

# Jesuit Missionaries in the Colonial Amazon: Long-term Effects on Human Capital\*

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## Abstract

This paper examines the long-term effects of Jesuit missions on human capital and development in the Brazilian Amazon. Using novel Brazilian census data from 1872 and 1890, along with the modern census of 2010, combined with a new dataset on the locations of Jesuit missions in the Brazilian Amazon, I find that areas closer to former missions had higher literacy rates in the 19th century and that difference persists to the present day. Additionally, I observe similar results when employing an instrumental variable approach that considers the locations of Tupi-speaking tribes in the area, and when comparing the Jesuits' impact to that of other missionary orders. By analyzing individual-level data from the decennial censuses between 1970 and 2010, I demonstrate that these effects have persisted over time.

**Keywords:** Brazil, Amazon, Colonization, Missionaries, Jesuits, Human Capital

**JEL Classification:** I25, N36, O15, O43, Z12

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## 1. Introduction

“Everything [of political and economic nature in the Amazon is] related to the deeds, ideas, and goals of the Society of Jesus.”

- The Jesuits in Grão-Pará, J. L. Azevedo ([1930](#), p. 9)

During the Catholic Reformation in Europe, the Catholic Church proselytized Christianity to the recently discovered New World through several religious orders. In Brazil, the most prominent of these orders was the Society of Jesus, known as the Jesuits. While they were present throughout Brazil, their missionary activity was particularly focused in the South, among the Guarani, and in the Amazon, among the Tupi. Through their work, the Jesuits established several successful missions and were the first to codify the Tupi-Guarani language.

Given the Jesuits’ important role in colonizing the Amazon, this paper quantifies the persistent effects of Jesuit missions on human capital in the Brazilian Amazon. The colonial Amazon provides an ideal setting for studying persistence for various reasons. First, the Amazon’s large area and geographical isolation allowed the Jesuits to be relatively undisturbed until their expulsion. Second, colonization in the Amazon was slower than in the rest of Brazil due to several factors. By 1720, there were only one thousand Portuguese speakers in the region ([Mufwene, 2014](#)), with indigenous people making up a high share of the population. Third, the Amazon had an active missionary presence throughout its colonial period, receiving a large proportion of the Jesuit missionaries in Brazil. Lastly, to this day, its inhabitants remain both culturally and genetically connected to the former indigenous people ([Arenz, 2012](#), p. 50; [Parker, 1989](#); [Souza et al., 2019](#)).

To measure the impact of the Jesuits in the Brazilian Amazon, I combine data from the Brazilian censuses with a novel dataset on the location of Jesuit missions in the Amazon. The Jesuit mission locations are obtained from a map drawn by Serafim Leite, a Jesuit priest.<sup>1</sup> The map contains the approximate locations of 60 former Jesuit missions in the present-day Brazilian states of Pará, Amazonas, Roraima, and Amapá. The geographical location of the Jesuit missions is combined with the 1872 and 2010 Brazilian censuses to measure the effects of proximity to a Jesuit mission on human capital. My preferred measure of human capital is the literacy rate, as it is available already in 1872 and 1890.

I exploit the variation in the locations of the Jesuit missions by following [Valencia Caicedo \(2019\)](#), using the distance from municipalities to the nearest Jesuit mission as the main

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<sup>1</sup>Leite compiled the Jesuits’ history in Brazil in ten volumes on his encyclopedia entitled *The History of the Company of Jesus in Brazil*. Volumes 3 and 4 focus on the Amazonian region of Brazil from which the map is obtained.

explanatory variable. I initially address the endogeneity of the Jesuit missions' locations by controlling for a rich set of controls, which include: mean elevation, mean slope, distance to the nearest river, distance to the coast, latitude, longitude, and potential calories from agriculture pre- and post- the Columbian exchange ([Galor and Özak, 2016](#)). The main estimates indicate that localities further away from Jesuit missions had significantly lower literacy rates in 1872, 1890, and 2010. Being 100km farther away from a Jesuit mission decreased the literacy rate by 3.3% in 1872, 3.1% in 1890, and 3.8% in 2010.

I further address endogeneity with two other specifications. First, I instrument the distance to a Jesuit mission with the distance to the nearest Tupi-speaking area obtained from [Clement et al. \(2015\)](#) and [Eriksen \(2011\)](#). The Jesuits developed a “lingua-geral” based on Tupi-Guarani to communicate with the indigenous population. Indigenous tribes that spoke Tupi were easier to communicate with and convert, which facilitated the establishment of missions on their land. The instrumental variable estimates indicate that in 1872, 1890, and 2010, being 100km farther from a Jesuit mission decreased literacy by 6.6%, 4.8%, and 3.9%, respectively. Lastly, I compare the effects of proximity to a Jesuit mission with the proximity to other religious orders, the Carmelites and Franciscans. The point estimates for the proximity to the Jesuit missions remain similar to the ones without the inclusion of the proximity to non-Jesuit missions. In contrast, the effects of non-Jesuit missions are statistically insignificant. The results indicate that only places near Jesuit missions see increased literacy rates, while other orders have no significant effects.

Using individual-level data from the censuses of 1970, 1980, 1991, 2000, and 2010, I find that the effects have persisted throughout the centuries. The point estimates indicate that people living 100 km away from a former Jesuit mission are 4.2 to 12.6% less likely to be literate. This effect exists for both men and women, for all races, and for locals. Overall, these results indicate the persistence of human capital even into the 20th century, as measured by literacy at places close to former Jesuit mission locations in the region.

I explore alternative channels that might account for the results. In terms of demographics, I find no significant differences in 1872, except for a modest increase in the share of slaves in parishes located near Jesuit missions. There is also no strong evidence of differential effects on the types of occupations individuals held at that time. Similarly, there are no general impacts on school attendance among children in 1872. However, when disaggregated by gender, I find significant positive effects on girls' school attendance, but not for boys. Looking at more contemporary outcomes, I find no significant effects on GDP per capita in 2010, even when disaggregated by economic sector. However, when I use nightlight density as an alternative proxy for economic development, the results show strong and significant effects, with municipalities closer to Jesuit missions exhibiting higher nightlight density. Finally, I

find no effects on the urban population share or the number of schools in 2010. Nonetheless, municipalities near Jesuit missions show significantly higher population density.

I also conduct several robustness checks, including changing treatment assignments based on localities within varying radii from a Jesuit mission, excluding localities too far away from a mission, using several tests of robustness of the instrumental variable, varying Conley standard errors, and addressing the issues of persistence from [Conley and Kelly \(2025\)](#). The results remain significant and indicate the Jesuits' effect in the region.

This paper contributes to the literature that analyses the long-term effects of colonial missionary activity in South America. [Valencia Caicedo \(2019\)](#), who first analyzed the effect of the Jesuits on the Guarani people of South America. The author finds significant positive effects of the Jesuits' missions on literacy rate and income.<sup>2</sup> [Gómez-i-Aznar \(2023\)](#) further corroborates the evidence, also analyzing the effect of Jesuit missions on the Guarani people with mission censuses. The paper finds strong evidence of high levels of the indigenous people's numeracy in the location of those former Jesuit missions.

Also closely related to this paper is [Waldinger \(2017\)](#), who studies Catholic missionaries in Mexico. Unlike the results of this paper and [Valencia Caicedo \(2019\)](#), the author finds positive impacts only for the Mendicant order but not for the Jesuits. [Solá \(2023\)](#) studies the more recent expansion of evangelical missionaries in Brazil and finds positive effects of conversion and political association with right-wing parties in Brazil. By analyzing the Jesuits' effect on the Brazilian Amazon, I conduct, to the best of my knowledge, the first empirical and economic analysis of missionary activity in the Brazilian Amazon. The extended geographical coverage of this paper provides additional evidence of the missionaries' impact during colonial times.

This paper also adds to the literature on the colonization of the Americas and the role of colonial and pre-colonial institutions and demographics. [Dell \(2010\)](#) finds persistent negative effects of the Spanish mita system in Peru. [Barsanetti \(2021\)](#) and [Franco et al. \(2021\)](#) find that local pre-colonial indigenous roads in Brazil and with the Inca in Peru increased urbanization and current development. [Sellars and Alix-Garcia \(2018\)](#) finds that a population collapse in indigenous people in Mexico led to land concentration by a few owners in

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<sup>2</sup>While the estimates between this paper and [Valencia Caicedo \(2019\)](#) are similar in magnitude, the context of the Jesuit settlement and expulsion was different. In the Amazon, there was continuity in the administration of the missions, as they were transferred from Jesuits to Portuguese officials. In contrast, the Guarani missions had an uprising against the new Portuguese rule as the Spanish Guarani were afraid of being enslaved by Portuguese *Bandeirantes*. The historical difference here points to other mechanisms that allowed the Guarani missions to preserve their human capital after the Jesuits' expulsion, and possibly the resilience of the introduction of human capital. Further, the similarity of the results indicates that the Jesuit presence is strongly associated with increased human capital, regardless of the region, the indigenous people they taught, and the challenges they faced.

Mexico. [Angeles and Elizalde \(2017\)](#) and [Arias, Girod, et al. \(2011\)](#) finds an important role of pre-colonial institutions on present-day development.

The paper further contributes to the literature that explores the historical causes of human capital accumulation in Brazil, that have analyzed trade shocks and the development of elementary education ([Musacchio et al., 2014](#)). [Maloney and Valencia Caicedo \(2016\)](#) finds that pre-colonial population density is a strong predictor of higher income in the present in the Americas. Other papers have also analyzed the impact of local institutions on the long-term inequality in Brazil ([Wigton-Jones, 2020](#); [Naritomi et al., 2012](#)). [Rocha et al. \(2017\)](#) studies the effects of immigration in the state of São Paulo and finds positive lasting effects on human capital. I build on the literature by analyzing the historical causes of human capital accumulation in a previously under-researched area, the Brazilian Amazon.

Also related is the vast literature studying the effects of missionaries in Africa, which finds significant effects of missionary presence on human capital accumulation, health, and democratic institutions ([B. Becker and Selhausen, 2023](#); [Brown, 2024](#); [Cagé and Rueda, 2020](#); [Cagé and Rueda, 2016](#); [Gallego and R. Woodberry, 2010](#); [Guirkinger and Villar, 2022](#); [Jedwab et al., 2022](#); [Nunn, 2014](#); [Nunn, 2010](#); [Nunn, 2020](#); [Okoye and Pongou, 2014](#); [Wantchekon et al., 2015](#); [R. D. Woodberry, 2012](#)). Also related is the smaller literature of Christian missionaries in China, which finds that both Jesuits and Protestant missionaries led to technological and economic development ([Bai and Kung, 2015](#); [Ma, 2021](#)). Missionaries also had similar positive effects in India by providing healthcare or educating women ([Calvi and Mantovanelli, 2018](#); [Lankina and Getachew, 2013](#)).

The remainder of this paper is structured as follows. [Section 2](#) provides historical context regarding the colonization of the Amazon and the role played by the Jesuits. In [Section 3](#), I describe the data utilized in the analysis. [Section 4](#) outlines the three main empirical strategies employed. I discuss the methods and the results from the primary specification are presented in [Subsection 4.1](#). In [Subsection 4.2](#), I introduce estimators based on an instrumental variable approach and discuss the results. I also show results comparing the effects of the Jesuits against other missionary orders in [Subsection 4.3](#). Using microcensus data, [Section 5](#) explores the potential mechanisms behind the observed persistence. [Section 6](#) further analyzes other possible mechanisms that could explain the results of the previous sections, such as demographics, economic development, and urbanization. Several robustness checks are provided in [Section 7](#). Finally, [Section 8](#) wraps up the paper with concluding remarks.

## 2. Historical Background

The colonization of the Amazon began relatively late compared to the rest of Brazil. The central city in the region, Belém, was founded by the Portuguese only in 1616 (Chambouleyron, 2019). Several factors explain the Portuguese's relative lack of interest in the region. First, settlements near the coast in the Northeast and Southeast provided easy transportation of goods from and to Portugal and its African colonies. Second, settlement for traditional European-style agriculture and husbandry was difficult in the Amazon.<sup>3</sup> The dense tropical forest of the region hindered exploration, required effort to clear the land, and provided poor soil for plantations.<sup>4</sup> Lastly, the Amazon lacked precious metals such as gold or silver, which were the focus of the Portuguese Crown in their New World colonies. As a result, most settlements by Portuguese colonizers were located on the coast and alongside the fertile Tocantins valley (Assis Costa, 2018, p. 44; Chambouleyron and Ibáñez-Bonillo, 2019).

Unlike the rest of Brazil, a key characteristic of the region was the importance and intense use of free and enslaved indigenous people as part of the labor force (Chambouleyron, 2019; Hall, 1973, p. 199). The Amazon was home to a large number of indigenous people, who could be enslaved to work as labor for the colony.<sup>5</sup> Indigenous labor was cheaper compared to African slaves, which had high transportation costs and, as a result, were not a large part of the population in the region during the colonial era (Diffie, 1987, p.415). A final benefit of indigenous people was that since the local economy was based on the extraction of resources and spices, they were the only ones who knew the region's intricacies (Júnior and Macedo, 1968, p .28-29; Parker, 1989). Given the necessity of the Portuguese crown to settle in the region, it tried to organize and pacify the indigenous people to make them more welcoming to future Portuguese colonizers.

With the support of the Portuguese Crown, the Jesuits were invited to the Amazon to pacify the local indigenous people and fortify Portuguese borders.<sup>6</sup> The Jesuits, formally known as the Society of Jesus, were established in 1534 by Saint Ignatius of Loyola during the Catholic Reformation in Europe. John II, King of Portugal, viewed the Jesuits highly, making them the pioneering missionaries in Portuguese colonies. The Jesuits arrived in Brazil

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<sup>3</sup>The Jesuits tried introducing animals in the region; however, it was unsuccessful (Hoornaert, 1992).

<sup>4</sup>Agriculture was viable near the rivers in the area called *varzea*; however, that required knowledge of the river cycles, which only the indigenous people knew (Hoornaert, 1992, p. 15-16).

<sup>5</sup>The Brazilian Amazon's indigenous population in pre-colonial times is estimated to be over two million, with a higher density of them located along the rivers of the region (Melatti, 2007; Denevan, 2014; Bethell, 1987, p. 119)

<sup>6</sup>Another role of the Jesuits was to establish Portuguese colonization past the Tordesillas line, in Spanish territory, such that Portugal would be able to *de jure* claim it (Hall, 1973, p. 88).

in 1549 and quickly established several missions throughout the territory (Paiva, 2015). The Jesuits were most successful in Southern Brazil with the Guarani tribes and in the North along the Amazon River and its tributaries (Hemming, 1988, p. 3). The Jesuits' first arrival in the Amazon would be in Belém in 1653. The Amazon quickly became a focus of Jesuit missionaries due to its large native population.

Initially, the Jesuits set up missions near the major cities of the Amazon. Logistics and housing challenges hindered further Jesuit expansion into the dense tropical forest. However, partly because of conflicts with settlers over the rights of indigenous labor and the need to secure the Amazon's western borders, this led to the establishment of missions farther from the main colonial cities.<sup>7</sup> The new missions were often situated along the colony's frontier on the Amazon River, yet isolated from European presence. Other than priests, non-indigenous people could not reside in the missions (Cardoso, 1984, p. 100).

As Portuguese dominance over the region grew, the settlers eventually pushed the frontier and made contact with the isolated Jesuit missions. This effectively increased conflicts between the Jesuits and Portuguese settlers.<sup>8</sup> To resolve the conflict, the Portuguese Crown established the *Regimento das Missões* in 1686. Its main goal was to delineate the power, responsibilities, rights, and jurisdiction of missionary orders and the colonizers. The *Regimento das Missões* benefited the Jesuits by granting all religious orders complete political and spiritual control of their missions' indigenous people. However, it also delineated specific areas under Jesuit jurisdiction, which included the southern bank of the Amazon River (Chambouleyron and Ibáñez-Bonillo, 2019).

While the Jesuits were colonizers themselves, and the indigenous people often were suspicious of their actions, they offered refuge from the harsher oppression of Portuguese settlers. The Jesuits primarily focused on preaching to the indigenous people through the Bible.<sup>9</sup> The Jesuits also defended the rights of the indigenous people, unlike the Portuguese settlers, who wanted to use them as slave labor.<sup>10,11</sup> While the regimented life under the missions was as physically demanding as working under Portuguese settlers, economically, the Jesuits were

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<sup>7</sup>"Religious orders had the merit of trying to protect Indians from being enslaved by colonists, which gave rise to considerable friction between colonists and priests"(Fausto, 2014, p. 16)

<sup>8</sup>Fr. António Vieira was the most prominent Jesuit who lobbied the Portuguese Crown on behalf of the indigenous people in Brazil. Due to the pressure of Portuguese settlers, Vieira was exiled from Brazil from 1661 to 1681. (Zeron, 2015).

<sup>9</sup>The teachings would ideally happen daily in the local parish, present at every mission.

<sup>10</sup>It is even mentioned in Chambouleyron et al. (2020) how "everything indicates, that although the interference on the natives' customs, the missionaries cherished the principle that the missions' lands belonged to the Indians'

<sup>11</sup>Boxer (1962, p. 277) states that the "The Jesuits alone among the Religious Orders in Brazil had a consistent tradition of upholding the freedom of the Amerindians against all the efforts of the colonists to enslave and exploit them".

able to protect the indigenous people by reinvesting any of their profits in their missions ([J. L. Azevedo, 1930](#), p. 235).

