The Mission: Human Capital Transmission, Economic Persistence and Culture in South America*

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April 12, 2017

Abstract

This article examines the long-term consequences of a historical human capital intervention. The Jesuit order founded religious missions amongst the Guarani, in modern-day Argentina, Brazil, and Paraguay. Missionaries instructed indigenous inhabitants in reading, writing and various crafts, before their expulsion in 1767. Using archival records and municipal census data, I show that educational attainment was and remains higher (by about 15%) 250 years later in areas of former Jesuit presenence. These educational differences also translate into 10% higher incomes today. The differential effect of Jesuit missions emerges after comparing them with abandoned Jesuit missions and Franciscan missions. The enduring effects observed are consistent with transmission mechanisms of occupational and cultural persistence. Robustness checks suggest that results are not driven by migration, urbanization or tourism.

Keywords: Economic Persistence, Human Capital, Culture, Religion, Missions, Institutions, Structural Transformation, Technology

JEL: I25, N36, O15, O43, Q16, Z12

*I thank the editor, Andrei Shleifer, and three anonymous referees. I thank Hans-Joachim Voth for his guidance and support as well as Oded Galor, Guy Michaels and Marta Reynal-Querol. I thank Jörg Baten, Alex Eble, Eduardo Engel, Leopoldo Fergusson, Nicola Gennaioli, Rachel McCleary, Ömer Özak, Jacopo Ponticelli, Pablo Querubín, Ferdinand Rauch and Yanos Zylberberg for comments. I have benefited from conversations with Tim Besley, Pedro dal Bó, Melissa Dell, Jeremiah Dittmar, Quoc-Ahn Do, Mauricio Drelichman, Ruben Enikolopov, James Fenske, Claudio Ferraz, Paola Giuliano, William Maloney, Stelios Michalopoulos, Luigi Pascali, Giacomo Ponzetto, Martin Rossi, Shanker Satyanath, Moritz Shularick, Rodrigo Soares, Leonard Wantchekon and Fabrizio Zilibotti, as well as from comments by participants at the NEUDC 2014, SAEe 2014, RES 2015, WEHC 2015, RIDGE 2015, FRESH 2015, ZEF, Brown, NYU, Georgetown, UBC, LSE, Oxford, Warwick, Sciences Po, Louvain, UPF, CREi, PSE, Zurich, Bonn, LMU, Humboldt, Gothenburg, UNSW, ANU, Queen Mary, Navarra, Utretch, FGV Rio / SP, UDP, Los Andes, El Rosario and Javeriana Universities. Financial support from Universitat Pompeu Fabra and the Catalan Government (FI-DGR) is gratefully acknowledged. All remaining errors are mine.

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> "When in 1768 the missions of Paraguay left the hands of the Jesuits, they had arrived at perhaps the *highest degree of civilization* to which it is possible to conduct a young people." "The Jesuits have civilized the [Guaranis], have taught them to be industrious, and have succeeded in governing a vast country (...) [making] a virtue of subduing savages by mildness and *instruction*."
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> Voltaire, 1756 and 1770.[1]

1 Introduction

The importance of history in economic development is well-established. Historical shocks and "critical junctures" have been shown to influence modern outcomes through geography and natural endowments, legal origins and institutions, genetics, human capital and culture.[2] Although historical persistence of outcomes appears to be strong in many cases, the channels of transmission are less clear. While Europeans often imposed extractive institutions and created exploitative economic relationships (Acemoglu et al. 2001), they also transferred human capital, cultural values and technological know-how (Glaeser et al., 2004, Easterly and Levine, 2016), which may have led to beneficial effects in the long run. Focusing on extractive institutions, Dell (2010) stresses the negative effect of the *mita* labor system in Latin America, and Nunn and Wantchekon (2011) document the adverse effect of African slavery through decreased trust. Less is known, however, about how other colonial arrangements might have led positive outcomes in the long run.

In this paper, I demonstrate the important benefits of European missionary activity in South America. Jesuit missionaries settled in what were essentially the frontier lands of the Spanish and Portuguese empires, before being expelled from the continent in 1767. While religious conversion was the official aim of the missions, they also enhanced human capital formation as a result of schooling children and training adults in various crafts.[3] I focus on the repercussions of the Guarani

[1] *Histoire Philosophique et Politique des Indes* (1770) and *Essay on the Customs and the Spirit of the Nations* (1756). In Graham (1901), p. 52. Emphasis added.

[2] The literature on historical persistence has been recently summarized in Nunn (2009 and 2013), Spolaore and Wacziarg (2013) and Michalopoulos and Papaioannou (2017). Seminal contributions on these determinants include Diamond (1997), Engerman and Sokoloff (1997), Gallup et al. (1999), La Porta et al. (1998), Acemoglu et al. (2001 and 2002), Ashraf and Galor (2013), Glaeser et al. (2004) and Landes (1998).

[3] Compared to McCleary and Barro (2003 and 2006), Guiso et al. (2003), and Glaeser and Sacerdote (2008), I emphasize less the direct effects of religion and more its human capital externalities (Becker and Woessmann, 2008

Jesuit Missions in modern-day Argentina, Brazil and Paraguay. In municipalities where Jesuits carried out their apostolic efforts, median years of schooling and literacy levels remain markedly higher after almost 250 years. These differences in educational attainment of 10-15% have also been translated into higher modern per capita incomes of nearly 10%. To explain such enduring differences, I analyze cultural and occupational transmission mechanisms. I find that people closer to missionary areas specialize in relatively more skilled labor, moving away from agriculture and towards manufacturing and services, as in Botticini and Eckstein (2005, 2007 and 2012).

The Jesuit conversion and education of the Guarani allows for a unique set up to study the potential long-term impact of religious missionaries. I exploit the fact that Jesuits were expelled from the Americas in 1767, following political disputes in Europe. This event precludes any direct continuation effect as a result of enduring treatment. The political rupture between the Jesuit order and the Spanish Crown was arguably exogenous to the location of proselytizing activities amongst the Guarani. Therefore, before-and-after identification provides a suitable setting for examining the persistence of income, human capital and culture.[4] The early stage of development of the indigenous inhabitants also makes the setting special. To disentangle the national institutional effects from the human capital shock, I focus on fine-grained within country (and state) variation in missionary activity in three different nations. The area under study was populated by a single semi-nomadic indigenous tribe, so I can abstract from the direct effects of pre-colonial ethnic tribes (Michalopoulos and Papaioannou, 2013; Maloney and Valencia Caicedo (2016)). The Guarani area also has broadly similar geographic and weather characteristics, though I still control for a host of such variables in the estimation.

To assess the impact of the Guarani Jesuit Missions I assemble a novel data set that combines archival information about the missions with modern outcomes at the municipal level. The geo-coded data set covers the municipalities in the states of Misiones and Corrientes in Argentina, Rio Grande do Sul in Brazil, and Misiones and Itapúa in Paraguay (Figures 1 and 2). To quantify the

and 2009; Botticini and Eckstein, 2005 and 2007).

[4]The effect of Protestant missions has also been analyzed by Nunn (2010 and 2014) and Cagé and Rueda (2016) for the African case.

Jesuit missionary treatment I use as main explaining variable distance to the nearest mission. I then estimate an econometric model of modern outcomes –such as education and income– based on this measure of missionary presence. I find a positive effect on educational attainment of 15% (.8 median years of schooling) and income (or reduced poverty) of 10%. The human capital effects are greater during historical periods. Still, the location of the Jesuit missions can still be endogenous.

To address the potential endogeneity of missionary placement, I conduct two empirical tests. The first one is a placebo type test that looks at missions that were initially founded by the Jesuits but were abandoned early on (before 1659). I can thereby compare places that were initially picked by Jesuit missionaries with those that actually received the missionary treatment. I find no effect for missions that were abandoned by the Jesuits, which suggests that what mattered in the long run is what they did and not where they first settled. Second, I study the potential effect of neighboring Guarani Franciscan Missions. The comparison is relevant in that both orders wanted to convert souls to Christianity, but Jesuits emphasized education and technical training in their conversion. Contrary to the Jesuit case, I find no positive long-term effect –on either income or education– for Franciscan Guarani Missions.[5]

Lastly, I focus on mechanisms of transmission. I find that municipalities closer to historic missions have changed the sectoral composition of employment, moving away from agriculture and towards manufacturing and services. I document, for instance, that these places still produce more handicrafts such as embroidery, a skill introduced by the Jesuits. These areas also have more professionals in general and have specialized in skill-intensive industries. In particular, I find that former missionary areas have adopted faster new agricultural technologies such as genetically modified soy varieties (as in Bustos et al. 2016). Moreover, I find that knowledge –of skills, traditional medicine and myths– was transmitted differentially from generation to generation in these areas. Robustness tests suggest that results are not driven by migration, urbanization or tourism.

[5]I also employ an Instrumental Variables estimation strategy in the Appendix, using the distance from early (pre Jesuit) exploration routes as well a distance to Asunción, for the Brazilian sub-sample of the data.

The rest of the paper is organized as follows. Section 2 provides the context in terms of the relevant literature and historical background. Section 3 describes the data and presents the empirical strategy. Section 4 contains the main results on education and income. It also presents the results for abandoned Jesuit missions and Franciscan missions as well as intermediate historical outcomes. Section 5 discusses occupational and cultural transmission mechanisms. Section 6 contains the robustness checks and Section 7 concludes.

2 Context

2.1 Related Literature

This article builds on the historical development literature, which has been recently summarized by Nunn (2009 and 2013), Spolaore and Wacziarg (2013) and Michalopoulos and Papaiannou (2017). The literature has moved away from cross-country studies and towards sub-national analyses.[6] This piece relates more specifically to the literature on the aftermath of colonialism and the impact of colonial investments.[7] I contribute to this literature by documenting the positive long-term effect of a specific colonial institution and examining the mechanisms behind economic and human capital persistence.

Of particular relevance to the current work are studies that emphasize the role of human capital for long-term economic development. Seminal pieces and modern reinterpretations stress the importance of human capital accumulation for growth.[8] Micro evidence from Heckman (2000), and Hanushek and Woessmann (2008), among others, points toward the same direction for personal income. Questions remain, however, about the the degree of persistence and channels of transmission of human capital shocks, especially during historical times (Waldinger, 2012). I show here persistent educational differences after more than 250 years.

[6] See, for instance Banerjee and Iyer 2005, Nunn 2008, Bleakley and Lin 2012, Naritomi et al. 2012, Dell 2012, Jha 2013, and Michalopoulos and Papaioannou 2013

[7] As in Feyrer and Sacerdote 2009, Huillery 2009, Dell 2010, Bruhn and Gallego 2012, Becker et al. 2014, Grosfeld and Zhuravskaya 2014, and Jedwab et al. 2014

[8] See Mankiw et al. (1992), Benhabib and Spiegel (1994), Barro (2001), Glaeser et al. (2004), Galor (2011), Gennaioli et al. (2013 and 2014).

Cultural explanations of economic performance date back to Max Weber's Protestant work ethic hypothesis (Weber, 2011). The importance of cultural norms for economic activity was restressed by Greif (1993 and 1994) and Putnam et al. (1994) and recently summarized by Alesina and Giuliano (2015). Both the positive (Guiso et al. forthcoming, Tabellini 2008) and negative (Grosjean 2010; Voigtländer and Voth 2012; Grosfeld et al. 2013) long-term effects of culture have been documented in the literature. Such historical studies avoid the issue of reverse causality, but cannot disentangle the continuation effect of the phenomena analyzed, be it social capital or anti-Semitism. An outstanding empirical question is whether cultural traits are transmitted horizontally or vertically, as in the theoretical models of culture of Cavalli-Sforza and Feldman (1981), Boyd and Richerson (1985), and Bisin and Verdier (2000 and 2001). I emphasize occupational persistence and its relation to structural transformation (as in Botticini and Eckstein 2005, 2007 and 2012) and present empirical evidence for vertical transmission.

Religion is a fundamental aspect of culture. Classic papers on this topic include Iannaccone (1990), Guiso et al. (2003), McCleary and Barro (2003 and 2006), Glaeser and Sacerdote (2008), and modern re-interpretations include Becker and Woessmann (2008 and 2009), Botticini and Eckstein (2005, 2007 and 2012), Campante and Yanagizawa-Drott (2013), and Cantoni (2015). An emerging literature has explored the long-term effects of nineteenth-century Christian missions in Africa. At the country level, Woodberry (2004 and 2012) and Lankina and Getachew (2012) find a positive effect of Protestant missions on democracy. At the sub-national level, Nunn (2010) finds that missions resulted in higher levels of religiosity, Gallego and Woodberry (2010) and Nunn (2014) find a positive effect on educational attainment, and Cagé and Rueda (2016) on political participation. Acemoglu et al. (2014) use Protestant missions as instruments for education to argue that institutions had a significant impact on long-run development. Within countries, Wantchekon et al. (2015) find positive human capital externalities from religious schools in Benin, Okoye and Pongou (2014) on school provision in Nigeria and Wietzke (2015) in Madagascar. Outside Africa, Mantovanelli (2013) and Castelló-Climent et al. (2015) report a positive effect of missions on Indian literacy and higher education and Bai and Kung (2015) on Chinese economic performance.

I contribute to the emerging missionary literature in several ways. By focusing on Africa and excluding Latin America from the analysis the existing papers have essentially neglected an area with one of the most intense missionary presences. In a notable exception, Waldinger (2013) documents the positive impact of Mendicant orders in Mexico. I also go further back in time –from the nineteenth to the seventeenth century– and focus on Catholic as opposed to Christian missions. For instance, McCleary and Pesina (2011) and McCleary (2017) show that Guatemalan Christian missions established during the early twentieth century did *not* emphasize literacy in their conversion. I address here the potential endogeneity of missionary location and postulate novel occupational and cultural mechanisms through which missions may have had a persistent effect on income and education.

Lastly, this paper relates to the literature on technological transfer in a historical setting. Spolaore and Wacziarg (2009), Comin et al. (2010) and Maloney and Valencia Caicedo (2014) demonstrate the very long-term effects of technological shocks. Dittmar (2011) argues that the introduction of the printing press had a positive impact on urban growth in Europe between 1500 and 1600; Hornung (2014) finds a positive effect for the Huguenot diaspora in Prussia; and Squicciarini and Voigtländer (2014) relate French industrialization to *Encyclopédie* subscriptions. In this paper, I focus broadly on technological transmission and document the differential usage of specific technologies (e.g., embroidery and accounting) introduced by Jesuit missionaries as well as the adoption of new technologies in agriculture (genetically engineered soy).

2.2 Historical Background

The history of the Jesuits spans volumes, and I provide just a sketch here.[9] The Society of Jesus was founded as part of the European Counter-Reformation movement in 1534 at the University of Paris by the Basque knight St. Ignatius of Loyola *ad maiorem Dei gloriam* [for the greater glory of God]. From the outset it stressed education and Papal obedience. The Society of Jesus is a relatively new Catholic order when compared to the Order of Saint Benedict (founded in 529), as

[9]See, among many others Hernández (1913), Furlong (1955), Palacios and Zoffoli (1991), Carbonell de Massy (1992), and more recently Ganson (2003), Maeder and Gutiérrez (2009), Wilde (2009) and Sarreal (2014).

well as the Franciscan, Dominican and Carmelite Orders (all founded in the 1200s). The Jesuits were the last major Catholic order to arrive in the Americas through the Spanish and Portuguese empires. Religion was –along with profit making and a desire for adventure– one of the main reasons for embarking to the New World.

The Jesuit order's focus on human capital cannot be overemphasized. Furlong and Storni (1994) stress the Jesuit's contributions to human knowledge in terms of cartography, ethnography, linguistics, botany, mathematics and medicine, among others. Jesuits were at the technological frontier of the time, and their cultural contributions to both music and the arts are well-renowned. They introduced the printing press to Argentina, Brazil and Paraguay, and even established an astronomical observatory in San Cosme and Damián (Paraguay).[10] Jesuits also played an important role in the development of tertiary education in Brazil (Tobias, 1972). José de San Martín, who would go on to lead the independence movement of the Southern Cone, was born at the Jesuit mission of Yapeyú, in Corrientes, Argentina.

The first Jesuits arrived in South America at Salvador de Bahia, modern-day Brazil, in 1549 (Alden, 1996 and Bethell, 1984, chapter 14). Jesuits followed a two-pronged strategy: educating the elites in the major colonial capitals (Mexico City, Lima, Bogota and Quito) while developing indigenous missions in some of the most isolated (and contested) areas of the Spanish and Portuguese empires (Bethell 1984, chapter 15). The first Jesuit mission in South America was established in Juli in 1565 in modern-day Puno, at the border of Bolivia and Peru. Jesuits also started missions in Mainas (Peru), Moxos and Chiquitos (Bolivia), Casanare and Orinoco (Colombia and Venezuela), Baja California (Mexico), and California (United States). Outside the Americas, the Jesuits established missions in China, India and Japan during the sixteenth and seventeenth centuries.

The Guarani missions in modern-day Argentina, Brazil and Paraguay constitute the heart of the Jesuit missionary efforts (Figures 1 and 2). Jesuits arrived in Asunción, Paraguay, on August 11, 1588. From Asunción, they explored the surrounding area and established the first Guarani Jesuit

[10]It is worth noting that the printing press was not formally introduced into Brazil until the arrival of the Portuguese court in 1807 (Landes, 1998, p. 134).

Mission in 1609 (Figure A.1). Jesuit missions were still quite isolated from the colonial capital of Asunción, which itself only numbered 6,451 inhabitants in 1761 (Ganson, 2003). Jesuits were not the first to establish religious missions in the Guarani area, as the Franciscans had established their first Guarani mission in 1580 (Duran Estragó, 1987). The Jesuit original foundation was followed by a period of exploration that lasted for around fifty years, until 1659. Jesuits founded a total of 30 missions or *reducciones* (reductions) in the modern-day territories of Argentina, Brazil and Paraguay (Table A.1). At their peak, the Guarani Jesuit Missions involved more than 120,000 inhabitants (Figure A.2), four times the population of Buenos Aires in 1779.[11] Guarani Jesuit Missions constituted one of "the most original experiments of the spiritual conquest of the New World" (Roa Bastos, in Saguier, 1991, p. 9) and were admired by contemporaries as prominent (and anticlerical) as Voltaire.

The Guarani area was populated by the same indigenous tribe, also known as the *Tupis* in Portuguese. The Guaranis were semi-sedentary, and cultivated manioc root and maize through slash-and-burn agriculture. When the Jesuits arrived, the Guarani were considered to be at a Neolithic stage of development, lacking iron weapons and tools (Ganson, 2003), so the colonial human capital intervention took place in a primeval setting. By focusing on the Guarani area I abstract from the direct effects that different pre-colonial ethnic tribes have been shown to have in Africa and the Americas.[12] The geographic zone is covered by subtropical forests, its climate is humid, and the area contains no major mineral resources (Palacios and Zoffoli, 1991).

Even though the official aim of the missions was to convert souls to Christianity, the Jesuits taught children (boys and girls, separately) how to read and write and carry out basic arithmetic (Ganson, 2003). They also trained adults in masonry, wood carving and embroidery (Gálvez, 1995). This emphasis on education can be seen in Figure A.3, which reproduces a historical blueprint of the emblematic Guarani mission of San Ignacio de Miní, Argentina. Right next to the main square and the church, can be seen a school (*colegio*) for children along with a workshop (*taller*) for

[11] Ganson (2003) reports a maximum of 141,182 people in 1732.

[12] See, for instance Gennaioli and Rainer 2007; Michalopoulos and Papaioannou, 2013; Maloney and Valencia Caicedo, 2016.

adults. For the Spanish and Portuguese Crowns missions were a tool for incorporating people into the empire. For the Guaranis, missions provided not only educational opportunities but also security and protection (Sarreal, 2014). The communities were self-sustaining, were allowed to barter restrictively, and thrived raising cattle and producing *yerba mate* (Paraguayan tea).

The expulsion of the Jesuits represents a watershed moment in Latin American colonial history. After intense political fights in Europe, the Jesuits were expelled from Spain and Portugal –and their Latin American colonies– in 1767. Kings Charles III of Spain and Joseph I of Portugal, counselled by the Marquis of Pombal, pressured the (Franciscan) Pope Clement XIV to issue an order of expulsion.[13] The order was carried out with surprising efficacy in the Guarani area by Francisco de Paula Bucarelli, the Governor of Buenos Aires, so by 1768 no Jesuit missionaries reamained. Clement XIV proceeded to dissolve the Jesuit order in 1773. The Jesuits were exiled in Ferdinand the Great's Prussia and Catherine the Great's Russia and the order was not restored until 1814 by Pope Pius VII. The Jesuits missionaries were never to return to the Guarani area.

