From Conquest to Centralization: Domestic Conflict and the Transition to Direct Rule*

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Abstract

Why do governments centralize control over regions? We develop a theory of the transition from indirect to direct rule, focusing on the strategic interaction between a ruler and local potentates who provide civil order in exchange a share of tax revenue. When the threat of rebellion from below falls and elites become less willing and able to resist centralization, the ruler can replace local potentates with direct agents of the state and invest in a fiscal bureaucracy, with implications for state development. We assess our theory using subnational data from 16th- and 17th-century Mexico around the time of a dramatic demographic collapse, which undermined the threat of domestic conflict. Using difference-in-differences and instrumental-variables empirical strategies, we show that state centralization occurred faster in areas experiencing a more dramatic decline in population. Our instrumental-variables strategy leverages variation in the climate shocks associated with a virulent series of epidemics during this period.

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What drives state centralization? States with direct forms of rule over their territory and centralized fiscal institutions are better able to provide the basic administrative infrastructure required to sustain economic growth (e.g., Bockstette, Chanda and Putterman 2002; Gannaioli and Rainer 2007; Michalopoulos and Papaioannou 2013; Osafo-Kwaako and Robinson 2013; Dincecco and Katz 2014). By contrast, states that rely on indirect forms of rule over hinterland regions—wherein local elites retain considerable power and autonomy in fiscal and military matters—tend to experience worse economic and political performance (e.g., Migdal 1988; Boone 1994; Mamdani 1996; Lange 2004; Hariri 2012; Acemoglu et al. 2014). Given this evidence, it is crucial to understand when and how rulers transition from indirect to direct rule, centralizing control over their territory.

In this paper, we theoretically and empirically explore the transition to direct rule, drawing on evidence from colonial Mexico. Building on past work on indirect rule and state formation, we construct a theory of political centralization that highlights the strategic dilemma faced by rulers as they seek to centralize power over their domain. Under indirect rule, local potentates provide civil order in exchange for local political and fiscal autonomy. Centralization allows rulers to exert more control over their territory and increase their share of tax revenue, but it also strips power from elites, who may be better able to monitor and enforce order in their regions. The transition to direct rule is therefore a risky enterprise, exposing rulers to an increased threat of revolt by local elites, who may wish to contest their loss of power, and by commoners, who may take advantage of temporarily reduced local political control. We demonstrate that a rapid decline in local population can facilitate the adoption of direct rule by reducing both the threat of generalized rebellion and the incentives of local elites to resist the centralization of power. Our theory provides one mechanism through which demographic change shapes political structure (e.g., Herbst 2000; Boone 2003; Voigtländer and Voth 2013*a*; Sellars and Alix-Garcia 2017) and highlights the role of domestic elite conflict in the process of state centralization (e.g., Gerring et al. 2011; Mares and Queralt 2015; Beramendi, Dincecco and Rogers 2016; Garfias 2016*b*).

We find empirical support for this theory using subnational panel data on the transition to direct rule in 16th- and 17th-century Mexico. In the early colonial period, Spain relied on an institution of indirect rule, the *encomienda*, to quickly establish control over territory. Elites were given the right to extract taxes and labor from the local population in exchange for providing for local defense and converting the populace to Christianity. As political control was consolidated, royal officials gradually moved to centralize colonial administration, replacing private *encomiendas* with *corregimientos*, publicly held offices through which direct agents of the state collected taxes for the Crown. The establishment of a Crown-controlled bureaucracy in charge of tax collection laid the foundation for the later development of local state capacity. However, the transition to direct rule was uneven, and some parts of the colony remained under indirect rule until the end of the colonial period.

Importantly, the centralization of fiscal authority in Mexico occurred alongside a cataclysmic demographic collapse. Within a century of the Conquest, Mexico's indigenous population had fallen by around 90%, mostly due to disease. The severity of the collapse varied considerably across space and shaped the Crown's ability and willingness to centralize power in different regions. In disease-affected areas, ruling elites' opportunities to extract local tax revenue and labor evaporated, undermining both their incentives and ability to contest the loss of political authority to the center. Moreover, the population collapse directly reduced the potential benefits of indirect rule for the Crown by undermining the threat of rebellion among surviving commoners and the incentives of elites to defend their regions in the face of declining tax revenues. The Crown was thus more willing and able to wrest political control from local elites in areas of high population loss.