The Jesuits' presence in South America ended in 1759 with the rise of Sebastião José de Carvalho e Melo, also known as the Marquis of Pombal ([Botelho, 2011](#)). Pombal gained prominence on the Portuguese throne, serving as a key advisor to the king. Pombal was a strong anti-Jesuit who blamed them for economic stagnation in the Portuguese colonies, especially in the Amazon. He listened to settlers' complaints that the Jesuits were monopolizing native labor, which led to the underdevelopment of the land in the region ([Parker, 1989](#); [Boxer, 1962](#), p. 277). To weaken the Jesuits' influence, Pombal appointed his brother, Paulo António de Carvalho e Mendonça, as governor of the provinces of Grão-Pará and Maranhão. Pombal and his brother launched a smear campaign against the Jesuits, further turning colonists against them. In 1759, Mendonça ended the *Regimento das Missões* and established the *Directorate of the Indians*, which remained until 1798.

The Directorate effectively ended all Jesuit presence in Brazil during its colonial era. All religious orders with missions in the Amazon were expelled, and any remaining farms and goods were confiscated. The expulsion of the religious order eliminated direct Jesuit influence on the region's indigenous people. The Directorate transferred the administration of the missions to local Portuguese government officials. Sixty former missions became villages under a new lay administration by Portuguese officials ([Chambouleyron, 2019](#)).

The significant impact of the Jesuits on the Amazon cannot be overstated. First, the Amazon was a region of intense missionary activity, with a quarter of the total Jesuit missionaries in Brazil living there before their expulsion ([Bethell, 1987](#)). Second, the Jesuits established 60 missions along the rivers and developed a thriving economic base centered on spices from the forest.<sup>12</sup> Third, the Jesuits contributed to the economic development of the Amazon by introducing new technology, reinvesting capital into their missions, and teaching the indigenous people basic literacy.<sup>13</sup> Lastly, the Jesuits created the first European-style settlements, leading to the development of the region's first urban centers, which would eventually become some of its main cities in the region.<sup>14</sup>

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<sup>12</sup>In comparison to the *Guarani* missions, where the Jesuits had a total of 30 mission stations ([Gómez-i-Aznar, 2023](#)).

<sup>13</sup>Previous literature also discusses how the Jesuits "in the Amazon completely replaced civil power in the education of a people, reaching the most remote corner of the Amazon Basin" ([Paiva, 2015](#))

<sup>14</sup>At its height, the number of indigenous people living in Jesuit missions reached 200,000 ([Alden, 1996](#); [Bethell, 1987](#)). In comparison, the total population of the two states comprising the Amazon in 1872 was just over 300,000. This figure is comparable to the estimated 140,000 indigenous people in the *Guarani* missions, which are estimated to be around 140,000 ([Gómez-i-Aznar, 2023](#)).

### 3. Data

The main source of data for the Jesuit missions comes from Leite (1943). Serafim Leite was a Jesuit priest who documented the history of the Jesuits in Brazil. Leite, using official records, includes a detailed map of the Jesuit missions in Northern Brazil.<sup>15</sup> The map is georeferenced using QGIS, covering a sample of 60 Jesuit missions across four states: Pará, Amazonas, Roraima, and Amapá.<sup>16</sup> I show the geographical distribution of the 60 Jesuit missions in Figure 2.

Census data for 1872 is obtained from the Nucleus of Research in Economic and Geographic History from the Federal University of Minas Gerais.<sup>17</sup> The 1872 Imperial Census contains demographic data at the municipality and parish level.<sup>18</sup> I georeference the parishes to present-day locations for a total of 91 observations for 1872.<sup>19,20,21</sup> I also digitized and geo-referenced the 1890 Brazilian census to obtain literacy rates for a total of 103 parishes in the same two states.<sup>22</sup> In Figure A.3 and Figure A.4, I show the geographical distribution of parishes for both censuses, and how they relate to the 1872 municipality boundaries. Modern censuses in Brazil from 1970 to 2010 are obtained from the IBGE, including literacy rates, GDP per capita, and urban populations.

Shapefiles for the Brazilian coast, navigable rivers, and municipality seats are obtained from IBGE through Pereira and Goncalves (2023). Slope data comes from the European Environment Agency<sup>23</sup>, and elevation comes from Amatulli et al. (2018). Data on the maximum amount of calories based on pre-Columbian and post-Columbian crops are obtained from Galor and Özak (2016). The location of Franciscan and Carmelite missions in the region is obtained from Bombardi (2014). The location of pre-colonial Tupi-speaking areas is obtained from a map used in Clement et al. (2015) and Eriksen (2011). The number of

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<sup>15</sup>The original map is available in Figure 1. I only consider missions in which there are points directly on the map, or arrows pointing towards it. Places with only the name and a date are often Jesuit expeditions, and no full settlement were made.

<sup>16</sup>All four states were part of Pará or Amazonas during colonial times. Acre is not included in the sample since it was not a part of Brazil until 1903. Based on the map, I cannot identify missions in the states of Rondônia or Tocantins.

<sup>17</sup>Available at <http://www.nphed.cedeplar.ufmg.br/>

<sup>18</sup>For the 1872 census, a parish represents the smallest geographical unit available. Given the importance of the Catholic Church in Brazil, parishes were often the base for collecting data such as birth (baptism) and marriages.

<sup>19</sup>Information on how the variables were constructed for this paper can be found in Appendix E

<sup>20</sup>Information on the georeferencing process for the 1872 parishes can be found in Appendix F

<sup>21</sup>Literacy rate as defined in the 1872 census only counts for people of age five and above, following Ferraro (2002).

<sup>22</sup>There are technically 104 parishes in the 1890 census; however, the parish of *Nossa Senhora da Conceição do Affuá* in the municipality of Affuá does not have information on literacy rate.

<sup>23</sup>Available at <https://www.eea.europa.eu/data-and-maps/data/world-digital-elevation-model-etopo5>

schools per municipality is obtained from INEP (National Institute for Educational Studies and Research Anisio Teixeira), based on [Pereira and Goncalves \(2023\)](#).

Since the distance to a Jesuit mission is a continuous variable, I provide summary statistics considering a location treated if it is within 50km of a Jesuit mission in [Table 1](#), [Table 2](#), and [Table 3](#). For all three censuses, it is already possible to observe that places near the Jesuit missions have higher literacy rates than those farther away.<sup>24</sup>

## 4. Methodology

### 4.1. Baseline Specification

I estimate the effect of proximity to a Jesuit mission on literacy rate with the following specification, which follows from [Valencia Caicedo \(2019\)](#):<sup>25</sup>

$$Y_{i,s} = \beta DistanceToJesuitMission_{i,s} + \gamma GEO_{i,s} + \mu_s + \epsilon_{i,s} \quad (1)$$

Where  $DistanceToJesuitMission_{i,s}$  is the main dependent variable of interest. It measures the Euclidean distance in kilometers from a unit of observation  $i$  in a state  $s$  to the nearest Jesuit mission. The coefficient of interest is  $\eta$ , which indicates the effect of being 1km away from a Jesuit mission on the outcome variable. If the Jesuits had a positive effect on the outcome variable,  $\eta$  would be negative, suggesting that localities farther from their missions have worse outcomes than those near them.  $GEO_{i,s}$  is a set of geographical control variables that includes the average slope, average elevation, distance to the coast, distance to the nearest navigable river, potential calories from agriculture, longitude, latitude, and whether the location is the state capital. I argue that all these control variables are good measures of pre-colonial characteristics that the Jesuits would have considered when settling in the region. Slope, elevation, distance to the coast, and the distance to the nearest river are measures of accessibility, which would have been important for the Jesuits to reach and convert indigenous populations. The potential calories from [Galor and Özak \(2016\)](#) indicate soil suitability. For pre-Columbian crops, these measures indicate where indigenous people could have grown food, while post-Columbian calories are a good indicator of regions suitable for European-style agriculture. Latitude and longitude are flexible controls for how the locations are geographically distributed. Lastly, controlling for whether the location is the

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<sup>24</sup>I further plot unconditional literacy rates on distance to a Jesuit mission in [Figure A.1](#). All three graphs provide further evidence of how proximity to the Jesuit mission influences the literacy rate, as there is a negative trend between the distance to the nearest Jesuit mission and the literacy rate.

<sup>25</sup>Literacy rate is chosen as the main outcome variable because it is consistently available in the censuses and can be traced back to 1872. For example, while median years of schooling is another proxy for human capital, it is not available in either the 1872 or 1890 censuses.

capital of the state is important, since in the region, the capitals were the first places to be settled and developed, and therefore would be expected to have higher literacy rates.  $\mu_s$  represents state fixed-effects. In all specifications, robust standard errors are in parentheses, while Conley standard errors are in brackets (Conley, 1999).<sup>26</sup>

The identification assumption assumes that, conditional on the set of geographical variables and fixed effects, the location of the Jesuit mission was exogenous. While most of the controls included in the regression would likely be considered by the Jesuits when selecting their mission location, this may not fully capture their decision. Therefore, I subsequently analyze in Subsection 4.2 and Subsection 4.3 additional specifications to address the missions' endogenous location choices.

Another potential concern is that the number of municipalities has changed throughout the centuries analyzed. To maintain consistency in the observations, I present results from later censuses (1890 and onwards) by subsetting locations close to the original 1872 parishes. I show results when subsetting for parishes/municipalities within a radius of 10, 25, and 50 km from a 1872 parish. I also show results when including the entire sample.

#### 4.1.1. Results - Baseline

The results for this specification are found in Table 4. To capture persistence, I first use the earliest census available, the 1872 Imperial Census. If there are any persistent effects of the Jesuits on human capital, they would have to exist on the earliest possible date.<sup>27</sup> I show that in column (1) of Table 4, the coefficient of interest is -0.033, indicating that being 100km away from a Jesuit mission would decrease the literacy rate by 3.3%.<sup>28</sup>

I further reinforce that the results were already present in the 19th century, by also using the 1890 census. The results are found in columns (2) to (5) in Table 4. When considering parishes close to the 1872 parishes to maintain a consistent geographic sample, I find that the coefficients range from -0.031 to -0.032, indicating a 3.1 to 3.2% decrease in literacy for every 100 km away from a Jesuit mission. The point estimates are very similar to the 1872

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<sup>26</sup>Conley standard errors use a Bartlett kernel with a distance cutoff of 400km. The Conley standard errors are reported in brackets when possible.

<sup>27</sup>A possible concern addressed with the 1872 census was the Rubber boom and the drought in the Northeast, which led to massive immigration to the region (Parker, 1989). While the rubber boom began in the 1870s, it was not fully developed until later; additionally, the first wave of migration to the region due to the drought began only in 1877. Therefore, it is unlikely that either affected the 1872 results. Further, the results holding in 1890 would indicate that the movement to the region did not affect literacy, at least in the short run.

<sup>28</sup>While I cannot test it directly, these results could be argued to be a result of the Jesuits' effects on literacy being transmitted through the descendants of the indigenous people. I show later in the paper that there are no effects on the proportion of school-age children attending school in 1872, which would indicate that the results found are not driven by better access to education.

estimates, which is not surprising since the literacy rates in the two periods were also very similar. The point estimates in both censuses are especially economically significant, as the literacy in the region was only around 20%. Relative to the mean, the estimates indicate that being 100km away from a Jesuit mission would decrease the literacy rate by 14-16% relative to the mean. The results for 1890 are not significant when including parishes that were created in locations far different than those in the 1872 census, as shown in column (5). Overall, the results of the earliest two possible censuses already indicate that the Jesuit presence in the region had a significant effect on literacy rates.

When measuring if the effects of the Jesuit missions have persisted up to modern-day, I use the 2010 census, and the results are found in columns (6) to (9) in [Table 4](#). The first important thing to note is that although the literacy rate has increased from 21.6% in the region up to 82.7%, the effects of the Jesuits are not only present, but the point estimates are remarkably similar to what was found in 1872 and 1890. In columns (6) to (8), when considering 2010 municipalities close to the 1872 parishes, the coefficients range from -0.034 to -0.038, which are close to the -0.033 and -0.031 found in 1872 and 1890, respectively. That also implies that in relative terms, the economic effects are smaller, as being 100km away from a Jesuit mission would decrease the literacy rate by 4.2 to 4.4% relative to the mean. The estimates in this section are similar to [Valencia Caicedo \(2019\)](#), who finds coefficients of 0.0313 when considering illiteracy in Southern Brazil, indicating that the Jesuits had a similar effect on literacy in two very different regions of Brazil.

All three censuses indicate that the Jesuit missionaries had a lasting effect on human capital development in the Amazon. However, there are valid endogeneity concerns with the location of the missions, even after controlling for geographical characteristics. It is possible that the Jesuits chose locations based on a set of unobservables not considered in this section. In the following two sections, I further address endogeneity concerns by using an instrumental variable and by comparing the effects of the Jesuits with other religious orders.

## 4.2. Instrumental Variable - Tupi Language

Brazil had a large variety of local languages by the time of colonization.<sup>29</sup> Given the variety of local languages, the Jesuits needed a language to communicate with the indigenous people. The natural choice was the Tupi-Guarani language family, which the Jesuits and Portuguese settlers came in early contact with as it was the most common language spoken

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<sup>29</sup>For example, during his travel up the Amazon River, a Spanish Jesuit missionary came in contact with over 150 different languages ([Mufwene, 2014](#)).

by the indigenous people who lived on Brazil's coast (McGinness, 2019).<sup>30</sup> As a result, in 1595, the Jesuit Father José de Anchieta created the *lingua-geral* based on Tupi-Guarani to facilitate communication with the indigenous people. The *lingua-geral* was the first effort to create an orthography for Tupi-Guarani, and it provided a written and standardized form that would be usable for future Jesuits to communicate with the indigenous people of South America (Newson, 2020, p. 192; McGinness, 2019).<sup>31,32</sup>

I exploit the language barrier between the Jesuits and the indigenous people at the time of colonization as an instrument to estimate the Jesuits' causal effect on the literacy rate. The exclusion restriction for the instrument assumes that the proximity to a Tupi-speaking tribe only affects literacy through closer proximity to a historical Jesuit mission. This assumption can be violated if it affects other outcomes that would also have led to higher economic output, which in turn can also lead to higher literacy. While there may be language spillovers, Tupi was primarily a spoken language, in which the Jesuits introduced the written form. As a result, any literacy effects must come from the Jesuits' teaching in their missions.

Of importance is that the *lingua-geral* was created before the arrival of the Jesuits in the Amazon.<sup>33</sup> Instead, the Jesuits developed the *lingua-geral* based on their interactions with the tribes on the Brazilian coast. Therefore, it was not the case that the Jesuits constructed this language to facilitate the creation of their missions in the Amazon. Also noteworthy is that missionaries faced difficulties communicating with indigenous people who did not speak Tupi. For example, when non-Tupi speaking indigenous people decided to settle in the missions, they "could not understand the catechisms, nor could those schooled in Tupinamba grammar understand the indigenous speakers" (Mufwene, 2014).

The Jesuits also required the cooperation of the indigenous people to establish missions, as the number of priests was limited for such a vast region. Most established missions arose from cooperation between the Jesuits and the indigenous people. Therefore, initial communication was essential when deciding where to establish a mission. Finally, given the importance of interrelation between tribes, befriending a Tupi tribe allowed the Jesuits to

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<sup>30</sup>It is important to note that the Tupi people had recently had a territorial expansion throughout the 16th century, often engaging in fights with other language speaking tribes. It is often assumed that the Tupi originated from the Amazon Basin or throughout the south, quickly expanding to the richer areas along the coast of Brazil.

<sup>31</sup>*General Language*, references how it was a catch-all term for the variety of languages it would be used to communicate

<sup>32</sup>The *lingua-geral* was so successful, especially in the Amazonian region, that it eventually became the *lingua-franca* of the region and remained so until the Portuguese government pushed Portuguese to become the official language (Chambouleyron, 2019).

<sup>33</sup>As previously mentioned, the *lingua-geral* was finalized in 1595, and the Jesuit arrival in the Amazon only began in 1653.

be better received by their allies, making contact with a new tribe safer and easier (Reeve, 1993).

An estimation of the location of the Tupi-speaking tribes' pre-colonization is obtained from Clement et al. (2015) and Eriksen (2011) who, based on archeological evidence, estimate the distribution of the main languages in the Amazon.<sup>34,35</sup> I then estimate the Euclidean distance from each location to the nearest Tupi-speaking area and use it as an instrument for the proximity of a Jesuit mission.<sup>36</sup>

The first stage regression is:

$$DistanceToJesuitMission_{i,s} = \beta DistanceToTupiArea_{i,s} + \gamma GEO_{i,s} + \mu_s + \epsilon_{i,s} \quad (2)$$

The second stage regression is:

$$Y_{i,s} = \beta \widehat{DistanceToJesuitMission}_{i,s} + \gamma GEO_{i,s} + \mu_s + \epsilon_{i,s} \quad (3)$$

The identification assumption for the instrument, is that conditional on the set of controls and fixed-effects, the distance to a Tupi-speaking area only affects literacy through the distance to a Jesuit mission.<sup>37</sup>

#### 4.2.1. Results - Instrumental Variable

I first show first-stage and reduced form results in Table A.1. In Panel A, I show the first-stage results, which confirm the historical records that the Jesuits created missions near Tupi-speaking areas. All coefficients are statistically significant and range from 0.6 to 0.9, indicating that for every 100 kilometers further away from a Tupi-speaking area, the distance to the nearest Jesuit mission increases by 60 to 90 kilometers. It is also important to note that, regardless of the census used or the sample, there is a strong first-stage F-statistic, which ranges from 12.8 to 43.1. The first-stage results indicate that the Jesuits placed their

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<sup>34</sup>The other main language families other than Tupi are: Arawakan, Carib, Macro-Ge, Panoan, and Tucanoan. The most prominent ones are the former three. The Arawakan were located along the Negro River and the Western Amazon, the Carib were located along the Northern Amazon, and the Macro-Ge were near the Tupi areas of the Eastern Amazon. The entire map of their estimated geographic distribution is available in Eriksen (2011). The author uses a combination of maps from the “*Mapa etno-histórico do Brasil e regiões adjacentes*”, “Handbook of South American Indians”, and several other sources. The author then combines it into polygons to represent estimates on ethnolinguistic families in the region (Eriksen, 2011, p. 12-13)

<sup>35</sup>The language distribution map is only available for the Amazonian region of Brazil. Therefore, I am unable to estimate effects on other regions of Brazil.

