Agricultural and Mining Labor Interactions in Peru: A Long-Run Perspective (1571-1812)

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Abstract

This essay evaluates the context and persistence of extractive colonial policies in Peru on contemporary development indicators and political attitudes. Using the 1571 Toledan Reforms—which implemented a system of draft labor and regularized tribute collection—as a point of departure, I build a unique dataset of annual tribute records for 160 districts in the Cuzco, Huamanga, Huancavelica, and Castrovirreyna regions of Peru over the years of 1571 to 1812. Pairing this source with detailed historic micro data on population, wages, and regional agricultural prices, I develop a historic model for the annual province-level output. The model's key parameters determine the output elasticities of labor and capital and pre-tribute production. This approach allows for an conceptual understanding of the interaction between mita assignment and production factors over time. I then evaluate contemporary outcomes of agricultural production and political participation in the same Peruvian provinces, based on whether or not a province was assigned to the mita. I find that assigning districts to the mita lowers the average amount of land cultivated, per capita earnings, and trust in municipal government

Introduction

For nearly 250 years, the Peruvian economy was governed by a rigid system of state tribute collection and forced labor. Though the interaction between historical extraction and economic development has been studied in a variety of post-colonial contexts, Peru's case is unique due to the distinct administration of these tribute and labor laws. The implementation of these policies began in 1571, following a deliberate assignment of "tasas" or tribute rates in accordance to a composition of district level factors—of population, size, and economic potential, and continued through to the onset of the Republican period, in 1821.

Recent empirical studies suggest that Peru's history can help account for the current economic development outcomes. Building on this work, I assess the role of the mita, or forced mining labor, in the Peruvian economy at two levels. Drawing on a detailed dataset of tribute collection, I first examine trends in tribute values within the historic interval of 1571-1812 and in relation to whether or not a district was assigned to the mita. Tribute was levied from both districts that assigned to the mita and those that did not. Given that tribute reflected a region's economic potential, I develop and estimate a simple model of each province's combined agricultural and mining output to probe how the distinct factors entered the model and how these values shifted over time. Doing so allows me to estimate a historic parameter of agricultural production, and then evaluate the surplus output by province. I then assess this "predicted output" through historic province level factors of agricultural prices, population, land size, and whether or not a province contributed mita conscripts. For the mita, districts that fell within a particular boundary were initially assigned to contribute 1/7 of their Indian population for work in the mines of Potosí and Huancavelica.

In a contemporary context, I match the historic provinces studied earlier with modern regions to evaluate how the mita "treatment" affects development outcomes of agriculture and political participation. Agriculture presents a useful variable to evaluate, as about 25 percent of the Peruvian labor force is still employed in agriculture.[1] I find a negative relationship between the presence of the mita and agricultural production. Assigning a district to a mita region lowered the purchasing power per capita, even after controlling for education and other demographic variables. Districts that were assigned to the mita were more likely to mistrust district-level governments, and rely on province-level administration, the same unit as the colonial tribute collection. Though this finding alone does not illuminate the how the discrepancies in the values arrived, it highlights possible avenues for later research on channels of causality.

The paper is structured as follows. I first present a overview of the geographic and historic context, focusing particularly on the 1571 Toledan Reforms, which implemented the extractive state-driven tribute tax and labor draft. In Section 2, I describe the construction of my datasets. In Section 3, I identify baseline attributes of the tribute data and present a model to estimate the parameter of output elasticity. In Section 4, I introduce the framework for linking the historic data to the modern

[1]World Bank, 2008, p. 27-28

outcomes and assess the values. Section 5 concludes the paper.

1.1 Toledan Reforms of 1571: Tribute and Mita

The 1571 Reforms of Viceroy Francisco Toledo fundamentally reordered the economic base of colonial Peru, placing the state at the center of tribute collection and administration. Toledo reorganized the Andean region into *repartimientos*, or units based on tribute producing communities, assigned a district level tribute rates, and implemented a system of forced labor.[2] Toledo's twelve years as viceroy left a colony that had previously engaged with its indigenous population through disordered and inconsistent polices operating a disciplined financial bureaucracy.

Toledo's Reforms stemmed from an imperial impetus to assess the sources of tribute wealth in the New World and extract accordingly. The reigning monarch, Phillip II saw Peruvian tribute collection faltering in the face of an inefficient colonial administration. Phillip II believed tribute assessments were compromised by a lack of good data, and instructed the incoming Viceroy Toledo to compile a "libro de tasas," or a tax register, in 1568. The libro de tasas would survey each private landowner, tabulate the tributaries and corresponding income lost by the state.[3] Toledo went further, however, creating repartimientos that spanned public and private land, and appointing 63 secular and ecclesiastical inspectors who were charged with evaluating the productive capacities of each new unit.[4]

[2] Ann M. Wightman "Indigenous Migration and Social Change: The Forasteros of Cuzco,"(Durham: Duke University Press, 1990), 15

[3] Ibid, 77

[4] Ibid, 15

These "evaluations" took the form of censuses that focused on the tribute eligible population and their crops. The detailed census records documented the number of married Indians, the number of their offspring, the blind, the ill, and incapacitated males, widows, and other community members. Each Indian male who was not present at the time of the survey had to be accounted for by the inspectors, who documented where their relatives claimed they were at the time of the survey and when they would return. The census revealed a vast population of potential tributaries, many of whom had not previously paid tribute to their overseeing encomendero, or private Spanish-appointed administrator.[5] This evidence, coupled with the vast number of potential tributaries, convinced Toledo to implement a state operated tribute. The assessments captured in the pre-1572 records serve important measures for our later checks on whether the mita-assignment was independent of the baseline tribute producing population and their resources.

Toledo's reforms had an immediate impact on channels of Peruvian production through agricultural and mining labor. I focus on the following primary features of the reforms: the new tribute (tax) and labor schema the reforms implemented. Clear emphasis needs to be placed on the impact also of the new administrative units Toledo introduced, the 614 repartimientos. Toledo gave each repartimiento a distinct name and documented its population thoroughly. In addition to assigning a tribute collecting official, each community member was indexed by name, age, sex, and martial status.[6] Indians were also resettled into repartimientos based on areas that demonstrated economic benefit to the Crown, such as the rich agricultural or mining zones.[7] These, most commonly, represented fertile agricultural valleys in the Sierra

[5]Ibid, 3
[6]Ibid, 16
[7]Ibid, 15

and mining zones like Potosí and Huancavelica.[8]

1.1.1 Tribute

Communal obligations were levied on the Indian communities in each province studied in this sample. The total annual tax was declared in accordance with an estimate from the repartimiento's "tribute-eligible" population and potential from agricultural production or proximity to a mining region.[9] At a per-capita level, the population considered in tribute assessments were the number of male Indians between the ages of 18 and 50. Administrators were perennially paranoid that local officials would fabricate population counts to reduce the tribute requested from a district. Harsh penalties were declared for administrators who attempted to circumvent population counts.[10] These laws coupled with historic testimony provides minimal conclusive evidence that there was a systematic manipulation of population values.

The tribute was delivered either in cash or crops, with historic records suggesting the total tribute was split between 44% cash and 56% in-kind goods.[11] The Toledan reforms regimented the days of the week when tribute could be delivered and transformed into currency by officials at the *caja*. According to TePaske et al, the caja officials spent Tuesday and Friday mornings, either from eight to ten or nine to eleven in the morning, selling commodities paid to the caja in kind, such as corn, cloth, chickens and other products, to currency.[12]

[8] Ibid

[9] Melissa Dell, "The Persistent Effects of Peru's Mining Mita," *Econometrica* Vol. 78 (2010), 1874

[10] Wightman, 87

[11] Cook et al. 1975 [1582]:217–218

[12] John Jay TePaske, Herbert S. Klein, Kendall W. Brown, "The Royal Treasuries of the Spanish Empire in America: Peru," ix

Historic notarial records do not identify a precise relationship between a district's characteristics and the tribute assessed. It is this absence that my later estimation will attempt to address, given that there is copious historic testimony about the importance of auditing tribute districts along specific factors. Proxies of this "tribute rate" appear in the reports of per-capita tribute rates and classification of regions by size, which offer some insight into the assessment of the tribute potential of a region. These estimates are incomplete, however, because they fail to take into account population changes at a provincial level.

The rates of this annual tribute varied. At the time of their initial implementation, in 1572, the average annual tribute rate was between 5 to 7 reales per eligible tributary.[13] Yet later reports from 1591 indicated that households paid on average rate of around 6.0 reales per tributary, though almost 18 years had passed since the last population assessment making the accuracy of such an estimate questionable.[14] Generating the cash (or equivalent produce) Per capita tribute values, however, varied with some communities paying up to 20 reales a tributary. For these regions, the tribute tax would have cut into household consumption that was already suppressed. Estimates using administrative data from 1591 to 1617, project that around 30% of tributary households in the neighboring Colca Valley were producing 80% or less than their subsistence needs. For these households, already suffering from underproduction, tribute demands would have added additional economic burden and driven

[13]Chocano et al. "Economía del Periodo Colonial Tardío" *Banco Central de Reserva del Perú* (2010), 345

[14]Steven Wernke and Thomas Whitmore, "Agirculture and Inequality in the Colonial Andes: A Simulation of Production and Consumption Using Administrative Documents" *Human Ecology* (2009), 425

households to subsistence levels.[15]

1.1.2 Mita

Beyond assessing and implementing tribute, the second primary avenue of Toledo's reform concerned the allocation of labor, with the introduction of the *mita*. Provinces that fell inside the mita boundary were required to send one-seventh of each repartimento's tributary population to work in the mines.[16] Our consideration of the mita follows the following broad categories: the scope, the timing of the mita assignment, and the compensation associated with the practice. Indians who served in the mita were referred to as mitayos.

