldly force. Several princes and dukes saw the Reformation as an opportunity to cut down on Roman influence and united in the so-called Schmalkaldischer Bund, the political union of Protestant rulers. Even if some Protestant princes at the time may also have had religious motives and personal convictions, Reformation historians agree that the adoption of the Reformation in different German regions was largely exogenous to the stage of economic development. As an example, Lorenzen-Schmidt (1979) shows that there was no relationship between the stage of development of municipal capital markets and the adoption of the Reformation in Northern German towns. There is no evidence from German Reformation history that economically more advanced regions were more likely to adopt the Reformation.

Fourth, it might be argued that regions that were educationally advanced already in Lutheran times might have been more conducive to Luther's preaching and its methods of distribution.<sup>27</sup> However, as is well documented (cf. Scribner 1994), Luther's theses were mostly distributed to the general public in the form of caricatures which denounce the unethical behavior of the Pope and his allies, so that they

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<sup>27</sup> See Sander (2002) for a discussion (and rejection) of possible effects of education on religious behavior in US data.

were equally accessible to the illiterate as to the literate. Furthermore, the available evidence suggests that around 1500, literacy in Germany was as low as about 1 percent of the population, exclusively restricted to the nobility and some townsmen (cf. Engelsing 1973, p. 19). So, if there was any systematic aspect about the spread of Protestantism, it might have been centered in cities. However, as discussed above, the share of Protestants in rural and urban areas was in fact identical in late 19<sup>th</sup> century, and controlling for urbanity does not change our results.

A potential exception to the general rule that the spread of Protestantism was unrelated to the pre-existing economic and educational state might be the free imperial cities (*Reichsstädte*). Free cities were virtually self-ruling enclaves independent from the rule of regional princes. Many of them had accumulated substantial wealth through trade, and they were well-known for their liberal thinking, which might have been conducive to adopting the Reformation. Therefore, as a further robustness check, we exclude all Prussian counties from our sample that contain former free imperial cities. As the first column of Table 8 shows, our qualitative results are unaffected. The same is true when all free Hanseatic cities are excluded (not reported).

Fifth, the regional origination of Protestantism has to be viewed against the background of a very specific event, namely a particularly vicious example of indulgence practice to which many of Luther's parishioners succumbed. In 1517, the Dominican mendicant Johannes Tetzel started to sell indulgences in the province of Magdeburg to support the construction of St. Peter in Rome, by order of Bishop Albrecht of Brandenburg. In reality, half of the revenues were used to pay off Albrecht's debts with the Fugger family, the most influential economic dynasty at the time. Martin Luther, who taught in Wittenberg, proclaimed his 95 Theses in reaction to his specific experience with this selling of indulgences and in protest over the abuse of the money for Albrecht's private affairs. Thus, the geographic spread of Protestantism originating from Wittenberg was initiated by a specific event that can be viewed as a random shock, unrelated to the economic or educational reality of the time.

#### ***E. The Concentric Dispersion of Protestantism: Distance to Wittenberg as Instrument***

While the historical origin of the denominational differences in literacy rules out the most obvious forms of potential endogeneity, some possible sources of endogeneity might remain. For example, Ekelund, Hébert, and Tollison (2002, 2006) hypothesize that the diffusion of the Reformation might have been facilitated in societies characterized by the decline of feudalism and relatively unstable distribution of wealth. This hypothesis is explicitly aimed at the diffusion across countries, though, and may be less relevant for the diffusion within Prussia. Similarly, while the idea that choice of denomination may be endogenous to education (Sacerdote and Glaeser 2001) in principle provides an

additional source of endogeneity, this source also seems less of an issue in our case, because there was hardly any effective individual denominational choice in the 19<sup>th</sup> century.

Still, to rule out potential remaining worries of endogeneity, we use a particular aspect of the historical diffusion of Protestantism across the German Empire in order to restrict the variation in Protestantism used in the estimation to a part that is credibly exogenous. Reformation historians refer to the diffusion of Protestantism as resembling the propagation of a wave caused by a stone thrown into water.<sup>28</sup> Luther's preaching had its most imminent effect in the area surrounding his city of Wittenberg, and there is a tendency for the impact to diminish with distance to Wittenberg. In effect, in the German Empire, Protestantism dispersed around Wittenberg in a mostly concentric pattern.<sup>29</sup> As evidenced in Figure 2 above, it seems that the Reformation spread out from Wittenberg in all directions, but then came to a halt after some distance.

The main reasons for a circular dispersion around Wittenberg may have been the costs of traveling and of information diffusion through space, and these transportation and transaction costs played a crucial role at the time. Among other things, rulers who wanted to convert their church system to Protestantism had to send priests to study the new denomination in Wittenberg. Thus, thousands of students came to Wittenberg to hear Luther's sermons and speeches, and they spread the word as preachers back in their home regions (cf. Peters 1969; Bunkowske 1985). Given the arduousness of travel in the early 1500s, the propensity to come to Wittenberg to listen to Luther and his successors likely declined with distance to Wittenberg. The fact that the German regions spoke ever more different dialects the further distant the regions may also have contributed to a concentric pattern of the dispersion of Protestantism, both in oral and written means of dissemination, and in the dissemination both to rulers and to the population at large.

It is generally accepted that Wittenberg was an "unimportant place" (Holborn 1942, p. 133) until 1517. Therefore, distance to Wittenberg should be unrelated to a county's economic and educational state before it adopted Protestantism. However, it is hard to ascertain this rigorously across our 452 Prussian counties because there is hardly any data on the economic or educational situation for the time

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<sup>28</sup> Luther himself likened the spreading of the sermon to "throwing a stone into the water which makes waves, circles, and streaks around it, and the waves push each other further and further; one pushes the other..." (Luther 1522, p. 140). He also stressed that the preaching "will be disseminated further and further and that from the Church which is located in a certain place many others will be drawn to the Word" (Luther 1528, p. 224). In the latter source, Luther explicitly refers to Wittenberg as the place from which a creek irrigates the neighboring regions.

<sup>29</sup> We do not purport that the dispersion was concentric outside the German Empire. Other countries had other Protestant reformers, who for example provided the first Bible translation in the native languages. Our argument is strictly referring to the diffusion within Prussia and the German Empire.

of Reformation, and the 1871 Population Census is explicitly the first occasion where consistent data on literacy were surveyed.<sup>30</sup>

But several pieces of evidence support the idea that distance to Wittenberg is unrelated to the economic and educational situation before 1517. First, in our sample of 452 Prussian counties, distance to Wittenberg is completely insignificant in predicting the probability of being a free imperial city, measured in pre-Reformation status (Table 9). Second, distance to Wittenberg is similarly uncorrelated with the probability of being a free Hanseatic city. Third, we use data from Eulenburg (1904) on German universities founded before 1517 to estimate whether distance to Wittenberg predicts whether a county in our sample had a university before 1517. We also regress the year of foundation of universities in existence before 1517 on distance to Wittenberg. In both exercises, we find that distance to Wittenberg is completely unrelated to the spread of universities before Lutheran times.

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

The first two columns of Table 10 report the instrumental-variable (IV) estimate of Protestantism on literacy, where Protestantism is instrumented by distance to Wittenberg. As is evident from the *F*-statistic of the instrument in the first stage, distance to Wittenberg is a strong instrument for the share of Protestants in a county. Each 100 km distance to Wittenberg is associated with a Protestant share that is 9.5 percentage points lower. The second stage uses only that part of the Protestant share that is due to distance to Wittenberg to predict the literacy rate. The positive effect of Protestantism on literacy is highly robust in the IV specification. In fact, the point estimate is significantly higher, with a difference in literacy of 18.9 percentage points between an all-Protestant and an all-Catholic county.

How do the results for economic outcomes hold in the IV specification? As a first step, we can use the reduced form of the model just presented, regressing literacy on distance to Wittenberg, and use this as a first stage in a model that estimates the effect of literacy on economic progressiveness. This model is presented in columns (3) and (4) of Table 10. In the first stage, distance to Wittenberg is a strong instrument of the literacy share in a county. In the second stage, the variation in literacy that is due to distance to Wittenberg has a significant positive effect on economic progressiveness. The results

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<sup>30</sup> There is only scattered historical evidence on the spread of literacy and schooling in Prussia between 1500 and 1871, discussed in Appendix B, which suggests that Luther's educational postulations did have a long-lasting effect. Our analysis has to leave open whether Luther's educational postulations had economic effects already in the agrarian economy of the 16<sup>th</sup> to 18<sup>th</sup> centuries, or whether they had to wait for the industrial revolution to raise the economic payoff to education, as has been argued for Sweden (Sandberg 1979).

suggest that a 10 percentage point increase in the literacy rate results in a 4.4 percentage point increase in the share of non-agriculture – a point estimate very close to the OLS estimate of Table 4. Given the exogeneity of the instrument, we can interpret this as a causal effect of literacy on economic outcomes. Furthermore, given that a Hausman test can in no way reject the null hypothesis that the difference in coefficients between the IV and the OLS model is not systematic, we should actually prefer the estimates of Table 4 as being the efficient estimates.

The specification in columns (5) and (6) adds the share of Protestants to the list of instruments. This allows us to use over-identification restrictions to test whether we can exclude the share of Protestants from the second stage. The Sargan test clearly shows that the over-identification restrictions cannot be rejected. As long as we accept distance to Wittenberg as a valid instrument for literacy, we can accept the share of Protestants as exogenous to economic outcomes, justifying its omission from the second stage.