<sup>36</sup>The areas that were inhabited by Tupi-speaking tribes can be found in Figure 3

<sup>37</sup>That is important, as I limit the instrument variable analysis only to measure literacy, as trying to study economic development would be more likely to violate the exclusion restriction as the increased literacy in 1872 and 1890 could lead to increased development in the future.

missions closer to areas where the indigenous people spoke Tupi. In Panel B, I also show the reduced-form results. In seven out of the nine columns, the reduced-form estimates have a negative and significant effect, indicating that the further away from a Tupi-speaking area, the greater the decrease in the literacy rate. Overall, both the first-stage and reduced-form results give some credibility to the relevance of the instrument.

The second-stage results are presented in [Table 5](#). Focusing on column (1) for the 1872 census, the coefficient of -0.066 is about twice as large as the one found in column (1) of [Table 4](#), indicating that being 100km away from a Jesuit mission decreases the literacy rate by 6.6%. In columns (2) through (5), the results for the 1890 census are shown. The coefficients are smaller than the 1872 results, but larger than the ones found in [Table 4](#), with the results from columns (2)-(4) indicating a decrease of 4.7-4.9% in literacy for being 100km away from a Jesuit mission. Similar to [Table 4](#), when the full sample of parishes is included, the results are no longer significant. A very similar pattern emerges in columns (6)-(9) when using the 2010 census. The coefficients are similar to the [Table 4](#), ranging from effects of 2.4-3.9% decrease in literacy for being 100km away from a Jesuit mission.<sup>38</sup>

The results of this section reinforce the previous findings, as all the coefficients remain negative, and the point estimates are larger than found in [Subsection 4.1](#). If endogeneity of the mission locations was a concern in the previous section, the results of this section show that the bias would have been likely downwards, making the coefficients smaller and a lower bound of the true effect.<sup>39</sup>

### 4.3. Comparison with Carmelites and Franciscans

In 1686, under the decree of the King of Portugal, the *Regimento das Missões* was established to determine the role of different missionary orders in the Amazon. A vital aspect of the *Regimento das Missões* was the assignment of missionary activity to non-Jesuit religious orders. Since the Jesuits were being overstretched and running out of supplies for their missions, the *Regimento das Missões* allowed different missionary orders to create missions and even overtake some of the Jesuits.

The Franciscans and the Carmelites were two of the most successful religious orders introduced. The Franciscans arrived in the Amazon earlier than the Jesuits; however, they never

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<sup>38</sup>While the results are not significant for columns (6) and (8), that is natural coming from the instrumental variable approach, which has a trade-off between bias and variance. However, the fact that the point estimates are similar further validates the OLS results.

<sup>39</sup>A possible explanation for why it would be biased downwards is that the Jesuits, as part of their missionary work, instead of settling in better economic locations, settled in areas where they could have better cooperation with the indigenous people. Later in the paper, I show that when measuring the effect of Jesuit missions on GDP per capita, I find no results, which supports the previous argument.

created as many missions in their early years. After the establishment of the *Regimento das Missões*, the Franciscans took over some successful Jesuits' missions and the profitable cattle farms on the Island of Marajo.<sup>40</sup> They also established their missions north of the Amazon River. The Carmelites gained exclusive rights to establish missions along the Negro and Branco rivers in the Western Amazon. The Carmelites eventually built successful missions such as Barcellos, which became the capital of the Captaincy of Rio Negro ([Perdigão, 2020](#)).

While successful, Franciscans and Carmelites were more traditional monastic orders; therefore, they preferred to live in poverty, in sharp contrast to the Jesuits, who focused on developing their missions and protecting the indigenous peoples within them.<sup>41</sup> As a result, Franciscans and Carmelites invested little in the human capital formation of the indigenous people living in their missions. At the same time, the Jesuits are known to have been pioneers and foremost educators during the colonial period ([F. d. Azevedo, 1944](#), p. 288; [Diffie, 1987](#), p. 93).

Following [Valencia Caicedo \(2019\)](#), I compare the effect of the Jesuit missions with missions established by different orders. Specifically, I compare the impact of the distance to the nearest Jesuit mission with the distance to the nearest Carmelite or Franciscan mission on the literacy rate. Other missionary orders would want to establish their missions in suitable locations. Therefore, when comparing within missionary orders, this specification controls for possible unobservables not captured in the previous regressions. The locations of the 21 Carmelite and Franciscan missions are shown in [Figure A.2](#), obtained from [Bombardi \(2014\)](#).

To compare the differential impact of Jesuit and non-Jesuit missions, I also estimate the following specifications:

$$Y_{i,s} = \beta DistanceToJesuitMission_{i,s} + \theta' DistanceToNonJesuitMission_{i,s} + \gamma GEO_{i,s} + \mu_s + \epsilon_{i,s} \quad (4)$$

$\beta$  estimates the effect of being 1km farther from a Jesuit mission on the dependent variable.  $\theta'$  measures the effect of being 1km farther from a Carmelite or a Franciscan mission on the literacy rate. Suppose the proximity to a Jesuit mission had a different positive effect on the literacy rate than the Franciscans and Carmelites. In that case,  $\theta' > \beta$ , as a more negative coefficient, indicates a stronger decrease in literacy as a locality becomes

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<sup>40</sup>While I refer to them as Franciscans, the name of the order was the Capuchins of St. Anthony, a branch of the main Franciscan order.

<sup>41</sup>The protection of the indigenous people was an important aspect of the Jesuits, and it often caused anger among Portuguese settlers. Even though the Carmelites and Franciscans were equally as successful, they never drew such outrage, with some arguing that it is due to the Jesuits' "unaccommodating attitude on the issue of Indian slavery" ([Bethell, 1987](#), p. 125)

farther away from a mission. I further compare if  $\beta$  and  $\theta'$  are different through an F-test of equality of coefficients.

#### 4.3.1. Results - Other Missionary Orders

[Table 6](#) shows results for the differential effects between Jesuit and non-Jesuit religious missionaries. The first important detail to note is that the addition to the proximity to a non-Jesuit Mission does not drastically affect the coefficient in either column, when compared to [Table 4](#). The second important detail is that neither of the coefficients for the distance to other missions is significant, regardless of the census year and the sample used, which indicates that solely the distance to a Jesuit mission affects the literacy rate.

In column (1), there is still a negative coefficient on the distance to the nearest Jesuit mission, with a point estimate of -0.033, even though it is statistically insignificant. When considering the 1890 census in columns (2) to (5), all the coefficients are negative and significant, except when including the entire sample of parishes, which is the same pattern found in [Table 4](#). For 1890, the point estimates on the subsetted sample range from -0.027 to -0.028, indicating a drop of 2.7-2.8% in literacy for being 100km away from a Jesuit mission. In both 1872 and 1890, it is not possible to reject that the coefficients between the distance to the nearest Jesuit mission and the distance to the nearest non-Jesuit mission are equal, as the F-statistic p-values range from 0.245 to 0.499.

For 2010, in columns (6) to (9), the results are similar to the ones found in [Table 4](#), with point estimates ranging from -0.040 to -0.024, indicating a drop of 4.0-2.4% in literacy for being 100km away from a Jesuit mission. Most importantly, for 2010, it is possible to reject that the coefficients between the distance to the nearest Jesuit mission and the distance to the nearest non-Jesuit mission are equal. The results highlight that among the religious orders that established missions in the Amazon, only those established by the Jesuits have long-term evidence of impacting literacy rates. The results corroborate the historical evidence that during the early colonial period in Brazil, the Jesuits were the primary teachers of both Portuguese settlers and indigenous people.

The results of this section can be contrasted with [Waldinger \(2017\)](#), who finds that in Mexico, municipalities with a history of Mendicant missionaries have higher literacy rates. In contrast, municipalities with Jesuit missionaries had lower or insignificant effects on literacy. The non-existent effect of Jesuits in Mexico can be attributed to the Jesuits' focus on teaching the Spanish youth to control the local elites ([Waldinger, 2017](#)). In the Brazilian Amazon, while some Jesuit activity involved teaching the local elites, the priority was teaching the indigenous people in their missions as a means of conversion. The results are also related to [Valencia Caicedo \(2019\)](#) where the author finds similar null effects of other missionary

orders in the region, with the results being driven only by the Jesuits.

This section's results measure the Jesuits' unique impact on the literacy rate.<sup>42</sup> Unlike the previous literature, there are no adverse effects from the other missionary orders. Franciscans and Carmelites successfully established missions in the Amazon and even took over some of the Jesuits' missions in the Amazon. However, since their evangelization approach differed from the Jesuits, the results do not indicate any long-lasting effect on human capital in localities near their former missions. Following [Valencia Caicedo \(2019\)](#), all the following regressions, unless specified, will include the distance to the nearest non-Jesuit mission as a control. Additionally, throughout the rest of the paper, all regressions will be subset to include only parishes and locations within 25 km of a 1872 parish, as this provides geographically similar locations and a consistent number of observations throughout the centuries analyzed.

## 5. Census Microdata

For the censuses from 1970-2010, I use the available microdata to exploit information at the individual level.<sup>43,44,45</sup> I estimate the following equation:

$$Y_{i,m,s} = \theta DistanceToJesuitMission_{m,s} + \gamma GEO_{m,s} + \eta_i + \mu_s + \epsilon_{i,s} \quad (5)$$

Where  $i$  is the outcome of an individual living in a municipality  $m$  in a state  $s$ . The set of geographical controls is identical to the ones used in [Equation 4](#), including the distance to the nearest non-Jesuit mission. Further, I add a set of individual controls,  $\eta_i$ , which include age fixed-effects and gender fixed-effects.<sup>46</sup> In all regressions, the standard errors are clustered at the municipality level. Additionally, I also subset the data to municipalities within 25 km of a 1872 parish and include only respondents above the age of five, which was the first age at which the literacy question was asked in the censuses.

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<sup>42</sup>Further breakdown and discussion into the Jesuits, Carmelites, and Franciscans is available on [Appendix C](#).

<sup>43</sup>Data is obtained from IBGE through the R package *geobr* ([Pereira and Barbosa, 2023](#)).

<sup>44</sup>These censuses are used since they are the only ones that contain microdata at the municipality level which allows me to analyze possible mechanisms. For example, IPUMS does provide the 1960 census microdata; however, the smallest geographical unit is the state level, and even then, most of the northern states are not included.

<sup>45</sup>Other censuses, such as the 1920 and 1940 censuses, exist and are available as documents on the IBGE virtual library; however, they have not been digitized. Further work could be done in extracting the tables from these censuses and georeferencing the parishes/municipalities to study the dynamics of the changes in literacy using these other censuses.

<sup>46</sup>In some following sections, I break down the results by race, and whether or not the person is a migrant.

## Baseline Results

The estimates based on the individual level data for those years are in [Table 7](#).<sup>47</sup> Important to note that literacy in the region has increased significantly throughout these four decades, going from only 61.0% in 1970 up to 85.8% in 2010. When analyzing the coefficients, consistent with the previous estimates, there is a negative relationship between proximity to a former Jesuit mission and an individual's literacy through the censuses.<sup>48,49</sup> The point estimates vary from -0.063 in column (1), -0.073 in column (2) for 1980, -0.126 in column (3) for 1991, -0.070 in column (4) for 2000, and -0.042 in column (5) for 2010. Combined, they indicate a decrease ranging from 4.2% to 12.6% in literacy for municipalities 100km away from a Jesuit mission. Interestingly, similar to the results in [Table 4](#), the point estimates are consistent in magnitude regardless of the increase in baseline literacy through the censuses. The results of this section further reinforce the previous results, indicating that the effects on the literacy rate have persisted from 1970 up to 2010.

In the following sections, I explore possible mechanisms that are driving the results over the last centuries after the Jesuits' expulsion.

## Race

A possible channel of human capital transmission would be the effects being present only for the groups of people whose descendants were educated in former Jesuit missions.<sup>50</sup> If that is to be expected, then the effects on the persistence of human capital would be more pronounced on direct descendants, who would likely be the people considered “pardos” in the region.

The results for the effects on literacy by race are in [Table 8](#).<sup>51</sup> First, we see that throughout the censuses, white respondents have a higher average literacy rate than both Black and mixed-race respondents; however, this gap has narrowed by 2010. The point estimates

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<sup>47</sup>It is important to note that the estimates for the 2010 census are not that different from when aggregated at the municipality level.

<sup>48</sup>The definition of literacy variable is to be 100 if the person was literate and 0 otherwise. This was used to make the interpretation of the coefficients easier, and more comparable to the estimates aggregated at the municipality level.

<sup>49</sup>Another concern would be the increase in literacy caused by Bible translations by evangelical Christians in the region as found in [Solá \(2023\)](#).

<sup>50</sup>While I am not able to distinguish in the 1872 and 1890 censuses the literacy by race, some historical evidence suggests that the effects might have been broad across the population. The effects of the “lingua franca” in the region were not only concentrated among the indigenous people, as “mestizo children learned the language from their indigenous mothers; white children learned it from their indigenous nursemaids” ([Mufwene, 2014](#)).

<sup>51</sup>Information on race is only available beginning in 1980. From 1980 to 2010, I consider pardos both mixed-race people and indigenous people, as in 1970, there was no descriptive information on the census on whether the respondent was of indigenous origin.

indicate that the effects on literacy are present for all groups across the four different censuses. Nonetheless, relative to the region's mean literacy rate, the effects are more significant for non-whites in the censuses after 1991. For example, when analyzing the 1980 census in columns (7) to (9), the coefficient for whites is -0.074, while for Blacks it is -0.077, and for mulattos, it is -0.066. However, relative to the mean, the effects show that for every 100 km away from a Jesuit mission, the effects for whites correspond to an 8.6% increase relative to the mean, while for Blacks it is 10.4%, and for mulattos, it is 8.2%.

Overall, the results of this section indicate that the persistence channel is not only through a specific group of people, such as the pardos, whose ancestors were more likely to have been educated at the Jesuit missions. Next, I consider the differential effects by locals vs. migrants in the modern censuses.

## Migration

A possible concern when analyzing the entire sample is that the estimates are a lower bound of the true effect. During both the 1970s and 1980s, Brazil was under a military dictatorship that heavily invested in expanding the highway network system in the Amazon. In 1972, the first main highway, the Trans-Amazonian highway, was built, connecting the Northeast to the center of the Amazon. The construction of highways in the region led to a large wave of migration to the area. Therefore, during the 1970s, there was a period of structural change in the region, with new migrants settling in new areas, expanding the population, and possibly masking the effects on literacy.

To address those concerns, I reestimate [Equation 5](#) by subsetting the sample into local and migrant relative. I define a local as someone who was born in the same municipality where the census was taken, and a migrant otherwise.<sup>52,53</sup> If the Jesuits drive the increases in literacy through an intergenerational effect, in which the local people get more educated, the effects should be present for locals.

[Table 9](#) shows the results comparing people born in a municipality who have never moved with those who have moved to that municipality. It is interesting to note that over the years, migrants to these municipalities in the north have had a much higher literacy rate. For example, in the 1980 census, migrants had a literacy rate of 74.1% compared with the

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<sup>52</sup>For the 1970 census, I am unable to distinguish whether the person has always lived in the same municipality. Therefore, I am considering a non-migrant as someone who reports that was born in the same municipality where they took the census survey. For the other censuses, it is reported if the person was born and only lived in the same municipality. These regressions exclude people who were born in the municipality, moved, and then returned.

<sup>53</sup>Also, keeping municipalities within 25km of the 1872 parishes limits the effects being driven by new municipalities created due to the expansion in the region.

locals' 63.1%, an 11% difference. The point estimates in columns (1), (3), (5), (7), and (9) all indicate that the effect on literacy exists for the local population. There are similar effects for migrants, but notably, the effect is not significant in 1980, which was the first census conducted after the construction of the Trans-Amazonian Highway, likely obscuring the results.

The results of this section support the historical evidence of increased migration of lower-skilled labor from the Northeast to the Amazonian region following the construction of the highways. However, they also show that the results in the more recent censuses are not driven by migration to the region. Instead, the findings remain even when only considering the subset of people who were born and have lived all their lives in those municipalities. In the next section, I examine the role of race and its different effects on literacy.

Next, I consider the differential effects by gender, not only in the modern censuses, but also considering the 1872 and 1890 censuses.

## Gender

Another consequence of the *Regimento das Missões* was the division of indigenous labor between the Jesuits and the Portuguese Crown. The assignment of indigenous people to work outside the missions broke down the Jesuits' monopoly over indigenous labor. The *Regimento das Missões* established that two-thirds of the male indigenous people in the *aldeias* had to work for the Portuguese Crown and the Portuguese colonists for up to six months ([Chambouleyron et al., 2020](#)). Given that a large part of the male population of the missions would be away for significant periods, the Jesuits were then only able to teach women and children.<sup>54</sup> Since women were most exposed to the Jesuits' teachings, it is likely that the impact on literacy would be more significant among women, at least shortly after their expulsion.