We empirically demonstrate the link between the demographic collapse and the adoption of direct rule using two related empirical strategies. We first employ a difference-in-differences approach, exploiting within-district variation in population size and form of rule over time. To further address potential concerns about reverse causality and measurement error, we also adopt an instrumental-variables approach based on the features of a series of climate-related epidemics that impacted the country beginning in the middle of the sixteenth century. These epidemics, caused by a pathogen known as cocoliztli, emerged during rebound periods of rainfall following severe droughts (Acuña Soto et al. 2002). Building on the empirical strategy of Sellars and Alix-Garcia (2017), we instrument for the decline in population using proxies for these climate conditions derived from tree-ring chronologies (Cook and Krusic 2004). We show that the transition from indirect (*encomienda*) to direct (*corregimiento*) rule occurred more rapidly in areas that experienced a more precipitous decline in population. These results are robust under several different empirical specifications and when controlling for other potential correlates of state centralization. We further demonstrate that the effect of the collapse on the transition to indirect rule was magnified in areas where the threat of rebellion had been high and where elites had more profitable outside earnings opportunities, providing additional support for the theory.

This paper contributes to the literatures on state formation, historical dependence and development, and the political economy of population. Past scholarship on the development of state capacity has emphasized the role of interstate war in the centralization of fiscal authority. In Europe, the increasing costs of interstate conflict generated incentives to centralize tax collection to wage wars successfully (e.g., Tilly 1990; Besley and Persson 2011; Hoffman 2012; Gannaioli and Voth 2015). The capacity-enhancing legacy of tax-financed warfare has been demonstrated both in Europe and beyond (e.g., Herbst 2000; Centeno 2003; Queralt 2016), though some have questioned the applicability of the bellocentric model in other contexts (e.g., Osafo-Kwaako and Robinson 2013). Other work on state capacity has focused on the availability of technologies to project direct rule into the hinterland (e.g., Cederman and Girardin 2010; Gerring et al. 2011; Mayshar, Moav and Neeman 2017) or on potential institutional bargains between the ruler and local elites (e.g., Ertman 1997; Hoffman and Rosenthal 1997; Dincecco 2009; Garfias 2016*a*). By contrast, we provide a rationale for state centralization that focuses on the role of domestic conflict (e.g., Gerring et al. 2011; Mares and Queralt 2015; Beramendi, Dincecco and Rogers 2016; Garfias 2016*b*).

This focus on domestic conflict also sets our paper apart from the literature on population dynamics and state formation, and particularly work linking the Black Plague with the rise of the European nation-state (e.g., Epstein 2000; Levine 2006; Voigtländer and Voth 2013*a*;*b*). In these and other works, the institutional impacts of population scarcity operate largely through increasing the income and bargaining power of surviving labor. This in turn undermines feudal arrangements and increases incentives for expanded interstate warfare and tax capacity. The severe drop in population serves a somewhat different role in our theory, weakening the bargaining power of elites through reducing their opportunities for rent-seeking and decreasing the threat of local rebellion, thus obviating the Crown's need to outsource local political control. The theorized link between the population collapse and a decrease in the threat of rebellion is supported both by historical evidence on the time period and by the growing literature on population density and civil unrest (e.g., Katz 1988; Homer-Dixon 1999; Salehyan and Gleditsch 2006; Reuveny 2007). Furthermore, our work calls attention to several mechanisms through which population scarcity—rather than density, as is often argued—may facilitate state centralization and the development of state capacity. This provides an interesting contrast to work arguing that population scarcity hinders institutional development, in particular the literature linking low population density to underdevelopment in sub-Saharan Africa (e.g., Herbst 2000; Boone 2003; Fenske 2013).

More broadly, this paper also contributes to the literatures on historical dependence and development in Mexico and beyond. It is now well established that historical institutions, and especially those developed under colonial rule, have long-reaching impacts on development (e.g., La Porta et al. 1997; Acemoglu, Johnson and Robinson 2002; Nunn 2009; Dell 2010; Mahoney 2010). Colonial institutions in general, and those resulting from the sixteenth-century population collapse in particular, have been blamed for contemporary Mexican underdevelopment (e.g., Borah 1951; Acemoglu and Robinson 2012; Sellars and Alix-Garcia 2017). Our work extends this literature by connecting the population collapse to the uneven development of Mexican state capacity through its effect on domestic conflict and on early fiscal centralization. By focusing on subnational variation in the transition to direct rule, we also draw attention to within-country differences in political development in Mexico and beyond (e.g., Soifer 2008; Naseemullah and Staniland 2016).

The paper proceeds as follows. In Section 1, we present our theory on the transition to direct rule. We then discuss the empirical setting and provide preliminary evidence in support of our main argument in Section 2. We describe the sources and construction of our data in Section 3. We discuss our empirical strategy and present our main results in Section 4. We conclude in Section 5.