Because mita conscripts were also considered in the allocation of tribute demands on a province, their assignment to the mines was intended to minimize disruption to the agricultural calendar.[17] Mitayos, in theory, would be able to help their communities harvest before leaving for their service in the mines. The rotating labor shifts lasted around 17-weeks and were also affected by another key factor: distance. Provinces were assigned to either the Potosí (silver) or Huancavelica (mercury or *azogue*) mines based on their proximity to the locations.[18] Moreover, Toledo mandated that Indians be compensated for their journey to the mines, which led administrators to recruit labor from districts located closer to the mine.[19]

[15]Ibid, 437

[16]Steve J.Stern, *Peru's Indian Peoples and the Challenge of Spanish Conquest: Huamanga to 1640* (Madison: University of Wisconsin Press, 1982), 82

[17]"Mita service, though theoretically timed to minimize disruption to the agricultural calendar, in practice did impact agricultural productivity of conscripted households." Wernke and Whitmore, 437)

[18]14

[19]For a more complete discussion of tributary compensation for the distance traveled refer to section 3

Assignment to a mita district affected potential tribute revenue of a community beyond the loss of agricultural labor, with workers now relocated to the mines. Mitayos paid tribute over the course for their time at the mines, which would go towards their community's tribute quotas. The amount of tribute demanded weekly from each worker varied. Most tributaries reported paying 2 pesos (de oro en plata), equivalent to about three of the later standard pesos corrientes. A few others reported higher demands, up to 2 marks (one pound of silver) and in one case (Sicasica), which was equivalent to almost 15 pesos Corrientes.[20]

This tribute came from "wages" that were paid to the Indians. The administrator of the mines Polo de Ondegardo (1564-1575) changed the wages to 1.5 psesos de oro en plata, or some 2.25 pesos Corrientes. These values shifted under Viceroy Velasco in 1614 and stayed constant through the 1640s.[21] If these wages were paid, the Indians in theory had little difficulty helping their communities reach the tribute burdens placed on them, according to Bakewell (1984). [22] For example, *mitayo* in 1603 would be paid 46 pesos for 17 months of work, yet would pay 100 pesos in tribute for the corresponding time.

How did these values compare to other wages in the colonial market for labor? In 1578, mita workers were required to receive one peso ensayado, or around 13 reales, per day. Yet at the same time, encomenderos, or private landowners, in the same region paid their workers around .8 reales in addition to a ration of corn each day.

[20]Peter Bakewell, *Miners of the Red Mountain: Indian Labor in Potosí 1545-1650*,(Albuquerque: University of New Mexico Press, 1984), 44
[21]Ibid, 101
[22]Ibid, 44

Indians in charge of herding animals were paid 8 reales every four months, and a ration of corn every 20 days.[23]

While studies have shown that mita salaries would have easily supported the caloric intake of a mitayo and their family, these payments were not enough once the the tribute demands placed on a mitayo were factored into considerations.[24] As Bakewell writes, "It was not a simple matter of the grasping encomenderos' dispatching hapless natives to distant mines, for the natives seemed willing enough to go, and expressed at least some satisfaction in their lot in Potosí. It was, rather, the Indians' general circumstances were coercive: their ingrained acquiescence to the notion of tribute (and it is worth recalling that the Incas had demanded tribute in labor), the Spanish notion (shared, of course, by the crown) that hatunrunas should yield tribute."[25] The mita thus institutionalized the notion of extractive tribute on the indigenous population, luring them into "well-compensated" work at the mines that only perpetuated their tribute obligations.

1.2 Region of Study

This paper focuses on the geographic regions associated with the treasuries, or Cajas, of Cuzco, Huamanga, Huancavelica, and Castrovirreyna. The Cajas themselves represented a series of "autonomous but interdependent fiscal districts was organized into a rather loose network."[26] The treasuries were located at major administrative

[23]Susan Ramírez, *Provincial Patriarchs: Land Tenure and the Economics of Power in Colonial Peru*, (Albuquerque: University of New Mexico Press), 40-41

[24]Bakewell, 103

[25]Bakewell, 77

[26]Maria Irigoin and Regina Grafe "The Spanish Empire and its Legacy: Fiscal Re-distribution and Political Conflict in the Colonial and Post-Colonial Spanish America" GEHN Conference Proceedings

colonial centers or trading points, and were responsible for disbursing public financing, collecting tribute, and managing other taxable transactions. They also served as the nexus for sub-cajas which operated at a lower level. The region covered by the cajas in this study, which were primary treasuries or *cajasprincipales*, cover the south central highlands of Peru. This area corresponds to the modern regions of Cuzco, Ayacucho, Arequipa, Huancavelica, and Puno. Climatically, all the regions share the weather patterns created by the Andean range, with temperature proportional to altitude. Precipitation is largely consistent across seasons, unlike coastal Peru which faces periodic, abnormal weather patterns like el Niño.[27]

Please refer to Map I in the Appendix for a visualization of the region of study and its intersection with the mita boundary. This modern regions considered by this study are shaded in pink in the map, with the mita boundary in black.

1.3 Demographics of the Region

The central and southern highlands of Peru have long represented the region with the most per-capita Indian inhabitants. When the Spanish arrived in Peru, Cuzco marked the administrative and economic center of the Inca empire. As the Spanish established their capital seat at Lima, the south-central highlands continued to be the primary population center for Indian labor and the most representative region for evaluating tribute drawn from agricultural sources.

At the onset of the Toledan reforms, almost half the Indian inhabitants of Peru,

(2005), 6

[27]David N. Cook, *Demographic Collapse in Indian Peru 1520-1620*,(Cambridge: Cambridge University Press, 1981), 199

around 600,000 people, lived in the southern highlands.[28] Significant to our study, this region also marks the area with fairly stable population values during the colonial period, in the face of a high variation in population in other parts of the country, like the coast and northern highlands. From the 1570s to mid 1600s, the population change was the lowest across all of Peru.[29]

Moreover, the decline of the tributary population within this figure was proportional to the overall population decline, suggesting that the demographic patterns of the tributary population were not distinct or abnormal. Over the century following the implementation of the Toledan Reforms, the overall population of Cuzco declined -1.2 relative to the decline in the tributary population of -1.1 percent annually.[30]

1.4 Agricultural Production in Colonial Peru

In each province considered within this study, agricultural production varied between a set of about six crops with "zones" of production determined largely by the topography and climactic conditions of the province. Overall variation between these zones, remains fairly constant, as observed earlier due to the relative proximity of all provinces.

The New World marked a region with higher per hectare agricultural yields relative to Europe, a benefit quickly exploited by the Spanish. In the new world maize, potatoes, sweet potatoes, and manioc, grew at rates of 7.3, 7.5, 7.1, 9.9 in millions of

[28]Cook, 211
[29]Ibid, 211
[30]Ibid, 212

calories per hectare, compared to the rates in the Old World of wheat (4.2), barley (5.1), and oats (5.5).[31] The Spanish inventory of the list of Peruvian crops cultivated at the time of conquest represents a wide diversity of agricultural produce. Beyond producing nearly all of crops grown in North America, Peruvian agriculture also featured distinct produce due to its high elevation. Peruvian cereals, such as quinoa and cañihua, as well as tubers like oca and ullucu represented just a few examples of these goods.[32]

Such agricultural potential did not go unnoticed by Viceroy Francisco Toledo at the time of the tax assessments. The Viceroy allegedly saw the fertile Peruvian climate surrounding Cuzco in conjunction with a "great many people of all kinds who wandered idly through the city and towns." [33] These observations, taken together, provided later justifications for the tribute polices.

Contributions to the Relative Literature

Scholarship on the endogeneity of historic institutions in economic development marks a growing field. A specific subset of this field can be identified with the study of the impact of colonial historic institutions. Most notably, the contributions of Daron Acemoglu et al (2001, 2002) evaluate the relationship between early mortality rates and the creation of "good" and "bad" institutions by European colonists. Engerman and Sokoloff (1997, 2002) evaluate how resource rich regions, such as those with natural deposits or suitable to economically profitable exports of large-scale crops, led to the creation of political institutions that extracted this potential while leading to

[31]Cook, 15
[32]Cook, 212
[33](Wightman, 3)

a substantial inequality in wealth and political power.