3 Data and Empirical Strategy

3.1 Data

I use archival records, government census data and household surveys to run my empirical analyses. My data set covers all of the municipalities in the five states of three countries where the Guarani Jesuit Missions were originally located (Figure 2). Namely, the states of Misiones and Corrientes in Argentina, Rio Grande do Sul in Brazil, and Misiones and Itapúa in Paraguay. In total, there are 578 observations, covering around ten million inhabitants, that correspond to the municipal or third level divisions of these countries (*departamentos* in Argentina, *municipios* in Brazil, and *distritos* in Paraguay). Although quite specific, the area under consideration is not small and comparable in size to Uruguay or Ecuador.

[13]The order became effective in 1759 in Portugal and the Portuguese territories and in 1767 in Spain and their Spanish counterparts.

The data come from three separate sources. First, there is information taken from historical archives on the location, year of foundation, population and general workings of the Guarani Jesuit Missions.[14] Additional historical data come from the National Censuses of Argentina in 1895 and 1914; Brazil in 1890, 1920 and 1940; and Paraguay in 1950. Second, there is an extensive set of geographic and weather controls at a highly disaggregated level from BIOCLIM and comparable sources.[15] Third, there are a series of educational outcomes (literacy and median years of schooling) and income (or poverty) measures from modern censuses for Argentina (2001, 2010), Brazil (2000, 2010) and Paraguay (2002, 2012). Modern census data are in turn complemented by two specialized survey modules on culture from the 2006 Brazilian Municipal Survey and the Paraguay Public Household Survey of 2011.

Summary statistics for some of the key variables can be found in Table 1, by missionary proximity, divided into education, income Jesuit missionary presence, geographic and weather characteristics. Aside from standard measures, I include more sophisticated controls, such as ruggedness and distance to rivers that may have been relevant for missionary settlement. Literacy levels border 90% and median years of schooling 5.08, which are typical values for Latin American developing countries. Municipalitiess 50 kilometers or closer to missionary areas appear more literate and with higher income.[16] The specific variables used along with their sources and units are described in detail in the Data Appendix.

3.2 Estimating Equations

In order to estimate the effect of Jesuit missions on contemporary outcomes, I use the following econometric models:

$$HK_{2000,ij} = \alpha + \beta d(M_{ij}) + \gamma GEO_{ij} + \mu_j + \epsilon_{ij} \quad (1)$$

[14] These include the *Archivo de Indias* (Seville), *Archivo General de la Nación* (Buenos Aires), *Archivo Nacional* (Asunción) and the Roman Jesuit Archives (Vatican).

[15] http://www.worldclim.org/bioclim, see the Appendix for more detailed sources and definitions.

[16] Poverty rates available for Argentina and Paraguay tell a different picture, though differences are not significant. I complement missing data with similar indicators such as nighttime satellite data in the Appendix.

$$f(Y_{2000,ij}) = \alpha + \beta d(M_{ij}) + \gamma GEO_{ij} + \mu_j + \epsilon_{ij} \quad (2)$$

where HK and Y are human capital and income in municipality i in state / country j in equations 1 and 2, respectively. M measures missionary presence at the municipality level and the d function is either a missionary dummy or distance to the nearest mission in kilometers. Hence the coefficient of interest is β which in the case of a positive effect would be positive in the dummy formulation and negative in the distance to the nearest mission formulation. GEO is a vector of geographic and weather controls with a corresponding vector of coefficients γ. μ captures a country or state-fixed effect, depending on the specification. α is a generic constant and ϵ is an idiosyncratic error term. I use a similar formulation to Equation 1 when I analyze cultural outcomes. To actually estimate the equations above, I use OLS with fixed effects.[17]

3.3 Identification

The identification of the missionary effect hinges on several assumptions. First, the historical record suggests that the foundation of the missions proceeded in a relatively haphazard manner. Hernández (1913) describes as a "coincidence" the entrance of the Jesuit priests to Paraguay. Other historians describe the foundation of San Ignacio de Guazú as an unprecedented "adventure" and the initial establishment of the first missions as "perilous and random" (Astrain, 1996). The remarkable success of some missionaries is contrasted with the failure and even death of some of their contemporaries. Priests like Antonio Ruíz de Montoya, were very successful in founding several missions, while others like Diego de Alfaro and Alfonso Arias died trying. I also control directly for favorable geographic conditions such as low altitude and proximity to rivers that might have influenced the initial settlement choices.[18] Being the last Catholic order to arrive to the Americas, the Jesuit missionaries had last pick and ended up in peripheral areas of the Spanish

[17] I use robust standard errors throughout, except when the number of observations is too small and I jointly report bootstrapped standard errors. I also use Conley (spatial) standard errors for robustness.

[18] In the robustness section, I show that the Jesuit areas do not have higher population densities in modern and pre-colonial times.

and Portuguese empires.[19]

4 Main Results

4.1 Human Capital

4.1.1 Raw Data

Before running any regression, Figure 3 summarizes the spirit of this section. The graph plots modern literacy rates for people aged 15 and older versus distance to the nearest Jesuit mission in kilometers. Municipalities that had missions (orange triangles) cluster at the left hand upper corner with rates above 90%.[20] It appears with the linear trend line that the farther away a municipality is from a historic mission, the lower its literacy level. This unconditional relationship is negative and highly significant with a t-statistic of -4.36. Although literacy rates are relatively high and have converged in modern times, the negative relationship appears substantial and remarkable given the 250 year lag. To better quantify this phenomenon I estimate Equation 1 using literacy rates for the three countries and median years of schooling, which is only available at the municipality level for Brazil. The pattern already observable in the raw data is confirmed in the regressions.

4.1.2 Literacy Rates

As a proxy for human capital I use il/literacy rates, which are reported for the three countries. The results of estimating Equation 1 using this variable and the distance formulation can be seen in Table 2. The point estimates are positive and significant for illiteracy rates without and with a geographic controls (Columns 1 to 2). With a mean literacy rate of around 90%, the effect estimated suggests a reduction in illiteracy of at least 10% when moving 100 kilometers closer to a mission.[21] Though I do not find any interactive effects by country, the missionary effect on

[19] I examine this issue further in the section contrasting Jesuit and Franciscan missions. This comparison, along with the study of abandoned missions aim to get at the causal impact of the Jesuit Missions.

[20] Note that distances for missionary districts are not necessarily zero, as they are measured from the municipality's centroid.

[21] Although the R-squared is quite low, a Shapley decomposition reveals that the distance coefficient explains 10% of its variation.

education is notable given the different historical and institutional trajectories of Argentina, Brazil and Paraguay. The education results are comparable in size and slightly larger than the ones found by Nunn (2014) for Christian missions in Africa.

4.1.3 Median Years of Schooling

As an alternative proxy for human capital, I use data on median years of schooling for Brazil. The results using this variable are similar to the previous ones using literacy. The coefficient is negative and statistically significant (Column 3).[22] With a mean value of 5 years of education, the estimates suggest that moving 100 kilometers closer to a mission increases years of schooling by .67 years or almost 15%. So these magnitudes are economically important, especially when considering that Brazil has a low level of education, even by Latin American standards (Hanushek and Woessmann, 2012). Notably, the results are also in the 10% ballpark of educational benefits of the Brazilian *Bolsa Familia* conditional cash transfer program (Glewwe and Kassouf, 2012).

4.2 Income and Poverty

4.2.1 Per Capita Income

The results of estimating Equation 2 using the the distance formulation for income can be seen again in Table 2 for Brazil and Paraguay. The coefficients appear negative and strongly significant without and with geographic controls (Columns 4 and 5). Being 100 kilometers closer to a mission brings a maximum of .2 log points of income per capita.[23] To gauge the economic importance of the human capital results, I run a specification of income on literacy, instrumented by distance to the nearest Jesuit mission (not shown). The unconditional estimates are of around 27% while the ones with geographic and weather controls are of around 8%, which is consistent with micro evidence in general and the particular estimates for Argentina, Brazil and Paraguay (Psacharopoulos and Patrinos, 2004, and Acemoglu et al., 2014).

[22] For robustness, I look at the effect at different distance tresholds in the Appendix (Table A.2). The effects are stable and, if anything, larger at the local level.

[23] Results at different distance thresholds can be found in Figures A.4 adn A.5 as well as Table A.2. I also present alternative formulations such as logarithmic specifications and income proxies using nighttime satellite data in the Appendix (Figure A.6, Tables A.3 and A.4).

4.2.2 Poverty: Unsatisfied Basic Needs Index

Due to data limitations, I study Argentina and Paraguay separately using instead the Unsatisfied Basic Needs (UBN) Index as a multidimensional measure of poverty.[24] The coefficient for distance to the nearest mission now emerges significantly positive in Column 6 for individual poverty. By construction, the poverty index allows for an easier interpretation of the results. In terms of magnitude, as one moves 100 kilometers farther away from a missionary district, the poverty index increases by approximately 10%. The results are also robust to using the household as opposed to the person UBN index (Column 7).

4.3 Abandoned Missions

Jesuit missionaries might have sorted into better places, beyond observable geographic and weather characteristics.[25] In order to address the potential endogeneity problem of missionary location I conduct a placebo type test where I look at missions that were initially founded but abandoned early on by the Jesuits. This goes to the heart of the question as to whether Jesuits simply picked better places *ex ante*. In particular I retrieve the coordinates for the abandoned missions of Guayra, Alto Paraná and Itatín, which did not receive the full missionary treatment of the Guarani missions. In the absence of a grand plan for the construction of the Jesuit missions, these abandoned establisments are as close as I can get to unbuilt missions (see for instance, Bolton 1917, Greenstone et al. 2010 and Michaels 2008).

The nearby missionary nuclei of Guayra, Alto Paraná and Itatín were founded during the exploratory missionary period lasting for 50 years until 1659. In the Guayra region the Jesuits founded Loreto and San Ignacio in 1610; and in Alto Paraná they founded the missions of Nuestra Señora de la Natividad de Acaray in 1624 and Santa María la Mayor de Iguazú in 1626. In the

[24]The UBN methodology seeks to determine, with the help of a few simple indicators, if the population's basic needs are being satisfied. The groups that do not reach the minimum threshold are classified as poor. The selected simple indicators are: inadequate housing, housing with critical overcrowding, housing with inadequate services, households with high levels of economic dependence, and households with school-age children not enrolled in school. The UBN index is normalized from 0 to 100.

[25]I quantify this possibility by calculating Altonji ratios (Altonji et al. 2005), which suggest that selection on unobservables would have to be more than 4 times larger than selection on observables to drive the results.

Itatin region they founded several reductions the last of which was Yatebó in 1634. Itatin foundations were disbanded in 1648 and finally relocated in 1659. The Guayra foundations lasted from 1610 to 1630 and the Alto Paraná nuclei from 1609 to 1638. These missions were abandoned early on and were not integrated with the rest of the Guarani system of missions (Hernández, 1913 and Furlong, 1955).

The principal threat to the survival of these missions was their proximity to the Portuguese bands of slave hunters or *bandeirantes* (Ganson, 2003). The *bandeirantes* attacks started in 1611 and intensified from 1628 to 1632. Father Diego de Alfaro was was killed by the Portuguese in 1637 Garruchiños and Alfonson Arias in 1645 in Itatin (Hernández, 1913). The whole Guarani area would remain prone to attacks, as evinced by the *bandeira* of Francisco Pedroso Xavier in 1676.[26] The *bandeirantes* were not the only threats to the consolidation of missions, which also depended critically on the survival of priests. The early years of 1650-1655 are described as the worst in terms of Jesuit recruitment to the New World (Galán García, 1995). Jesuit priests faced difficult circunstances and even death in the apostolic front lines. Such deaths were critical blows to fledging missions, which counted only one or two Jesuit priests per mission.

I find no effects for the abandoned missions, either in terms of education or income. For literacy (Table 3, Columns 1 to 4), some of the coefficients are significant separately but appear now with the opposite (positive) sign.[27] When estimated jointly, they lose significance or do not appear with a consistent sign. As can be seen in the last four Columns of Table 3, the coefficients for income for the missions of Alto Paraná, Guayra and Itatin are not significant either separately or jointly. The findings in this section suggest that it was not just the original placement of missions but the actual development of the missionary activities for centuries which had an effect in the long-term.

[26] For robustness, I control directly for horizontal distance to the Tordesillas line that divided the Spanish and the Portuguese empire, from which the *bandeirantes* departed, which leaves the results unchanged.

[27] The Guarani Jesuit mission results are robust to the inclusion of these abandoned missions (not shown).

4.4 Franciscan Guarani Missions

The study of Franciscan Guarani Missions allows for the comparison between two Catholic orders with a different focus in a similar area. The analysis is a relevant one, as many of the elements that led to their location—such as indigenous availability, European presence, favorable climatic and geographic conditions—were common to the Jesuit missions. Ultimately, both Catholic orders wanted to maximize the number of souls converted to Christianity. However, relative to the Jesuits, Franciscans did not stress human capital formation and technical training in their conversion.

The first Guarani Franciscan Missions were established between 1580 and 1615 by Fathers Bolaños and Alonso, while the first Guarani Jesuit Mission appeared in 1609 (Durán Estragó, 1987). By choosing first, Franciscans located themselves further North and closer to the existing population centers. I study the early missions of Altos founded in 1580, Itá in 1585, Yaguarón in 1586; Atyrá, Guarambaré, Tobatí and Ypané from 1580 to 1600, Caazapá in 1606, and Yuty in 1611. I use the exact location and historical population data for these Franciscan Guarani Missions.

An initial way to see the differences between Jesuit and Franciscan Guarani Missions is by using contemporary population data. Figure 4 shows the mean population in both sets of missions from 1640 to 1760. Though the data series is incomplete, the divergence between Jesuit and Franciscan missions is apparent (Maeder, 1995).[28] Starting from a similar base of around 1,500 people, Jesuit missions reached almost three times that number at their peak in 1730. By comparison, Franciscan missions remained fairly stable in terms of population, declining from 1720 onward. In a Malthusian population regime, these differences in population can also be interpreted as early differences in income (Galor and Weil 2000; Ashraf and Galor 2011).

Second, I test directly whether Franciscan missionaries had the same effects as Jesuits in the long term, by re-estimating the human capital and income equations, using instead distance to the nearest Franciscan mission. The results, or lack thereof, can be seen in Table 4. I find no effect for

[28] Even when they were devoted to similar activities (cattle raising and *yerba mate* cultivation), the Jesuits proved more effective (Maeder, 1995).

either modern literacy or income (Columns 1 and 2). In a horserace between the missions from the two orders I find that the beneficial effect on education and income is preserved for the Jesuits and appears now negative for the Franciscans (Columns 3 and 4). Even though the two variables are highly correlated, so it is hard to take these results at face value, it is still worthwhile to discuss what could be driving the disparities.

First there is a difference in terms of focus. As has been argued before, from the outset there was a clear emphasis on human capital formation and technical training on the part of the Jesuits, a difference that prevails today (Langer and Jackson, 1995). The mendicant orders, to which the Franciscans belonged, were characterized since their inception by tending for the sick and the poor, charitable giving and reducing inequality; "The Jesuit order, in contrast [to the Mendicant orders], was not defined by its commitment to poverty and to the poor." Waldinger (2016, p. 2). In the last two columns of Table 4, I examine this possibility.[29] Areas closer to Franciscan missions do not seem to have lower levels of inequality relative to the Jesuit areas (Column 5). The same is true for health, proxied by mortality under five (Column 6). If anything, the Jesuit areas also do better in these regards. It is the Jesuit focus on human capital, which appears to have had a beneficial role in the long run.[30]

4.5 Intermediate Historical Outcomes

I examine intermediate human capital outcomes for to see how the effects I find for the modern era have been accumulated differentially over time. Additionally, the historical data can also be used to identify heterogeneous effects. I focus on the Argentinean Census of 1895, the Brazilian Census of 1920 and the (first) Paraguayan Census of 1950. Overall, I find that Jesuits missions had an even larger effect on human capital during historical periods.

[29] To see how the mendicant character of some Catholic orders actually benefited human capital formation in the case of Mexico, see Waldinger (2016). These Mendicant orders arrived very early on during the colonization of the country in 1524. A key distinction between the two scenarios is that the Jesuits focused more on elite education in Mexico City relative to Paraguay, where the missions took the lion's share of their apostolic efforts. "In Mexico, the order dedicated only minimal finances to the maintenance of missions in frontier areas." (Waldinger, 2016, p. 5). Institutionally, Franciscans were more open towards the colonial labor system of *encomienda*, while Jesuits were more successful in obtaining lower labor tributes and taxes from the Spanish Crown (Salinas, 2010).

[30] Intrumental Variables results are reported in the Appendix (Table A.6).

Table 5 presents the results for the 1895 Argentinean census (Columns 1 to 4). Due to the small number of observations, I also report bootstrapped standard errors. Illiteracy appears consistently higher the farther away the municipality is from a Jesuit mission. The results are not only positive and significant but also larger in magnitude than before (Column 1). Being 100 kilometers closer to a mission leads to a reduction in illiteracy of 4%. The larger effect might be due to the significantly lower levels of literacy during this period, which had an average of 23% and a standard deviation of 8%. Alternatively, the missionary educational treatment might have faded away over time, so it is not surprising to see a stronger effect in the past.[31]

In terms of heterogeneity, the results are higher for females than males (Columns 2 and 3), consistent with the historical record. Results also appear concentrated among Argentineans as opposed to foreigners (Column 4).[32] This is sensible, as the first were largely the descendants of those who received the missionary treatment, while the second had only recently arrived to the country. The heterogeneous findings are also consistent with a story of vertical cultural transmission (Cavalli-Sforza and Feldman, 1981; Boyd and Richerson 1985; Bisin and Verdier 2000 and 2001) for the post expulsion period, a possibility I explore further in the mechanisms section.

The results for the 1920 Brazilian census are very similar to the ones for Argentina.[33] The effect on illiteracy is statistically significant and large for the entire sample (Table 5, Column 5). As for Argentina, the effect is also larger historically, in the order of 10% with a base of 35%. Again it appears concentrated on Brazilians as opposed to foreigners (Columns 6 and 7).[34] Results for the first Census of Paraguay in 1950 again reveal larger effects historically (Column 8) with a base of 74%. Additional results show a large degree of persistence between historical and modern levels of literacy (Figure A.8). This is especially true for Argentina, with a slope of .23, but also holds for Brazil, albeit with a higher degree of convergence with a slope of .193. A similar

[31] It is well known that literacy levels have converged during modern times (Hanushek and Woessmann, 2012).

[32] These results also hold when using the 1914 census (Table A.7). Using that census I find additionally that missionary areas have higher levels of educational instruction and schools per capita.

[33] For an analysis of migration in these countries see Droller (2015) and Rocha et al. (2015).

[34] Results for different age groups show a larger effect for those over 15 years of age versus those in schooling age from 7 to 14 years old, not shown. The literacy results also hold for the 1940 census, which census allows for the estimation of educational instruction as an alternative educational variable (Table A.7).

exercise with the 1950 Paraguay data reveals a slope of .217. All relationships are statistically significant at the 1% level. Though striking, this degree of historical persistence is not all that surprising if one considers the earlier results for the missionary period. Indeed, one interpretation of the intermediate historical results is that the missionaries altered the early levels of human capital, generating differences in accumulation that were observable during historical times and are prevalent even today.

5 Persistence Mechanisms

This section presents particular occupational and cultural mechanisms that can be behind the persistent human capital and income results observed. In his 1827 visit to the former mission of Loreto French naturalist Alcide D'Orbigny reported how indigenous inhabitants still lived "following the old missionary customs" (cited in Gálvez, 1995, P 392). I focus here on the persistence of occupational structures, technological adoption in agriculture and intergenerational knowledge transmission.[35] To this end I use information from modern censuses and household surveys for the three countries as well as two specialized surveys: the Brazilian Cultural Module of the 2006 Municipal Survey and the Cultural Module of the 2011 Paraguayan Household Survey.

5.1 Occupational Persistence

An important mechanism of cultural transmission comes from the long-lasting transformation of occupational structures. There is an inextricable link between human capital investment decisions and occupational choices (Doepke and Zilibotti, 2008). In the spirit of Botticini and Eckstein (2005, 2007 and 2012) individuals that attended religious missions, receiving instruction and technical training, moved away from agriculture to start a proto-artisan class. Three pieces of empirical evidence point towards this direction.

[35] In a companion piece, I perform lab-in-the field experiments with indigenous inhabitants in Paraguay and Argentina to better understand the micro mechanisms at play (Valencia Caicedo and Voth, work in progress). Preliminary evidence shows that people living in former Jesuit missionary areas possess higher non-cognitive abilities and exhibit more pro-social behavior.