I first use the 1872 and 1890 censuses to explore whether there were effects in the 19th century, since the data is available. Results for the effects of literacy by gender in 1872 and 1890 are in [Table A.2](#). The regression estimates suggest that both men and women near Jesuit missions had higher literacy. In 1872, the estimated effect of living in a parish 100km away from a Jesuit mission is associated with a 2.9% drop in literacy for men, while for women, the effect is 3.8%. While neither is significant, the point estimates are both larger in magnitude and relative to the mean for women, indicating some suggestive evidence that

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<sup>54</sup>During the *Regimento das Missões*, there were reports of the villages being “empty of men” ([Chambouleyron et al., 2020](#)). In the later period of the Directorate, estimates indicate that the indigenous men who were part of the former missions would spend 64% of the time working in expeditions for spices, either for the government or the settlers ([Hemming, 1988](#), p. 46).

the effects were larger for women. When analyzing the 1890 census, in columns (3) and (4), I find statistically significant point estimates of -0.036 for men and -0.023 for women. While the point estimates are larger for men, when considering their effect relative to the mean of each group, the effects are proportionally larger for women. In 1890, the mean literacy rate for men was 29.4%, while for women, it was 11%. Therefore, being 100km away from a Jesuit mission would decrease the literacy rate by 12.2% relative to the mean for men, and by 20% for women. This set of results is also similar to [Valencia Caicedo \(2019\)](#), who finds that in the 1895 Argentinian census, the Guarani Jesuit missions had a greater impact on female literacy than on male literacy.

This trend does not seem to persist in future years. When considering the 1970-2010 censuses, the results are in [Table A.4](#), and there are no differential effects between men and women during 1970-2010. Even just considering the mean literacy rates in the region, they have converged between the two genders with no significant gaps through this period, with women having literacy rates on average since 1990. When considering the point estimates, both men and women have negative and significant effects on their literacy if they lived in a municipality further away from a Jesuit mission.

The results of this section suggest that the effects are more pronounced for women in earlier censuses, aligning with previous literature, such as [Valencia Caicedo \(2019\)](#) and [S. O. Becker and Woessmann \(2008\)](#). However, that effect has dissipated in the more modern censuses.

## 6. Alternative Mechanisms

### Demographics - 1872

In [Table A.5](#), I check whether there are any demographic differences between the parishes in 1872 that could explain the results. There are four different categories for race in the 1872 census: whites, blacks, pardos, and caboclos.<sup>55</sup> The 1872 census reveals how diverse the population in the region was. When checking the sample means for each group, it reveals that only 30% of the population was considered white, while mixed race and *caboclos* made up over 65% of the population. The point estimates in columns (1) to (4) suggest that the demographics of places closer to Jesuit missions are not statistically different from those of places farther away. There are no significant effects on the proportion of *caboclos*, blacks, whites, or pardos. The results indicate that it is unlikely that the literacy effects found in column (1) of [Table 4](#) are driven by the fact that some parishes had a higher share of

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<sup>55</sup>For the 1872 census, “caboclos” refers to either an indigenous person or a person of mixed indigenous and white ancestry. Similarly, pardos were defined as a mix between Africans and white people.

educated white people.<sup>56</sup>

I also test potential concerns that any sort of immigration drives the 1872 results in columns (6) and (7).<sup>57</sup> The share of people born in a different state in the region is relatively low, only 2%, and people born outside of Brazil is only 1.7%. The point estimates suggest no differential effect in either category for places close to a Jesuit mission.

The only significant results are when measuring the proportion of slaves relative to the total population of the parish in column (5). The point estimate indicates that being 100km away from a Jesuit mission would decrease the enslaved people population of a 1872 parish by 1.9%. The significant results on the proportion of enslaved people could indicate that places near Jesuit missions used a lower share of indigenous labor, and instead had to rely on the imports of enslaved Africans to work in the region. Overall, the results indicate that the demographic composition of parishes near Jesuit missions in 1872 was not significantly different from those farther away.

## Labor - 1872

I analyze whether there were significant differences in 1872 in the types of jobs people were working in. An argument could be made that the Jesuit presence might lead to higher development and literacy if it resulted in the specialization of people into more human-capital intensive sectors, such as industry or manufacturing, while ignoring work such as agriculture.

The results for the breakdown into the types of jobs are found in [Table A.6](#). I find no large differences in the types of jobs people were choosing in 1872 for people working in industrial, manual, agricultural, or for people with no jobs. However, I do find two significant differences in the proportion of people working in liberal professions in column (1) and the proportion of people working in other jobs in column (5).<sup>58</sup>

The results of this section point out that parishes close to the Jesuit missions did not have an early industrialization or development in 1872. However, there is some evidence that there was some divergence on the types of jobs people were specializing in, particularly in liberal professions, which included being a teacher.

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<sup>56</sup>I cannot fully rule out this possibility because I do not have information on literacy by race in the 1872 census.

<sup>57</sup>A special concern is that literacy effects could be capturing some early effects of the Amazonian rubber boom, even though the peak happened during the beginning of the first decade of the twentieth century ([Assis Costa, 2018](#), p.101). A consequence of this was that low-educated people from the Northeast moved towards the inside of the region to help in the extraction of rubber from trees.

<sup>58</sup>I discuss in more detail what types of jobs fall into each category in [Appendix E](#)

## School Attendance - 1872

Another possible explanation for the 1872 results is that parishes near the Jesuit missions had a higher proportion of children attending school, which could explain the larger effects on literacy. To examine this, I use the fact that the 1872 census provides data on the number of children aged 6 to 15 attending school.

The results are in [Table A.3](#). First, I find that school attendance in the region was very low, with an average of 14.3% of children attending school, with 18% of boys and only 11% of girls. In column (1) of [Table A.3](#), I find that there are no effects of proximity to a Jesuit mission on school attendance. In columns (2) and (3), I break it down between boys and girls, respectively. I find no effects for boys; however, I do find a significant effect of -0.023, indicating that being 100km away from a Jesuit mission would decrease the share of girls attending school by 2.3%. The results reinforce [Table A.2](#), indicating that the missions had a more pronounced effect on women, mainly because they were the ones who were more likely to be taught at the missions.

## GDP per Capita and Nightlights

I consider whether the effects on literacy are also associated with an increase in the long-run development in the region. I first consider the effects of proximity to a Jesuit mission on the 2010 GDP per capita of a municipality as a proxy for development. The results are found in [Table A.7](#).

Surprisingly, I find no effects on either GDP per capita (column (1)) or its components, such as agriculture (column (2)), industry (column (3)), services (column (4)), and government spending (column (5)). These results do match what was discussed in [Table A.6](#), in which there were no significant differences in 1872 for people working in a variety of jobs. These results directly contrast with what is found in [Valencia Caicedo \(2019\)](#), who reports that the Guarani Jesuit missions had a significant impact on the income per capita of municipalities in southern Brazil, mainly driven by increases in specialization in human capital-intensive sectors. The GDP per capita results strongly suggest that municipalities near former Jesuit missions are not more developed than those farther away, implying that economic development might not be the channel through which the Jesuits influenced literacy.

Alternatively, I use a different proxy for development, which is the nightlight density around the capital of each municipality.<sup>59</sup> The results are shown in [Table A.8](#). Unlike the GDP results, I find significant effects of proximity to a Jesuit mission on nighttime light

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<sup>59</sup>Nightlight data for 2010 is obtained from [Li et al. \(2020\)](#).

density. When considering only a 1km buffer around the municipality, there are no effects, as seen in column (1). However, for larger buffers, such as 5, 10, and 25 km, there's a significant decrease in the intensity of nightlight density around the capital of a municipality.

The results of this section indicate that in terms of income or specialization into different sectors, there is no effect on how close a municipality is to a Jesuit mission. However, in a broader definition of development, using nightlight data, the main cities in each municipality are more developed, even if that does not translate directly into a measure of increased income.

## Urbanization and School Supply

For the 2010 census, I consider whether urbanization, population density, or the availability of schools could be possible explanations for the effects on human capital from [Table 4](#). Urbanization and population density indicate agglomeration and city development, which could lead to higher human capital through channels other than the Jesuit presence. If municipalities near Jesuit missions also have more schools, that could explain the higher literacy effects.

The results on the effect of proximity to a Jesuit mission on urban population, density, and school supply are available in [Table A.9](#). The results in column (1) show that municipalities near Jesuit missions do not have a higher proportion of residents living in urban areas. However, in column (2), I find a significant decrease in population density in municipalities farther from the missions. The coefficient suggests a drop of 8.3 people per square kilometer for every 100 km away from a Jesuit mission. This also roughly corresponds to an 11% when compared relative to the mean. In columns (3) to (5), I examine whether the presence of more schools explains the literacy effects. I find no consistent effects based on the number of schools per 10,000 people, schools per 10,000 urban inhabitants, or schools per 10,000 children under 15. The results suggest that the effects are not driven by a higher availability of schools in municipalities closer to Jesuit missions.

## 7. Robustness Checks

### 7.1. Excluding Municipalities Far Away

I check whether the results are being driven by outliers, such as municipalities located far from a mission but with lower literacy rates due to isolation. Using the 2010 census, I estimate [Equation 4](#) by sequentially excluding municipalities that are too far away from a Jesuit mission.

[Figure A.5](#) shows the point estimates along with the 95% confidence intervals using robust standard errors for various cutoff distances. While the estimates are negative and close to the main estimates, the coefficients are not statistically significant for the subsample of observations between 50 and 100 kilometers from a Jesuit mission. However, the coefficients become significant once I include observations within 150 kilometers and remain significant thereafter. Therefore, the results are not driven by extreme outliers. This also holds when considering a more representative subsample of the treated group, which does not change the results.

## 7.2. Redefining Treatment

I also consider changing the definition of treatment to be a binary variable. Using the 2010 census, I estimate the following equation:

$$Y_{i,s} = \beta Treated_{i,s} + \gamma GEO_{i,s} + \mu_s + \epsilon_{i,s} \quad (6)$$

Where  $Treated_{i,s}$  is a dummy variable that equals one if the municipality seat is within a certain distance of a Jesuit mission. The coefficient  $\beta$  then estimates how much higher the literacy is for municipalities within the cutoff distance to the Jesuit mission than those outside the cutoff distance. Results for this specification are found in [Figure A.6](#). The point estimates indicate that being within 10km of a former Jesuit mission is associated with an increase in literacy rate of 4.3%. The coefficient decreases but remains significant and settles around 3% when considering treatment being within 20-100 kilometers of a former Jesuit mission.

## 7.3. Other Robustness

I further examine the robustness of the instrumental variable in [Appendix B](#), and I also address the concerns of spatial autocorrelation from [Conley and Kelly \(2025\)](#) in [Appendix D](#). The OLS and the instrumental variable approaches are robust in both sections. I also show in [Table A.10](#) that changing the distance chosen in the Conley standard errors used throughout the paper does not substantially affect the standard errors or the significance of the results.

# 8. Conclusion

This paper shows the persistent effects on human capital through literacy associated with the Jesuits in the Amazon. Similar to Southern Latin America, the area studied by [Valencia Caicedo \(2019\)](#) and [Gómez-i-Aznar \(2023\)](#), the Amazon had both a strong and

successful missionary presence. The results indicate that being closer to a Jesuit mission strongly predicts literacy rate in 1872, 1890, and 2010.<sup>60</sup> More surprisingly, the effects remain consistent throughout the 128-year gap between the censuses.

I use multiple methods to isolate the influence of the Jesuit presence: First, all the specifications include a detailed set of geographical variables that account for differences in geography and the region's suitability for settlement. Second, I leverage the richness of local languages at the time of colonization as an instrumental variable. The results remain significant when using the distance to a Tupi-speaking area as an instrument for the likelihood of Jesuit activity in the region. More importantly, the point estimates are larger in magnitude, suggesting that the OLS estimates could be a lower bound of the true effect. Lastly, proximity to Carmelite or Franciscan missions does not explain the results. This indicates that the effect on literacy rates is not solely due to any missionary presence but is specifically attributable to the Jesuits, who historically focused on proselytization and educating the local indigenous populations. Overall, these three methods provide strong evidence of the impact of Jesuit missions on long-term literacy rates in the region.

Using microcensus data from Brazil for the 1970, 1980, 1991, 2000, and 2010 censuses, I show that the effects on literacy are still persistent through the 20th and 21st centuries. I also examine potential mechanisms that could have caused these effects to persist into the present day. Suggestive evidence suggests that these effects are transmitted intergenerationally, as literacy effects are observed among local populations from 1970 to 2010. Literacy effects are present across all races; however, they are more pronounced among minorities in the region since the 1990s. Historical records indicate that these effects should have been more significant for women. I find some suggestive evidence of larger effects for women in the 1872 and 1890 censuses; however, this effect has not continued to the present.

I analyze other possible channels that could explain the results. I find no significant demographic differences in 1872, with only a small effect on the share of slaves in parishes close to the Jesuit missions. I also find that in 1872, there are no general effects on the proportion of children attending school. However, when considering the effects by gender, I find that there are significant effects for girls but not for boys' school attendance. Turning to more modern measures, I surprisingly find no effects on GDP per capita even when breaking it down by sectors in 2010. However, when using a different measure of development, nightlight density, I do find strong significant results indicating that municipalities near Jesuit missions have increased nightlight density. Lastly, I find no results on the share of the population

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<sup>60</sup>It is important to note that while the Jesuits seem to have generated positive human capital impacts on the regions near their missions, they served a colonial empire. This paper does not claim that Brazil's colonization was advantageous to the indigenous people, especially since many of them succumbed to diseases and enslavement.

living in urban areas or on the number of schools in municipalities closer to Jesuit missions. I do, however, find that those municipalities have increased population density in 2010.

The paper complements the literature that measures European missionaries' positive impacts on the human capital in the New World and Africa ([Barsanetti, 2021](#); [Cagé and Rueda, 2016](#); [Dell, 2010](#); [Franco et al., 2021](#); [Gallego and R. Woodberry, 2010](#); [Nunn, 2014](#); [Nunn, 2010](#); [Waldinger, 2017](#); [Wantchekon et al., 2015](#)). The results of this paper can help better inform how the development of present-day municipalities in the Brazilian Amazon is correlated with historical settlement patterns.

Future work must be done to analyze the impact of missionaries across all of Brazil. While this paper and [Valencia Caicedo \(2019\)](#) focus on the regions where the Jesuits had a significant presence, the Jesuits and other missionary orders had a strong presence throughout South America. Understanding the effects of missionaries in other countries, such as Colombia, Peru, and Bolivia, would help clarify the mechanisms driving the results. This is especially important if the outcomes differ, as [Waldinger \(2017\)](#), who finds that the Jesuits did not have an effect in Mexico. Such differences offer an opportunity to explore how the various approaches of the Jesuits and other missionaries in different regions influenced the local populations. Another potential avenue of research would be to examine the negative consequences of colonialism. While the current literature often views gains in human capital as positive, it also led to the loss of local identity, customs, and traditions languages.<sup>61</sup>

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<sup>61</sup>While the Jesuits were often associated with the protection of the indigenous people in the Amazon, throughout Brazil they were also known for having large plantations with slaves and were more accepting of African slavery.