Beyond assessing the impact of these institutions, new work has been done to identify and test the channels of persistence of slavery and tribute collection. Nunn (2008) uses shipping manifestos and historical documents to document the number of slaves being shipped to and from different African countries. He observes a negative correlation between the slave trade and modern economic potential. He concludes further that modern political structures in Africa operated in the same equilibrium as colonial infrastructure, which was by nature extractive. Banerjee and Iyer (2005) evaluate the long-run impact of land-revenue collection in India. They contrast colonial districts where revenue was collected by British officials, through a non-landlord system, with districts were revenue was collected by native landlords. They identify this difference ultimately created a discrepancy in modern outcomes of education, health, and agricultural investment. Dell (2010) studied the impact of the Peruvian mining mita from Potosí, and demonstrated its impact on contemporary patterns of consumption, subsistence farming, and human capital formation. She identifies two channels through which the presence of this institution could have had a long-run impact: land tenure and public goods provision.

This paper synthesizes the approaches identified in each of these papers, but builds on them in new dimensions. Specifically, by evaluating tribute production in parallel to mita districts, I provide an alternate channel for future studies of the intensity of the impact of the mita and long-run outcomes. This results in a more nuanced picture of mita intensity and impact over the period when it was enforced and the way factor endowments of mita and non-mita provinces shifted throughout this period time. Studying tribute allocation, in particular, offers a new perspective of how Spain extracted local revenues. This effort contributes to a broader goal of understanding how agents could use state structures to extract profit in Latin America.

While this paper certainly fits within the research agenda of evaluating the legacy of historic institutions, my contributions are more significant to the field of financial history. The paper adds new dimension to Spanish financial history, which has largely ignored their economic policy in the Americas in favor of studying Spanish administration of their more immediate European domain. Those studies that have focused on the colonial history of Peru, such as those of Kathryn Burns (1999) and Alberto Flores Galindo (1984), either offer a distinctly "Spanish" or "Indian" portrait of the colonial economy. They consider Spaniards or Indians as operating in isolation or in strictly hierarchical relationships (colonists versus colonized). Burns presents a history of financial agreements between Cuzco convents, which operated as early endowment funds—loaning funds to other Spanish colonists—within the commercial economy. Flores Galindo studies the stratification of the Lima Spanish aristocracy and its impact on early social mobility. Studies that center the role of Indians within the Peruvian colonial economy, like that of Ann Wightman (1990), continue to exacerbate this treatment of Indians and Spaniards operating in distinct economic realms. Dell (2010) implicitly treats the Spanish and Indian economic activity as separate. The historic reality, however, appears quite different. Indian land owners and Spanish colonists drew contracts together, and engaged in complex financial agreements beginning in the late 1500s. The marketplace for wage labor offered just one instance of how Indians and Spanish formed economic arrangements, albeit flawed.

This paper also marks a departure from existing studies that use the Cajas Reales as a data source. These studies have focused on the relative size of each treasury, using it to study the devaluation of silver and other precious metals over the colonial period. They have used the Cajas to assess the per-capita wealth of different regions of Peru at a largely (departmental) level. Those that have focused on Caja components, like Ale and Gehn (2005), have taken a macro approach to understanding the values recorded. They classify the caja components into six different types of economic activity—commercial, public, agricultural, mining, trade—with little historic justification for how these classifications were generated. This paper marks the first attempt to study the components of the Cajas with other province-level factors to shed fresh light on the early colonial economy.

Data

In this section, I discuss the primary data sets assembled in this study. The smallest geographic unit evaluated in the study, repartimiento or district, marks a historic antecedent of the Peruvian administrative division of the country. Toledo's visita classified distinct districts by their populations and their resources. Districts can be matched to historic provinces and then departaments as identified the Geografía del Perú Virrenal (1764-1778). The list of district names by province was unique, there was never a case with duplicate district names in a particular province.[34] Moreover, the colonial provinces match with modern provinces, allowing for a one-for-one accounting between the historic and modern regions at a province level.

Despite this geographic context, I was particularly cognizant of shifts in toponymy and borders. The seminal Geografía del Perú Virrenal by Cosme Bueno provided a particularly helpful guide, as it documented estimates of the longitudinal and latitudinal positions of Peru provinces (during the 18th century) by observing astronomical movements. Bueno writes, "Bringing together longitudes and latitudes of the principle places of the territory, or of every province, we have enough. We are able to orient smaller areas using itinerant measures, observing the course of the land, known early in every area by the movement of the needle [compass]."[35] He specifically provides an

[34] Dell, Table A-1

[35] "Con tener las longitudes y latitudes de los principales parajes del reino, o de cada Provincia, tuviéramos bastante. La coloccación de los menos principales se haría por las medidas itinerarias,

overview of the shifts in districting in the pre-Toledan period, reporting the names of the major provinces in 1544, 1559, and 1609. For 1764, he identifies the provinces in conjunction with their corresponding districts, and assigns a size in "leguas" (approx. 5.55 km) for each province, their climate, and their primary agricultural products. A table of each department, and the classification of size, climate, and production reported by Bueno is attached in the appendix. The classification of the mita boundary came from Dell (2010), who drew on Saignes (1984) and Amat y Juniet (1947). Modern Peru is composed of 24 departments, 194 provinces, and 1838 districts.

3.1 Historic Data

This paper uses a rich administrative source—the semi-annual ledgers of the Caja Reales, or regional treasuries—of colonial Peru. The caja ledgers were digitized by John J. TePaske and Herbert S. Klein.[36] The Cajas offer a staggering amount of data on the early colonial financing. They provide insight into the relative role of religious orders, local landowners, and colonial administrators in the early economic landscape with their information on rents and salaries. Moreover, taxes documented in the cajas such as sales taxes (*alcabalas*) serve as a proxy for commercial activity, while port taxes (*almojarifazgos*) at the costal cajas offer an insight into patterns of trade.

I assemble a dataset of annual tribute collection from 1571-1812, documented at the district, province, and departmental level, by extracting information from departmental cajas. I focus on four (Cuzco, Huamanga, Huancavelica, and Castrovir-

observando sus rumbos, conocida antes en cada paraje de varaciación de la aguja." (Cosme Bueno, *Geografia del Peru Virreinal*, 14)

[36]The online datasets, which represent the annual ledgers (for Peru) of the Cajas of Arequipa, Cailloma, Carabaya, Castrovirreyna, Chachapoyas, Cuzco, Huamanga, Huancavelica, Jauja, Lima, Piura y Paita, Puno, San Juan de Matucana, Saña, Trujillo, and Vico y Pasco at: http://eh.net/database/caja-files-royal-treasury-dataset-for-spanish-colonies/

reyna) Departmental Cajas, which collectively cover the (contemporary) departments of Cuzco, Ayacucho, Arequipa, Puno, Huancavelica, and Apurimac. I use the Visita General (1571) to identify 126 districts and their associated tribute flows in the Caja data. These districts were then matched to 25 historical provinces using the *Geografía del Perú*(1764-1777) by Cosme Bueno. This assignment approach is consistent with the strategy employed by other scholars in matching pre-1600 districts with provinces. I merge in historic province level demographic information on the ethnic composition and number of mitayos that I extract from the 1571 Visita, 1690 Census, and 1792 census.

I construct an index of the agricultural prices for wheat, maize, and barley per kilocalorie by region covered in the study. This approach combines data from Cosme Bueno's *Geografía del Perú*, which identified the major crops by province and region, with the baseline basket of historic Peruvian consumption identified by Arroyo Abad et al (2011), which estimates the calories per unit for wheat, maize, and other goods, with the regional prices of agricultural and manufacturing goods—evaluated at each decade since the 1560—by the Central Reserve Bank of Peru (1992). The final units of the expression are in $\frac{reales}{kilocalorie}$. The results are presented in the appendix.

I also document the changing value of the ocho real using silver indices from TePaske et al, which represented the primary currency in which tribute was recorded in the Caja.

3.2 Modern Data

CENAGRO

The crux of the modern dataset comes from the Peruvian National Agricultural census, or CENAGRO conducted in 2012. The CENAGRO provides estimates at the district, province, and departmental level of cultivated land, altitude, permanent/semi-permanent crop production, literacy, hydrographic zones, fertilizer use, and irrigation practices. These variables are used in tandem with the GAEZ values to assess patterns in agricultural production and productivity.

Global Agro-Ecological Zones (GAEZ)

The GAEZ project provides information on climate parameters at 5 arc minute partitions, which can be used to assess the agricultural potential of different regions. The Food and Agricultural Organization and International Institute for Applied Systems Analysis (FAO-IIASA) released a methodology in 2012 that estimates potential land yield by integrating information on land types, water resources, and weather conditions to a model of agricultural production. This dataset has been used extensively by Costinot and Donaldson (2011), and has a precedent of being used to assess Peruvian agricultural productivity in the work of Sebastian Sotelo (2012). I use the GAEZ maps to provide assessments of soil quality, moisture patterns, and altitude. Using ArcGIS, I spatially join the values from those attributes with a modern map of the districts of this study's focus. ArcGIS collapses the attributes along the district boundary to assign the majority of a single attribute discretely to a given district.

Demographic Dataset

The agricultural dataset was then merged with a Peruvian demography dataset (2014) from ArcGIS, which was compiled by the Michael Bauer Research Institute. I overlaid this map with my target districts, regions, and departments to only select the values that appeared with the overlapping layers. Bauer's dataset provides information on population values, elementary, primary, secondary, and higher education, and purchasing power per capita.This combined with the CENAGRO and GAEZ information formed the core of the modern dataset.

