RULERS, RESISTANCE, AND RETREAT: FLIGHT AS A CONSTRAINT ON PREDATORY RULE

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Predatory rulers attempt to extract as much revenue as possible from the population, but that does not mean they are unconstrained. Scholars have often focused on rebellions as such a constraint due to the costs they impose on rulers. However, rebellions also involve severe costs for participants, including risks of injury, punishment, or death. Given these costs, I argue that commoners frequently opted to resist predatory extraction by fleeing, especially during the pre-industrial era. To explore the implications of this contention, I model the dynamic between a revenue-maximizing ruler and a peasant, who chooses to comply, flee, or rebel. This simple model shows that when rebellion is relatively costly, flight, rather than rebellion, serves to constrain the ruler. I provide empirical evidence for this insight by drawing from the case of indigenous exploitation in colonial Peru. First, I demonstrate that the Spanish Crown set lower tax rates where indigenous peasants could more easily flee. Using a difference-in-differences design, I then show that when peasants were subjected to overextraction through forced labor in mines, they responded by fleeing. These findings provide a new perspective on the relationship between rulers and their subjects that can be applied to numerous phenomena and settings.

I. INTRODUCTION

Autocratic rulers seek to extract as much revenue as possible from the population (Levi 1988). This behavior was particularly evident in the pre-industrial era, when peasants were subjected to forced labor and heavy taxation. However, while rulers may be predatory, this does not mean that they are unconstrained. The prospect of rebellions can serve as such a constraint, as rebellions pose a threat to regimes' survival and require a costly use of force to put down. Scholars have incorporated the dynamic between autocratic rulers and rebellious masses into explanations for phenomena including democratization (Acemoglu and Robinson 2005, Boix 2003), strategies of authoritarian control (Gandhi 2008; Svolik 2012), state building (Garfias and Sellars 2023), and institutional development (Gailmard 2017).

However, rebellions often fail to materialize despite the circumstances that might warrant them. As Zinn has noted, "[W]e have infinitely more instances of forbearance to exploitation, and submission to authority, than we have examples of revolt. Measure the number of peasant insurrections against the centuries of serfdom in Europe—the millennia of landlordism in the East…" (1968, pg. 17). Scott has similarly observed, "[I]f anger born of exploitation were sufficient to spark a rebellion, most of the Third World (and not only the Third World) would be in flames" (1976, pg. 4). Indeed, periods of a century or more of relative peace amidst exploitation can be found in contexts as diverse as feudal Japan (Bix 1992, pg. xxiii), colonial Mexico (Katz 1988), and medieval Europe (Wickham 2017).

Though uprisings engender power, their relative absence is not necessarily surprising given the severe costs borne by rebellion participants. For rebellions to take place, insurgents must surmount organizational costs and endure risks of grave injury or death, while those captured are subject to imprisonment, execution, or other forms of punishment (e.g., Taylor 1979, pg. 121). Disgruntled commoners faced with these high costs might reasonably hesitate to join a rebellion; but this does not imply that the alternative is passive submission. Rather than rebel or comply, I contend that the masses often resist autocratic extraction through flight. Indeed, several works have recognized flight as an important response to undesirable government actions (e.g., Herbst 2000; Hirschman 1970; Scott 2009; Stasavage 2020). Flight may have been especially prevalent during the pre-industrial period, when governments' capacity to restrain movement was low and remote lands offered ample opportunities for refuge.

To understand the implications of flight for autocratic extraction, I model the dynamic between a ruler, who sets a revenue-maximizing tax rate, and a peasant, who responds by choosing to comply, flee, or rebel. This simple model shows that when flight is less costly to the peasant than rebellion, the ruler will tax the peasant up to the point of provoking her to flee. Flight thus serves as a constraint on predatory rule whenever rebellion is relatively costly. A testable implication of this result is that rulers will extract less from peasants who can more easily flee. Moreover, peasants faced with overextraction will respond by fleeing.

To provide empirical evidence for these contentions, I draw from the case of indigenous revenue extraction in colonial Peru. Following the Spanish conquest of Peru in the 16th century, indigenous peasants were subjected to a form of head tax called the tribute and required to perform forced labor under the *mita*. In this sense, colonial Peru can be seen as a typical case of predatory rule in the pre-industrial era (Seawright and Gerring 2008). As the Spanish Crown sought to maximize revenues from the colony, officials were aware that native Peruvians were fleeing colonial extraction and abuse (Assadourian 2002; Beltrán y Rózpide 1921, pg. 83), while indigenous rebellions were rare (Glave 1999). I test whether this flight served as a constraint on revenue extraction by examining the determinants of tribute rates, which varied by community. Whereas tribute rates were lower for communities that had less ability to pay, I show that they were also lower where rugged, high-altitude terrain facilitated peasants' ability to retreat and hide. These results corroborate the proposition that rulers' ability to extract revenues was indeed constrained by their subjects' propensity to flee.

Though telling, the observed results only provide suggestive evidence of peasants' flight as the operative mechanism. Additional support for the contention that flight constrained rulers' extraction can be found if indigenous peasants indeed responded to excessive demands by fleeing. However, quantifying flight is a difficult undertaking given that neither migration, nor its underlying motivations, were systematically recorded. To address these challenges, I conduct a quasi-experimental design focused on the mining mita, a system of forced labor that required designated peasants to work in the mercury mine of Huancavelica or the silver mine of Potosí. Although multiple protections were originally set out for mining mita workers, the dangerous and grueling nature of mine work made the mining mita more demanding than other forms of forced labor at the time. I take advantage of this variation in the degree of hardship in a difference-in-differences design that compares the population of tributaries in mining mita to control areas before and after the mita's initiation. The results demonstrate that the population of tributaries declined considerably in areas subjected to the mining mita, a significant portion of which can be attributed to flight.

By highlighting flight as an important form of resistance to autocratic extraction, this paper shows that flight, rather than rebellion, can constrain predatory rule. This insight draws from a novel theoretical model, which I build upon in related work to explore how an equilibrium in which flight is preferred can veer towards rebellion. Moreover, the model can be applied towards examining phenomena like democratization, authoritarian politics, and state building through a new lens.

In addition to theoretical contributions, this paper's empirical findings enhance social scientists' understanding of colonialism and its effects. Many studies examining the Spanish colonial period have focused on the long-term outcomes of colonialism (e.g., Acemoglu, Johnson, and Robinson 2001; Dell 2010; Guardado 2018; Sokoloff and Engerman 2000). By providing quantitative evidence that indigenous peasants fled exploitation, this paper sheds light on the contemporary consequences of colonialism, potentially clarifying paths of long-term persistence (see also Arroyo Abad and Maurer 2022). Moreover, this study joins the growing body of literature explaining how indigenous peoples have exercised agency in the face of colonial rule and other forms of oppression (Carter 2024; Diaz-Cayeros, Espinosa-Balbuena, and Jha 2022; Franco-Vivanco 2021).

Though this paper is set in colonial Peru, its insights transcend geographic and temporal bounds. Examples ranging from the fugitive peasants who fled serfdom to the countless Venezuelans who have braved the Darien Gap underscore that flight has been and continues to be a key form of resistance to autocratic regimes. The model developed in this paper can be adapted towards understanding how flight affects the logic of autocratic extraction in a broad array of settings.

II. MODEL AND IMPLICATIONS

To explore the relationship between flight and autocratic extraction, I develop a simple game-theoretic model set in the pre-industrial era (see Figure 1). The model begins with a ruler, who selects a level of taxation that is imposed on a peasant. The peasant then chooses to comply, flee, or rebel in response to the tax. These actions are intended to reflect the primary choices available to each player in the context of pre-industrial extraction.[1]

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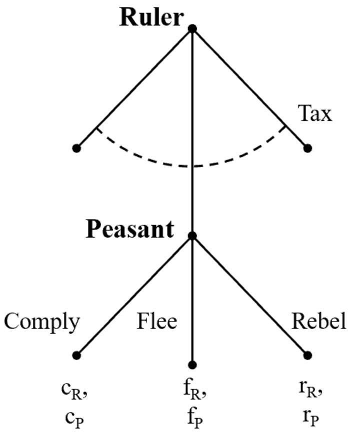
[1] In furthering this goal, I have deliberately omitted certain actions that the players could theoretically take but that were not consequential given the setting and context. For example, the ruler does not have the choice to invest in the state's ability to prevent the peasant's flight, as states had low capacity to effectively control movement at the time. Additionally, the peasant's actions exclude the option to file a petition, given that petitions served to curb the abuses of agents rather than rulers (Franco-Vivanco 2021). I have also chosen not to include every-day forms of resistance like foot-dragging as an independent action (Scott 1985), as foot-dragging can be considered a form of (unwilling)

Figure 1. Game-Theoretic Model



Payoff	Variables
c_R	Value of tax (+), tax collection (-), public goods provision (-)
c_P	Public goods (+), value of tax (-)
f_R	-
f_P	Pr(successful flight) × income differential (+/-), pr(unsuccessful flight) × punishment (-), travel costs (-)
r_R	Pr(successful rebellion) × value of tax (+), pr(unsuccessful rebellion) × loss of peasant as subject (-), repression costs (-)
r_P	Pr(successful rebellion), pr(unsuccessful rebellion) × severe punishment (-), rebellion participation costs (-)

Rather than establish precise payoffs for the outcomes of this game, Figure 1 enumerates the variables involved in each. The payoffs are set with reference to a baseline in which the ruler collects no taxes, and the peasant also pays no taxes. If the peasant complies with the ruler's tax, the ruler receives the value of the tax net the costs of tax collection and any public goods provided. The peasant, for her part, benefits from public goods while paying the value of the tax. If the peasant instead chooses to flee, the ruler receives his baseline payoff, while the peasant receives the expected value of flight minus travel costs. In the case of successful flight, the peasant evades the tax and earns the income differential in her new location, while the unsuccessful peasant is punished and returned home. Finally, if the peasant rebels, each player receives their expected value of rebellion, minus the costs of repression or rebellion participation, respectively. For the ruler, a successful rebellion yields collection of the tax, while an unsuccessful rebellion results in the loss of the peasant as a subject. The successful peasant rebel, for her part, avoids the tax,[2] while the unsuccessful rebel faces severe punishment.[3]

A key contention of this paper is that fleeing was often a less costly form of resistance to exploitation than rebelling, particularly in the pre-industrial period. Examining the variables

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compliance.