1. Domestic Conflict and the Transition to Direct Rule

The centralization of political and fiscal authority is a key feature of state development. Both contemporary and historical governance arrangements, however, have differed widely in the extent to which decision-making is concentrated in the hands of a central ruler or government. Under forms of indirect rule, central authorities delegate considerable political and fiscal authority to local power-holders. The local potentates provide political control over their regions while holding fealty to the central ruler. This is often done in exchange for the right to extract local resources or tax revenues. This is the classic model of the relationship between lords and the monarch under feudalism. Similar institutional arrangements can be found in the territorial organization of empires and in the administration of colonial holdings acquired through conquest. Under direct rule, by contrast, power is concentrated in a central state administration. Salaried agents of the state are deployed to hinterland regions to govern. These agents typically do not hold independent coercive power, and can be removed through regularized bureaucratic procedures (e.g., Doyle 1986; Mamdani 1996; Lange 2009; Gerring et al. 2011). Though studies of direct and indirect forms of rule typically focus on colonial institutions, indirect rule arrangements persist today under a variety of forms and labels (e.g., Gerring et al. 2011; Naseemullah and Staniland 2016). Central rulers in many parts of the world continue to rely on local actors to extend power over areas that are difficult to govern.

Reliance on indirect rule has been linked with long-term political and economic underdevelopment. However, establishing direct fiscal and political control over territory is not always feasible or optimal from the perspective of the central ruler. Indirect rule arrangements are often implemented in areas where political control might otherwise be tenuous, such as in territory that has been recently conquered or that is far from the seat of power. Even when it might be possible to centralize authority, indirect rule arrangements may be useful to the central ruler. Local elites may be better positioned to establish political order given their physical proximity to the district, their access to information about those live there, and their ability to put down incipient rebellions using local sources of force. Delegating the responsibility for maintaining political control and administering territory to these elites may therefore be attractive. The costs of state administration may also be lower under indirect rule. Under these arrangements, local intermediaries often control key features of the state apparatus, such as the institutions used to collect taxes or control labor. By delegating fiscal authority to these local elites, the ruler can extend control over territory without having to invest in the extensive administrative bureaucracy that would be needed to govern directly.

However, the reliance on intermediaries to establish order is also costly for the ruler. Indirect rule entails a loss of revenue from the ruler to local potentates as compensation for establishing political control. In addition, indirect rule arrangements may give local elites considerable bargaining power when dealing with the ruler because of the important role these intermediaries play in maintaining order. Though local potentates might not be powerful enough to directly challenge the ruler, they can often extract concessions from the center through the veiled or explicit threat of facilitating popular unrest in their districts (e.g., Lange 2004; Hetcher and Kabiri 2008; Siroky, Dzutsev and Hechter 2013). In extreme cases, the local potentates themselves may organize and violently challenge a central ruler, especially when their interests are threatened by efforts to centralize power.

In determining whether to establish direct rule, a central authority therefore faces a trade-off. Direct rule holds the promise of higher future revenue and improved political control, but it also heightens the risk of rebellion and requires a costly up-front investment in setting up an administrative apparatus.[1] As long as the risk of rebellion is high and local potentates have an incentive to contain unrest, the ruler may be unable or unwilling to centralize authority. However, when the risk of rebellion drops, local elites lose bargaining power, and establishing direct rule becomes easier. In addition, when local potentates are no longer willing or able to maintain order, the benefits of indirect rule disappear, and centralizing authority becomes more attractive.

A shock that alters the risk of rebellion, and with it the bargaining power of local elites, can thus facilitate political centralization. We argue that a sudden and large loss of population, such as occurred during the waves of epidemics in early colonial Mexico, represents one such centralizing shock. In our theory, a population collapse has two effects that facilitate the transition to direct rule. First, and most directly, a fall in population reduces the threat of popular uprising by reducing pressure on resources. This contention is supported by a large literature linking population density and conflict in political science and economics (e.g., Boserup 1965; Homer-Dixon 1999; Goldstone 2002; Acemoglu, Fergusson and Johnson 2017). In addition, a severe demographic collapse can

[1] The ruler's objective of maximizing revenue while carefully considering the risk of rebellion has a parallel in the *revenue* and *power* hypotheses in Gerring et al. (2011).

rupture informal institutions that facilitate collective action. This mechanism is highlighted by the Mexico-specific literature on indigenous mobilization (or lack of mobilization) in the early colonial period as the region was dealing with cycles of massive population loss (e.g., Taylor 1979; Katz 1988). Facing a lower likelihood of rebellion and declining revenues in the face of a population collapse, local potentates may cut back on costly efforts to defend their regions. This further undermines their usefulness and bargaining power to central rulers, reducing the risk of centralizing political authority and undermines the bargaining power of local elites, who have a comparative advantage in maintaining order.

A second mechanism through which a demographic shock may influence the transition to direct rule is through reducing local tax or tribute revenue. In colonial Spanish America, tribute burdens were calculated as a standard capitation tax on households, making the link between population and revenue explicit (Cook and Borah 1971; Zavala 1973). In this setting and in many others, local elites were compensated for the expense of providing authority with a share of local revenues. By reducing the amount of revenue available to these potentates, a population collapse can reduce the elite's perceived benefit of maintaining indirect rule arrangements. This may especially be the case when local elites have profitable outside earnings opportunities in commerce, farming, or mining. Even if local elites would prefer to maintain indirect rule, a sharp reduction in revenue can undermine their ability to raise an army and directly resist attempts to centralize authority. Though a sharp decline in population would also reduce the ruler's immediate revenue gain from centralizing power, establishing direct rule is often attractive to central authorities for other reasons. Direct rule reduces the ruler's dependence on local elites and can facilitate the creation of institutions that enhance revenue collection and state power going forward. A sudden reduction in population may therefore provide an opportunity to centralize power while local potentates are relatively weak and the threat of generalized rebellion is low.