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## Figures

Figure 1. Location of Jesuit Missions along the Amazon as in the book by Leite (1943)

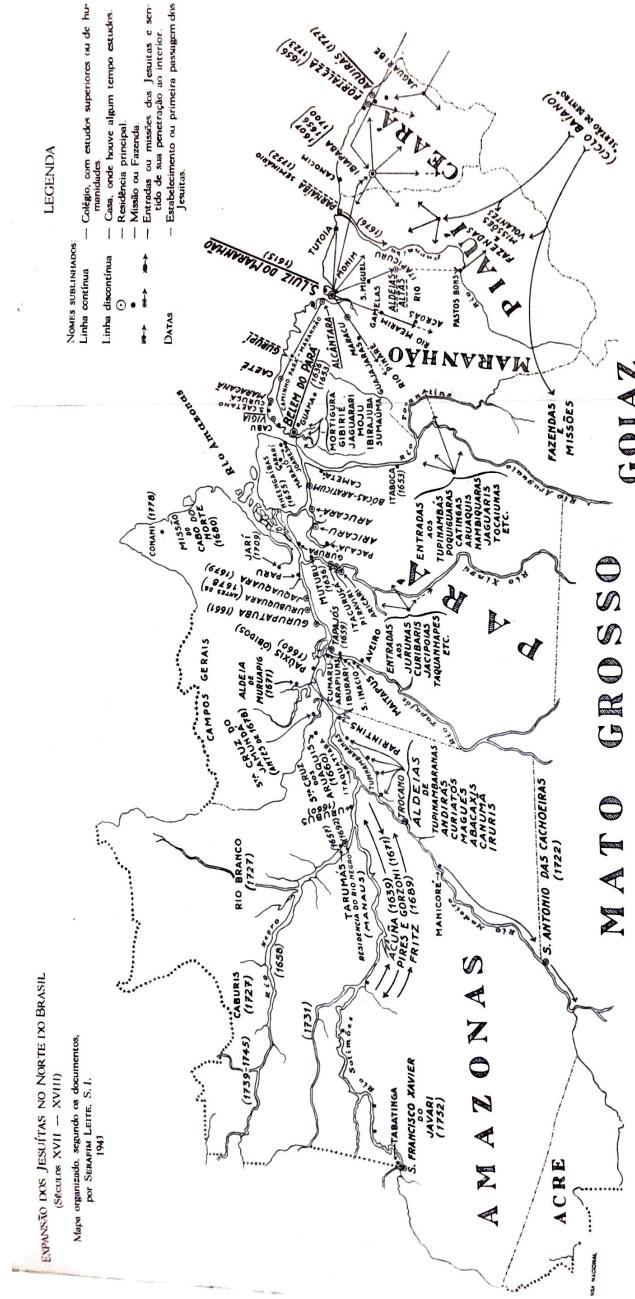
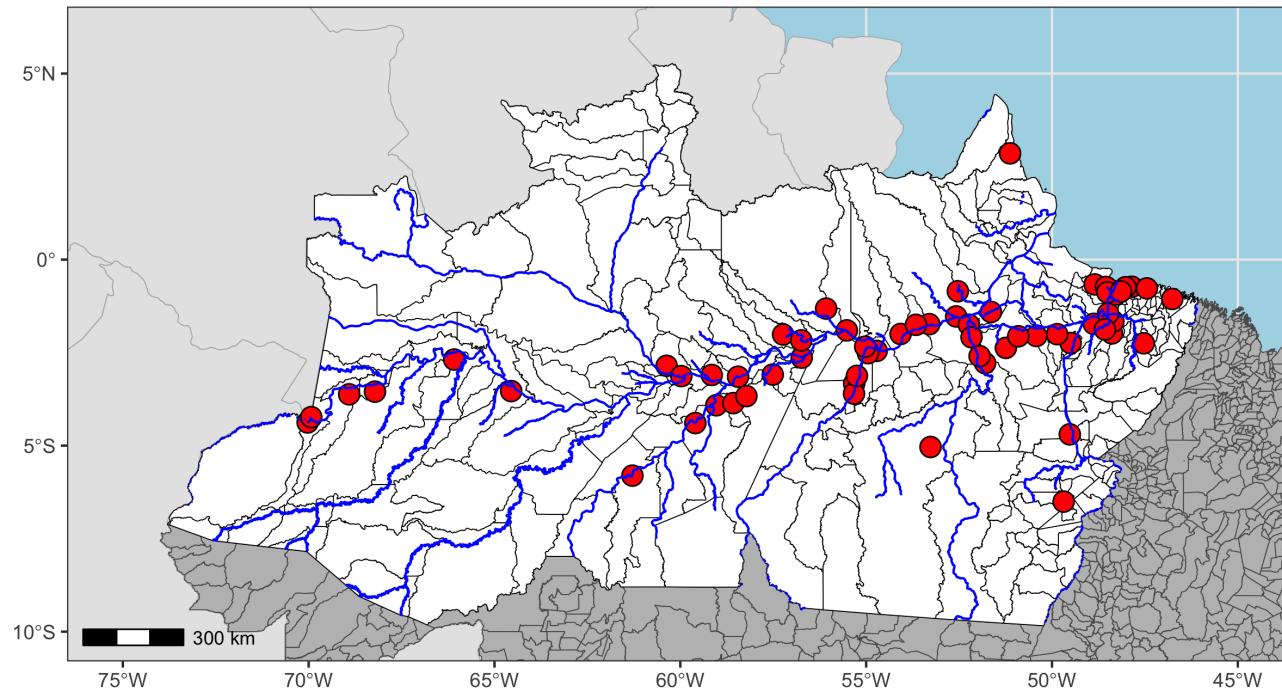


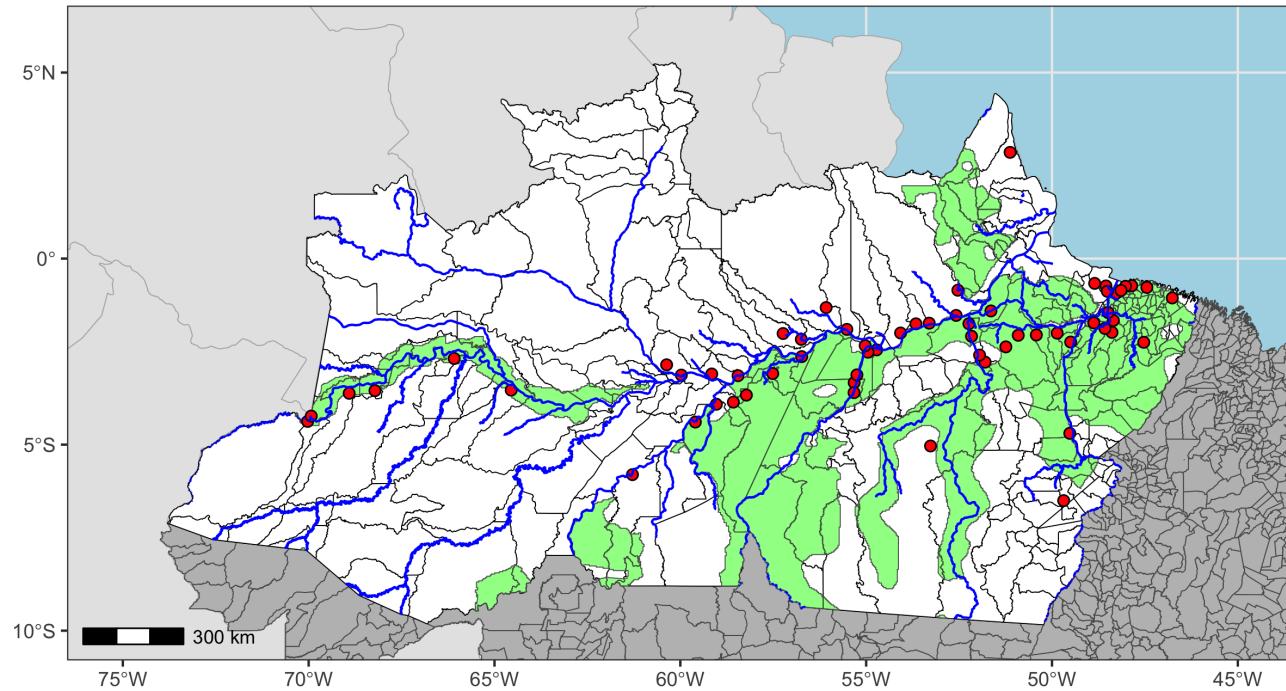
Figure 2. Location of Jesuit Missions

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*Notes:* This figure shows the distribution of the Jesuit missions in the Brazilian Amazon. The red circles indicate unique Jesuit mission sites georeferenced from [Figure 1](#) based on [Leite \(1943\)](#). 2010 municipality boundaries are shown. The blue lines indicate the main rivers of the region.

Figure 3. Distribution of Tupi-Speaking areas in the Amazon pre-colonization



*Notes:* This figure shows the distribution of Tupi-speaking tribes in the Brazilian Amazon overlayed with 2010 municipality boundaries. Tupi-speaking areas are represented as the green shaded areas and are based from [Clement et al. \(2015\)](#). Red dots in the map indicate the location of Jesuit Missions as described in [Figure 2](#); the blue lines indicate the main rivers of the region

## Tables

Table 1. Socioeconomic and Geographic Characteristics of 1872 Parishes by Distance to Jesuit Missions

	Less than 50 km of a Jesuit Mission (N=68)		More than 50 km of a Jesuit Mission (N=23)		Diff. in Means	Std. Error
	Mean	Std. Dev.	Mean	Std. Dev.		
<b>Education:</b>						
Literacy Rate (%)	21.94	16.89	20.41	16.86	-1.53	4.07
Men Literacy Rate (%)	28.47	15.59	27.15	17.09	-1.32	4.03
Women Literacy Rate (%)	15.35	19.36	13.56	18.42	-1.79	4.50
Children 6–15 Attending School (%)	14.32	8.98	14.30	10.08	-0.01	2.37
Boys 6–15 Attending School (%)	17.96	12.34	17.96	13.37	0.00	3.16
Girls 6–15 Attending School (%)	10.90	8.14	11.18	10.95	0.27	2.49
<b>Demographics:</b>						
Proportion Slaves (%)	8.06	9.34	6.77	7.38	-1.29	1.91
Proportion Caboclo (%)	29.78	26.88	34.84	25.96	5.05	6.32
Proportion White (%)	31.95	15.24	25.83	13.11	-6.12*	3.30
Proportion Pardo (%)	33.03	16.39	33.39	14.65	0.36	3.64
Proportion Black (%)	5.23	4.34	5.94	6.32	0.71	1.42
Proportion Foreign (%)	1.85	3.53	1.39	1.88	-0.46	0.58
Proportion Other State (%)	2.00	3.53	1.97	4.36	-0.03	1.01
<b>Geography:</b>						
Distance to Tupi-Speaking Areas (km)	5.86	17.43	82.43	160.62	76.57**	33.56
Distance to Non-Jesuit Mission (km)	137.69	86.36	158.94	111.79	21.25	25.55
Distance to River (km)	13.62	22.79	6.61	10.16	-7.01**	3.48
Distance to the Coast (km)	346.55	499.16	557.35	594.23	210.80	137.90
Average Slope	1.04	0.76	1.02	1.09	-0.02	0.24
Average Elevation	17.65	27.26	36.87	36.78	19.22**	8.35
Longitude	-52.34	5.36	-54.46	6.71	-2.12	1.54
Latitude	-2.00	1.01	-1.53	1.54	0.48	0.34
Potential Calories (Pre-1500)	7496.08	1148.48	7578.55	1357.56	82.47	315.48
Potential Calories (Post-1500)	8268.30	847.54	8338.63	1154.74	70.33	261.80

*Notes:* This table shows the summary statistics and the balance on a table of the socioeconomic and geographic characteristics of 1872 parishes based on their proximity to a Jesuit mission. I compare parishes located within 50km of the nearest Jesuit mission to those more than 50km away.

Table 2. Socioeconomic and Geographic Characteristics of 1872 Parishes by Distance to Jesuit Missions

	Less than 50 km of a Jesuit Mission (N=75)		More than 50 km of a Jesuit Mission (N=29)		Diff. in Means	Std. Error
	Mean	Std. Dev.	Mean	Std. Dev.		
<b>Education:</b>						
Literacy Rate (%)	21.68	9.79	15.66	6.52	-6.02***	1.67
Men Literacy Rate (%)	31.10	10.69	23.65	9.96	-7.46***	2.25
Women Literacy Rate (%)	12.06	10.42	6.90	3.92	-5.15***	1.41
<b>Geography:</b>						
Distance to Tupi-Speaking Areas (km)	7.23	19.75	71.31	145.31	64.08**	27.08
Distance to Non-Jesuit Mission (km)	131.53	84.57	174.00	120.97	42.47*	24.49
Distance to River (km)	13.68	22.50	7.86	14.47	-5.83	3.74
Distance to the Coast (km)	313.23	442.95	585.63	625.05	272.40**	126.84
Average Slope	1.08	0.88	0.93	0.99	-0.15	0.21
Average Elevation	16.24	26.42	35.17	35.10	18.93**	7.20
Longitude	-52.00	4.86	-54.67	6.74	-2.68*	1.37
Latitude	-1.96	0.99	-1.90	2.08	0.06	0.40
Potential Calories (Pre-1500)	7549.90	1117.11	7654.08	1346.23	104.18	281.31
Potential Calories (Post-1500)	8271.13	803.52	8349.18	1153.17	78.05	233.37

*Notes:* This table shows the summary statistics and the balance on a table of the socioeconomic and geographic characteristics of 1890 parishes based on their proximity to a Jesuit mission. I compare parishes located within 50km of the nearest Jesuit mission to those more than 50km away.

Table 3. Socioeconomic and Geographic Characteristics of 2010 Municipalities and their distance to the nearest Jesuit Mission

	Less than 50 km of a Jesuit Mission (N=99)			More than 50 km of a Jesuit Mission (N=137)			Diff. in Means	Std. Error
	Mean	Std. Dev.	Mean	Std. Dev.				
<b>Education:</b>								
Literacy Rate (%)	85.0	6.9	81.0	7.7	-4.0***	1.0		
Schools per 10k population	16.6	8.8	18.3	12.9	1.6	1.4		
Schools per 10k for People Under 15	46.3	23.0	48.6	30.3	2.3	3.5		
<b>GDP (2010 Reais):</b>								
GDP per Capita	6798.9	8473.2	7993.5	8586.6	1194.6	1124.0		
Agricultural GDP per Capita	1372.0	1167.2	1540.0	1242.8	168.0	158.2		
Industry GDP per Capita	1486.7	6561.0	1635.6	6980.6	148.9	889.1		
Service GDP per Capita	1413.4	1710.7	1511.0	1663.7	97.6	223.1		
Government GDP per Capita	2139.9	720.5	2941.5	1637.4	801.6***	157.5		
<b>Demographics:</b>								
Urban Population (%)	52.4	19.8	53.3	19.5	0.9	2.6		
<b>Geography:</b>								
Distance to Tupi-Speaking Areas (km)	10.3	24.7	116.5	195.0	106.3***	16.8		
Distance to Non-Jesuit Mission (km)	162.2	125.1	335.6	225.5	173.3***	23.0		
Distance to River (km)	21.4	27.7	31.3	43.4	10.0**	4.6		
Distance to the Coast (km)	399.4	562.6	748.2	617.3	348.8***	77.3		
Average Slope (m)	1.1	0.9	1.7	1.1	0.6***	0.1		
Average Elevation (m)	45.7	60.6	135.2	112.5	89.5***	11.4		
area	8931.3	16912.5	16817.8	24848.5	7886.5***	2719.6		
Longitude	-52.5	6.1	-55.2	7.0	-2.7***	0.9		
Latitude	-2.1	1.4	-3.0	3.3	-0.9***	0.3		
Potential Calories (Pre-1500)	7719.6	1034.7	7724.9	1189.8	5.3	145.4		
Potential Calories (Post-1500)	8398.5	912.1	8581.5	1186.5	183.0	136.7		

*Notes:* This table shows the balance on a table of the socioeconomic and geographic characteristics of 2010 municipalities based on their proximity to a Jesuit mission. I compare parishes located within 50km of the nearest Jesuit mission to those more than 50km away.

Table 4. Distance to Jesuit Mission Effects on Literacy in 1872, 1890, and 2010 for parishes/municipalities in the Brazilian Amazon

	1872 Census			1890 Census			2010 Census		
	(1) Entire Sample	(2) <10km	(3) <25km	(4) <50km	(5) Entire Sample	(6) <10km	(7) <25km	(8) <50km	(9) Entire Sample
Distance to Jesuit Mission (km)	-0.033* (0.019) [0.018]	-0.031** (0.012) [0.011]	-0.031*** (0.012) [0.011]	-0.032*** (0.011) [0.010]	-0.007 (0.009) [0.009]	-0.038** (0.015) [0.019]	-0.038*** (0.013) [0.020]	-0.034*** (0.011) [0.015]	-0.023*** (0.006) [0.005]
Mean Literacy Rate	21.6	20.5	20.3	20.2	20.0	85.0	84.7	84.4	82.7
N	91	92	97	100	103	74	97	128	236

Notes: This table presents the OLS results from the effects of a proximity to a Jesuit Mission on the literacy rate at the parish/municipality level for the 1872, 1890, and 2010 censuses as described in [Equation 1](#). All regressions include state fixed effects, and dummies indicating whether the parish/municipality is the capital of the state. Geographical controls include latitude, longitude, average elevation, average slope, distance to the nearest navigable river, distance to the coast, and maximum caloric output from pre-Columbian and post-Columbian crops. Column (1) shows the results using the entire sample of parishes in the 1872 Census. Columns (2) and (6) indicate results for the subsample of parishes/municipalities in the 1890 and 2010 censuses within 10km of an 1872 parish. Columns (3) and (7), (4) and (8), are for parishes/municipalities in the 1890 and 2010 censuses within 25km and within 50km respectively. Columns (5) and (9) includes all the parishes/municipalities in the 1890 and 2010 censuses. Standard errors in parentheses are traditional robust standard errors while standard errors in brackets are Conley standard errors with a Bartlett Kernel with a radius of 400km

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

Table 5. Distance to Jesuit Mission Effects on Literacy in 1872, 1890, and 2010 for parishes/municipalities in the Brazilian Amazon - Instrumental Variable Estimates

	1872 Census			1890 Census			2010 Census		
	(1) Entire Sample	(2) <10km	(3) <25km	(4) <50km	(5) Entire Sample	(6) <10km	(7) <25km	(8) <50km	(9) Entire Sample
Distance to Jesuit Mission (km)	-0.066** (0.031)	-0.047** (0.021)	-0.048** (0.021)	-0.049*** (0.018)	-0.017 (0.012)	-0.035 (0.024)	-0.039* (0.023)	-0.030 (0.021)	-0.024** (0.012)
First Stage F-Statistic	37.60	25.05	23.91	29.18	25.60	12.88	14.56	16.45	43.11
Mean Literacy Rate	21.6	20.5	20.3	20.2	20.0	85.0	84.7	84.4	82.7
N	91	92	97	100	103	74	97	128	236

Notes: This table presents the instrumental variable results from the effects of a proximity to a Jesuit Mission on the literacy rate at the parish/municipality level for the 1872, 1890, and 2010 censuses when using the proximity to a Tupi-speaking area as described in [Equation 3](#). Geographical controls include latitude, longitude, average elevation, average, slope, distance to the nearest navigable river, distance to the coast, and maximum caloric output from pre-Columbian and post-Columbian crops. Column (1) shows the results using the entire sample of parishes in the 1872 Census. Columns (2) and (6) indicate results for the subsample of parishes/municipalities in the 1890 and 2010 censuses within 10km of an 1872 parish. Columns (3) and (7), (4) and (8), are for parishes/municipalities in the 1890 and 2010 censuses within 25km and within 50km respectively. Columns (5) and (9) includes all the parishes/municipalities in the 1890 and 2010 censuses.