First, I examine the broad occupational structure of Paraguay and Argentina using the 2012 Household Labor Survey and the 2001 Census, respectively.[36] Because the data is now at the individual level, I employ a probit specification with state fixed effects and errors clustered at the district level. In Table 6, it is evident that areas in Paraguay closer to Jesuit missions have moved away from agriculture to manufacturing and commerce, a proxy for services (Columns 1 to 3). The pattern for Argentina is very similar, showing a movement out from agriculture and into manufacturing and services (Columns 4 to 7).

I further examine more specific professions beyond broad occupational aggregates.[37] Embroidery was one of the crafts in which the Jesuit missionaries trained the Guarani. Father Antonio Sepp, S.J., (1655-1773) describes in his letters how he instructed the indigenous people to copy Dutch lace and embroidery in the workshops (Amable, 1996, p. 58). In the state of Rio Grande do Sul the most important handicraft today is precisely embroidery. Surprisingly, hundreds of years after the Jesuit expulsion, missionary areas report more prevalence of this activity (Table 7, Column 1). More generally, I also find more professionals and market-oriented skilled agricultural workers in the area (Columns 2 and 3). In terms of more specific occupations, I also encounter more teachers and blacksmiths (Columns 4 and 5). This is consistent with historical descriptions of the missions where, "Full-time craftsmen included blacksmiths, carpenters, statuary artisans, gilders, silversmiths, tailors, hat makers, and bronze fabricators such as bell makers" (Crocitti, 2002, p. 9). The results for Argentina are similar to those for Brazil. Again I find more artisans and educators in former Jesuit missionary territories, consistent with their technical and educational roles (Columns 6 and 7). Lastly, I look at accounting, which was introduced by the Jesuits and taught in the missions (Crocitti, 2002 and Blumers, 1992). This practice emerges more emphatically in missionary areas (Column 8). The results for specific professions are consistent with the technical and manual training promoted by the Jesuits.

[36] I examine the case of Brazil in the next section, when I look at the interaction of technological adoption and structural transformation. Labor force participation is analyzed in the Appendix.

[37] The data for Argentina is again from the 2001 census and for Brazil it encompasses the 2010 Census and the 2006 Municipal Survey. Information at this level of disaggregation is not available for Paraguay.

Lastly, I expand the analysis by looking at skill-intensive manufacturing industries following the categorizations of Romalis (2004) and Ciccone and Papaioannou (2009).[38] The idea is to test whether higher human capital led to specialization in industries that depend more intensely on this factor. I find and important effect for "tobacco", "non-ferrous metals", "beverages", "iron and steel", "fabricated metal products", "industrial chemicals", "transport equipment", "chemicals, other", "machinery, electric" and "plastic products" (Table 8, Columns 1 to 10). These are industries with medium to high levels of human capital according to the Ciccone and Papaioannou (2009) categorization. [39] I also find a significant effect for newspapers (Column 11), which are one of the top ten most skill-intensive industries in Romalis (2004). This finding squares well with the emphasis on literacy and the missionary results for Africa, whereby more Protestant missions during the XIXth and early XXth centuries led to higher newspaper readership (Cagé and Rueda, 2016). Overall, I find a relatively developed manufacturing industry, with some agro-industrial products, basic industrial inputs, machinery and supplies to the service industry. The more disaggregated findings at the industry level for Brazil square with the broader structural transformation described above and the better trained labor force needed to sustain it. The next section looks at the particular case of human capital aiding technological adoption in agriculture.

5.2 Technological Adoption

Another related mechanism of transmission relates to human capital and technological adoption. Nelson and Phelps (1966), and Benhabib and Spiegel (2005) have argued for the importance of human capital for technological adoption and modern economic growth. Foster and Rosenzweig (1995 and 1996) focus on agriculture through the adoption of High Yield Variety seeds during India's Green Revolution. I focus here on the adoption of genetically modified varieties of soy

[38] I thank an anonymous referee for suggesting this point. Such disaggregated data is only available for Brazil.

[39] Industrial and other chemicals are in the top three in their ranking, the highest being oil refineries, which are not present in the area. Interestingly, I also find the opposite or no effect for what Ciccone and Papaioannou (2009), rank as some of the least school-intensive sectors, namely: leather, apparel (clothing), footwear, textiles and furniture (not reported). The Romalis (2004) classification overlaps with the previous categorization for products such as machinery and electrical equipment, and has other products that are too advanced for the area such as space propulsion units and vehicles.

seeds in Brazil, following Bustos et al. (2016).[40] The hypothesis to test is whether areas with higher human capital close to Jesuit Missions adopted faster this new agricultural technology.

To begin with, I find a higher share of land harvested with soy closer to former Jesuit areas, controlling for time fixed effects and soy suitability (Table 9, Column 1). In Figure 5 as well as in columns 2 and 3 of the table we see that areas farther away from former Jesuit Missions have a lower share of land harvested with genetically engineered (GE) soy while the opposite is true for non-genetically engineered varieties.[41] Consistent with the argument in Bustos et al. (2016) that GE soy is a labor saving technology I also find higher agricultural productivity closer to Jesuit areas (Column 4). As a result of this, I find that that municipalities closer to Jesuit territories have now lesss workers agriculture, and more workers in manufacturing and services (Columns 5 to 7).

One way to interpret these results is as a heterogeneous effect for the findings in Bustos et al. (2016). Areas with higher human capital due to the historical intervention of the Jesuit missionaries were able to incorporate faster a newly introduced technology. This is consistent with the literature on human capital and technological adoption, especially in the context of agriculture. These results also speak to the issue of historical persistence and change. In this case a historical intervention allowed individuals to adapt to their changing environment through the implementation of newly available technologies.

5.3 Knowledge Transmission

As a specific element of cultural persistence I look directly at intergenerational knowledge transmission.[42] This type of transmission is crucial for sustaining the persistent nature of the results

[40] I thank an anonymous referee for suggesting this point and Bruno Caprettini for sharing and helping me navigate their data. I follow the changes specifications in their paper, which uses logs. Results have the same significance and magnitude, though smaller coefficients when I use distance linearly, not reported.

[41] Additional results (not reported) show that technical change in soy has been stronger in farms under the "Agricultural Familiar" or Family Agriculture program.

[42] I study the issue of differential indigenous assimilation in the Appendix (Table A.8).

shown.[43] The results of this exercise can be found in Table 10. First, I find that people closer to missionary areas report having acquired from their parents more knowledge about skills (such as mechanic or agricultural skills, carpentry, sewing and embroidery), as well knowledge of traditional medicine and folktales (Columns 1 to 3). Moreover, in areas closer to historical missions people report transmitting these same skills and traditional knowledge to others (Columns 4 to 6). So the empirical evidence suggests that, though the explanatory power is low, intergenerational knowledge transmission is a cultural mechanisms behind the persistent outcomes observed.

I also examine other literacy and cultural practices that are more related to the Jesuit interventions. Just as with embroidery and accounting, we now observe a similar result for the literacy practice of keeping a diary (Column 7). The same is true for the cultural practice of visiting a library (Column 8). Overall, it appears that areas closer to missions have higher levels of transmitted native knowledge and imported skills. The long-lasting prevalence of these portable skills is also consistent with theoretical models of intergenerational transmission (Cavalli-Sforza and Feldman, 1981, Boyd and Richerson 1985, Bisin and Verdier, 2000 and 2001). After the "transversal" transmission of skills from the part of the Jesuits, some of these traits seem to have been transmitted "vertically" from generation to generation.

6 Robustness Checks

In this last section, I present complementary evidence for the Jesuit effect on modern human capital and income. I do so by exploring alternative channels and analyzing heterogeneous effects. In particular, I rule out possible confounders such as population density, migration, and tourism.

6.1 Population Density

One of the most plausible alternative channels of transmission of the missionary effect is population density. The religious entities might just have initiated future urban agglomerations, as in Becker

[43] Information comes from the Cultural Module of the 2011 Paraguayan Household Survey. Special thanks to Yolanda Barrios, Norma Medina and Zulma Sosa from the Paraguayan statistical office for sharing these data.

at al. (2010) or Bai and Kung (2015) in the case of China. The results of this empirical test can be found in Table 11. I find, if anything, that places close to the Jesuit missions are less dense today (Column 1). These results do not come as a surprise when collated with the historical record, since Jesuit missionaries went to peripheral areas isolated from existing population centers. Even though the Jesuit missions thrived historically, by no means did these places become modern metropolises. I also explore the possible prior role of pre-colonial population density in Column 2. Data come from Maloney and Valencia Caicedo (2016) and are only available at the state level. I do not find that the states where Guarani Jesuit Missions were located are any denser relative to their Argentinean, Brazilian and Paraguayan counterparts.

6.2 Infrastructure and Market Access

I analyze here the potential role of infrastructure as a mechanism of transmission, using current road and railway networks. I find a significant effect of missionary distance on modern road network density (Column 3) and the opposite effect for railroad density (Column 4), reflecting the few lines on the Brazilian coast. I do not find any interactive effect of these variables with the human capital or income effects.[44] To give a sense of the magnitude of the missionary results, I compare them with distance to the capital (Columns 5 and 6). The coefficient of distance to the capital appears smaller, but the beta coefficients are of similar magnitude (.4 for literacy and -.2 for income).

6.3 Migration

To test for the possible role of migration I divide the Brazilian sample into municipalities with high and low mobility, namely, where people declare that they are residents or not of that municipality. It appears that the human capital results are concentrated among residents (Column 7). The results for non-residents are insignificant and smaller in magnitude (Column 8). It does not appear that people are sorting themselves into the missionary locations in modern times. If anything, there might have been historical outmigration from the area, so the results I find could

[44] I do find some interactive effects with rivers, the original transportation networks, when I look at intensity of treatment effects (Table A.5).

be seen as underestimates.[45] To test this spillovers hypothesis I run specifications where I exclude missionary districts, which leaves the results unchanged (Columns 9 and 10). The importance of such knowledge externalities has been stressed recently by Wantchekon et al. (2015) for Benin.

6.4 Health

I study here health as a human capital investment complementary to education. The data availability is restricted to Brazilian municipalities. I use standard indicators such as mortality under 5 years of age and infant mortality, as well as a multidimensional health index.[46] I find negative and significant coefficients for the health index suggesting better health outcomes in these areas (Column 11). Moving 100 kilometers away from a mission is enough to go from a high to a fair level of health development, a sizable downgrade.

6.5 Tourism

One last possible confounder of the Jesuit missionary results could be tourism. These areas might simply receive more visitors and this could explain their relative prosperity. Results of this test can be found in Column 12. I find no effect on tourism when using distance to the nearest Jesuit mission. The coefficient is slightly positive (opposite sign) and insignificant. The results are not surprising given the relative isolation and inaccessibility of the places studied, even nowadays.

7 Conclusion

Going back to Voltaire and the controversy over the Guarani Jesuit Missions, though it is hard to measure mildness, I do find significant long-lasting effects of these religious institutions on education and income. I show a positive and significant effect of 15% on median years of schooling

[45] Historically, missions grew through natural reproduction rather than immigration (Livi-Bacci and Maeder, 2004).

[46] The IFDM (Indice FIRJAN de Desenvolvimento Municipal) is the Brazilian counterpart of the UN Health Development Index (HDI). The health index includes items such as the number of prenatal visits and deaths due to ill-defined and avoidable causes. I also find positive and significant coefficients for the infant mortality and mortality under five measures, not reported.

and literacy, and even larger magnitudes during intermediate historical time periods. Places that are closer to historic missionary districts have incomes that are 10% higher today. The impact is specific to missions that were not abandoned and for those of the Jesuit as opposed to the Franciscan Order, which stressed less human capital and technical training in its conversion. The enduring differences are consistent with specific cultural mechanisms of occupational persistence, technological adoption and intergenerational knowledge transmission. Additional robustness tests suggest that results are not driven by urbanization, migration or tourism.

The Jesuit missionary results are consistent with those of Nunn (2014) for nineteenth-century Christian missions in Africa and similar in magnitude to well-established conditional cash transfer programs such as *Bolsa Familia*. It is remarkable that these effects are still observable centuries after the Jesuit expulsion and are present in countries with different national and institutional trajectories. The results point towards the importance of human capital investments for long-term economic development. Future research will further examine the (cooperative) behaviour of individuals *in situ* (Valencia Caicedo and Voth, work in progress).

Overall, the findings in this paper underscore the importance of particular historical events for long-term development and growth (Nunn, 2009 and 2013). Such historical accidents can be instrumental in answering policy-relevant questions for which few counterfactuals exist today. This type of research can help us uncover deep-rooted factors of development (Spolaore and Wacziarg, 2013). Far from advocating historical determinism, a thorough understanding of these historical forces and their implied constraints offers the opportunity to make development policies more targeted and effective.

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I. Data Appendix

A. Income and Poverty

Income: Data for Brazil comes from the *Instituto Brasileiro de Geografia e Estatística* (IBGE) and can be accessed through IPEA.[47] The data measures total annual income in 2000 in contemporary Brazilian R$. As is standard, I take the natural logarithm of this number. Comparable data for Paraguay are available from the World Bank (2008) World Development Report on Reshaping Economic Geography. The data are for mean per capita income in 2005 US dollars; for details see Maloney and Valencia Caicedo (2016).

Poverty: Since income data are not available at the municipality level for Argentina, I instead use comparable poverty data on the Unsatisfied Basic Needs (UBN) index measured for both households and individuals. The data for Argentina are from the *Instituto Nacional de Estadística y Censos* (INDEC)for 2001.[48] Similar data for Paraguay comes from the *Dirección General de Estadística, Encuestas y Censos* (DGEEC) and is for 2002.[49]

Nighttime Satellite Images: I use the nighttime satellite data from the F18-2010 mission, available at http://ngdc.noaa.gov/eog/dmsp/downloadV4composites.html.

B. Human Capital

Literacy: Illiteracy rates are measured in percentages of the relevant population. Data for Brazil are also from the IBGE is for people aged 15 or 25 and above in 2000. Data for Paraguay come from DGEEC and are for people aged ten years and above in 2002. Literacy data for Argentina are again from INDEC for people aged ten years and above in 2001.

Median Years of Schooling: Brazil's IBGE reports data on median years of schooling for people 25 aged years and above in 2000. No similar information is reported for Argentina or Paraguay.

C. Missionary Presence

Missionary Dummy: is the simplest measure and takes the value of 1 for the municipality that had a mission historically and 0 otherwise.

Missionary Distance: This more continuous variable denotes the closest distance between a municipality's centroid and a historical mission. It is measured in kilometers and calculated using

[47] http://www.ibge.gov.br/home/ and http://www.ipeadata.gov.br/
[48] http://www.indec.mecon.ar/
[49] http://www.dgeec.gov.py/

STATA and ArcGIS. This measure is more informative and flexible with respect to missionary boundaries. A similar measure is used to study the effect of abandoned and Franciscan Missions.

Missionary Population: For most of the thirty Jesuit missions I was able to obtain historic information on the indigenous population from the Archivo General de Indias and the Roman Jesuit Archive (Vatican). Though incomplete, the records cover the period from 1650 to 1790, giving a rough picture of the contemporary conditions of the religious establishments (see Figure A.2). Comparable information is also available for some Franciscan missions.

Year of Foundation: Similarly, I obtain the year of foundation of Guarani Jesuit Missions.

Mission Moved: Lastly, I construct a dummy variable taking the value of 1 if the Mission moved and 0 otherwise.

D. Geographic and Weather Controls

Area: Total area in squared kilometers taken from IBGE (2010) for Brazil, and calculated with ArcGIS for Argentina and Paraguay.

Altitude: Elevation measured in meters over sea level originally available at very high resolution from WorldClim and processed using ArcGIS.[50] Similar data are also available from IBGE (2000) for Brazil and used alternatively for robustness.

Latitude and Longitude: Measured in decimal degrees for the municipal centroid and taken from IPEA (2000) for Brazil, and calculated with ArcGIS for Argentina and Paraguay.

Temperature: Annual mean temperature measured in °C x 10 available originally at very high resolution (around 1 kilometer grid cells) from BIOCLIM (BIO12) and processed using ArcGIS.[51] Alternative comparable data are also available for Brazil from IPEA based on the Climate Research Unit of University of East Anglia (CRU-UEA) project.

Rainfall: Annual precipitation in millimeters also available from BIOCLIM (BIO1) converted using ArcGIS. Alternative data are also available for Brazil from IPEA based on the CRU-UEA project.

Ruggedness: Terrain ruggedness index in millimeters, originally available from Nunn and Puga 2012) at high-resolution (30 x 30 arc-seconds) and later processed using ArcGIS.[52]

Slope: Similar to ruggedness, in thousandths of a percentage point, also originally from Nunn and Puga (2012) at the grid cell level and processed with ArcGIS.

Distance to River: Distance to the nearest river in decimal degrees is calculated using ArcGIS with the waterways shape file for South America.[53]

[50] http://worldclim.com/
[51] http://www.worldclim.org/bioclim
[52] http://diegopuga.org/data/rugged/
[53] Available, among others at: http://mapcruzin.com/

Distance to Coast: Distance to the nearest coast in decimal degrees is also calculated using ArcGIS using the world coastline shape file.[54]

Coastal Dummy: Alternatively, a simple dummy taking the value of 1 for a municipality that has direct access to the coast and 0 if landlocked, also calculated using ArcGIS.

E. Historical Outcomes

Historical Education: Illiteracy rates are measured in percentages over the relevant population. Data for Argentina comes from the 1895 and 1914 censuses.[55] Data for Brazil is from the 1920 and 1940 censuses and data for Paraguay from the 1950 census.[56] The municipal level data provides information for different age groups and for males and females separately. Data for Argentina (1895 and 1914) and Brazil (1920) further distinguish between native and foreign literacy rates, while the former also distinguishes by gender. The Argentinean Census of 1914 and the Brazilian Census of 1940 also provide data on instruction, and the 1914 School and Education Census for Argentina the number of schoools.

Religion: The religion of the respondent is first recorded in the 1890 Brazilian Census. The Brazilian IBGE also reports the religion of the respondent in modern times.

Mixed Marriage: Data on the partner's race (white, mixed, caboclo and mestizo) are available from the 1890 Brazilian Census.

Language: Since Paraguay is a bilingual country, the 1950 Paraguayan census records the language of the respondent: Guarani, Spanish or both.

F. Occupational and Cultural Variables

Handicrafts: The Brazilian Municipal Survey of 2006 records very detailed information on handicraft production, most importantly, embroidery.

Knowledge Transmission: The Paraguayan Cultural Module of 2011 contains specific information about traditional knowledge of skills, medicine and folktales, as well as diary usage and library visits.

Language: The main language of the respondent (Spanish, Guarani, both or other) was asked in Paraguay in the 2012 Household Survey.

Race: The percentage of indigenous population is reported by the IBGE for Brazil in 2010.

[54]See: http://openstreetmapdata.com/data/coastlines
[55]The 1869 Argentina Census does not report data for the province of Misiones.
[56]The 1890 Brazil Census does not report literacy.

Hours Worked: Total number of hours worked for people 10 and older is taken from the 2010 Brazilian Census and the 2012 Paraguayan Household Survey.

Labor Force Participation: Labor force participation is available for Brazil through IPEA for 2000.

Occupation: From the Paraguayan Household Survey of 2012, the Argentinean Census of 2001 and the Brazilian Census of 2000 and 2010, I collect information on occupations including agriculture, manufacturing, commerce and services. The Argentinean and the Brazilian censuses also have more detailed occupations and professions. The Brazilian 2010 Census also has data on specific industries.

Soy Cultivation: Data on soy farmed, changes in Genetically Engineered soy and non GE soy is all from Bustos et al. (2016). The authors also report data on changes in agricultural productivity and labor force in agriculture, manufacturing and services from 1996-2006.

G. Additional Data

Population Density: Population counts are taken from the 2001 census for Argentina, the 2000 Brazilian census and the 2002 Paraguayan census, and area is as reported previously.

Pre-colonial Population Density: Number of indigenous people per square kilometer, taken from and described in detail in Maloney and Valencia Caicedo (2016).

Migration: Data on migration and resident status are reported for Brazil by the IBGE in 2010.

Inequality: A Theil index on income is available for Brazil from IPEA for 2000 and for Paraguay from the World Bank (2008).

Health: A series of health variables including mortality under 5, infant mortality, number of doctors, and Health Development Indexes are available for Brazil from IPEA for 2000.

Tourism: Data on the prevalence of touristic activities come from the Brazilian Municipal Survey of 2006.