We present a formalization of this argument in the Appendix. From our theory, we derive a series of testable hypotheses on the relationship between the demographic collapse and the transition to direct rule. First, a central authority should more likely to establish direct rule in the wake of a precipitous population collapse (Hypothesis 1). If the benefits of indirect rule are based on containing the threat of rebellion from below, as we argue, a demographic shock that targets areas where the potential for contentious action is high should have a disproportionate effect on the transition to direct rule. We therefore expect that the causal effect of a decline in population on the transition to direct rule should be amplified where the latent threat of rebellion would have been higher (Hypothesis 2). Our argument also generates hypotheses about the role of elite outside options on the transition to direct rule. In particular, the effect of the population collapse on the transition to direct rule should be greater where elite outside options are more attractive as local potentates will become less likely to contest the centralization of power as revenues decline (Hypothesis 3). Additionally, our theory predicts that the overall level of direct rule should be greater where elite outside options are more attractive because this lowers the relative benefits of indirect rule for the elite (Hypothesis 4).

We empirically evaluate these hypotheses in the remainder of the paper. In the next section, we provide background on the context we examine: 16th- and 17th-century Mexico.

2. Historical Setting

Though primarily thought of as an institution of labor exploitation, the Spanish *encomienda* was designed in part to facilitate the rapid extension of political authority through indirect rule[2] (García Martínez 2011). Following the fall of the Triple Alliance (Aztec Empire), the Spanish Crown was faced with the challenge of administering an expansive new territory far from the metropole. Royal authorities used the promise of indigenous tribute (a traditional capitation tax levied on heads of household) and labor to outsource the conquest of new territory to freelance conquistadors, who became the first *encomenderos* or holders of *encomiendas*. In exchange for the right to extract from the local population, the encomenderos provided for local defense, tax collection, and Christian conversion. As with British indirect rule in Africa and South Asia, the Spanish *encomienda* functioned by superimposing institutions of indirect rule over the pre-existing political organization and tribute system in the territory. In this case, they primarily relied on the

[2]The institutions associated with indirect rule vary widely. The Mexican case arguably corresponds most closely with what Naseemullah and Staniland (2016) term "hybrid rule" in their typology of direct rule institutions.

tribute system of the Triple Alliance or Aztec Empire, but they also incorporated institutions from smaller outlying kingdoms (Gibson 1964; Hassig 1985; Abernethy 2000; García Martínez 2011). In the early years of the colony, the *encomienda* provided a relatively low-cost way to incorporate both conquistadors and indigenous elites into the colonial state, providing a "rickety superstructure of government" in places where the reach of the Crown might not have extended otherwise (Knight 2002, p. 29; see also Zavala 1973, p. 47–9; García Martínez 2011, p. 1938). In this respect, it played a similar role facilitating the rapid expansion of the empire as did indirect rule institutions in other settings (Boone 2003; Naseemullah and Staniland 2016).

The delegation of power to local intermediaries does not come without costs, as highlighted in Section 1. The emerging power and autonomy of the *encomendero* class quickly began to be perceived as a threat to the Crown (Gibson 1964; Yeager 1995; Knight 2002). The first royal decrees aimed at curtailing the rights of *encomenderos* came in 1523, only two years after the fall of Tenochtitlan. However, the Crown's early efforts to regain political control from local elites were met with decidedly limited success given the ongoing political challenges of the Conquest and extensive *encomendero* resistance (Gibson 1964; Yeager 1995; Knight 2002). A striking example of this resistance came following the announcement of the New Laws of 1542, which were designed to place limits on *encomendero* authority, but which were quickly repealed in the face of a significant and organized elite rebellion (Gibson 1964; Knight 2002). While comparatively subdued in Mexico, the revolt of *encomenderos* in Peru culminated in the overthrow of the local colonial government and the execution of the viceroy, severely threatening control over the colony. Alarmed at these developments, King Charles I reversed course on plans to phase out the *encomienda* and rein in the *encomendero* class, tentatively allowing *encomenderos* to maintain a degree of local political autonomy (Zavala 1973; Knight 2002).