[2] This payoff for a successful rebellion may seem like a meager prize, but history suggests that rebellions were often about contesting undesired policies rather than overturning a regime (e.g., Hobsbawm 1952; Taylor 1979). Slantchev and Kravitz (2020) argue that even suppressed rebellions could trigger policy changes, as uprisings inform the regime that policies are so unacceptable that people are willing to face grave risks to contest them.

[3] For the sake of parsimony, I leave the free rider problem out of the peasant's rebellion payoff. As a form of collective action, rebellion can certainly involve free riding, however this problem was mitigated by pre-industrial peasants' tight-knit, ethnically-homogenous communities, which fostered low sanctioning and monitoring costs as well as reciprocity norms (Coleman 1988; Habyarimana et al. 2009).

enumerated in Figure 1 helps to clarify this claim. Take, for example, the peasant's probability of successful flight. During the pre-industrial era, borders were fluid and permeable, rulers' capacity to control movement was limited, and remote, unsettled areas offered abundant opportunities for retreat. These conditions made for a setting in which the probability of successful flight was relatively high. On the other hand, peasants' probability of winning a rebellion was relatively low. While standing armies were not yet universal in the pre-industrial period, rulers could dispatch small groups of armed forces, who had vastly superior weaponry, to repress peasant uprisings. Moreover, peasants could be gravely injured, killed, or severely punished as a result of participating in a rebellion, whereas the repercussions for an unsuccessful flight attempt were far less serious.[4]

If rebellion is more costly to the peasant than flight, then the peasant always prefers to flee rather than rebel. In this case, the peasant will respond to the ruler's tax by either complying or fleeing. The ruler, then, chooses a tax rate that maximizes his revenues given the peasant's potential actions. If the ruler's tax rate prompts the peasant to flee, he will receive nothing. The ruler thus prefers the highest net-positive tax under which the peasant chooses to comply rather than flee. In this way, the peasant's ability to flee serves as a constraint on the ruler's extraction. [I will add a plot to illustrate this proposition in the next version of the paper.]

The proposition that flight, rather than rebellion, can constrain rulers' predatory instincts yields two testable implications. First, if the ruler plays the game across multiple peasants, the ruler will tax those peasants less who can more readily flee. For example, some peasants may live close to areas of refuge, increasing their chances of successfully fleeing and minimizing travel costs. As these peasants derive more utility from flight, a lower tax rate will prompt them to flee, and the ruler must consequently tax them at a reduced rate.

Second, if the peasant is taxed above the point where she prefers to comply, she should respond by fleeing as opposed to rebelling. While the ruler prefers not to trigger flight, which results in a worse payoff, he may not know at exactly what point the peasant will flee or the ultimate impact of the tax rate on the peasant. The assumption of incomplete information is fitting in the pre-industrial age, when rulers had imperfect knowledge of local conditions. Thus, even revenue-maximizing rulers should have provoked peasants to flee in some cases.

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[4] For example, Russian laws targeting runaway serfs in the 17th century specified that captured fugitives were to be flogged and sent home (Gornostaev 2019).

III. INDIGENOUS REVENUE EXTRACTION IN COLONIAL PERU

Christopher Columbus's first voyage of discovery in 1492 set off an era of Spanish conquest and settlement in the New World. In 1521, *conquistador* Hernán Cortés led an expedition that defeated the Aztec Empire, resulting in the acquisition of huge sums of gold and silver. This lucrative conquest inspired other ambitious Spaniards to seek out similarly wealthy native civilizations. One such Spaniard was the conquistador Francisco Pizarro. Following rumors of a wealthy civilization to the south, Pizarro led an expedition to what would become the Viceroyalty of Peru[5], where he defeated the Inca Empire in the 1530s.

After vast troves of Inca silver and gold were divided between the participating conquerors, the Spaniards turned to the remaining source of wealth: the people. Indigenous peasants were divided between conquistadors in *encomiendas*, a system in which *encomenderos* had the right to extract metals, goods, or labor from their assigned peasants. As the Spanish regime proceeded to establish itself in the viceroyalty, it gradually transferred encomenderos' authority to extract from indigenous peasants to itself.

In 1569, Viceroy Francisco de Toledo arrived in Peru intent on consolidating Spain's hold over the viceroyalty. Among his main contributions were reforming two key systems of indigenous extraction: the tribute and the *mita* [6]. The tribute was a form of head tax in which indigenous peasants were required to pay a designated amount of silver, gold, crops, and/or goods to Crown officials on a biannual basis. Revenues from tribute payments largely went towards costs associated with administering the indigenous population, with any residual retained by either encomenderos or the Crown (De la Puente Brunke 1991). The mita, for its part, was a system of compulsory labor for public projects. Depending on the needs of a given location, mita labor could be used for tasks like mining, working in textile mills, or agricultural work (Wiedner 1960). Under both systems, only tributaries—i.e., men between the ages of 18 to 50 years old[7]—were obliged to comply, however meeting the

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[5] The Viceroyalty of Peru centered on modern-day Peru, with its capital in Lima. As Spanish colonialism expanded, the viceroyalty grew to include most of Spanish-speaking South America before the Viceroyalties of New Granada and Río de la Plata were broken off in the 18th century.

[6] Both the tribute and the mita pre-dated Viceroy Toledo, with antecedents in pre-colonial times. However, Toledo overhauled these systems, shaping them into the forms that they would take on for the foreseeable future (Cole 1985; Escobedo Mansilla 1979).

[7] Tributaries also included married boys under 18, while men with physical impediments and village chiefs' oldest

requirements of the tribute and the mita was often a family effort (Escobedo Mansilla 1979, pg. 24; Tandeter 1993, pg. 42).

To formalize these systems of extraction, Viceroy Toledo undertook an unprecedented census of the viceroyalty's indigenous population from 1570 to 1575. The main goals of the census were to count the number of tributaries in each area, assess tribute rates, and consolidate traditionally scattered villages into more compact communities called *reducciones* or resettlements, which would be easier to administer (Cook 1975, pg. XI). Tribute obligations were to be determined based on factors indicative of local populations' ability to pay, including access to silver and gold, the type of crops and goods produced in the area, and previous tribute rates (Escobedo Mansilla 1979). The end result of this process was official tribute rates tailored to the characteristics of each locality.

Indigenous Peruvians, for their part, did not simply grin and bear the steep taxes, forced labor, and abusive officials foisted upon them by the Spanish regime. According to historical sources, many peasants chose to flee, a phenomenon that was known at the highest levels of Peru's viceregal administration. For example, Viceroy Luis de Velasco (1596-1604) observed:

> "The [resettlements] which Don Francisco de Toledo established in the Andean provinces are in ruin … some have fled to avoid the [mining mita] or the personal service to which they are assigned, and others have left to escape the abuses of the [governors], parish priests, and [Indian chiefs], who are their worst enemies; still other Indians have fled to private estates, where the owners protect them.... Also, the Indians hide in mountains and isolated pastures, where they can not easily be discovered" (Wightman 1990, pg. 24).

Similar observations were echoed by Rafael Ortiz de Sotomayor, governor of Potosí (1608-14):

> "The Indians who have returned to their [resettlements] have been very few.... Many hide themselves in remote, isolated locations. Others withdraw to the ranches and farms of Spaniards and rich Indians of other provinces…. Others go to various mine discoveries…" (Zavala 1979, pg. 68, self-translation).

While these passages postdate Toledo's reforms, the enterprising viceroy was likewise aware

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sons were exempted (Escobedo Mansilla 1979, pgs. 23–24).

of indigenous Peruvians' propensity to flee. During a meeting about the viceroy's new tribute rates, which was attended by Toledo's agents and native participants, the latter group claimed that 4,000 peasants from the province of Chucuito were in hiding and avoiding the tribute (Assadourian 2002, pg. 747). Moreover, in a summary of his term as viceroy of Peru written for the Crown, Toledo himself referenced peasants "in the mountains and hills where they were dispersed and hidden so as to flee the … Spaniards, who were abhorrent to them…." (Beltrán y Rózpide 1921, pg. 83, self-translation). These data points suggest that Toledo had native peasants' willingness to flee exploitation in mind during his governance of the Spanish colony.

IV. EVIDENCE OF FLIGHT AS A CONSTRAINT ON EXTRACTION

As a rational ruler of colonial Peru, the Spanish Crown would have sought to maximize revenues from indigenous extraction subject to applicable constraints. If native peasants' flight served as such a constraint, then the Crown should have adjusted levels of extraction accordingly, with less burdens imposed on peasants who could more easily flee. The proceeding section seeks to test this hypothesis in the context of Viceroy Toledo's tribute rates.

A. Data and Variables

To assess whether indigenous Peruvians' facility of flight affected tribute rates, I employ an indicator of peasants' ease of fleeing the tribute as my independent variable. The quotes in the previous section show that peasants had various options for avoiding tribute payments, such as working on the ranches of Spaniards,[8] however there is a clear pattern presented in the references to "mountains and isolated pastures", "remote, isolated locations", and "mountains and hills". What these places have in common is that they are difficult to access, oftentimes due to elevation and rugged terrain. Indeed, high-altitude, rugged regions are emphasized as refuges for those fleeing state domination in both Beltrán's *Regions of Refuge* (1979) and Scott's *The Art of Not Being Governed* (2009).