Given the result that Protestantism does not have an impact on economic outcomes independent of its effect on literacy, we can go one step further and estimate the following system of three equations:

$$\begin{aligned}
 Y &= \alpha_4 + \beta_4 \widehat{LIT} && + X\gamma_4 + \varepsilon_4 \\
 LIT &= \alpha_5 && + \beta_5 \widehat{PROT} && + X\gamma_5 + \varepsilon_5 \\
 PROT &= \alpha_6 && + \beta_6 WITT && + X\gamma_6 + \varepsilon_6
 \end{aligned} \tag{10}$$

In this system, the first stage predicts the share of Protestants in a county by its distance to Wittenberg (WITT). The part of the variation in Protestantism which is due to distance to Wittenberg is then used in the second stage to predict the literacy rate of the county. Finally, in the third stage, the part of the variation in literacy which is due to that part of the variation in Protestantism which is due to distance to Wittenberg is used to predict economic progressiveness. In effect, this system of three equations specifies a “double-IV” estimation, which can be estimated via three-stage least-squares (3SLS).

The 3SLS results, reported in columns (7) - (9) of Table 10, support our previous findings. Distance to Wittenberg is negatively associated with Protestantism; that part of Protestantism which is due to distance to Wittenberg has a positive effect on literacy; and that part of literacy which is due to that part of Protestantism which is due to distance to Wittenberg has a positive effect on the share of non-agriculture in the economy. Viewing distance to Wittenberg as yielding exogenous variation in the spread of Protestantism, we get the same qualitative results as before.

Given these results, and for all the reasons discussed in the previous sections, the denominational variance in literacy can be viewed as exogenous to ethical and economic considerations. We therefore argue that the only interpretation of the presented results which lives up to the historical facts is that the

higher literacy among Protestants across Prussia is a mere side effect of Luther's postulations, a "shock" exogenous to the ethical and economic system. Therefore, the higher economic prosperity of Protestant regions can be interpreted as the consequence of higher education.

***F. Additional Aspects of Identification and Interpretation: Prussian Annexations, Migration, Distance to School, and Teaching of Ethics***

This section addresses a set of additional issues of identification and interpretation. First, Prussia grew substantially over the centuries. At least for the areas annexed by Prussia shortly before the 1870s, the assumption of an effectively uniform institutional setting might be questioned. Second, there might have been non-random migration, in particular for different religious affiliations. Third, we use data on the supply of schools, both as an alternative measure of education and to provide evidence on the importance of the two channels proposed by our theoretical model, namely reduced cost due to rulers' building of schools and increased non-monetary benefits. Fourth, we test for the importance of Protestant ethics in the sense that the crucial aspect of schools in Protestant counties might have been to transmit the Protestant work ethic, rather than teaching literacy.

The first issue, that several territories had been annexed by Prussia in the course of the 19<sup>th</sup> century, might undermine a key strength of our within-country approach, namely that all counties are effectively exposed to the same set of laws and institutional settings. To the extent that there is path dependency in the effective working of institutions, the territories more recently annexed by Prussia may be subject to unobserved heterogeneity in effective institutions. We perform two empirical tests to deal with this issue. First, we control for the year in which a county came to Prussia, either as a linear variable or as 36 dummies for all the rounds of annexations after 1525. As is evident from columns (2) and (3) of Table 8, our qualitative results are unaffected by these controls. The first specification also shows that there is no significant linear effect of the year of annexation on economic outcomes, suggesting that more recent annexations do not perform systematically different from earlier Prussian territory. Second, we restrict the analysis in an increasingly restricted manner to sub-samples of counties that had been with Prussia for a long time. We start with the 361 counties that had been part of Prussia for more than 50 years in 1871, and then go on to restrict to the 235 counties that had been part of Prussia before 1800, 179 counties before 1750, and 89 before 1650 (see columns (4) to (7) of Table 8). Again, our main qualitative results are perfectly robust in these sub-samples.

The second issue is that migration might not have been independent of religion, literacy, and economic outcomes. Such migration might render the share of Protestants in a county endogenous to its economic state. First, note that our basic model already includes the share of the population born in the

respective municipality and the share of the population that is of Prussian origin. Therefore, patterns of migration over the lifespan of the 1871 population are already controlled for. Second, we can restrict our analysis to the sub-sample of counties that are hardly intertwined in terms of denomination, i.e. only to counties that are either mostly-Protestant or mostly-Catholic (defined as having either more than 80 percent or less than 20 percent Protestants). The idea is to exclude all counties where migration might be a substantive issue. Given the very limited pattern of migration, the dominant denomination in the counties with very low and very high fractions of Protestants will derive from the historical choices of local princes, but not from migration. As the first column of Table 11 shows, our results are unaffected by restricting the analysis to this sample of 343 counties.

While in this specification, the main variation in the share of Protestants comes from the variation between the two extreme types of counties, the variation in the share of Protestants within the two types might still be affected by migration. Therefore, we transform the Protestantism measure into a dummy variable equaling one for the counties with more than 80 percent Protestants and zero for the counties with less than 20 percent Protestants. Such a specification uses only the variation that stems from historical regional choices and is unaffected by any type of migration. As column (2) of Table 11 reveals, our substantive results are again robust.

The third issue opens the black box of higher literacy, looking at whether Protestantism had indeed an effect on the supply of schools. The 1886 Education Census provides county-level information on the share of students who had a distance to school of more than three kilometers. While the information is limited to those who were students in 1886 (rather than the adult population), the measure may still provide a useful proxy for the supply of schools. Note also that the measure applies only to those children who actually attended school; it may underestimate the true average distance to school if there are children who did not attend school because the distance was too far. To begin with, in column (3) of Table 11 we ascertain that the share of Protestants in a county is indeed negatively related to the share of students who had a long distance to their school, indicating that there was a denser supply of schools in Protestant counties. This pattern is robust to the inclusion of our geographic controls, including urbanity. When the share of literate adults in the county is added to the estimation, both literacy and Protestantism have a significant negative association with distance to school.

Next, we use distance to school as an alternative measure of human capital in explaining economic outcomes, substituting for our previous literacy measure. As column (4) of Table 11 reveals, distance to school has the very same effect as the literacy measure in a horse race against Protestantism: Distance to school is significantly negatively related to economic progressiveness, and it renders the share of Protestants in the county insignificant.

Finally, we enter distance to school and literacy jointly in the economic-outcome equation (column (5) of Table 11). Both distance to school and the share of literates enter significantly in explaining economic progressiveness, while the share of Protestants again does not. Against a specification without distance to school, the coefficient on literacy is reduced from 0.49 to 0.40. These results allow us to draw some tentative conclusions about the two alternative aspects depicted by our human capital model. Remember that we suggested that Protestants may have higher education both because Luther urged regional rulers to build schools (Luther's 1524 pamphlet), thereby reducing marginal costs of schooling, and because Luther suggested that there are individual religious benefits of schooling to every Protestant citizen (Luther's 1530 sermon). Now, the results just reported suggest that part of the higher education of Protestants (and its effect on economic outcomes) is due to the increased supply of schools, and thus reduced marginal costs of schooling ("Luther 1524"). But there also remains an additional part of higher education of Protestants (and its effect on economic outcomes) that cannot be attributed to the better supply of schools, and in terms of our theoretical model may be best attributed to the higher individual marginal benefits of literacy ("Luther 1530").

The same pattern is underscored by special tables in the 1871 Population Census which report literacy rates by religious denomination within each county. The descriptive evidence reveals that the literacy gap between Protestants and Catholics is smaller in predominantly Protestant counties, suggesting that Catholics profit from the supply effect of higher school density in Protestant counties. At the same time, the fact that Catholic literacy still significantly lags behind Protestant literacy even in the face of the same (better) school infrastructure points to an additional demand effect.

The fourth issue concerns the extent to which the higher literacy of Protestants, and its effect on economic outcomes, may still be an outflow of a distinct Protestant work ethic, rather than a mere unintended by-product of Luther's educational postulations. We have already argued above that the historical origin of the denominational differences in literacy make it unlikely that they are endogenous to any individual consideration of work ethic. However, while the origins may have been exogenous to ethical considerations, over the centuries Protestants might have developed a specific work ethic. Our previous results show that any higher economic prosperity of Protestant counties can be attributed to differential literacy, but a remaining concern is that the schools that taught the literacy might at the same time also have taught a specific work ethic. Thus, schools might have functioned as transmitters of denominational ethics, and our measure of literacy may just serve as a proxy for the fact that Protestant schools convey Protestant ethics.

However, if this were the case, Protestant schooling should have a larger effect on economic outcomes than Catholic schooling, because Protestant schools transmitted the Protestant work ethic

while Catholic schools did not. Therefore, we can test for the quantitative substance of the ethic-transmission channel in determining economic outcomes by adding an interaction term between Protestantism and literacy to our economic-outcome model. As the results reported in the final column of Table 11 reveal, this interaction term is statistically and quantitatively insignificant. The same is true when distance to school is used instead of literacy as an alternative measure of human capital. That is, Catholic schooling has the same effect on economic progressiveness as Protestant schooling. It is human capital as such that matters for economic outcomes, not any possible differential work ethic of the two denominations.

We can also address two further concerns with our proposed human capital channel. The one is that Protestants might be more likely to get literacy from the *same* years of schooling if they work harder in school. Thus, literacy as an outcome measure may not proxy for differences in the exposition to education, but only for differences in learning effort stemming from a Protestant work ethic. However, the fact that our data on distance to schools show that Protestant regions have a higher density of schools reveals that there is more to higher Protestant literacy than just working harder in school. The other concern is that Protestants and Catholics may differ in the quality of governance more generally. However, our result that literacy rather than Protestantism has a significant effect holds in the two sub-samples of mostly-Protestant and of mostly-Catholic counties (again defined as having more than 80 percent and less than 20 percent Protestants). Given that the quality of governance will be mainly determined by the denominational majority in both of these sub-samples, the sub-sample specifications hold differences in the quality of governance between Protestant and Catholic counties constant and then vary literacy and denomination within the setting of constant governance. The result suggests that the effect of literacy is independent of potential differences in the quality of governance.

