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**Lectures and Readings**

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THE IMPORTANCE OF HISTORY FOR ECONOMIC DEVELOPMENT

Nathan Nunn

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The Importance of History for Economic Development  
Nathan Nunn  
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**ABSTRACT**

This article provides a survey of a growing body of empirical evidence that points towards the important long-term effects that historic events can have on current economic development. The most recent studies, using micro-level data and more sophisticated identification techniques, have moved beyond testing whether history matters, and attempt to identify exactly why history matters. The most commonly examined channels include: institutions, culture, knowledge and technology, and movements between multiple equilibria. The article concludes with a discussion of the questions that remain and the direction of current research in the literature.

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## 1. Introduction

In recent years, an exciting new literature has emerged empirically examining whether historic events are important determinants of economic development today. The origins of this literature can be traced to three lines of research that began roughly a decade ago. Engerman and Sokoloff (1997, 2002) examined the importance of factor endowments and colonial rule for the subsequent economic development of colonies within the Americas. Acemoglu, Johnson, and Robinson (2001, 2002) developed a research agenda that sought to better understand the historical origins of current institutions and their importance for long-term economic development. The line of inquiry undertaken by La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1997, 1998) also examined the importance of colonial rule, but focused on the legal institutions that were transplanted by the different colonial powers and the long-term consequences this had for investor protection and financial development.

What united these three lines of research, and what made them particularly novel at the time, was their analysis of the potential importance of a historic event, colonial rule, for long-term economic development. These three studies spawned a large literature of empirical studies seeking to identify the importance of historic events for economic development. The earliest subsequent studies typically examined correlations between variables quantifying the impact of historic events, which almost exclusively was colonial rule, and typically the unit of observation was a country. These initial studies were successful at highlighting correlations in the data consistent with the notion that history can matter, even in the long-run. However, because of their inability to establish causality, the evidence presented was suggestive at best.<sup>1</sup>

Since these early contributions, the literature has developed in a number of significant ways. Much more effort has been put into collecting and compiling new variables based on detailed historic data. Recent studies, exploiting these richer data sources, are also able to employ much more satisfying identification strategies that typically rely on instrumental variables, falsification tests, regression discontinuities, differences-in-differences estimation, or propensity score matching techniques.<sup>2</sup>

The literature has also moved beyond simply estimating reduced form causal relationships

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<sup>1</sup>Examples of these early studies include Grier (1999), Englebert (2000a,b), Bertocchi and Canova (2002), and Price (2003).

<sup>2</sup>See for example Acemoglu and Johnson (2004), Banerjee and Iyer (2005), Berger (2008), Dell (2008), Feyrer and Sacerdote (2009), Huillery (2008a), Iyer (2007), Nunn (2008a), Nunn and Qian (2008), and Nunn and Wantchekon (2008).

between historic events and economic development. For many studies, the goal is to also explain exactly how and why specific historic events can continue to matter today. That is, the literature has moved from asking whether history matters to asking why history matters.<sup>3</sup>

This paper provides a survey of this body of empirical research. I begin by reviewing the seminal articles by Acemoglu *et al.* (2001), Engerman and Sokoloff (1997, 2002), and La Porta *et al.* (1997, 1998) as well as the body of literature that each contribution has generated. The next section reviews the additional evidence from second generation studies that provide identification-based evidence that history matters. Section 4 then surveys the precise channels of causality that have been examined in the literature. The evidence for the importance of (i) multiple equilibria and path dependence; (ii) domestic institutions; (iii) cultural norms of behavior; and (iv) knowledge and technology are examined. The penultimate section of the paper, section 5, discusses the interesting relationship between geography and history that has developed in the literature. While some studies have pitted these two factors against each other as alternative determinants of economic development, other studies have shown that the two factors interact in interesting and important ways. As will be discussed, the existing body of evidence indicates that the greatest effect that geography has on economic development is through its influence on history. The final section of the paper, section 6, concludes by discussing the current direction of future research.

## 2. The Seminal Contributions

The literature linking history to economic development has its origins in three distinct but related strands of research: Acemoglu *et al.* (2001); La Porta *et al.* (1997, 1998); and Engerman and Sokoloff (1997, 2002). All three examine one of the largest and most important events in the world's history: European expansion and colonization of the globe, which began in the 16th century.

The studies document the lasting impact that Europe's colonization had on the development paths of former colonies. They also share a common view that an important part of the causal mechanism was the impact that colonial rule had on the domestic institutions that persisted after independence.<sup>4</sup> Viewed in this light, all three lines of research are conceptually consistent with one another. All three argue that the institutions of a society are an important determinant of long-

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<sup>3</sup>See for example Acemoglu, Johnson, and Robinson (2005a) Acemoglu and Johnson (2004), Becker and Woessmann (2009), Dell (2008), Iyer (2007), Munshi and Wilson (2008), Nunn (2008b), Nunn and Qian (2008), and Nunn and Wantchekon (2008).

<sup>4</sup>The studies build on an even earlier literature arguing for the importance of domestic institutions for long-term growth. See for example North and Thomas (1973) and North (1981, 1990). More recently, also see Greif (2006).

term economic development, and that historical events can be an important determinant of the evolution and long-term persistence of domestic institutions. Where the studies differ, however, is in their views of which aspects of colonial rule were crucial for shaping institutions, and in the specifics of the proposed causal mechanisms.

For La Porta *et al.*, the identity of the colonizer determined whether a civil law or common law legal system was established and this was important for long-term development. Unlike La Porta *et al.*, Engerman and Sokoloff and Acemoglu *et al.* share the common view that it is the characteristics of the region being colonized that were crucial factors that determined the effect of colonial rule on long-term economic development. For Acemoglu *et al.*, the initial disease environment shaped the extent to which secure property rights were established in the colony, and through their persistence these initial institutions had a large effect on long-term economic development. Engerman and Sokoloff focus on the importance of a region's endowment of geography suitable for growing lucrative globally traded cash crops that were best cultivated using large scale plantations and slave labor. These large plantations resulted in economic and political inequality, which in turn impeded the development of institutions that promoted commercial interests and long-term economic growth.

We now examine the three seminal contributions, as well as the resulting literature that has been generated by each.

#### **A. La Porta, Lopez-de-Silanes, Shleifer and Vishny**

The core of La Porta *et al.*'s (1997, 1998) analysis is their emphasis on the differences between legal systems based on British common law versus Roman civil law. They argue that countries with legal systems based on British common law offer greater investor protection relative to countries with legal systems based on civil law. They then recognize that in British colonies common law based legal systems were transplanted, while the European countries with a legal system based on Roman civil law – namely Spain, France, and Portugal – transplanted civil law legal systems. La Porta *et al.* (1997, 1998) use this historic fact to examine the causal effect of the strength of legal rules protecting investor rights on financial development. The authors argue that for former colonies legal origin is largely exogenous to country characteristics and is therefore a potential instrument that can be used to estimate the effect of the protection of investor rights on financial development. The first stage of their IV estimates show that civil law countries, relative to common law countries,

do have better investor protection, and their second stage estimates indicate that countries with weaker investor protection have smaller debt and equity markets.

Since these initial studies a large literature has emerged exploring the potential effect that legal origin may have on other factors.<sup>5</sup> These studies show that legal origin is also correlated with a host of other country characteristics, such as military conscription (Mulligan and Shleifer, 2005*a,b*), labor market regulation (Botero, Djankov, La Porta, de Silanes, and Shleifer, 2004), contract enforcement (Djankov, La Porta, Lopez-de-Silanes, and Shleifer, 2003, Acemoglu and Johnson, 2004), comparative advantage (Nunn, 2007*b*), and even economic growth (Mahoney, 2001). These results are both good and bad for La Porta *et al.*'s (1997, 1998) initial studies. They suggest that legal origin may have effects that are even more wide-ranging than originally assumed in La Porta *et al.* (1997, 1998). However, if this is the case, then this calls into question the validity their use of legal origin as an instrument for investor protection. Given that legal origin appears to be correlated with a host of other country characteristics that may also affect financial development, it is unlikely that the exclusion restrictions from their original papers are satisfied. As discussed in La Porta *et al.* (2008), the authors are clearly aware of this fact.

Subsequent studies also look for similar relationships involving legal origin within the United States. Ten U.S. states that were first settled by either France, Spain, or Mexico initially developed civil law legal systems.<sup>6</sup> Berkowitz and Clay (2005, 2006) find that today these civil law states have a less independent judiciaries, lower quality courts, and less stable constitutions. Although both studies rely on OLS estimates, they do show that the correlations remain robust to controlling for a number of additional factors, such as slavery, date of entry into the Union, state size, and climatic characteristics.

Other studies also highlight correlations in the data and show that there exists a relationship between the identify of the colonizer and various measures of long-term economic development. For example, Grier (1999) finds that at independence former British colonies on average had a larger share of their populations in school. Bertocchi and Canova (2002) find that within Africa, former British and French colonies have higher levels of investment and education after independence. Although these correlations do not provide proof of the causal importance of the identity of

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<sup>5</sup>La Porta, Lopez-de-Silanes, and Shleifer (2008) provide a survey of these early studies as well as the subsequent literature that they generated.

<sup>6</sup>The ten states include: Alabama, Arizona, Arkansas, California, Florida, Louisiana, Mississippi, Missouri, New Mexico, and Texas. Of these states only Louisiana continues to have a civil law legal system.



colonizer, they are consistent with La Porta *et al.*'s emphasis on the impact that the identity of the colonizer (specifically, its legal system) has on the long-term economic development of its colony.

### **B. Acemoglu, Johnson and Robinson**

Like La Porta *et al.* (1997), Acemoglu *et al.* (2001) also examine the effect of colonial rule on the institutions that were implemented and their long-term impact on economic development. However, Acemoglu *et al.* (2001) focus on a different determinant of the differences in institutions that evolved across former colonies. They hypothesize that since colonies with a less deadly disease environment had greater European settlement, in these colonies growth promoting institutions that protected property rights were established during colonial rule. In colonies in which European mortality was high and settlement low, the colonizers did not have an incentive to establish strong property rights and instead established extractive rent-seeking institutions. Using this logic, the authors estimate the causal effect of current domestic institutions on per capita income, using early European mortality rates as an instrument for institutions. One of the assumptions underlying the IV strategy is that initial settler mortality is not correlated with current income other than through domestic institutions. In the first stage of their IV procedure, the authors find a strong negative relationship between initial settler mortality and institutional quality today. The second stage estimates indicate that domestic institutions exert a strong positive effect on per capita income.

The elegance of the paper lies in its ability to develop a clear and convincing historical narrative with supporting empirical evidence and show how a historic event can affect past institutions, which through their persistence have an influence on income levels today. The study provided an empirical foundation to support the seminal works on the importance of institutions written by North and Thomas (1973) and North (1981, 1990).<sup>7</sup> The study emerged at a time when the literature was still in the process of trying to convincingly estimate the causal impact of domestic institutions on economic development.<sup>8</sup> An important contribution of Acemoglu *et al.* (2001) was to develop a much more satisfying identification strategy than previous empirical studies.

A number of studies have attempted to extend Acemoglu *et al.*'s line of research, providing evidence for the importance of historic institutions for current economic development. Two recent studies by Banerjee and Iyer (2005) and Dell (2008), rather than taking a broader more macro

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<sup>7</sup>More recently, also see Greif (2006).

<sup>8</sup>Early papers in this literature include DeLong and Shleifer (1993), Knack and Keefer (1995), Mauro (1995), Hall and Jones (1999) and Englebert (2000a,b).

perspective, focus on a specific regions. By doing this, the authors are able to collect and analyze much richer data at a more micro level. The use of this richer data also allow the authors to employ additional estimation strategies that help identify the causal effects of history on economic outcomes today.

Dell (2008) examines the mita forced labor system, which was instituted by the Spanish in Peru and Bolivia between 1573 and 1812. The study combines contemporary household survey data, geographic data, and data from historic record, and uses a regression discontinuity estimation strategy to identify the long-term impacts of the mita system. Her identification exploits the fact that there was a discrete change in the boundaries of the mita conscription area and that other relevant factors likely vary smoothly around the mita boundary. Because of this, comparing the outcomes of mita and non-mita districts very close to the border provides an unbiased estimate of the long-term effects of the mita. The study finds that the mita system had an adverse effect on long-term economic development. All else equal, today former mita districts have an average level of household consumption that is 32% lower than households in former non-mita districts. The study finds that a significant proportion of the difference can be explained by lower levels of education and less developed road networks. Dell's study provides valuable evidence showing that the institutions established during colonial rule can have long-term impacts that continue to be felt today.

Like Dell (2008), Banerjee and Iyer (2005) also analyze the long-term effects of colonial institutions, but examine differences in revenue collection institutions across districts within colonial India. The authors compare districts where revenue was historically collected directly by British officials to districts where revenue was collected by native landlords. They find that after independence districts with non-landlord systems have higher levels of health, education, and agricultural technology investments relative to landlord systems. To determine the extent to which the correlation is causal, the authors exploit the fact that in the parts of India conquered between 1820 and 1856, non-landlord revenue collection was implemented. They argue that the historic reasons for this pattern are orthogonal to district characteristics and therefore the date of British conquer can be used as an instrument for the revenue collection system. Their IV estimates are consistent with their OLS estimates. They also show that their OLS results are robust when the sample is restricted to 35 districts, in which all landlord districts are bordered by non-landlord districts.

Although the analysis of Banerjee and Iyer (2005) and Dell (2008) provide evidence of the long-term impacts of initial colonial institutions, the studies do differ from Acemoglu *et al.* (2001) since the transmission mechanism is not the persistence of these initially implemented institutions. In Dell, the hypothesized mechanism is the concentration of wealth and power, and the resulting provision of public goods. Similarly, in Banerjee and Iyer's analysis the transmission mechanism is not through the persistence of these initially implemented institutions, since the differences in colonial land revenue collection systems no longer exist.

One study that does empirically link early colonial institutions to institutional outcomes today is sociologist Matthew Lange's (2004) analysis of the differential effects of indirect rule relative to direct rule on the quality of institutions and governance today. Using colonial documents housed in Britain's Public Records Office, Lange compiles information on court cases held in 33 former British colonies in 1955. He then uses the fraction of the court cases that were presided over by local chiefs, rather than colonial officials, as a measure of the extent of indirect rule in each country. The measure is intended to provide a proxy for the overall extent to which colonial rule in the country relied on traditional legal, political, and institutional structures. The study finds a positive relationship between the extent of indirect rule and a variety of measures of institutional quality and good governance. The primary shortcoming of the study, however, lies in its lack of a convincing identification strategy. Because the paper relies on OLS estimates it is unknown whether the correlations between past and current institutions capture the causal effect of historic institutions on institutions today or simply reflect a spurious correlation driven by omitted country characteristics.

### C. *Engerman and Sokoloff*

The studies by Engerman and Sokoloff (1997, 2002) focus on the differential paths of development among the New World countries of the Americas.<sup>9</sup> Engerman and Sokoloff argue that the different development experiences of the countries in the Americas can be explained by initial differences in endowments of land and geography suitable for growing globally traded crops like sugar, which were best grown on large-scale plantations using slave labor. These areas were characterized by severe economic and political inequality, which resulted in the subsequent evolution of the domestic institutions that protected the privileges of the elites and restricted the participation of the

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<sup>9</sup>For a review and discussion of these and related studies see Hoff (2003).

rest of the population in the commercial economy. In former Spanish colonies endowments of rich mineral resources further strengthened the tendency towards political and economic inequality.

Since the analysis of Engerman and Sokoloff (1997, 2002) is primarily qualitative in nature, the literature has taken the natural next step, which is to begin to empirically examine the core predictions that arise from their analysis. A number of studies have uncovered correlations in the data that support the authors' hypothesis that slavery was detrimental for subsequent economic development. The studies find a negative relationship between various measures of economic development and past slave use, looking across U.S. states (Mitchener and McLean, 2003) or counties (Lagerlöf, 2005) or across New World countries (Nunn, 2008*b*).

Studies have also examined additional hypotheses that arise from their study. Nunn (2008*b*) uses information from the 1860 U.S. Census to examine whether the data support the inequality channel proposed by Engerman and Sokoloff. The study, based on OLS estimates, finds a strong positive relationship between slavery and inequality in the size of land holdings, when looking across either states or counties. This finding is consistent with the notion that slavery resulted in economic inequality. However, Nunn fails to find any evidence of an empirical relationship between initial economic inequality and current income levels. Although it is true that the counties and states with higher levels of land inequality in 1860 also have higher levels of income inequality today, it is not true that these states and counties have lower levels of income today.<sup>10</sup> In other words, there is no evidence of a relationship between historic inequality and current economic underdevelopment as hypothesized by Engerman and Sokoloff. Instead, the data are most consistent with slavery having had two unrelated consequences. It increased economic inequality, which persists today, and it also resulted in lower levels of economic development.

Nunn (2008*b*) also looks outside of the U.S. to examine the inequality channel proposed by Engerman and Sokoloff. Specifically, he examines their argument that slavery was detrimental because it took the form of large-scale plantation slavery, which promoted extreme inequality. Using data from British Slave Registrars, Nunn disaggregates slave populations into those that were used on plantations and those that worked in other occupations such as industry, livestock, salt, timber, fishing, and shipping. In a second exercise, Nunn does something similar, disaggregating slave populations by the size of the holdings that they were held on. By doing this he is able to

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<sup>10</sup>Related to this is Frankema's (2006) finding of a positive relationship between colonial land inequality and post-colonial income inequality across former colonies.

examine whether the negative correlation between slavery and economic development is being driven by large-scale plantation slavery. He finds that this is not the case. All forms of slavery are negatively correlated with subsequent economic development, and when statistically significant differences in the estimates exist, large-scale plantation slavery is found to be less correlated with underdevelopment than smaller-scale non-plantation slavery.

Additional evidence on the validity of Engerman and Sokoloff's hypothesized inequality channel comes from the study by Acemoglu, Bautista, Querubin, and Robinson (2008) that examines variation across municipalities within the state of Cundinamarca, Colombia. The analysis shows that within Cundinamarca there is a positive relationship between 19th century land inequality and current economic development proxied by measures of primary and secondary school enrollment rates. This relationship is opposite to the negative relationship that one would expect to observe if Engerman and Sokoloff's hypothesis was correct. This finding can also be contrasted to evidence from the United States showing that until 1940 there was a negative relationship between inequality and education (Galor, Moav, and Vollrath, 2009). The study also shows that in Cundinamarca economic inequality and political inequality are negatively correlated, a fact that also runs counter to Engerman and Sokoloff's hypothesis that initial economic inequality resulted in political inequality.

Additional evidence can be gleaned from Melissa Dell's (2008) study of colonial Peru and Bolivia. In her analysis, Dell explains her finding of a negative effect of the mita system on education and the development of road networks by the fact that in mita districts the colonial government restricted the formation of large Spanish land holdings, called haciendas. Because the large land owners typically lobbied for the greater provision of public goods, the non-mita districts, without these large land owners, had lower levels of public goods. Dell provides empirical evidence to support her argument. Comparing districts on both sides of the mita boundary, one observes a significantly lower presence of haciendas in former non-mita districts both during and after the mita, as well less dense road networks and less market integration today. These estimates support her explanation that because non-mita districts had less haciendas, they did not have large landowners that were able to lobby for local public goods. Dell's explanation and her supporting evidence run contrary to the inequality channel put forth by Engerman and Sokoloff. In Dell's setting, not enough (rather than too much) concentration and inequality in land ownership, was the cause of long-term economic underdevelopment.

### 3. Additional Evidence that History Matters

Much of the early literature examining the importance of history for economic development examined correlations between different measures of colonial rule and current economic performance across countries (Grier, 1999, Englebert, 2000a,b, Bertocchi and Canova, 2002, Price, 2003). Although these studies are useful in highlighting correlations that exist in the data, they stop short of providing causal evidence of the effect of history on long-term development. The more recent empirical studies at the forefront of this literature combine much richer data, typically at a level of analysis much finer than the country, with much more sophisticated identification techniques to provide causal evidence of the importance of history for long-term economic development.

One example of this line of research is Huillery's (2008a) analysis of the differential effects of colonial rule across districts within French West Africa. Her study combines data from historic documents from archives in Paris and Dakar with household surveys from the 1990s. She shows that looking across districts there is a positive relationship between early colonial investments in education, health and infrastructure and current levels of schooling, health outcomes, and access to electricity, water, and fuel. The study then moves to testing for the causal effect of colonial policy on these subsequent outcome measures. Exploiting the richness of her district level data set, Huillery uses a regression discontinuity estimation strategy, comparing the differences in her outcomes of interest between neighboring districts only. Her estimates provide strong support that colonial investments on education, health and infrastructure have positive and persistent effects on current education, health, and infrastructure.

Like Huillery (2008a), the recent study by Berger (2008) also uses micro-level data to identify long-term impacts of colonial policies. The study also uses a regression discontinuity estimation strategy and examines the difference in outcomes between Northern Nigeria and Southern Nigeria, two regions of colonial Nigeria. During colonial rule the two districts were split by a straight line running East-West located at  $7^{\circ}10'$  N. Although there were many differences between the two regions, one of the primary differences was the form of taxation. In the coastal Southern region revenue was raised primarily through tariffs on internationally traded goods. The landlocked North relied on a poll tax to raise revenue. As a result, in the North it was necessary to develop an institutional structure and network to collect taxes, and to develop mechanisms to control corruption and incompetence of government officials and native chiefs.