Based on this historical evidence and support from the literature, I employ an interaction term between elevation and ruggedness as my indicator of indigenous peasants' ease of flight. The elevation

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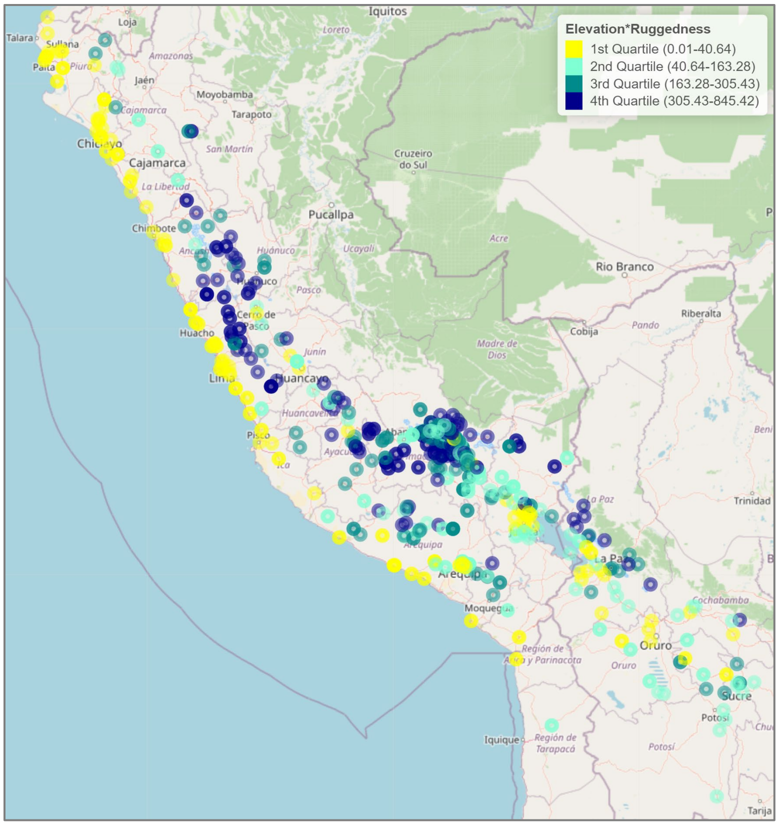
[8] I choose not to focus on Spaniards' ranches as an indicator of flight ease because these could only accommodate a limited number of peasants.

of each district is measured in kilometers in order to avoid excessive decimal places in the regression results that follow. Ruggedness, for its part, is given by the Terrain Ruggedness Index (TRI), a measure of the discrepancy between the elevation of a location and its immediate surroundings.[9] Higher values of elevation×ruggedness thus represent greater ease of flight. Figure 2 displays a map of flight ease by quartile for the area under study. While the highest values of flight ease are, unsurprisingly, found in the Andean mountain range that lies parallel to the coast, they are spread throughout fairly evenly, and there is significant variation within this high-altitude region.

Figure 2. Map of Flight Ease (Elevation×Ruggedness)



The dependent variable of this analysis is the tribute rates set through Viceroy Toledo's 1570s census. More specifically, the rates reflect the total value of the tribute obligation in Spanish silver pesos divided by the number of tributaries per *repartimiento*, or district. Data on tribute rates are

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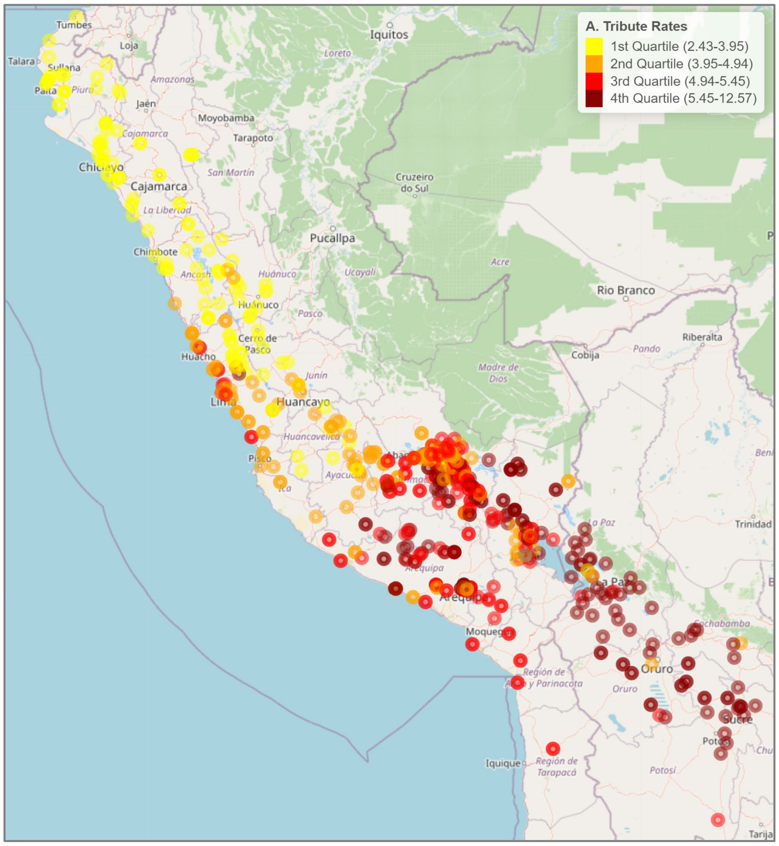
[9] More specifically, the TRI represents the mean of the absolute differences between the elevations of a grid cell and its 8 surrounding cells. Both elevation and the TRI are calculated using the raster package in R.

digitized from Cook (1975) and Escobedo Mansilla (1979). Figure 3 provides a map of tribute rates by quartile for the study region. As the map shows, there is significant regional variation in tribute rates, with the northern portion of colonial Peru paying significantly less in tribute than the south.

Figure 3. Map of Tribute Rates



The unit of analysis for these data is the district, which is the lowest level at which tributary populations were systematically recorded. A district was the jurisdictional level beneath a province and consisted of several kinship-based communities whose combined tributary population was not to exceed 500 (Gade and Escobar 1982), although actual tributary numbers could be significantly larger or smaller. I focus on the districts included within Toledo's census that are located in modern-day Peru, Bolivia, and Chile, yielding a sample size of 541.

To geolocate districts, I manually tracked them down one by one. As many colonial-era Peruvian towns still exist today, I was able to find about half of the districts in my sample using Google Maps by identifying modern-day towns with names that are the same or very similar to colonial districts. If I could not find a name match, I referenced the geographical dictionary Paz Soldan (1877), the geographical index logarandes.org, as well as a wide variety of other historical sources that link colonial districts to modern locations, which are detailed in the study's replication data. In all cases, I ensured the accuracy of matches by confirming that districts within the same colonial provinces are in close proximity to one another. I have so far been able to locate over 95% of districts in my data.

B. Causal Identification

Given the cross-sectional nature of the tribute data as well as the lack of opportunity for a quasi-experimental design, I proceed with a cross-sectional regression paired with selection on observables. This method can yield causal estimates if a set of covariates is identified so that conditioning on those covariates makes treatment assignment independent of potential values of the outcome variable (Keele, Stevenson, and Elwert 2020). While accounting for all confounding variables is a tall order, I nevertheless attempt to do so given the causal nature of the claim that peasants' ease of flight constrained tribute rates.

The set of covariates I have identified are factors that historical sources suggest Viceroy Toledo used to determine tribute rates. Data come from secondary sources, transcribed primary sources, and online data sources, with details on the source of each covariate and its coding provided in the data appendix. The covariates are as follows:

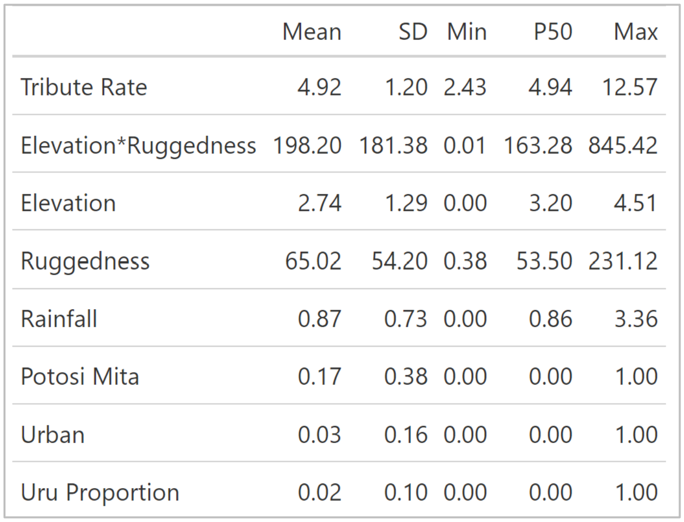
- *Elevation*: The northern and coastal areas of colonial Peru suffered greater population loss in the aftermath of the Spanish conquest, due in large part to the increased presence of Spaniards in these low-elevation areas as well as the easier transmission of Old World diseases in warmer climates (Cook 1981). Districts at higher elevations thus may have been subjected to higher tribute rates.
- *Rainfall*: Crops were a key component of tribute payments. Thus, factors that contributed to greater crop yields—including increased rainfall—should have led to higher tribute rates. Rainfall is a key source of variation in the regions that comprised colonial Peru, where environments range from the arid coast to the tropical interior. [In the next version of the paper, I will include additional covariates related to crop yields, including soil attributes.]
- *Potosí Mita*: The payment of tribute was required in the form of metals whenever possible. The largest source of metals in colonial Peru was the massive silver mine at Potosí. In fact, tributaries assigned to mita work at Potosí were required to pay tribute entirely in silver

(Escobedo Mansilla 1979, pg. 119), presumably due to their ability to access the metal. Districts assigned to the Potosí mita thus likely paid higher tribute rates.

- *Urban*: Toledo created resettlements around cities in order to accommodate the indigenous Peruvians who made a living working for Spaniards (Málaga Medina 1974). Having abandoned their traditional lands, these urban migrants had less capacity to produce crops for tribute and were likely assessed at a lower rate.
- *Uru proportion*: The colonial authorities singled out some indigenous ethnic groups for differential treatment. One group that was treated differently with regards to the tribute was the Urus, an ethnic group that lived around Lake Titicaca and whose livelihood was based on fishing, hunting, and gathering. Considered more primitive than their agricultural neighbors, the Urus were assessed at a lower tribute rate (Wachtel 1978).

Table 1 provides descriptive statistics for these covariates along with the dependent and independent variables.