What eventually subverted *encomendero* power was the catastrophic collapse of Mexico's indigenous population. Though precise figures vary, it is estimated that the indigenous population of Central Mexico declined by over 90% during the first century of colonial rule due to drought and disease (Cook and Borah 1971; Hassig 1985; Knight 2002). Much of the demographic collapse can be attributed to a series of epidemics that swept across the colony in the sixteenth century (Hassig

1985; Acuña Soto, Calderon Romero and Maguire 2000; Acuña Soto et al. 2002). The sharp decline of the population reshaped the political economy of the colony in numerous ways. The evaporation of tribute income undermined the *encomienda*, reducing both the willingness and ability of "politically subdued" and "largely impoverished" *encomenderos* to resist the Crown's efforts to centralize political authority (Zavala 1973; Hassig 1985; Knight 2002, p. 57). Faced with a declining local population to tax, elites increasingly transitioned to other forms of wealth extraction in the agricultural and mining sectors (Gibson 1964; Lockhart 1969; Zavala 1973). The collapse itself facilitated this process by making it easier for elites to acquire land and reducing the competition from indigenous growers in agricultural markets (Florescano 1976; Sellars and Alix-Garcia 2017). Increasing mining activity provided other opportunities for elites to gain wealth and power outside of the *encomienda*, further lowering their incentives to resist direct rule.

Beyond reducing the incentives and ability of elites to resist the transition from the *encomienda*, the demographic collapse had broader societal effects that also facilitated the centralization of political control. The sharp decline in population and subsequent relocation of survivors greatly depressed the threat of indigenous rebellion. In the wake of major epidemics, indigenous social institutions facilitating collective action collapsed, population pressures on land decreased, and survivors were left "demoralized and disorganized" (Katz 1988, p. 80). Controlling local rebellion had been a central responsibility of *encomenderos* and a justification for the continuation of indirect rule. Though pacification efforts were costly to the Crown and *encomenderos* alike, the latter were perceived to be better able to provide security given their proximity to the districts and specialized local knowledge. The risk of increasing rebellion was even cited by some elites, and even the clergy, as a justification for opposing political centralization (Gibson 1964; Zavala 1973, p. 83). For instance, in a 1545 letter, one *encomendero* mentions that the mere act of announcing limits on *encomienda* holdings "had increased the insolence of the Indian population" and diminished local control (qtd in Zavala 1973, p. 84). As the threat of social unrest declined following the population collapse, however, such concerns arguably became less salient for Crown authorities.

By the end of the sixteenth century, the Crown had implemented numerous provisions eroding *encomendero* power and the encomienda had faded from importance in much of central Mexico

(Gibson 1964; Hassig 1985; Knight 2002). Private *encomiendas* were gradually replaced by *corregimientos*, public offices through which royal officials directly collected taxes for the Crown. This institution had several features that enhanced royal control over the colony. Unlike *encomenderos*, the holders of these offices, *corregidores*, were paid directly by the royal government, answered to higher-level royal officials, and were tasked with a variety of new administrative responsibilities (Gibson 1964; Knight 2002; García Martínez 2011).[3]

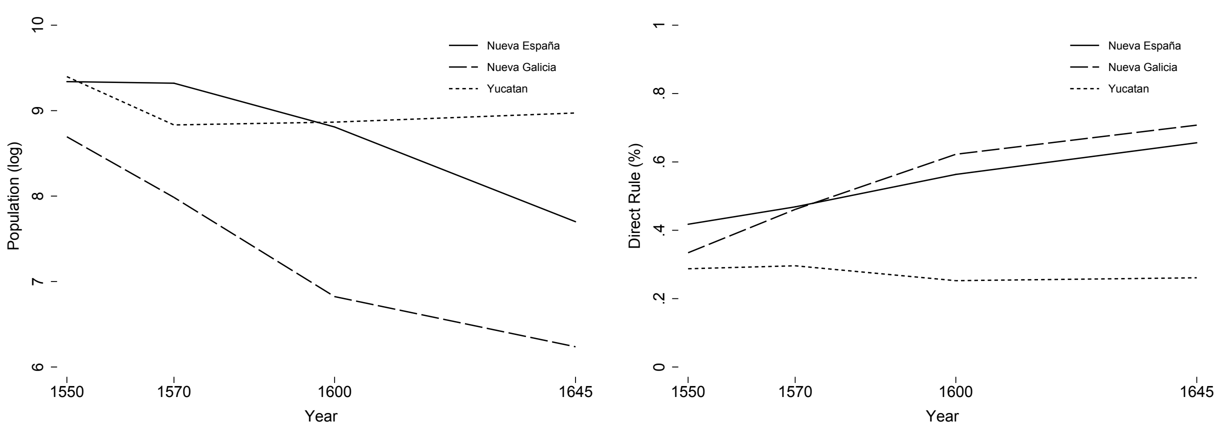
Though the immediate effects of this transition on the surviving indigenous population remain the subject of debate (e.g., Gibson 1964, p. 82–3), *corregidores* became "useful agents of centralization," helping the government to consolidate power within the royal bureaucracy (Knight 2002, p. 54). *Corregimientos* became the keystone of the Spanish bureaucracy in the Americas. Through centralizing tribute collection through the *corregimiento*, the Crown "penetrated and dissolved the private fiefs of the early *encomenderos*", reigning in the political and economic power of local elites and strengthening state institutions (Knight 2002, p. 57). The centralization of fiscal authority through the *corregimiento* enabled the Crown to standardize tribute rates and to further bureaucratize the process of tax collection (Gibson 1964; Zavala 1973; Knight 2002).