II. Additional Empirical Results

A. Alternative Specifications and Income Proxies

First I explore the impact of missions on income in Brazil using dummy variables. In this first specification, a municipality receives a value of 1 if it had a Jesuit mission in the past and 0 otherwise. The missionary effect on logarithm of income appears positive, large and statistically significant at different distance thresholds (Figure A.4). This is true both for the full sample at around .8 log points as well as for progressively smaller samples (starting with 500 kilometers to the nearest mission in 100 decreases). Because missionary presence might just be capturing different geographic and weather characteristics, I control for these variables directly next (Figure A.5). Although now smaller in magnitude, at around .6 log points, the results are largely unchanged. The coefficients are positive and significant, stable and larger at the local level.

To formally assess the role of observable variables and unobservable characteristics, I calculate Altonji ratios (Altonji et al. 2005; Bellows and Miguel, 2009, and Nunn and Wantchekon, 2011). The intuition of this exercise is to see how large the selection in unobservables would need to be relative to observables in order for it to drive the results observed. For the full sample the ratio is 4.15 (Altonji et al. 2005 report 3.55) meaning that selection in unobservables would need to be that much higher to drive the results.[57]

I also explore in this section other non-linear formulations, beyond the dummy variable and distance to the nearest mission specifications. The first is a log-log rather than a log-linear specification for income. As can be seen in the first two Columns of Table A.3, this variation leaves the results largely unchanged. The coefficients are negative, significant and stable and, if anything, they appear larger in the reduced sample. An alternative formulation uses concentric distance rings as opposed to continuous distance. This measure is a combination of the dummy and the distance formulation used previously. Specifically, I use a dummy to ascertain whether the municipalities lie within 100

[57] Technically, for this result to hold the R-squared of the regressions should be approaching the maximum R-squared (Oster, 2013). In this case the R-squared increases from around .3 to (a very high) .66 in the localized sample.

kilometers from a mission, in concentric increments of 100 kilometers up until 500 kilometers, with more than 500 kilometers as the excluded category. The results of this formulation, in Table A.3, again lead to the familiar pattern. Places closer to missions have lower literacy (Columns 3 and 4) are richer today (Columns 5 and 6). At a finer level, I use a dummy for places within 50 kilometers of a mission. The results are statistically significant for illiteracy, but are now insignificant for income (Columns 7 and 8). Lastly, I estimate a quantile regression model, which shows that the missionary effect works not only at the mean but also at the median level of the sample (Columns 9 and 10).[58] Taken together, the results using alternative formulations show the robustness of the Jesuit missionary results.

In Table A.4 I explore alternative specifications and income formulations for Brazil (Columns 1 to 6), Argentina and Paraguay (Columns 7 and 8). To illustrate the impact of the Jesuit missions on income on the three countries I use nighttime satellite data (Henderson et al. 2012).[59] From outer space, the missionary area is depicted in Figure A.6, along with municipal level boundaries. Though missions are still in very isolated areas, far away from the main population centers, many of the light spots associated with higher income correspond to the historical placing of the Jesuit missions. Econometric results reveal heterogeneous effects: negative for Argentina and positive for Brazil and Paraguay (Column 9).

B. Robustness: Intensity of Treatment

In this section I provide intensity of (missionary) treatment results. In particular, I exploit historical information on the year of foundation, indigenous population and a dummy variable for whether a given mission moved or not. Instead of only using distance to the nearest mission as in Equation 2, I interact this variable with the year of foundation and / or the mean of the indigenous population of the nearest mission. The results of this exercise can be seen in Table A.5. In the

[58] This formulation also allows for testing robustness for outliers. As is standard, I use bootstrapped standard errors in this formulation.

[59] Michalopoulos and Papaioannou (2013) use nighttime satellite data due to the lack of reliable GDP per capita and income measures for the African continent, while Acemoglu and Dell (2010) and Maloney and Valencia Caicedo (2016) use income measures for Latin America.

Distance X Year of Foundation formulation in the first Column, the log coefficient is negative and significant, reflecting that not only distance to the nearest mission, but also how many years it was active, was important. The results are positive and significant when I use instead the mean of indigenous population divided by distance, again in logs (Column 2). So not only the number of years, but also the quantity of people treated appears to matter. Combining this information, I estimate a model with population interacted with years of missionary activity normalized by distance. Once again the log coefficient is positive and statistically significant (Column 3).[60] Additional results (Figure A.7) illustrate the intensity of treatment effects for income and historical population and literacy and year of foundation. I also interact distance to the nearest mission with distance to the nearest river, as a proxy for isolation or market access, finding a negative effect for income (Column 4) and a positive one for education (Column 5). Lastly, I explore whether a missions that moved during some point in their history have a differential effect. I find using a dummy variable that indeed such movers had less of an impact on income (significant at the 10%) in the long-run (Column 6). Taken together, the results in this section show that the intensity of the Jesuit treatment also mattered in terms of years of exposure and population size.

C. Instrumental Variables

An alternative way to address the potential endogeneity of Jesuit missionary placement is to use instrumental variable techniques. I present two such candidates: original exploration routes and distance to Asunción, for the Brazilian sub-sample.

C.1 Exploration Routes

Jesuit missions were located in remote areas of the Spanish and Portuguese colonies that remain relatively isolated even today. Here I use distance from early exploration routes as a measure of isolation that can be used to proxy for missionary location (Figure A.9). Historical exploration routes such as Lewis and Clark's in the US have been recently used as instruments for highway development (Duranton and Turner 2012; Duranton et al. 2014). The first European expeditions

[60] Results are not robust to the inclusion of fixed effects and are insignificant for education.

in the missionary area were conducted by Pedro de Mendoza (1535-1537) and Alvar Nuñez Cabeza de Vaca (1541-1542).

Under the aegis of the Spanish Crown, Pedro de Mendoza explored the Río de la Plata (River Plate) region of South America. Sailing from Spain and the Canary islands and following the delta of the River Plate, he founded the city of Buenos Aires in 1535. Mendoza became the first Governor of the Río de la Plata region, but died shortly thereafter from syphilis in 1539 (Chipman, 2014). From Buenos Aires, lieutenant governor Juan de Ayolas sailed almost 1,000 kilometers up the Paraná River and founded the fort of Corpus Chirsti in 1536. Similarly, interim governor Domingo de Irala founded Nuestra Señora Santa María de la Asunción (Asunción) in 1541 (see, for instance Acemoglu and Robinson, 2012). Alvar Núñez Cabeza de Vaca, famous for his conquest of Florida and the Gulf of Mexico, also played an important role in the exploration of South America (Chipman, 2014). Cabeza de Vaca was given permission to explore the Río de la Plata region in 1540 (Figure A.9). He started off in the island of Santa Caterina (modern-day Brazil) and instead of sailing to Buenos Aires took the fateful decision to cross the interior and walk barefoot more than 1,200 kilometers to Asunción. After four and a half months of traversing "a trackless wilderness filled with cannibals, impassable rivers, jungles and poisonous snakes" (Chipman, 2014, p. 54) he arrived to Asunción the morning of March 11, 1542.

The rationale of the instrumental strategy is to proxy for the remoteness of the Jesuit missions using distance from the expedition routes (negative first stage). These routes served to found the initial settlements, whereas the missionary area remained relatively unexplored. At the same time, as in North America, the exact path of the expeditions was somehow arbitrary. The results of instrumenting missionary location with distance to the exploration routes can be seen in Table A.6. The first stage is negative and significant (F-statistic well above 10). The second stage results are positive for illiteracy (Column 1) and negative in the income formulation (Column 4), as before. The magnitudes are similar for education and slightly larger for income.

C.2 Distance to Asunción

The first Jesuit priests arrived in Asunción on the 11th of August of 1588. From that base, Fathers Manuel Ortega and Thomas Fields started their evangelical expedition in the territory of Guayra. Subsequent expeditions explored the area controlled by the Guarani, leading to the foundation of the first mission of San Ignacio Guazú in 1609. Asunción would remain an exploratory base throughout the missionary period (Figure A.10). Still, one should not to overemphasize the importance of Asunción, which had a population of only 6,451 in 1761, twenty times less than the Guarani Jesuit Missions combined (Ganson, 2003).

In 1750, less than twenty years before the expulsion of the Jesuits, the Treaty of Madrid changed the Spanish and Portuguese borders in South America. This treaty replaced the Tordesillas Treaty of 1494, largely leaving the territory of Brazil in its current form.[61] In the missionary area, the modern state of Rio Grande do Sul passed to Portuguese hands along with the seven missions (also known in Portuguese as the *sete povos*) of São Borja, São Luiz Gonzaga, São Nicolau, São Miguel, São Lourenço Martir, São Joao and Santo Angelo. The center of influence for this region shifted abruptly from the Spanish to the Portuguese empire, diminishing the importance of Asunción as a colonial capital. My working assumption is that this city is even less relevant for Rio Grande do Sul in modern times, but that it was influential in the original placing of the Jesuit missions.[62] For robustness, I control directly for distance to São Paulo, which became the new pole of influence for the region.

I instrument distance to the nearest Jesuit mission using distance from Asunción, only for the Brazilian subsample of the data. I exclude the states in Paraguay given the importance of the national capital and Argentina, which remained part of the Spanish Empire after the borders were changed in 1750, until it became independent in 1810. The results of this instrumental variables exercise can be found in Table A.6. The first stage is very robust (F-statistic > 10), and the instrumented coefficients appear significantly positive for illiteracy (Column 2) and negative for

[61] The San Idelfonso Treaty of 1777 would confirm the 1750 boundaries.

[62] Despite being a neighboring country, Paraguay is not among the main trading partners of Brazil and its trade share (exports plus imports) was less than 2% in 2010.

income (Column 5). The coefficients for education appear slightly larger and the ones for income have a similar magnitude than the OLS results.

By and large, the instrumental variable results confirm the OLS results for income and education. Taken together with the placebo results, they suggest a causal effect of the Jesuit missions on income and education. The results for exploration routes and distance to Asunción are broadly similar though slightly larger in magnitude than the OLS results. It does not seem that this is caused by weak instruments or by the difference in samples. Beyond measurement error, this might be due to differences between average and local treatment effects due to heterogeneous effects (Imbens and Angrist, 1994 and Heckman, 1997). To further explore the robustness of the instrumental variables results, I combine all instruments in Columns 3 and 6 of Table A.6. I restrict the sample to the Brazilian municipalities, to be able to use the distance to Asunción instrument. The sign and significance is preserved both for the education and income results. I cannot reject an overidentification test for the two instruments. Still, it is possible that the instruments may be violating the exclusion restriction, in light of the very strong first stages.[63]

D. Labor Force Participation

Another source of variation in labor patterns, at the intensive margin, can be observed in Figure A.11. The figure plots the number of people working 15 to 39 hours a week. It appears that those closer to the missions are working more hours, consistent with Weberian cultural explanations.[64] According to Weber this same ethic was found among the Catholic orders, "as early as St. Benedict [480-547], more so for the Cistercians [1098], and, finally, most decisively, for the Jesuits [1534]." (Weber, 2011, p. 130).[65] He concluded that, "The gradual rationalization of asceticism into an exclusively disciplinary method reached its apex in the Jesuit order." (Weber, 1978, p. 1172). Statistically, more people participate in the labor force in general and this effect is concentrated

[63]Results are robust to estimation with both 2SLS and LIML. Exogeneity tests à la Conley et al. (2012) reveal more robust effects for the exploratory distance formulation, especially for illiteracy.

[64]The relationship is statistically significant at the 1% level. A similar pattern can be observed for Paraguay, not reported.

[65]For recent evidence comparing the thrift of these Catholic orders, see Barnebeck Andersen et al. (2013) for the Cistercian order in England and Akcomak et al. (2013) for the Brethren of the Common life in the Netherlands.

among females relative to males, though results (not shown) are not robust to geographic controls.

E. Indigenous Assimilation

As a final way to analyze long-term cultural behavior I look at indigenous assimilation (Diaz-Cayeros and Jha, 2012). Presumably, indigenous inhabitants that attended religious missions had an easier time assimilating into colonial society when the Jesuits left, due to the skilled training they acquired. An early indication of this mechanism can be observed in the 1890 Brazilian Census.[66] In Table A.8 we can see that people reported more mixed marriages (general mixed and *caboclo:* European and indigenous) in places closer to religious missions (Columns 1 and 2). Interestingly, they also report being more Catholic, albeit from a very high base of 93% (Column 3).

The prevalence of indigenous people in the missionary area can also be observed up until today. In 2010, slightly more people report being indigenous the closer they are to a mission (Column 4). This is interesting, since in Latin America areas with higher modern indigenous population density have been associated with lower levels of income (Easterly and Levine, 2016). A similar pattern can be found for Paraguay, when focusing on language. Guarani is one of the two official languages of Paraguay, along with Spanish, in itself a remarkable testament to the survival of the indigenous tribes. In fact, linguists point directly to the religious missions for the survival of Guarani (Engelbretch and Ortiz, 1983). Results using this data can be seen in Table A.8, Columns 5 to 7. It appears that there are less people speaking Guarani in the missionary areas and more people speaking Spanish. Furthermore, there are more people who report speaking *both* languages in these areas, again suggesting a differential process of assimilation.[67] From early records of mixed marriages to contemporary data on indigenous population and indigenous languages, it appears that indigenous people assimilated better in the missionary areas from colonial times up until the present day.

[66] Technically this is the first Republic Census of Brazil, which was declared independence from Portugal by on November 15, 1889.

[67] These results also hold using data from the 1950 Census (not shown). The colloquial combination of Spanish and Guarani is termed Yopará.

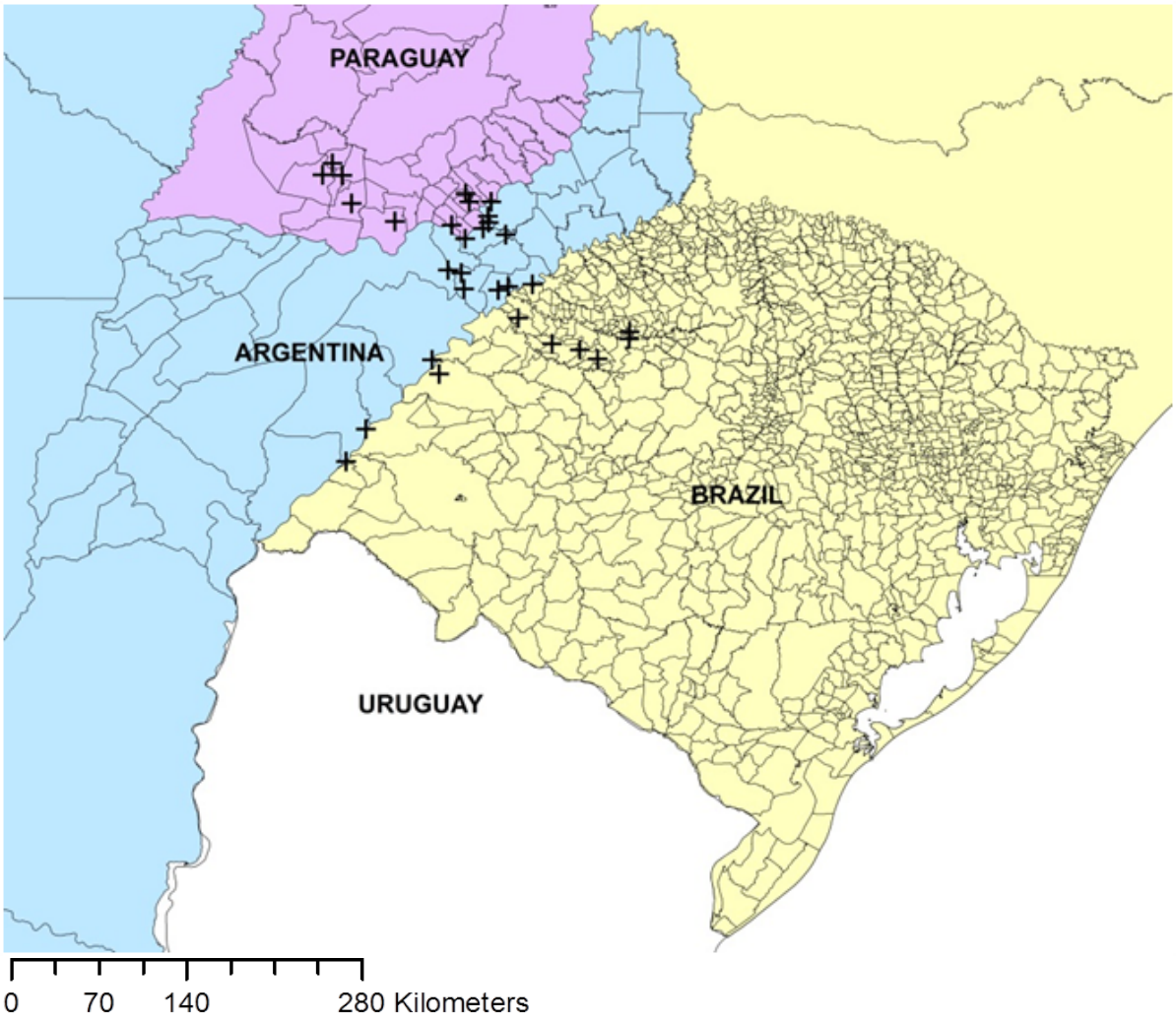
Figures

Figure 1. Location of the Guarani Jesuit Missions in Latin America



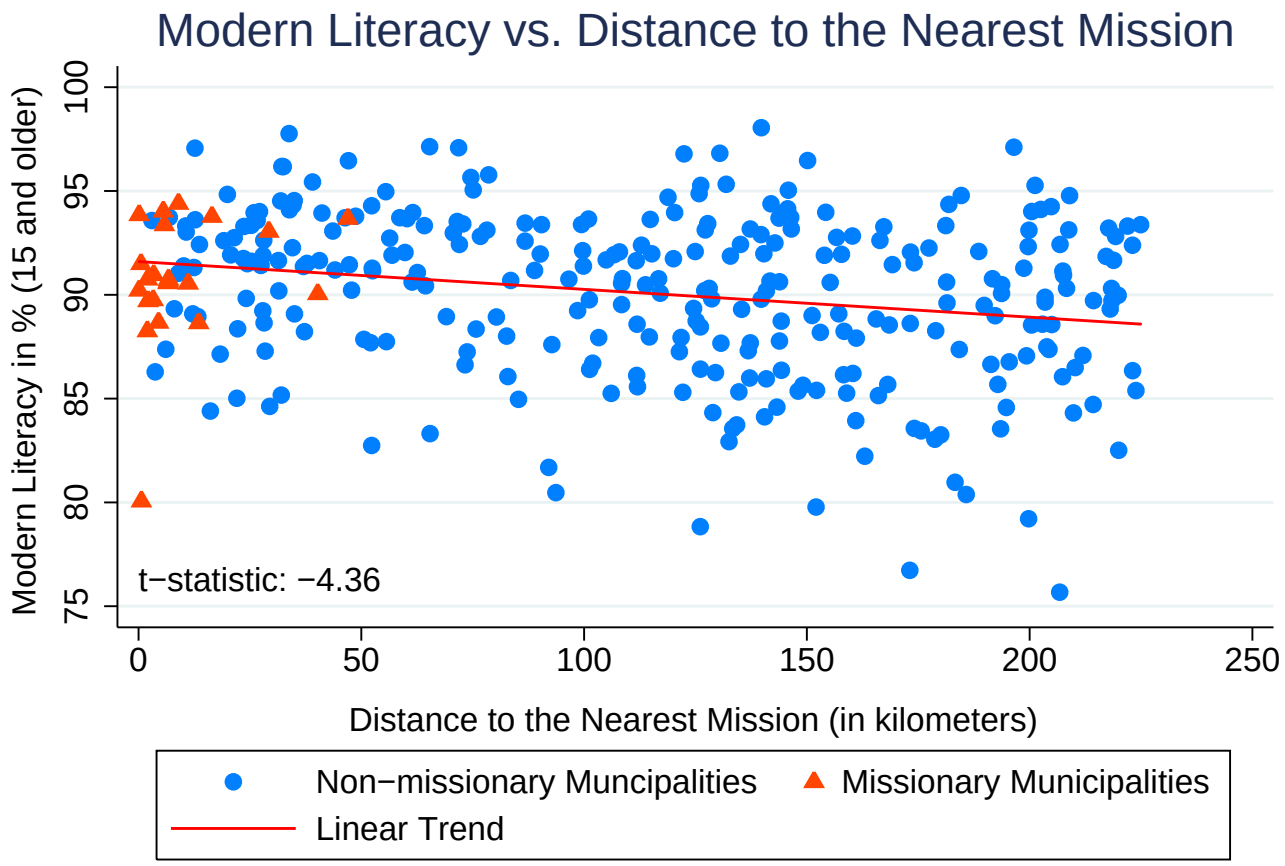
Note: The map shows the location of the Guarani Jesuit Missions, along with state level boundaries for Argentina, Brazil and Paraguay, and national level boundaries for the rest of Latin American countries.