Table 1. Descriptive Statistics for Tribute Rate Analysis

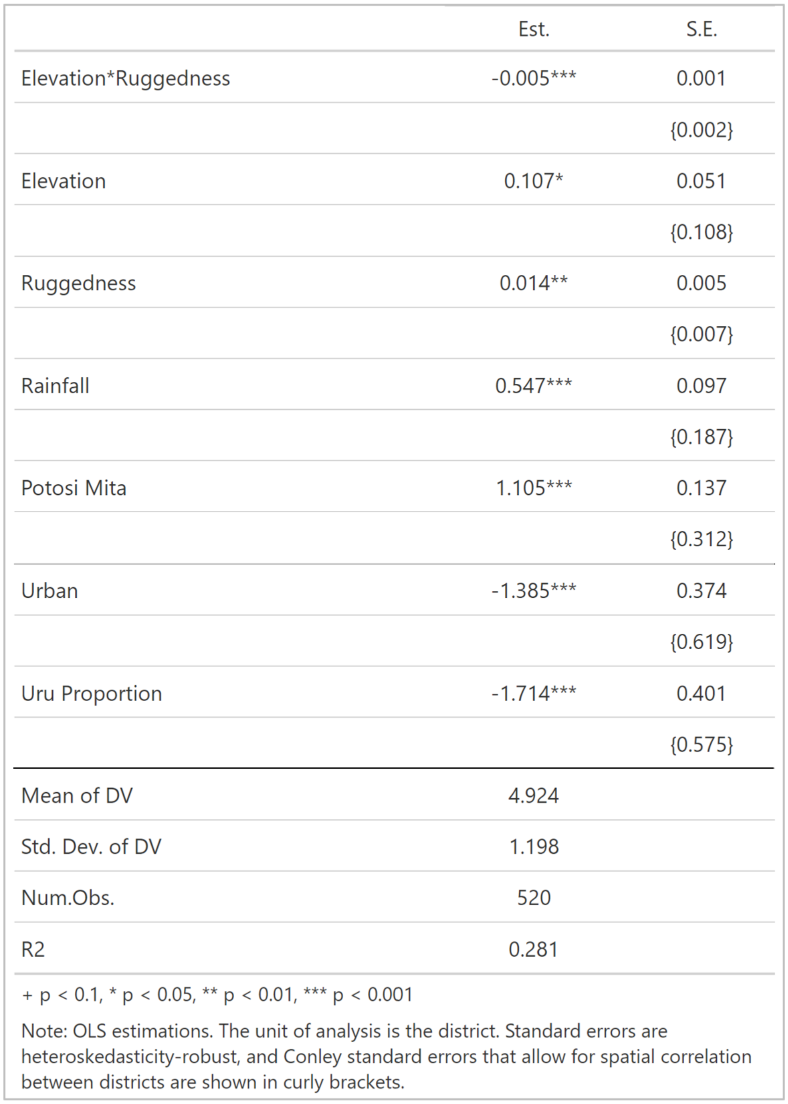


	Mean	SD	Min	P50	Max
Tribute Rate	4.92	1.20	2.43	4.94	12.57
Elevation*Ruggedness	198.20	181.38	0.01	163.28	845.42
Elevation	2.74	1.29	0.00	3.20	4.51
Ruggedness	65.02	54.20	0.38	53.50	231.12
Rainfall	0.87	0.73	0.00	0.86	3.36
Potosi Mita	0.17	0.38	0.00	0.00	1.00
Urban	0.03	0.16	0.00	0.00	1.00
Uru Proportion	0.02	0.10	0.00	0.00	1.00

C. Results and Robustness

Table 2 presents the results of an OLS regression of tribute rate on flight ease, controlling for the covariates identified above. The regression employs robust standard errors given heteroskedasticity in the dependent variable, while Conley standard errors that allow for spatial correlation between districts are shown in curly brackets. The results show that the indicator for flight ease, elevation×ruggedness, is estimated to be negative and statistically significant at the level $p < 0.001$, corroborating the proposition that the Spanish Crown's extraction of tribute revenues was constrained by indigenous peasants' ability to flee. Moreover, the estimated coefficients for the covariate controls are also statistically significant, and their signs align with theoretical predictions.

Table 2. Regressions Results for Tribute Rate Analysis



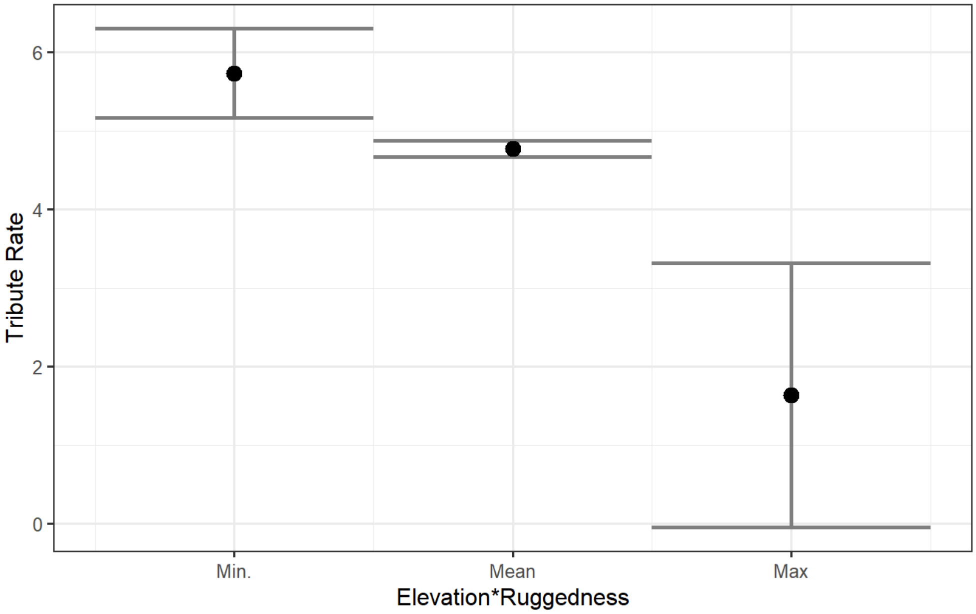
	Est.	S.E.
Elevation*Ruggedness	-0.005***	0.001
		{0.002}
Elevation	0.107*	0.051
		{0.108}
Ruggedness	0.014**	0.005
		{0.007}
Rainfall	0.547***	0.097
		{0.187}
Potosi Mita	1.105***	0.137
		{0.312}
Urban	-1.385***	0.374
		{0.619}
Uru Proportion	-1.714***	0.401
		{0.575}
Mean of DV	4.924	
Std. Dev. of DV	1.198	
Num.Obs.	520	
R2	0.281	

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: OLS estimations. The unit of analysis is the district. Standard errors are heteroskedasticity-robust, and Conley standard errors that allow for spatial correlation between districts are shown in curly brackets.

While the negative sign of the flight ease indicator is telling, it is difficult to interpret the interaction term in isolation. Figure 4 thus presents the predicted effects of flight ease at the minimum, mean, and maximum values of elevation×ruggedness, holding all other variables constant. As the plot shows, tributaries living in districts at the minimum level of elevation×ruggedness are predicted to pay about 20% more in tribute per capita than the mean. On the other hand, those living at the maximum level of elevation×ruggedness are predicted to pay only a third of the tribute rate paid by the mean. Flight ease thus has a marked relationship with tribute rates across its range of values.

Figure 4. Predicted Effects of Flight Ease



Note: The predicted effects are calculated from the model presented in Table 2. All variables not shown are taken at their mean or median values, the latter in the case of dummy variables.

[I will add robustness tests in the next version of the paper here, including alternative measures of the independent variable.]

If indigenous peasants' ability to flee constrained the Spanish Crown's extraction of tribute revenues, then the Crown should have demanded less in tribute from those who could more easily flee. The results of this section, which show that districts with high altitudes and rugged terrain were assessed lower tribute rates, provide empirical support for this contention. However, these results are not dispositive in isolation, as the cross-sectional regression from which this evidence is drawn is vulnerable to unaccounted-for confounding variables, despite my efforts to control for numerous confounders. In the sections that follow, I thus bolster the claim that flight constrained the Crown's extraction by providing evidence for another testable implication of my game-theoretic model: that overextraction caused peasants to flee.

V. THE MINING MITA

While indigenous Peruvians suffered through many hardships, perhaps the greatest among these were forced labor in the mercury mine of Huancavelica and the silver mine of Potosí. Beginning in the 1540s, massive deposits of silver were discovered high in the Andes in Potosí. Combined with Huancavelica's large supply of mercury, which was required to process silver, the discovery at Potosí set the stage for a silver boom in colonial Peru. Indeed, Potosí produced nearly half of the world's silver in its first century of operation (Lane 2019, pg. 8). Given the Spanish Crown's collection of the "royal fifth" (i.e., 20% of silver proceeds), Peru's silver provided a major source of royal revenue.

But before this revenue could be realized, Huancavelica and Potosí required a cheap, reliable pool of labor. The outcome of this situation was Viceroy Toledo's creation of the mining mita[10] in the 1570s. The mining mita required approximately one seventh of tributaries in designated districts to serve in the mercury mine of Huancavelica or silver mine of Potosí at any given time (Cole 1985, pg. 7; Cook 1981, pg. 205). In Huancavelica, mita rotations generally spanned two months due to the health risks of handling mercury, while rotations in Potosí lasted for a year (Brown 2001, pg. 470; Cole 1985, pg. 12). In return for their labor, mita workers were paid wages substantially below market rates.[11] Mita workers initially made up a substantial portion of the mines' workforce, with Huancavelica originally allocated 3,000 workers and Potosí allocated 4,000 (Cole 1985, pg. 12; Lohmann Villena 1949, pg. 144).

Working in the mines was difficult. Depending on the exact role, mine work could involve digging ore out of dark, dank tunnels, carrying heavy loads up rickety ladders, or grinding up ore in workshops with little ventilation. All of these tasks were physically taxing and involved risks of injury and illness, such as mercury poisoning or the lung disease silicosis (Bakewell 2009, pgs. 142–47; Brown 2001). Despite these hardships, Viceroy Toledo had not intended for the mining mita to be unduly burdensome. He had established numerous protections and incentives for mining mita workers, including limitations on work hours, meal rations, travel stipends, and the right to mine silver for one's personal benefit on certain days (Cole 1985, pgs. 12–14; Cook 1981, pg. 205). However, mine

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[10] The Huancavelica and Potosí mitas are referred to throughout this paper as the "mining mita", although there were other, smaller mitas dedicated to different mines for periods of time.