The transition to direct rule, however, was not universal. While the Crown quickly moved to centralize control over holdings in parts of the colony, in other areas it actively perpetuated institutions of indirect rule, quickly reassigning private holdings to new *encomenderos* upon their reversion to Crown management. Scholars emphasizing the near-complete collapse of the Mexican *encomienda* by the end of the sixteenth century have focused almost exclusively on the area surrounding Mexico City (e.g., Gibson 1964; Hassig 1985). Several factors contributed to the rapid transition to direct rule in this region, as highlighted in Section 1. As the center of Spanish power in the Americas, Mexico City was a hub of economic and political activity and the primary area of colonist settlement (Gibson 1964; Knight 2002). Royal control over this region was as strong as anywhere else in the Empire, reducing the potential political and social benefits of indirect rule for the Crown. In addition, the relative attractiveness of maintaining the *encomienda* for local elites was somewhat

[3] *Corregimientos* remained salaried offices throughout our period of analysis. However, the Crown began to auction them off in the second half of the seventeenth century (Pietschmann 1972; Guardado 2016).

diminished given other opportunities for economic extraction in the region. This was especially true as tribute revenues declined following the demographic collapse (Hassig 1985; Knight 2002). Land investment in particular became increasingly attractive as colonists' demand for agricultural products in Mexico City outstripped the productive capacity of the shrinking indigenous population. Land concentration and speculation powered the rise of a new class of landed elites in central Mexico, which included no small number of former *encomenderos* in its ranks (Gibson 1964; Lockhart 1969; Keith 1971; Florescano 1976). This economic and political shift to land (as opposed to tribute and labor) exploitation further dampened the incentives of local elites to contest the centralization of fiscal capacity through the *corregimiento* (Knight 2002).

Figure 1: Regional Trends in Indigenous Population and Direct Rule



(a) Population (log) (b) Direct rule

Note: The graphs plot the average population (log) and direct rule (%) across the districts in each region. Data sources and construction are discussed in Section 3. These data use a ten-year bandwidth around population cutpoints.

By contrast, in the Yucatan, where indigenous populations remained relatively dense and tied to villages, the *encomienda* thrived as an institution well into the eighteenth century (Garcia Bernal 1979; Gerhard 1993*c*; Knight 2002). Though Spanish contact with Yucatan's indigenous population predated the conquest of central Mexico, political control over the region remained tenuous until the mid-1540s (Gerhard 1993*c*). The conquest of the Yucatan was complicated by several factors, many of which also contributed to the long-term survival of indirect rule. One such factor was the high level of resistance provided by the region's indigenous population due to its relative homogeneity (nearly all spoke mutually intelligible dialects of Yucatec Maya) and to the surviving decentralized political structure of the Mayan Empire, which complicated efforts to establish political dominance (Huerta and Palacios 1976; Gerhard 1993*c*). An additional factor was the difficulty of attracting Spanish settlement to the region due to the relative absence of outside earnings opportunities. The region contained few precious metals, and the potential for agricultural investment was limited both by the generally poor quality of its land and by its considerable distance from trade routes in the center of the colony. Granting rights to indigenous tribute and labor thus remained the primary mechanism for attracting Spanish settlement to the Yucatan, and the Crown saw increasing settlement as crucial to maintaining control over the region (Gerhard 1993*c*; Knight 2002, p. 28–9). As a result, the Yucatec *encomienda* survived until late in the colonial period, continuing to serve as a low-cost method of colonial administration as it had earlier in central Mexico (Garcia Bernal 1979; Gerhard 1993*c*; Knight 2002).

In the north, the trajectory of the transition to direct rule differed considerably within the region. In much of Nueva Galicia, both economic and political conditions resembled those of central Mexico, and the centralization of fiscal capacity happened in a similar manner. Though farther from the capital, this region's fertile soil and proximity to growing mining centers like Guanajuato and Zacatecas made it especially suitable for agricultural production. In addition, the potential for rural revolt was mitigated by the small and fragmented nature of the surviving indigenous population in much of the region (Gerhard 1993*b*, p. 39–45).[4] This further reduced the Crown's reliance on indirect rule for political control in this region. Together, these factors enabled the relatively quick centralization of fiscal authority, especially in the southern portions of Nueva Galicia (Gerhard 1993*b*; Knight 2002).