INAHO: Political & Ethnicity Dataset

As a final consideration, I also employ the ethnicity module of the 1996 LAPOP (Latin American Public Opinion Project). While the district level information for some departments is incomplete, the LAPOP survey provides a rich data source for self-identified responses of race, discrimination, trust in municipal and departmental government structures, belief in the rights of the central government, and ownership of technology (fridge, car, etc). Summary statistics of this data is included in the Appendix. The survey include 1,508 individuals across 112 districts, 40 provinces, and 18 (of Peru's 24) departments.

Tribute and Production 1571-1812

The following section analyzes the interaction between tribute and production within the context of the colonial period. This analysis is motivated by the growing difference in the average values of tribute collected in mita and non-mita districts, a difference that persists over time, and the declining number of *mitayos* as a fraction of the tribute population in mita-districts. I begin by briefly presenting trends that characterize the tribute data in relation to the time period of study, geography, agricultural prices, and mining labor. I then outline a model for the value of tribute from a given province, and estimate tribute from this model by connecting selected moments with the model using a rich microdataset. By fitting the tribute model to a sub-set of the data, partitioned by time, I obtain a parameter α–the output elasticity of labor. I then predict the out-of-sample tribute for each province for all years using this α. I then evaluate the overall fit of the model, and examine whether there was a statistical difference in the predicted values for mita or non-mita provinces across time.

Using the model to solve for the out-of-sample α that fits the values for mita and non-mita provinces generates two distinct α, with a lower α or output elasticity of agricultural labor associated with the mita districts. This suggested that the added value of an additional unit of agricultural labor was less for mita districts than non-mita districts over time. I also investigate the ways the model could be improved to fit the data—by varying the tax rate on mita and non-mita tribute contributions, and considering an endogenous expression for the share of mining labor as a function of the agricultural output elasticity.

4.1 Tribute vs. Time

I evaluate tribute by province rather than the individual district tribute reports because my demographic data on population and the number of mitayos is available at a province level. This approach has its limitations, primarily because the "inputs" into that mean value may change from year to year due to the availability of data at the district level. In order to control for this, I generate the mean tribute by district in a province, by summing across the provinces reporting and dividing by the number of distinct provinces each year. Some districts recorded tribute values on a semi-annual basis. Baseline calculations identify that there is no significant difference in the composition of districts reporting by province over time eliminating the possibility that there are "clusters" of data from distinct geographic zones within a province at different times during the interval of study. The composition of provinces represented in the data over the interval of study is similarly even. If a province was represented in early data, it continued to be present at a province level for later periods. The notable exception comes at the regional level, where the values after 1800 come primarily from only from Ayacucho and Puno region due to the mapping of provinces into regions. I thus choose to evaluate the values at a province level.

The mean value of tribute, across time, is 14,363 reales. Taking the log of the mean district level tribute illustrates an increase in tribute collected over time. I evaluate to see if there are any cyclical patterns in the data. Average values decrease until the early 1700s, and then increase. The decades with the lowest mean tribute values—1710 and 1720—coincide with major plagues that affected the mining communities of Potosí as well as the region of Ayacucho and Arequipa.[37] Of the provinces represented in the values from 1700 to 1720, 56% corresponded to the regions (larger administrative subunit) of Puno, Arequipa, Ayacucho, potentially accounting for the decline in the overall values of tribute collected.

4.2 Tribute Collection at a Province Level

Given the overall increasing trend in the tribute collected, I evaluate the variation in tribute values across provinces. The values, represented in Table 2, report the mean tribute for a district in the given province, as well as the standard error and confidence interval. The district with the highest mean tribute was Andahuaylas, with an average tribute value of 30712.18 reales de ocho. The district with the lowest value of tribute collected was Calca y Lares, with an average tribute value of 242 reales de ocho.

The point raised above, however, raises a few pertinent variables that are needed for a more comprehensive picture of tribute collection. I assess tribute in relation to per-capita values, agricultural prices (regional level), and mita assignment across provinces.

[37]Vintage Moquegua: History, Wine, and Archaeology on a Colonial Peruvian Periphery, 183)

4.2.1 Population and Provincial Tribute Collection

Conditioning on the tributary population values of each province—as reported in the 1572 Visita, 1690 census, and 1792 census—I evaluate the per-capita values of tribute collected. The mean per capita value of tribute was 2.15 ocho reales. Evaluating the mean from 1571 to 1600 was 4.6 ocho reales. This value corresponds to historic testimony of per-head tribute values reported in Ruiz (1991) and Jacobsen (1993) at the onset the Toledan reforms.

4.2.2 Agricultural Prices and Provincial Tribute Collection

But what exactly did "4 reales" of tribute per head correspond to? To evaluate this in terms of the goods that the Indian communities would have had to deliver, I use the index of the agricultural prices per kilocalorie by region described in the Data Section. There are two limitations to pairing this data on regional prices with the tribute values-—one, the fact that I do not have enough historic output values by either region or district for meaningful analysis and, two, the absence of province-level prices. For the latter point, however, given that tribute was recorded in cajas that functioned at a regional level, where officials would convert in-kind contributions to currency, regional prices may not be entirely inappropriate for evaluating the value of agricultural produce.

A graph of the average tribute relative to the agricultural prices is in the Appendix, Graph 1. Following the case of a single region, Ayacucho, may be illustrative. The average tribute per capita for Ayacucho was 3.06 reales, compared to the averaged price of wheat, maize, and barley (scaled to the decade's price of maize) to the nearest kilocalorie. Converting back into "fanegas" the standard unit of measurement for dry goods, or a bushel, this would be equivalent to around 3 bushels of a scaled cereal good from 1590 to 1680 (given that p_a, the average price for a basket of goods normalized to the price of corn for Ayacucho is less than 1 real per bushel) per head.

4.3 Tribute by Province and Mita

The example above, comparing the average tribute collected from the Region of Arequipa to the agricultural prices from the region, is appropriate because none of the provinces in Arequipa faced a mita draft. This implies that the entirety of the tribute from Arequipa would have come from agricultural sources. For provinces that did feature a mita, however, the portion of the Indian population assigned to the mita draft offered another source of potential income for the community, from the mining wage.

Evaluating the difference in the average tribute collected from provinces that did and did not feature the mita illustrates the difference in the values of mita collected clearly. Thirteen provinces of the sample of 24 provinces in this study had a mita. Baseline evaluations were conducted to ensure that the representation of mita and non-mita values in the data is consistent across time. Because the share of mita versus non-mita districts in the data was constant across the period, it eliminates the concern that the composition of districts at a given moment might disproportionately represent on type of district or the other.

I conduct a t-test to evaluate whether the mean tribute values of the mita versus non-mita are statistically different. Though initial tribute values (evaluated 1571) were not statistically difference based on mita or non-mita assignment, the values of tribute across time are statistically different. Mita provinces report significantly higher values of annual tribute. This relationship between mita and tribute appears clear in the historic surveys of mining workers of the period. A report from Licenciado Juan Polo de Ondegardo, a Spanish administrator tasked with assessing tribute-giving Indians describes the following response an Indian gave him after being offered the possibility of leaving, "[he] said, in tears, that he does not want to go home until the next batch of workers arrives, because he wishes to be in this mining town seeking some silver for his master and for himself." [38] Polo concluded from this response, and others, that the Indians "appeared satisfied" with the possibility of working in the mines. The historical research of Bakewell (1984) and Stern (1993) indicate that this "enthusiasm" for communal work was because it allowed Indians to meet their tribute obligations.[39]

Tribute Production

The various factors represented in the earlier evaluations and the historic data allow us to consider the following model for tribute production. Given provinces $i = [1, 2, \ldots 24]$, and sectors of agriculture (A) and mining (M), I define the following variables.

1. $\bar{L} = L_a + L_m$ = The tribute population, which is divided between either working on the land (L_a) or in the mine (L_m). For non-mita districts, L_m is zero.

2. p_a = the prices of the agricultural goods for a given district

3. p_m = the tribute demanded per mining laborer

[38]Polo de Ondegardo as cited in Bakewell, 43-44. Original Spanish: "dijo llorando que no quiere ir a su tierra sino cuando viniere la otra mita porque él quiere estar aquí en este asiento para buascar alguna plata por su amo y para sí."