[11] For example, free laborers at Huancavelica earned 3-4 times more than mita workers during the 17th century (Bradby 2000, pg. 247).

operators quickly cast these policies aside and intensified demands on mita workers as the most accessible ore was depleted and costs climbed (Cole 1985, pgs. 24–25). While the Crown took steps to reign in these abuses through measures like reasserting Toledo's original protections and taking mita workers away from offenders, it was dependent on mine operators to realize silver revenues and lacked the capacity to fully control them (Cole 1985, ch. 4).

Given the unique burdens imposed by the mining mita, historians suggest that it represented the greatest cause of indigenous flight in the areas subjected to it (Sánchez-Albornoz 1978, pg. 70; Wightman 1990, pgs. 49–50).[12] Fleeing was not especially difficult because of the particular way in which the mining mita was implemented. Unlike the tribute, peasants did not need to retreat to remote areas to avoid the mita. Instead, tributaries had only to abandon their kinship-based communities for new locales, where they would become migrants (*forasteros*), a status that was passed down to future generations (Wightman 1990, pg. 53).[13] Taking advantage of this escape route did not even require leaving the area assigned to the mining mita, although deserters likely had to travel some distance to avoid being found by their village chiefs and returned to their original homes (Saignes 1995, pg. 177). In addition to travel costs, migrants paid the price of lost lands and community rights in their home villages (Cook 1990, pg. 56).

The porous implementation of the mining mita might seem strange, but it took advantage of the kinship structure of indigenous villages in which native chiefs were able to exercise various sources of authority over their tributary constituents (Cole 1985, pg. 112). Spanish authorities thus counted on chiefs to implement various policies involving tributaries, including the fulfillment of mita quotas, and rewarded the chiefs in return. While this approach optimized the Spanish colony's fledgling state apparatus, it also resulted in a loophole concerning the governance of migrants. Though the Crown attempted reforms, they were not successfully realized until the 1720s due to opposition from powerful economic interests that competed with the mining mita for scarce indigenous labor and benefitted from migration (Cole 1984). During the same period, indigenous rebellions were only sporadic and local in nature (Glave 1999).

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[12] The mining mita could also be avoided by paying for a replacement worker to cover one's mita rotation, but this required a payment at the hefty free-market rate, which was out of reach for most peasants (Tandeter 1993, pgs. 64–66).

[13] In contrast, migrants still had to pay tribute after leaving their home villages, albeit at a lower rate (Cole 1984).

VI. QUASI-EXPERIMENTAL EVIDENCE OF FLIGHT

If flight served to constrain the rulers of colonial Peru, then fleeing should have also been indigenous peasants' reaction to overextraction. While historical accounts suggest that this is what occurred, these narratives are only anecdotal in nature. This section thus seeks to bring quantitative evidence to bear towards supporting the contention that overextraction caused native Peruvians to flee by employing a difference-in-differences design in the context of the mining mita.

A. Data and Variables

Demonstrating quantitatively that indigenous Peruvians fled overextraction is far from straightforward. While migration was clearly taking place during the colonial period, there is no systematic data on what motivated this movement. Factors unrelated to extraction likely prompted peasants to leave their homes, including disease, droughts, and earthquakes (Wightman 1990, pg. 47).

One solution to this challenge is to use the mining mita as the treatment of focus. Given the unique burdens involved with forced labor at Huancavelica and Potosí, comparing mining mita areas to areas that served in other mitas (e.g., agriculture or textile mills) introduces variation in the level of hardship endured by indigenous peasants. Employing the mining mita as treatment also provides the advantage that the comparison of treated to untreated units is within the Viceroyalty of Peru. This helps to isolate the effect of the mining mita by avoiding the compound treatments that are often inherent in studying the effects of policies, which typically vary across rather than within political entities (Keele and Titiunik 2016).[14]

The independent variable of this analysis is thus assignment to the mitas of Huancavelica or Potosí, which I determine with reference to both transcribed primary sources and secondary sources.[15] Figure 5 depicts the location of districts assigned to treated versus untreated districts across the area under study. The map shows that Huancavelica and Potosí mita areas tend to be clustered together and located in the Andes, which was a deliberate choice given the high altitude of the mines (Crespo Rodas

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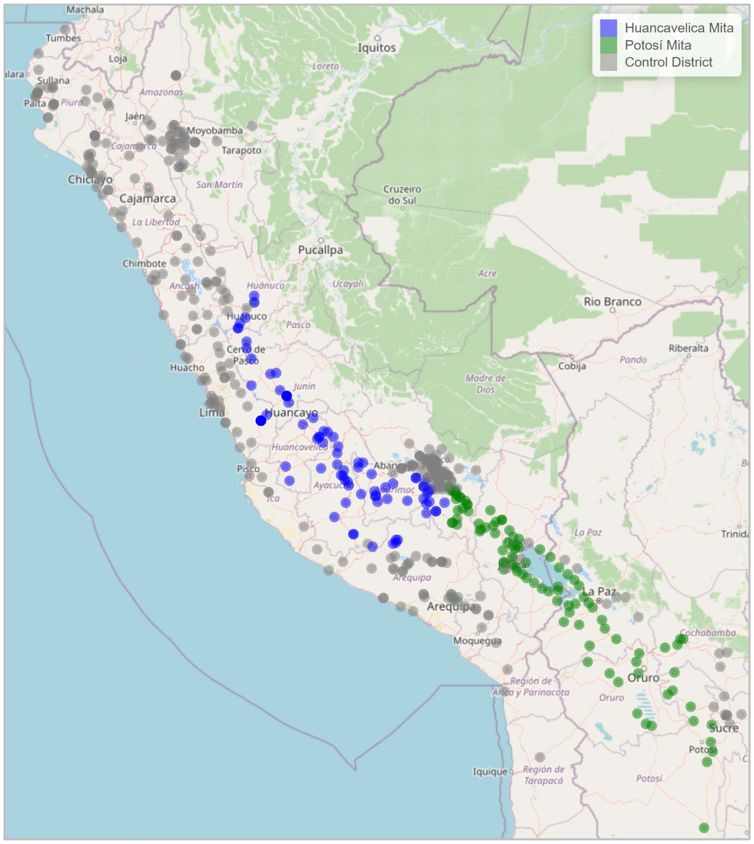
[14] Assignment to the mining mita did adhere closely to the borders of provinces, although this was not always the case. However, the main implication of provincial borders was to designate the territories presided over by different governors (*corregidores*), who served limited terms and whose main responsibilities were administrative in nature (Lohmann Villena 2001, pgs. 261–64).

[15] I use Lohmann Villena (1949, pg. 331) to identify districts assigned to the Huancavelica mita and Sarabia Viejo (1989) and Sánchez-Albornoz (1983) to identify districts assigned to the mita at Potosí.

1970). The Huancavelica mita area roughly centers on the mercury mine, while the Potosí mita stretches to the mine's northwest, reflecting Potosí's location near what was then Spanish America's southern boundary. The control districts, for their part, are largely located along Peru's desert coast, although many are also in the Andes—in particular the northern Andean region of Peru and a cluster around the former Inca capital of Cuzco, which was reserved for labor service to the city (Crespo Rodas 1970). Given this, the treatment and control areas differ systematically.

Figure 5. Map of Treated and Control Districts



To infer flight, I use district-level tributary population as my dependent variable. The tributary population provides an indicator of flight because when tributaries left their home villages, they took on the status of migrants and dropped off of tributary rolls. Migrant status was also hereditary, meaning that descendants carried on the migrant designation (López Beltrán 1987, pg. 263). Thus, localities with a greater decline in tributaries should have experienced more flight, all else equal. However, flight was not the only cause of tributary decline, with mortality being the most obvious alternative. I address the mechanisms behind tributary decline in the Alternative Mechanisms subsection below.

My data on tributary population is primarily digitized from Cook (1982), which compiles indigenous population counts from the 16th and 17th centuries collected from a vast array of archival sources over the course of a decade. Despite the breadth of this data source, it does not provide comprehensive cross sections for both the pre- and post-treatment periods. I thus supplement this data with tributary population counts from over a dozen additional transcribed primary and secondary sources, which are detailed in the data appendix. The resulting dataset contains a complete cross section from 1570-78 encompassing population counts from the census undertaken by Viceroy Toledo, which I use as my pre-treatment baseline. This pre-treatment period is appropriate as Toledo's consolidation of indigenous villages into resettlements had the effect of reclassifying any previous migrants into tributaries (Saignes 1995). Thus, there were no migrants recorded in the baseline measure, and no subsequent reclassifications took place during the period under study.

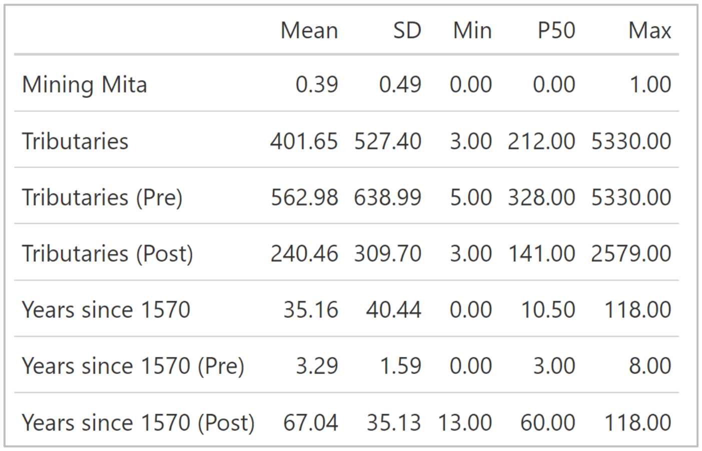
Following Viceroy Toledo's census, few population counts were undertaken during the 17th century, and no complete census is available for this period (Cook 1982). Given this, I construct a post-treatment cross section from population counts recorded between the years 1579, after Viceroy Toledo's most enduring mining mita assignment went into effect (Zagalsky 2014), and 1688, when attempts were first made to close the tributary-migrant loophole (Cole 1984). In the regressions that follow, I select the latest observation if there was more than one for a given district and include a term to account for time trends affecting observations recorded in different years.