### ***G. An Addendum: Protestantism, Education, and Economic Outcomes in Contemporary Germany***

As a sequel to the historical analysis, we briefly analyze the association between Protestantism, education, and economic outcomes in contemporary Germany. The German Socio-Economic Panel (GSOEP) provides data on individual incomes for a representative sample of Germans in 1997. On a descriptive basis, Protestants have both higher incomes and higher education even today (Table 12).

As long as we do not condition on education in a regression analysis of a simple earnings equation (Table 13), Protestants earn significantly more than Catholics.<sup>31</sup> But as soon as we condition on the significant positive association between education and income, the income difference between

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<sup>31</sup> See Tomes (1985) for an early summary on earnings differentials between religious groups, reporting inconclusive results for Catholic-Protestant differentials in the United States and Canada.

Protestants and Catholics vanishes. Thus, just as in the historical analysis, Protestants do perform better economically even in contemporary Germany, but again, the whole gap can be accounted for by different levels of human capital.<sup>32</sup>

This observation goes largely unnoticed in present-day Germany because few data sets collect information on religious denomination, education, and income. Still, the current Catholic education gap is not completely surprising, considering the fact that family background plays an important role in human capital accumulation, which perpetuates the education gap over time. Even after more than a hundred years of a public school system that gives equal access to schooling independent of religious affiliation, Protestants are still better educated. The results suggest that Luther's educational postulations may have had very long-term repercussions. The precise nature of the contemporary associations is a matter for future research, however.

#### **IV. Conclusion**

This paper advances an alternative to the Weber thesis: an explanation for the historically higher economic prosperity of Protestant regions based on a standard human capital argument. As an unintended side effect of Luther's postulations to enable everyone to read the Gospel, Protestants acquired the literacy that serves as human capital in the economic sphere. This human capital theory of Protestant economic history is consistent both with Luther's preaching and with county-level evidence from late 19<sup>th</sup>-century Prussia. The higher literacy in Protestant regions can account for their whole edge in economic progressiveness relative to Catholic regions. We argue that the roughly concentric dispersion of Protestantism around Luther's city of Wittenberg yielded exogenous variation in Protestantism, allowing us to use distance to Wittenberg as an instrument in a "double-IV" specification estimated by 3SLS. In this system of three equations, we find that distance to Wittenberg predicts Protestantism, which predicts literacy, which predicts economic prosperity.

So, was Weber wrong? Or, more precisely, is what has come to be known as the Weber thesis, as commonly interpreted, wrong? Given the complexity and multifaceted character of the thesis, there can of course be no simple answer to this question. Within the scope of this paper, there are at least three aspects to the question, with three different answers. The separate aspects are the descriptive validity of

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<sup>32</sup> The three most recent GSOEP waves that collected data on religious affiliation are 1990, 1997, and 2003. We find the same reported (1997) pattern in 1990, but not in 2003. Whether this is due to data problems (e.g., a refreshment sample with relatively young households and thus more volatile income information) or a true change in economic associations is left for future investigation.

the fundamental relationship of the Weber thesis, the main channel through which it arises, and the relevance of ethical aspects in it.

First, is the Weber thesis wrong in the main descriptive pattern of its argument? In contrast to the conclusion reached by the existing cross-country evidence (Delacroix and Nielsen 2001), we show that Weber was *right* in his observation that Protestant regions were economically more affluent than Catholic regions, at least in Prussia in the second half of the 19<sup>th</sup> century.

Second, is the Weber thesis wrong with respect to the main channel through which this pattern arises? Our evidence suggests that in this aspect, the Weber thesis has to be viewed as *wrong*. We find that the key channel is the acquisition of literacy (which is not among the key channels generally associated with the Weber thesis), which can account for the whole association between Protestantism and economic prosperity in late 19<sup>th</sup>-century Prussia. This leaves little room for substantial effects of the main channels advanced by the Weber thesis, namely working harder and being thriftier.

Third, is the Weber thesis wrong with respect to the importance of ethical considerations in the association between religious denomination and economic success? This aspect is hard to answer (as always when dealing with topics of ethics), given the virtual impossibility of observing ethical considerations, particularly more than a century after the fact. However, we present several pieces of evidence suggesting that the Weber thesis seems likely wrong in this regard. Several historical facts indicate that the spread of Protestantism, and with it the spread of literacy, can be traced back to incidents occurring centuries before our time of observation and lying beyond the influence of individual citizens driven by differential ethics. We can even reject the possibility that the important role of schools in progressing economic outcomes was to transmit differential denominational work ethics, rather than literacy, because schooling has the same effect in Protestant and Catholic regions.

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## Appendix A: Census Data for Prussia in the 1870s/1880s

Three major censuses in Prussia provide the data for our analysis: the 1871 Population Census, the 1882 Occupation Census, and the 1886 Education Census. By the second half of the 19<sup>th</sup> century, the Prussian Statistical Office collected huge amounts of demographic and socio-economic data, and the quality of the census material is generally viewed as outstanding. Knodel (1974, p. 28) concludes that the quality of Prussian demographic data was of a very high standard by the 1860s. Similarly, Wojtun (1968) reports that population counts were virtually complete by 1864. Demographers have found county-level data for Prussia at the end of the 19<sup>th</sup> century to be a unique source of highest-quality data for analyses at a disaggregate level (cf. Galloway, Hammel, and Lee 1994, 1998; Lee, Galloway, and Hammel 1994). We have compiled the county-level data from respective archives.

In 1871, Prussia consisted of 452 counties,<sup>33</sup> structured in 35 districts and 11 provinces. Table A1 lists the names of the Prussian provinces and districts, together with a count of counties in each district.

Table A1: PRUSSIAN PROVINCES AND DISTRICTS

Province (Provinz)	District (Regierungsbezirk)	Counties (Kreise)	Province (Provinz)	District (Regierungsbezirk)	Counties (Kreise)
Brandenburg	Frankfurt / Oder	18	Preussen	Königsberg	20
	Potsdam	16		Marienwerder	13
Hannover	Aurich	3	Rheinprovinz	Aachen	11
	Hannover	7		Düsseldorf	21
	Hildesheim	7		Koblenz	13
	Lüneburg	7		Köln	11
	Osnabrück	5		Trier	13
	Stade	8		Sachsen	Erfurt
Hessen	Kassel	23	Magdeburg		15
	Wiesbaden	12	Merseburg		17
Hohenzollern	Hohenzollern	4	Schlesien	Breslau	24
Pommern	Köslin	12		Liegnitz	20
	Stettin	13		Oppeln	19
	Stralsund	4	Schleswig- Holstein	Schleswig	20
Posen	Bromberg	9		Westphalen	Arnsberg
	Posen	18	Minden		10
Preussen	Danzig	8	Münster		11
	Gumbinnen	16			

<sup>33</sup> We combined Communionharz, a tiny county of 690 inhabitants, with neighboring county Zellerfeld, as the Occupation and Education Censuses do. After 1871, some bigger counties were split in two separate counties; we aggregated the Occupation and Education Census data up to the 452 counties existing in 1871.

## *1871 Population Census*

The 1871 Population Census took place on December 1, 1871. Questionnaires were to be filled out by household heads after personal instruction through an agent of the Prussian Statistical Office. The agent assisted in filling out the questionnaire, where requested, and made sure the information provided was correct. The Census surveyed standard demographic variables such as gender and age, but also religion and literacy.

Religious affiliation was surveyed in four categories: Catholic, Protestant, other Christian denominations, and Jews.

Literacy was surveyed for the first time ever in Prussia in 1871. It is measured as the ability to read and write of those who are aged 10 years or older. In the volume detailing the results of the Census, the Prussian Statistical Office attested to the unexpectedly high quality of the literacy question. Only slightly more than one percent of respondents did not respond to the question (captured by our variable “% Missing education info”). The Statistical Office expressed surprise about the fact that more than 10 percent of all males are illiterate, given the authorities’ official long-standing educational objectives.

In contrast to the 1882 Occupation Census and the 1886 Education Census, the data from the 1871 Population Census allow a separate analysis of urban and rural areas in each county, where a population size of 2,000 was used to classify municipalities into urban and rural. Table A2 reports descriptive statistics of our Population Census data separately by urban and rural municipalities in the counties.

The source of the Population Census data is: Königliches Statistisches Bureau (1874), *Die Gemeinden und Gutsbezirke des Preussischen Staates und ihre Bevölkerung: Nach den Urmaterialien der allgemeinen Volkszählung vom 1. December 1871*, Berlin: Verlag des Königlichen Statistischen Bureaus.

Table A2: RURAL-URBAN BREAKDOWN OF POPULATION CENSUS DATA

	Total	Rural	Urban
	(1)	(2)	(3)
% Protestants	64.62 (38.09)	64.57 (39.32)	64.69 (35.33)
% Literate	87.33 (12.56)	86.27 (13.78)	91.00 (8.13)
% Missing education info	1.71 (1.11)	1.87 (1.30)	1.18 (.98)
% Age below 10	24.91 (2.18)	25.56 (2.25)	22.82 (2.48)
% Jews	1.08 (1.18)	.43 (.63)	3.44 (4.18)
% Females	51.09 (1.42)	51.16 (1.44)	51.13 (2.32)
% Born in municipality	59.65 (11.93)	61.03 (13.16)	55.34 (10.23)
% Of Prussian origin	99.16 (1.85)	99.35 (1.46)	98.69 (2.31)
% Blind	.09 (.03)	.09 (.03)	.11 (.06)
% Deaf-mute	.10 (.05)	.10 (.05)	.12 (.16)
% Insane	.23 (.18)	.22 (.15)	.27 (.52)
Average household size	4.79 (.34)	4.89 (.40)	4.51 (.36)
Total population size	51965.22 (19124.29)	38736.12 (14255.86)	13229.11 (10659.00)
Popul. growth 1867-1871 (in %)	1.03 (4.08)	1.79 (25.98)	2.26 (6.16)
Number of observations	452	427	437

All columns show means. Standard deviations in parentheses.