Much of the north frontier, however, differed from this general pattern. The areas north and east of Nueva Galicia rarely received *encomiendas* as they had existed in central Mexico. Too sparsely settled to provide a source of tribute, the *encomienda* in these regions referred to a distinct set of institutions aimed at harnessing indigenous labor for mining and other activities (Cuello 1988;

[4]Though a major rebellion, the Mixtón War (1540–2), was centered in what became Nueva Galicia, the threat of large-scale rebellion was reduced by the period under study due to an earlier depopulation and the disruption caused by the repression of the revolt. See Gerhard (1993*b*).

Gerhard 1993*b*, p. 9–10, 165). Though different in practice from the *encomienda* of the center, these institutions also enabled the Crown to consolidate territorial control through outsourcing security to local elites (Cuello 1988; Pastore 1998). The reasons for the long survival of the *encomienda* in this region are similar to those explaining the institution's persistence in the Yucatan. In Nuevo Leon and Saltillo, for example, the long survival of *encomienda*, and the large-scale abuse of the institution, can be traced to the tenuous royal political control of the region, the ongoing threat of rebellion from indigenous groups, and the absence of outside possibilities for elite extraction to attract settlement (Cuello 1988, p. 693–4; Gerhard 1993*b*, p. 344–6).

The transition to direct rule thus differed considerably across space in Mexico. In some areas, the precipitous decline in population undermined the threat of rebellion and the economic value of local tribute collection, reducing the attractiveness of and reliance on indirect rule institutions for both the Crown and local elites. In other areas, the survival of the local population kept the threat of rebellion comparatively high and made the transition to wealth extraction through land more difficult. In the remainder of the paper, we systematically evaluate whether the differing severity of Mexico's demographic collapse can explain these spatial differences in Mexican institutional development using quantitative data on smaller jurisdictions and econometric analysis.

3. Data

We empirically evaluate the relationship between Mexico's population collapse and the adoption of direct rule using subnational panel data from colonial Mexico and two empirical strategies: a difference-in-differences approach and an instrumental-variables approach (Section 4). These approaches allow us to leverage plausibly exogenous subnational variation in the magnitude of the population decline so that we can examine the causal effect of the collapse on the adoption of direct rule. To conduct our analysis, we digitize data on the population collapse, the dissolution of the *encomienda* and adoption of the *corregimiento*, and a series of covariates for north-central, central, and southern Mexico.[5] Our primary source is Gerhard's classic three-volume guide to

[5] As noted above, the institutions governed by the *encomienda* in the north of Mexico were fundamentally different given the absence of sedentary indigenous populations in much of this area.

colonial Mexico (1993*a*; 1993*b*; 1993*c*). These tomes contain a host of information on population, cultural history, and local political economy at the level of Mexico's political divisions as of 1786. We discuss the construction of our dataset below.

3.1 Colonial Indigenous Population

Gerhard draws on numerous sources to construct estimates of district population at scattered intervals during the colonial era, relying most heavily on the *relaciones geográficas*, a series of questionnaires distributed by the Crown to local officials beginning in the middle of the sixteenth century. A goal of these questionnaires was to assess the size of the local population to improve tribute collection and colonial administration (Gerhard 1993*a*; Knight 2002). Given the importance of this information, the Crown implemented several policies to discourage misrepresentation on the questionnaire, including a review process through which both Spanish and Indian observers could challenge the results in an official hearing (Cook and Borah 1960; 1971; Gerhard 1993*a*; Knight 2002). Gerhard complements information from the *relaciones* with additional sources, such as parish registers and census lists, to construct more complete population estimates when possible. The reliability of Gerhard's population data is discussed in depth in Gerhard (1993*a*) and Sellars and Alix-Garcia (2017).

While data are sparse for much of the colonial period, we are able to construct comprehensive estimates of local population at four time points between the middle of the sixteenth and middle of the seventeenth centuries: 1550, 1570, 1600, and 1645. These dates correspond with the years of relatively complete *relaciones* (Gerhard 1993*a*, p. 28–33). Because the exact year in which population was reported varies considerably across the sample, we use a five-year bandwidth on either side of each year cutoff to measure district population.[6] Where district populations are measured in tributary units (i.e., the number of individuals paying tribute to the Crown), we convert to population using a multiplier of 2.8 as suggested by Cook and Borah (1960; 1971). In Appendix B.2, we replicate our analysis using tributary units in the subsample of district-years where data was recorded in terms of tribute-payers.

[6]Our results are robust to using a larger bandwidth to 10 years, which increases the sample size considerably. These results are presented in Appendix B.3.

3.2 *Encomienda* and Direct Rule

To construct our measure of direct rule, we draw on Gerhard's lists of *encomiendas* in each district. These lists were compiled from the *relaciones* and other archival sources. Gerhard traces the history of each private holding where possible, noting the dates where an *encomienda* was brought under Crown control or was reassigned to another *encomendero*. Though the record of individual *encomienda* holdings is often sparse, we are able to use this source to calculate a district-level measure of the expansion of direct rule over time. To do this, we aggregate the list of *encomiendas* in Gerhard by district and calculate the proportion of holdings that have been taken by the Crown in each of the population cutoffs identified above. We exclude districts where there were no *encomiendas*, which were generally places with a limited pre-Columbian population.[7] We record the status of a given *encomienda* as missing if Gerhard is unable to identify its status as of a given time point, though this is rare in our data.