As with the tribute rate analysis, the unit of analysis is the district, and there are a total of 541 districts for which Toledo-era data are available across modern-day Peru, Bolivia, and Chile. This sample size is reduced in the analyses that follow due primarily to districts that I have yet been unable to locate and missing post-treatment observations of the tributary population. Table 3 provides descriptive statistics for the variables discussed in this subsection.

B. Causal Identification

Given the availability of both pre- and post-treatment observations for a set of treated and control districts, I opt for a difference-in-differences design (DID) to measure the causal effect of the mining mita. In doing so, I diverge from Dell (2010), which broke new ground in the area of geographic regression discontinuity designs (RDD) by using the provincial boundaries that divided mining mita from control provinces to measure the mining mita's long-term effects.[16] Despite the influence of this study, I decline to use a geographic RDD for three key reasons. First, geolocated provincial boundaries did not exist in the Viceroyalty of Peru during the 16th or 17th centuries, when this study is set.[17] As such, a design based on precisely located boundaries is not ideal. Second, as has been noted by Arroyo Abad and Maurer (2022), Dell's provincial boundaries do not accurately reflect assignment to the mining mita. Finally, a key assumption of RDDs is that the outcome variable must be continuous in the absence of treatment. However, there is a pre-treatment discontinuity in the tributary population at the mining mita boundary, suggesting that this assumption is not met (see Figure A1).[18] Nevertheless, I employ a RDD as a robustness check in the analyses that follow.

Table 3. Descriptive Statistics for DID



	Mean	SD	Min	P50	Max
Mining Mita	0.39	0.49	0.00	0.00	1.00
Tributaries	401.65	527.40	3.00	212.00	5330.00
Tributaries (Pre)	562.98	638.99	5.00	328.00	5330.00
Tributaries (Post)	240.46	309.70	3.00	141.00	2579.00
Years since 1570	35.16	40.44	0.00	10.50	118.00
Years since 1570 (Pre)	3.29	1.59	0.00	3.00	8.00
Years since 1570 (Post)	67.04	35.13	13.00	60.00	118.00

For a DID to properly estimate the average effect of treatment on the treated (ATT), two assumptions must be met. First, the treatment must not have caused anticipatory effects. In the context

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[16] Dell (2010) inspired subsequent scholarship investigating the long-term effects of the mining mita using a geographic RDD approach, including studies focused on population decline (Carpio and Guerrero 2021), population composition (Guardado 2023), and social unrest (Huaroto and Gallego 2022). While Dell (2010), Carpio and Guerrero (2021) and Guardado (2023) each consider flight from the mining mita as a mechanism contributing to their observed results, these studies do not attempt to measure this phenomenon. Arroyo Abad and Maurer (2022) directly estimate population losses attributed to forced labor in colonial Peru but do not differentiate between flight and other causes of population loss.

[17] Instead, provinces consisted of districts that were roughly clustered together. However, there were no precise boundaries between provinces (e.g., Cole 1985, pg. 11).

[18] Figure A1 reflects the fact that district-level tributary populations were significantly smaller near the city of Cuzco. As the capital of the Inca Empire, Cuzco was the center of power and wealth at the time of the Spanish conquest and drew many Spaniards, requiring the division of nearby indigenous inhabitants into smaller encomiendas (which were eventually transitioned into districts) to satisfy demand (De la Puente Brunke 1991, pg. 271). Although Dell (2010) excludes observations from the city of Cuzco from her analysis, this does not account for districts surrounding Cuzco.

of the mining mita, it is hard to see how anticipatory effects could have taken place, as indigenous peasants would have had little opportunity to learn about plans for high-level policy changes.

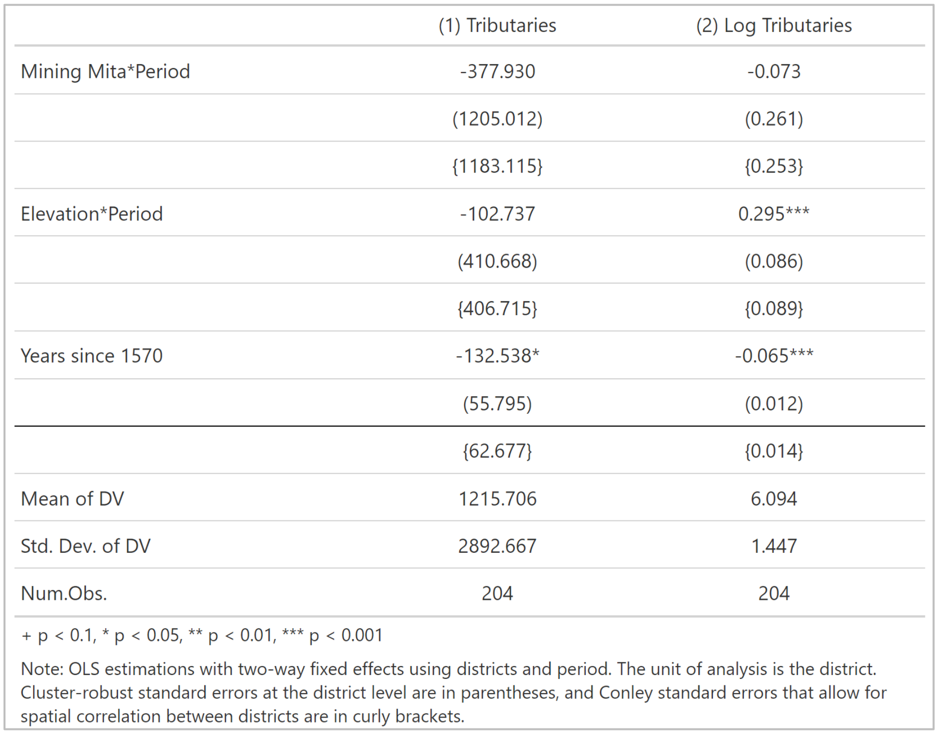
The second DID assumption is that the treated and control groups would have followed parallel trends had treatment not taken place. This assumption is typically supported by showing that the two groups displayed parallel trends prior to the start of treatment. Providing evidence to support parallel trends is a challenge in the present context, as Peru was conquered only 40 years before the 1570s baseline measure. Tributary population counts prior to that point are rare and do not always align with Viceroy Toledo's reconstituted districts. Still, there are pre-1570 observations for 102 districts, which can be used to construct a limited pre-baseline cross section using observations from different points in time.

Another consideration regarding the parallel trends assumption is whether covariates must be conditioned on for parallel trends to hold. In his thorough analysis of indigenous population trends during Peru's early conquest period, Cook (1981) concludes that the low-lying coastal and northern areas fared worse than the Andes, due in large part to less Spanish settlement at high altitudes and the mitigating effect of cool climates on the spread of Old World diseases. As the control areas encompass the coast and the north, while the treatment area largely includes the Andes, the implication is that for parallel trends to hold, elevation must be controlled for.

Table 4 presents regression results for the conditional parallel trends analysis. The two models displayed vary in terms of their use of tributaries or log tributaries as the dependent variable. Both models employ district and period (pre-baseline vs. baseline) fixed effects, in addition to controlling for elevation and the number of years since 1570, which accounts for the varying years represented by observations in the pre-baseline cross section. Standard errors are cluster-robust at the district level, and Conley standard errors that allow for spatial correlations are shown in curly brackets.

As Table 4 shows, the coefficients for the Mining Mita×Period interaction term in each model lack statistical significance. This indicates that there is no statistical difference in the trend between mining mita and control districts in the pre-treatment period for either tributaries or log tributaries, suggesting that either model would be appropriate for a DID analysis. However, it is important to keep in mind the relatively small sample on which these results are based, which can lead to false negatives. Given this limitation, I will employ both tributaries and log tributaries as dependent variables in the analyses that follow, in addition to using both the full and parallel trends samples. On a different note, it is worth highlighting that there was an overall trend of declining tributary population in the pre-treatment period, as evidenced by the negative Years since 1570 coefficients, which can be primarily attributed to the effects of Old World diseases on the indigenous population (Cook 1981).

Table 4. Regression Results for Conditional Parallel Trends Analysis



	(1) Tributaries	(2) Log Tributaries
Mining Mita*Period	-377.930	-0.073
	(1205.012)	(0.261)
	{1183.115}	{0.253}
Elevation*Period	-102.737	0.295***
	(410.668)	(0.086)
	{406.715}	{0.089}
Years since 1570	-132.538*	-0.065***
	(55.795)	(0.012)
	{62.677}	{0.014}
Mean of DV	1215.706	6.094
Std. Dev. of DV	2892.667	1.447
Num.Obs.	204	204