[39]Bakewell 44; Stern, 41

4. R_i = the land available in each province.

5. d_i = the distance to the mine, as workers were compensated for their travel to and from the mines[40]

6. τ = the tax rate on output from a region

The tribute levied in each province will be equal to a function of these inputs into the agriculture and mining. When I set $\tau = 1$, implying the entirety of the agricultural output is taken as tax, it effectively generates a "GDP" estimate for each i–the combined value of the output from the two sectors of the provincial economy of mining and agriculture. I recognize that specification below places strong assumptions on the value of mining labor for the Spanish. It is possible that the value of the goods produced by mining was much larger than the amount collected in tribute, if the metal was remitted to Spain and transformed somehow there. For the sake of our initial calculations I evaluate the model below, with the complexity raised by these considerations addressed later.

$$T_i = \tau p_a f(L_A, R_i) + p_m L_m - dL_m \tag{4.1}$$

I specify further that the production function is Cobb-Douglas, taking the form

[40]Bakewell, 90. I evaluate the distance between assembly points recorded for mita workers (Tinta, Pomamache, Azángaro, Llampa, Andahuaylas, Cotabambas, etc) and the mine they were assigned to in order to calculate this value. This approach is consistent with the estimation strategy used by Bakewell. Once I have this value for the distance, I refer to colonial surveys of the average speed of a mita worker's journey. A report from 1620 by Viceroy Príncipe de Esquilache suggested that mita workers would travel 3 leagues, or around 15 kilometers, a day. An earlier report by Alonso Mesías (1607), "Sobre las cédulas del servicio personal de los indios" suggested that 2 leagues per day was a more reasonable estimate. I average between the two. By this estimation I calculate the average trip for the provinces in this sample would take between 7 to 60 days. These values fall within the range of time taken to travel to the mines identified by Bakewell in historical records. Because of the conversion between d into a time, I collapse d_i in the estimation of L as a reduction in the total amount of L available at a given moment. Moreover, see appendix for graph of the number of mita conscripts by distance. D does not have an impact on the number or share of laborers sent to the mita.

${L_A}^{\alpha}R^{\beta}$. Specifying that $\alpha + \beta = 1$ implies the function has constant returns to scale, allowing us to replace $\beta = 1 - \alpha$. This feature of the relationship between agricultural output and tribute has been corroborated in historic records by Irigoin and Grafe (2005) writing "Taxes on mining and tribute were directly and proportional to the growth of output and evasion was low."[41] Given the data for T at various moments in time, p_a at a regional level for each decade, p_m, I first solve for the parameter of interest α when all mita districts are levied the level of mitayos declared in the 1571 reforms, $\frac{1}{7}$. If that is the case:

$$L_m = \frac{\bar{L}}{7}$$

$$L_a = \bar{L}\frac{6}{7}$$

The equation thus becomes, where ϵ is an error term that captures the variation in agricultural output:

$$Tribute_i - p_m(\frac{\bar{L}}{7}) = \tau p_a(\frac{6}{7}\bar{L})^{\alpha}R_i^{1-\alpha}\epsilon \tag{4.2}$$

Note this conveniently fits our formulation for a regression, allowing us to solve for α. Taking logs of both sides of the expression, $log\epsilon$ becomes ϵ', yields:

$$\underbrace{\log(T_i - p_m(\frac{\bar{L}}{7})) - \log(\tau(p_a)) - \log(R_i)}_{A} = \alpha\,\underbrace{[\frac{6}{7}\bar{L} - \log(R_i)]}_{B} + \epsilon'$$

[41] Irigoin and Grafe, p.26

Sample and Results

For a given province, i, and year, t, I generate the components of α, A and B. These are an expression in terms of the R_i distinct size of the province, $\bar{L}$ the Indian population count of the province at the specified time, and p_a, the regional agricultural prices for the decade in which t falls, and T_i^t, the total tribute collected for province i in time t. This calculation would be repeated for multiple values of t for each province.

I generate the value of α, given the knowledge of the province level values of tribute, and prices paid to the miners. The prices, at a regional level for Cuzco, Huamanga, Huancavelica, and Castrovirreyna, follow the formulation described in the earlier section on tribute and agricultural prices, and are recorded for every decade. The prices become a function of $\frac{p_m}{p_a}$ once the expression is expanded. Given data from Bakewell (1984), which report the value of a miner's wages in terms of local agricultural outputs, I can obtain a relative price for converting between the agriculture and mining earnings per tributary so all units are in $\frac{reales}{kilocalorie}$. The population values $\bar{L}$ come from the censuses of 1572, 1689, and 1786. T_i represents the total possible value of tribute for the province, so the average I took earlier multiplied by the number of distinct districts in the province.

Because the 1689 and 1786 Census specify the "real" number of *mitayos* per district, I can observe that in practice this value does not remain $\frac{1}{7}$ of the tribute-eligible population. Given that this is such a key specification to our formulation, that $L_m = \frac{\bar{L}}{7}$, I conclude that it would not be reasonable to assume the original policy is valid at capturing the share of mining labor across time. Thus it does not make sense to use later annual Tribute data in the estimation of α given this model. I generate the values of A and B for the years 1571 to 1590. I quickly illustrate the regression below:

$$A = \alpha B + \epsilon'$$

Given the last equation I identified, 4.3, regressing the component B on A will generate α as a coefficient. I find that α is equal to 0.64, with associated t-statistic = 7.57. The results from this regression are included in Table 1.

The t-statistic associated with the coefficient indicates that α is significant to predicting A. It also implies that the marginal added value of an additional input of labor is .64, relative to an additional input of land. Given that $\alpha = 0.64$, a 1% increase in labor would lead to approximately a 0.64% increase in output.

I plug α back into the expression identified earlier to solve for the out-of-sample predicted output for each province from $t = 1571$ to 1812 and evaluate the fit of the model. The larger predicted output relative to tribute can be be interpreted as agricultural surpluses that may have affected communities at different times. These results of sizeable agricultural surpluses are consistent with other estimations of historic agricultural production from Peruvian administrative documents.[42] I then condition on whether or not the values came from mita or non-mita districts to graph each series in either blue or red, see graph in the Appendix. The predicted mita values exceed the non-mita values. A t-test of the predicted values confirms that the predicted output by mita and non-mita districts is statistically different. Given the difference in the predicted means of the mita and non-mita districts, I attempt to regress B on A after conditioning for whether or not a district fell in the mita. I

[42] Wernke and Whitmore, 321

find that α_{mita} =.30 compared to α_{nomita}= .74 over the out-of-sample period. This suggests that the additional agricultural value of a mita laborer was less than the the value of an additional agricultural laborer in a non-mita district. This also suggests more information about the relationship between p_m and p_a, as the equivalence for p_m in p_a units would be lower for mita districts due to the lower α.

There are a few immediate limitations with the specification articulated above. The first issue arises from fitting a Cobb-Douglas model using data that spans a historic time period. Doing so assumes that the parameters α will stay the same across time, an assumption that may not hold true due to changes in the labor force or agricultural resource. Second, I assumed that the labor share was constant, 1/7, across time, which I noted earlier does not hold true in the observed values of *mitayos* form 1689 and 1786. See Graph in the Appendix for *mitayos* relative to the labor force in 1689 and 1786. Third, the basket of goods used represent a disproportionate amount of cereals/grains which could have limited the variation in agricultural prices relative to including other goods, like potatoes.

Mining Labor Share

Because the observed mita share of tributaries is declining over the period of study, I cannot necessarily assume that the assigned quota of 1/7 held throughout the period of implementation. A growing trend emerged among districts who were not able to meet their quota of mita laborers. These districts chose, according to Wightman (1990) to "remit part or all of their labor service in goods or money, and in order to substitute cold cash for warm bodies they were forced into the market economy. In Cuzco an unusually high rate of commuting labor service to cash intensified the indigenous role in the cash economy. By the 1720s most Cuzco-area communities participated directly in the market economy."[43] This decline in the average number of mitayos reveals interesting dimensions for our study of the long run mita impact, given that the "intensity" of the mita may not have solely been felt by losing a fraction of one's population to the mine. Being sent to the mita, or the wage labor it represented, could have come from drawing a larger, more consistent fraction of a province with low-agricultural production attributes.

A key assumption made earlier was that the mining labor share was equal to $\frac{1}{7}$ of the total value of tribute eligible population of a district. As the point above, and the historical data, illustrates, this need not necessarily be the case. The logic is as follows, because the labor quotas were declared across all mita districts, if the Spanish had information about the land and labor inputs as well as the associated prices, the remaining factor that would govern how they tax would be the marginal added value of an additional unit of labor versus land in a particular province, or α. Once we solve for this parameter within this initial framework for the baseline values of the years below 1600, where labor shares for mining and agriculture are held constant, I then solve the first order conditions of the production model after taking the derivative w.r.t. L_m to determine the optimal levels of mining labor, L_m. In particular, I solve for L_m as a function of α, the output elasticity of agriculture.

$$L_m = \bar{L} - \frac{p_m}{\alpha * p_a}^{1/\alpha - 1} R$$

Using our earlier expression for the output $p_A[L - L_m][L - L_m]^{\alpha-1} R^{1-\alpha} + p_m L_m$, we can substitute this expression for L_m as a function of α to get:

[43] Wightman, 128

$$p_a[L - L_m](\frac{p_m}{p_a^\alpha}\frac{1}{R^{1-\alpha}}R^{1-\alpha}) + p_m L_m =$$

$$\frac{LP_M}{\alpha} - \frac{(1-\alpha)}{\alpha}p_M[L - R(\frac{(p_M)}{(p_A)\alpha})^{\frac{1}{1-\alpha}}]$$

Using Excel, I solve for the variance minimizing α. I then evaluate the predicted L_M at this optimal α. This approach does not result in a model that necessarily fits predicted tribute values with the observed data without making significant adjustments to p_M. Nevertheless, it is a helpful exercise to understand the dynamics between α, L_M, and p_m. It crucially links how reducing the output elasticity with respect to agriculture, α reduces the added value of L_A and conversely increases the share of the population a community would allocate to mining L_M, thus affecting p_M.