Berger uses vaccination rates as his measure of local government quality today. Comparing households within 1 degree on either side of the historic border between Northern and Southern Nigeria, he finds that vaccination rates are significantly lower on the Northern side of the border. A falsification test shows that there is something distinct about the historic border located at  $7^{\circ}10'$  N. As one moves the border north or south, the estimates find no difference in vaccination rates of households on either side of the false borders. It is only for this historic border, which does not correspond to any modern boundary, that a significant difference exists.

Other studies, using more sophisticated identification techniques, have revisited old questions that were never satisfactorily answered in the early literature. One of these questions is the effect that the length of colonial rule had on subsequent development. This question has been examined previously by Grier (1999) and Price (2003), but their analysis relies on OLS estimates. Feyrer and Sacerdote (2009) use a novel instrumental variables estimation strategy to provide the first causal estimates of the impact of the length of colonial rule. The authors, as part of their identification strategy, consider only former island colonies. They argue that how early an island was discovered was determined in part by its location relative to prevailing wind patterns and that these wind patterns most likely do not affect long-term development through channels other than through the island's date of discovery. If this is the case, then the wind vectors surrounding an island can be used as instruments to estimate the causal effect of the length of colonial rule on subsequent development. Their baseline set of instruments, which are constructed from satellite imagery data reported monthly on a 1 degree by 1 degree global grid, include the annual mean and variance of monthly East-West wind vectors.

Their first stage estimates show that stronger westerly winds are associated with earlier discovery and more years under colonial rule. According to their second stage estimates, the length of colonial rule has a positive effect on per capita income in 2000. This result may seem surprising since it appears to provide evidence that colonial rule was good for economic development. However, this conclusion does not follow from their study. Because the estimated effects are for the length of colonial rule conditional on being colonized, it does not provide an estimate of the average effect of being colonized relative to not being colonized.

A second long-standing question that has recently been revisited with improved identification is the long-term effect of direct colonial rule relative to indirect rule. The distinction between direct and indirect rule, although not always clear-cut, lies in the amount of bureaucratic responsibility

given to native agents rather than European administrators. Direct rule occurs when only the lowest levels of responsibility are given to natives and all other positions are occupied by Europeans. Under indirect rule, much more power is given to natives, and typically local governance structures and local elites are integrated into the colonial governance structure.

The recent study by Iyer (2007) employs an empirically persuasive identification strategy to examine the relative effects of direct versus indirect rule across regions within India. She addresses the problem of the endogeneity of the form of British rule by exploiting the 'Doctrine of Lapse', which was in place between 1848 and 1856. The doctrine, which stated that a native ruler's adopted heirs were not to be recognized by the British government, allowed the British to annex several states where the native ruler died without a natural heir. Exploiting the Doctrine of Lapse, Iyer constructs a district specific indicator variable that equals one if the ruler died without a natural heir between 1848 and 1856 when the Doctrine of Lapse was in place.<sup>11</sup>

Looking across 415 districts, Iyer estimates the effect of colonial indirect and direct rule on investment in agriculture and agricultural productivity today. She first estimates the relationship using OLS and finds a positive and statistically significant relationship between direct rule on agricultural investments and productivity. On the other hand, her IV estimates report no statistically significant difference between the two types of districts. The difference between the IV and OLS estimates is consistent with the British selectively annexing the most productive states. Iyer (2007) also examines the effect of direct rule on the availability of public goods such as health, education, and roads. Again she finds that the IV estimates are consistently lower than the OLS estimates, which again is consistent with the British selecting the 'better' states. According to the IV estimates, direct rule exerted a negative effect on the long-term availability of public goods.<sup>12</sup>

As is always the case with IV estimates, the validity of the estimates rests crucially on whether the instruments satisfy the necessary exclusion restrictions. As a test of the validity of her instruments, Iyer performs a number of falsification tests. She first reports the reduced form relationship between her instrument and her measures of the availability of public goods. Consistent with the IV estimates, her reduced form shows a statistically significant negative relationship between her instrument and the public goods measures. Iyer then constructs a 'fake instrument', which is an indicator variable that equals one if a state's ruler died without a natural heir between 1858

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<sup>11</sup>In her analysis, Iyer only considers the subset of states that were not annexed before 1848.

<sup>12</sup>Banerjee, Iyer, and Somanathan (2005) examine the robustness of this result across 27 different public good measures. Overall, the results confirm the findings of Iyer (2007) looking across a more restricted range of public goods.



and 1884, a period when the Doctrine of Lapse was no longer in place. According to the channel proposed by Iyer, the results with the fake instrument should not provide the same reduced form estimates as with the actual instruments. This is exactly what she finds. For all outcome measures except one, she finds no statistically significant relationship between the fake instrument and the outcome measures.

One of the most dramatic examples of how history can shape long-term economic development comes from Nunn's (2008a) study of the impact that the external trade in slaves had on long-term political and economic development within Africa. Combining data from historic shipping records, reporting the total number of slaves shipped on each voyage from Africa, with historic records that report the ethnic identity of the slaves being shipped, Nunn constructs estimates of the number of slaves shipped during the trans-Atlantic Slave Trade. He also constructs similar estimates for Africa's three other slave trades: the Indian Ocean, Red Sea and trans-Saharan slave trades. The study finds that the parts of Africa from which the largest number of slaves were taken (normalized by land area or historic population) today are the poorest parts of Africa. The core issue in interpreting this correlation is selection into the slave trades. If, for example, the societies with the most poorly functioning institutions and the poorest future growth prospects selected into the slave trades, then this would explain the negative relationship even if the external trade in slave trades had no direct impact on the societies within Africa.

Nunn tests whether selection is driving the results by looking at the evidence on the nature of selection during the slave trades. He finds that the descriptive and quantitative evidence suggest that it was not the least developed societies that selected into the slave trade. Instead, it was actually the more developed and more densely populated societies that supplied the largest numbers of slaves. Nunn also constructs instruments based on the distance of each country from the external locations of demand for the slaves. The key identification assumption is that the location of demand influenced the location of supply and not vice versa. If, as Sokoloff and Engerman (2000) argue, the demand for slaves was determined primarily by geographic characteristics, such as soil quality suitable for plantation agriculture, then this assumption is reasonable. The IV estimates provide estimates that is consistent with the OLS estimates. Overall, Nunn concludes that the empirical evidence suggest that Africa's external trade in slaves did have a significant negative impact on the subsequent economic development of the regions within Africa.

## 4. Why History Matters

### A. *Multiple Equilibria and Path Dependence*

If one thinks about classical models in economics, it far from obvious why historic events should have any impact in the long-run. For example, in the classic Solow model, for a given set of parameter values, there is a unique steady state level of capital and income per worker. Any event that shocks either capital or output has a temporary impact only. In the long-run the economy eventually converges back to a unique steady state equilibrium. Viewed in this light, it is unclear why history should matter. However, once models with multiple equilibria are considered, then historic events have permanent effects if they cause a movement from one equilibrium to another.<sup>13</sup>

A recent paper by Nunn (2007a) illustrates this point by developing a model that features multiple equilibria in the security of property rights and output per worker. It is then shown that a period of severe extraction, by temporarily causing the optimal equilibrium to disappear, can cause a permanent movement to an equilibrium with significantly lower income levels. Because this equilibrium is stable, the society remains ‘stuck’ in this equilibrium even after the high-income equilibrium returns. Using historic evidence, Nunn argues that the movement from one equilibrium to another explains why in Africa the slave trade and colonial rule appear to have had permanent impacts.

On many levels, it is clear that the world we live in is filled with multiple equilibria. Suggestive evidence of this fact can be found in a variety of real world phenomena, such as the fact that this article was typed on a QWERTY keyboard rather than the significantly more efficient DVORAK keyboard<sup>14</sup> or the fact that cars are driven on the right hand-side of the road in the U.S., but on the left side in the UK. As well, historic events, such as the battle for market dominance between VHS and Betamax in the 1980s, also provide further evidence that multiple equilibria exist.

Very recently, a number of studies have undertaken the task of testing empirically for the existence of multiple equilibria. One strategy that some of studies have employed is to examine cases where there has been an extremely large shock to an equilibrium. The studies then test whether the shock causes a movement from the previous equilibrium to a new equilibrium. Davis

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<sup>13</sup>For early examples of models of this type see Murphy, Shleifer, and Vishny (1993), Acemoglu (1995), and Mehlum, Moene, and Torvik (2003).

<sup>14</sup>For a discussion of the historic reasons for the adoption of the QWERTY keyboard see David (1985).

and Weinstein (2008) examine the effect of bombings on 114 Japanese cities during World War II.<sup>15</sup> The authors find that after the bombings, the cities returned to their pre-bombing populations, regained their shares in total manufacturing output, and most surprisingly, they also regained their pre-existing industrial composition. Overall, the results point towards the existence of a unique stable equilibrium of production, rather than the existence of multiple equilibria. A similar result is found in Miguel and Roland's (2006) analysis of the long-term effects of the U.S. bombings in Vietnam. The authors find that the bombings had no long-term effects on populations, poverty or consumption 25 years later.

These tests, although very suggestive, do not provide airtight proof against the existence of multiple equilibria in these environments. This is true for a number of reasons. It is possible that other equilibria exist, but the shocks were not large enough to cause a movement to a new equilibrium. It is also possible that the shocks were large enough to cause a movement, but that the pre-bombing equilibrium is focal and therefore after the bombings this equilibrium was selected among all possible equilibria (see Schelling, 1960).

An innovative study by Redding, Sturm, and Wolf (2007) tests for the existence of multiple equilibria in an environment very different from Davis and Weinstein (2008) and Miguel and Roland (2006). The study examines the location of airport hubs in Germany before and after the division of Germany following World War II. It is shown that after division, the location of West Germany's primary airport hub switched from Berlin to Frankfurt. After reunification in 1990, the location of the hub did not switch back to Berlin. Redding *et al.* show that this shift cannot be explained by changes in fundamentals over the time period. Thus, the evidence suggests that the temporary division of Germany resulted in a permanent movement of the location of Germany's largest airport hub.

One of the most dramatic examples of how a historic event can drastically alter the subsequent path of economic development is the history of Tasmania. According to archaeological evidence, humans first arrived in what today is Tasmania as early as 22,000 years ago across a land bridge that connected present day Australia to Tasmania. Approximately 12,000 years ago, at the end of the Pleistocene, rising sea levels drowned the land bridge, turning it into what is now the shallow Bass Strait (Diamond, 1978). The archeological evidence indicates that the technologies used by the Tasmanians deteriorated over time. The Tasmanians lost their ability to construct bone tools,

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<sup>15</sup>See also Davis and Weinstein (2002) which was a precursor to this paper.

make cold-weather clothing, and to catch fish.

An explanation for Tasmania's dramatic deterioration has been put forth by Anthropologist Joseph Henrich (2004). He develops a model where skills are imperfectly transmitted from the most skillful or successful individual in the society to all other members of the society. Henrich shows that in this environment the size of the population matters. This is because in a larger population the most skilled individual is, on average, more skilled. He also shows that because of imperfect transmission, there exists a minimum population size below which the average skill of the society actually decreases over time. Therefore, his model explains the Tasmanian technology losses by the drop in effective population size after rising sea levels isolated Tasmania from Australia.

The Tasmanian experience provides a dramatic example of path dependence. One historic event – the rising sea levels and flooding of the Bass Strait – resulted in a permanent change in the evolutionary process and moved the society to a new trajectory, where technologies and skills deteriorated over time. One historic event permanently changed, in a very dramatic way, the long-term social and economic development of the Tasmanians.

## **B. *Domestic Institutions***

Even without the existence of multiple equilibria, historic events can still affect economic development in the long-run if they alter deep determinants of long-term economic growth. The deep determinant that has received the greatest attention in the literature is domestic institutions. The emphasis on institutions can be seen clearly from the fact that in each of the seminal papers by Acemoglu *et al.* (2001, 2002), Engerman and Sokoloff (1997, 2002), and La Porta *et al.* (1997, 1998) the mechanism through which colonial rule affects current development is domestic institutions.

The focus on institutions as a causal mechanism has also continued in subsequent research. An example of this is Acemoglu *et al.*'s (2005a) study of the effect that early Atlantic trade had in Europe. The authors argue that in countries with access to the lucrative Atlantic three corner trade, economic and political power shifted towards commercial interests. As the merchant class became more powerful, they were able alter domestic institutions to protect their interests against the interests of the royalty, and these institutional changes in turn had a positive effect on long-term prosperity. Using data on historic urbanization rates and per capita incomes, the study first shows

that the rise of Europe was actually a rise of the nations with access to the lucrative Atlantic trade.<sup>16</sup> Their explanation is shown to be robust even when controlling for alternative explanations of the rise of Western Europe, such as the rise of a Protestant work ethic (Weber, 1930, Landes, 1998), war and inter-state competition (Tilly, 1990), and the legacy of the Roman Empire.<sup>17</sup>

The authors argue that profits alone are not able to explain the divergent growth of Atlantic traders and that the evolution of domestic institutions played an important role in the process.<sup>18</sup> To test this hypothesis, the authors extend the Polity IV data back to 1350 and show that Atlantic trade increased the quality of domestic institutions as measured by an index of the constraints on the executive. They further hypothesize that the process of institutional change could only occur in countries that initially had non-absolutist political institutions. They show that the data is also consistent with this. They show that the increase in economic growth generated by the Atlantic trade was higher for countries with better initial domestic institutions, again measured by the constraint on the executive.

The recent study by Gennaioli and Rainer (2007) also provides evidence of the persistence of domestic institutions, but within the African context. The authors use ethnographic data to construct a measure of the level of state development in pre-colonial African societies. Their OLS estimates show that there is a positive correlation between pre-colonial political development and the provision of public goods today. This result can be combined with evidence from Nunn (2008a) showing that the parts of Africa from which more slaves were taken had less developed political systems after the slave trade (and before official colonial rule). Because the evidence for both relationships is based on correlations in the data, one must be cautious when drawing conclusions. However, the combined evidence from Gennaioli and Rainer (2007) and Nunn (2008a) is consistent with a chain of causality where the slave trade resulted in a deterioration of domestic political institutions, which in turn had a long-term adverse impact on the provision of public goods. Therefore, the evidence from the two studies provides support for the notion that history can matter through the evolution and persistence of early institutions.

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<sup>16</sup>These countries were Britain, France, the Netherlands, Portugal and Spain.

<sup>17</sup>More recently, Becker and Woessmann (2009) also provide empirical support for the importance of the Protestant religion, but focuses instead on the religion's emphasis on the importance of literacy so that each individual was able to read the Bible. The analysis identifies a positive effect of the Protestant religion on literacy and industrialization in 19th century Prussia. (Also related is the evidence put forth by Iyigun (2008) showing that the rise of the Ottoman Empire and its movement into Europe is partly responsible for the Protestant Reformation.)

<sup>18</sup>See Inikori (2002) for the alternative view that the profits that accrued to Western Europe during the three corner Atlantic trade explains much of its growth during the time.

The persistence of historically determined institutions is also the channel of causality in the recent study by Saumitra Jha (2008) that examines the effect of early medieval trade on the formation and persistence of institutions promoting religious tolerance. The study by Jha shows that when looking across cities within India, one finds a positive relationship between participation in overseas trade during the medieval period and religious conflict during the late 19th and early 20th centuries. Jha addresses the endogeneity of the selection of medieval ports by using the existence of natural harbors as an instrument for whether a coastal city was a trading port and by using propensity score matching techniques. His estimates show that being a town that was a medieval trading port made it less likely that the town later experienced Hindu-Muslim riots. Using historical evidence, Jha argues that because Muslims provided access to the markets of the Middle East, in the towns connected to this overseas trade the returns to Hindu-Muslim cooperation was much higher. As a result, institutions that supported exchange and a peaceful coexistence between Hindus and Muslims were developed. Although Jha's analysis provides evidence of a causal effect of medieval trade on long-term religious tolerance, it stops short of verifying empirically that the intervening channel is the persistence of historic institutions.

A number of studies also provide suggestive evidence of the importance of historic institutions. Rather than empirically documenting the evolution and persistence of institutions over time, they show that historic institutions have a strong effect on economic outcomes today. Examples include Dell's (2008) analysis of the impact of the early forced labor institutions in colonial Peru and Bolivia, as well as Banerjee and Iyer's (2005, 2008) studies of the effects of early land tenure institutions in colonial India.

Overall, the literature since Acemoglu *et al.* (2001) has succeeded at providing additional evidence showing that institutions are an important channel through which history matters. However, much work remains to be done before we have a clear understanding of the effect that historic events have on the formation or early institutions and their persistence and importance for long-term development. For example, in past studies (typically at the macro-level) institutions have been conceptualized and measured as a broad cluster of institutions. The result of this is that by and large institutions have remained a black box that we do not clearly understand the details of. As empirical research continues to examine specific examples of institutional change and persistence at the micro-level, our understanding of the causes and consequences of specific institutions will naturally improve.

The recent study by Acemoglu and Johnson (2004) directly tackles the task of unpacking the black box we call institutions. The authors make a distinction between two broad clusters of institutions that they refer to as “property rights institutions” and “contracting institutions”. According to their definitions, property rights institutions protects individuals from theft or expropriation by the government or elites, and contracting institutions enforce private contracts written between individuals. The study explores the historical determinants of both types of institutions. They show that although there is a strong relationship between a country’s legal origin and the quality of its contracting environment today,<sup>19</sup> legal origin is not correlated with measures of property rights institutions. Extending previous research by Acemoglu *et al.* (2001), the study shows that there is a strong correlation between initial European settler mortality rates and property rights institutions, but no correlation between settler mortality and contracting institutions.

To unbundle the effects of these different types of institutions on economic outcomes, the authors use legal origin as an instrument for contracting institutions and initial settler mortality as an instrument for property rights institutions.<sup>20</sup> Using this IV procedure, the authors estimate the effect of both types of institutions on three outcome variables: current income, investment, financial development, and the form of financial intermediation (i.e. equity versus debt contracts). They find that property rights institutions have a positive and significant effect on income, investment and financial development. On the other had, contracting institutions appear to have a much more limited impact, only affecting the form of financial intermediation.

### ***C. Cultural Norms of Behavior***

Another way in which historic events can have long-term impacts is if these past events permanently affect culture or norms of behavior. Although in economics the notion of culture is often batted around with little meaning, in other disciplines culture is often given much more content.<sup>21</sup> For example, evolutionary anthropologists have long recognized that there are clear micro-foundations that explain the existence of a phenomenon like culture (e.g., Cavalli-Sforza and Feldman, 1981, Boyd and Richerson, 1985). If information acquisition is either imperfect or

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<sup>19</sup>This is consistent with the previous findings of Djankov, La Porta, Lopez-de-Silanes, and Shleifer (2002), Djankov *et al.* (2003) and Lerner and Schoar (2005).

<sup>20</sup>Motivated by Acemoglu *et al.* (2002), the authors also use initial population density in 1500 as an alternative instrument for property rights institutions.

<sup>21</sup>This is not to say that there are not serious studies in economics that seek to understand and model in a concrete way culture and its transmission. Examples include Verdier (2000, 2001) and Tabellini (2008).

costly, then selection favors short-cuts to learning. Individuals, rather than using scarce resources to acquire all of the information needed for every decision to be made, will instead develop 'rules-of-thumb'. These short-cuts or norms of behavior allows individuals to free-ride on the learning of others. These short-cuts then become internalized as individuals come to believe that certain behaviors are the 'right' behaviors in certain situations.

The idea that norms of behavior may be a channel through which history can affect long-term economic development is not new. One of the most famous links between history, culture, and development is Max Weber's (1930) hypothesis that the Protestant Reformation was instrumental in facilitating the rise of industrial capitalism in Western Europe. He argues that Protestantism, in contrast to Catholicism, approved the virtues of hard work and the accumulation of wealth, and that these values, referred to as the "Protestant work ethic", provided the moral foundation that spurred the transition to a modern market based industrial economy. A more recent example is Mokyry's (2008) argument that an important determinant of the Industrial Revolution was the development of a social norm he calls 'gentlemanly culture' that emphasized honesty, commitment, and cooperation.

Empirical studies exploring the link between history and culture typically attempt to isolate culture by comparing the some measure or proxy of a cultural belief across individuals in the same external environment. If individuals' stated beliefs or actions vary in a systematic manner when faced with the same situation, then this provides suggestive evidence of the importance of culture.

This logic builds on earlier studies that attempt to identify the existence of cultural differences between groups. In this literature, two strategies are employed in an attempt to identify systematic differences in behavior among individuals in the same environment. The first strategy is to bring the same environment to people of different backgrounds. This is the strategy undertaken in the studies by Henrich, Boyd, Bowles, Camerer, Gintis, McElreath, and Fehr (2001) and Henrich, Boyd, Bowles, Gintis, Fehr, Camerer, McElreath, Gurven, Hill, Barr, Ensminger, Tracer, Marlow, Patton, Alvard, Gil-White, and Henrich (2005) where the ultimatum game was conducted in 15 extremely remote small-scale societies across the world. The second strategy that has been employed is to examine situations where individuals from different backgrounds have been brought into the same environment. Miguel and Fisman (2007) look for a culture of corruption using the accumulation of unpaid parking violations among foreign diplomats stationed in Manhattan. Following a similar logic, Miguel, Saiegh, and Satyanath (2008) seek to identify the existence of a culture of violence



by examining the number of yellow and red cards fouls given to soccer players from different countries playing in six professional soccer leagues. Fernandez and Fogli (2007) examine the behavior of individuals whose parents were born in different countries, but today live in the United States. They find that the labor force participation and fertility of second generation females are positively correlated with the historic labor force participation and fertility of the individual's country of ancestry.