Source: Data for Prussian counties from the 1871 Population Census.

Column 1 displays county totals. Column 2 display values for rural municipalities ( $\leq 2,000$  inhabitants) in these counties. Column 3 is for urban municipalities ( $> 2,000$  inhabitants) in these counties.

### ***1882 Occupation Census***

The 1882 Occupation Census collected information on employment and self-employment across two-digit sectors. We calculate the share of the total labor force, as well as the share of the male labor force, working in the manufacturing sector and in the service sector. We use the classification provided by the Prussian Statistical Office to classify the two sectors.

The manufacturing sector (sector B in the 1882 classification) includes mining, construction, and manufacture of metals, machinery, equipment, chemicals, textiles, paper, leather, food products, and wood.

The service sector (sector C in the 1882 classification) includes trade business, insurance, transport, lodging, and restaurants. Note that the service sector C does not include servants and housemaids, nor does it include those working in the public administration and the military.

Our results are robust with respect to dropping or including certain sub-sectors in the analysis, e.g. the mining industry, which in modern sector classifications would not be included in the manufacturing sector.

The source of the Occupation Census data is: *Preussische Statistik*, Volume 76b, pp. 232-695 and Vol. 76c, p. 239.

### ***1886 Education Census***

The 1886 Education Census collected information on both primary schools and secondary schools.

From the Education Census, we derive the average annual income of full-time male elementary school teachers in a county. Given that teacher incomes were almost entirely financed from local contributions, they should provide a reasonable proxy for the average income of the county (cf. Schleunes 1989).

The Education Census also provides county-level information on the share of students who had a distance to school of more than three kilometers. While the information applies to students (rather than the adult population) in 1886 and does not include school-aged children who did not attend school, the measure may still provide a useful proxy for the supply of schools in the different counties in our analysis.

The source of the Education Census data is: *Preussische Statistik*, Volume 101, pp. 2-391.

## **Appendix B: The Spread of Literacy from Lutheran Times to 1871**

This paper shows that Luther's educational postulations, expressed in the early 1500s, ultimately transmitted into higher literacy of Protestants in the late 1800s. Unfortunately, as a consequence of limited data availability, the time in-between is mostly regarded as a black box. However, at least some cursory discussion and analysis of what happened between Luther and 1871 Prussia is possible. This appendix gives a brief description of what is known about how the educational pattern emerged from Luther to the 1870s.

While there are no consistent data on the development of literacy in Prussia before 1871, there is some scattered evidence on the spread of literacy and schooling between 1500 and 1871. Engelsing (1973) suggests that not more than 1 percent of the German population was literate at the time of the Reformation. It is well known and well documented in many German cities that the new Protestant church had regular visitations in the parishes to make sure that a decent system of basic schooling was introduced, particularly in the tradition of Luther's closest collaborator Melanchthon (e.g., Rupp 1996b, 1998). Lanzinner (2001, pp. 114, 119) observes a boom in the education system in the second half of the 16<sup>th</sup> century and puts the share of literates in the German population in 1600 at at least 10 percent. However, the Thirty Years' War (1618-1648), with its tremendously devastating consequences of military and civilian casualties, lootings by mercenary soldiers, dislocations, famines, and diseases across the whole German empire, put a hold on many of the structured attempts to build a functioning school system. Still, even in the midst of the war, there are examples such as the Protestant Duke Ernst II the Pious of Saxe-Gotha-Altenburg who introduced a form of compulsory schooling in his area in 1642.

The Treaties of Westphalia (1648), which terminated the Thirty Years' War, reaffirmed the supreme authority of the church in matters of schooling, describing the school as an "annexum ecclesia" (ecclesiastical annex; cf. Schleunes 1989, p. 12). And in line with the preaching of Luther and Melanchthon, it was the Protestant churches which tried to advance matters of schooling, to a much larger extent than the limited attempts within the Catholic church. Schleunes (1989) points out that quite generally, when comparing the politics of Protestant-led Prussia and Catholic Bavaria over 1750-1900, it has always been Prussia that led school reforms and Bavaria that followed.

A common interpretation of the history of the German schooling system is that it experienced a manifest surge after the Reformation, but subsequently did not make noteworthy advancements until far into the 18<sup>th</sup> century. For example, the first academy for teachers in Prussia was not established

before 1749. Only slowly recovering from the devastations after the Thirty Years' War, the German regions managed to accomplish slow advances in literacy. While any concrete figures seem mostly approximate guesses, and there is no tangible evidence for the relative literacy of Protestants and Catholics, Müller (1986) puts the 18<sup>th</sup>-century average of adult Germans who were literate at 10 percent, with an increasing tendency, so that the figure was around 15 percent in 1770, 25 percent in 1800, and 40 percent in 1830 (cf. also Blanning 2002, p. 113).

A hallmark in the development of the Prussian schooling system is the General Elementary School Regulation ("Generallandschulreglement") of Frederick the Great (notably devised by a Protestant theologian), which in 1763 contained an explicit general invitation to attend school – although not, as often purported, consequent compulsory universal schooling requirements. Still, the regulation constitutes an important pre-stage for a vigorous development over the following decades. Starting with the early 1800s, there is some official data on school enrollment in Prussia, which may serve as a reasonable proxy for later literacy. According to official Prussian statistical publications, school enrollment (the proportion of children aged 6 to 14 attending a public school) in Prussia was 60.3 percent in 1816 and 82.4 percent in 1846 (Dieterici 1849, p. 47). By the 1860s, most of Prussia had achieved nearly universal enrollment in basic education.

In view of the human capital theory of Protestant economic history, these descriptive historical patterns suggest that Luther's educational postulations did have a long-lasting effect. While there are no data to provide a consistent picture of the relative literacy of Protestants and Catholics before 1871, the pattern of slowly increasing literacy from Lutheran times to 1871 and the evidence of this paper that, everything else equal, Protestant regions had significantly higher literacy in 1871, combine with the narrative patterns to suggest that Protestants took a strong lead in the advancement of literacy. With ever so slowly advancing means, Protestants did manage to get and keep ahead of Catholics in terms of schooling and literacy.