Mita, Agriculture, and Political Participation

In this section, I link the historic values to modern provinces by evaluating the impact the mita, as a legacy of the Toledo Reforms, on agricultural and political outcomes. At the time of its inception, the mita was implemented in districts largely based on proximity to the mine, a topic investigated thoroughly by Dell (2010). If a district was assigned to the mita, a fraction of its tribute population—initially 1/7—was sent as conscripts to work in the mines (Bakewell 1984). The treatment of whether provinces and their associated districts had to send individuals to the mines for the mita changed discretely at the mita boundary. I thus attempt to observe this 'treatment effect' to evaluate the causal effect of the binary (0) or 1 assignment of a district to a (non-mita) or mita province. There are two specifications needed before this treatment can be evaluated. First, all factors prior to the intervention of the mita must vary smoothly. I evaluate the difference in baseline values of population, size, and crop prices in 1571, the same factors studied in relation to tribute in the earlier section. Second, the treatment or 'discontinuity' itself must be identifiable. I use the assignment of whether or not a district sent community members to the mita to identify the treatment. This approach is slightly different than Dell, who also included a cubic-polynomial distance to the mita boundary and to the mine in her regression. She concludes that the former is not significant and uses the latter as a control. Given the scope of the current paper, I do not include these distance variables in my regression. It may also be helpful to note that the "unit" of our analysis has gotten smaller, zooming in to the district level rather than the province level of the preceding section.

The districts considered here include values from the contemporary regions of Apurimac, Ayacucho, Arequipa, Puno, Cuzco, the capital, and Huancavelica. The last region represents a geographic section not entirely explored in previous literature. The provinces included in this sample reflect the contemporary provinces matched from the historic provinces of tribute sample.

4.1 Baseline Specifications

To evaluate the first treatment specification, I look at the whether the population of tribute giving Indians, the land size, and the agricultural prices varied significantly by mita or non-mita assignment prior to the enactment of the mita.

A two-sample t-test of the Indian population in 1572 does not reveal that the difference in the population means based on mita/non-mita classification is statistically significant. This confirms that there was not a bias towards assigning laborers from only more populous districts. Similarly, a comparison of the means of the land size based on whether or not a population was assigned to the mita/non-mita was not statistically significant. This suggests that the availability of land for agricultural production in mita and non-mita districts varied evenly, though I recognize there could be several other factors that affect how the total land available in a province reflects the total area available for production, including factors like land quality, altitude, and rainfall. While I have modern estimates of these variables for the regions, the logic of assigning them to historic provinces seems unclear. Soil quality, for example, could change over time due to continued agricultural practices. The closest approximation I have to historic production information comes from Cosme Bueno's Geografía del Peru. I record the inventory of products and climate associated with each province to evaluate the in-region variation and variation across groups. A t-test of the agricultural prices by mita and non-mita for the decade prior to 1570 similarly yields that the null hypothesis (that the two means are different) can be rejected with probability $Pr(|T| > |t|) = 0.0024$. This suggests that non-mita districts did not serve as distinct agricultural hubs for trading goods, and that the region-level agricultural prices were shared by mita and non-mita districts.

4.2 Mita and Agricultural Outcomes

I first test for the mita's impact on agricultural production, using the log of total cultivated land reported in the 2012 Peruvian agricultural census as a dependent variable; see Table 2. This measure has been used in other studies of agricultural productivity in Peru, including Sotelo (2010). The value reflects the amount of cultivated land reported by individual agricultural producers in the census, collapsed to a district level.

Performing a stepwise regression, with additional land factors from the dataset, I find the following variables significant at a 5% level: the region the district was in, the assignment of mita/non-mita, the nutrient retention, rainfall, and average age of producers in the province.

Assigning a district to mita implies 3.5% less land is cultivated. Increasing the nutrient retention by one unit increased the land worked in a district by 1.6%. This "unit" ordering comes from the GAEZ classification, which ranks nutrient retention by a composite of constraints from soil quality to proximity to bodies of water. Moving an area one "nutrient" unit would require changing the composition of its soil and location, i.e. moving it from an arid high altitude area to a fertile valley.

$$landworked = \alpha(region) + \beta(mita) + \gamma(nutrient) + \delta(rainfall) + \tau(age) + \epsilon$$

A key piece of information missing from this is the crop types from the cultivated land, which would provide a better picture of the output. In order to get a closer understanding of this from the data, I evaluate amount of land recorded as being dedicated to "more than one crop" and the land dedicated to "permanent" crops. The mita is not significant at the 5% level for determining either of these values. For both, the primary factors that are significant to their outcomes appear to be the nutrient retention, rainfall, and altitude of the district.

4.3 Mita and Per Capita Earnings

I next evaluate the purchasing power per capita of districts based on assignment to either mita or non mita. The purchasing power per capita" values were based on the regional market calculations by consumer goods manufacturers, banks, insurance companies, saving banks and consumer-oriented service providers, with the purchasing power specifically based on net incomes from employment and assets (after taxes and social contributions), pensions, unemployment benefits, and other national transfer payments.[44] These values on regional income distribution came from tax statistics at a national and regional state level. I control for education indicators (the fraction of the population who has some schooling, primary school, secondary school, or higher education), the region, the province, district level literacy rates, and the mita. I conduct a stepwise regression and identify that region, literacy, mita, and the education factors of education and completion of superior school are significant at the 5% level. These results are in Table 3. Mita assignment lowered the district per-capita purchasing power by 867 soles per capita, with minor increase (0.7) due to completing superior schooling and decreases (-0.191) for provinces with The fixed effects of each province are also evident in the significance of the Province variable. Because this is a categorical value the value of the coefficient on the Variable is not immediately evident.

Map 2 in the appendix shows the per-capita earnings in 2013 within the mita boundary. The map helps visualize the difference in per-capita values relative to assignment within the mita catchment or outside it, yet it is incomplete. The Peruvian districts with the lowest per capita earnings in the map coincide with the ridge of the Andes, suggesting that access could have an impact to the area's potential income. Omitted from the relationship between highland communities and per capita earnings is a precise formulation of the connectivity of these different districts by roads or other access routes. To control for this I include the variable for average altitude of a district from the agricultural census as a rough attempt at introducing the potential difference between more isolated highland communities and lowland, fertile ones. These results are represented in Table 4.

[44]The value is accessible at "Methodological Notes and Usage of MB-Research Market Data" hosted by ESRI

Even after controlling for the altitude, the model indicates that mita is negatively correlated with purchasing power. To this end, changing a district from mita to non-mita increased the purchasing power per capita of the district by 986 soles. Increasing the amount of higher education individuals were exposed to increased earnings, while increasing the average altitude of a province one meter had a lower PPP.

4.4 Mita and Political Participation

I finally merge in the information on whether or not a district had the mita with a dataset of values from the LAPOP Political and Ethnicity Dataset. I evaluate whether the ethnic and linguistic composition of the mita and non-mita districts is statistically different before looking at responses by individuals from mita and non-mita regions regarding certain political attitudes.

4.4.1 Language and Race

On average mita districts reported having more Quechua speakers, but for both mita and non-mita districts Spanish was the language most frequently spoken. A t-test of this indicated a statistical difference in the language spoken in mita and non-mita districts. Language is important for our consideration, given its interactions with education and market access. Given the Spanish-language basis for all public schooling in the regions studied, regions with a higher number of speakers identifying Quechua as their primary language might reflect less exposure to these factors.

The racial composition by mita and non-mita districts varied by mita or non-mita. The districts that pertained to former mita regions had more self-reported ”mestizos” or mixed-heritage respondents compared to the regions that did not have the mita, where "indio" was more frequent. Conditioned on a respondent's race, a survey respondent was asked if they felt they had faced discrimination in Peru. Sixteen percent of respondents in mita districts felt they had faced discrimination based on their race, compared to 13 percent in non-mita districts. While this difference in itself cannot be purely attributed to the institution of the mita, evidence of the persistence of cultural attitudes by geographic region has been validated in other contexts. The work of Voigtländer and Voth (2010) evaluates the persistence of cultural traits in medieval Europe. They use plague pogroms as an indicator of medieval anti-Semitism in Europe to find a significant and robust connection between the killing of jews and participation in the Nazi party during the 1920s. [45] In the case of the mita, forced migration may have disrupted cultural lineages, leading to a higher number of "mestizo" descendants.

4.4.2 Politics

The next phase of the analysis focuses on the responses regarding hypothetical political outcomes and attitudes recorded from the respondents from districts matched to non-mita and mita areas.[46]

The samples from mita and non-mita districts had statistically significance differences in their attitudes towards the fairness of justices and their faith in "Peruvian

[45]Nathan Voth "Persecution Perpetuated" The Medival Origins of Anti-Semitism in Nazi Germany, NBER Working Paper (2011), http://isites.harvard.edu/fs/docs/icb.topic868135.files/Voth%20Paper.pdf

[46]The political attitudes expressed in the 1996 LAPOP survey are particularly interesting as they capture baseline awareness and attitudes towards the Peruvian Constitutional Crisis (1992), when Alberto Fujimori dissolved the legislative and judicial powers into the executive office. The actions were driven in part by the economic crisis facing Peru at the time, but also largely due to the insurgent Shining Path terrorist group, an guerrilla group known for land seizures in the rural highlands and Amazons of Peru.

political institutions." Those who were responding from a mita-district were more likely report a lower level of support for the political institutions of Peru. There was no significant difference in the attitudes towards national pride or political support of the existing government across mita and non-mita districts.