Figure 2. Location of the Guarani Jesuit Missions in Argentina, Brazil and Paraguay



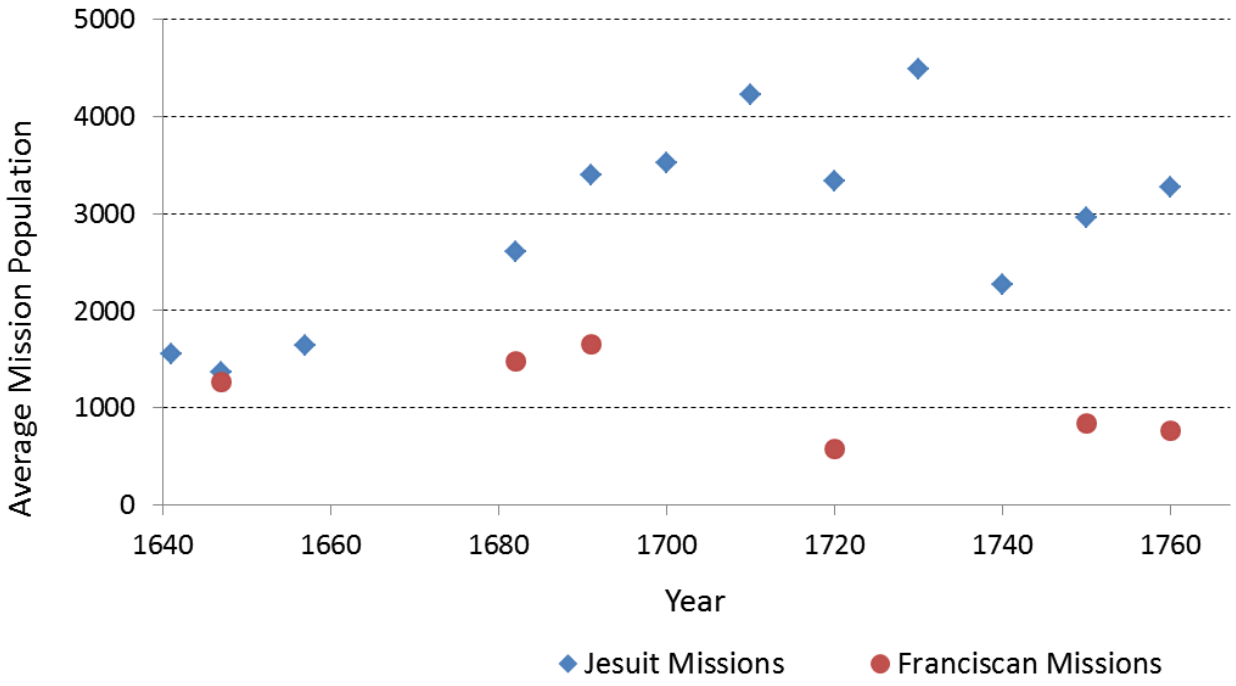
Note: The map shows the exact location of the Guarani Jesuit Missions, along with municipal level boundaries for the states of Corrientes and Misiones (Argentina), Itapúa and Misiones (Paraguay) and Rio Grande do Sul (Brazil), state boundaries for other states in Argentina, Brazil and Paraguay, and national level boundaries for Uruguay.

Figure 3. Literacy vs. Missionary Distance: Unconditional Plot



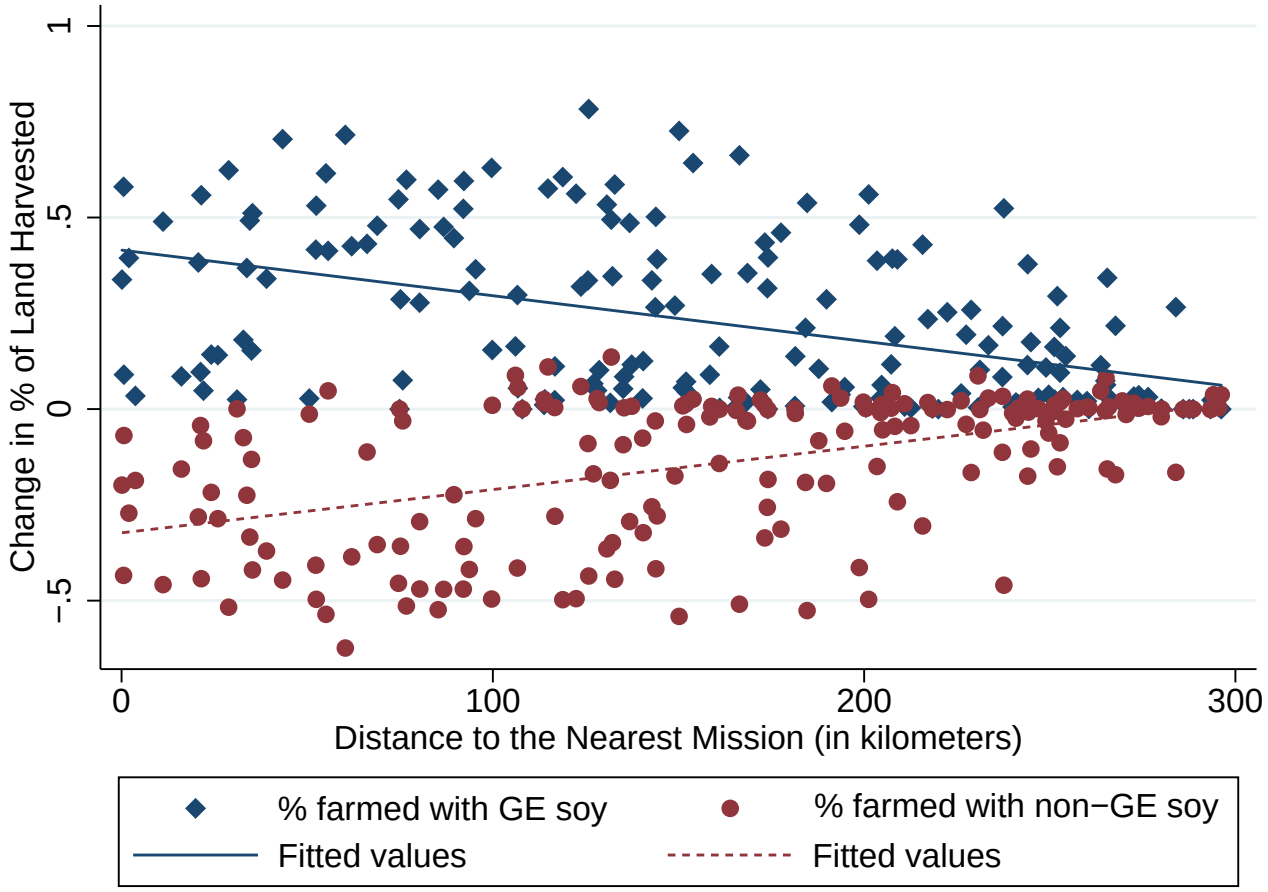
Note: Unconditional plot of 2000 literacy in percentages for people aged 15 and older in Argentina, Brazil and Paraguay versus distance of the municipality centroid in kilometers to the nearest Jesuit mission. Orange triangles represent missionary municipalities and blue dots non-missionary ones. The red line is a linear trend. The sample is restricted to a 225 kilometers distance threshold.

Figure 4. Historical Population of Jesuit and Franciscan Guarani Missions (1640-1760)



Note: This graph plots average indigenous population for Jesuit (blue diamonds) and Franciscan (red dots) Missions from 1640 to 1760.

Figure 5. Missionary Effect on Technological Adoption in Agriculture (Genetically Engineered Soy) in Brazil



Note: Unconditional plot of percentage change of land in farm harvested with GE (blue diamonds) and non-GE soy (red circles) with fitted lines in Brazil from 1996 to 2006 versus distance to the nearest Jesuit mission in kilometers.

Tables

Table 1. Summary Statistics: Municipal Level Data (Argentina, Brazil and Paraguay) by Missionary Distance

		Less than 50 kilometers					More than 50 kilometers				
CATEGORY	**VARIABLES**	**N**	**Mean**	**SD**	**Min**	**Max**	**N**	**Mean**	**SD**	**Min**	**Max**
EDUCATION	Literacy	87	91.4	3.0	80.1	97.8	462	90.8	4.2	75.7	98.4
	Illiteracy	87	8.4	3.0	2.2	19.9	462	9.2	4.2	1.6	24.3
	Median Years of Education	39	5.1	0.7	3.8	6.8	428	5.1	0.8	3.3	9.0
INCOME	Ln Income	74	6.7	1.6	4.7	9.2	432	5.5	0.4	4.4	8.8
	Individual Poverty Index	15	45.9	12.7	27.7	64.0	67	42.8	13.8	20.8	75.9
	Household Poverty Index	15	47.2	15.8	24.0	68.1	67	41.4	16.6	17.7	77.0
MISSION	Mission Distance	87	22.17	14.08	0.12	48.72	462	228.60	106.11	50.57	567.02
GEO CONTROLS	Latitude	87	-27.7	0.7	-29.8	-26.5	462	-28.9	1.2	-33.7	-25.9
	Longitude	87	-55.5	0.9	-57.4	-53.8	462	-52.7	1.7	-59.3	-49.7
	Area	87	990	1503	94	8613	491	669	1151	28	9588
	Temperature	86	209	7	193	226	491	187	11	146	222
	Altitude	86	182	83	67	385	491	351	234	3	1157
	Rainfall	86	1714	126	1291	1875	491	1609	194	1050	1995
	Ruggedness	86	55008	36347	7397	158153	491	52024	41616	6335	173076
	Slope	86	1750	927	199	4372	491	1404	1216	32	6739
	Distance to River	86	0.1	0.2	0	0.7	491	0.3	0.3	0	1.3
	Distance to Coast	86	4.9	1.0	3.1	7.0	491	2.1	1.4	0	6.5
	Landlocked	87	1	0	1	1	491	0.95	0.22	0	1

Note: For specific descriptions and sources, please refer to the Data Appendix. Poverty data is only for Argentina and Paraguay, where I use instead the 10 kilometer threshold.

Table 2. Missionary Effect on Modern Education, Income and Poverty: Brazil, Argentina and Paraguay

	1	2	3	4	5	6	7
	Illiteracy	Illiteracy	Med. Years Edu.	Ln Income	Ln Income	Ind. Poverty Index	HH Poverty Index
	ARG BRA PAR	ARG BRA PAR	Brazil	BRA & PAR	BRA & PAR	ARG & PAR	ARG & PAR
Mission Distance	**0.0105*** **	**0.0112** **	**-0.00665*** **	**-0.00166*** **	**-0.00204*** **	**0.0938** **	**0.0801***
	(0.004)	**(0.005)**	**(0.002)**	**(0.000)**	**(0.001)**	**(0.043)**	**(0.045)**
	{0.004}	**{0.005}**	**{0.002}**	**{0.000}**	**{0.001}**	**{0.046}**	**{0.047}**
GEO Controls	**NO**	**YES**	**YES**	**NO**	**YES**	**YES**	**YES**
Fixed Effects	**YES**	**YES**	**NO**	**YES**	**YES**	**YES**	**YES**
Observations	547	548	427	506	506	81	81
R-squared	0.042	0.073	0.172	0.869	0.876	0.202	0.175

Note: The table shows the coefficient of distance to the nearest Jesuit mission in kilometers (Equations 1 and 2). The dependent variables are illiteracy for people aged 15 years and older in 2000 in percentages for Argentina, Brazil and Paraguay in Columns 1 to 2 and median years of schooling in Brazil in Column 3, as well as the logarithm of income per capita in 2000 in Brazil and Paraguay in columns 4 and 5, and the Unsatisfied Basic Needs (UBN) Poverty Index in Argentina and Paraguay at the individual level in Column 6 and the household level in Column 7. Geographic controls include distance to the nearest coast, distance to the nearest river, altitude, temperature, area, rainfall, latitude and longitude. Please refer to the paper for units and additional details of these variables. Estimation is by OLS with state fixed effects. Robust standard errors in parentheses and Conley standard errors in brackets *** p<.01, ** p<.05, *p<.1

Table 3. Placebo Effect of Abandoned Jesuit Missions on Modern Income and Education

	1	2	3	4	5	6	7	8
	Illiteracy	Illiteracy	Illiteracy	Illiteracy	Ln Income	Ln Income	Ln Income	Ln Income
	ARG BRA PAR	ARG BRA PAR	ARG BRA PAR	ARG BRA PAR	BRA & PAR	BRA & PAR	BRA & PAR	BRA & PAR
Alto Parana Mission Dist.	**-0.0123*** **			**-0.014**	**0.000317**			**0.011**
	(0.004)			**(0.024)**	**(0.001)**			**(0.007)**
	{0.004}			**{0.025}**	**{0.001}**			**{0.007}**
Guayra Mission Dist.		**-0.00371**		**0.0380*** **		**-0.00129**		**-0.00403**
		(0.008)		**(0.013)**		**(0.003)**		**(0.004)**
		{0.008}		**{0.013}**		**{0.003}**		**{0.004}**
Itatin Misision Dist.			**-0.0258*** **	**-0.028**			**-0.000122**	**-0.0189**
			(0.008)	**(0.044)**			**(0.003)**	**(0.015)**
			{0.009}	**{0.045}**			**{0.003}**	**{0.014}**
GEO Controls	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Fixed Effects	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Observations	548	548	548	548	506	506	506	506
R-squared	0.079	0.065	0.081	0.095	0.398	0.399	0.398	0.401

Note: The table shows the coefficient of distance to the nearest abandoned mission in kilometers. The dependent variables are illiteracy for people aged 15 years and older in 2000 in percentages for Argentina, Brazil and Paraguay (Columns 1 to 4) and the logarithm of income in 2000 for Brazil and Paraguay (Columns 5 to 8). Geographic controls include distance to the nearest coast, distance to the nearest river, altitude, temperature, area, rainfall, latitude and longitude. Please refer to the paper for units and additional details of these variables. Estimation is by OLS with country fixed effects. Robust standard errors in parentheses and Conley standard errors in brackets *** p<.01, ** p<.05, *p<.1

Table 4. Franciscan and Jesuit Missionary Effect on Modern Income and Education

	1	2	3	4	5	6
	Illiteracy ARG BRA PAR	Ln Income BRA & PAR	Illiteracy ARG BRA PAR	Ln Income BRA & PAR	Inequality BRA & PAR	Mortality Brazil
Franciscan Mission Distance	**-0.00899**	**-0.00010**	**-0.0335*** **	**0.00356*** **	**-0.126*** **	**-0.0296**
	(0.008)	**(0.001)**	**(0.008)**	**(0.001)**	**(0.038)**	**(0.029)**
	{0.011}	**{0.001}**	**{0.012}**	**{0.001}**	**{0.038}**	**{0.029}**
Jesuit Mission Distance			**0.0183*** **	**-0.00356*** **	**0.0603*** **	**0.0417*** **
			(0.005)	**(0.001)**	**(0.023)**	**(0.014)**
			{0.006}	**{0.001}**	**{0.023}**	**{0.014}**
GEO Controls	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Fixed Effects	**YES**	**YES**	**YES**	**YES**	**YES**	**NO**
Observations	548	506	548	506	506	467
R-squared	0.067	0.872	0.082	0.879	0.448	0.107

Note: The table shows the coefficient of distance to the nearest Franciscan and Jesuit missions in kilometers. The dependent variables are illiteracy for people aged 15 years and older in 2000 in percentages for Argentina, Brazil and Paraguay (Columns 1 and 3); the logarithm of income in 2000 for Brazil and Paraguay (Columns23 and 4); a Theil inequality index for income in Brazil and Paraguay in 2000 (Column 5) and mortality under 5 for Brazil (Column 6). Geographic controls include distance to the nearest coast, distance to the nearest river, altitude, temperature, area, rainfall, latitude and longitude. Please refer to the paper for units and additional details of these variables. Estimation is by OLS with state fixed effects. Robust standard errors in parentheses and Conley standard errors in brackets *** p<.01, ** p<.05, *p<.1

Table 5. Missionary Effect on Historical Education: Argentina (1895), Brazil (1920), and Paraguay (1950)

	1	2	3	4	5	6	7	8
	Illiteracy	Illiteracy	Illiteracy	Illiteracy	Illiteracy	Illiteracy	Illiteracy	Illiteracy
	ARG 1895	ARG 1895	ARG 1895	ARG 1895	BRA 1920	BRA 1920	BRA 1920	PAR 1950
	Argentinean	Males	Females	Foreigners	Total	Brazilian	Foreigners	Total
Mission Distance	**0.0456*** **	**0.0457*** **	**0.0886*** **	**-0.0454*** **	**0.118** **	**0.115** **	**0.0542**	**0.147***
	(0.016)	**(0.015)**	**(0.018)**	**(0.006)**	**(0.040)**	**(0.039)**	**(0.105)**	**(0.085)**
	{0.021}	**{0.017}**	**{0.019}**	**{0.005}**	**{0.051}**	**{0.062}**	**{0.117}**	**{0.141}**
GEO Controls	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Observations	32	33	34	33	18	18	18	20
R-squared	0.56	0.63	0.804	0.799	0.553	0.553	0.36	0.784

Note: The table shows the coefficient of distance to the nearest Jesuit mission in kilometers (Equation 1). The dependent variable is illiteracy in percentages in Argentina in 1895 in Columns 1 to 4 and in Brazil in 1920 in Columns 5 to 6 and Paraguay in 1950 in Column 7. Geographic controls include distance to the nearest coast, distance to the nearest river, altitude, temperature, area, rainfall, latitude and longitude. Please refer to the paper for units and additional details of these variables. Estimation is by OLS. Robust standard errors in parentheses and bootstrapped errors in brackets *** p<.01, ** p<.05, *p<.1

Table 6. Missionary Effect on Structural Transformation in Paraguay and Argentina

	1	2	3	4	5	6	7
	Employed in Agriculture	Employed in Manufacturing	Employed in Commerce	Employed in Agriculture	Employed in Manufacturing	Employed in Stores	Employed in Services
	Paraguay 2012	Paraguay 2012	Paraguay 2012	Argentina 2001	Argentina 2001	Argentina 2001	Argentina 2001
Mission Distance	**0.0141****	**-0.0175*****	**-0.0143*****	**0.00885*****	**-0.00240*****	**-0.00413*****	**-0.00247*****
	(0.007)	**(0.006)**	**(0.005)**	**(0.003)**	**(0.000)**	**(0.001)**	**(0.001)**
GEO Controls	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Fixed Effects	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Observations	1,928	1,928	1,928	48,476	48,476	48,476	48,476
R-Squared	0.1092	0.0459	0.0518	0.1689	0.0136	0.0131	0.0216

Note: The table shows the coefficient of distance to the nearest Jesuit mission in kilometers. The dependent variables are the probability that a person is working in Agriculture, Manufacturing and Commerce in Paraguay in 2012 in Columns 1 to 3, as well as the same probility for employment in Agriculture, Manufacturing, Stores and Services in Argentina in 2001. Geographic controls include distance to the nearest coast, distance to the nearest river, altitude, temperature, area, rainfall, latitude and longitude. Please refer to the paper for units and additional details of these variables. Estimation is for a Probit model with state fixed effects and errors clustered at the district level. Robust and clustered standard errors in parentheses *** p<.01, ** p<.05, *p<.1

Table 7. Missionary Effect on Professions in Brazil and Argentina

	1	2	3	4	5	6	7	8
	Embroidery	Professionals	Skilled Agro.	Teachers	Blacksmiths	Artisans	Educators	Accountants
	Brazil 2006	Brazil 2010	Brazil 2010	Brazil 2010	Brazil 2000	Argentina 2001	Argentina 2001	Argentina 2001
Mission Distance	**-0.00215***	**-0.00119***	**-0.00485*****	**-0.00139*****	**-0.00422*****	**-0.00239*****	**-0.00134****	**-0.00446***
	(0.001)	**(0.001)**	**(0.001)**	**(0.000)**	**(0.001)**	**(0.000)**	**(0.001)**	**(0.003)**
GEO Controls	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Fixed Effects	**NO**	**NO**	**NO**	**NO**	**NO**	**YES**	**YES**	**YES**
Observations	427	337,584	171,460	171,460	166,124	48,476	48,476	48,476
R-Squared	0.0263	0.03	0.028	0.0045	0.0188	0.0109	0.0038	0.0233