The earliest studies examining the possibility that cultural norms may be historically determined use an experimental setting to control for the external environment of individuals. Psychologists Cohen, Nisbett, Bowdle, and Schwarz (1996) test whether in the U.S. South there is a 'culture of honor', where a special importance is placed in defending one's reputation and honor, even if this requires aggression and violence. Their explanation for why this culture exists in the U.S. South and not the North lies in the different histories of settlement in the two areas. The North was settled by groups with a farming background, while the South was settled primarily by the Celts which had been herders since prehistoric times and had never engaged in large-scale agriculture. They argue that historically in herding cultures, with their low population densities and weak states, protection of one's property was left to the individual. The result of this is that some aspects of the norms of aggressive behavior that were developed as a means to protect one's herds continue to persist today.

To test the culture of honor hypothesis, Cohen *et al.* (1996) conducted a series of experiments involving white males from the U.S. North and South. In the experiments, each individual was bumped by an accomplice and called an "asshole". (The participants did not know this was part of the experiment.) Cohen *et al.*, using a number of methods including direct observation, psychological tests, and saliva tests, compare the effects of this incident on Southerners relative to Northerners. They find the Southerners became more upset, were more likely to feel that their masculinity was threatened, became more physiologically and cognitively primed for aggression as measured by a rise in testosterone and cortisol levels, and were more likely to engage in aggressive behavior subsequently.

Another study, which is well-known study in the sociology literature, is Salaman's (1980) comparison of two similar towns located in the same county in Eastern Illinois. Both towns were settled about 100 years ago, but one was settled by German immigrants from East Frisia and the other by Irish immigrants. Using survey data, Salaman documents the persistence of norms relating

to land inheritance, which reflect the ethnic heritage of the two communities.

Avner Greif (1994), relying on game theory and historic evidence, examines the historical origins of the divergent evolution of collectivist and individualist cultures among the Genoese and Maghribis, respectively. Relying on qualitative historical evidence, Greif argues that the differences between the two groups have their origins in the different enforcement strategies undertaken by merchants towards overseas agents during long-distance medieval trade. Among the Maghribi, merchants relied on a collective enforcement strategy, where all merchants collectively punish any agent who had cheated. Among the Genoese, enforcement was achieved through an individual punishment strategy (Greif, 1993).

Although these pioneering studies provide scarce evidence supporting the role of norms as a channel through which history matters, the shortcoming of each study is that only two groups are being compared. Although the studies by Cohen *et al.* (1996), Salaman (1980), and Greif (1994) carefully document differences between the two groups being examined, the studies are unable to prove that the source of these difference is the historical channel being examined. In all three examples, the two groups being examined differ along many dimensions other than the historic dimension under consideration. Because of this, one cannot conclude that the cultural differences observed today do not arise as a result of other factors.

More recent studies attempt to use the same comparative logic of these early studies, but extend the sample to include many more observations. By doing this, more sophisticated statistical techniques can be employed to help identify with greater certainty the importance of history in determining current cultural norms of behavior. Guiso, Sapienza, and Zingales (2008) empirically examine the well-know hypothesis put forth by Putnam, Leonardi, and Nanetti (1993) that within Italy city states that became independent during the 1000–1300 period developed higher level of social capital and these higher levels of social capital continue to persist today. The authors bring Putnam *et al.*'s hypothesis to the data by collecting various city level measures of social capital. They show that looking across 400 Italian cities, there is a positive relationship between their measures of social capital and whether the city was free in 1176.

The core issue when interpreting this correlation is that these independent cities may also be different along many other dimensions which may also affect social capital today. In an attempt to overcome this identification issue, the authors rely on historically motivated instrumental variables. Motivated by the historic fact that after the collapse of the Holy Roman Empire, local

autonomy was often formed around existing religious authorities, the authors use whether a town had a local bishop in the 5th century as one instrument. Their second instrument is motivated by the author's argument that a city that was a part of the Etruscan civilization during the 8th century was more likely to have become an independent city during the Middle Ages. Using these instruments, the authors provide IV estimates that are consistent with their OLS estimates.

The authors also use the historic presence of the Norman Kingdom in the South of Italy to develop a falsification test to assess the validity of their instruments. Because of the Norman Kingdom in the South of Italy, Southern cities were unable to gain independence. Using the first stage estimates from their IV procedure, the authors derive, for each Southern city, the predicted probability of its being free if it wasn't located in the South. They show that among these Southern cities, this predicted probability is uncorrelated with their measures of social capital. The authors argue that this result provides suggestive evidence that the exclusion restrictions for their IV estimates are satisfied. Having a local bishop during the Holy Roman Empire and being an Etruscan city does not appear to have an effect on social capital in the South, where their potential effect through independence was shut down historically. If the relationship between their instruments and social capital was because of a correlation with factors other than independence, then one would also expect to find a similar relationship in Southern Italy.

The recent study by Guido Tabellini (2007) also considers the historical origins of norms of behavior, but is interested in using this relationship to identify the causal effect of norms on economic development. His analysis examines differences in trust in others, respect for others, and confidence in the benefit of individual effort across regions within Europe. Using an IV estimation strategy to isolate exogenous variation in cultural norms, Tabellini uses two historically based instruments: (i) the literacy rate at the end of the 19th century, and (ii) the political institutions in place over the past several centuries. According to the first stage estimates, European regions with historically lower literacy and less well developed institutions today have less trust in others, less respect for others, and less confidence in the benefit of individual effort. The second stage of the IV estimates report a positive effect of the measured norms on current per capita income levels and average annual growth between 1977 and 2001.

Although the instruments are relevant, it is less clear whether the necessary exclusion restrictions are satisfied. The historic variables may have affected the evolution of factors other than cultural norms. Tabellini clearly understands this concern and controls for a variety of factors

including current literacy, current political institutions, and the historic urbanization rate. He also controls for the capital stock and the sectoral composition of employment in the 1970s, arguing that these are also possible channels through which the historic variables may affect current economic development. The extent to which one takes the estimates as causal rather than correlations observed in the data is clearly a matter of individual judgement based on the plausibility of the identification strategy.

Like Tabellini (2007), Nunn and Wantchekon (2008) also consider the historical determinants of trust, but in a very different environment. The authors examine whether the trans-Atlantic and Indian Ocean slave trades were responsible for a culture of mistrust within Africa. This is done by combining survey data from the 2005 Afrobarometer with estimates of the number of slaves taken from each ethnic group in Africa. The study finds a very strong negative relationship between an individual's reported trust in others and the number of slaves taken from the individual's ethnic group during the slave trades. As always, the core concern with this correlation is the non-random nature of the selection of the historic event. To better understand whether the relationship is causal, the authors instrument for slave exports using the historic distance from the coast of each individual's ethnic group, while controlling for each individual's current distance from the coast. The IV results confirm the OLS estimates. They also perform a number of falsification tests, the results of which suggest that the instrument's exclusion restrictions are likely satisfied.

The study then attempts to distinguish between the two most plausible channels through which the slave trade could have adversely affected trust. One channel is that the slave trade altered the cultural norms of the ethnic groups exposed to the trade, making them inherently less trusting. A second channel is that the slave trade resulted in a long-term deterioration of the legal and political institutions, and these weak institutions cause individuals to be less trusting of others. To distinguish between these two channels, the authors construct a second measure of slave exports, which is the average number of slaves that were taken from the geographic location that each individual is currently living in. This is different from the first measure, which is the average number of slaves taken from an individual's ethnic group.<sup>22</sup>

Identification between the two channels is based on the fact that when an individual relocates the individual's internal norms move with them, but the individual's external institutional en-

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<sup>22</sup>Both measures are averages over a given land area. Because the two variables are measured in the same units, if the individual lives in the same location as his ancestors the two variables will take on the same value.

vironment is left behind. In other words, institutions, which are external to the individual, are much more geographically fixed, relative to cultural beliefs which are internal to the individual. Therefore, if one accepts that the slave trade had a causal effect on trust, then the two variables can be used distinguish to which extent the slave trade affects trust through the culture channel and through the institutions channel. If the slave trade affects trust primarily through internalized norms and cultural beliefs, which are ethnically based and internal to the individuals, then when looking across individuals what should matter is whether their ancestors were heavily enslaved. If the slave trade affects trust primarily through its deterioration of domestic institutions, which are external to the individual and geographically immobile, then what should matter is whether the external environment the individual is living in was heavily affected by the slave trades.

The empirical results provide evidence consistent with the slave trades adversely affecting trust through both cultural norms and institutions, but the magnitude of the culture channel is approximately twice the magnitude of the institutions channel. This result is significant because it provides one of the first pieces of evidence attempting to quantifying the impact of a historic event through both its effect on institutions and on its effect on culture.

Although, there has been a recent surge in papers seeking to test whether norms of behavior are one channel through which history matters, the literature is still very young and still very far from developing a clear understanding about norms. For example, we still do not understand a number of very fundamental and important issues related to history, norms, and economic development. In what environments do norms be changed and when do they tend to persist? Which norms are more persistent and which are more prone to change? What is the relationship between norms and institutions? How do the two interact? Are they complements or substitutes?

#### **D. *Knowledge and Technology***

A number of studies have hypothesized that knowledge, education and technology may also be channels through which historic events have long-term impacts. Glaeser, La Porta, Lopez-De-Silanes, and Shleifer (2004) conjecture that part of the positive relationship between European settlement and economic growth documented by Acemoglu *et al.* (2001) may reflect the knowledge and “know how” brought by the settlers to the colony. Although their study is unable to provide causal evidence proving their hypothesis, it does highlight correlations in the data that are consistent with their view. Using OLS estimates the authors show that across countries, school

enrollment in 1900 is positively correlated with income in 2000, and that a country's initial settler mortality rate is strongly correlated with schooling in 1900. The authors also examine panel data over five year intervals between 1960 and 2000. They find a strong positive relationship between initial education and the subsequent five year change in democracy.<sup>23</sup> However, in a subsequent study, Acemoglu, Johnson, Robinson, and Yared (2005b) show that this result is driven by the worldwide increase in average education and democracy that has occurred between 1960 and 2000. Once one includes time period fixed effects, then the correlation disappears.

Evidence from other studies also provide evidence consistent with education being a channel through which historic events affect long-term development. A recent study by sociologist Robert Woodberry (2004) documents correlations between measures of the historic presence of missionaries and current per capita income and democracy across former non-settler colonies. Woodberry argues that the historical presence of missionaries, particularly protestant missionaries, resulted in a number of benefits for the native populations, such as increased education and a decrease in injustice and abuse by the colonizers. Because these abuses angered the indigenous populations, making missionary work more difficult, missionaries had an incentive to fight against these injustices. According to Woodberry, these consequences in turn served to promote democracy after independence.

As well, Huillery's (2008a) finding that in French West Africa differences in colonial investments in schooling can still be observed today also provides some evidence that consistent with a persistent impact of education. Similarly, Bolt and Bezemer (2008) also show that there is a positive correlation between colonial education levels and current income across African countries.

As Glaeser *et al.* (2004) acknowledge, their analysis (as well as the other studies cited here) are unable to prove the primacy of education as a fundamental factor affecting long-term development. The primary difficulty is establishing a causal link. Both the demand for and the supply of education are potentially endogenous to a large number of factors, including the quality of domestic institutions. Countries with better institutions also tend to have better governments that provide a higher level of public goods, including education. As well, countries with better institutions tend to have more secure property rights, which raises the returns to investments, including human capital investments. Therefore, when examining correlations between colonial

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<sup>23</sup>For additional evidence on the possible link between education and democratic institutions also see Glaeser, Ponzetto, and Shleifer (2006).

education and current economic development, it is possible that this correlation is being driven by other omitted factors.

Although these studies all focus on the transfer of education and knowledge from Europe to the colonies, historically, there was also knowledge transfer in the other direction. An example is the Columbian Exchange. A study by Nunn and Qian (2008) examines one part of this exchange: the introduction of the potato to the Old World from the New World. Their study estimates the impact of the new food technology on population growth and development in the Old World. The authors show that the potato was calorically and nutritionally superior to all Old World crops, such as wheat, barley, rye, and rice. Because of this, for the parts of the Old World that were able to adopt the potato, its diffusion from the New World resulted in a large positive shock to agricultural productivity. The authors use a difference-in-differences estimation strategy and compare the difference in population growth before introduction relative to the population growth after introduction between countries that were able to adopt potatoes and those that were not. A country's ability to adopt potatoes is measured using GIS based climate and soil data from the FAO. According to their estimates, the introduction of the potato had a very large positive impact on population growth, accounting for about a quarter of the observed increase in population after 1700. The authors also find that the introduction of the potato spurred economic development, which they measure by the urbanization rate, but that this effect is felt approximately 100 years after the increase in population growth.

The recent study by Comin, Easterly, and Gong (2007) provides a unique analysis of the possible historical persistence and importance of knowledge and technology. The authors document a positive relationship between historic technology levels (as far back as 1000BC) and current income per capita across different parts of the world. The authors interpret their findings using a model where the stock of existing technology decreases the cost of adopting new technologies, they show that if a society has a more advanced technology in the past, then because of lower costs to technology acquisition, this will increase its stock of technology and income today. Therefore, according to the model, past technology levels can have a direct causal impact on economic development today. However, other interpretations of their correlations are also possible. The most obvious is that the relationship between historic technology and current technology is being driven by some omitted factor, which tends to persist over time. Viewed in this light, their correlation is not at all surprisingly, especially given that previous studies have also documented a similar persistence in

economic and political performance over time. For example, Bockstette, Chanda, and Putterman (2002) empirically document a positive relationship between state antiquity and current economic performance. The persistence of technology may simply be another manifestation of the persistence of economic performance over long periods of time.

## 5. The Relationship between History and Geography

An alternative determinant of economic development which is often pitted against history is geography. Proponents of the geography view argue that unchanging fixed geographic factors, such as ecology, climate, natural endowments, and the disease environment, are the primary determinants of long-term economic development. This view has been emphasized by a number of studies that highlight strong statistical correlations between economic development and a variety of geographic characteristics, such as the climate (Kamarck, 1976), the disease environment (Sachs, Mellinger, and Gallup, 2001, Sachs and Malaney, 2002), natural openness (Rappaport and Sachs, 2003), and resource endowments (Sachs and Warner, 2001).

An example of the tension between the ‘geography matters’ and the ‘history matters’ views can be seen if we return to Acemoglu *et al.*’s (2001) examination of the effects of institutions on long-term growth.<sup>24</sup> In their study, because initial settler mortality is used as an instrument for domestic institutions to explain the causal effect of institutions on income, the exclusion restriction that must be satisfied is that initial settler mortality only affects current income through its historic effect on institutions. Jeffrey Sachs (2003), a proponent of the geography view, argues that the IV estimates are biased because there is a direct and persistent effect of geographic characteristics on income today. The argument is that areas that had high settler mortality during colonial rule continue to have deadly disease environments and this results in low income levels today. Therefore, initial settler mortality is correlated with income through a channel other than institutions and the exclusion restriction is not satisfied.

Acemoglu *et al.* (2001) clearly understand this concern and address it directly in their study. They argue that the primary diseases that killed Europeans were malaria and yellow fever, and that these diseases have a limited effect on indigenous populations that have developed immunities to the diseases. Because of native immunities, it is unlikely that European settler mortality rates are

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<sup>24</sup>This debate often takes the form of ‘geography matters’ versus ‘history matters’. See for example Rodrik, Subramanian, and Trebbi (2004).



highly correlated with the disease burdens faced by native populations either historically or today. The authors also show that their results remain robust to the inclusion of a host of controls that measure geographic characteristics and the local disease environment.

Another piece of evidence of the relative importance of history versus geography has been put forth by Acemoglu *et al.* (2002), who document that there has been a ‘reversal of fortunes’ among countries that were colonized. The countries that were the most prosperous in 1500 are the poorest countries today.<sup>25</sup> They argue that if geography is a fundamental determinant long-term economic development, then we would not expect this drastic change in the relative prosperity of countries over time.

Part of the reason for the debate lies in the fact that geography affects human actions in the past, and it affects human actions today. In other words, in addition to affecting income directly, geography also influences history which in turn affects income today. There are many examples where small and seemingly innocuous geographic differences become magnified through historic events and as a result end up having large impacts on long-term economic development. One example is the differences in soil and climate which made plantation agriculture and its reliance on slavery more or less profitable in different parts of the Americas (Engerman and Sokoloff, 1997, 2002). Even more dramatic examples of the effect of geography through history come from Jared Diamond’s (1997) book *Guns, Germs and Steel*. The book is devoted to exploring the answer to the question of why Europeans colonized the rest of the world and not the other way around. The proximate answer to this question is clear. It is because Europeans had superior technology, such as guns, swords, and ships. As well, they also brought with them germs with them that killed large numbers of native populations, particularly in the Americas and Australia. But why did Europeans have superior technology? And why did their germs kill native populations and not the other way around?

Diamond’s answer to the first question is that the Europe’s technological advantage, which stems from more complex specialized societies, arose because crops and animals were domesticated earlier and in more varieties than in other parts of the world. Among the nine locations that food production initially arose, the Fertile Crescent was the first and domesticated the most

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<sup>25</sup>Huillery (2008b) tests for a reversal of fortunes within districts of former French West Africa. She does not find any evidence of a reversal at this more micro level. Instead, she finds that Europeans tended to settle in the initially more prosperous parts of French West Africa and European settlement exerted a strong positive effect on long-term development.

species. Despite its name, the Fertile Crescent was not the most fertile region on earth. Instead, its advantage lied in its having the largest number of species of wild plants that were suitable for domestication. Similarly, the Fertile Crescent, and Eurasia more generally, also had the largest endowment of animals that could be domesticated.

The domestication of plants and animals quickly spread East and West throughout Eurasia, but diffused much less quickly South to the African continent. This is because when moving East or West, the length of the day does not change, and the climate is generally not drastically different. However, this is not true when moving North or South, where the length of the day changes and the climate typically is very different. More generally, for continents with a North-South orientation, such as the Americas or Africa, domestication or technological advance tended not to spread as quickly as in Eurasia with its East-West orientation. Because of the early domestication of animals in Eurasia, humans lived in close proximity to animals. As a result of this, new animal-based diseases, such as measles, tuberculosis, influenza, and smallpox, developed. Over time genetic resistances to the diseases were developed. The parts of the world without domesticated animals did not develop these diseases or a genetic resistance to the diseases. This explains why European diseases decimated native populations and not the other way around.

Overall, Diamond's explanation for Europe's global dominance illustrates clearly the large effects that geography can have through history. The historical origins of European colonization of the globe lies in two deep determinants: (i) being endowed with wild plants and animals suitable for domestication, and (ii) being located on a continents with an East-West orientation.

Although Diamond's analysis provides descriptive evidence showing that geography can have large impacts through history, it does not provide a quantitative assessment of the relative importance of the historic effect of geography relative to its direct contemporaneous effect on development.<sup>26</sup> A recent study by Nunn and Puga (2007) attempts to estimate the magnitude of these two channels for one geographic characteristic, terrain ruggedness, which is measured as the average absolute slope of a country's surface area. The study identifies two channels through which terrain ruggedness should matter for economic development. One is a direct contemporaneous effect of ruggedness on income. All else equal, on rugged terrain it is more difficult to build buildings, roads, bridges and other infrastructure; agriculture and irrigation is also more difficult; and trade

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<sup>26</sup>Olsson and Hibbs Jr. (2005) empirically tests Diamond (1997). Overall, their estimates provide strong support for his hypotheses.

is more costly. For these reasons, terrain ruggedness is expected to have a direct negative effect on income.

The study also identifies a historic effect of terrain ruggedness. During Africa's slave trade, societies were able to use rugged terrain to protect and hide from slave raiders and kidnappers. This allowed individuals, villages, and societies to partially defend against the negative effects of the slave trades documented in Nunn (2008a). Therefore, for the African continent which was exposed to the slave trade, ruggedness also had a historic indirect positive effect on income. Ruggedness allowed areas to escape from the slave trade, thereby increasing long-term economic growth. Exploiting the fact that the slave trade only affected Africa, Nunn and Puga are able to estimate the magnitude of both effects of ruggedness. They find that the indirect historic effect of ruggedness is consistently twice the magnitude of the direct contemporaneous effect of ruggedness, suggesting that for this geographic characteristics, the importance of geography through history swamps its importance today.

Overall, the body of evidence reviewed here suggests that the largest effects of geography on current economic development may work through its influence on past events rather than through its direct effect on economic outcomes today.

## 6. Conclusions

The empirical literature examining the relationship between history and current economic development has developed considerably in the past years. The main fact established by this literature is that history matters. A wide variety of papers have documented the important effects that certain historic events have had on long-term economic development. These studies range from Acemoglu *et al.*'s (2001) study showing that colonial rule affected the subsequent development of domestic institutions and economic development to Banerjee and Iyer's (2005) study that shows the importance of colonial land revenue systems within India to Nunn's (2008a) analysis showing that Africa's slave trade adversely affected subsequent development.

Although the literature has made considerable progress in showing that history matters, what remains less well understood are the exact channels of causality through which history matters. For most of the studies undertaken to date, their greatest shortcomings lie in their inability to precisely identify the exact mechanism or channel of causality. For example, Nunn's (2008a) study of Africa's slave trade documents the adverse long-term effects of the slave trade, but it is unable

to identify the precise channels and mechanisms at play. Similarly, Banerjee and Iyer's (2005) analysis is unable to pin down the precise channels through which the historical land revenue system in India, established by the British 150 years ago, continues to have an effect long after it was abolished. Even in Acemoglu *et al.*'s (2001) analysis, which identifies a broad cluster of institutions as the intervening mechanism, this broad cluster remains, by and large, a black box left to be unpacked. Although the follow-up paper by Acemoglu and Johnson (2004) takes initial steps in this direction, much remains to be done before this historic channel of causality is clearly understood.