Figure 1: MARGINAL BENEFIT AND MARGINAL COST SCHEDULES FOR DIFFERENT DENOMINATIONS

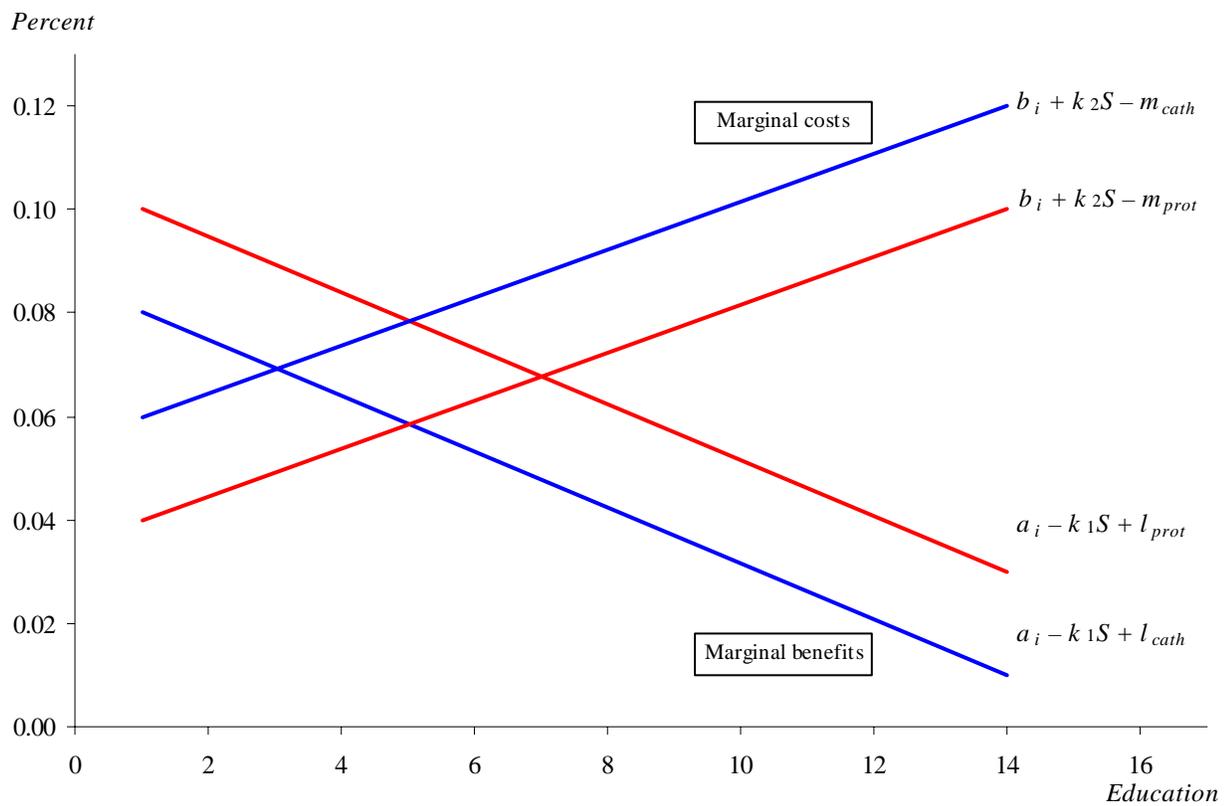
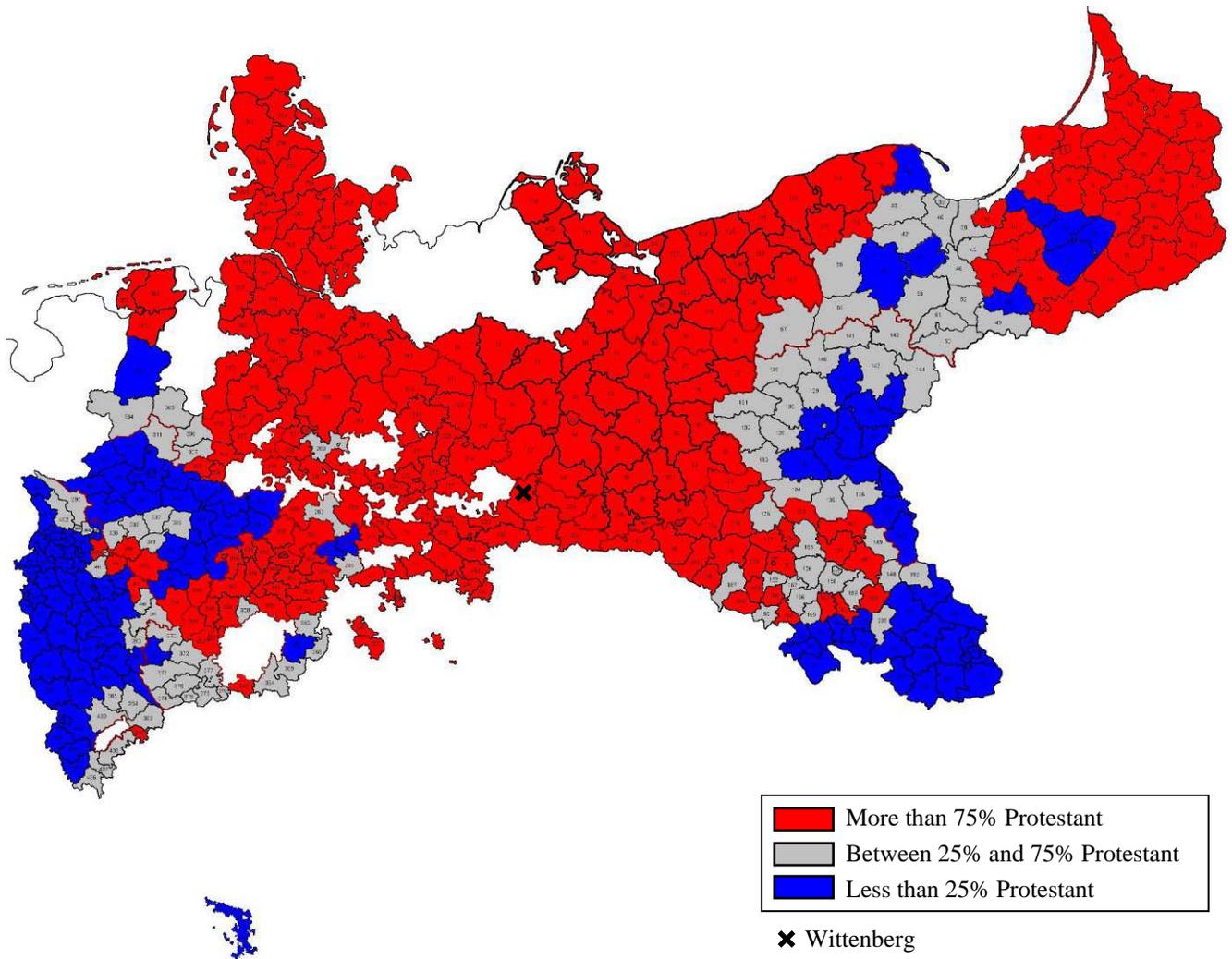


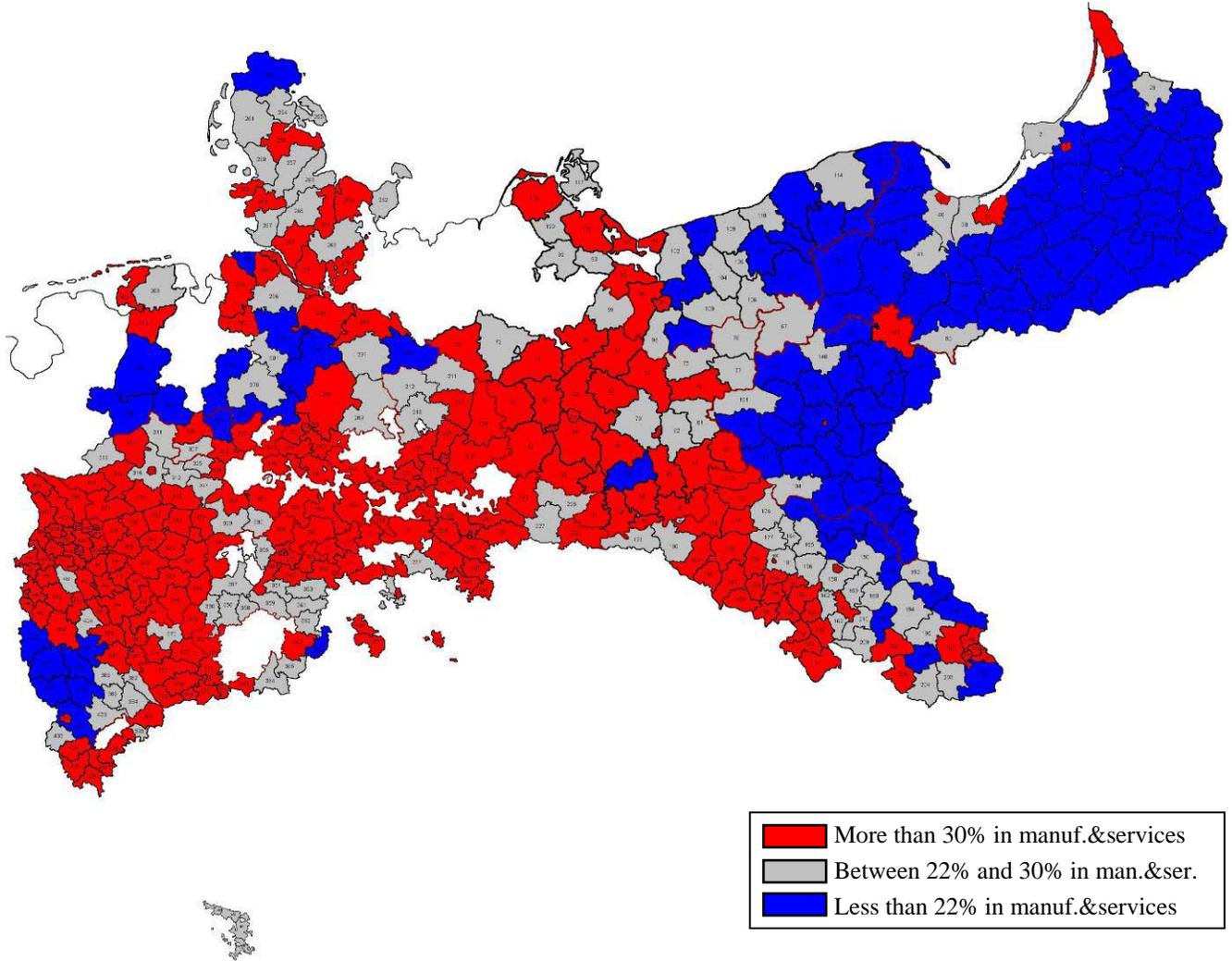
Figure 2: PROTESTANTISM IN 19TH CENTURY PRUSSIA



County-level depiction based on 1871 Population Census. See appendix A for data details.