Note: The table shows the coefficient of distance to the nearest Jesuit mission in kilometers. The dependent variables are the prevalence of embroidery in percentages in Brazil in 2006 in Column 1, the probability that a person is a Professional, Skilled Agricultural worker, Teacher or Blacksmith in Brazil in Columns 2 to 4 in 2010 and 2000, and the same probability for Artisans, Educators and Accountants in Argentina in 2001. Geographic controls include distance to the nearest coast, distance to the nearest river, altitude, temperature, area, rainfall, latitude and longitude. Please refer to the paper for units and additional details of these variables. Estimation is for a Probit model with state fixed effects and errors clustered at the district level. Robust and clustered standard errors in parentheses *** p<.01, ** p<.05, *p<.1

Table 8. Missionary Effect on Skill-intensive Industries in Brazil

	1	2	3	4	5	6	7	8	9	10	11
	Tobacco Products Brazil	Non-ferrous Metals Brazil	Beverages Industry Brazil	Iron and Steel Brazil	Fabricated Metal Products Brazil	Industrial Chemicals Brazil	Transport Equipment Brazil	Chemicals Other Brazil	Electric Machinery Brazil	Plastic Products Brazil	Newspaper Industry Brazil
Mission Distance	**-0.00874***	**-0.0112*****	**-0.00423*****	**-0.00273***	**-0.00415***	**-0.00273****	**-0.00489***	**-0.00376***	**-0.00672*****	**-0.00592****	**-0.00150****
	(0.005)	**(0.004)**	**(0.002)**	**(0.002)**	**(0.002)**	**(0.001)**	**(0.003)**	**(0.002)**	**(0.002)**	**(0.003)**	**(0.001)**
GEO Controls	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Fixed Effects	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Observations	174,964	174,964	174,964	174,964	174,964	174,964	174,964	174,964	174,964	174,964	174,964
R-Squared	0.3025	0.0397	0.0251	0.0175	0.0667	0.0234	0.1186	0.0449	0.0502	0.078	0.0038

Note: The table shows the coefficient of distance to the nearest Jesuit mission in kilometers. The dependent variables are the prevalence of Tobacco Products, Non-ferrous Metals, Beverages Industry, Iron and Steel, Fabricated Metal Products, Industrial Chemicals, Transport Equipment, Other Chemiclas, Electric Machinery, Plastic Products and Newspaper Industries in Brazil in 2010. Geographic controls include distance to the nearest coast, distance to the nearest river, altitude, temperature, area, rainfall, latitude and longitude. Please refer to the paper for units and additional details of these variables. Estimation is for a Probit model and errors clustered at the district level. Clustered standard errors in parentheses *** p<.01, ** p<.05, *p<.1

Table 9. Missionary Effect on Technological Adoption in Agriculture (Genetically Engineered Soy) and Structural Transformation in Brazil

	1	2	3	4	5	6	7
	Total Soy Farmed	Change in GE Soy	Change in Non-GE Soy	Change in Ag. Productivity	Change in Agriculture	Change in Manufacturing	Change in Services
	Brazil 1996-2006	Brazil 1996-2006	Brazil 1996-2006	Brazil 1996-2006	Brazil 1996-2006	Brazil 1996-2006	Brazil 1996-2006
Ln Mission Distance	**-0.0781*** **	**-0.0661*** **	**0.0573*** **	**-0.0469** **	**0.0131*** **	**-0.00586*** **	**-0.00710*** **
	(0.012)	**(0.017)**	**(0.014)**	**(0.020)**	**(0.004)**	**(0.002)**	**(0.002)**
Soy Suitability	**YES**	**YES**	**YES**	**NO**	**NO**	**NO**	**NO**
Time FE	**YES**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Observations	509	245	239	261	262	262	262
R-Squared	0.31	0.242	0.281	0.011	0.046	0.024	0.029

Note: The table shows the coefficient of log distance to the nearest Jesuit mission in kilometers. The dependent variables are total area planted in Soy, changes in GE Soy and non-GE Soy in Columns 1 and 3. Changes in Agricultural Productivity, labor force in Agriculture, Manufacturing and Services in Brazil from 1996 to 2006 in Columns 4 to 7. Controls include time fixed effects in Column 1 and Soy Suitability in Columns 2 and 3. Estimation is by OLS. Robust standard errors in parentheses *** p<.01, ** p<.05, *p<.1

Table 10. Missionary Effect on Intergenerational Knowledge Transmission and Skills in Paraguay

	1	2	3	4	5	6	7	8
	Skills Transmitted	Medicine Transmitted	Tales Transmitted	Transmits Skills	Transmits Medicine	Transmits Tales	Diary Usage	Library Visits
	Paraguay 2011	Paraguay 2011	Paraguay 2011	Paraguay 2011	Paraguay 2011	Paraguay 2011	Paraguay 2011	Paraguay 2011
Mission Distance	**-0.0152*** **	**-0.0107** **	**-0.0135*** **	**-0.00692***	**-0.0119*** **	**-0.00983*** **	**-0.0117***	**-0.0154** **
	(0.005)	**(0.005)**	**(0.005)**	**(0.004)**	**(0.003)**	**(0.004)**	**(0.007)**	**(0.006)**
GEO Controls	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Fixed Effects	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Observations	890	890	890	890	890	890	890	890
R-Squared	0.0592	0.0152	0.0249	0.0371	0.0354	0.0137	0.0646	0.1198

Note: The table shows the coefficient of distance to the nearest Jesuit mission in kilometers. The dependent variables are parental transmission of skills, medicinal knowledge and folktales in Columns 1 to 3; intergenerationsl transmission of skills, medicinal knowledge and folktales in Columns 4 to 6; diary usage in Column 7 and and visits to the library all in percentages in Column 8. Geographic controls include distance to the nearest coast, distance to the nearest river, altitude, temperature, area, rainfall, latitude and longitude. Please refer to the paper for units and additional details of these variables. Estimation is for a Probit model in Columns with state fixed effects and errors clustered at the district level. Clustered standard errors in parentheses *** p<.01, ** p<.05, *p<.1

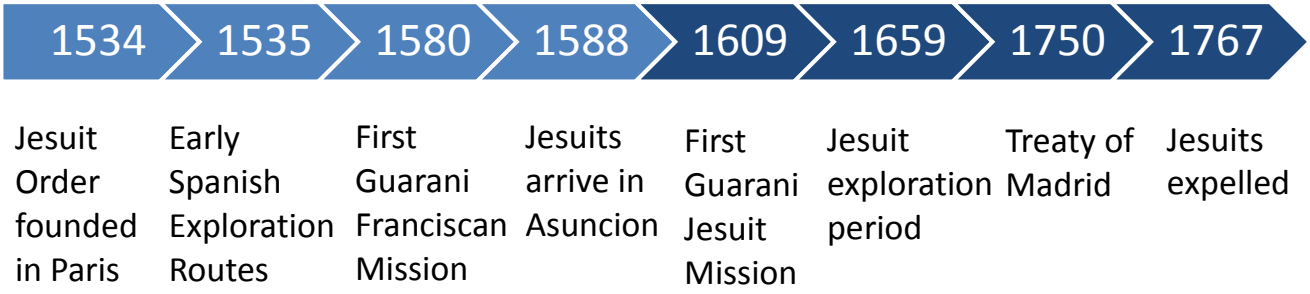
Table 11. Robustness Checks: Missionary Effect on Population Density, Infrastructure, Migration, Health and Tourism

	1	2	3	4	5	6	7	8	9	10	11	12
	Population Density	Pre-Colonial Pop. Density	Road Density	Railroad Density	Illiteracy Dist. Capital	Ln Income Dist. Capital	Med. Yrs. Edu. Resident	Med. Yrs. Edu. Non-Resident	Illiteracy Spillovers	Ln Income Spillovers	Health Index	Touristic Activities
	ARG BRA PAR	ARG BRA PAR	ARG BRA PAR	ARG BRA PAR	ARG BRA PAR	BRA PAR	Brazil	Brazil	Brazil	Brazil	Brazil	Brazil
Mission Distance	**0.426****	**1.028**	**-0.00589*****	**0.00138*****	**0.0118****	**-0.00274***	**-0.00836*****	**-0.00357**	**0.0129****	**-0.00206*****	**-0.0385****	**0.000109**
	(0.166)	**(1.119)**	**(0.002)**	**(0.000)**	**(0.005)**	**(0.002)**	**(0.002)**	**(0.003)**	**(0.005)**	**(0.001)**	**(0.017)**	**(0.001)**
Distance to Capital					0.00989***	-0.00091						
					(0.003)	(0.002)						
GEO Controls	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Fixed Effects	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Observations	548	69	548	548	548	506	237	190	526	492	467	427
R-squared	0.18	0.302	0.622	0.351	0.083	0.403	0.176	0.137	0.074	0.856	0.144	0.0261

Note: The table shows the coefficient of distance to the nearest Jesuit mission in kilometers. The dependent variables are population density and pre-colonial population density in Columns 1 and 2; Road and Railroad density in Columns 3 and 4; illiteracy in Argentina, Brazil and Paraguay in Column 5; logarithm of income per capita in Brazil and Paraguay in Columns 6 and 10; median years of schooling in Brazil for residents and non-residents in Columns 7 and 8; the IFDM Health Index in Column 11; and prevalence of tourism in percentages in Column 12. Geographic controls include distance to the nearest coast, distance to the nearest river, altitude, temperature, area, rainfall, latitude and longitude. Please refer to the paper for units and additional details of these variables. Estimation is by OLS with state fixed effects for Columns 3 and 4 and of a Probit model in Column 8. Robust standard errors in parentheses (except in Column 8) *** p<.01, ** p<.05, *p<.1

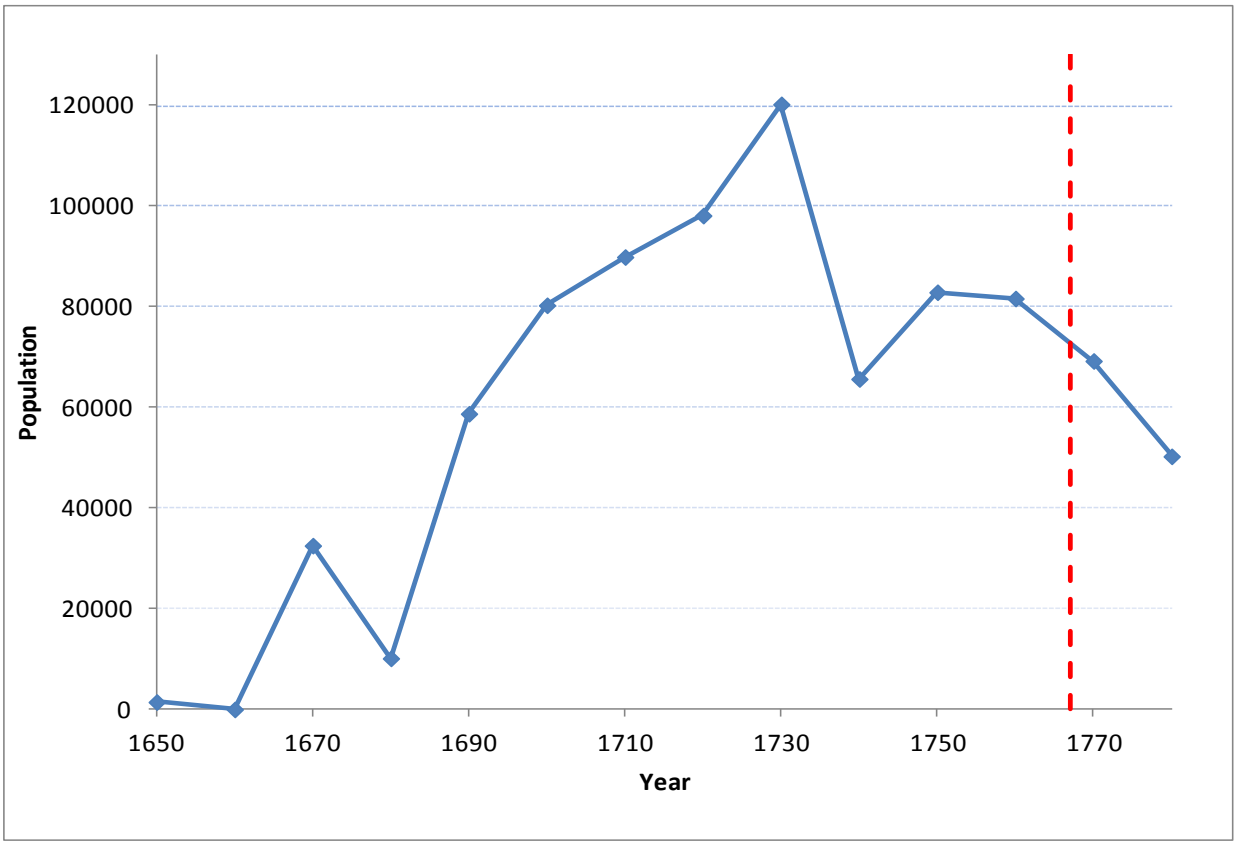
Appendix Figures

Figure A.1. Historical Timeline



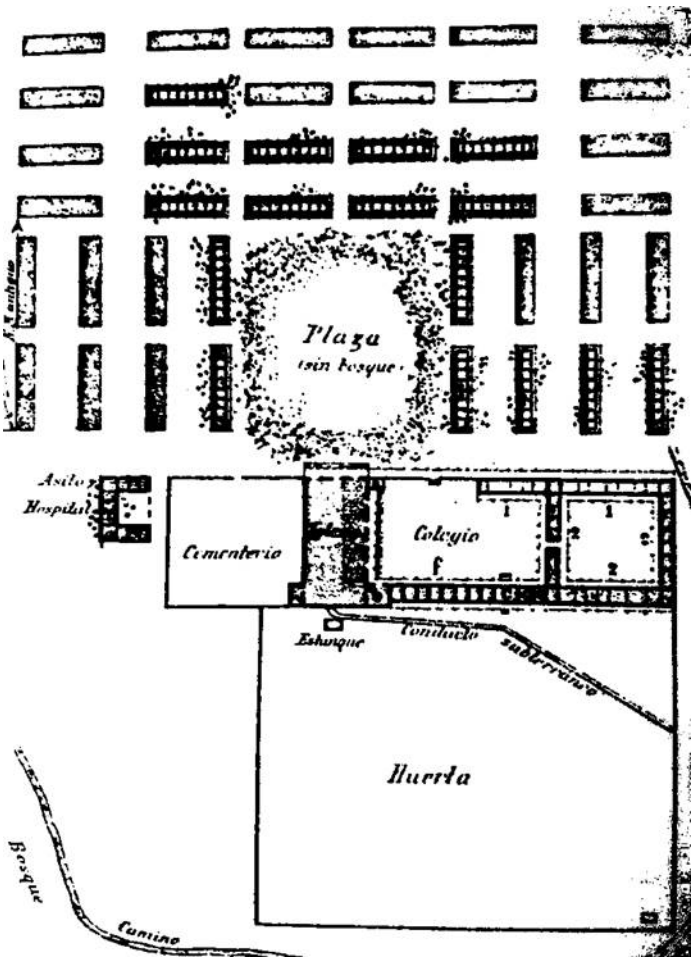
Note: The figure depicts the key historical events studied in the paper, the darker shade of blue depicts the 150 years of Jesuit missionary intervetion.

Figure A.2. Historical Population of the Guarani Jesuit Missions (1650-1780)



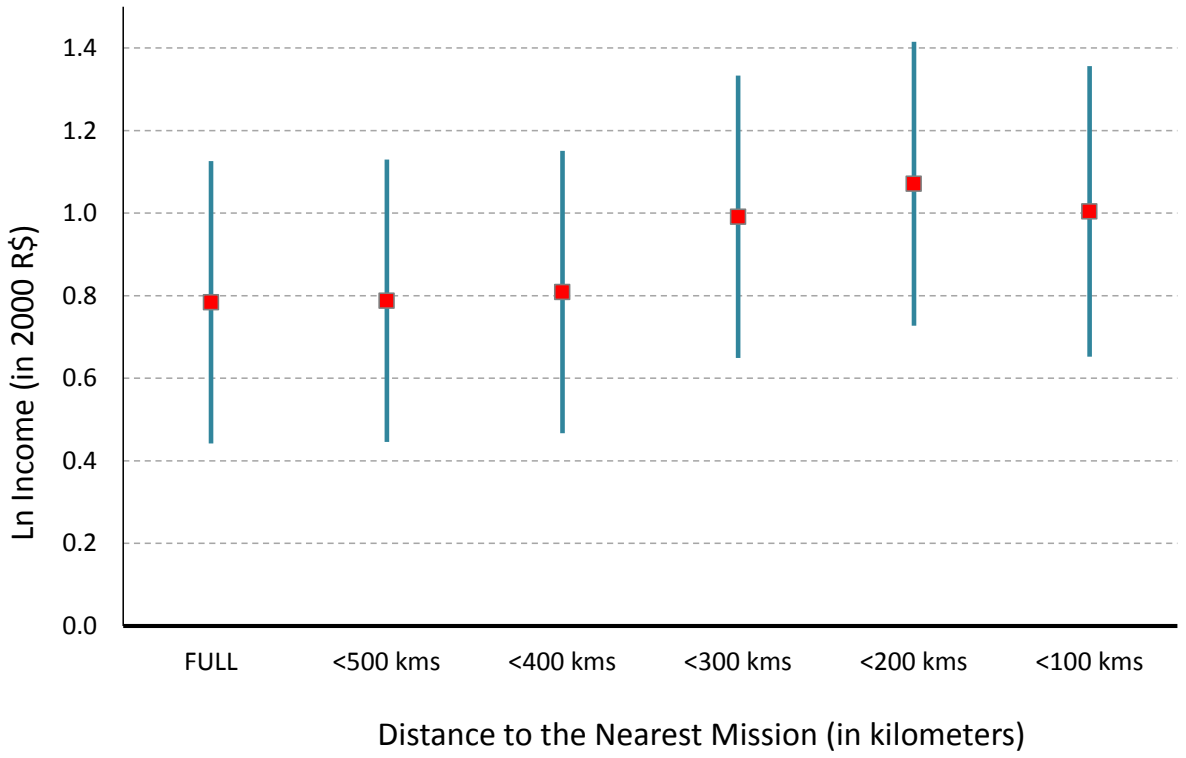
Note: Total contemporary Guarani Jesuits Missions population counts from surviving records. The red line represents 1767, which corresponds to the expulsion of the Jesuits from Latin America.

Figure A.3. Historical Blueprint of a Guarani Jesuit Mission



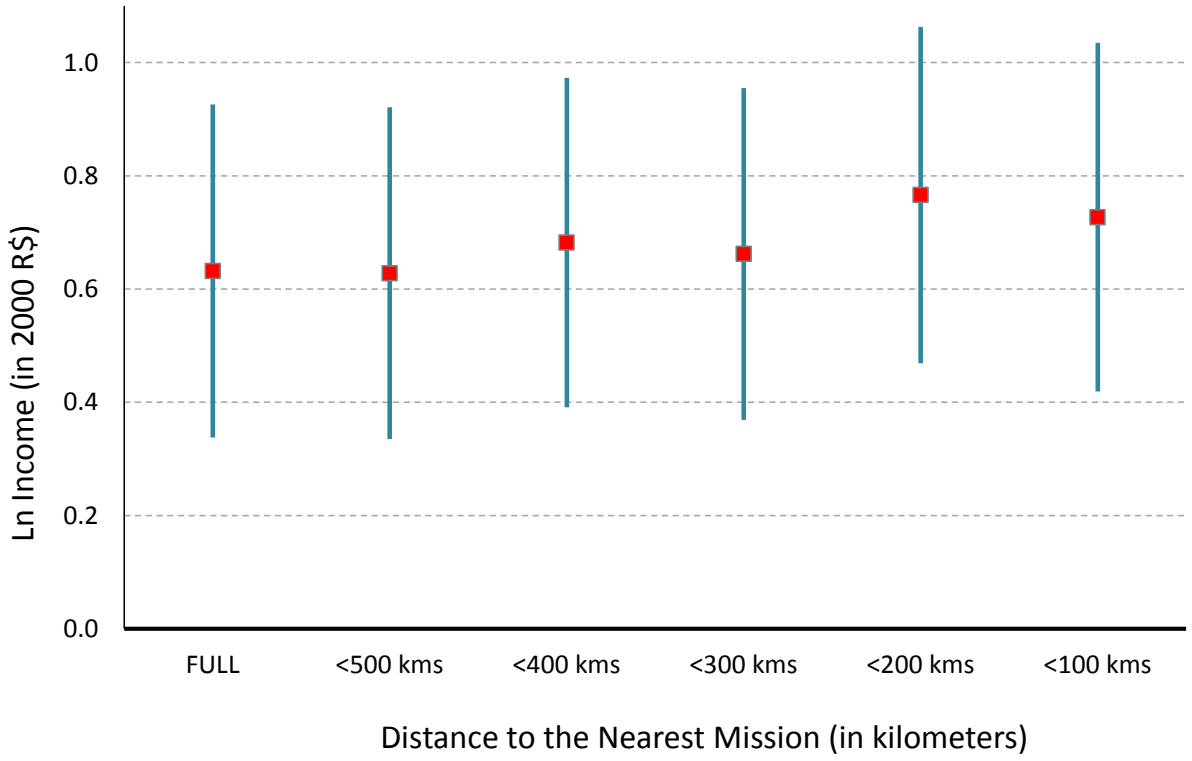
Note: Urban blueprint of the Jesuit mission of San Ignacio de Miní taken in 1899 by Juan Queirel, taken from Hernández (1913).