This trend away from institutions and local level governance carried over in the responses regarding confidence in various branches of government. Mita districts expressed more relative support for their provincial government than their municipal government. This is reflected in the mita districts' respondents confidence in the provincial government, which was lower than that of the non mita districts, and later questions about what part of the government they see as "solving their problems." Faced with the options of the municipality, congress, central government, district government, and provincial government, mita districts were less likely to report their distict level government as being a problem solver. Of the mita districts, 30% of respondents found the district government as more conducive to problem solving, compared to 53% for non-mita districts.

Conclusion

Taken as a whole, these results add nuance to the study of extractive colonial institutions and highlight avenues for future research. Studying tribute flows within the colonial context, provided a lens into historic levels of production through state collected "taxes" or tribute. I observed differences in the level of tribute by province, with mita assignment being a significant factor of a province's level of tribute. Tribute was also positively correlated with the movement in agricultural prices. Considering the various factors that went into the model systematically, I generated an estimate of the parameter of the output elasticity of agricultural labor over the initial period of the tribute's implementation. The parameter provided insight into how the added value of labor might have diminishing returns in mita districts relative to non-mita districts. I then used the estimate of α to calculate the predicted output of each province for the years represented in the data, and found that predicted tribute was consistently higher than the observed values. This result coincided with estimates of historic production in other regions of Peru, which have also projected significant agricultural surpluses. I then attempted to attenuate the model by solving for the share of mining laborers as a function of the output elasticity of agricultural labor. These considerations raised avenues for future work potentially studying the intensity of the mita over the period, by focusing on the number of workers allocated to the mines. Considering the average outputs of haciendas, or private land enterprises, relative to tribute communities could help delineate the distinction between public and private enterprise during the historical period. These values in turn could help illuminate the formation of a landed elite and divergence in economic status.

Moving into the contemporary context, I found that assigning a district to the mita had a negative impact on the amount of land cultivated, the purchasing power per capita, and different political attitudes. These conclusions deserve to be probed further to identify potential channels of persistence for the mita. Evaluating historic patterns of inheritance of land cultivation could help illuminate whether mita districts were more likely to result in marginalizing mining workers to minimize agricultural labor. Similarly, looking at patterns in cultivation or discrete historical events (like crop failures or major climatic changes) might help understand the evolution of values of agricultural production. Evaluating the ethnic composition of administration of mita and non-mita districts, whether native or Spanish leaders were assigned, could help illuminate how racial patterns might interact with the long-run impact of the mita.

Though this analysis raises several questions, it ultimately offers a framework for evaluating the economic interactions between the Spanish and Indians and evaluating these hypotheses empirically. By simulating and analyzing province-scale economics, I begin to shed light on how communities, and the households within them, operated within in a colonial economy of surplus extraction. Pairing these regions with their modern descendants helps evaluate the long-run impact of these factors, and the vital, contemporary relevance of the economic history of Peru.

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Appendix

Table 1: Solving for α : A

Variable	Coefficient	(Std. Err.)
B	0.648	(0.086)
Intercept	0.366	(0.044)

Table 2: Estimation results : log($landworked$)

Variable	Coefficient	(Std. Err.)
region	-0.042	(0.011)
mita	-0.352	(0.151)
nutrient_ret	0.168	(0.060)
rainfall_cv	-0.021	(0.005)
prov_age	-0.028	(0.015)
Intercept	10.293	(0.704)

Table 3: Estimation results : purchasing power per capita

Variable	Coefficient	(Std. Err.)
Province	-33.591	(37.803)
Literacy	12892.448	(1259.634)
mita	-867.115	(216.286)
popeducnoeducationmbr	-0.191	(0.085)
popeducsuperiorunivcompletembr	0.701	(0.056)
Intercept	-4643.416	(1164.901)

Table 4: Estimation results : purchasing power per capita

Variable	**Coefficient**	**(Std. Err.)**
Region	-42.277	(16.975)
mita	-986.292	(201.406)
popeducnoeducationmbr	-0.414	(0.092)
popeducsuperiornounivincompletem	0.299	(0.173)
popeducsuperiorunivcompletembr	0.696	(0.075)
$prov_{altitud}$	-1.003	(0.104)
Intercept	9933.148	(296.164)

Table 5: Summary statistics of Historic Dataset

Variable	Mean	Std. Dev.	N
historical province			0
annual	1648.373	68.567	1481
averagetributeperdistictinprovin	14363.635	43818.084	1473
cargo			0
year			0
mita	0.48	0.5	1481
month	4.722	3.891	1481
tot_trib	8141.677	23681.695	1475
pop1689	14580.667	5779.02	825
ind1689	0.923	0.05	825
pop1786	21615.21	7463.397	825
ind1786	0.810	0.105	825
pop_ind1791	12043.907	5663.821	1422
Huancavelica	0.154	0.361	1311
Potosi	0.286	0.452	1311
avgcropprices	1.79	0.37	1299
priest	1924.601	1646.37	784
justice	1105.433	944.930	784
cacique	427.093	357.742	784
construct_church	16.5	57.423	784
hospital	25.51	110.09	784
tot_ind1572	1933.522	1626.751	784
old_men	594.208	661.284	784
boys	2137.441	1852.22	784
women	5692.883	4918.632	784
tot_ind1689	13372.428	5265.613	825
tot_ind1786	17898.743	7163.704	825
mitayos_1776	147.36	91.659	337
mitayos_1790	150.977	108.314	577
R	5027.268	2921.796	1431
D	35.688	12.623	578
p001			0
unique_prov	1.274	0.565	168
prov_tot	96928.758	96160.208	172
Tribute_Population	7435.231	6720.396	1019
num_districts	9.218	5.047	1319
p_A	5.756	1.944	1348

Table 6: Modern Dataset Summary statistics

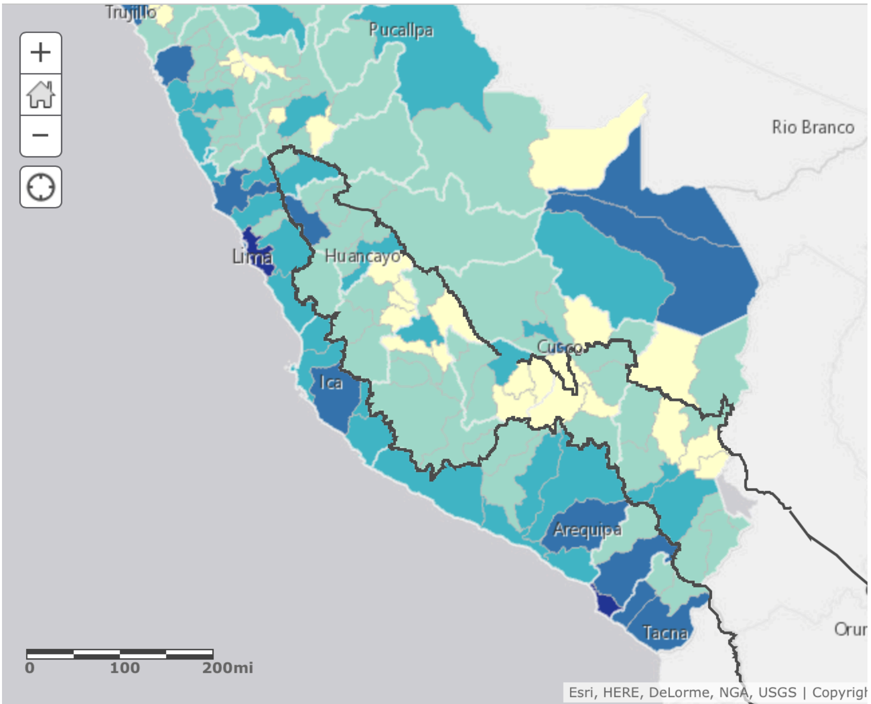
Variable	Mean	Std. Dev.	N
p001	7.708	6.03	322
p002	3.863	2.672	322
p003	7.851	5.676	322
name			0
totalpopulationmbr	10625.255	20849.332	322
totalhouseholdsmbr	2823.528	5472.833	322
popeducnoeducationmbr	1356.394	1771.592	322
popeducprimarymbr	3279.848	4729.6	322
popeducsecondarymbr	3139.637	6568.929	322
popeducsuperiornounivincompletem	507.683	1456.578	322
popeducsuperiornounivcompletembr	631.919	1868.882	322
popeducsuperiorunivcompletembr	840.311	2868.272	322
purchasingpowertotalmbr	101101045.891	278119557.487	322
purchasingpowerpermillmbr	0.255	0.905	322
purchasingpowerpercapitambr	6165.96	3100.582	322
nutrient_ret	1.464	1.071	224
rainfall_cv	33.763	15.42	224
prov_wsup17	2.87	17.251	317
prov_wpiso	3.956	1.593	317
prov_altitud	3138.641	1064.177	317
prov_wredhi	2.334	1.65	317
prov_lit	0.854	0.091	317
prov_age	52.232	4.633	317
prov_landworked	2982.798	6116.576	317
prov_wsup13	34.22	91.246	317
prov_wsup12	19.881	229.095	317
prov_wsup14	15920.524	26698.867	317
prov_wsup06	2201.986	3715.396	317
prov_wsup07	1030.991	2495.205	317
prov_wsup08	660.465	954.007	317
prov_wsup09	635.241	2969.151	317
prov_wsup10	86.326	411.593	317
prov_wsup11	354.442	1736.54	317
prov_wsup18	2046.277	3104.004	317
prov_land	43819.394	58663.204	317
mita	0.512	0.501	322