Figure 3: ECONOMIC OUTCOMES IN 19TH CENTURY PRUSSIA

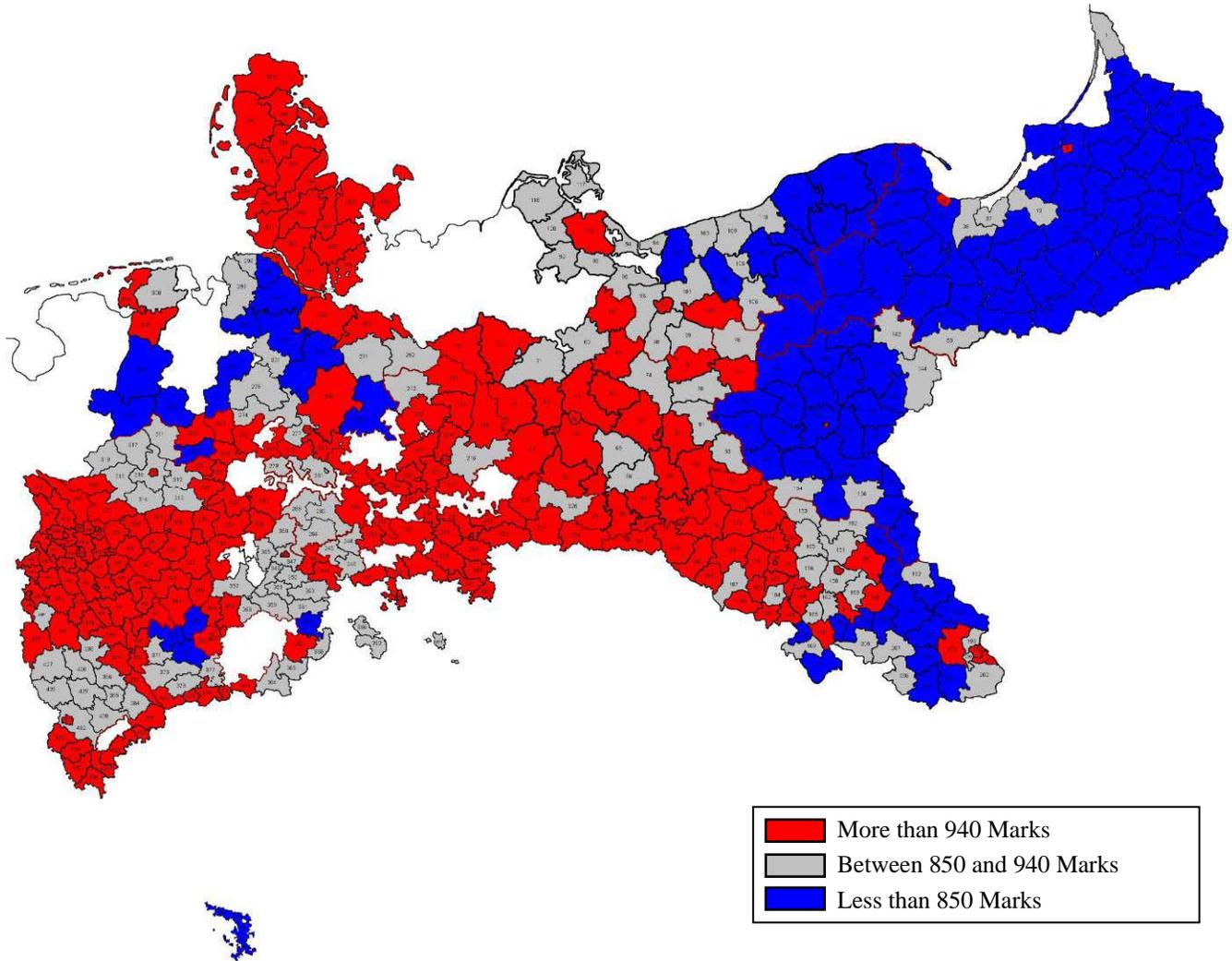
(a) *Share of Employment in Manufacturing and Services*



County-level depiction based on 1882 Occupation Census. See appendix A for data details.

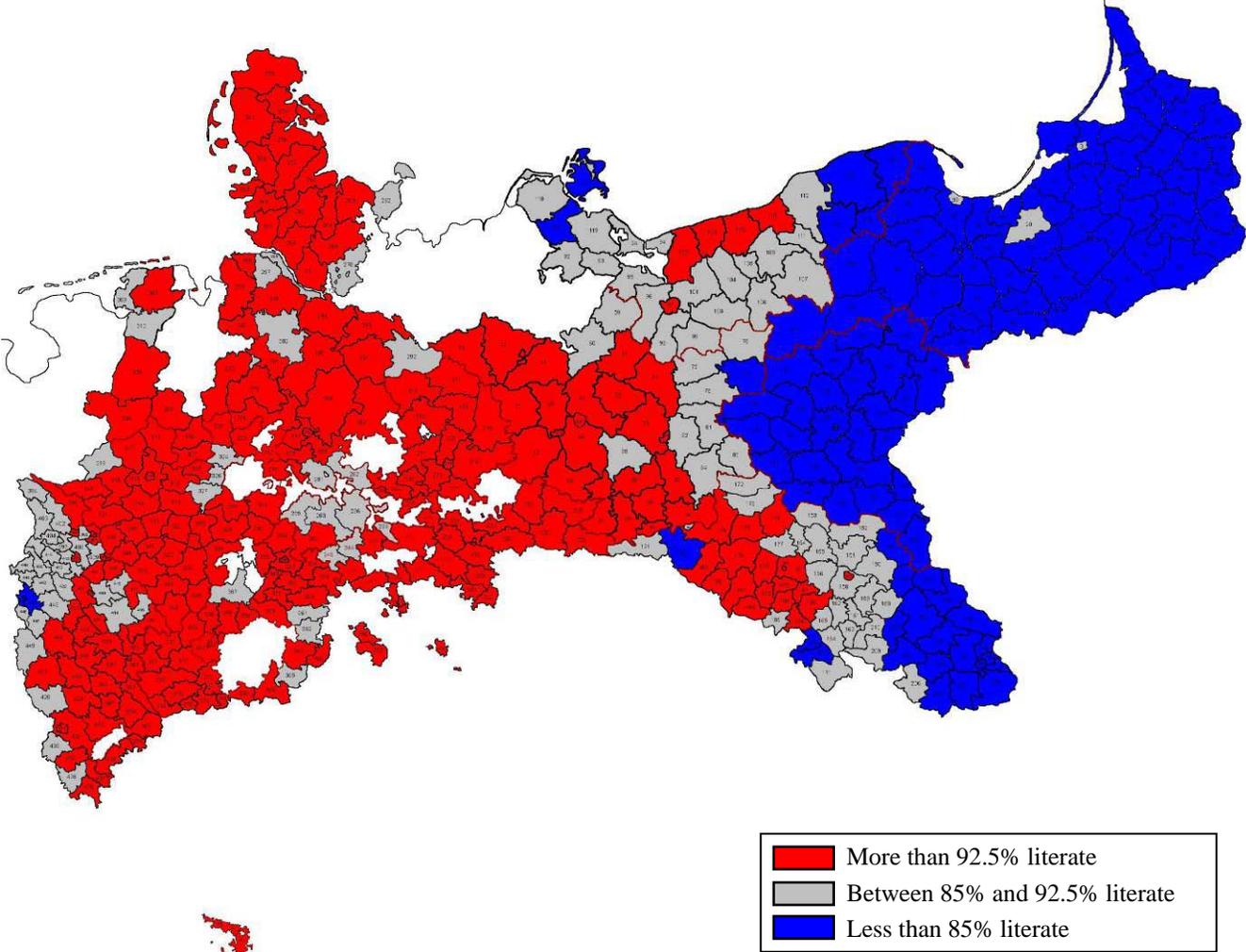
FIGURE 3: ECONOMIC OUTCOMES IN 19TH CENTURY PRUSSIA

*(b) Income*



County-level depiction based on 1886 Education Census. See appendix A for data details.

Figure 4: LITERACY IN 19TH CENTURY PRUSSIA



County-level depiction based on 1871 Population Census. See appendix A for data details.

Table 1: DESCRIPTIVE STATISTICS IN 19TH CENTURY PRUSSIA

	Mean	StdDev	Min	Max
	(1)	(2)	(3)	(4)
% Protestants	64.18	37.83	.26	99.89
% Catholics	34.48	37.54	.04	99.73
% Literate	87.51	12.67	37.40	99.33
% of labor force in manufacturing	27.65	13.41	6.12	71.76
% of labor force in services	6.26	3.55	1.80	24.46
% of labor force in manu and serv	33.91	15.31	7.93	81.53
% of male workers in manufacturing	32.74	14.83	7.20	80.89
% of male workers in services	7.31	4.39	2.04	33.24
% of male workers in manu and serv	40.05	16.96	9.24	90.74
Income of male elementary school teachers (in Marks)	982.83	200.42	711.96	1954.19
% Missing education info	1.69	1.10	.00	6.72
% Age below 10	24.71	2.48	15.33	29.87
% Jews	1.14	1.33	.00	12.87
% Females	51.00	1.51	43.97	54.63
% Born in municipality	58.97	12.39	32.01	87.23
% Of Prussian origin	99.07	1.97	74.22	100.00
% Blind	.09	.03	.03	.24
% Deaf-mute	.10	.05	.02	.42
% Insane	.23	.17	.02	1.56
Average household size	4.79	.34	3.83	5.86
Total population size	54426.16	42078.42	11609	826341
Popul. growth 1867-1871 (in %)	1.60	4.93	-7.76	33.83
Distance to Berlin (in km)	332.89	146.61	.00	650.04
Latitude (in rad)	90.88	2.53	83.93	97.24
Longitude (in rad)	22.08	8.17	10.52	39.40
Poland dummy	.38	.49	.00	1.00
% of labor force in mining	2.54	7.57	.00	54.19
% of county population in urban areas	27.53	21.90	.00	100.00
Distance to Wittenberg in km	326.19	148.77	.00	731.46
Year in which annexed by Prussia	1751.69	111.05	1525	1866
% Pupils with distance to school over 3 km	2.99	3.42	.00	19.79

*Source:* Data for Prussian counties (452 observations) from the 1871 Population Census, 1882 Occupation Census, and 1886 Education Census; see main text and appendix for details.

Table 2: PROTESTANTISM AND ECONOMIC OUTCOMES IN 19TH CENTURY PRUSSIA

Dependent variable:	Total labor force			Male labor force			ln(Income) <sup>a</sup>
	Share	Share	Share	Share	Share	Share	
	Manuf & serv	Manufacturing	Services	Manuf & serv	Manufacturing	Services	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
% Protestants	.035 (.015)**	.021 (.013)	.014 (.004)***	.049 (.016)***	.029 (.015)**	.020 (.005)***	.063 (.019)***
% Age below 10	-.440 (.232)*	-.020 (.211)	-.420 (.060)***	-.449 (.256)*	.119 (.232)	-.568 (.074)***	-1.816 (.302)***
% Jews	-.005 (.413)	-.710 (.375)*	.705 (.106)***	.321 (.457)	-.614 (.412)	.936 (.132)***	1.258 (.538)**
% Females	-2.857 (.439)***	-2.372 (.399)***	-.485 (.113)***	-2.844 (.485)***	-2.520 (.438)***	-.325 (.140)**	-4.320 (.572)***
% Born in municipality	.361 (.049)***	.355 (.044)***	.006 (.013)	.408 (.054)***	.407 (.049)***	.0004 (.016)	.264 (.063)***
% Of Prussian origin	-.373 (.265)	-.081 (.241)	-.292 (.068)***	-.460 (.293)	-.066 (.265)	-.394 (.084)***	-.133 (.345)
Average household size	-10.818 (1.840)***	-9.041 (1.673)***	-1.777 (.473)***	-12.735 (2.035)***	-11.099 (1.838)***	-1.636 (.586)***	-7.149 (2.397)***
ln(Population size)	5.217 (1.276)***	3.264 (1.160)***	1.952 (.328)***	5.727 (1.411)***	3.182 (1.275)**	2.546 (.407)***	6.013 (1.663)***
Popul. growth 1867-1871 (in %)	1.642 (.137)***	1.513 (.125)***	.129 (.035)***	1.873 (.152)***	1.716 (.137)***	.157 (.044)***	1.002 (.179)***
Obs.	452	452	452	452	452	452	452
R <sup>2</sup>	.611	.581	.521	.612	.586	.519	.534

Standard errors in parentheses: \* significance at ten, \*\* five, \*\*\* one percent.