Figure A.4. Missionary Effect on Income (Dummy Formulation, Unconditional): Brazil



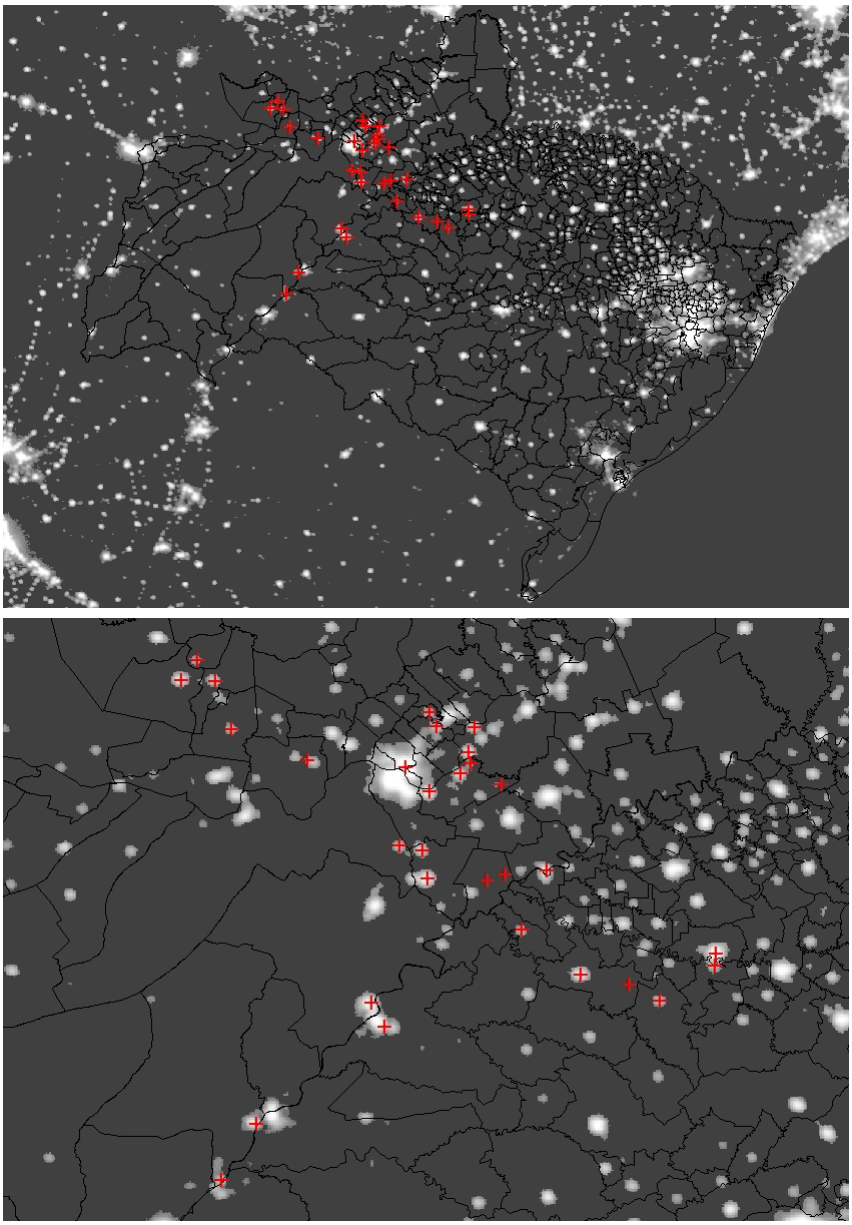
Note: The graph plots the unconditional coefficients for a regression of the logarithm of (2000) income in Brazilian Reals on a dummy for missionary presence at different distance thresholds. Point estimates are represented by red squares and 95% robust error bands by blue lines.

Figure A.5. Missionary Effect on Income (Dummy Formulation, with Geographic Controls): Brazil



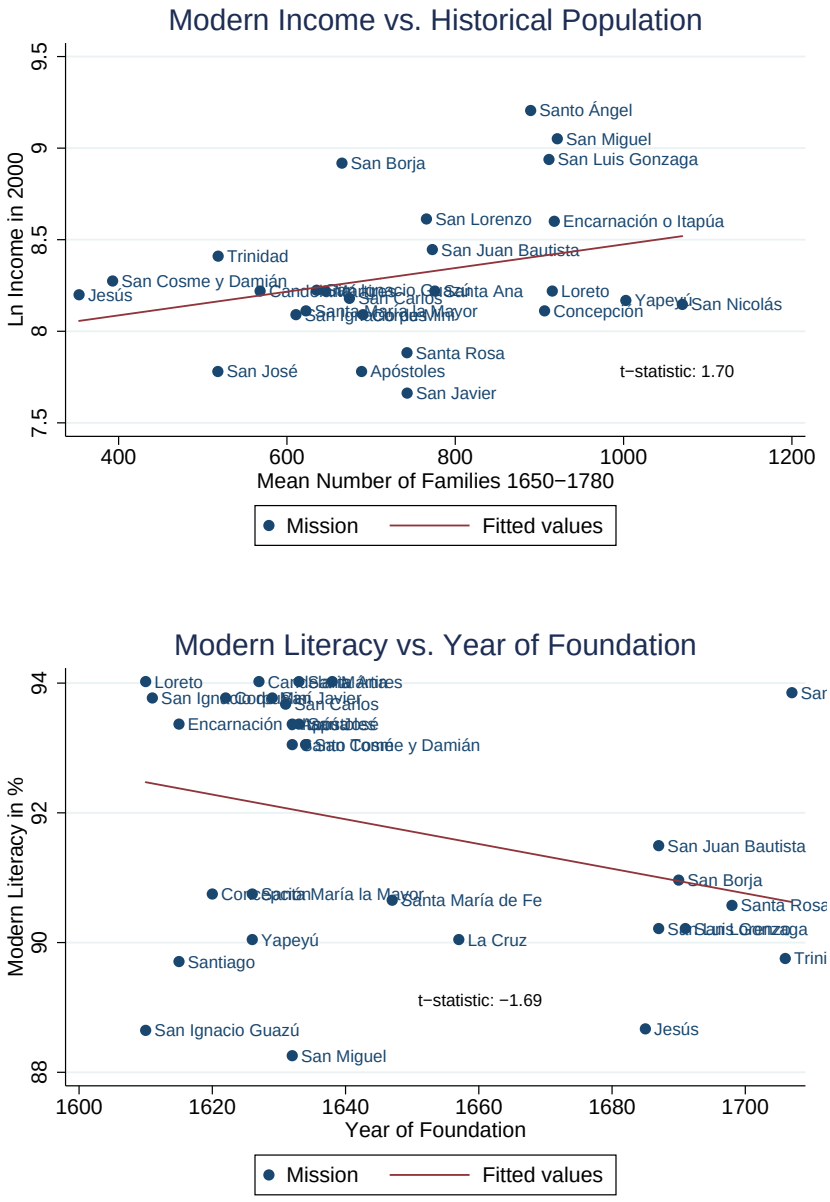
Note: The graph plots the conditional coefficients for a regression of the logarithm of (2000) income in Brazilian Reals on a dummy for missionary presence with geographic and weather controls (altitude, area, temperature and rain) at different distance thresholds. Point estimates are represented by red squares and 95% robust error bands by blue lines.

Figure A.6. Nighttime Satellite Maps of the Guarani Jesuit Missionary Area



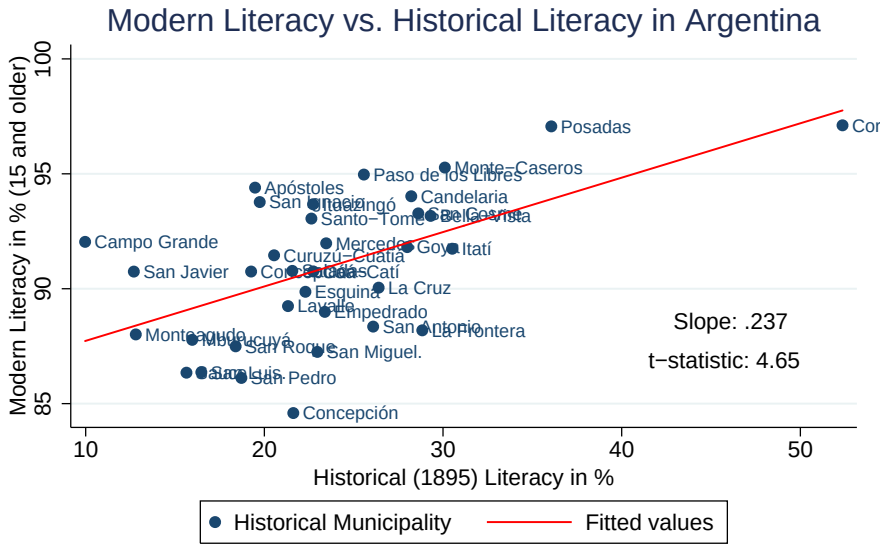
Note: The maps depict the nighttime satellite images (F18-2010) of the Guarani Jesuit missionary area along with municipal level boundaries for the states of Corrientes and Misiones (Argentina), Itapúa and Misiones (Paraguay) and Rio Grande do Sul (Brazil), with the location of the Guarani Jesuit Missions (red crosses), general and zoomed areas.

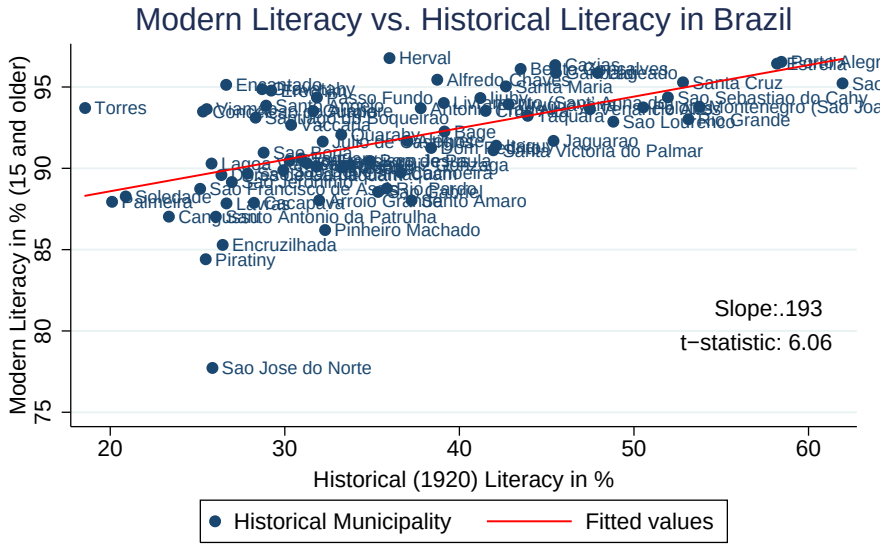
Figure A.7. Within Mission Intensity of Treatment

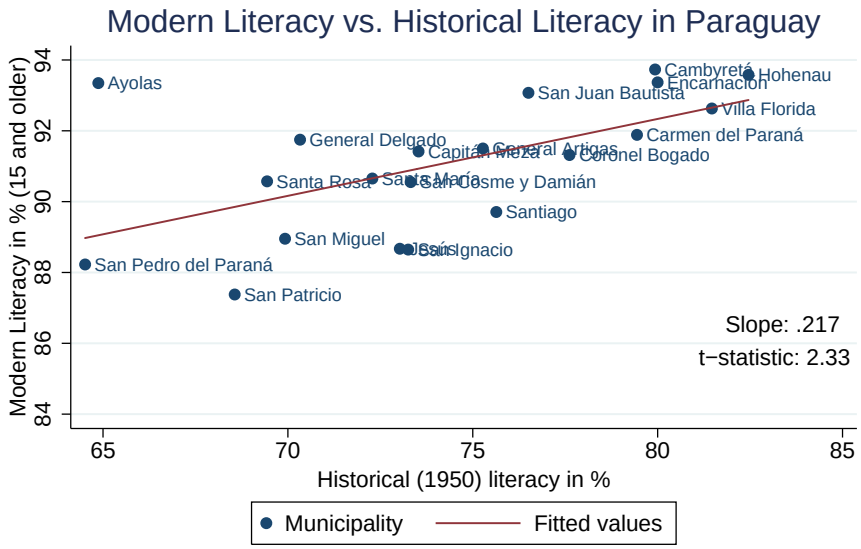


Note: Unconditional plots of modern income versus historical missionary population and modern literacy versus year of foundation. Misions in blue circles with names and red linear trends.

Figure A.8. Modern vs. Historical Literacy in Argentina, Brazil and Paraguay: Unconditional Plots

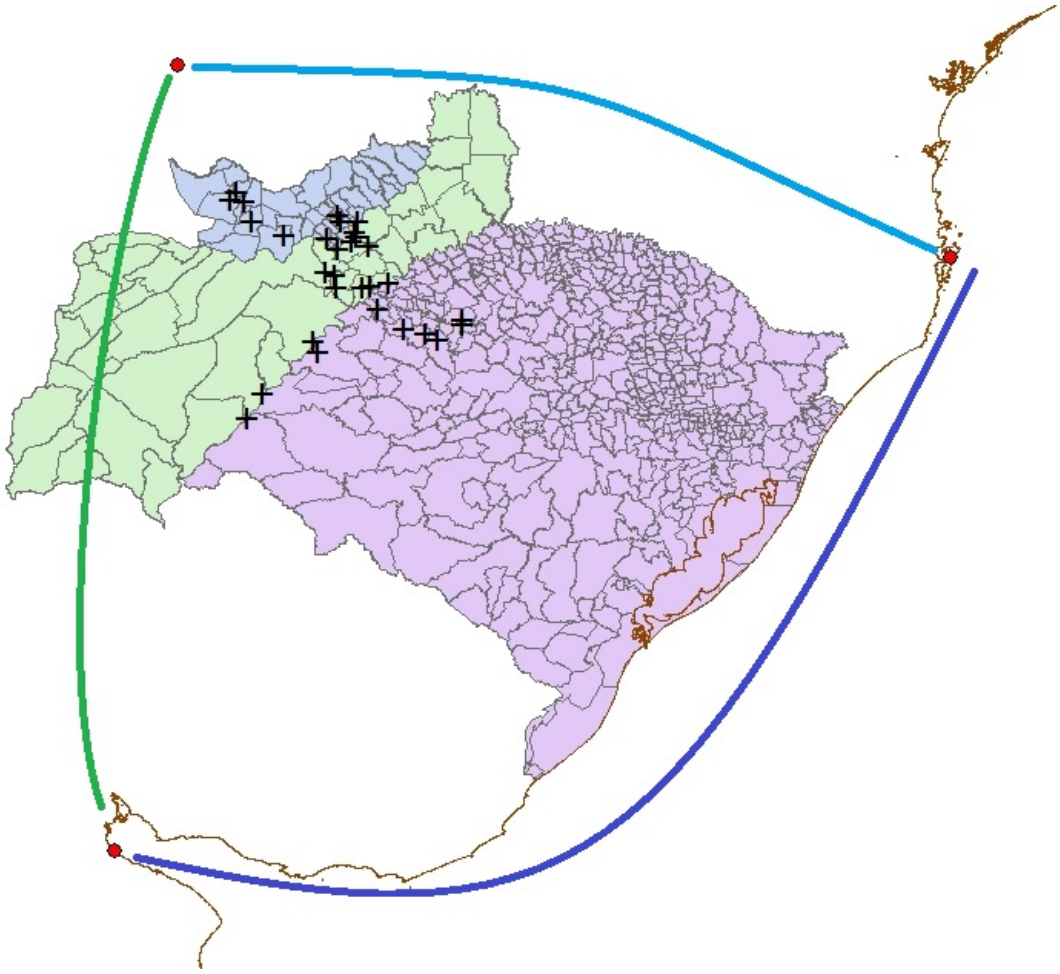






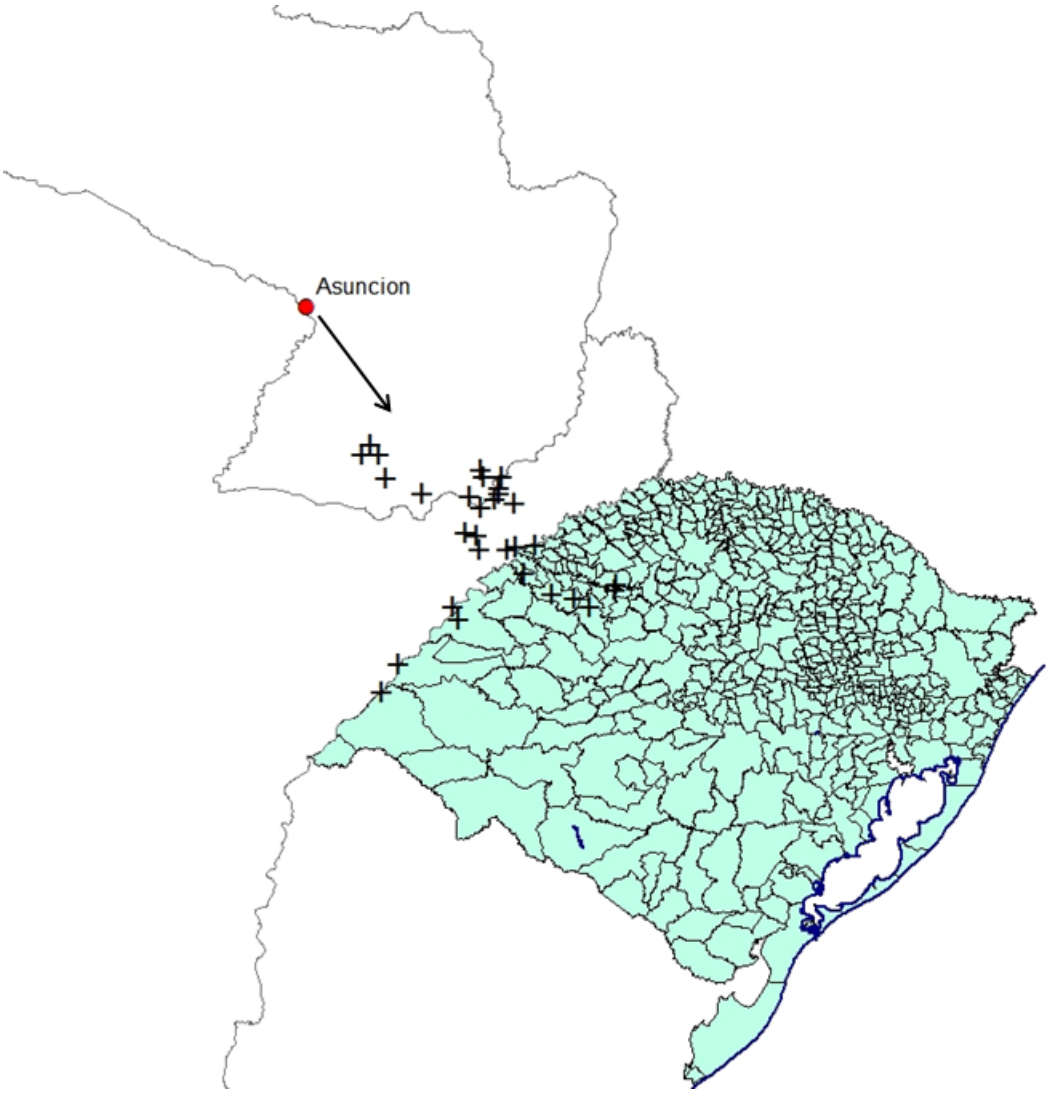
Note: Unconditional plots of 2000 literacy in percentages for people aged 15 years and older in Argentina, Brazil and Paraguay on 1895 literacy in percentages in Argentina, 1920 in Brazil, and 1950 in Paraguay respectively. Blue dots represent municipalities with historical names and red lines are linear trends.