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

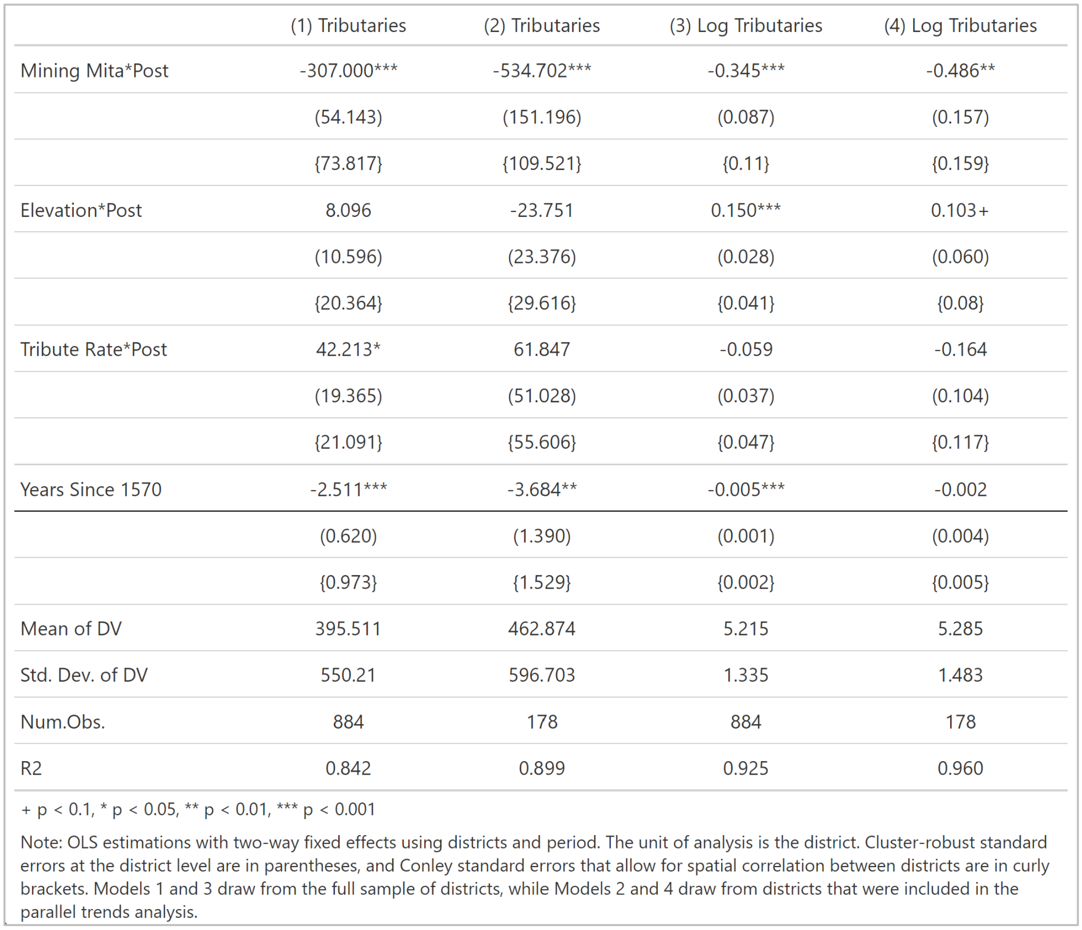
Note: OLS estimations with two-way fixed effects using districts and period. The unit of analysis is the district. Cluster-robust standard errors at the district level are in parentheses, and Conley standard errors that allow for spatial correlation between districts are in curly brackets.

C. Results and Robustness

Table 5 presents the results of the main DID analysis, which employs both tributaries and log tributaries as dependent variables. While Models 1 and 3 use the full sample of districts, Models 2 and 4 draw from the sample that was used for the parallel trends analysis. As with the previous regressions, all models employ district and period (baseline vs. post-treatment) fixed effects, use cluster-robust standard errors, and control for elevation and the numbers of years since 1570, which accounts for the range of years represented by the observations in the post-treatment cross section. In addition, I include the Toledo-era tribute rate as a control variable, given that it was implemented alongside the mining mita treatment and could have been a cause of flight.

As shown in Table 5, estimates of the Mining Mita×Post interaction term are negative across the board and statistically significant at the level of at least $p < 0.01$. These results indicate that the mining mita caused the population of tributaries to decline. Figure 6 illustrates the magnitude of this population decline by drawing from Model 1 to plot the predicted effects of the mining mita. The plot shows that for districts that started with 372 tributaries, control districts are predicted to retain 330 tributaries in the post-treatment period, while only 23 tributaries remain in treated districts. In other words, the mining mita is predicted to cause a 307-person discrepancy between treated and control districts, accounting for a loss of 80% of the tributary population in mining mita districts.

Table 5. Regression Results for DID



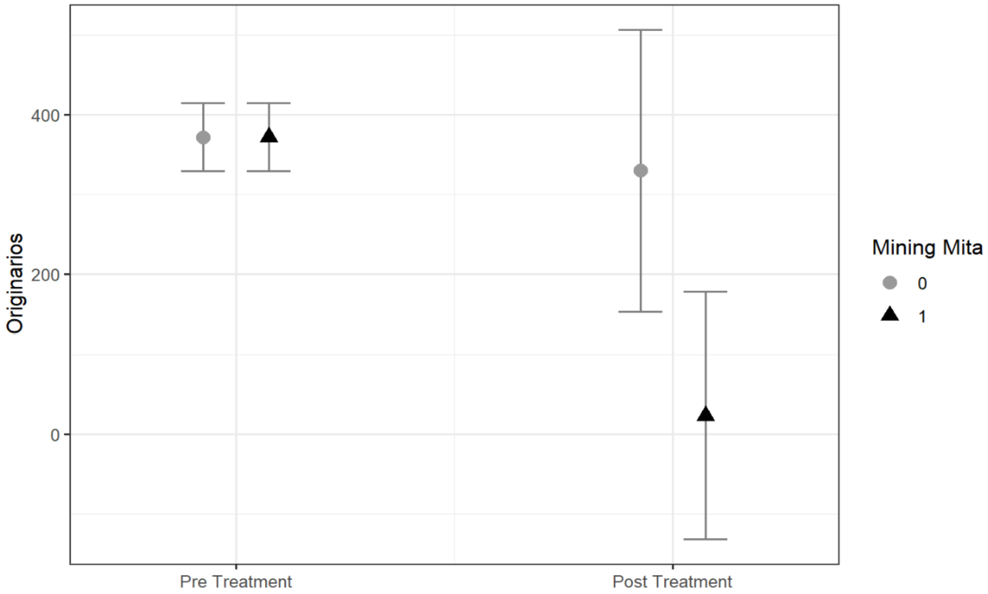
	(1) Tributaries	(2) Tributaries	(3) Log Tributaries	(4) Log Tributaries
Mining Mita*Post	-307.000***	-534.702***	-0.345***	-0.486**
	(54.143)	(151.196)	(0.087)	(0.157)
	{73.817}	{109.521}	{0.11}	{0.159}
Elevation*Post	8.096	-23.751	0.150***	0.103+
	(10.596)	(23.376)	(0.028)	(0.060)
	{20.364}	{29.616}	{0.041}	{0.08}
Tribute Rate*Post	42.213*	61.847	-0.059	-0.164
	(19.365)	(51.028)	(0.037)	(0.104)
	{21.091}	{55.606}	{0.047}	{0.117}
Years Since 1570	-2.511***	-3.684**	-0.005***	-0.002
	(0.620)	(1.390)	(0.001)	(0.004)
	{0.973}	{1.529}	{0.002}	{0.005}
Mean of DV	395.511	462.874	5.215	5.285
Std. Dev. of DV	550.21	596.703	1.335	1.483
Num.Obs.	884	178	884	178
R2	0.842	0.899	0.925	0.960

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Note: OLS estimations with two-way fixed effects using districts and period. The unit of analysis is the district. Cluster-robust standard errors at the district level are in parentheses, and Conley standard errors that allow for spatial correlation between districts are in curly brackets. Models 1 and 3 draw from the full sample of districts, while Models 2 and 4 draw from districts that were included in the parallel trends analysis.

As the parallel trends assumption underpinning the results in Table 5 is supported by limited data, I also pursue three alternative strategies for estimating the causal effect of the mining mita on the tributary population. First, I use a DID drawing from treated and control groups that have been balanced using entropy weights involving five covariates that are conceivably related to pre-treatment population decline: the pre-treatment tributary population, elevation, ruggedness, rainfall, and distance to the nearest large city (Lima, Cuzco, or Potosí). As with the original DID, the results of this analysis also yield negative and statistically significant estimates of the Mining Mita×Post interaction term for both tributaries and log tributaries (see Table A1).

Figure 6. Predicted Effects of the Mining Mita



Note: The predicted effects are calculated from Model 1 in Table 5. All variables not shown are taken at their mean or median values, the latter in the case of dummy variables.

Another alternative strategy I use is referred to as the Local Geographic Ignorability (LGI) design. Formalized by Keele and Titiunik (2016), this design resembles a geographic RDD in that it involves locating a boundary that separates treated and control groups in close proximity to one another. However, instead of assuming that covariates are continuous across the boundary, the design requires that covariates be equal, which allows for a straightforward comparison of the treated and control units. An area with these characteristics can be found in the Andean region at the northern boundary of the Huancavelica mita (see Figure A2), where the five covariates used for entropy balancing are statistically indistinguishable at the level $p < 0.05$ (see Table A2). The results of using a DID with this sample also provide negative and statistically significant estimates of the Mining Mita×Post interaction term for both tributaries and log tributaries (see Table A3).

[I will include results for a RDD design as another robustness check in the next version of this paper. I will also address the possibility that missing tributary population observations in the post-treatment period are due to districts that declined to 0.]

D. Alternative Mechanisms

The results discussed above show that the mining mita caused a significant decline in tributary populations. However, can the disparity in population decline between mining mita and control districts be attributed to flight? A key alternative mechanism for the greater population decline caused by the mining mita is that mine work involved higher levels of mortality than other mitas due to its unique health risks. Indeed, some scholars have argued that the mining mita was a major contributor to indigenous mortality (Brown 2001; Rendón 2020).

It is undoubtedly true that working in the mines involved greater hazards than other forms of forced labor at the time. However, that mortality from the mining mita accounted for population decline of close to 80% does not stand to reason. Given the Crown's reliance on silver revenues from Potosí as well as its long time horizon, it was not in the Spanish regime's interest to deplete its work force. Threats to silver production, including the labor supply, were a topic of prime concern among colonial officials. However, official reports rarely mentioned mine-related deaths or injuries as a threat to that supply (Bakewell 2009, pg. 146). Moreover, despite the Crown's capacity limitations, it did attempt to reign in the abuses of mine operators. The mines were subjected to official inspections, and in many cases mine operators were prosecuted and fined for safety violations or the mistreatment of indigenous workers (Bakewell 2009, pgs. 147–49). While reports of extreme mortality rates existed, these may have been exaggerated by individuals with an interest in keeping peasant labor away from the mining mita and for themselves (Bradby 2000, pg. 231).