Source: Data for Prussian counties from the 1871 Population Census, 1882 Occupation Census, and 1886 Education Census; see main text and appendix for details.

<sup>a</sup> Coefficients multiplied by 100.

Further controls: % Blind, % Deaf-mute, % Insane.

Table 3: PROTESTANTISM AND LITERACY IN 19TH CENTURY PRUSSIA

	Total (1)	Rural (2)	Urban (3)
% Protestants	.099 (.010)***	.112 (.010)***	.027 (.008)***
% Missing education info	-.307 (.320)	-.360 (.309)	-.622 (.229)***
% Age below 10	-1.936 (.158)***	-1.660 (.197)***	-.840 (.113)***
% Jews	-.965 (.284)***	.448 (.663)	-1.049 (.063)***
% Females	-1.280 (.300)***	-.858 (.314)***	-.663 (.131)***
% Born in municipality	.484 (.033)***	.470 (.035)***	.274 (.030)***
% Of Prussian origin	-.324 (.181)*	-.201 (.258)	-.667 (.098)***
Average household size	-1.812 (1.273)	-.323 (1.198)	-1.493 (.844)*
ln(Population size)	-1.183 (.873)	-1.897 (1.016)*	-.680 (.295)**
Popul. growth 1867-1871 (in %)	.186 (.093)**	.022 (.014)	.118 (.047)**
Obs.	452	427	437
$R^2$	.737	.743	.691

Dependent variable: % Literate among those aged  $\geq 10$ .

Standard errors in parentheses: \* significance at ten, \*\* five, \*\*\* one percent.

*Source*: Data for Prussian counties from the 1871 Population Census; see main text and appendix for details. Column 1 is for county totals, column 2 for urban municipalities, and column 3 for rural areas inside these counties.

Further controls: % Blind, % Deaf-mute, % Insane.

Table 4: PROTESTANTISM, LITERACY, AND ECONOMIC OUTCOMES IN 19TH CENTURY PRUSSIA

Dependent variable:	Share	Share	Share	ln(Income) <sup>a</sup>	Share	Share	Share	ln(Income) <sup>a</sup>
	Manuf & Serv	Manuf	Services		Manuf & Serv	Manuf	Services	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
% Literate	.465 (.060)***	.357 (.055)***	.107 (.016)***	.638 (.078)***	.490 (.066)***	.390 (.061)***	.100 (.017)***	.636 (.086)***
% Protestants					-.013 (.015)	-.018 (.014)	.004 (.004)	.001 (.020)
% Missing education info	.164 (.443)	.224 (.409)	-.060 (.116)	-.179 (.576)	.196 (.445)	.266 (.410)	-.070 (.117)	-.182 (.579)
% Age below 10	.456 (.248)*	.664 (.229)***	-.208 (.065)***	-.569 (.322)*	.507 (.254)**	.730 (.235)***	-.223 (.067)***	-.573 (.331)*
% Jews	.503 (.396)	-.298 (.366)	.801 (.104)***	1.914 (.516)***	.463 (.399)	-.351 (.368)	.814 (.105)***	1.917 (.520)***
% Females	-2.240 (.424)***	-1.893 (.392)***	-.347 (.112)***	-3.477 (.552)***	-2.234 (.425)***	-1.884 (.392)***	-.349 (.112)***	-3.477 (.553)***
% Born in municipality	.151 (.047)***	.201 (.043)***	-.050 (.012)***	-.045 (.061)	.124 (.056)**	.166 (.052)***	-.042 (.015)***	-.043 (.073)
% Of Prussian origin	-.207 (.252)	.051 (.233)	-.258 (.066)***	.090 (.328)	-.217 (.252)	.038 (.233)	-.255 (.066)***	.091 (.329)
Average household size	-9.677 (1.739)***	-8.062 (1.605)***	-1.614 (.457)***	-5.759 (2.263)**	-9.963 (1.769)***	-8.435 (1.632)***	-1.528 (.465)***	-5.738 (2.305)**
ln(Population size)	5.760 (1.212)***	3.700 (1.119)***	2.060 (.319)***	6.677 (1.577)***	5.806 (1.213)***	3.760 (1.119)***	2.046 (.319)***	6.674 (1.580)***
Popul. growth 1867-1871 (in %)	1.582 (.125)***	1.481 (.115)***	.102 (.033)***	.884 (.163)***	1.550 (.130)***	1.439 (.120)***	.111 (.034)***	.887 (.170)***
Obs.	452	452	452	452	452	452	452	452
R <sup>2</sup>	.654	.615	.554	.586	.654	.617	.555	.586

Standard errors in parentheses: \* significance at ten, \*\* five, \*\*\* one percent. Sectoral shares refer to total labor force.

Source: Data for Prussian counties from the 1871 Population Census, 1882 Occupation Census, and 1886 Education Census; see main text and appendix for details.

<sup>a</sup> Coefficients multiplied by 100.

Further controls: % Blind, % Deaf-mute, % Insane.

Table 5: PROTESTANTISM AND ECONOMIC OUTCOMES: GEOGRAPHICAL ROBUSTNESS

	(1)	(2)	(3)	(4)
% Protestants	.062 (.017)***	.053 (.016)***	.031 (.014)**	.032 (.017)**
ln(Distance to Berlin in km)	.327 (.963)	-.470 (.935)	.542 (.794)	1.133 (1.341)
Latitude (in rad) * 100	-2.310 (.605)***	-2.100 (.583)***	-1.547 (.494)***	-4.278 (1.439)***
Longitude (in rad) * 100	-6.017 (2.206)***	-6.130 (2.121)***	-4.290 (1.799)**	-10.378 (5.266)**
Latitude * Longitude * 100	5.757 (2.383)**	5.802 (2.290)**	3.918 (1.942)**	11.273 (5.725)**
Poland dummy	1.023 (2.356)	1.299 (2.265)	2.350 (1.917)	-1.412 (2.266)
% of labor force in mining		.459 (.076)***	.637 (.065)***	.609 (.064)***
% of county pop. in urban areas			.306 (.023)***	.221 (.025)***
District dummies				yes
Obs.	452	452	452	452
R <sup>2</sup>	.663	.689	.778	.839

Dependent variable: Share of total labor force in manufacturing and services.

Standard errors in parentheses: \* significance at ten, \*\* five, \*\*\* one percent.

Source: Data for Prussian counties from the 1871 Population Census and the 1882 Occupation Census; see main text and appendix for details.

Further controls: % Age below 10, % Jews, % Females, % Born in municipality, % Of Prussian origin, Average household size, ln(Population size), Population growth 1867-1871 (in %), % Blind, % Deaf-mute, % Insane.

Table 6: PROTESTANTISM AND LITERACY: GEOGRAPHICAL ROBUSTNESS

	(1)	(2)	(3)	(4)
% Protestants	.124 (.011)***	.122 (.011)***	.118 (.011)***	.070 (.012)***
ln(Distance to Berlin in km)	-.821 (.615)	-1.031 (.618)*	-.842 (.614)	-1.999 (.935)**
Latitude (in rad) * 100	-.725 (.386)*	-.672 (.384)*	-.570 (.382)	-.775 (1.005)
Longitude (in rad) * 100	.590 (1.410)	.550 (1.403)	.895 (1.393)	-1.287 (3.682)
Latitude * Longitude * 100	-1.484 (1.522)	-1.461 (1.514)	-1.815 (1.503)	.367 (4.004)
Poland dummy	2.793 (1.504)*	2.873 (1.496)*	3.063 (1.482)**	2.838 (1.582)*
% of labor force in mining		.119 (.050)**	.151 (.050)***	.074 (.045)*
% of county pop. in urban areas			.056 (.018)***	.034 (.017)**
District dummies				yes
Obs.	452	452	452	452
$R^2$	.801	.804	.808	.886

Dependent variable: % Literate among those aged  $\geq 10$ .

Standard errors in parentheses: \* significance at ten, \*\* five, \*\*\* one percent.

Source: Data for Prussian counties from the 1871 Population Census; see main text and appendix for details.

Further controls: % Missing education info, % Age below 10, % Jews, % Females, % Born in municipality, % Of Prussian origin, Average household size, ln(Population size), Population growth 1867-1871 (in %), % Blind, % Deaf-mute, % Insane.