Figure A.9. Map of the Guarani Jesuit Area along with Exploration Routes



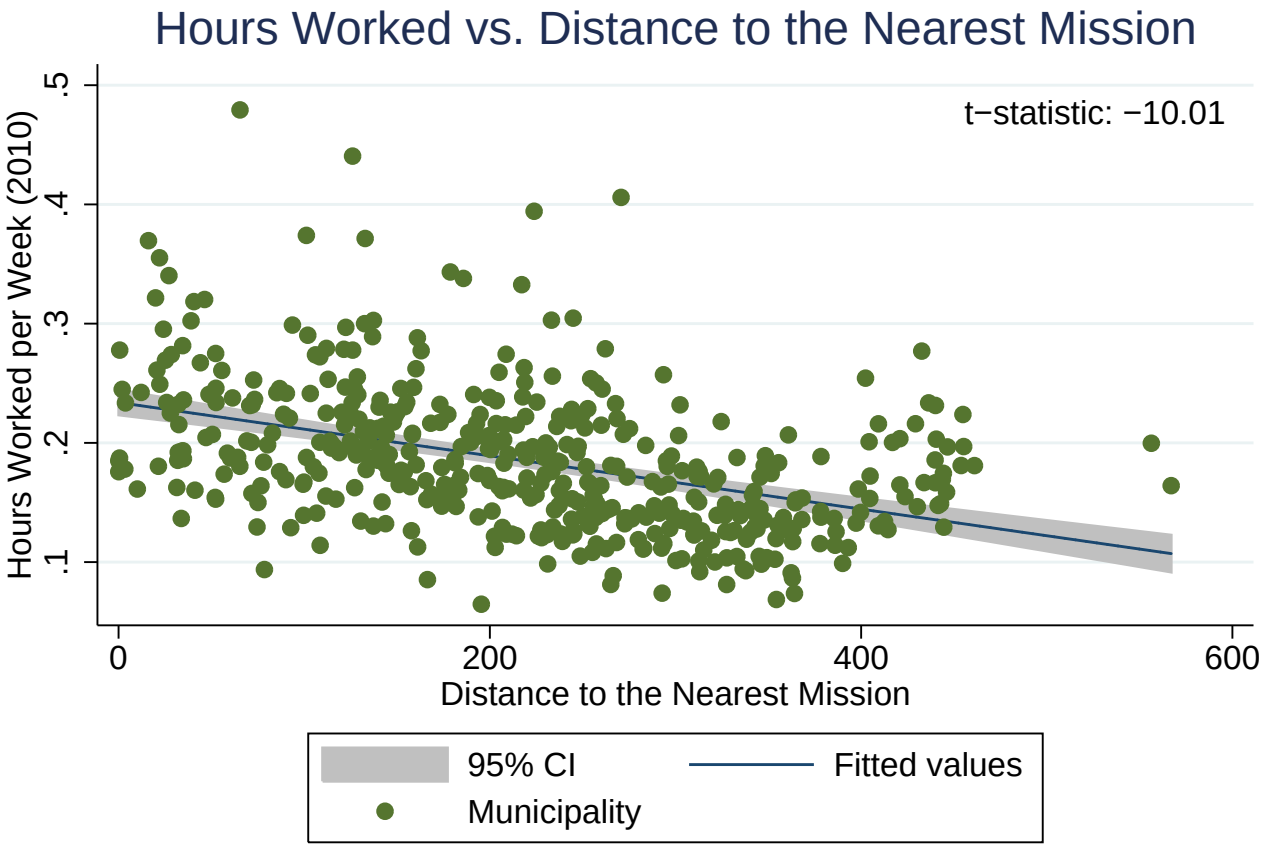
Note: The map shows the location of the Guarani Jesuit Missions along with municipal level boundaries for the states of Misiones and Corrientes (Argentina), Misiones and Itapúa (Paraguay) and Rio Grande do Sul (Brazil). The lines mark the expeditions by Pedro de Mendoza, Alvar Nuñez Cabeza de Vaca, Juan de Ayolas and Domingo de Irala. The red points demarcate Asunción, Buenos Aires and Santa Caterina.

Figure A.10. Map of Rio Grande do Sul with the Direction of the Jesuit Missions from Asunción



Note: The map shows the location of Asunción, the Guarani Jesuit Missions, along with municipal level boundaries for the state of Rio Grande do Sul (Brazil), and national level boundaries for Argentina and Paraguay.

Figure A.11. Hours Worked vs. Missionary Distance: Brazil



Note: Unconditional plot of percentage of people reporting working 15 to 39 hours in Brazil in 2010 versus distance to the nearest Jesuit mission in kilometers. Municipalities in green circles, blue linear fit with gray 95% confidence bands.

Appendix Tables

Table A.1. Guarani Jesuit Missions: 1609-1767

#	Mission Name	Year of Foundation	Country	Mean Number of Inhabitants	Mean Number of Families
1	San Ignacio Guazú	1609	Paraguay	2,610	635
2	Loreto	1610	Argentina	3,797	915
3	San Ignacio de Miní	1611	Argentina	2,464	611
4	Santiago	1615	Paraguay	-	-
5	Encarnación o Itapua	1615	Paraguay	4,239	918
6	Concepción	1620	Argentina	3,867	906
7	Corpus	1622	Argentina	3,209	690
8	Santa María la Mayor	1626	Argentina	2,480	623
9	San Nicolás	1626	Brazil	4,692	1,070
10	Yapeyú	1626	Argentina	4,202	1,003
11	Candelaria	1627	Argentina	2,361	568
12	San Javier	1629	Argentina	3,000	743
13	San Carlos	1631	Argentina	2,854	674
14	San Miguel	1632	Brazil	3,870	921
15	Apóstoles	1632	Argentina	2,999	689
16	Santo Tomé	1632	Argentina	-	-
17	San José	1633	Argentina	2,391	518
18	San Cosme y Damián	1634	Paraguay	1,611	393
19	Santa Ana	1638	Argentina	3,409	776
20	Mártires	1638	Argentina	2,554	646
21	Santa María de Fe	1647	Paraguay	-	-
22	La Cruz	1657	Argentina	-	-
23	Jesús	1685	Paraguay	1,719	353
24	San Luis Gonzaga	1687	Brazil	3,765	911
25	San Juan Bautista	1687	Brazil	3,310	773
26	San Borja	1690	Brazil	2,960	665
27	San Lorenzo	1691	Brazil	3,067	766
28	Santa Rosa	1698	Paraguay	3,195	743
29	Trinidad	1706	Paraguay	2,459	518
30	Santo Ángel	1707	Brazil	3,614	890

Source: Maeder and Gutiérrez (2009).

Table A.2. Missionary Effect on Modern Education and Income at Different Distance Tresholds: Brazil, Argentina and Paraguay

	1	2	3	4	5	6	7	8
	Illiteracy ARG BRA PAR <400 kms	Illiteracy ARG BRA PAR <200 kms	Med. Years Edu. Brazil <400 kms	Med. Years Edu. Brazil <200 kms	Ln Income Brazil <400 kms	Ln Income Brazil <200 kms	Poverty Index ARG & PAR <100 kms	HH Poverty Index ARG & PAR <100 kms
Mission Distance	**0.00942***	**0.0253*****	**-0.00797*****	**-0.00444****	**-0.00319*****	**-0.00189****	**0.147****	**0.129****
	(0.005)	**(0.007)**	**(0.002)**	**(0.002)**	**(0.001)**	**(0.001)**	**(0.004)**	**(0.006)**
GEO Controls	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Fixed Effects	**YES**	**YES**	**NO**	**NO**	**NO**	**NO**	**YES**	**YES**
Observations	514	281	400	187	400	187	59	59
R-squared	0.101	0.133	0.189	0.231	0.28	0.21	0.208	0.16

Note: The table shows the coefficient of distance to the nearest Jesuit mission in kilometers (Equations 1 and 2). The dependent variables are illiteracy for people aged 15 years and older in 2000 in percentages for Argentina, Brazil and Paraguay in Columns 1 to 2; median years of schooling in Brazil in Columns 3 to 4, logarithm of income in 2000 for Brazil and Paraguay in columns 5 to 6, and the Unsatisfied Basic Needs (UBN) Poverty Index in Argentina and Paraguay at the individual level in Column 7 and the household level in Column 8. Geographic controls include distance to the nearest coast, distance to the nearest river, altitude, temperature, area, rainfall, latitude and longitude. Please refer to the paper for units and additional details of these variables. Estimation is by OLS with state fixed effects. The results are for the <400, <200 and <100 kilometers from the nearest Jesuit mission samples. Robust standard errors in parentheses *** $p<.01$, ** $p<.05$, *$p<.1$

Table A.3. Missionary Effect on Modern Income and Education, Alternative Formulations

	1	2	3	4	5	6	7	8	9	10
	Ln Income BRA & PAR Full	Ln Income BRA & PAR <200kms	Illiteracy ARG BRA PAR Full	Illiteracy ARG BRA PAR Dist. Dummies	Ln Income BRA & PAR Full	Ln Income BRA & PAR Dist. Dummies	Illiteracy ARG BRA PAR <200kms	Ln Income BRA & PAR <200kms	Illiteracy ARG BRA PAR Full	Ln Income BRA & PAR Full
Ln Mission Distance	**-0.237*** **	**-0.283*** **								
	(0.08)	**(0.08)**								
Mission Dummy (<100 kms)			**-1.616*** **	**-4.103** **	**0.363** **	**1.115*** **				
			(0.61)	**(1.60)**	**(0.16)**	**(0.38)**				
Mission Dummy (<50 kms)							**-2.028*** **	**0.133**		
							(0.69)	**(0.21)**		
Mission Distance (Q-reg)									**0.0148*** **	**-0.00364** **
									(0.005)	**(0.002)**
Fixed Effects	**NO**	**NO**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
GEO Controls	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Observations	506	245	548	548	506	506	281	245	548	506
R-squared	0.313	0.354	0.074	0.13	0.393	0.405	0.114	0.427	0.0505	0.2559

Note: The table shows the coefficient of the logarithm of distance to the nearest Jesuit mission in kilometers in Columns 1 and 2, a dummy for whether a municipality is within 100 kilometers of a Jesuit mission in Columns 3 to 6, within 50 kilometers in Columns 7 and 8, distance to the nearest Jesuit mission in kilometers in Columns 9 and 10. The dependent variables are the logarithm of income in 2000 for Brazil and Paraguay in Columns 1, 2, 5, 8 and 10 and illiteracy for Argentina, Brazil and Paguay in Columns 3, 4, 7, 9 and 10. Geographic controls include distance to the nearest coast, distance to the nearest river, altitude, temperature, area, rainfall, latitude and longitude. Please refer to the paper for units and additional details of these variables. Estimation is by OLS, except for the quantile regressions in Columns 9 and 10. Robust standard errors in parentheses and bootstrapped standard errors in Columns 9 and 10 *** p<.01, ** p<.05, *p<.1

Table A.4. Missionary Effect on Modern Income, Alternative Formulations: Brazil

	1	2	3	4	5	6	7	8	9
	Ln Income Brazil	Ln Income Brazil	Income Brazil	HD Index Brazil	IFDM Index Brazil	Ln Lights Brazil	Poverty Index ARG & PAR	Ln Lights ARG & PAR	Ln Lights ARG BRA PAR
Mission Distance	**-0.00275*** **		**-1.309*** **	**-0.0562*** **	**-0.0438*** **	**-0.0106*** **	**0.123** **	**-0.0140***	**-0.0551*** **
	(0.001)		**(0.274)**	**(0.010)**	**(0.010)**	**(0.002)**	**(0.058)**	**(0.007)**	**(0.014)**
Ln Mission Distance		**-0.0426***							
		(0.023)							
Mission Distance x ARG							**0.0768***		**0.0245*** **
							(0.044)		**(0.007)**
Mission Distance x BRA									**-0.0295*** **
									(0.008)
GEO Controls	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Fixed Effects	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**YES**	**YES**	**YES**
Observations	427	406	427	427	427	426	81	69	547
R-squared	0.178	0.155	0.162	0.108	0.18	0.602	0.233	0.724	0.563

Note: The table shows the coefficient of distance to the nearest Jesuit mission in kilometers (Equation 2), logarithm of distance to the nearest Jesuit mission in Column 2, and the linear formulation interacted wtih a dummy for Argentina in Column 7 and Argentina and Brazil in Column 9. The dependent variables are logarithm of income for Brazil in Columns 1 to 3, the Human Development Index in Column 4, the Brazilian IFDM Index in Column 5, the UBN Index in Column 7 and the logarithm of nighttlight satellite divided by population in Columns 6, 8 and 9. Geographic controls include distance to the nearest coast, distance to the nearest river, altitude, temperature, area, rainfall, latitude and longitude. Please refer to the paper for units and additional details of these variables. Estimation is by OLS with state fixed effects. Robust standard errors in parentheses *** p<.01, ** p<.05, *p<.1

Table A.5. Intensity of Treatment Effect of Jesuit Missions on Income: Brazil and Paraguay

	1	2	3	4	5	6
	Ln Income	Ln Income	Ln Income	Ln Income	Illiteracy	Ln Income
	BRA & PAR	BRA & PAR	BRA & PAR	BRA & PAR	ARG BRA PAR	BRA & PAR
Ln (Mission Distance X Foundation)	**-0.337*** **					
	(0.089)					
Ln (Population / MissionDistance)		**0.373*** **				
		(0.101)				
Ln (Population X Years Active)			**0.380*** **			
Mission Distance			**(0.106)**			
Mission Distance X River Distance				**-0.00428*** **	**0.0199*** **	
				(0.002)	**(0.006)**	
Mission Moved						**-0.0984* **
						(0.059)
GEO Controls	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Fixed Effects	**NO**	**NO**	**NO**	**YES**	**YES**	**YES**
Observations	506	498	498	506	548	506
R-squared	0.51	0.51	0.55	0.411	0.093	0.873

Note: The table shows the coefficient of the logarithm of distance to the nearest Jesuit interacted with year of foundation, mean population and distance to the nearest river in Columns 1 to 5 and a dummy variable for whether a Mission moved is in Column 6. The dependent variable is the logarithm of income in 2000 for Brazil and Paraguay. Geographic controls include distance to the nearest coast, distance to the nearest river, altitude, temperature, area, rainfall, latitude and longitude. Please refer to the paper for units and additional details of these variables. Estimation is by OLS. Robust standard errors in parentheses *** p<.01, ** p<.05, *p<.1

Table A.6. Instrumental Variables Effect of Jesuit Missions on Modern Income and Education

	1	2	3	4	5	6
Panel A	Illiteracy	Illiteracy	Illiteracy	Ln Income	Ln Income	Ln Income
Second Stage	Explorers	Asuncion	Both	Explorers	Asuncion	Both
	ARG BRA PAR	Brazil	Brazil	BRA & PAR	Brazil	Brazil
Mission Distance	**0.0140****	**0.0215****	**0.0245*****	**-0.00337*****	**-0.00199*****	**-0.00243*****
	(0.006)	**(0.011)**	**(0.009)**	**(0.001)**	**(0.001)**	**(0.001)**
GEO Controls	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Fixed Effects	**YES**	**NO**	**NO**	**YES**	**NO**	**NO**
Observations	548	467	467	506	467	467
R-Squared	0.058	0.143	0.145	0.874	0.262	0.262
Panel B	**Mission Distance**			**Mission Distance**		
First Stage	-0.6874	2.0410		-0.4832	2.0410	
	(0.021)	(0.205)		(0.027)	(0.205)	
T-statistic	-33.40	9.94		-17.91	9.94	
F-test			798.26			798.26
Overidentification Test			0.290			1.465
P-value			0.590			0.226

Note: The table shows the instrumented coefficient of distance to the nearest Jesuit mission in kilometers. The instrumental variables are distance to the Exploration route and Asunción. The dependent variables are illiteracy for people aged 15 years and older in 2000 in percentages for Argentina, Brazil and Paraguay in Columns 1 to 3, and the logarithm of income in 2000 for Brazil and Paraguay in Columns 4 to 6. Geographic controls include distance to São Paulo, distance to the nearest coast, distance to the nearest river, altitude, temperature, area, rainfall, latitude and longitude. The first stage in Panel B on Mission Distance is for Exploration route in Columns 1 and 4, distance to Asuncion in Columns 2 and 5, and both instruments in Columns 3 and 6. Please refer to the paper for units and additional details of these variables. Estimation is by two step least squares with state fixed effects in Columns 1 and 4. Robust standard errors in parentheses *** p<.01, ** p<.05, *p<.1

Table A.7. Missionary Effect on Historical Education: Argentina (1914) and Brazil (1940)

	1	2	3	4	5	6	7	8
	Illiteracy ARG 1914 Argentinean	Illiteracy ARG 1914 Foreigners	Instruction ARG 1914 Total	Schols *pc* ARG 1914 Total	Illiteracy BRA 1940 Total	Illiteracy BRA 1940 7 to 14	Illiteracy BRA 1940 5 to 39	Instruction BRA 1940 Total
Mission Distance	**0.0641*** **	**-0.0472*** **	**-0.313***	**-0.00333** **	**0.146*** **	**0.0325** **	**0.0364** **	**-0.0770** **
	(0.019)	**(0.010)**	**(0.1770)**	**(0.0016)**	**(0.0528)**	**(0.0125)**	**(0.0143)**	**(0.0301)**
	{0.016}	**{0.009}**	**{0.180}**	**{0.003}**	**{0.059}**	**{0.017}**	**{0.020}**	**{0.039}**
GEO Controls	**NO**	**NO**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
Observations	32	32	32	24	37	37	37	37
R-squared	0.298	0.193	0.584	0.671	0.401	0.394	0.418	0.381

Note: The table shows the coefficient of distance to the nearest Jesuit mission in kilometers (Equation 1). The dependent variable is illiteracy in percentages in Argentina in 1914 in Columns 1 and 2, instruction in 1914 in Column 3, schools per capita in 1914 in Column 4, illiteracy in Brazil in 1940 in Columns 5 to 7 and instruction in 1940 in Column 8. Geographic controls include distance to the nearest coast, distance to the nearest river, altitude, temperature, area, rainfall, latitude and longitude. Please refer to the paper for units and additional details of these variables. Estimation is by OLS. Robust standard errors in parentheses and bootstrapped standard errors in brackets *** p<.01, ** p<.05, *p<.1

Table A.8. Missionary Effect on Indigenous Assimilation: Marriage, Population and Language in Brazil and Paraguay

	1	2	3	4	5	6	7
	Mixed Marriage	Caboclo Marriage	Percentage Catholic	Percentage Indigenous	Guarani Language	Spanish Language	GUA & SPA Language
	BRA 1890	BRA 1890	BRA 1890	BRA 2010	PAR 2012	PAR 2012	PAR 2012
Mission Distance	**-0.0911*** **	**-0.0401*** **	**-0.0353***	**-0.302****	**0.0218*** **	**-0.0172*** **	**-0.00778****
	(0.018)	**(0.010)**	**(0.019)**	**(0.136)**	**(0.007)**	**(0.006)**	**(0.004)**
	{0.016}	**{0.012}**	**{0.021}**				
GEO Controls	**YES**	**YES**	**YES**	**NO**	**YES**	**YES**	**YES**
Fixed Effects	**NO**	**NO**	**NO**	**NO**	**YES**	**YES**	**YES**
Observations	63	63	63	467	1928	1928	1928
R-squared	0.582	0.661	0.229	0.006	0.1273	0.1447	0.0291

Note: The table shows the coefficient of distance to the nearest Jesuit mission in kilometers. The dependent variables are the percentage of mixed and caboclo marriages in Brazil in 1890 in Columns 1 and 2 and percentage Catholic in Column 3; percentage of indigenous population in 2010 in Column 4; and percentage of Guarani, Guarani and Spanish, and Spanish speakers in Paraguay in 2012 in Columns 5 to 7. Geographic controls include distance to the nearest coast, distance to the nearest river, altitude, temperature, area, rainfall, latitude and longitude. Please refer to the paper for units and additional details of these variables. Estimation is by OLS in Columns 1 to 4 and for a Probit model with state fixed effects in Columns 5 to 7 with errors clustered at the district level. Robust and clustered standard errors in parentheses and bootrsrapped standard errors in brackets *** p<.01, ** p<.05, *p<.1