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

Table 6. Effects of Distance to Jesuit and Other Missions on Literacy in 1872, 1890, and 2010

	1872			1890			2010		
	(1) Entire Sample	(2) <10km	(3) <25km	(4) <50km	(5) Entire Sample	(6) <10km	(7) <25km	(8) <50km	(9) Entire Sample
Distance to Jesuit Mission (km)	-0.033 (0.021) [0.020]	-0.028** (0.012) [0.011]	-0.027** (0.011) [0.010]	-0.028** (0.011) [0.010]	-0.003 (0.009) [0.009]	-0.040*** (0.014) [0.018]	-0.040*** (0.013) [0.019]	-0.035*** (0.011) [0.014]	-0.024*** (0.006) [0.004]
	0.002 (0.014) [0.013]	-0.007 (0.009) [0.007]	-0.011 (0.010) [0.007]	-0.011 (0.010) [0.007]	-0.013 (0.010) [0.008]	0.009 (0.009) [0.011]	0.010 (0.009) [0.010]	0.009 (0.009) [0.010]	0.007 (0.005) [0.006]
	F-test of Difference in Coefficients (p-value)	0.245	0.207	0.334	0.292	0.499	0.001	0.000	0.003
Mean Literacy Rate	21.6	20.5	20.3	20.2	20.0	85.0	84.7	84.4	82.7
N	91	92	97	100	103	74	97	128	236

Notes: This table presents the OLS results from the effects of a proximity to a Jesuit Mission and the proximity to a Non-Jesuit Catholic mission on the literacy rate at the parish/municipality level for the 1872, 1890, and 2010 censuses as described in [Equation 4](#). All regressions include state fixed effects, and dummies indicating whether the parish/municipality is the capital of the state. Geographical controls include latitude, longitude, average elevation, average slope, distance to the nearest navigable river, distance to the coast, and maximum caloric output from pre-Columbian and post-Columbian crops. Column (1) shows the results using the entire sample of parishes in the 1872 Census. Columns (2) and (6) indicate results for the subsample of parishes/municipalities in the 1890 and 2010 censuses within 10km of an 1872 parish. Columns (3) and (7), (4) and (8), are for parishes/municipalities in the 1890 and 2010 censuses within 25km and within 50km respectively. Columns (5) and (9) includes all the parishes/municipalities in the 1890 and 2010 censuses. Standard errors in parentheses are traditional robust standard errors while standard errors in brackets are Conley standard errors with a Bartlett Kernel with a radius of 400km

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

Table 7. Distance to Jesuit Mission on Literacy Rate using Census microdata (1970 - 2010)

	1970 - Literacy (1)	1980 - Literacy (2)	1991 - Literacy (3)	2000 - Literacy (4)	2010 - Literacy (5)
Distance to Jesuit Mission (km)	-0.063** (0.029)	-0.073** (0.028)	-0.126*** (0.036)	-0.070*** (0.020)	-0.042*** (0.014)
Number of Municipalities	81	81	88	97	97
Mean Literacy Rate:	61.0	66.3	71.4	81.0	85.8
N	580424	806354	489752	635292	611102

Notes: This table presents the results from the effects of a proximity to a Jesuit Mission on literacy at the individual level 2010 by estimating Equation 5. The sample of municipalities used are those in 1970, 1980, 1991, 2000, and 2010 censuses that are within 25km of the nearest 1872 parish. All regressions include state fixed effects, and dummies indicating whether the municipality is the capital of the state. Geographical controls include latitude, longitude, average elevation, average, slope, distance to the nearest navigable river, distance to the coast, and maximum caloric output from pre-Columbian and post-Columbian crops. Standard errors are clustered at the municipality level.

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

Table 8. Distance to Jesuit Mission on Literacy Rate using Census microdata - Racial Differences (1980 - 2010)

	1980 - Literacy			1991 - Literacy			2000 - Literacy			2010 - Literacy		
	(1) White	(2) Black	(3) Mulatto	(4) White	(5) Black	(6) Mulatto	(7) White	(8) Black	(9) Mulatto	(10) White	(11) Black	(12) Mulatto
Distance to Jesuit Mission (km)	-0.126*** (0.036)	-0.072* (0.037)	-0.065** (0.028)	-0.093* (0.048)	-0.167*** (0.025)	-0.124*** (0.036)	-0.074*** (0.022)	-0.077*** (0.028)	-0.066*** (0.020)	-0.035** (0.014)	-0.045** (0.020)	-0.042*** (0.014)
Number of Municipalities	81	80	81	88	85	88	97	97	97	97	97	97
Mean Literacy Rate:	77.4	56.3	64.0	80.8	61.9	69.4	86.0	73.8	79.8	89.2	82.9	85.1
N	152711	19965	626935	95083	14099	377599	159228	28581	439723	122994	37123	445782

*Notes:* This table presents the results from the effects of a proximity to a Jesuit Mission on literacy at the individual level by race by estimating [Equation 5](#). The sample of municipalities used are those in 1970, 1980, 1991, 2000, and 2010 censuses that are within 25km of the nearest 1872 parish. All regressions include state fixed effects, and dummies indicating whether the municipality is the capital of the state. Geographical controls include latitude, longitude, average elevation, average, slope, distance to the nearest navigable river, distance to the coast, and maximum caloric output from pre-Columbian and post-Columbian crops. Individual level controls include fixed-effects for the age of the respondent alongside gender fixed-effects. Standard errors are clustered at the municipality level.

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

Table 9. Distance to Jesuit Mission on Literacy Rate using Census microdata - Respondent Was Born in the Same Municipality (1970 - 2010)

	1970		1980		1990		2000		2010	
	(1) Local	(2) Migrant	(3) Local	(4) Migrant	(5) Local	(6) Migrant	(7) Local	(8) Migrant	(9) Local	(10) Migrant
Distance to Jesuit Mission (km)	-0.064** (0.029)	-0.072*** (0.026)	-0.079*** (0.029)	-0.035 (0.024)	-0.138*** (0.039)	-0.048* (0.026)	-0.066*** (0.021)	-0.041*** (0.015)	-0.041*** (0.015)	-0.027** (0.011)
Number of Municipalities	81	81	81	81	88	88	97	97	97	97
Mean Literacy Rate:	59.1	69.1	63.1	74.1	68.1	79.2	78.0	86.6	84.4	88.3
N	471391	108990	570559	235795	350857	126910	411636	223656	412619	179116

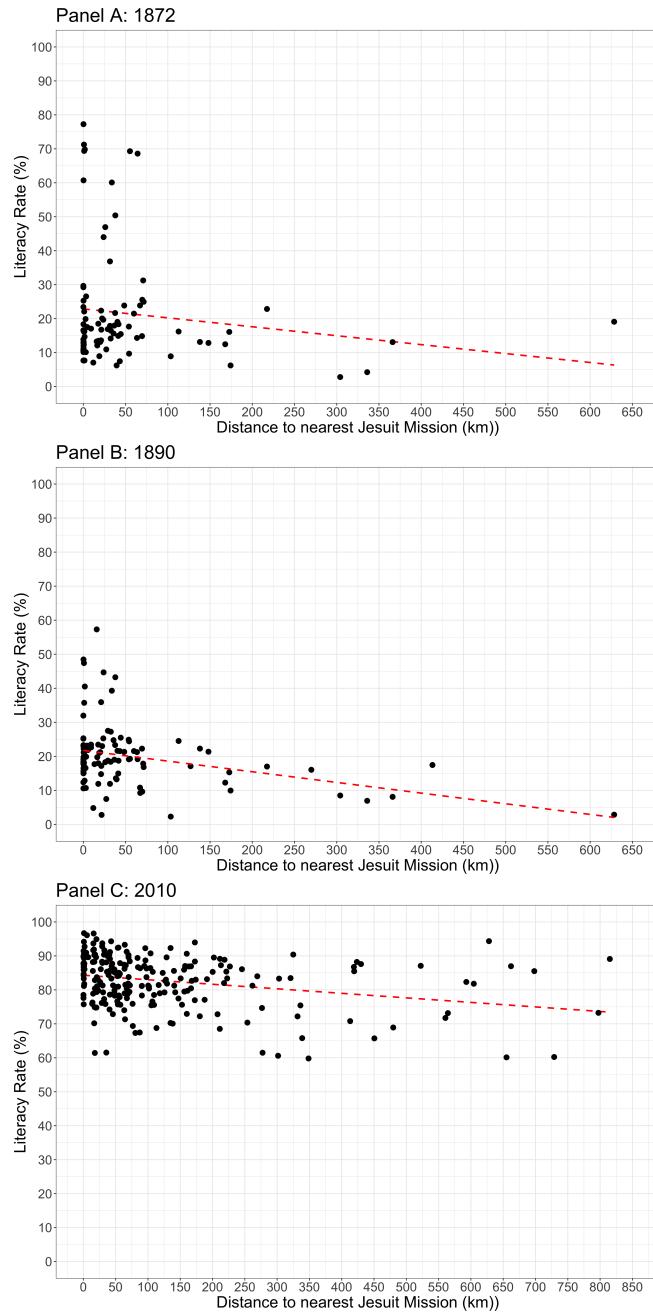
**Notes:** This table presents the results from the effects of a proximity to a Jesuit Mission on literacy at the individual level by whether the respondent was born in the same municipality he took the census by estimating [Equation 5](#). The sample of municipalities used are those in 1970, 1980, 1991, 2000, and 2010 censuses that are within 25km of the nearest 1872 parish. All regressions include state fixed effects, and dummies indicating whether the municipality is the capital of the state. Geographical controls include latitude, longitude, average elevation, average, slope, distance to the nearest navigable river, distance to the coast, and maximum caloric output from pre-Columbian and post-Columbian crops. Individual level controls include fixed-effects for the age of the respondent alongside gender fixed-effects. Standard errors are clustered at the municipality level.

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

## A. Robustness Figures and Tables

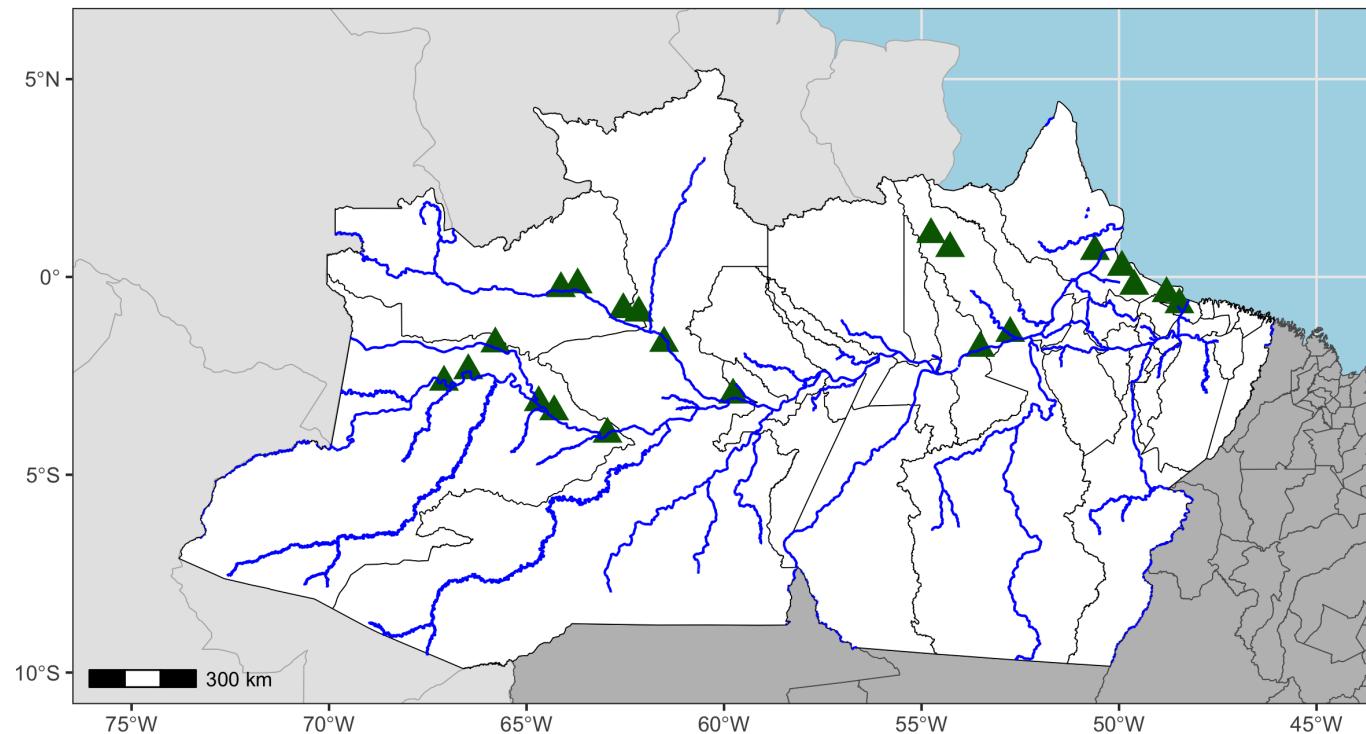
### Figures

Figure A.1. Unconditional Plots for Literacy Rate on the Distance to the Nearest Jesuit Mission - 1872, 1890, and 2010



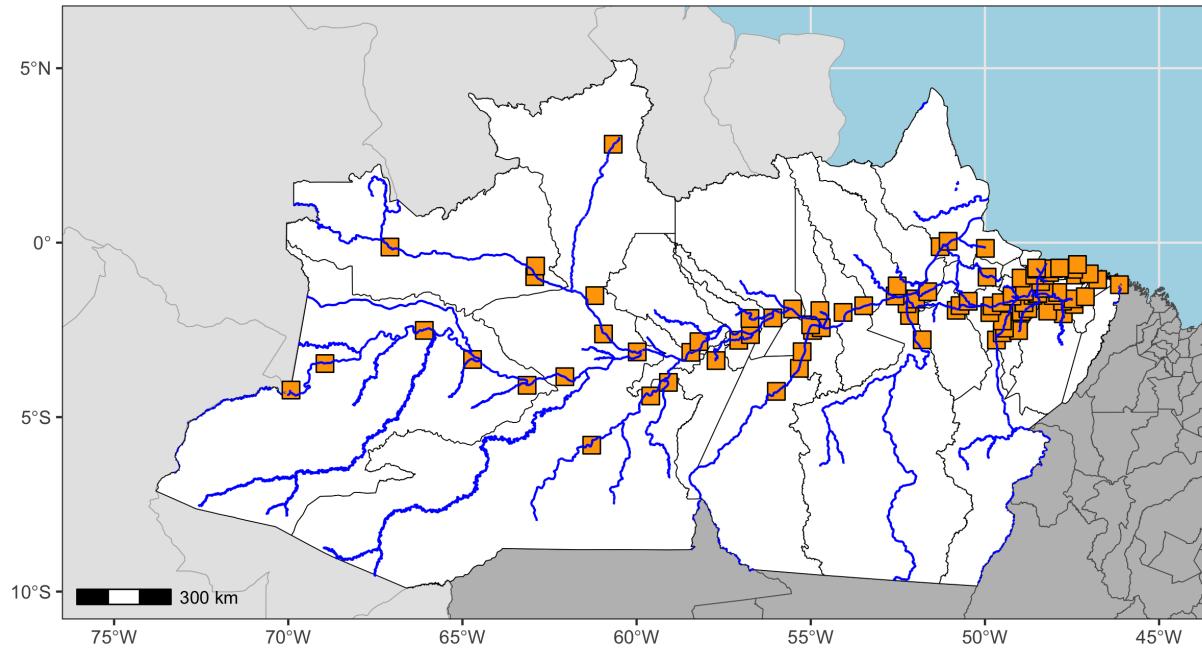
*Notes:* This figure shows the unconditional trend between literacy rate and the distance to the nearest Jesuit mission in 1872 (Panel A), 1890 (Panel B), and 2010 (Panel C), estimated. The red-dashed line indicates the best-fit line.