Maps

Map 1: Region of Study Relative to the Mita Boundary

Map generated by author in ArcGIS

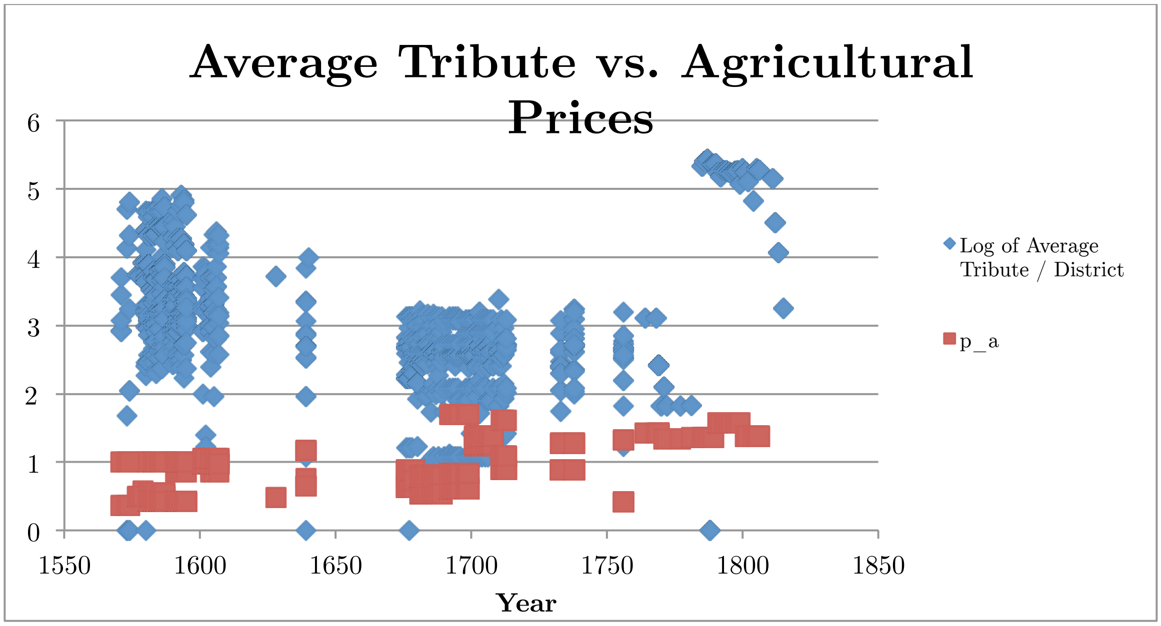
Map 2: Mita Boundary and PPP



Map generated by author in ArcGIS using basemap from Mark Bauer Research Institute.

Graphs:

Graph 1: Average Tribute Relative to Agricultural Prices



Source: Paulo Macera, *Los Precios del Peru Siglos XVI-XIX* (1992), Tribute data downloaded from TePaske et al. http://eh.net/database/caja-files-royal-treasury-dataset-for-spanish-colonies/

Historic Data:

Tribute by District by Province

Mean District Tribute by Prov	Mean	Std. Error	[95% confidence interval]	
Abancay	1120.301	39.11207	1043.58	1197.023
Andahuaylas	30712.18	3726.405	23402.55	38021.81
Andamarcas	5040.452	352.4489	4349.097	5731.808
Arequipa	962.6609	188.4352	593.0307	1332.291
Aymaraes	1557.379	342.8885	884.7765	2229.981
Azangaro	378.7143	128.4793	126.6923	630.7363
Calca y Lares	242.1693	41.52507	160.7147	323.624
Canas y Canchis	3351.425	300.8776	2761.231	3941.62
Cangallo	3002.072	656.303	1714.683	4289.461
Carabaya	547.7223	105.5063	340.7635	754.6811
Chilques y Marques	889.8614	61.44826	769.326	1010.397
Chumbvilcas	3288.94	210.8365	2875.369	3702.512
Condesuyo de Cuzco	1563.488	134.6411	1299.379	1827.597
Cotabambas	34599.29	3504.584	27724.78	41473.8
Huamanga	131280.3	8504.919	114597.2	147963.3
Lampa	1795.401	95.40928	1608.248	1982.553
Lucanas	1134.442	270.0638	604.6912	1664.193
Parinacochas	18647.5	958.302	16767.72	20527.28
Paucarcolla	426.848	254.8895	-73.13732	926.8334
Quispicanchis	1671.676	212.1765	1255.475	2087.876
Tayacaxas	5748.07	598.0361	4574.976	6921.164
Urubamba	672.7116	50.98238	572.7057	772.7174

Source: TePaske et al. http://eh.net/database/caja-files-royal-treasury-dataset-for-spanish-colonies/

Population and *Mitayos* by Province (1789)

Provincias	Arzobispado	N.o de Mitayos	Mita	Indios originarios
Huanta	Huamanga	251	Huancavelica	811
Angaraes	Huamanga	104	Huancavelica	125
Castrovirreina	Huamanga	170	Huancavelica	722
Lucanas	Huamanga	112	Huancavelica	775
Parinacochas	Huamanga	46	Huancavelica	649
Vilcashuamán	Huamanga	108	Huancavelica	1.811
Andahuaylas	Huamanga	28	Huancavelica	1.822
Yauyos	Lima	144	Huancavelica	1.337
Tarma	Lima	104	Huancavelica	1.479
Jauja	Lima	181	Huancavelica	3.747
Cotabambas	Cuzco	175	Huancavelica	1.452
Chumbivilcas	Cuzco	140	Huancavelica	1.544
Aymaraes	Cuzco	289	Huancavelica	1.412
Lampa	Cuzco	363	Potosí	1.146
Azángaro	Cuzco	149	Potosí	1.553
Quispicanchis	Cuzco	44	Potosí	2.766
Canas y Canchis	Cuzco	269	Potosí	2.516
Chayanta	Chuquisaca	349	Potosí	2.307
Tarija	Chuquisaca	105	Potosí	653
Carangas	Chuquisaca	185	Potosí	1.362
Porco	Chuquisaca	383	Potosí	2.347
Cochabamba	Chuquisaca	131	Potosí	958
Paria	Chuquisaca	412	Potosí	1.504
Omasuyos	La Paz	66	Potosí	1.174

Sicasica	La Paz	239	Potosí	2.159
Pacajes	La Paz	398	Potosí	2.822
Chucuito	La Paz	473	Potosí	2.033
Paucarcolla	La Paz	73	Potosí	849
		5.491		43.835

Source: Scarlett O'Phelan, *Un siglo de rebeliones anticoloniales: Perú y Bolivia, 1700-1783*. Cuzco: Centro de Estudios Rurales Andinos "Bartolomé de las Casas", 1988, p. 71. La tabla se elaboró con la información colectada en diversas Memorias de Virreyes.

Crops and Climate by Province (1764-1778)

Province	Este-Oeste	Ancho	Clima	Productos
Abancay	26	14	Templado en casi todo, excepcion de uno o otro valle que es humeda"	trigo, maiz, ganado vacuno,
Andahuaylas	24	15	Frio	Trigo, Cebada, Maiz, y Papas
Arequipa				
Aymaraes	26	40	generalmente frio	arboles frutales, azucar
Azangaro	20	5	Muy frio	Papa, Quina, Cañigua
Calca y Larges	36	25	templado	Trigo, Quinua, Maiz, Legumbres, papa
Canas y Canchis	30	15	Sumamente Frio	Trigo, Quinua, Maiz, Legumbres, papa
Cangallo	24	18	templado	Trigo, Maiz, Legumbres, papa
Carabaya			templado	
Chilques y Masques	13	25	Caliente	Trigo, Maiz, Legumbres, papa
Chumbvilcas			Frio	Trigo, Maiz, Legumbres, papa
Condesuyo de Cuzco			templado	
Cotabambas	25	23	generalmente frio	Trigo, Maiz, Legumbres, papa
Cuzco			templado	
Lampa	30	20	Muy frio	Papa, Chuno, Quina, costales y alfombras
Lucanas	60	21	Frio	Trigo, Cebada, Maiz, y Papas
Parinacochas	35	22	Frio	Trigo, Maiz, Legumbres, papa
Paucarcolla	30	35	Frio	Trigo, Maiz
Quispicanchis	30	35	Vario	Trigo, Maiz
Urubamba			templado	Trigo, Maiz
Castrovirreyna	22	37	Precipitado	Trigo, Cebada, Maiz, y Papas

Source: Geografía del Perú Virreinal, Cosme Bueno (1764-1778)