The most recent studies that rely on micro-level data and analysis (e.g., Acemoglu *et al.*, 2008, Dell, 2008, Huillery, 2008a, Iyer, 2007, Nunn and Wantchekon, 2008) are beginning to identify finer causal factors and more precise mechanisms. However, since these studies rely on data at a much more micro level, the scope of their analysis is more limited. For example, it is difficult to know if the effects of the mita forced labor system convincingly identified by Dell (2008) are similar to the effects of other coercive labor systems in other parts of the world. For this reason, as studies becomes much more focused, evidence from complementary studies from other locations and times are also needed before one can assess whether specific results are part of broad systematic patterns that exist in the data or whether the results are specific to that environment. For this reason, although this literature has grown greatly in recent years, many more historic events and mechanisms left to be examined before we have a clear picture of the overall importance of historic events and the specific channels through which they continue to affect economic development today.

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## **The Long-Term Effects of Protestant Activities in China**

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## The Long-Term Effects of Protestant Activities in China\*

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Does culture, and in particular religion, exert an independent causal effect on long-term economic growth, or do culture and religion merely reflect the latter? We explore this issue by studying the case of Protestantism in China during the late nineteenth and early twentieth centuries. Combining county-level data on Protestant presence in 1920 and socioeconomic indicators in 2000, we find that the spread of Protestantism has generated significant positive effects in long-term economic growth, educational development, and health care outcomes. To better understand whether the relationship is causal, we exploit the fact that missionaries purposefully undertook disaster relief work to gain the trust of the local people. Thus, we use the frequency of historical disasters as an instrument for Protestant distribution. Our IV results confirm and enhance our OLS results. When we further investigate the transmission channels over the long historical period between 1920 and 2000, we find that although improvements in education and health care outcomes account for a sizable portion of the total effects of missionaries' past activities on today's economic outcomes, Protestant activities may have also contributed to long-term economic growth through other channels, such as through transformed social values. If so, then a significant amount of China's growth since 1978 is the result not just of sudden institutional changes but of human capital and social values acquired over a longer historical period.

Keywords: Protestantism, Economic Growth, Education, Health Care, China

JEL Classification Numbers: I25, N15, N35, O11, O43, Z12

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*The missionaries . . . have been among the pioneers of civilization.*

—William McKinley, 1900<sup>1</sup>

## 1. Introduction

One of the most contentious issues with respect to the effects of religion on economic growth is the role of Protestantism. Much of the debate has focused on whether the rise of Protestantism has had any causal effect on long-term economic growth in predominantly Christian nations. In *The Protestant Ethic and the Spirit of Capitalism*, Max Weber (2001) suggested that Reformed Protestantism, by promoting stronger societal preferences for hard work and thrift, has led to greater economic prosperity in Western societies. Recent empirical studies of the role of Protestantism in the economic growth of the Western world have found mixed results. Cantoni (2013) argues that Protestantism had no effect on economic growth for 272 cities in the Holy Roman Empire during the period between 1300 and 1900. Meanwhile, other studies find significant positive effects and have identified a few mechanisms through which religion may have contributed to economic growth. Some of these studies echo Weber's and suggest that religious beliefs may have fostered certain moral codes or social values that are conducive to economic growth (Stulz and Williamson, 2003; Barro and McCleary, 2003; McCleary and Barro, 2006a, 2006b; Arruñada, 2010). But other studies emphasize that it is not religious practices per se but rather by-products that accompanied these practices (e.g., the accumulation of human capital that may result from reading the Bible) that have contributed to economic growth (Glaeser and Sacerdote, 2008; Becker and Woessmann, 2009).

An equally interesting question revolves around how the expansion of Protestantism has affected economic growth in peripheral nations and, more specifically, in non-Christian societies. Throughout their history, Christian missionaries have attempted to transplant Protestantism—together with Western science, technology, culture, and institutions—into peripheral nations, many of which have had long-established indigenous religions, cultures, and institutions of their own. Despite countless clashes and compromises, Protestantism has deeply transformed some of these societies and generated persistent, significant impacts to their economic growth.

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<sup>1</sup> The U.S. president addressed the Ecumenical Missionary Conference at Carnegie Music Hall in New York City on April 21, 1900.

Yet the prospect of conducting an empirical examination of the effects of Protestantism on long-term economic growth in peripheral nations can be daunting because of the scarcity of within-country data on nations that are suitable for such study.<sup>2</sup> Consequently, scholars conduct cross-country studies to examine the effects of religion on economic growth in both Western and peripheral nations. These cross-country studies are illuminating. They are also fraught with questions of causality, however, as the effects of religion are often inextricably related to other factors that have been shown to contribute to economic prosperity, such as geography and the establishment of formal and informal institutions, which vary from one country to another. Identifying the internal mechanisms of the correlations between religion and economic growth in these studies thus remains a somewhat murky proposition.

Even when within-country data are available, establishing causality between Protestantism and long-term economic growth is difficult because of the issue of endogeneity. It is possible, for example, that more developed regions attracted more Protestant activity in the past, and that they continue to perform better in the present. A few existing studies use the instrumental variable method to tackle this problem. In their study of nineteenth-century Prussia, Becker and Woessmann (2009) use distance to Wittenberg—the city in which the Reformation originated—as an exogenous predictor of Protestantism.<sup>3</sup> However, this identification strategy is hard to adapt for use in peripheral nations. Protestantism was transplanted to these countries, usually through easily accessible places such as seaports. The locations at which Protestantism initially emerged frequently coincide with economic centers, thus making the distances to these locations invalid instruments for studying the causal effects of Protestantism on long-term economic growth. Therefore, the issue remains an enigma, and resolving it is important for, as we shall see, its resolution helps explain China’s rapid growth since 1978 and the enormous variation in contemporary income levels across China.

In this study, we assemble historical and contemporary data to investigate whether the spread of Protestantism in the late nineteenth and early twentieth centuries had a persistent impact on China’s recent economic growth, educational development, and health care outcomes and, if it did, what mechanisms were involved. To our knowledge, this paper provides the first empirical evidence for the long-term effects of religious activities on socioeconomic outcomes in

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<sup>2</sup> Bai and Kung (2012) explore the within-China variations to examine the effects of Christianity’s spread on educational development in different Chinese counties in the early twentieth century.

<sup>3</sup> This identification is adopted by Cantoni (2013), as well.

China today.

Studying the long-term effects of Protestantism in China is valuable for two reasons. First, China provides an ideal setting for studying within-country variations in religious activities and socioeconomic development. Throughout its history, China has been a large country with a relatively homogeneous culture and a uniform political system, yet its socioeconomic development has been quite heterogeneous. The Chinese setting thus provides variations large enough to conduct clean empirical tests and thereby examine the role of religion on long-term socioeconomic development. Second, the transplantation of Protestantism to a vast peripheral nation such as China has been, to some extent, a quasi-natural experiment. Chinese culture was dominated by Confucianism for thousands of years. Christianity was prohibited until late in the nineteenth century, when China was defeated by Western powers and forced to open its doors to foreign trade and influences. Thereafter, foreign missionaries self-selected to go to different Chinese counties and evangelize Chinese people. Yet missionary activities turn out to have constituted a largely external and exogenous intervention, both in China's economy and in its society. This feature allows us to examine the long-lasting effects of a sudden and exogenous historical event on socioeconomic development eighty years later. In this regard, our research contributes to a large body of literature on the effects of historical events on current economic developments that includes the works of Acemoglu, Johnson, and Robinson (2001, 2005), Nunn (2008), and Dell (2010).

In this paper, we marshal county-level data on the numbers of Protestant converts, missionaries, and churches in 1920 from original historical survey materials, and then match these data with county-level data on developments in the economy, education, and health care outcomes in 2000. Our OLS results show that diverse socioeconomic developments across counties in 2000 are positively correlated with the intensity of Protestant presence 80 years ago.

By themselves, however, these correlations do not prove that Protestantism caused China's subsequent socioeconomic development; they may simply reflect it. It might be possible that more developed counties attracted more Protestant activities in the past, and that they continue to perform better at present. We tackle the endogeneity issue in three ways. First, we investigate the historical record, which suggests missionaries were usually more inclined to go to less developed areas. Second, we proxy historical economic prosperity by population density and land tax

revenues of Chinese counties, and we find no positive correlation between historical economic prosperity and Protestant presence. Third, in light of the fact that missionaries purposefully undertook disaster relief work to gain the trust of Chinese people, we use the frequency of severe droughts and floods in the early twentieth century as the instrument for the intensity of Protestant presence across counties. Our IV coefficients are positive and significant, suggesting that more Protestant activities in 1920 produced better economic, educational, and health care outcomes in 2000.

We then investigate the precise channels through which the impacts of Protestant activities in 1920 have survived China's political turbulence and managed to persist into the present. Our investigations of historical facts and our empirical tests suggest that a greater Protestant presence results in better education and health care outcomes in 1920, and that these effects persisted into the present and contributed to economic growth in 2000. While proselytizing in remote inland counties, missionaries also worked to help local people build modern educational and health systems and to diffuse Western science and technologies. Such efforts accelerated modernization in many Chinese counties, contributed to the accumulation of human capital, and reshaped the social values of local people. The transformation of Chinese society was permanent. Although missionary work was suppressed during the Cultural Revolution in the 1960s and 1970s, Protestantism rapidly resurged at the end of the 1970s when China began to open up and reform. In this market-oriented environment, the human capital and social values that had been transformed by historical Protestant activities began to contribute substantially to improvements in education and health care outcomes. Our further empirical tests corroborate that while education and health care outcomes have accounted for a significant part of the effects of Protestantism on economic development in 2000, missionaries' undertakings have also affected economic outcomes through other channels. This finding is not surprising. Historical Protestant activities have affected Chinese society in very complex ways. Many of those effects are difficult to quantify, but they might have played an indispensable role in enhancing long-term economic growth, such as by transforming social values and work ethics.

If we are correct, our conclusions have important implications for understanding China's spurt of economic growth since 1978. This growth, the so-called Chinese miracle, is usually attributed entirely to the Reform and Open-up, a series of radical institutional changes that began in the late 1970s. Our findings imply that (1) China's Reform and Open-up was to a large extent



a continuation of a modernization movement that started in the mid-nineteenth century but was disrupted by wars and political turbulence, and (2) Protestant missionaries pioneered that modernization movement by introducing Western-style education, health care, science, technology, and social values to China. Missionaries disseminated Western science, technology, and social values to even the most remote parts of China, and they fostered the accumulation of certain types of human capital that have been conducive to modern economic growth. The historical legacies of human capital and social values that were acquired from missionaries' undertakings almost a century ago continue to promote radical institutional changes and rapid economic growth at the present time. Therefore, we concur with Brandt, Ma, and Rawski (2013) when they attribute "China's recent economic success to a combination of beneficial historic legacies, recent accumulations of capital, skill, and policy expertise, and important economic and political changes that facilitated the realization of old and new potentials."

In the next section, we provide some historical background on the spread of Protestantism during the late nineteenth and early twentieth centuries. Section 3 describes the data we use to study the long-term effects of Protestantism. Section 4 establishes the causal relationship between historical Protestantism and contemporary economic development. Section 5 explores the causal effects of Protestantism on educational development, both historically and currently. Section 6 explores the causal effects of Protestantism on medical development, both historically and at present. Section 7 examines the channels through which historical Protestantism has contributed to contemporary economic growth, such as through improved education and health care outcomes or through transformed social values and work ethics. The final section discusses the implications of our findings.

## **2. Historical Background**

Christianity has never been a major religion in China, a Confucianism-dominated country. It began to spread in China as early as in the seventeenth century. In 1704, Pope Clement XI forbade Chinese Christians to engage in Confucius-related activities. This outraged Emperor Kangxi, who consequently banned all Christian practices in 1720. This ban was upheld by successive emperors. In the early nineteenth century, trade between Europe and China reached a historically high record, and Christian missionaries renewed their efforts to penetrate China. As Christian activities continued to be banned by the Qing court, however, the Christian presence

remained negligible until the 1840s.

China was forced to open its doors to Western powers when in 1842 it was defeated by Britain in the First Opium War. As a result, missionaries and other foreigners were allowed to take residence in China. After the Second Opium War and another defeat in 1860, the Qing government signed the *Convention of Peking*, which granted freedom of religion in China and allowed missionaries to own land and build churches. This led to a rapid expansion of Protestantism throughout China. In 1860 there were 198 foreign Protestant missionaries and 2,000 converts; those numbers increased to 473 and 13,035 respectively by 1876. By the end of the nineteenth century, there were 1,500 missionaries and more than 80,000 Protestant converts (Wang, 1991). The first two decades of the twentieth century witnessed the fastest expansion of Christianity in Chinese history. In 1905 3,445 foreign Protestant missionaries arrived in China, more than double the number that had arrived in 1900. This number climbed to 8,000 in 1927. There were 130,000 Protestant converts in 1904, and this number soared to 402,539 in 1922. By 1920 there were more than 120 Protestant denominations in China, and church activities had penetrated nearly 70% of Chinese counties (Wang, 1991). Roman Catholicism also enjoyed a rapid expansion during the same period.

Christianity's expansion throughout China was a far from smooth process. On the contrary, it generated a great deal of mistrust and hostility between foreign missionaries and local Chinese residents. Mistrust and hostility led to frequent—and increasingly violent—confrontations, culminating in the Boxer Rebellion in 1900. More than 20,000 Christians were killed and three-quarters of churches were destroyed in this tragic xenophobic conflict.

Frequent and serious conflicts that accompanied the diffusion of Christianity compelled missionaries to reflect on the deep reasons behind these conflicts. Learning from the conflicts of the late nineteenth century, in particular the Boxer Rebellion, many Christian organizations came to realize that the hostility with which many Chinese regarded Christianity was a response to condescending missionaries who all too often refused to respect local cultures. For example, missionaries forbade ancestor worship among their Chinese converts, and missionaries' egalitarian beliefs clashed with Chinese society's entrenched hierarchical traditions. As a result, a growing number of missionaries began to seek new strategies for building trust and promoting mutual understanding.

China is a nation that is frequently afflicted by natural disasters. Over its long history of coping with disasters, the Chinese government developed a set of sophisticated relief mechanisms. However, when the central empire began to collapse in the late nineteenth century, those mechanisms gradually fell into disarray. Noticing the absence of government support, many missionaries actively engaged in disaster relief work and purposefully sought to build trust and diffuse Christianity through those efforts. Timothy Richard, for example, explicitly stated that disaster relief was “an ideal way to reduce prejudices and prepare the ways for the Chinese to accept Christianity” (Gu, 2010), and “the Chinese might not receive written evidences of the truth of Christianity, but help rendered to them in distress would afford unanswerable evidence of the motives of religion” (Richard, 1916, p125). While engaged in relief work in 1877, Presbyterian missionary Arthur Smith reported to his superiors, “It seems to me the grandest opportunity in all the history of China to demonstrate the spirit of our religion. We can show that Christianity teaches us to love our neighbors as ourselves and to recognize all men as brethren” (Eshrick, 1987, p78). Another American missionary, John L. Nevius, concurred: “The people in the famine region were very appreciative and grateful, and I believe this work will have a strong influence in removing prejudices and preparing the way for the reception of Christianity” (Nevius, 1895, p329).

Protestant missionaries’ organized disaster relief efforts began in the late 1870s, in the wake of the most severe famine in modern Chinese history. Between 1876 and 1879, a catastrophic drought hit Shandong and five other provinces in North China, and the resulting famine killed over ten million people. Missionaries who had been stationed all over China responded, gathering in disaster-stricken areas to help people in need. In 1877 Protestant missionaries set up an aid agency, the Shandong Disaster Relief Commission, to coordinate their relief work. By 1879 the commission had raised over 200,000 silver taels (US\$300,000) and had eased the suffering of millions of Chinese people (Gu, 2004, p289). Since then, missionaries have provided emergency humanitarian responses to almost all of China’s large disasters. When another severe drought hit Shandong Province in 1888, the English Baptist Mission and the American Presbyterian Church worked together to raise over 300,000 silver taels (US\$450,000) and help over 300,000 drought-affected people (North China Famine Relief Committee, 1889, p25). Missionaries became even more active and organized during the disasters of the early twentieth century, such as the 1906 north Jiangsu flood, the 1910–1912 Anhui flood, and the 1917–1918

Zhejiang drought. When North China was struck by severe drought yet again in 1920, missionaries established the China International Famine Relief Commission, a nationwide organization that coordinated international disaster relief efforts and raised over 20 million U.S. dollars (Gu, 2004, p294).

Lacking both modern medical knowledge and a functioning public health system, thousands of people were decimated by cholera, plague, and other epidemics that accompanied China's natural disasters. Missionaries responded by trying to control disease and save life, putting forth great efforts to establish hospitals and public health systems in the afflicted regions. As Christian missionaries became more deeply engaged in local communities and in their disaster relief work, they reported that while many government officials and gentry elites were experts in Confucian classics, they were largely ignorant of modern science and technology. This institutional ignorance impeded effective disaster relief efforts. As a result, the missionaries worked even harder to persuade the Chinese government to improve its educational system. Moreover, many missionaries put into practice the idea of education reform and established elementary schools, middle schools, and even universities throughout China. Many of these Christian schools soon became exemplary models that secular schools learned from. These educational achievements increased the human capital of the local people and may also have changed their social values, such as their work ethic and their attitudes toward Western culture.

Christianity reverted to its previous, unwelcome status when the People's Republic of China was established in 1949. The central government regarded missionaries as a form of "Western imperialism."<sup>4</sup> Consequently, it established a set of state-endorsed religious organizations and severed all connections with foreign denominations. By 1952, all foreign missionaries had been ordered to leave China. During the Cultural Revolution (1966–1976) all religious activities, including those of the government-regulated churches, were prohibited. Christian schools and hospitals were taken over by the government. Yet many of these schools continued to function much as they had under missionary control, training large numbers of students and persistently contributing to local economic development. Similarly, most of the formerly Christian hospitals continued to benefit local communities as they had in the past. Furthermore, the missionaries' endeavors before 1949 had so thoroughly promoted consciousness of education and public health

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<sup>4</sup> This point was stressed many times by former Chinese Premier Zhou Enlai in meetings with Chinese Christian leaders.

among Chinese people that they permanently transformed Chinese society. Such effects were suppressed but not exterminated during the Cultural Revolution. When Christianity was legalized in China during the Reform and Open-up in 1978, the suppressed effects of Protestantism revived rapidly and began to persistently contribute to improvements in economic growth, education, and health care outcomes. These improvements, coupled with other complex long-lasting effects of Protestantism such as changed social values and work ethics, generated a significant boost to economic growth—particularly in counties with a history of more intense Protestant activity.

### **3. Data**

To examine the impact of Protestant activities on long-term socioeconomic development, we assemble three county-level data sets: Protestant activities and socioeconomic conditions in 1920, socioeconomic conditions in 2000, and the geophysical conditions of all counties in our data set. Our examination is complicated, however, by the geopolitical reality that many of those counties' borders have changed over time. Therefore, we address the issue of changing borders by using GIS methods to match historical data with contemporary data. This section explains those details.

#### **3.1 Historical Data**

Our data of Protestant activities in China in 1920 are obtained from a statistical report that was compiled and published by the China Continuation Committee, the central organization of Protestant churches in China at the time. One of the committee's main tasks was to coordinate and promote more effective evangelization in China. For that purpose, beginning in 1918, the China Continuation Committee conducted a three-year county-level survey on the status of Protestant activities in China. The committee published its results in a statistical report entitled *The Christian Occupation of China: A General Survey of the Numerical Strength and Geographical Distribution of the Christian Forces in China (COC)*. The *COC* reports on various measures of Protestant activities such as numbers of Protestant missionaries, converts, churches, schools, and hospitals in Chinese counties. It also collects and publishes other important socioeconomic information, such as political orientation, population, and educational attainment, obtained from county gazetteers and various local government surveys. The China Continuation Committee strove to ensure the quality of its survey data in order to deliver reliable and objective

descriptions of the extent of Protestant influence in Chinese counties. Therefore, the *COC* is generally accepted as a good source of information for studying the socioeconomic conditions in Chinese counties in the early twentieth century.

[Table 1 about here]

In this paper, we measure the intensity of Protestant activities in each county by three indicators: the numbers of Protestant converts, churches, and missionaries for every 1,000 people. The summary statistics are reported in Table 1. On average there were 0.74 converts, 0.016 churches, and 0.024 missionaries per 1,000 people in each Chinese county in 1920. Figure 1 shows the density of Protestant converts across counties in our sample. Darker shading indicates counties with higher densities of Protestant converts. Although many coastal counties had a high density of Protestant converts, the figure also depicts an active Protestant presence in a number of inland counties. Therefore, our data suggest that the different intensity levels of Protestant activities were not simply driven by the distances of these counties to the coastline.

[Figure 1 about here]

### **3.2 Contemporary Data**

To study the long-term impacts of Protestant activities, we assemble contemporary socioeconomic indicators of Chinese counties. We obtained county-level data on economic development and local government budgets in 2000, including aggregate GDP, GDP by sector, infrastructure expenditures, and government subsidies, from the *Statistical Materials of Public Finance of Cities and Counties*; maps of and information on primary and secondary highways in 2000 from the China Data Center at the University of Michigan; and data on population, mortality rates, and years of schooling from the Fifth National Population Census (2000). Our main dependent variable is GDP per capita in 2000, with a mean of 5,584 *yuan* (about 800 U.S. dollars). Figure 2 reports the GDP per capita of all the counties in our data set, and each region on the map represents a county; the darker the shading, the higher the county's GDP per capita. Similar to Figure 1, it is evident that not all rich counties are coastal ones. Quite a number of inland counties also have high GDP per capita.