Figure A.2. Location of Carmelite or Franciscan Missions



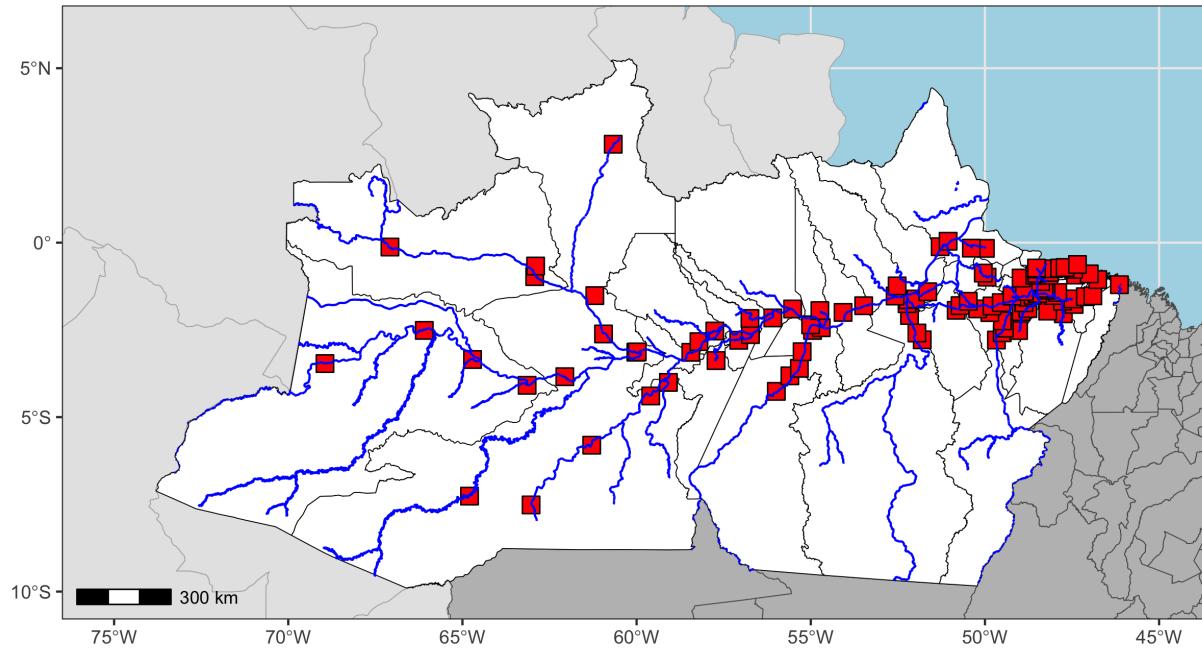
*Notes:* This figure shows the distribution of non-Jesuit missionaries in the region. 2010 Municipalities boundaries are used. The green triangles represent the locations of the Carmelite/Franciscan Religious Missions. The dark blue lines indicate the main rivers of the region. Data on the location of non-Jesuit missions comes from [Bombardi \(2014\)](#)

Figure A.3. Census Parishes in the 1872 Census



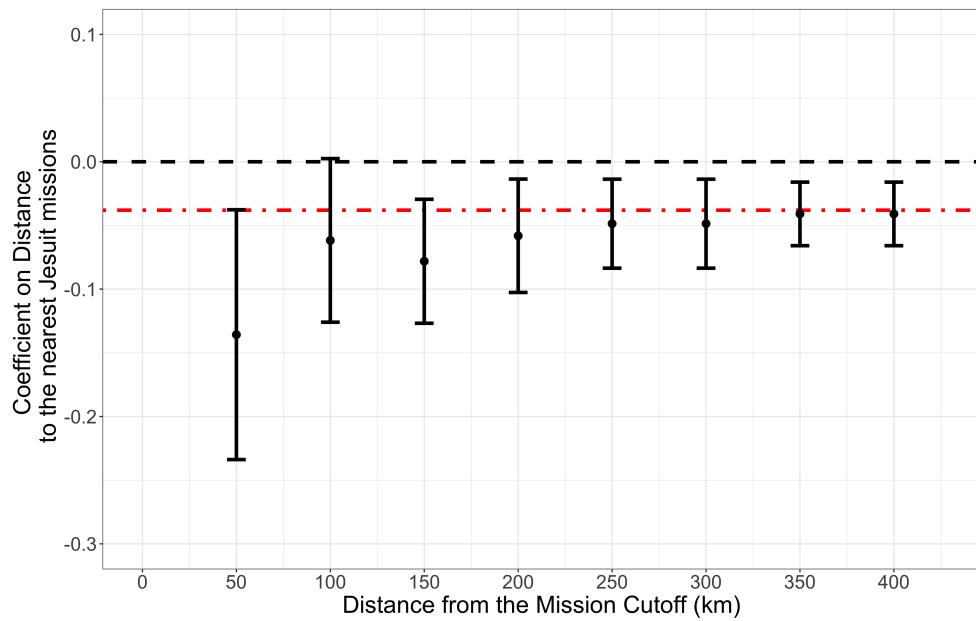
*Notes:* This figure shows the geographical distribution of the parishes in the 1872 census. 1872 municipality boundaries are used. The orange squares represent each parish in the region. For each municipality there existed at least one parish, in some cases, there were multiple parishes per municipality. The dark blue lines indicate the main rivers of the region.

Figure A.4. Census Parishes in the 1890 Census



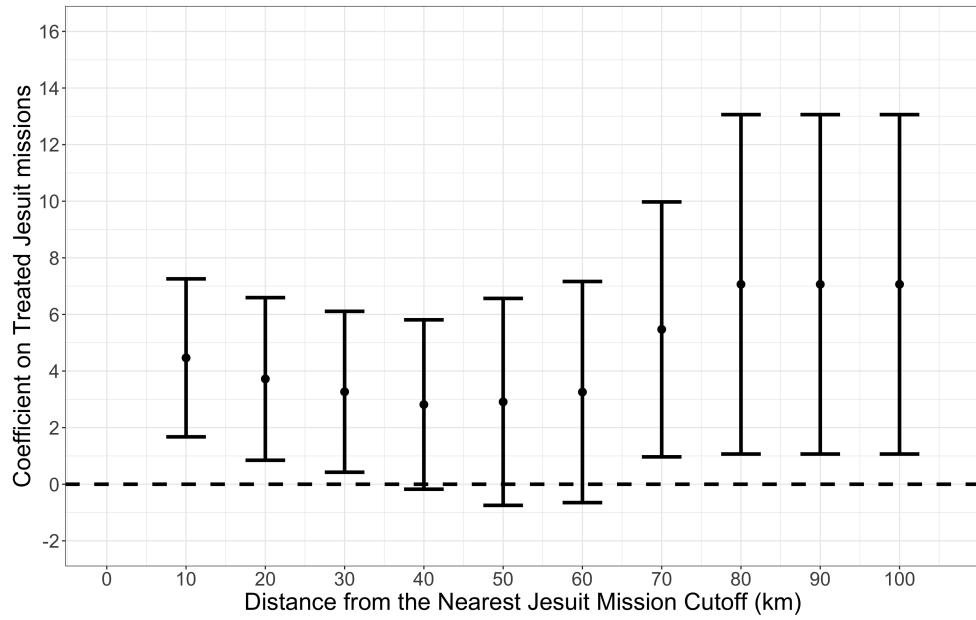
*Notes:* This figure shows the geographical distribution of the parishes in the 1890 census. 1890 municipality boundaries are used. The red squares represent each parish in the region. For each municipality there existed at least one parish, in some cases, there were multiple parishes per municipality. The dark blue lines indicate the main rivers of the region.

Figure A.5. Coefficient Plots when Excluding Municipalities Far Away From a Jesuit Mission



*Notes:* Results for [Equation 1](#) using 2010 data considering only municipalities within 25km of an 1872 parish that are also within a cutoff distance from a Jesuit mission. The red line indicates the original estimate from [Table 4](#) of -0.038. The black dashed line indicates zero. Error bars indicate the 95% confidence interval with robust standard errors.

Figure A.6. Results Considering a Treatment Indicator Based on a Distance Cutoff



*Notes:* Results for [Equation 6](#) using 2010 data, considering *Treated* as any municipality within a cutoff distance from a Jesuit mission. The data is the 2010 municipalities located within 25km of a 1872 parish. The black dashed line indicates zero. Error bars indicate the 95% confidence interval with robust standard errors.

## Tables

Table A.1. First Stage and Reduced Form Regressions

	1872 Census			1890 Census			2010 Census		
	(1) Entire Sample	(2) <10km	(3) <25km	(4) <50km	(5) Entire Sample	(6) <10km	(7) <25km	(8) <50km	(9) Entire Sample
<i>Panel A: First-Stage</i>									
Distance to Tupi-speaking areas (km)	0.712*** (0.116)	0.641*** (0.128)	0.623*** (0.127)	0.636*** (0.116)	0.964*** (0.192)	0.876*** (0.244)	0.796*** (0.209)	0.864*** (0.213)	0.788*** (0.120)
First Stage F-Statistic	37.60	25.05	23.91	29.18	25.60	12.88	14.56	16.45	43.11
N	91	92	97	101	104	74	97	128	236
<i>Panel B: Reduced Form</i>									
Distance to Tupi-speaking areas (km)	-0.047** (0.021)	-0.030* (0.016)	-0.030* (0.015)	-0.032** (0.014)	-0.016 (0.011)	-0.030 (0.020)	-0.031* (0.018)	-0.026 (0.018)	-0.019** (0.009)
N	91	92	97	100	103	74	97	128	236

*Notes:* This table presents the first-stage (Panel A) and reduced-form (Panel B) results from the effects of a proximity to a Jesuit Mission on the literacy rate at the parish/municipality level for the 1872, 1890, and 2010 censuses. Geographical controls include latitude, longitude, average elevation, average slope, distance to the nearest navigable river, distance to the coast, and maximum caloric output from pre-Columbian and post-Columbian crops. Column (1) shows the results using the entire sample of parishes in the 1872 Census. Columns (2) and (6) indicate results for the subsample of parishes/municipalities in the 1890 and 2010 censuses within 10km of an 1872 parish. Columns (3) and (7), (4) and (8), are for parishes/municipalities in the 1890 and 2010 censuses within 25km and within 50km respectively. Columns (5) and (9) includes all the parishes/municipalities in the 1890 and 2010 censuses.

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

Table A.2. Distance to Jesuit Mission Effects on Literacy Rate by gender per Parishes in 1872 and 1890

	1872 Census		1890 Census	
	(1) Men	(2) Women	(3) Men	(4) Women
Distance to Jesuit Mission (km)	-0.029 (0.018) [0.018]	-0.038 (0.026) [0.011]	-0.036** (0.017) [0.011]	-0.023*** (0.009) [0.010]
Mean Literacy Rate	28.1	14.9	29.4	11.0
N	91	91	97	97

*Notes:* This table presents the results from the effects of a proximity to a Jesuit Mission on the literacy rate for men and women at the parish level for the 1872 and 1890 censuses estimated with [Equation 4](#). All regressions include state fixed effects, and dummies indicating whether the parish/municipality is the capital of the state. Geographical controls include latitude, longitude, average elevation, average, slope, distance to the nearest navigable river, distance to the coast, maximum caloric output from pre-Columbian and post-Columbian crops, and the distance to the nearest non-Jesuit Catholic mission. The sample used for the 1890 census includes only parishes within 25km of a 1872 parish. Standard errors in parentheses are traditional robust standard errors while standard errors in brackets are Conley standard errors with a Bartlett Kernel with a radius of 400km

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

Table A.3. Distance to Jesuit Mission Effects on school attendance in 1872

	Proportion of children between 6-15 Attending School (%)	Proportion of boys between 6-15 Attending School (%)	Proportion of girls between 6-15 Attending School (%)
	(1)	(2)	(3)
Distance to Jesuit Mission (km)	-0.012 (0.018) [0.013]	-0.007 (0.026) [0.019]	-0.023* (0.014) [0.010]
Mean Dependent Variable	14.3	18.0	11.0
N	91	91	91

*Notes:* This table presents the results from the effects of a proximity to a Jesuit Mission on the school attendance for children, boys, and girls between the ages of 6-15 at the parish level for the 1872 census [Equation 4](#). Geographical controls include latitude, longitude, average slope, average elevation, distance to the nearest navigable river, distance to the coast, distance to the nearest non-Jesuit mission, and maximum caloric output from pre-Columbian and post-Columbian crops. Standard errors in parentheses are traditional robust standard errors while standard errors in brackets are Conley standard errors with a Bartlett Kernel with a radius of 400km

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

Table A.4. Distance to Jesuit Mission on Literacy Rate using Census Microdata - Gender Differences (1970–2010)

	1970		1980		1990		2000		2010	
	(1) Men	(2) Women	(3) Men	(4) Women	(5) Men	(6) Women	(7) Men	(8) Women	(9) Men	(10) Women
Distance to Jesuit Mission (km)	-0.060** (0.028)	-0.067** (0.031)	-0.060** (0.027)	-0.089*** (0.029)	-0.124*** (0.037)	-0.130*** (0.036)	-0.073*** (0.019)	-0.067*** (0.021)	-0.046*** (0.014)	-0.037*** (0.013)
N	289159	291265	402627	403727	243822	245930	317080	318212	306992	304110
Number of Municipalities	81	81	81	81	88	88	97	97	97	97
Mean Literacy Rate:	62.2	59.8	66.6	66.0	70.4	72.4	80.0	82.1	84.7	86.9

*Notes:* This table presents the results from the effects of a proximity to a Jesuit Mission on literacy at the individual level by whether the respondent's gender by estimating [Equation 5](#). The sample of municipalities used are those in 1970, 1980, 1991, 2000, and 2010 censuses that are within 25km of the nearest 1872 parish. All regressions include state fixed effects, and dummies indicating whether the municipality is the capital of the state. Geographical controls include latitude, longitude, average elevation, average, slope, distance to the nearest navigable river, distance to the coast, and maximum caloric output from pre-Columbian and post-Columbian crops. Individual level controls include fixed-effects for the age of the respondent. Standard errors are clustered at the municipality level.

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

Table A.5. Distance to Jesuit Mission Effects on Demographic Composition in 1872 for Parishes in the Brazilian Amazon

	Proportion of Caboclos (%) (1)	Proportion of Whites (%) (2)	Proportion of Blacks (%) (3)	Proportion of Pardos (%) (4)	Proportion of Slaves (%) (5)	Proportion Brazilians not born in the state (%) (6)	Proportion of Immigrants (%) (7)
Distance to Jesuit Mission (km)	0.020 (0.037) [0.041]	-0.017 (0.022) [0.023]	0.001 (0.009) [0.009]	-0.004 (0.021) [0.020]	-0.019* (0.010) [0.007]	-0.013 (0.008) [0.005]	-0.005 (0.006) [0.005]
Dependent Variable Mean	31.1	30.4	5.4	33.1	7.7	2.0	1.7
N	91	91	91	91	91	91	91

*Notes:* This table shows the effects of the proximity to a Jesuit mission on a parish demographics by race using the 1872 census estimated with [Equation 4](#). All regressions include state fixed effects, and dummies indicating whether the parish/municipality is the capital of the state. Geographical controls include latitude, longitude, average elevation, average slope, distance to the nearest navigable river, distance to the coast, and maximum caloric output from pre-Columbian and post-Columbian crops. Standard errors in parentheses are traditional robust standard errors while standard errors in brackets are Conley standard errors with a Bartlett Kernel with a radius of 400km.

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

Table A.6. Distance to Jesuit Mission Effects on Labor Composition in 1872 for Parishes in the Brazilian Amazon

	Proportion Working in Liberal Professions (%) (1)	Proportion Working in Industry (%) (2)	Proportion Working in Manual Professions (%) (3)	Proportion Working in Agriculture (%) (4)	Proportion Working in Other Jobs (%) (5)	Proportion with No Jobs (%) (6)
Distance to Jesuit Mission (km)	-0.005*** (0.002) [0.002]	0.011 (0.013) [0.011]	0.004 (0.009) [0.007]	0.031 (0.027) [0.023]	-0.048*** (0.016) [0.011]	0.007 (0.028) [0.020]
Dependent Variable Mean	0.8	2.8	6.3	33.7	13.3	43.1
N	91	91	91	91	91	91

*Notes:* This table presents the results from the effects of a proximity to a Jesuit Mission on the proportion of people in different jobs in the 1872 census estimated with [Equation 4](#). All regressions include state fixed effects, and dummies indicating whether the parish/municipality is the capital of the state. Geographical controls include latitude, longitude, average elevation, average, slope, distance to the nearest navigable river, distance to the coast, and maximum caloric output from pre-Columbian and post-Columbian crops.

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

Table A.7. Distance to Jesuit Mission Effects on GDP per capita by economic sector in the Brazilian Amazon (2010)

	GDP per Capita by Sector				
	(1) GDP per capita	(2) Agriculture	(3) Industry	(4) Services	(5) Government Spending
Distance to Jesuit Mission (km)	9.869 (13.497) [1.524]	0.529 (1.653) [1.524]	7.726 (10.083) [7.159]	-2.342 (2.965) [2.151]	0.443 (0.572) [0.350]
Dependent Variable Mean	6342.7	1233.4	1020.3	1455.9	2224.3
N	97	97	97	97	97

*Notes:* This table presents the results from the effects of a proximity to a Jesuit Mission on the GDP per capita, also broken down by sectors, at the municipality level for 2010 by estimating [Equation 4](#). The sample of municipalities used are those in 2010 that are within 25km of the nearest 1872 parish. All regressions include state fixed effects, and dummies indicating whether the municipality is the capital of the state. Geographical controls include latitude, longitude, average elevation, average, slope, distance to the nearest navigable river, distance to the coast, and maximum caloric output from pre-Columbian and post-Columbian crops. Standard errors in parentheses are traditional robust standard errors while standard errors in brackets are Conley standard errors with a Bartlett Kernel with a radius of 400km

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

Table A.8. Nighttime light density (2010)

	1km Buffer	5km Buffer	10km Buffer	25km Buffer
	(1)	(2)	(3)	(4)
Distance to Jesuit Mission (km)	-0.038 (0.028) [0.030]	-0.037** (0.018) [0.018]	-0.027** (0.011) [0.010]	-0.022*** (0.007) [0.007]
Dependent Variable Mean	30.2	12.9	5.7	3.2
N	97	97	97	97

*Notes:* This table shows the effects of the proximity to a Jesuit mission on the nighttime light density around a municipality's seat in 2010 with varying buffers. All regressions include state fixed effects and dummies indicating whether the municipality is the capital of the state. Geographical controls include latitude, longitude, average elevation, average slope, distance to the nearest navigable river, distance to the coast, distance to the nearest non-Jesuit mission, and maximum caloric output from pre-Columbian and post-Columbian crops.