Table 7: PROTESTANTISM, LITERACY, AND ECONOMIC OUTCOMES: GEOGRAPHICAL ROBUSTNESS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
% Literate	.378 (.065)***	.328 (.063)***	.195 (.055)***	.200 (.069)***	.341 (.074)***	.295 (.072)***	.177 (.062)***	.176 (.072)**
% Protestants					.019 (.019)	.018 (.018)	.010 (.016)	.020 (.017)
ln(Distance to Berlin in km)	.404 (.926)	-.372 (.905)	.579 (.776)	1.426 (1.342)	.605 (.947)	-.186 (.925)	.683 (.793)	1.473 (1.342)
Latitude (in rad) * 100	-1.966 (.588)***	-1.819 (.568)***	-1.397 (.486)***	-4.000 (1.433)***	-2.064 (.595)***	-1.909 (.576)***	-1.450 (.493)***	-4.101 (1.435)***
Longitude (in rad) * 100	-6.372 (2.164)***	-6.476 (2.090)***	-4.539 (1.790)**	-9.960 (5.256)*	-6.224 (2.168)***	-6.341 (2.095)***	-4.465 (1.795)**	-9.951 (5.254)*
Latitude * Longitude * 100	6.474 (2.335)***	6.471 (2.255)***	4.360 (1.931)**	11.034 (5.715)*	6.270 (2.343)***	6.283 (2.263)***	4.257 (1.939)**	10.982 (5.712)*
Poland dummy	-.407 (2.272)	.052 (2.196)	1.576 (1.878)	-2.132 (2.263)	.075 (2.321)	.492 (2.243)	1.824 (1.918)	-1.968 (2.266)
% of labor force in mining		.425 (.075)***	.611 (.066)***	.598 (.064)***		.424 (.075)***	.610 (.066)***	.595 (.064)***
% of county pop. in urban areas			.296 (.023)***	.218 (.024)***			.296 (.023)***	.215 (.025)***
District dummies				yes				yes
Obs.	452	452	452	452	452	452	452	452
R <sup>2</sup>	.678	.700	.782	.841	.679	.701	.782	.842

Dependent variable: Share of total labor force in manufacturing and services.

Standard errors in parentheses: \* significance at ten, \*\* five, \*\*\* one percent.

Source: Data for Prussian counties from the 1871 Population Census and the 1882 Occupation Census; see main text and appendix for details.

Further controls: % Missing education info, % Age below 10, % Jews, % Females, % Born in municipality, % Of Prussian origin, Average household size, ln(Population size), Population growth 1867-1871 (in %), % Blind, % Deaf-mute, % Insane.

Table 8: EXCLUDING IMPERIAL CITIES AND PRUSSIAN ANNEXATIONS

Specifications:	Excluding Imperial Cities	Prussian Annexations					
		Linear Trend	Set of dummies	Subsample of counties annexed before			
	(1)	(2)	(3)	1820 (4)	1800 (5)	1750 (6)	1650 (7)
% Literate	.497 (.068)***	.491 (.066)***	.310 (.074)***	.485 (.069)***	.529 (.074)***	.532 (.094)***	.583 (.127)***
% Protestants	-.008 (.016)	-.015 (.016)	.010 (.019)	-.005 (.017)	-.013 (.022)	.015 (.026)	-.120 (.078)
Year when annexed by Prussia		-.003 (.005)					
Dummies for years when annexed by Prussia			yes				
Obs.	428	452	452	361	235	179	89
$R^2$	.640	.654	.738	.721	.733	.747	.816

Dependent variable: Share of total labor force in manufacturing and services.

Standard errors in parentheses: \* significance at ten, \*\* five, \*\*\* one percent.

Source: Data for Prussian counties from the 1871 Population Census and the 1882 Occupation Census; see main text and appendix for details.

Further controls: % Missing education info, % Age below 10, % Jews, % Females, % Born in municipality, % Of Prussian origin, Average household size, ln(Population size), Population growth 1867-1871 (in %), % Blind, % Deaf-mute, % Insane.

Table 9: EXOGENEITY OF WITTENBERG INSTRUMENT

Dependent variable:	Imperial city in 1517 (1)	Hanseatic city in 1517 (2)	University in 1517 (3)	Year of foundation of university (4)
Distance to Wittenberg <sup>a</sup>	.0033 (.0071)	.0008 (.0080)	-.0018 (.0046)	-1.625 (7.998)
Obs.	452	452	452	16
$R^2$	.0005	.0000	.0004	.0029

<sup>a</sup> Distance to Wittenberg measured in 100km.  
See main text for details.

Table 10: IV AND 3SLS RESULTS BASED ON DISTANCE TO WITTENBERG

Dependent variable:	2SLS		2SLS		2SLS		3SLS		
	1st stage	2nd stage	1st stage	2nd stage	1st stage	2nd stage	1st stage	2nd stage	3rd stage
	Protestant	Literate	Literate	Manuf & serv	Literate	Manuf & serv	Protestant	Literate	Manuf & serv
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Distance to Wittenberg in km	-.095 (.011)***		-.018 (.003)***		-.010 (.003)***		-.095 (.011)***		
% Protestants		.189 (.028)***			.084 (.011)***			.189 (.028)***	
% Literate				.437 (.190)**		.375 (.129)***			.437 (.190)**
Obs.	452	452	452	452	452	452	452	452	452
$R^2$	.419	.689	.708	.653	.745	.652	.419	.689	.653
1 <sup>st</sup> -stage $F$ stat.	74.19		46.77		58.05				
Sargan test stat.						.196			
Sargan test p-val.						.658			
Durbin-Wu-Hausman $\chi^2$ test stat.		14.027		.025		.614			
Durbin-Wu-Hausman $\chi^2$ test p-val.		.0002		.878		.433			

Standard errors in parentheses: \* significance at ten, \*\* five, \*\*\* one percent.

Source: Data for Prussian counties from the 1871 Population Census and the 1882 Occupation Census; see main text and appendix for details.

Further controls: % Missing education info, % Age below 10, % Jews, % Females, % Born in municipality, % Of Prussian origin, Average household size, ln(Population size), Population growth 1867-1871 (in %), % Blind, % Deaf-mute, % Insane.

Table 11: MIGRATION, DISTANCE TO SCHOOL, AND INTERACTION OF LITERACY AND PROTESTANTISM

Dependent variable:	Counties with % Protestants < 20% or > 80%		Distance to school	Distance to school		Interaction b/w Prot. and Lit. Share
	Share	Share		Share	Share	
	Manuf & serv	Manuf & serv		Manuf & serv	Manuf & serv	
	(1)	(2)	(3)	(4)	(5)	(6)
% Literate	.499 (.081)***	.492 (.081)***			.401 (.072)***	.506 (.080)***
% Pupils with distance to school over 3 km				-.901 (.161)***	-.515 (.171)***	
% Protestants	-.015 (.016)		-.026 (.004)***	.012 (.015)	-.018 (.015)	.024 (.104)
Dummy: % Protestants > 80 %		-1.017 (1.442)				
Interaction between % Literate and % Protestants						-.0004 (.001)
Obs.	343	343	452	452	452	452
R <sup>2</sup>	.611	.610	.356	.637	.661	.654

Dependent variable in Column (3): % Pupils with distance to school over 3 km.

Dependent variable in all other Columns: Share of total labor force in manufacturing and services.

Standard errors in parentheses: \* significance at ten, \*\* five, \*\*\* one percent.

Source: Data for Prussian counties from the 1871 Population Census, 1882 Occupation Census, and 1886 Education Census; see main text and appendix for details.

Further controls: % Missing education info, % Age below 10, % Jews, % Females, % Born in municipality, % Of Prussian origin, Average household size, ln(Population size), Population growth 1867-1871 (in %), % Blind, % Deaf-mute, % Insane.

Table 12: DESCRIPTIVE STATISTICS IN CONTEMPORARY GERMANY

	Catholic	Protestant	Other Christian denomination	Non-Christian religious affiliation	No religious affiliation
	(1)	(2)	(3)	(4)	(5)
Years of schooling	11.56 (2.62)	12.36 (2.77)	10.97 (2.78)	9.72 (1.94)	12.35 (2.70)
Gross monthly income	4801.58 (2072.95)	5060.70 (2241.22)	4607.21 (1882.66)	3918.76 (1242.18)	5734.37 (3414.99)
Sample share	.40	.29	.05	.08	.18

All columns show means. Standard deviations in parentheses.  
*Source:* GSOEP 1997. Sample: full-time employed workers, ages 20-55.

Table 13: RELIGION, EDUCATION, AND EARNINGS IN CONTEMPORARY GERMANY

Dependent variable:	ln(gross monthly earnings)		years of schooling		ln(gross monthly earnings)	
	(1)	(2)	(3)	(4)	(5)	(6)
Years of schooling					.058 (.003)***	.066 (.003)***
Protestant	.048 (.020)**	.051 (.018)***	.806 (.128)***	.707 (.118)***	.002 (.018)	.004 (.016)
Other Christian denomination	-.033 (.034)	-.004 (.032)	-.579 (.242)**	-.306 (.225)	.0005 (.032)	.016 (.029)
Non-Christian religious affiliation	-.169 (.025)***	-.171 (.021)***	-1.826 (.202)***	-1.820 (.188)***	-.064 (.024)***	-.050 (.021)**
No religious affiliation	.154 (.024)***	.156 (.022)***	.805 (.148)***	.892 (.136)***	.108 (.022)***	.097 (.020)***
Female		-.268 (.016)***		-.412 (.107)***		-.241 (.015)***
Potential experience in years		.021 (.004)***		-.202 (.027)***		.035 (.004)***
Square of Potential experience in years		-.054 (.009)***		.184 (.061)***		-.066 (.009)***
Firm tenure		.012 (.003)***		.019 (.018)		.011 (.003)***
Square of Firm tenure		-.016 (.009)*		.027 (.059)		-.017 (.008)**
Obs.	2566	2566	2566	2566	2566	2566
$R^2$	.040	.183	.073	.210	.178	.339

Standard errors in parentheses: \* significance at ten, \*\* five, \*\*\* one percent.

Left-out category of religious affiliation is "Catholic".

Source: GSOEP 1997. Sample: full-time employed workers, ages 20-55.