[Figure 2 about here]

### 3.3 Climate Data

Our historical climate data are drawn from the *Distribution Gallery of Droughts and Floods in the Past Five Hundred Years of China*, which was compiled by the Institute of Synoptic Meteorology and Climatology under the administration of the China Meteorological Administration (CMA). The original sources of historical climate data are county gazetteers and official archives. Combining historical and contemporary climate data, this gallery allows us to build a data set of droughts and floods for 120 meteorological stations from 1470 to 2000. For each year, the gallery uses a five-point scale to assign a Drought/Flood Index (DF-index) number that categorizes the local disaster status at each station: 1, severe flood; 2, light flood; 3, moderate conditions; 4, light drought; and 5, severe drought.<sup>5</sup> The CMA's data set has been widely used in previous studies, and its consistency and reliability have been carefully examined and confirmed by a number of meteorologists (e.g., Yao, 1982; Ronberg and Wang, 1987, Zhang and Crowley, 1989).

In our study, we count the frequency of serious droughts and floods (DF-index=1 or 5) over our sample periods and use this total as a measure of disaster frequency. To convert station-level information into county-level variables, we use a conventional approach called the inverse-distance-weighted (IDW) method. The IDW method assumes that a county's climate is an average of the climates at all nearby stations, weighted by the distances between the county and the nearby stations (see the Appendix for further details on how the climate data were calculated). For one of the periods on which our paper focuses, 1880–1920, the frequency of serious droughts and floods among our sampled counties is 0.19 per year on average.

### 3.4 Geophysical Data

Our study makes use of county GIS data in 2000 (including longitudes, latitudes, and surface areas) obtained from the Australian Consortium for the Asian Spatial Information and Analysis Network Data Center at Griffith University in Brisbane, Australia, and SRTM 90m digital elevation data on average county altitudes obtained from the CGIAR Consortium for Spatial Information (Jarvis et al., 2008). We calculate distances between the coordinates of different locations by using the haversine formula, which takes into account the curvature of the

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<sup>5</sup> See Zhang and Crowley (1989) for a detailed description of this method of categorization.

earth.<sup>6</sup>

In our multivariate analyses, we also control for county-level geophysical characteristics by drawing from the Surface Meteorological Database, which was constructed by the CMA. The database contains annual precipitation and average temperatures for 754 meteorological stations between 1990 and 2000. As with our climate data, we use the IDW method to convert station-level variables to the county level.

### 3.5 County Matching

One of the challenges our study faced was the long historical period over which political regimes changed and the territorial borders of many counties shifted. We address this challenge by first comparing the GIS data for both 1920 and 2000 and then converting county-level variables in 1920 to those in 2000 using overlapping area as weights. To achieve those ends, we obtain historical GIS data from the China Historical Geographic Information System (CHGIS) project.<sup>7</sup> Then we construct a data set that combines historical Christian intensity data, historical and contemporary climate data, contemporary socioeconomic data, and geophysical data for 1,743 counties in China proper.

## 4. The Long-term Economic Effects of Protestantism

In this section we study the long-term economic effects of Protestant activities that took place in 1920. We use county-level GDP per capita in 2000 as the indicator of contemporary economic development. We begin our study with a correlation analysis. Then we use both historical evidence and the instrumental variable method to establish the causal effects of Protestantism on long-term economic development. We also scrutinize our results with instrument validity tests and robustness checks.

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<sup>6</sup> The haversine formula is used to calculate the spherical distance between any two points (Sinnott, 1984):

$$dist_{A-B} = 6371.004 \cdot 2 \cdot \sqrt{\sin^2\left(\frac{(A_{long} - B_{long}) \cdot \pi}{180}\right) + \cos(A_{long} \cdot \frac{\pi}{180}) \cdot \cos(B_{long} \cdot \frac{\pi}{180}) \cdot \sin^2\left(\frac{(A_{lat} - B_{lat}) \cdot \pi}{180}\right)}$$

where  $\pi = \pi/180$  and  $X_{long}$  and  $X_{lat}$  stand for longitude and latitude of point  $X$ , respectively.

<sup>7</sup> The historical county-level GIS data can be downloaded at <http://www.fas.harvard.edu/~chgis/>.



#### 4.1 Baseline Correlations

Figure 3 shows the correlation between log of converts per 1,000 people in 1920<sup>8</sup> and log per capita GDP in 2000 for all these counties. It is evident that the two variables have a strong positive correlation.

[Figure 3 about here]

We further examine this relationship with OLS regressions controlling for other county-level characteristics. The baseline specification is given by

$$\ln(\text{pcGDP}_i) = \alpha + \beta \cdot \ln(\text{Converts/Pop1920}_i) + \mathbf{X}_i' \cdot \boldsymbol{\gamma} + \varepsilon_i, \quad (1)$$

where  $\ln(\text{pcGDP}_i)$  is the natural log of GDP per capita in county  $i$  in 2000;  $\ln(\text{Converts/Pop1920}_i)$  is the natural log of Protestant converts per 1,000 people in 1920;  $\mathbf{X}_i$  is a vector of control variables including county locations, climates, and other geophysical characteristics; and  $\varepsilon_i$  is the error term.

Table 2 reports the results. Column 1 reports the estimate of  $\beta$  without control variable  $\mathbf{X}_i$ . This result reflects the relationship shown in Figure 3. Column 2 includes a set of regional fixed effects.<sup>9</sup> While the magnitude of the marginal effect is reduced, the coefficient of Protestant convert density remains positive and significant at the 1% level. We further control for a set of county geophysical variables, including longitudes, latitudes, and distances to provincial capitals (column 3), altitudes (column 4), and a set of climate variables such as precipitation and temperature (column 5). Table 2 shows that the coefficients of the convert densities remain significantly positive.

[Table 2 about here]

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<sup>8</sup> For counties with zero converts (272 such counties in our data), natural logs are not defined. For these counties, we use  $\ln(1/\text{Pop1920}_i)$ , pretending that they each had one convert. We also use alternative methods for dealing with the logarithmic transformation of the zeros, including (1) assuming  $\text{Converts/Pop1920}_i = 0.001$  for zero-convert counties (choosing 0.001 because it is the lowest value for  $\text{Converts/Pop1920}_i$  among the non-zero sample), and (2) excluding the zero-convert counties from our analyses. The main results remain robust.

<sup>9</sup> We follow the conventional method and divide China proper into seven regions: North China includes Beijing, Tianjin, Hebei, and Shanxi; East China includes Shanghai, Jiangsu, Zhejiang, Shandong, and Anhui; Northeast China includes Liaoning, Jinlin, and Heilongjiang; Middle China includes Hubei, Hunan, Henan, and Jiangxi; Southern China includes Guangdong, Guangxi, Hainan, and Fujian. Southwest China includes Sichuan, Chongqing, Guizhou, and Yunnan. Northwest China includes Shanxi, Gansu, Xinjiang, Qinghai, and Ningxia.

## 4.2 Establishing Causality: Instrumental Variables Results

The positive correlation between the density of Protestant converts in 1920 and contemporary economic outcomes in 2000 reported in Table 2 does not guarantee a causal relationship. One major concern for causality is that selection of counties for evangelization in 1920 was not random. It is possible that missionaries preferred to serve in richer counties in 1920, and that these counties remain more affluent today. In this subsection we study the location choices of Protestant evangelization prior to 1920 from a few different perspectives.

First, historical records indicate that a large number of missionaries actively worked in the less developed inland regions of China, and that many of them actually preferred to work in those regions. The British missionary Hudson Taylor believed that people in poor and remote regions were more likely to respond to God's call during times of hardship (Wang, 1997). Taylor founded the China Inland Mission (CIM) in 1865 and aimed to serve all of China's provinces. For that purpose, the CIM sent many groups of missionaries to serve in less developed regions such as Shanxi (since 1876), Sichuan (since 1877), Guizhou (since 1877), and Yunnan (since 1877) (Broomhall, 1901). As other missionaries came to share similar views and volunteered to work in poor and isolated counties, the CIM became China's largest Protestant denomination by the early twentieth century. More than 1,000 missionaries joined the CIM and spread the Gospel to remote villages. Other denominations followed the CIM's lead, and together they left a lasting influence on almost every part of this big country.

An empirical examination of whether missionaries were more active in less developed counties (and, conversely, less active in more developed counties) requires the economic indicators of those counties in 1920. Because direct measures of county-level economic development in 1920 are unavailable, we use two proxies for historical economic conditions: population density and per capita land tax revenue. Population density is a commonly used (if arguably crude) proxy for historical economic prosperity.<sup>10</sup> Per capita land tax revenue can also largely reflect local economic conditions.<sup>11</sup> Since both of these measures are relatively crude, we should consider the results here merely suggestive. Figure 4 plots these two measures against the

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<sup>10</sup> See Acemoglu, Johnson, and Robinson (2002) for example. The data on county-level population density are also obtained from the *COC*.

<sup>11</sup> Prefecture-level land tax data in 1820 were obtained from Liang (2008). Land taxes during the Qing dynasty were calculated based on the size and quality of arable lands multiplied by a fixed tax rate. After normalized by population, land tax revenues reflect the development of local agriculture sector, which to a large extent indicates the overall economic conditions in a traditional society.

numbers of churches and missionaries per 1,000 people for Chinese counties in 1920.<sup>12</sup> All of the panels show significant negative correlations, suggesting higher Protestant presence in less developed regions. Given this evidence, it is unlikely that the observed positive relationship between Protestant densities and current economic growth is completely driven by selection. In fact, selection tends to bias the OLS results toward zero.

[Figure 4 about here]

In order to rigorously establish the causality between historical Protestant activities and contemporary economic growth, we use the instrumental variable method. As described in Section II, starting in the late 1870s, Protestant organizations purposefully undertook disaster relief work to gain the trust of Chinese people. In light of this fact, we construct the county-level frequency of severe droughts and floods between 1880 and 1920 (DF index = 1 or 5) and use it as the instrument for Protestant densities. The results are reported in Table 3.

[Table 3 about here]

Panel B of Table 3 presents the first-stage results. It includes the same set of specifications as in Table 2. The coefficients on disaster frequencies are significantly positive, indicating higher densities of Protestant activities in the counties that experienced the most disasters. The F-statistics of the instrumental variable, which are higher than the critical value suggested by Stock and Yogo (2005), rule out weak instrument concern.

We report our second-stage regression results in Panel A. Instrumented by disaster frequencies from 1880 to 1920, the coefficients on  $\ln(\text{Converts}/\text{Pop}1920)$  remain significantly positive for all columns and vary around 0.15. These results are significant not only statistically but also economically. Take column 5 with the full set of controls as an example. The coefficient reveals that a 1 standard deviation increase in convert density leads to a 0.42 standard deviation increase in GDP per capita, or 1,892 *yuan*. This amounts to a 34% increase in income per person for our sampled counties. Moreover, the 2SLS estimates of  $\beta$  in Table 3 are significantly higher than the OLS estimates in Table 2, which confirms the underestimation of impacts of historical Protestant activities in our OLS regressions.<sup>13</sup>

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<sup>12</sup> Here we use the number of missionaries and the number of churches in each county to capture missionaries' location choices before 1920. As a robustness check, we also use the number of converts and find similar results.

<sup>13</sup> In an unreported regression, we regress convert population density in 1920 on disaster frequencies (DF index = 1 or 5) in

### 4.3 Validity of the Instrument

The validity of our 2SLS results in Table 3 rests on the assumption that historical disasters only affect current economic growth through the channel of past Protestant missionary activities. In this subsection we further substantiate this assumption by directly controlling for other factors that could plausibly be correlated with both historical missionary activities and current economic outcomes. We consider five such factors and report the results in Table 4. Column 1 of Table 4 reports the results without additional controls, which are copied from Column 5 of Table 3. Other columns in Table 4 report the results of various validity checks. It is evident that these results are quite robust.

[Table 4 about here]

First, we consider the possibility of China's climate exhibiting persistent regional patterns (Man, 2009). If past and present disasters were correlated, historical disasters would adversely affect today's economic outcomes directly and would, in turn, jeopardize the validity of our IV results. We find this channel unlikely. The correlations between disasters in different periods are weak in our data set when the two periods are reasonably far apart. In particular, the correlation coefficient of severe disasters between 1880–1920 and 1980–2000 is only 0.06. Therefore, as reported in column 2 of Table 4, the effect of historical Protestant activities remains almost unchanged when we control for recent disaster frequencies.<sup>14</sup>

Second, we consider whether a county's proximity to waterways could jeopardize the exclusivity of our instrumental variable. Although counties with major waterways within their borders are more likely to experience flooding, access to navigable waterways provides decided advantages in developing industry and commerce and contributing to economic growth. To address this concern, we create a variable indicating whether a county has a major river passing through it.<sup>15</sup> As shown in column 3, counties with rivers passing through them are 10% richer than other counties. Nevertheless, controlling this river dummy does not affect our estimate of the coefficient on Protestant densities at all.

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different periods simultaneously, including 1840–1880, 1880–1920, 1920–1940, and 1980–2000. Only the coefficient on period 1880–1920 appears to be positively significant. Coefficients on the other periods are both small in magnitude and insignificant.

<sup>14</sup> We should also keep in mind that, different from 100 years ago, the Chinese economy today relies more on manufacturing and is thus less vulnerable to weather shocks. In addition, with new technologies in communication, transportation, and weather forecasting, the impacts of extreme weather on economic outcome today are much smaller.

<sup>15</sup> Major rivers include the longest 40 rivers in China.

Third, we consider infrastructure. Frequent disasters may induce local societies to put more emphasis on infrastructure construction, which may benefit long-term economic growth. We use two variables to proxy local infrastructure conditions: road density in column 4 and local government expenditures on infrastructure in column 5. Once again, our estimates remain robust even after we control for local infrastructure conditions.

Fourth, we consider whether disaster-prone regions might shift toward industrially oriented development strategies and away from agriculture. In order to test this hypothesis, in column 6 we add in the share of agricultural sector in each country's GDP in 2000. Again, the result barely changes.

Fifth, we consider the possibility that the central government provides more subsidies to disaster-prone regions. This might be another reason frequent drought- and flood-prone counties can enjoy certain advantages in economic development. To rule out this possibility, we include subsidies (normalized by population) obtained by each county in column 7, and again we find the estimate unaffected.

In column 8, we simultaneously control all the additional variables from columns 2 through 7. We find that our results remain robust.

As another check of our instrumental variable, we separate our disaster instrument into two measures, severe flood (DF index = 1) and severe drought (DF index = 5). One advantage of this specification is that we now have more instruments than the endogenous variable so that the over-identification test is feasible. Column 8 shows that the result is unchanged. Based on the p-value of the Sargan statistics reported in Panel A, our specification passes the over-identification restriction at conventional statistical levels.

#### **4.4 Robustness Checks**

In Table 5 we conduct a number of robustness checks for our estimates. Column 1 of Table 5 shows the result of our baseline specification in column 5 of Table 3.

[Table 5 about here]

In column 2 we add historical land tax revenues (normalized by population) to control for

historical economic heterogeneities across counties.<sup>16</sup> The effect of Protestant activities becomes slightly larger than the result in the main specification in column 1. This increase is reasonable, given the selection bias we discussed in Subsection 4.2.

Before 1920, China's coastal counties were more easily accessible than its inland counties. Today, those coastal regions may enjoy more preferred economic policies. Therefore, one might wonder whether the observed long-term effects of Protestant activities are driven by coastal factors. In our study, we partially address this issue by controlling county longitudes. In column 3 we consolidate the results by adding an indicator of whether a county is in a coastal province. As expected, the coefficient of the coastal dummy is positive, large, and significant.<sup>17</sup> However, including this control reduces the coefficient of Protestant activities by only 0.02.

One might also worry that our results are merely driven by urban-rural differences. Like coastal regions, cities are easier to access and may enjoy preferable economic policies. Therefore, we have to consider whether urbanization could be positively correlated with both past Protestant activities and present economic growth. In column 4 we add a control variable indicating whether a county is urban. Our estimations are barely changed.

Catholic missionaries were also quite active in China during the period we study. However, reliable and detailed data on Catholic activities are simply unavailable. As a result, we focus on the effects of Protestantism instead of Catholicism in this paper. Nevertheless, as a robustness check, we include the number of prefecture-level Catholics mission stations per 1,000 people as a control variable to rule out the possible effects of Catholic activities.<sup>18</sup> The results are reported in column 5 of Table 5. The coefficient on the Protestant converts is reduced but remains positively significant.

In columns 6 through 8 of Table 5, we estimate equation (1) with alternative measures of economic growth and Protestant activities. In column 6 we switch the dependent variable from GDP per capita in 2000 to that in 2005. The effect becomes even more pronounced. In the main

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<sup>16</sup> Using population density in 1920 as a proxy for economic development yields similar results.

<sup>17</sup> The coefficient on the coastal province dummy is not significant in the first stage when controlling for a county's longitude. However, it becomes positively significant once the longitude variable is excluded from the regression.

<sup>18</sup> We thank Ying Bai and James Kung for generously providing the data on Catholic mission stations. In China, prefectures are subsidiary regions below provinces, and counties are subsidiary regions below prefectures. The original information was depicted in a crude map included in Stauffer's appendix (1922) and contained no information on prefecture boundaries. Bai and Kung (2012) locate the data to all the prefectures by their relative positions in the original map. Given the way the data were constructed, the results obtained with this measure of Catholic activities are only suggestive.

specification we use the number of converts to measure the density of Protestant presence in each county. We do so because the number of converts captures the effectiveness of Protestant evangelization, whereas the numbers of churches and missionaries captures the inputs. As robustness checks, in columns 7 and 8 of Table 5 we report the 2SLS results using numbers of churches and missionaries respectively, and we find the results unaffected.

## **5. The Long-term Effects of Protestantism on Education**

As we explain in Section 2, missionaries made tremendous efforts to promote education and health care while diffusing Protestantism in China throughout the late nineteenth and early twentieth centuries. Such efforts generated persistent effects in educational and health care development that have played an important role in long-term economic growth in the past century. In this section, we empirically examine the causal relationship between Protestantism and educational development both historically and at present.

### **5.1 Causality between Historical Protestantism and Contemporary Education**

Similar to the GDP analysis in the previous section, we first run an OLS regression of educational development in 2000 on the density of Protestantism in 1920. Then, using the frequency of severe droughts and floods (DF index = 1 or 5) as our instrumental variable, we run a 2SLS regression. The indicator of educational development in 2000, which is the dependent variable in our OLS and 2SLS regressions, is the log of years of schooling. We report the results in columns 1 through 4 of Table 6. The 2SLS estimates are reported in Panel A, and corresponding OLS estimates without the instrument are reported in Panel B.<sup>19</sup>

[Table 6 about here]

In column 1 of Table 6, we control for the basic set of geographical and climate controls as in column 5 of Table 3. The 2SLS estimate of the coefficient on convert density is 0.03, which confirms that past Protestant activities generated significant positive effects on long-term educational outcomes. When evaluated at the sample mean, a 1 standard deviation increase in converts per 1,000 people in 1920 leads to a 0.46 standard deviation increase in average years of schooling in 2000, which is equivalent to 0.46 years or a 6.4% increase relative to the mean

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<sup>19</sup> We do not report the first-stage results here because they are exactly the same as the first-stage results of the regressions in Table 3, 4, and 5 with the same set of controls.

value. OLS delivers a coefficient that is positive and significant as well, but its magnitude is much smaller than that of the 2SLS. This confirms the downward bias of OLS estimates caused by the selection issues in Protestant activities.

To evaluate the validity of our instrument in the education regression, we control for the same set of variables as in Table 4. The results are reported in column 2 of Table 6. The coefficient on convert density is unchanged. In column 3, we also examine the robustness of our estimates by adding in the same variables as in Table 5. And in column 4, we add in all variables from columns 2 and 3 simultaneously. Our results are remarkably robust in all specifications.

## **5.2 Protestant Missionaries' Efforts to Promote Education**

The causal effects of historical Protestantism on contemporary educational achievement that we observe in Table 6 are the result of missionaries' painstaking efforts to promote education in China during the late nineteenth and early twentieth centuries. As John K. Fairbank noted, "in the end the Christian influence was probably strongest in education" (Fairbank, 1974, p13).

China completely rebuilt its educational system in the early twentieth century, and missionaries played a critical role in this radical transformation. Protestant missionaries gradually realized the fundamental flaw of traditional Confucian education after they arrived in China in the early nineteenth century.<sup>20</sup> During their disaster relief efforts, missionaries found that a major obstacle to their work was a lack of understanding of modern science and technology among many Chinese people, including among some elites. The main cause was believed to be traditional Confucian education. Therefore, building a modern educational system became imperative. For instance, when missionary Timothy Richard wrote a proposal to the governor of Shanxi Province while he was overseeing disaster relief efforts in 1884, he emphasized the importance of reforming China's educational system. He said, "Education is the first priority for China. As the Western countries keep developing their education day-to-day, China will lose her chance to overtake them in ten years. In conclusion, education is the most significant and urgent thing for China" (Richard, 1889).

Protestant missionaries were determined to build new school systems in China for the purpose of not only educating Chinese people, but also converting them. Overwhelmingly,

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<sup>20</sup> E. C. Bridgman is believed to have been the first American missionary to work in China. As early as in 1830, he criticized the drawbacks of traditional education and its examination system, and he called for the establishment of a modern educational system (Barnett and Fairbank, 1985, p. 100).



missionaries were convinced that Western education was crucial to dissipating Chinese people's mistrust of and hostility toward Christianity. Alvin Pierson Parker, chairman of the Educational Association of China, explicitly expressed this opinion in 1896: "as a Christian educators' association, we should play a dominating role in China's education reform and satisfy the interests of Christianity" (Educational Association of China, 1896).