Unfortunately, systematic data that would allow for a direct comparison of mortality rates across control and treated areas do not appear to exist. However, it is possible to use limited data to estimate how much of the tributary decline in mining mita areas can be attributed to mortality from mine work. In an article discussing the health impacts of working in the Huancavelica mercury mine, Brown cites deaths attributed to the "evil of Huancavelica" reported by two ethnic groups (2001, pg. 491). The mortality rate for these workers over a five-year period is just shy of 10%.[19] Given that only one seventh of a community's tributaries were to serve in the mining mita at any one time, the mining-related mortality rate for these groups' tributaries overall can be estimated at $\frac{1}{70}$ per year. It is important to note that this rate may be an overestimate given that it derives from data related by indigenous groups, who had an interest in lowering their mita obligations. Moreover, the numbers were reported during the most dangerous period of mining at Huancavelica (Brown 2001), and it is unclear whether

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[19] Over the years 1598-1602, Brown states that the Hananhuancas lost 548 mita workers to Huancavelica, while the Lurinhuancas lost about 800 (2001, pgs. 490–91). During the same period, the Hananhuancas provided 140 workers for each two-month rotation, and the Lurinhuancas provided 320 workers. The mortality rate of about 10% is arrived at through the following equation: $\frac{548+800\ deaths}{\left(140\frac{workers}{rotation}*6\frac{rotations}{year}*5\ years\right)+(320\frac{workers}{rotation}*6\frac{rotations}{year}*5\ years)} = 0.098$.

the deaths encompass long-term wage workers in addition to short-term mita conscripts.

That being said, the mortality rate of $\frac{1}{70}$ can be used to arrive at a generous estimate of how much population should remain after a given time period by using the formula for exponential decay. To calculate this number, I use the values from Figure 5—specifically, a starting population of 372 tributaries and a period of 35 years (the mean number of years since 1570)—to determine that with an annual mortality rate of $\frac{1}{70}$, about 225 tributaries would be expected to remain in mining mita districts 35 years later.[20] In other words, mine-related mortality should have accounted for approximately 147 deaths. While this sum is nothing to sniff at, it pales in comparison to the predicted 307-person discrepancy between mining mita and control districts shown in Figure 5. These numbers suggest that 48% of the tributary loss caused by the mining mita can be explained by deaths due to the conditions at Huancavelica and Potosí. While it is possible that other consequences of the mining mita explain some of the unaccounted-for deaths, historical sources only discuss mortality from the mines and flight as major sources of tributary population decline unique to mining mita areas. Indeed, though data on migration is limited, available evidence suggests that migrants nearly rivaled tributaries by the late 17th century, comprising 42% of adult men in the villages they inhabited.[21] Combined with ample anecdotal evidence, these considerations suggest that close to 50% of the tributary decline cause by the mining mita was due to flight.

VII. DISCUSSION

[In this section, I will primarily discuss the extent to which this study's model applies to other settings, both historical and contemporary. Examples ranging from the fugitive peasants who fled serfdom to the Maroon communities of escaped slaves across the Americas suggest that flight was often the chosen reaction to exploitation during the pre-industrial period. While autocrats have become more capable of preventing flight over time, one only need look towards the countless North Koreans who have defected to South Korea against great odds or Venezuelans who have braved the Darien Gap to see flight's continued relevance. The model developed in this paper can be adapted towards understanding

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[20] Specifically, the formula I use is $x_t = x_0(1-r)^t$, where x_t is the population at time t, x_0 is the starting population, and r is the rate of decline. This yields the following equation: $372(1-\frac{1}{70})^{35} = 224.82$.

[21] This figure comes from 107 districts in which data on migrants were collected, as recorded in my replication data. Adult men in this context refers to tributaries and male migrants.

how flight affects the logic of autocratic extraction in these and other settings.]

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IX. APPENDICES

Figure A1. Pre-Treatment Geographic Distribution of Tributary Population

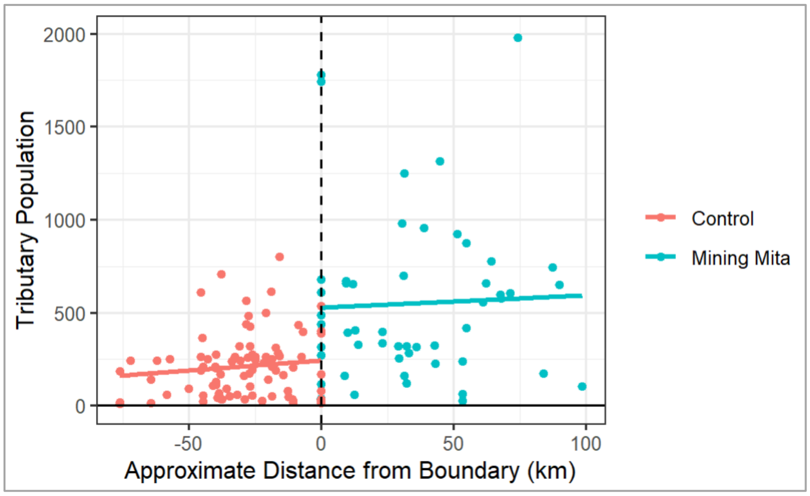
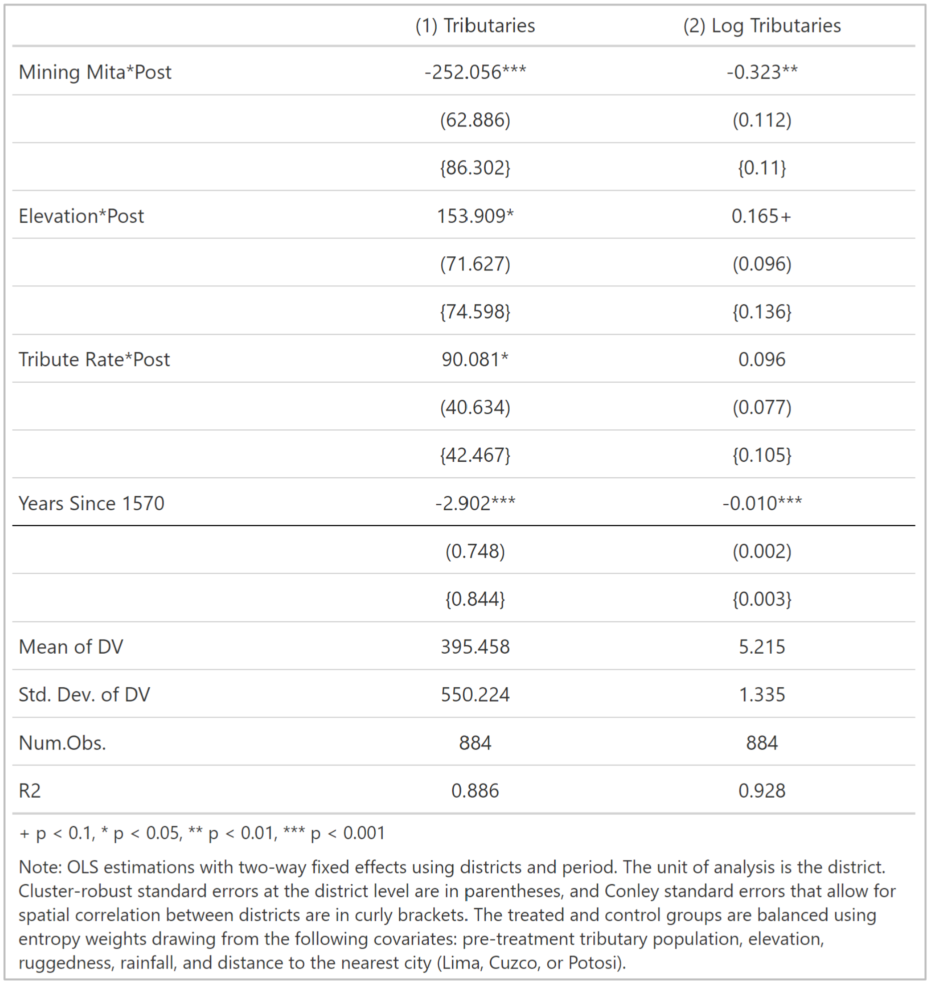


Table A1. Regression Results for DID with Entropy Balancing



	(1) Tributaries	(2) Log Tributaries
Mining Mita*Post	-252.056***	-0.323**
	(62.886)	(0.112)
	{86.302}	{0.11}
Elevation*Post	153.909*	0.165+
	(71.627)	(0.096)
	{74.598}	{0.136}
Tribute Rate*Post	90.081*	0.096
	(40.634)	(0.077)
	{42.467}	{0.105}
Years Since 1570	-2.902***	-0.010***
	(0.748)	(0.002)
	{0.844}	{0.003}
Mean of DV	395.458	5.215
Std. Dev. of DV	550.224	1.335
Num.Obs.	884	884
R2	0.886	0.928

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: OLS estimations with two-way fixed effects using districts and period. The unit of analysis is the district. Cluster-robust standard errors at the district level are in parentheses, and Conley standard errors that allow for spatial correlation between districts are in curly brackets. The treated and control groups are balanced using entropy weights drawing from the following covariates: pre-treatment tributary population, elevation, ruggedness, rainfall, and distance to the nearest city (Lima, Cuzco, or Potosi).

Figure A2. Map of LGI Sample

Table A2. Covariate Balance for LGI

	0		1			
	Mean	Std. Dev.	Mean	Std. Dev.	Diff. in Means	Std. Error
Tributaries (Pre)	689.7	539.4	842.7	995.5	152.9	165.7
Elevation (km)	3.1	0.5	3.3	0.5	0.2+	0.1
Ruggedness	121.4	45.2	102.3	67.9	-19.1	12.2
Rainfall	0.8	0.8	0.6	0.6	-0.2	0.2
Distance from City (km)	236.1	111.4	207.5	51.1	-28.6	20.9

Table A3. Regressions Results for DID with LGI

	(1) Tributaries	(2) Log Tributaries
Mining Mita*Post	-245.409*	-0.381**
	(120.546)	(0.116)
	{118.089}	{0.12}
Elevation*Post	-12.011	-0.179+
	(113.269)	(0.098)
	{104.645}	{0.13}
Tribute Rate*Post	-522.949**	-0.235
	(192.140)	(0.180)
	{174.582}	{0.123}
Years Since 1570	-8.633*	-0.016***
	(3.307)	(0.003)
	{2.191}	{0.003}
Mean of DV	395.458	5.215
Std. Dev. of DV	550.224	1.335
Num.Obs.	168	168
R2	0.782	0.936

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Note: OLS estimations with two-way fixed effects using districts and period. The unit of analysis is the district. Cluster-robust standard errors at the district level are in parentheses, and Conley standard errors that allow for spatial correlation between districts are in curly brackets.