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

Table A.9. Alternative explanations for the differences in literacy rate

	Urban Population (%)	Population Density	Schools per 10,000	Schools per 10,000 (Urban)	Schools per 10,000 (Under 15)
	(1)	(2)	(3)	(4)	(5)
Distance to Jesuit Mission (km)	-0.045 (0.038) [0.037]	-0.830* (0.449) [0.326]	0.006 (0.025) [0.024]	0.019 (0.101) [0.103]	0.004 (0.065) [0.059]
Dependent Variable Mean:	51.56	75.10	17.37	49.31	47.76
N	97	97	97	97	97

*Notes:* This table presents the results from the effects of a proximity to a Jesuit Mission on urban population, population density, and other measures of school supply at the municipality level for 2010 [Equation 4](#). The sample of municipalities used are those in 2010 that are within 25km of the nearest 1872 parish. All regressions include state fixed effects, and dummies indicating whether the parish/municipality is the capital of the state. Geographical controls include latitude, longitude, average elevation, average slope, distance to the nearest navigable river, distance to the coast, and maximum caloric output from pre-Columbian and post-Columbian crops. Standard errors in parentheses are traditional robust standard errors while standard errors in brackets are Conley standard errors with a Bartlett Kernel with a radius of 400km

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

Table A.10. Distance to Jesuit Mission Effects on Literacy Rate for 1872 and 2010 - Varying Conley Standard Errors

	Literacy Rate (%)	
	(1)	(2)
Distance to Jesuit Mission (km)	-0.033* (0.019) [0.019] [0.017] [0.017] [0.018] [0.017]	-0.023*** (0.006) [0.005] [0.005] [0.005] [0.005] [0.004]
Geographical Controls		✓
N	91	236

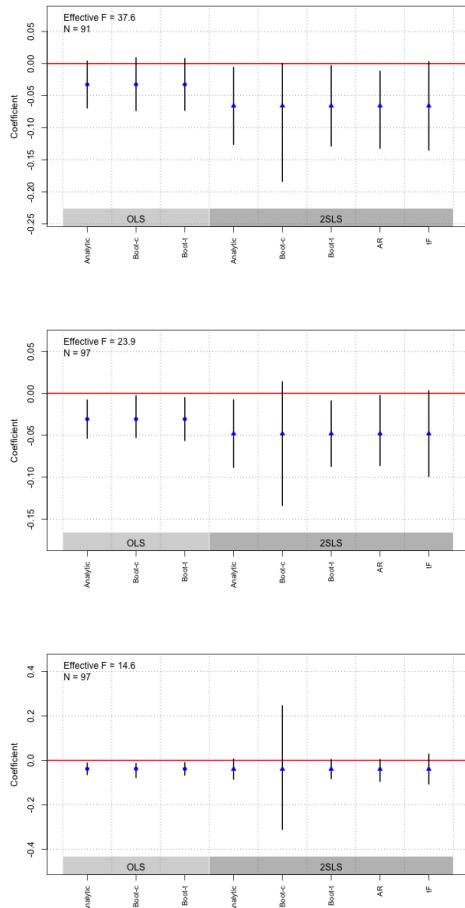
\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

<sup>a</sup> All regressions include state fixed effects, century of creation fixed effects and dummies indicating whether the municipality is the capital of the state. Geographical controls include latitude, longitude, average elevation, average, slope, area, distance to the nearest navigable river, distance to the coast, and maximum caloric output from pre-Columbian and post-Columbian crops. Conley standard errors are reported in brackets at thresholds of 50, 100, 200, 400, and 800 km respectively. The threshold of 400km, used throughout the paper, is highlighted in yellow.

## B. Validity of the Instrument

To check the robustness of the instruments, I conduct two checks. I estimate both Anderson-Rubin confidence intervals and tF confidence intervals ([Anderson and Rubin, 1949](#); [Lee et al., 2022](#)). Results are found below in [Figure B.1](#). Overall, the instrumental variable standard errors and results are robust to different specifications.

Figure B.1. Test for robustness of the Instrumental Variable for the 1872, 1890, and 2010 censuses



*Notes:* Robustness checks on the IV estimates and comparison to the OLS estimates for the 1872, 1890, and 2010 censuses. Including bootstrapped standard errors, Anderson-Rubin Confidence intervals ([Anderson and Rubin, 1949](#)), and tF Confidence Intervals ([Lee et al., 2022](#)). The 1890 and 2010 censuses are subset to include parishes/municipalities within 25km of the 1872 parishes, representing columns (3) and (7) of [Table 5](#). Confidence intervals shown are at the 95% level.

## C. Desegragating by Type of Mission

I further break down the missions into the individual effects of Carmelites and Franciscans to observe whether, individually, their historical missions have any effect on literacy. Results are found in [Table C.1](#).

For 1872, in column (1), there is no impact on the literacy rate for either Franciscan or Carmelite missions. The coefficient for the Jesuit missions drops to -0.031 and becomes insignificant under robust standard errors; however, it is significant at the 10% confidence level with the spatial Conley errors. For 1890, in column (2), there is no impact on the literacy rate for either Franciscan or Carmelite missions. The coefficient for the Jesuit missions drops to -0.024 but is significant. In 2010, in column (3), the Franciscan missions had a positive effect on literacy, as missions 100km away from them had 6.2% lower literacy. Even when including the Jesuit missions, the coefficient for the Franciscan missions is -0.062, while for the Jesuits it is -0.030, indicating that based on the 2010 census, the Franciscans had a stronger impact on literacy in 2010. Unsurprisingly, the Carmelites had no effect in both 1872 and 2010. They were more isolated, located along the Rio Negro, and never invested as much in human capital development at their missions.

A possible explanation for the difference in results between 1872 and 2010 is that, as mentioned, the Franciscans themselves did not establish many new missions; instead, they took over previous Jesuit missions, especially profitable cattle farms on the island of Marajo. Therefore, in 1872, there was an impact of the Jesuits but not on the Franciscans, which can be explained by the fact that the Jesuits invested in literacy while the Franciscans did not. However, by 2010, the effects of the Franciscans came through the economic development caused by their economic activity, instead of their missionary work. It is important to note that, regardless of the 2010 effects, the Jesuit missions are the only ones with consistently significant negative effects on literacy.

Table C.1. Literacy Rate and Proximity to Missions by Type

	1872 Census	1890 Census	2010 Census
	(1)	(2)	(3)
Distance to Jesuit Mission (km)	-0.031 (0.023) [0.020]	-0.024* (0.013) [0.012]	-0.030** (0.015) [0.017]
Distance to Carmelite Mission (km)	0.000 (0.000) [0.000]	0.016* (0.008) [0.007]	0.015 (0.009) [0.009]
Distance to Franciscan Mission (km)	-0.000 (0.000) [0.000]	-0.012 (0.013) [0.009]	-0.062*** (0.016) [0.014]
Dependent Variable Mean	21.6	20.3	84.7
N	91	97	97

*Notes:* This table presents the results from the effects of a proximity to a Jesuit, Carmelite, or Franciscan Mission on the literacy rate. The sample of municipalities used are those in 1890 and 2010 that are within 25km of the nearest 1872 parish. All regressions include state fixed effects, and dummies indicating whether the parish/municipality is the capital of the state. Geographical controls include latitude, longitude, average elevation, average slope, distance to the nearest navigable river, distance to the coast, and maximum caloric output from pre-Columbian and post-Columbian crops. Standard errors in parentheses are traditional robust standard errors while standard errors in brackets are Conley standard errors with a Bartlett Kernel with a radius of 400km

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

## D. Concerns from Conley and Kelly (2025)

To address the concerns raised on the standard errors of persistence by [Conley and Kelly \(2025\)](#) I conduct the tests as described in the paper. The entire code is available on the replication package.

### 1. Placebo Tests and Synthetic Outcomes to choose the Correct Inference

To conduct the tests, I use the R package *spatInfer* which is provided by the authors and I follow their procedure as stated in the tutorial.<sup>1</sup> I first choose the spatial basis for the 1872, 1890, and 2010 censuses. For 1872, the procedure gives a 5x5 linear tensor with 1 principal component (PC). For 1890, a 3x3 with 1 PC and for 2010 a 6x6 with 2 PCs.

When using the placebo and synthetic outcome tests, for both 1872 and 1890 the number of PCs is not ideal as they often give a placebo that is not close to the 5% recommended by the authors. In that case, the authors recommend two things: first, anything close to 8% or below can be considered acceptable, and second, to vary the number of PCs by one or two to see if the placebo value improves.<sup>2,3</sup>

In the case of 1872, that only happens when using 3 principal components and 3 clusters, in which the placebo p-value for the 5% confidence gets the closest to 0.05 at 0.09 (vs. 0.125 with 1 PC and 6 clusters and vs. 0.095 with 2 PC and 4 clusters). For 1890, the closest it gets is with two PCs and five clusters, at a value of 0.067 (vs. 0.072 with 1 PC and 3 clusters, and 0.073 with 3 PCs and 5 clusters). For 2010,

I follow up the placebo test with the synthetic outcome test that overall support the choices of the placebo test. For 1872, the lowest p-value is 0.105 which happens at 3 PCs and 3 clusters, for 1890 the lowest p-value is 0.06 which happens at 3 PCs and 5 clusters, and for 2010 For 2010, it is different, in which the lowest p-value happens with 6 clusters with a value of 0.09. As a result, I will show results for both 3 and 6 clusters in the next section.

### 2. Estimating the Spatial Basis Regression (BCH Adjustments)

The effects on the coefficients of the spatial basis regressions are available on the table below. It is important to note that for both 1872 and 1890 the coefficients are still significant, however, the point estimates are smaller. For 1872, the coefficient increases from -0.033 to

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<sup>1</sup>Accessed at: [https://morganwkelly.github.io/spatInfer\\_tutor/tutorial.html](https://morganwkelly.github.io/spatInfer_tutor/tutorial.html)

<sup>2</sup>“Following this, and highlighted in orange, is the percentage of simulations where the placebo is significant at 5%. If this is markedly higher than 5% it suggests that the inference method employed was inadequate. In practice a value in the range of 0.05 to 0.07 or 0.08 indicates satisfactory performance.”

<sup>3</sup>“It will sometimes happen that the proportion of placebos significant at 5% stays considerably above 5% regardless of the cluster number. In that case systematically increasing, or sometimes decreasing, the number of principal components *num\_pc* by one or two will usually give a satisfactory placebo value.”

-0.036 and for 1890 it decreases from -0.031 to -0.030 and is only significant at the 10% confidence level. Both coefficients decrease, but are also similar in their magnitudes which is reassuring since the two censuses are only 18 years apart. For 2010, the coefficient remains similar in magnitude, however, it is no longer significant as it was in the main results if using three clusters, but it is significant if using six clusters.

Table F.1. Basis Spline Estimates of Distance to Jesuit Missions on Literacy

	1872 Census	1890 Census	2010 Census	
	(1)	(2)	(3)	(4)
Distance to Jesuit Mission (km)	-0.036*	-0.030*	-0.027	-0.027**
	[-0.076, 0.004]	[-0.061, 0.002]	[-0.068, 0.013]	[-0.046, -0.009]
	p = 0.060	p = 0.059	p = 0.102	p = 0.013
Number of Splines	5	3	6	6
Number of Principal Components	3	2	4	4
Number of Clusters	3	5	3	6
N	91	97	97	97

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

*Notes:* This table presents the OLS results from the effects of a proximity to a Jesuit Mission on the literacy rate at the parish/municipality level for the 1872, 1890, and 2010 following the procedure described in [Conley and Kelly \(2025\)](#). All regressions include state fixed effects, and dummies indicating whether the parish/municipality is the capital of the state. Geographical controls include latitude, longitude, average elevation, average, slope, distance to the nearest navigable river, distance to the coast, and maximum caloric output from pre-Columbian and post-Columbian crops. For the 1890 and 2010 censuses, the data is a subset of parishes/municipalities within 25km of the original 1872 parishes.

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

### 3. Ibragimov–Müller inference

I do not conduct the test since the number of observations is too low, relative to the 250, that the authors recommend in the paper.

### 5. Conclusion

Overall, when addressing the potential concerns raised by [Conley and Kelly \(2025\)](#), the results for 1872 and 1890 remain significant, however, the point estimates are smaller. For 2010, the point estimates are similar to the main results, however, the coefficients are no longer significant depending on the number of clusters selected.

## E. Data Appendix - 1872

Below are the definitions of the variables measured for the 1872 census and how they were constructed. Some of the variables are already defined in the census:

### E.1. Base Variables, available by gender and free vs. enslaved:

1. Number of Literate People
2. Number of People 6-15 Attending/Not Attending/No Information on Schooling
3. Demographic Information on Race
  - (a) Number of Enslaved People
  - (b) Number of Pardos
  - (c) Number of Whites
  - (d) Number of Blacks
  - (e) Number of Caboclos
4. Number of People not born in the state based on origin: Within Brazil or from another country.
5. Number of people on types of jobs: Liberal/Manual/Agricultural/Industry/Other Jobs/No Jobs
  - (a) Liberal: Religious men/women, judges, lawyers, notaries, attorneys, justice officials, medics, surgeons, pharmacists, midwives, teachers, public officials, and artists.
  - (b) Manual or Mechanical:
  - (c) Agricultural: Farmers and livestock breeders.
  - (d) Industry: Manufacturers and merchants.
  - (e) Other: Military officers, mariners, fishermen, capitalists/owners, *jornaleiros* (workers that are paid based on a working day), domestic workers, and no information
6. Number of people by age group.

## E.2. Constructed Variables:

1. Number of Free People Above the Age of 15

$$\sum \# \text{ Of Free People Above 15}$$

2. Literacy Rates, following [Rocha et al. \(2017\)](#):

$$100 \times \frac{\# \text{ of Literate Free People}}{\# \text{ of Free People Above the Age of 5}}$$

3. Men Literacy Rates:

$$100 \times \frac{\# \text{ of Literate Free Men}}{\# \text{ of Free Men Above the Age of 5}}$$

4. Women Literacy Rates:

$$100 \times \frac{\# \text{ of Literate Free Women}}{\# \text{ of Free Women Above the Age of 5}}$$

5. Total number of children between 6-15

$$\begin{aligned} & \# \text{ of Free People between the ages 6-15 who attend school} + \\ & \# \text{ of Free People between the ages 6-15 who do not attend school} + \\ & \# \text{ of Free People between the ages 6-15 with no information on schooling} \end{aligned}$$

6. Percentage of Children between age 6-15 who are attending school:

$$100 \times \frac{\# \text{ of Free People between the ages 6-15 who attend school}}{\text{Total } \# \text{ of Free Children between 6-15}}$$

7. Percentage of Boys between age 6-15 who are attending school:

$$100 \times \frac{\# \text{ of Free Boys between the ages 6-15 who attend school}}{\text{Total } \# \text{ of Free Boys between 6-15}}$$

8. Percentage of Girls between age 6-15 who are attending school:

$$100 \times \frac{\# \text{ of Free Girls between the ages 6-15 who attend school}}{\text{Total } \# \text{ of Free Girls between 6-15}}$$

9. Proportion of Slaves to Free Population:

$$100 \times \frac{\# \text{ of Enslaved People}}{\# \text{ of Free People}}$$

10. Proportion of White/Caboclo/Black/Pardo:

$$100 \times \frac{\# \text{ of Free People of Certain Race}}{\# \text{ of Free People}}$$

11. Proportion of Internal/Foreign Immigrants:

$$100 \times \frac{\# \text{ of Free People of Certain Immigration Category}}{\# \text{ of Free People}}$$

12. Proportion of Teachers per 10,000:

$$10000 \times \frac{\# \text{ of Free People working as Teacher}}{\# \text{ of Free People}}$$

13. Proportion of Workers by Labor Market characteristics (as described in the data above):

$$100 \times \frac{\# \text{ of Total People in Certain Job}}{\# \text{ of Total People}}$$

## F. Parish Level Georeferencing

For the 1872, the four states in the region described in the paper only had 38 municipalities, and a similar issue arises when using the 1890 census. In order to increase the sample size, I georeferenced the information at the parish level for both censuses. The data was georeferenced for 1872 as follows:

1. If the municipalities only had one parish, then the parish location is the same as the municipality seat.
  - (a) The municipality of Serpa in Amazonas has only one parish, “Nossa Senhora do Rosário de Serpa”, therefore it is georeferenced to the municipality seat of Serpa.
2. If a municipality has more than one parish, first I checked based on the name whether or not the parish level can be traced to a present-day city.
  - (a) The municipality of Vigia in Para has three parishes: “Nossa Senhora de Nazaré da Vigia”, “Nossa Senhora do Rosário de Collares”, and “São Caetano de Odivellas”.
  - (b) All of these parishes can be traced down to present-day cities, “Nossa Senhora de Nazaré da Vigia” is the present-day municipality of Vigia, “Nossa Senhora do Rosário de Collares” is the present-day municipality of Collares, and “São Caetano de Odivellas” is the present-day municipality of São Caetano de Odivellas
3. If the parish cannot be traced down based on the name to a present-day municipality then I took a look at other historical sources.<sup>4</sup>

For 1890, a similar procedure was followed; the only difference is that the first step was to check if the 1890 parish had already been georeferenced in 1872 (e.g. they have the same name). In total, out of the 105 parishes in 1890, 89 were geofererenced based on their 1872 names.

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<sup>4</sup><https://cidades.ibge.gov.br/> includes information on historical names for municipalities, based on their history.