Driven by the twin motives of educating and converting the Chinese, missionaries made great achievements in revamping China's educational system. The number of Protestant schools rose sharply from 347 in 1877 to 7,382 in 1922, almost tripling every twenty years (Gregg, 1946, p.16–17). Among these Christian schools, 6,599 (86%) were elementary schools, 291 (7%) were middle schools, 16 (0.2%) were colleges, and 75 (1%) were vocational schools (China Educational Commission, 1922, p. 416).<sup>21</sup>

Primary schools form the foundation of modern mass education. To empirically test the effects of Protestant activities on the development of modern primary schools, we regress, at the county level, the number of Protestant primary school students per 1,000 people on the density of Protestant converts.<sup>22</sup> We report the results in column 1 of Table 7. Because our dependent variable is censored at zero, our estimate uses a Tobit model instead of OLS.<sup>23</sup> The coefficient shows a statistically and economically significant relationship between Protestant activities and Protestant primary school enrollment rates: when evaluated at the sample mean, a 1 standard deviation increase in convert per 1,000 people is associated with a 1.4 standard deviation increase in the enrollment rate of Protestant primary schools.

[Table 7 is about here]

Protestant missionaries built not only more schools but, critically, different schools. They introduced new curricula that emphasized both the natural sciences, such as mathematics, physics, and chemistry, and the social sciences, such as law and business. Protestant schools also offered practical subjects, such as foreign language studies and engineering. For example, 58% of students had taken English by the 4th or 5th grade (Stauffer, 1922, p. 1075). Class lectures were combined with practicums and laboratory experiments. Such teaching methods were vastly

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<sup>21</sup> The rest are special institutions, including orphanages and schools for the blind or deaf.

<sup>22</sup> If one assumes that portion of school-aged children is constant across counties, then this result can be viewed as clear evidence for the causal effects of Protestant activities on the enrollment rate of the school-aged children in Protestant elementary schools.

<sup>23</sup> The OLS results are not significantly different from the Tobit results.

different from traditional education, which typically featured rote learning of Confucian classics. As a result, Protestant schools enjoyed a decided advantage over traditional schools in training students who would be qualified to work in China's booming industrial and commercial sectors.

Another big advantage of Protestant schools was funding. According to one report on the status of Protestant schools in China, over half of the funding for Protestant schools came from foreign Protestant organizations (Stauffer, 1922, p. 1094). Such funding was usually quite stable and sufficient. In sharp contrast, because of frequent civil wars and political turbulence, public schools often lacked sufficient financial support from the government. In 1911, for example, education accounted for merely 1.5% of total government spending (Stauffer, 1922, p.1068).<sup>24</sup> The Chinese government's chronic underfunding of public education even extended to educators' salaries. In the early twentieth century, wage arrears frequently provoked protests among teachers, administrators, and even Ministry of Education staff members (China Educational Commission, 1922, p.22).

Better schools educate tend to produce better students. Take student promotion rates as an example. In 1920, 21% of the students in Protestant junior elementary schools entered senior elementary schools (as opposed to 10% of public school students), and 10% of the students in Protestant senior elementary schools entered middle schools (as opposed to 3.4% of public school students) (Stauffer, 1922, p. 404). Moreover, Protestant schools educated a large number of professionals whose skills were urgently needed by society. According to a survey published in the *COC*, among 5,500 high school graduates in 1918, 30% continued their studies and went on to college; 30% worked for churches; 20% became teachers; and 20% went into business or other professions such as medicine and law (Stauffer, 1922, p. 409). In contrast, 70% of public middle school graduates had difficulty finding jobs (China Educational Commission, 1922, p. 19).

### **5.3 Spillover Effects of Protestant Education**

As Protestant schools became demonstrably successful, they became exemplars for Chinese public schools. Wang (1997) documents three spillover effects of Protestant schools in China's educational system. First, the missionaries so effectively customized their textbooks to suit the needs of Chinese students that those textbooks—and the teachings therein—were widely adopted

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<sup>24</sup> 60% of government spending was diverted to military purposes and war indemnification.

in the public schools, as well (Wang, 1997, p223. See also Elman, 2006, p103 and p116). Second, a large number of graduates from Protestant schools went on to become public school teachers and to teach subjects that were in demand at those schools.<sup>25</sup> Third, both the teaching and the organizational methods of Protestant schools greatly influenced Chinese officials and educators, who would later put similar models into practice.<sup>26</sup> A missionary education association expressed this point explicitly in one of its documents: “by perfecting and strengthening this arm of the service [Protestant schools], we increase the probability that the future governmental educational system of China will be largely influenced and molded by such superior examples” (Silby, 1902, p 621).

Empirically, we corroborate the spillover effects of Protestant schools in China with two pieces of statistical evidence. First we investigate whether more intensive Protestant activities in a given county were associated with higher enrollment rates in that county’s public elementary schools. The results in column 2 of Table 7 support this hypothesis. When evaluated at the sample mean, our Tobit coefficient implies that a 1 standard deviation increase in convert density increases the public elementary school enrollment rate by a standard deviation of 0.24. This is the equivalent of a 0.18% increase in the enrollment rate, the mean value of which is 1.19%.

Next we examine, across counties, whether the public elementary school enrollment rate in one county was influenced by the Protestant activities in nearby counties. Specifically, we consider the following specification,

$$\ln(\text{Students/Pop}_{1920_i}) = \alpha + \beta_1 \ln(\text{Converts/Pop}_i) + \beta_2 \ln(\text{Converts/Pop}_{\text{contiguous}_i}) + \mathbf{X}_i' \gamma + \varepsilon_i, \quad (2)$$

where the public elementary school enrollment rate in county  $i$  ( $\text{Students/Pop}_{1920_i}$ ) is regressed on both the Protestant activities within county  $i$  ( $\text{Converts/Pop}_i$ ) and the Protestant activities in neighboring counties ( $\text{Converts/Pop}_{\text{contiguous}_i}$ ), all in logarithm. The latter variable is constructed by averaging the convert densities in all counties contiguous to county  $i$ , weighted by the distance of each of these counties to county  $i$ . The instrument for this variable, which is the average frequency of severe droughts and floods in nearby counties, can be constructed in a

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<sup>25</sup> For example, graduates from Tengchow College, a school established by the American missionary Calvin Mateer to train teachers, were highly sought by Chinese schools (Wang, 1997, p224).

<sup>26</sup> For example, when Zhang Zhidong, the Huguang Governor, planned to establish modern schools in the early 1900s, he sent many of his officials to Boone Memorial School, a Protestant academy established by American Episcopal Church in 1871, to study its educational and management models (Wang, 1997, p224).

similar fashion.

Column 3 of Table 7 reports our estimations of  $\beta_1$  and  $\beta_2$ . Both are positively significant, and the fact that  $\beta_1$  is greater than  $\beta_2$  is as expected: the within-county effects of Protestant activities on the development of modern primary education are more pronounced than the cross-county effects of Protestant activities. We further investigate this geographic spillover effect in column 4 by focusing on a subsample in which there are no converts. The results suggest that more intense Protestant activities in neighboring counties positively affected a county's public elementary school enrollment rate, even when that county had no Protestant converts.

## **6. The Long-term Effects of Protestantism on Health Care Outcomes**

As discussed in previous sections, missionaries actively promoted the establishment of Western medical and public health systems, particularly in poorer and less developed counties. Their efforts benefited a large population and might have generated persistent effects on health outcomes. In this section, we investigate the causal effects and transmission channels through which historical Protestant activities affect current health care outcomes.

### **6.1 Causality between Historical Protestantism and Contemporary Health**

In this subsection, we investigate whether historical Protestant activities have generated long-term impacts on current health care outcomes. The results are reported in columns 5 through 8 of Table 6. These columns are organized much as are columns 1 through 4, with one difference: the dependent variable is the child mortality rate in 2000.

Column 5 of Table 6 reports the results of our estimates with the same set of control variables as in our baseline specification, column 5 of Table 3. The coefficient on convert density is -0.44, once instrumented by historical disaster frequency (DF index = 1 or 5). This estimate is highly significant with a standard error of 0.16. It is in fact larger in magnitude than the corresponding OLS estimate reported in Panel B. To interpret this result, we find that a 1 standard deviation increase in converts per 1,000 people decreases the child mortality rate by 0.17 standard deviations, which amounts to a 36% decrease in the child mortality rate relative to the sample mean.

As before, we add in more controls and find in column 6 of Table 6 that the exclusion

restriction of our instrument is not likely to be violated in the child mortality rate regression. Columns 7 and 8 introduce another series of controls and further demonstrate the robustness of our results. In summary, our results confirm that historical Protestant activities have generated long-term effects on improving local health care outcomes.

## **6.2 Hospitals and Clinics**

As John K. Fairbank, a renowned Chinese historian, observed, “Modern Western medicine in China was to an important degree a consequence of missionary demonstration and instruction” (1983). Herbal therapy was the predominant form of medical treatment in China until Western medicine was introduced during the nineteenth century. Christian missionaries played a critical role in introducing Western medicine to China. Peter Parker, an American missionary, founded China’s first Western hospital in 1837. More than 2,000 patients received treatment in its first year of operation (Bush, 1879). Thereafter, Western medicine came to flourish throughout China. By 1889, 61 Protestant hospitals and 44 clinics were operating in China (General Conference of the Protestant Missionaries of China, 1890). These numbers increased during the first two decades of the twentieth century, reaching 326 and 244 respectively (Stauffer, 1922, p96). Annual numbers of patients treated soared to nearly 150,000 inpatients and over one million outpatients (Stauffer, 1922, p623). By 1937, over 300 Christian hospitals had been established in China, providing more than 20,000 beds. Endowed with strong support from Protestant organizations, Protestant hospitals were generally well financed and technologically advanced. Dr. Harold Balme, the dean of the School of Medicine at Shandong Christian University, surveyed conditions at 165 Protestant hospitals in 1919 and found that most housed medical laboratories, 75 were able to perform laparotomies, and 24 were equipped with X-ray machines (Balme and Stauffer, 1920). These hospitals were located not only in coastal provinces but also, notably, in remote inland regions. Moreover, many hospitals offered free medical services to the needy.

Figure 5 presents the correlation between Protestant activities and numbers of hospitals and pharmacies at the province level.<sup>27</sup> The positive correlations are very strong: a 1% increase in the number of converts is associated with a 1% increase in the number of modern hospitals as well as a 0.4% increase in the number of modern pharmacies.

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<sup>27</sup> We conduct this analysis at the province level because county-level data on the number of hospitals in 1920 are unavailable.

[Figure 5 about here]

### **6.3 Public Health**

Missionaries brought with them not only the Western hospital system but, more importantly, the Western idea of public health. Whenever outbreaks of disease occurred in disaster-stricken areas, missionaries were usually at the forefront in organizing effective remedial and preventive measures. Over the course of their periodic disaster relief and disease control efforts, Protestant missionaries found that a general lack of public health knowledge led to epidemic outbreaks that exacerbated the situation and contributed to the large death tolls that typically came in the aftermath of disasters. Disseminating knowledge of infection control thus became a priority during disaster relief efforts. Such knowledge included preventive measures such as sterilizing medical instruments, sanitizing food and drinking water, controlling flies and mosquitoes, and, critically, quarantining disaster-stricken areas to control the spread of communicable diseases. According to one study in the early twentieth century, 69 Protestant hospitals (42% of the total) were equipped with quarantine facilities (Balme and Stauffer, 1920). Such measures, when taken by missionaries, were very effective in controlling outbreaks of disease. A good example is control of leprosy. Wherever the disease emerged, local governments and missionaries collaborated to enforce quarantines. As a result, the number of leprosy cases in China declined drastically in the early twentieth century (Stauffer, 1922, p437–438).

Missionaries also focused on improving the health of women and children. Female missionaries, in particular, played a vital role in disseminating knowledge of obstetrics and gynecology among Chinese women. Among the services they offered, they paid regular visits to pregnant women and provided medical treatment in cases of necessity.<sup>28</sup> These female missionaries also trained obstetricians, midwives, and nurses throughout China. Their tremendous efforts produced significant declines in mortality rates for women and infants in the early twentieth century.

### **6.4 Medical Education**

Missionaries were also pioneers in promoting modern medical education in China. They

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<sup>28</sup> For example, in 1888, seven Canadian missionaries conducted a comprehensive survey of the overall health of women and children in Zhangde Prefecture, Henan Province. With funds they raised in their home country, they subsequently set up gynecological clinics and provided free medical services to local women and children. They also offered monthly training classes on obstetrics and gynecology. See Gryma (2008, p. 31) for details.

believed that “scientific medicine in China must not continue indefinitely to be a ‘foreign doctrine’” and “the medical profession of China must become national if it is to be universally accepted” (Mac Alister, 1921). Holding firmly to this belief, Protestant organizations established 116 medical education institutions by 1920. Among these institutions were 10 medical colleges, which accounted for one-third of all medical colleges in China at the time (Stauffer, 1922, p.425). Today most of these colleges remain operational and continue to train a large number of excellent doctors. The other 106 medical education institutions were schools of nursing (China Educational Commission, 1922, p. 416). These Protestant medical schools, which were usually larger and better equipped than public medical schools, offered an advanced model of medical education that public schools could only try to follow.

Setting up schools was not the sole means by which missionaries promoted medical education. They also published medical textbooks and translated a large number of Western works into Chinese. John Glasgow Kerr, a Presbyterian medical missionary, published China’s first journal of medicine in 1868.<sup>29</sup> A few years after that, in 1888, the Medical Missionary Association of China published its own journal with a focus on transmitting Western medical information to the Chinese. In 1908 missionaries published the first Chinese pharmaceutical dictionaries and in so doing standardized Chinese drug terminology (China Mission Year Book, 1912, pp. 267–268).

## 7. Possible Channels of Causality

What are the mechanisms behind the long-term effects of Protestantism? In this section we empirically examine whether there are any other channels, aside from education and health care outcomes, through which their undertakings have persistently affected today’s economic outcomes. When we control for current education and health care outcomes in our GDP regression and examine whether the effects of Protestant activities persist, we would like to be able to estimate the following model:

$$\ln(pcGDP_{2000}) = \alpha_2 + \beta_2 \ln(Converts/Pop_{1920}) + \chi_2 Edu_{2000} + \delta_2 Health_{2000} + X\gamma_2 + \varepsilon_2 \quad (3)$$

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<sup>29</sup> Kerr (1824–1901) arrived in China with the American Presbyterian Mission in 1854 and soon thereafter became the head of the Ophthalmic Hospital in Canton and later the Guangzhou Boji Hospital (The Canton Hospital). He worked there for 47 years and treated about 1 million patients. Besides his outstanding contributions in medical care, he was also known for his student, Dr. Sun Yat-sen, the founder of Kuomintang (Chinese Nationalist Party) and the Republic of China.

In Table 8, we report estimation results of equation (3) using, in columns 2 through 4, OLS and, in columns 6 through 8, 2SLS, where  $\ln(\text{Converts}/\text{Pop})$  is instrumented by historical disaster frequency (DF index = 1 or 5) from 1880 to 1920. The coefficients on years of schooling are positive and significant. Although the coefficients on child mortality rates are negative and significant in columns 2 through 4, they are insignificant in columns 6 through 8. To interpret the magnitude of coefficients on education and health, column 8 in Table 8 reveals that a 1% increase in years of schooling is associated with a 0.83% increase in GDP per capita, while a 1% decrease in child mortality rate is associated with a 0.04% increase in GDP per capita. These results are comparable to those found by existing studies that explore cross-country variations.<sup>30</sup>

[Table 8 about here]

Most importantly, column 8 in Table 8 shows that, compared to our baseline results (column 5 of Table 3), the coefficient on convert density is reduced by 25% (i.e.,  $[0.16-0.12]/0.16$ ) once both education and health care outcomes are controlled for. This suggests that effects on education and health care outcomes account for 25% of the total effects of Protestant activities on long-term economic growth.

A potential concern raised by the above argument is that current education and health care outcomes may also be endogenous. Unobservable county-level characteristics that affect education and health status can also affect economic outcomes, and there is no instrumental variable for them in our context. In this case, their coefficient could be biased and the estimation of the coefficient on convert density could be contaminated as well.

In order to address the possibility of endogeneity, we follow Becker and Woessmann (2009) and bound the effect of Christian activities on GDP per capita net of contemporary education and health outcomes. The bounding procedure involves two steps. In the first step, we run an OLS regression with equation (3). The results of this auxiliary regression are reported in column 4 of Table 8. In the second step, we subtract the contribution of education and health improvements and estimate the net effects of historical Protestant intensity on today's GDP in the following specification:

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<sup>30</sup> For example, a cross-country analysis conducted by Mankiw et al. (1992) found that a 1% increase in years of schooling is associated with a 0.66% increase in GDP per capita.



$$\ln(pcGDP_{2000}) - \bar{\chi}Edu_{2000} - \bar{\delta}Health_{2000} = \alpha_2 + \beta_2 \ln(Converts/Pop_{1920}) + X\gamma_2 + \varepsilon_2, \quad (4)$$

where  $\bar{\chi}$  and  $\bar{\delta}$  are based on the estimated values of  $\chi_2$  and  $\delta_2$ , obtained from the first step and adjusted for potential biases that have been reported in other studies.

Table 9 reports the bounding results. Each cell contains an estimate of  $\beta_2$  in equation (4), where Protestant activities in 1920 are instrumented by historical disaster frequencies. The row and column headings indicate the values we choose for  $\bar{\chi}$  and  $\bar{\delta}$ . In cell [1,1], when both  $\bar{\chi}$  and  $\bar{\delta}$  are set to 0, we obtain the point estimate of Protestant effect in the baseline regression. Informed by our review of the extensive literature on return to education, we bound the range of estimates of the economic return to years of schooling ( $\bar{\chi}$ ) from 80% to 140% of its OLS estimate ( $\chi_2$ ).<sup>31</sup> As for the effects of child mortality rates on GDP per capita ( $\bar{\delta}$ ), the related literature is less conclusive. Therefore, we opt for a more conservative approach and consider values for  $\bar{\delta}$  ranging from 80% to 200% of its OLS estimate ( $\delta_2$ ).<sup>32</sup>

[Table 9 about here]

Column 1 reports the results we obtain when we remove only the education channel in the dependent variable of the regression in equation 4. The coefficients on Protestant activities range from 0.12 to 0.13, depending upon the values chosen for  $\bar{\chi}$ , and they are significant both statistically and economically. Such results suggest that educational improvements account for 19–25% of the total effect of Protestant activities. Row 1 reports the results yielded when we take out only the health channel. With the wide range of  $\bar{\delta}$  we choose, the coefficients on Protestant activities vary from 0.12 to 0.14 and are also statistically significant. Such results suggest that long-term health improvements contribute 12–25% of the total effects of Protestant

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<sup>31</sup> Card (1999) reviews the literature on the return to education and concludes that the upward bias due to ignorance of ability accounts for about 10% of the OLS estimates. Moreover, studies using institutional changes to create exogenous variation in schooling have actually yielded estimates 20–40% higher than those of OLS. The main reason is that institutional improvements usually affect people with low educational outcomes, who tend to have higher marginal return to schooling. Similar downward biases may apply to the OLS estimates in our context, as well.

<sup>32</sup> Studies that evaluate the effects of health improvement on economic growth based on regional variation have been somewhat inconclusive (Jack and Lewis, 2009). They always suffer from omitted variable bias and reverse causality (Mankiw, 1995, p303–304). Gallup and Sachs (2001) and Bloom et al. (2004) are examples of the very few studies that construct instrumental variables to solve these issues of endogeneity. But their identification strategies continue to be debated, and their 2SLS results are not significantly different from their OLS results.

activities on GDP per capita today.<sup>33</sup>

When we estimate equation (4), through different combinations of  $\bar{\chi}$  and  $\bar{\delta}$ , the coefficients of education and health in Table 9, the effects of Protestant activities range from 0.08 to 0.14. Insignificant results appear only when the true effect of return to education is 40% higher than that of the OLS estimate and when the true effect of return to health is more than 120% of the OLS estimate. Even in these cases, the magnitudes of  $\beta_2$  continue to have significant economic meanings.

Based on the above analysis, we draw two conclusions that help us understand the effects of missionary work on long-term economic outcomes. First, improvements in education and health care outcomes account for a considerable proportion (up to 50%) of the long-term effects of Protestantism on economic outcomes. Second, there are other, unquantifiable channels through which historical Protestantism affects today's GDP per capita. Our study finds that they may contribute at least another 50% of the total effects. Indeed, aside from the channels of education and health care outcomes, Protestantism may have generated a variety of profound effects on Chinese society. For example, Protestant activities may have promoted more open attitudes toward new ideas and technologies, better work ethics, and increased entrepreneurship.

One implication of the second argument is that the long-term impact of Protestantism may have become most evident only after China's Reform and Open-up in 1978. Although most of Protestantism's effects on social values and work ethics were suppressed during the Cultural Revolution, their subsequent revival has boosted economic growth in an increasingly market-oriented environment. To test this, in Figure 6 we plot average GDP per capita between 1950 and 2010 for two groups of our sample provinces. One group consists of the eleven provinces with the lowest measures of  $\ln(\text{Converts/Pop})$  in 1920, and the other group consists of the twelve provinces with the highest measures of  $\ln(\text{Converts/Pop})$  in 1920.<sup>34</sup>

[Figure 6 about here]

Two patterns are worth noticing here. First, provinces with a higher intensity of Protestant

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<sup>33</sup> In fact, it is possible to calculate the threshold values of  $\bar{\chi}$  and  $\bar{\delta}$  beyond which  $\beta$  becomes insignificant. The  $\bar{\chi}$  value for  $\beta$  to lose significance at the 5% level is 2 times that of  $\chi_2$ , and the corresponding  $\bar{\delta}$  value is 3.1 times that of  $\delta_2$ .

<sup>34</sup> We obtained our province-level GDP data from *China Compendium of Statistics 1949–2008*. We use province-level data because county-level GDP data before 1993 are not available.

activities are, on average, richer than those with lower intensities. Second, and more interestingly, the gap between these two groups widened rapidly in the late 1970s. The GDP per capita in the first group almost doubled that of the second.

We consolidate the above finding by determining whether provinces with higher intensities of historical Protestant activities are associated with higher GDP per capita growth rate. Table 10 reports the results. During the pre-Reform period (1952–1978), the coefficient on converts per 1,000 people is small and insignificant in columns 1 through 3. In contrast, during the Reform period (1978–2008), the coefficient becomes large and significant in columns 4 through 6.

[Table 10 about here]

In summary, these patterns are consistent with our hypothesis. The unquantifiable effects of Protestantism, such as the reshaping of social values and work ethics, might have mattered in a centrally planned economy, yet they have come to matter much more in the years since the Reform and Open-up in 1978.

## **8. Conclusion**

In this paper we construct a data set mapping Protestant activities in 1920 at China's county level with county-level data on socioeconomic developments in 2000. Our OLS results show that diverse socioeconomic developments across counties in 2000 are positively correlated with the intensity of Protestant presence 80 years ago. To better understand whether the relationship is causal, we exploit the fact that missionaries purposefully undertook disaster relief work to gain the trust of the local people. Thus, we use the frequency of historical disasters as an instrument for Protestant distribution. Our IV results confirm and enhance our OLS results. To our knowledge, this paper provides the first empirical evidence for the long-term effects of religious activities on socioeconomic outcomes in China today.

We then investigate the channels through which the effects of missionaries' work have persisted over time. While spreading Protestantism throughout China, missionaries took an active role in building modern educational and medical systems. They set up a large number of Western-style schools and hospitals, and they helped build China's public health system. Tens of millions of Chinese people have benefited from their pioneering work. Such efforts might have contributed substantially to the accumulation of human capital in China over the past century.

However, we realize that the effects of the spread of Protestantism could be complex and profound. It is possible that missionaries' work induced the changes in social values, work ethics, and attitudes toward Western culture, entrepreneurship, and so on. Such changes might also have boosted long-term economic growth. Our empirical results suggest that improvements in education and health care outcomes account for less than half of the total effects of missionaries' work on today's economic outcomes, and that the rest of the effects may be attributed to changes in culture and social values.

If we are correct, our conclusions may have important implications for understanding the so-called Chinese miracle, which in the past has been entirely attributed to radical institutional changes that accompanied China's Reform and Open-up. Our findings imply that China's Reform and Open-up was, to a large extent, a continuation of a modernization movement that started in the mid-nineteenth century, was interrupted by wars and revolutions, and resumed in 1978. Our findings also imply that late-nineteenth- and early-twentieth-century Protestant missionaries pioneered that modernization movement by disseminating, along with Christianity, Western science and technology to even the most remote regions of China. Such efforts accelerated the pace of modernization, contributed to the accumulation of human capital, and reshaped the social values of local people. Although these historical legacies of missionaries' undertakings were suppressed during the Cultural Revolution, they rapidly resurged and began to contribute to socioeconomic developments when China began to open up and reform. Therefore, our findings imply that a significant amount of China's growth since 1978 is the result not just of sudden institutional change but of human capital and values acquired over a much longer historical period.

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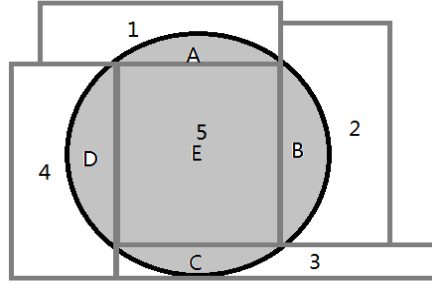
## Data Appendix

### 1. Mapping historical information onto current administrative units

Refer to Figure A1 as an illustrative example, where squares represent 1999's county boundaries and circles represent 1920's county boundaries. The 1920 county-level measures of Christian activities ( $X_i^{1920}$ ,  $i = 1, \dots, 5$ ), include number of converts, missionaries, and churches. The corresponding 2000 county-level measures ( $X^{1999}$ ), shown as the grey area, is calculated by

$$x_k = \sum_{k=A-E} x_k^{2000} \quad \text{where} \quad x_A^{1999} = x_1^{1999} \cdot \frac{S_A}{S_1}, \dots, x_E^{1999} = x_5^{1999} \cdot \frac{S_A}{S_5}$$

**Figure A1. An illustrative map**



The implicit assumption is that church activities in 1920 are equally distributed within a county.

### 2. Converting station-level information to the county level

Given the climate measures at the station level ( $Y_j$ ,  $j = 1, \dots, J$ ), county-level measures ( $Y_c$ ) are constructed by

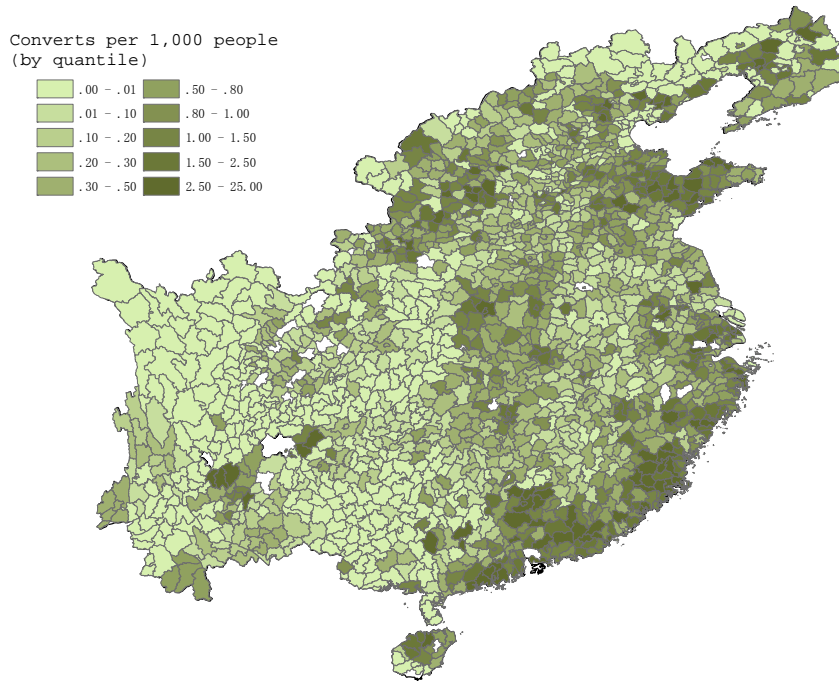
$$Y_c = \sum_{j=1, \dots, J} Y_j \cdot w_{cj}$$

where  $w_{ij}$  is the weight, which is constructed using Shepard's method (Shepard, 1968):

$$w_{cj} = \frac{dist_{ck}^{-2}}{\sum_{k=1, \dots, J} dist_{ck}^{-2}}$$

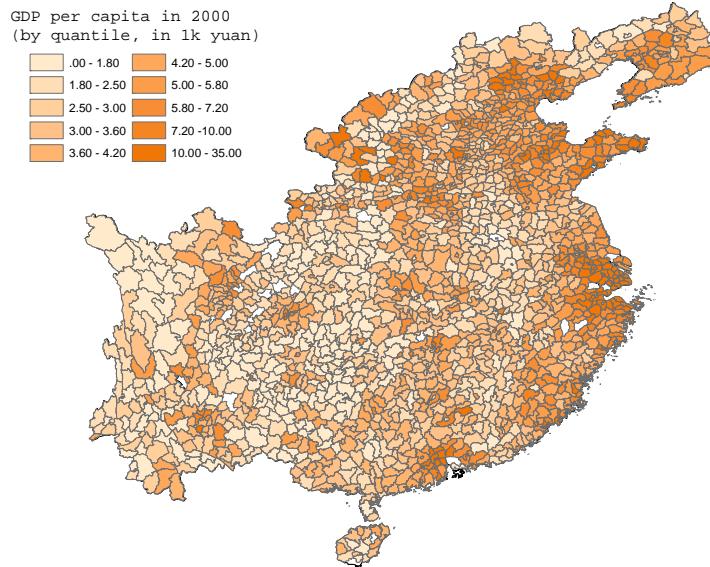
where  $dist_{ck}^{-2}$  is the distance between the centroid of county  $c$  and  $k$ .

**Figure 1. Protestant Converts per 1,000 people in 1920**



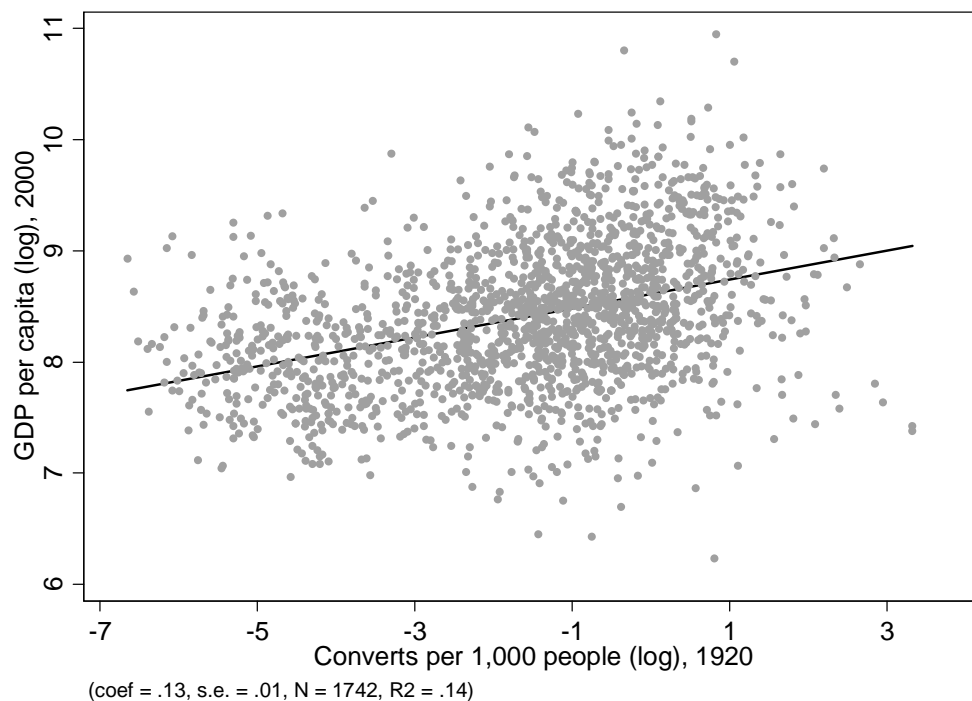
Note: This map shows the distribution of converts (normalized by population) in 1920 among counties in our sample. Darker shading indicates higher numbers of Protestant converts per 1,000 people.

**Figure 2. GDP per capita in 2000**



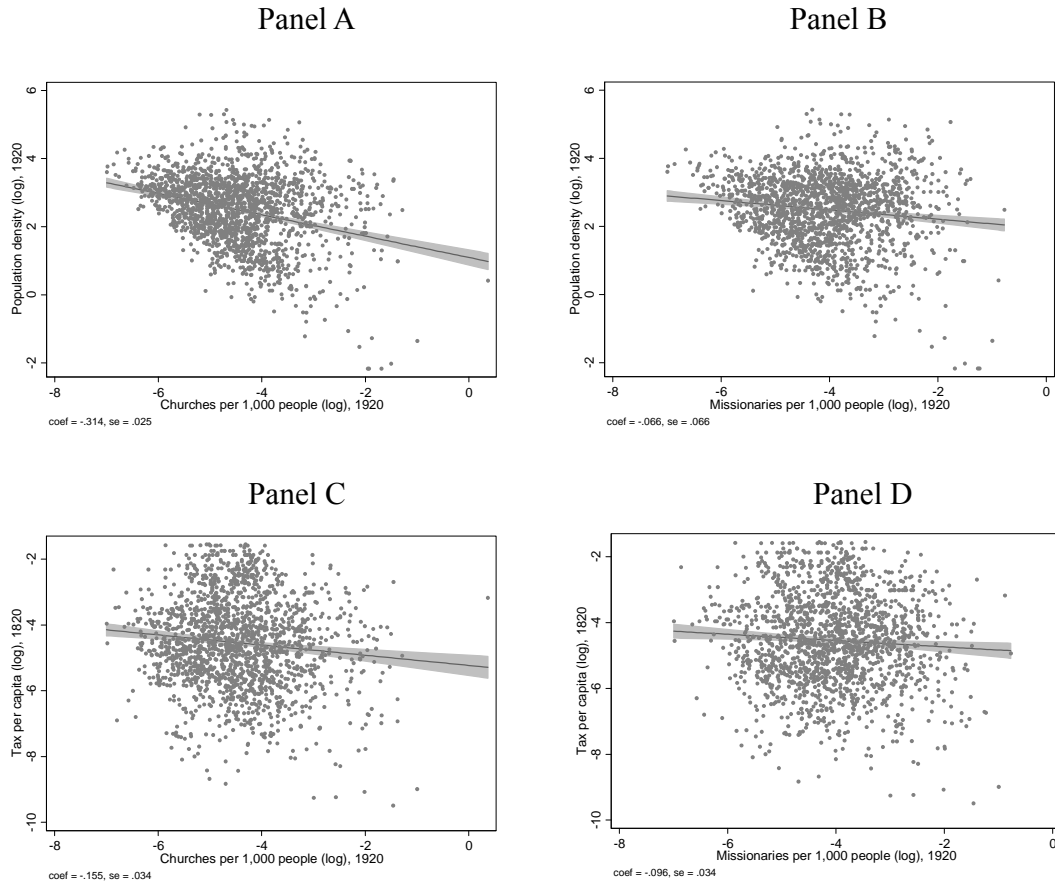
Note: This map shows the distribution of GDP (normalized by population) in 2000 among counties in our sample. Darker shading indicates higher GDP per capita.

**Figure 3. Correlation between historical Protestant activities and current GDP per capita**



Note: This figure plots the logarithm of converts per 1,000 people in 1920 against the logarithm of GDP per capita in 2000. Each dot represents a county. The solid line is the fitted regression line with slope equal to 0.13 and t statistics equal to 16.92. The correlation coefficient between these two variables is 0.38.

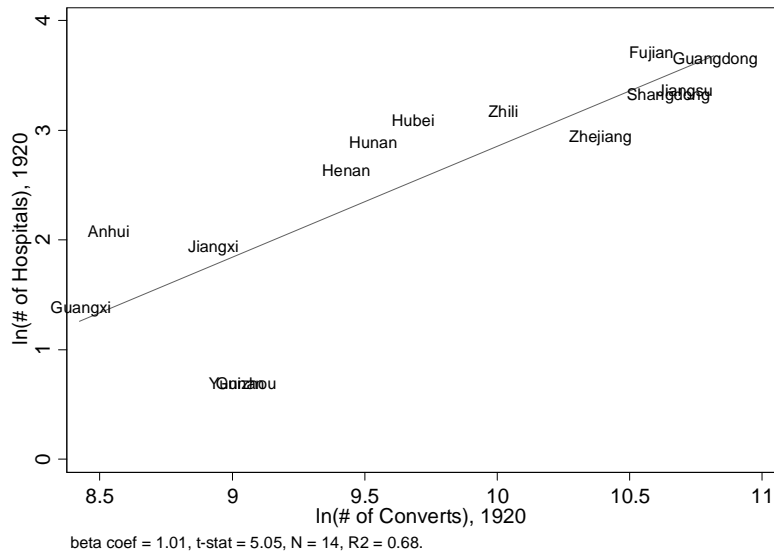
**Figure 4. Selection of counties by Protestant churches and missionaries**



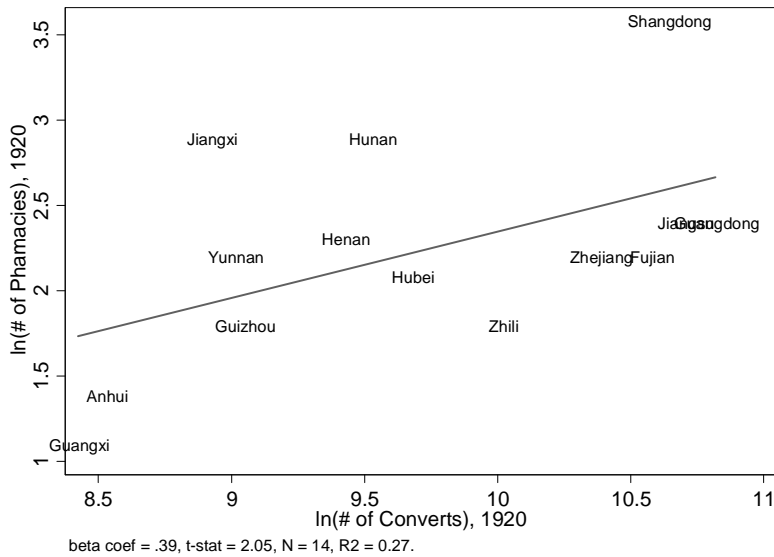
Note: The panels in this figure plot Protestant church activities in 1920 against historical economic development. Historical economic development is measured by the population density in 1920 (normalized by geographic area) in panels A and B, and by land tax per capita in 1820 in panels C and D. Protestant church activities are measured by number of churches per 1,000 people in panels A and C, and by number of missionaries per 1,000 people in panels B and D. All values are in logarithm. In each panel, the dot represents a county. The solid lines are fitted regression lines with slope and standard error reported below. The shaded areas represent the 95% confident interval.

**Figure 5. Correlation between historical Protestant activities and historical development of Western health care in China**

Panel A. Number of Western hospitals

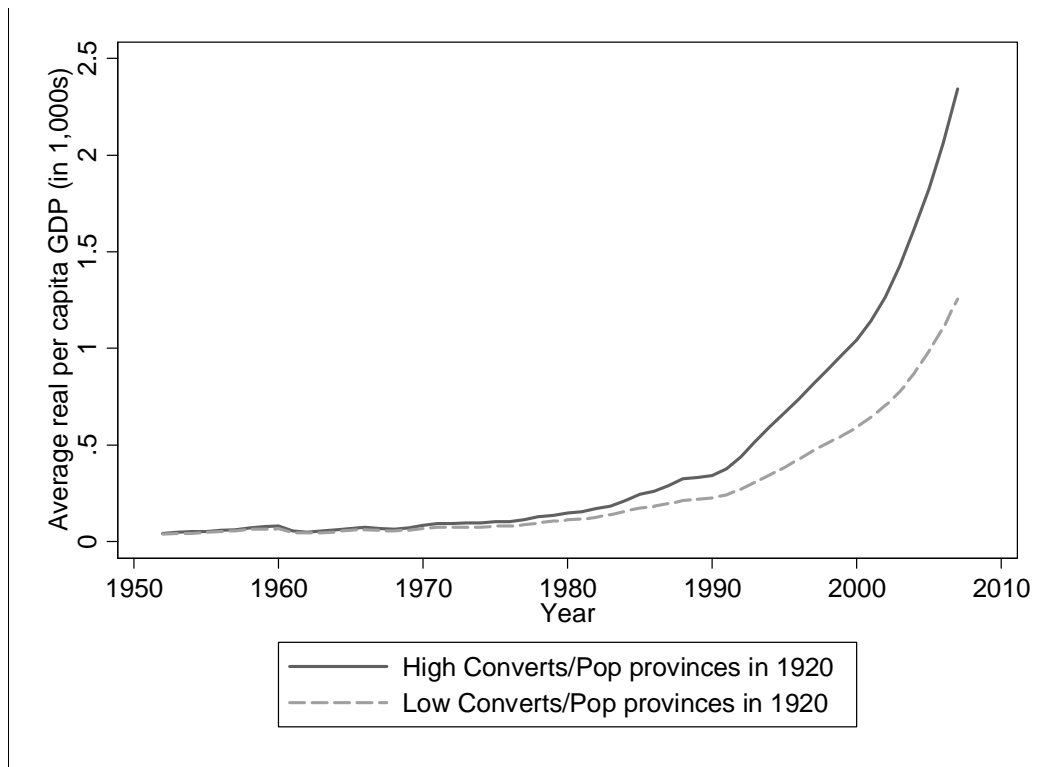


Panel B. Number of Western pharmacies



Note: The panels in this figure plot province-level numbers of converts against historical development of Western health care in China, measured by number of Western hospitals in 1920 (Panel A) and number of Western pharmacies in 1920 (Panel B). All values are in logarithm. In each panel, the solid line is the fitted regression line with its slope and other related statistics reported below.

**Figure 6. Trajectories of economic development across provinces since 1950**



Note: In this figure, 23 provinces in our sample are divided into two groups: 12 provinces with higher convert density in 1920 and 11 provinces with lower convert density in 1920. The figure plots the weighted average per capita GDP across years for each group. The weights are the provincial populations in each year. Nominal values are deflated to 2000 price levels.



**Table 1. Summary Statistics**

	Unit	Obs	Mean	Std.	Min	Max
	(1)	(2)	(3)	(4)	(5)	(6)
<i>I. Protestant activities (in 1920)</i>						
Converts per 1,000 people		1742	0.76	1.61	0.0000	27.71
Churches per 1,000 people		1742	0.02	0.04	0.0000	1.45
Missionaries per 1,000 people		1742	0.02	0.04	0.0000	0.46
<i>(Conditional on being positive)</i>						
Converts per 1,000 people		1470	0.90	1.72	0.0021	27.71
Churches per 1,000 people		1228	0.02	0.05	0.0001	1.45
Missionaries per 1,000 people		1343	0.03	0.04	0.0010	0.46
<i>II. Students per 1,000 people (in 1920)</i>						
Protestant primary schools		1742	0.00	0.00	0.00	0.00
Public primary schools		1742	11.91	12.74	0.00	207.77
<i>(Conditional on being positive)</i>						
Protestant primary schools		1219	0.46	0.78	0.00	8.01
Public primary schools		1734	11.96	12.74	0.37	207.77
<i>III. Medicine (in 1920, provincial level)</i>						
Number of Western hospitals		16	18.38	12.38	2.00	41.00
Number of pharmacies		16	12.38	8.82	3.00	36.00
<i>III. Socioeconomic outcomes (in 2000)</i>						
GDP per capita	yuan	1742	5584	4463	508	57065
Year of schooling		1742	7.22	1.00	1.85	11.06
Child mortality rate	%	1742	2.33	1.89	0.00	18.65
<i>IV. Geographical characteristics</i>						
Longitude	°C	1742	112.68	5.75	97.78	125.27
Latitude	°C	1742	31.19	5.34	18.57	42.99
Altitude	m	1742	615.81	736.77	33.14	4518.85
Distance to provincial capital	km	1742	187.43	108.11	0.58	611.09
<i>V. Climate characteristics</i>						
Freq. of DF = 1 or 5 in 1880–1920		1742	0.19	0.05	0.00	0.59
Freq. of DF = 1 or 5 in 1980–2000		1742	0.26	0.06	0.00	0.66
Average temperature in 1990–2000	°C	1742	13.52	3.68	0.16	23.72
Average precipitation in 1990–2000	cm	1742	9492	3537	90	22525

**Table 2. Relationship between historical Protestant activities and current economic development (OLS)**

Dependent variable is log GDP per capita in 2000					
	(1)	(2)	(3)	(4)	(5)
ln(Converts/Pop1920)	0.13 [0.01]***	0.09 [0.01]***	0.06 [0.01]***	0.05 [0.01]***	0.06 [0.01]***
Longitude			0.05 [0.01]***	0.04 [0.01]***	0.04 [0.01]***
Latitude			0 [0.01]	-0.01 [0.01]	-0.01 [0.01]*
Distance to provincial capital (in logs)			-0.17 [0.02]***	-0.15 [0.02]***	-0.16 [0.02]***
Altitude (in logs)				-0.1 [0.02]***	-0.11 [0.02]***
Temperature (in logs)					-0.29 [0.11]**
Precipitation (in logs)					0.1 [0.11]
Regional FE	NO	YES	YES	YES	YES
R-squared	0.14	0.26	0.34	0.36	0.36
Obs	1742	1742	1742	1742	1742

Note: This table reports OLS estimation results of equation (1). Each observation is a county in 2000. The dependent variable is the logarithm of GDP per capita in 2000. The Protestant activities variable ln(Converts/Pop1920) is the logarithm of converts in each county in 1920 normalized by population. Regional fixed effects include indicator variables for the 7 regions in China proper: North, East, Northeast, Middle, South, Southwest, and Northwest China. Coefficients are reported with standard errors in brackets. \*\*\*, \*\*, and \* indicate significance at 1%, 5% and 10% levels.

**Table 3. Relationship between historical Protestant activities and current economic development (2SLS)**

	(1)	(2)	(3)	(4)	(5)
Panel A. Second Stage. Dependent variable is log GDP per capita in 2000					
ln(Converts/Pop1920)	0.10 [0.04]***	0.23 [0.06]***	0.17 [0.06]***	0.15 [0.06]**	0.16 [0.07]**
Location Controls	NO	NO	YES	YES	YES
Altitude	NO	NO	NO	YES	YES
Climate Controls	NO	NO	NO	NO	YES
Reg. FE	NO	YES	YES	YES	YES
Obs	1742	1742	1742	1742	1742
Panel B. First Stage. Dependent is ln(Convert/Pop1920)					
Disaster Freq. (DF = 1 or 5, 1880-1920)	7.85 [0.89]***	6.99 [1.07]***	6.21 [1.08]***	5.81 [1.07]***	5.53 [1.06]***
F-stat on IV	77.68	42.74	33.37	29.82	27.05

Note: This table reports estimation results of equation (1), where historical Protestant activities are instrumented by historical frequency of disasters. Each observation is a county in 2000. Panel A reports the second-stage results of the estimation. ln(Converts/Pop1920) is the logarithm of converts of each county in 1920 normalized by population. Panel B reports the first-stage results of the estimation. Instrument variable is the frequency of severe floods (DF index = 1) and severe droughts (DF index = 5) between 1880 and 1920. "Location Controls" include longitude, latitude, and distance to provincial capital (in logs). "Climate Controls" include average temperature and annual precipitation between 1990 and 2000. Coefficients are reported with standard errors in brackets. \*\*\*, \*\*, and \* indicate significance at 1%, 5% and 10% levels.

**Table 4. Long-term effects on economic development, validity of instrument variable (Panel A)**

	Baseline	Recent disaster	Location	Infrastructure		GDP composition	Help from central gov't	All	Separate flood and drought
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A. Second Stage. Dependent variable is log GDP per capita in 2000									
ln(Converts/Pop1920)	0.16** [0.065]	0.16** [0.065]	0.16** [0.066]	0.14** [0.066]	0.14** [0.066]	0.15** [0.065]	0.19*** [0.066]	0.18*** [0.064]	0.18*** [0.060]
Disaster freq. (DF = 1 or 5, 1980-2000)		0.02 [0.248]						-0.15 [0.245]	
Rivers			0.09** [0.041]					0.06 [0.040]	
Road density (in logs)				0.04 [0.035]				-0.03 [0.031]	
Construction expenditure (in logs)					0.04*** [0.011]				
Agriculture/GDP (in logs)						-0.11*** [0.022]		-0.12*** [0.020]	
Subsidy/Pop2000 (in logs)							0.34*** [0.033]	0.37*** [0.032]	
Adjusted R-squared	0.295	0.294	0.292	0.309	0.314	0.321	0.285	0.321	0.27
F-stat on IV	27.05	27.57	26.76	26.15	25.99	27.11	26.74	26.97	16.38
Sargan Test (p-value)	.	.	.	.	.	.	.	.	0.491
Obs	1742	1742	1742	1742	1742	1742	1742	1742	1742

**Table 4. Long-term effects on economic development, validity of instrument variable (Panels B, C)**

	Baseline	Recent disaster	Location	Infrastructure		GDP composition	Help from central gov't	All	Separate flood and drought
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel B. First Stage. Dependent is ln(Convert/Pop1920)									
Disaster freq. (DF = 1 or 5, 1880-1920)	5.53*** [1.065]	5.63*** [1.073]	5.50*** [1.066]	5.44*** [1.066]	5.42*** [1.065]	5.48*** [1.055]	5.51*** [1.067]	5.55*** [1.070]	
Flood freq. (DF = 1, 1880-1920)									3.46** [1.378]
Drought freq. (DF = 5, 1880-1920)									8.33*** [1.592]
Panel C. OLS Results. Dependent variable is log GDP per capita in 2000									
ln(Converts/Pop1920)	0.06*** [0.008]	0.06*** [0.008]	0.06*** [0.008]	0.05*** [0.008]	0.05*** [0.008]	0.05*** [0.008]	0.06*** [0.008]	0.05*** [0.007]	0.06*** [0.008]

Note: This table reports estimation results of equation (1), where historical Protestant activities are instrumented by historical frequency of disasters. Each observation is a county in 2000. In all specifications, the unreported control variables include: longitude, latitude, distance to provincial capital (in logs), altitude (in logs), average temperature and annual precipitation between 1990 and 2000, and regional fixed effects. Panel A reports the second-stage results of the estimation. The dependent variable is the logarithm of GDP per capita in 2000. ln(Converts/Pop1920) is the logarithm of converts of each county in 1920 normalized by population. Panel B reports the first-stage results of the estimation. The dependent variable is the endogenous variable, ln(Converts/Pop1920). Coefficients are reported with standard errors in brackets. \*\*\*, \*\*, and \* indicate significance at 1%, 5% and 10% levels.

**Table 5. Effects on current economic development, robustness check (Panel A)**

	Baseline	Initial econ. condition	Coastal dummy	Rural dummy	Catholic stations	GDP per capita 2005	Alt. measures of Protestant activities	Add. IV	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A. Second Stage. Dependent Variable is log GDP per capita in 2000									
ln(Converts/Pop1920)	0.16** [0.065]	0.18*** [0.071]	0.14** [0.063]	0.15** [0.064]	0.10* [0.060]	0.22*** [0.075]			0.21*** [0.068]
ln(Missionaries/Pop1920)							0.64* [0.360]		
ln Churches/Pop1920)								0.28** [0.122]	
Land tax 1820 (in logs)		0.03*** [0.011]							
Coastal province			0.47*** [0.051]						
Rural county				0.26*** [0.053]					
ln(Catholic stations/Pop1920) (Prefecture level)					0.41 [0.624]				
F-stat on IV	27.05	24.14	26.84	27.68	26.41	27.05	5.03	26.96	13.92
Sargan Test (p-value)	.	.	.	.	.	.	.	.	0
Obs	1742	1742	1742	1742	1586	1742	1742	1742	1742

**Table 5. Effects on current economic development, robustness check (Panels B, C)**

	Baseline	Initial econ. condition	Coastal dummy	Rural dummy	Catholic stations	GDP per capita 2005	Alt. measures of Protestant activities		Add. IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel B. First Stage									
Dependent Variable			ln(Converts/Pop1920)				ln(Missionaries /Pop1920)	ln(Churches /Pop1920)	ln(Converts /Pop1920)
Disaster freq. (DF = 1 or 5, 1880-1920)	5.53*** [1.065]	5.28*** [1.075]	5.51*** [1.065]	5.51*** [1.047]	6.06*** [1.181]	5.53*** [1.065]	1.32** [0.599]	3.06*** [0.593]	5.51*** [1.065]
Disaster freq. (DF = 2 or 4, 1880-1920)									0.45 [0.508]
Panel C. OLS Estimates. Dependent Variable is log GDP per Capita in 2000									
ln(Converts/Pop1920)	0.06*** [0.008]	0.06*** [0.008]	0.05*** [0.008]	0.04*** [0.008]	0.06*** [0.008]	0.07*** [0.009]			0.06*** [0.008]
ln(Missionaries/Pop1920)							0.08*** [0.014]		
ln(Churches/Pop1920)								0.05*** [0.014]	

Note: This table reports a series of robustness checks. All specifications are estimated through 2SLS, where historical Protestant activities are instrumented by historical frequency of natural disasters. Each observation is a county in 2000. In all specifications, the unreported control variables include: longitude, latitude, distance to provincial capital (in logs), altitude (in logs), average temperature and annual precipitation between 1990 and 2000, and regional fixed effects. Panel A reports the second stage estimates. The dependent variable is the logarithm of GDP per capita in 2000. In column (1)-(5), and (9), Protestant activities are measured by logarithm of converts of each county in 1920 normalized by population, while in column (7) and (8), they are measured by logarithm of missionaries per 1,000 people and logarithm of Protestant churches per 1,000 people, respectively. Panel B reports the first stage estimates. The dependent variables are the endogenous Protestant activity variables. Panel C reports the corresponding OLS specifications of Panel A without instruments. Coefficients are reported with standard errors in brackets. \*\*\*, \*\*, and \* indicate significance at 1%, 5% and 10% levels.

**Table 6. Long-term effects on education and health care outcomes (Panel A)**

	Years of schooling				Child mortality rate			
	Baseline (1)	Validity (2)	Robustness (3)	All (4)	Baseline (5)	Validity (6)	Robustness (7)	All (8)
Panel A. Second Stage, Dependent Variable is log of years of schooling or childhood mortality rate in 2000								
ln(Converts/Pop1920)	0.030** [0.015]	0.028* [0.014]	0.029** [0.015]	0.028** [0.014]	-0.443*** [0.164]	-0.536*** [0.173]	-0.443*** [0.165]	-0.536*** [0.173]
Disaster freq. (DF = 1 or 5, 1980-2000)		-0.124** [0.054]		-0.118** [0.053]		-0.814 [0.649]		-0.802 [0.649]
Rivers		-0.002 [0.009]		-0.003 [0.009]		0.146 [0.106]		0.142 [0.106]
Road density (in logs)		0.035*** [0.007]		0.029*** [0.006]		0.024 [0.083]		0.011 [0.078]
Agriculture/GDP (in logs)		-0.034*** [0.005]		-0.025*** [0.004]		0.018 [0.055]		0.036 [0.048]
Subsidy/Pop2000 (in logs)		0.008 [0.007]		0.006 [0.007]		-0.101 [0.086]		-0.103 [0.087]
Coastal province			-0.003 [0.012]	-0.002 [0.011]			-0.042 [0.131]	-0.011 [0.137]
Urban county			0.078*** [0.012]	0.047*** [0.011]			0.005 [0.137]	0.095 [0.129]
ln(Catholic stations/Pop1920) (Prefecture level)			0.029 [0.145]	0.04 [0.141]			-0.936 [1.640]	-0.737 [1.718]
Adjusted R-squared	0.414	0.477	0.456	0.487	0.483	0.428	0.482	0.428
F-stat on IV	26.81	26.74	27.4	27.09	26.81	26.74	27.4	27.09
Obs	1742	1742	1742	1742	1742	1742	1742	1742



**Table 6. Long-term effects on education and health care outcomes (Panel B)**

	Years of schooling				Child mortality rate			
	Baseline (1)	Validity (2)	Robustness (3)	All (4)	Baseline (5)	Validity (6)	Robustness (7)	All (8)
Panel B. OLS Results, Dependent Variable is log of years of schooling or childhood mortality rate in 2000								
ln(Converts/Pop1920)	0.009*** [0.002]	0.005*** [0.002]	0.004*** [0.002]	0.003* [0.002]	-0.080*** [0.018]	-0.066*** [0.018]	-0.067*** [0.019]	-0.061*** [0.018]

Note: This table examines the long-term effects of Protestant activities on current education and health care outcomes. Each observation is a county in 2000. In all specifications, the unreported control variables include: longitude, latitude, distance to provincial capital (in logs), altitude (in logs), average temperature and annual precipitation between 1990 and 2000, and regional fixed effects. Historical Protestant activities are instrumented by historical frequency of disasters. Panel A reports the second stage estimates. The dependent variable is the logarithm of years of schooling (columns [1] through [4]) and logarithm of the childhood mortality rate (columns [5] through [8]) in 2000. ln(Converts/Pop1920) is the logarithm of converts of each county in 1920 normalized by population. Panel B reports the corresponding the OLS results. Coefficients are reported with standard errors in brackets. \*\*\*, \*\*, and \* indicate significance at 1%, 5% and 10% levels.

**Table 7. Relationship between historical Protestant activities and development of modern education**

Enrollment rate (in logs)	Church primary schools	Public primary schools	All Primary schools	
	(Tobit) (1)	(Tobit) (2)	Overall sample (3)	Converts/Pop1920 = 0 (4)
ln(Converts/Pop1920)	1.33 [0.04]***	0.12 [0.01]***	0.12 [0.01]***	
ln(Converts/Pop1920 in the neighboring counties)			0.06 [0.02]***	0.08 [0.04]**
R-squared			0.33	0.25
Obs	1742	1742	1742	250

Note: This table examines the effects of historical Protestant activities on development of modern educational system in the early 1920s of China. Each observation is a county in 2000. In all specifications, the unreported control variables include: longitude, latitude, distance to provincial capital (in logs), altitude (in logs), and regional fixed effects. Development of modern education is measured by enrollment rate (in logs) of Church primary schools (column [1]), Public primary schools (column [2]), and primary schools in total (column [3] and [4]). ln (Converts/Pop1920) is the logarithm of converts in each county in 1920 normalized by population. The cross-county spillover effects are captured by the weighted average of Converts/Pop in 1920 in contingent neighboring counties (in logs). Coefficients are reported with standard errors in brackets. \*\*\*, \*\*, and \* indicate significance at 1%, 5% and 10% levels.

**Table 8. Effects on current economic development: Channels**

	OLS				2SLS			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln(Convert/Pop1920)	0.06*** [0.008]	0.04*** [0.008]	0.05*** [0.008]	0.04*** [0.008]	0.16** [0.065]	0.13* [0.068]	0.14** [0.068]	0.12* [0.069]
ln(Years of schooling)		0.16*** [0.016]		0.15*** [0.017]		0.13*** [0.028]		0.12*** [0.027]
Child mortality rate			-0.06*** [0.010]	-0.04*** [0.010]			-0.05*** [0.014]	-0.03** [0.012]
Adjusted R-squared	0.358	0.391	0.369	0.395	0.296	0.348	0.325	0.362
F-stat on IV					26.89	23.81	24.07	22.27
Obs	1742	1742	1742	1742	1742	1742	1742	1742

Note: This table reports estimates of equation (1), where historical Protestant activities are instrumented by historical frequency of extreme weather. Observations are at the 2000 county level. Columns (1) through (4) report estimates of the OLS results while columns (5) through (8) report estimates of the second stage. The dependent variable is the logarithm of year of GDP per capita in 2000. The main independent variable is the logarithm of year of schooling and the child mortality rate in 2000. ln(Converts/Pop1920) is the logarithm of converts of each county in 1920 normalized by population. Panel B reports estimates of the OLS results. Instruments include the flood and drought frequency between 1880 and 1920. Coefficients are reported with standard errors in brackets. \*\*\*, \*\*, and \* indicate significance at 1%, 5% and 10% levels.

**Table 9. Effects of Protestant activities on economic development after adjusting for education and health: bounding analysis**

		Child mortality rate						
		(1) 0	(2) 80% $\delta_2$	(3) 100% $\delta_2$	(4) 120% $\delta_2$	(5) 150% $\delta_2$	(6) 180% $\delta_2$	(7) 200% $\delta_2$
ln(Years of schooling)	(1) 0	0.16 [0.07]**	0.14 [0.06]**	0.14 [0.06]**	0.14 [0.06]**	0.13 [0.06]**	0.13 [0.06]**	0.12 [0.06]*
	(2) 80% $\chi_2$	0.13 [0.06]**	0.12 [0.06]*	0.12 [0.06]*	0.11 [0.06]*	0.11 [0.06]*	0.1 [0.06]*	0.1 [0.06]
	(3) 90% $\chi_2$	0.13 [0.06]**	0.12 [0.06]*	0.11 [0.06]*	0.11 [0.06]*	0.11 [0.06]*	0.1 [0.06]	0.1 [0.06]
	(4) 100% $\chi_2$	0.13 [0.06]**	0.11 [0.06]*	0.11 [0.06]*	0.11 [0.06]*	0.1 [0.06]*	0.1 [0.06]	0.09 [0.06]
	(5) 110% $\chi_2$	0.12 [0.06]*	0.11 [0.06]*	0.11 [0.06]*	0.1 [0.06]*	0.1 [0.06]	0.09 [0.06]	0.09 [0.06]
	(6) 120% $\chi_2$	0.12 [0.06]*	0.11 [0.06]*	0.1 [0.06]*	0.1 [0.06]	0.1 [0.06]	0.09 [0.06]	0.09 [0.06]
	(7) 140% $\chi_2$	0.11 [0.06]*	0.1 [0.06]	0.1 [0.06]	0.09 [0.06]	0.09 [0.06]	0.08 [0.06]	0.08 [0.06]

Note: This table reports estimates of equation (4). Each cell reports the results of a separated regression. They are the 2SLS estimates of the coefficients on  $\ln(\text{Converts/Pop})$  in 1920 that are instrumented by flood and drought frequency in 1900-1920. The dependent variable is  $\ln(\text{GDP per capita})$  in 2000. The returns to education and health care outcomes stem from OLS coefficients in an auxiliary regression of the  $\ln(\text{GDP per capita})$  on years of schooling, child mortality rate,  $\ln(\text{Converts/Pop})$ , and the control variables (as reported in column (5) of Table 2). To adjust for the potential bias of the OLS estimates, the coefficient on years of schooling is multiplied by factors indicated in the stub headings, and coefficient on child mortality rate is multiplied by factors indicated in the column headings. Coefficients are reported with standard errors in brackets. \*\*\*, \*\*, and \* indicate significance at 1%, 5% and 10% levels.

**Table 10. Growth rate of GDP per capita before and after 1978**

	Dep. Var.: Growth rate of GDP per capita from year t to t+1					
	1952-1977			1978-2008		
	(1)	(2)	(3)	(4)	(5)	(6)
ln (Converts/Pop1920)	0.007 [0.012]	0.007 [0.008]	0.009 [0.008]	0.016 [0.004]***	0.016 [0.003]***	0.017 [0.003]***
GDP per capita (year t)			-0.168 [0.163]			-0.003 [0.004]
Year FE	No	Yes	Yes	No	Yes	Yes
Obs	468	468	468	540	540	540
R-squared	0	0.62	0.62	0.03	0.55	0.55

Note: This table examines the effects of historical Protestant activities on provincial level GDP growth rate before and after 1978. The dependent variable is the GDP per capita growth rate from year t to year  $t+1$ . Historical Protestant activities are measured by the logarithm of provincial-level converts per 1,000 people in 1920. Other control variables include provincial-level GDP per capita at year t, and the year dummies. Coefficients are reported with standard errors in brackets. \*\*\*, \*\*, and \* indicate significance at 1%, 5% and 10% levels.