3.3 Additional Variables

We include a series of geographic and political control variables to account for other factors that might have influenced both the decline in population and the adoption of direct rule. Most of the social indicators, such as the number of languages spoken in each district at the time of the Conquest and the number of settlements in 1786, were also digitized from Gerhard's data. We also include a series of geographic controls. These include the district land area, the minimum distance from the district to Mexico City, the average district elevation, and an indicator for whether a given district contains land in a malarial zone (i.e., under 1000 meters of elevation). The distances were calculated using GIS software using data from Mexico's National Institute of Statistics and Geography (INEGI). The elevation measures were extracted from a 90-meter resolution digital elevation model provided by INEGI. We extract a measure of low-input, rain-fed maize productivity (the primary staple crop in Mexico) using data from the Food and Agriculture Organization's Global Agro-Ecological Zones. Climate data for our instrumental-variables empirical strategy, described

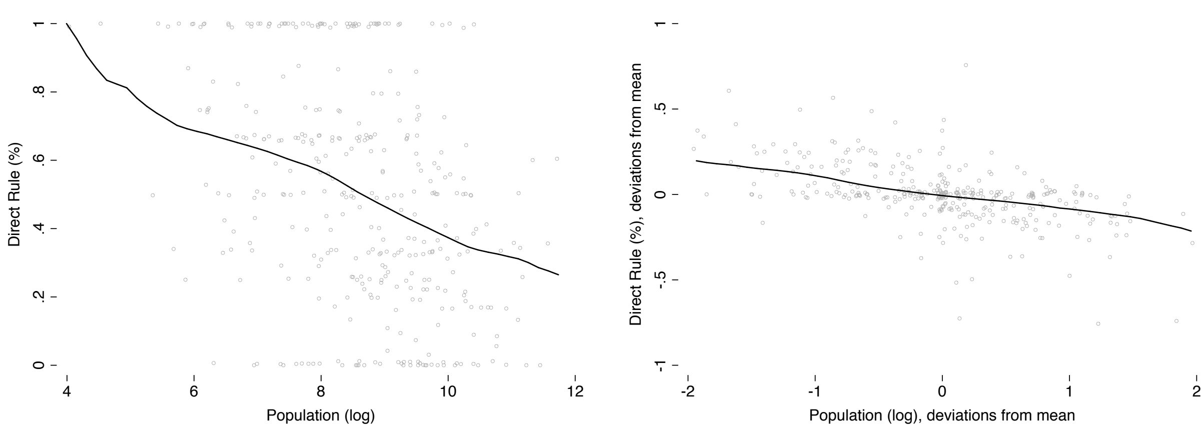
[7] A small number of areas were exempted from the *encomienda* for political reasons, notably Tlaxcala for its cooperation with Cortés during the Conquest. These areas are also excluded from this analysis.

in detail below, are calculated based on data from Cook and Krusic (2004). Finally, our measures of mine and road locations in the sixteenth century were digitized from data in UNAM (2007).

4. Empirical Analysis

As developed in Section 1, our theory posits an inverse relationship between the remaining size of the local indigenous population and the transition to direct rule. We begin by providing graphical evidence on this relationship in our data (Figure 2). In the left panel, we pool all district-year observations and plot the proportion of *encomiendas* that have been taken by the Crown by a given year in a given district (i.e., the extent of the transition to direct rule) over the logged local indigenous population in that year. In line with our theory, there is steep negative relationship between these variables. In the right panel, we provide further graphical evidence of this inverse relationship by demeaning the data and examining within-unit changes in population and the strength of direct rule over time. Together, these provide a first set of suggestive results in support of our theory.

Figure 2: Indigenous Population and Direct Rule



(a) Pooled data (b) Deviations from the mean

Evaluating the causal relationship between population dynamics and the transition to direct rule is challenging given the complex interplay between demographics and political institutions. Mexico's population collapse was related to numerous geographic and political factors, many of which are likely to have independently influenced the decision to centralize tribute collection and political rule. We empirically evaluate the relationship between Mexico's population collapse and the transition to direct rule using two related research designs. These are described in detail below.

4.1 Differences-in-Differences Estimation

We first adopt a difference-in-differences approach, examining within-district changes in population and the adoption of direct rule over time. This enables us to account for time-invariant district characteristics, such as geography or culture, that could be related to both the adoption of direct rule and the size of the population collapse. We also include time period fixed effects to flexibly account for common trends in the transition to direct rule and in population dynamics during this period. Our baseline estimating equation is:

$$DirectRule_{it} = \beta lnPop_{it} + \Theta_t X_i + \Pi U_{it} + \lambda_t + \gamma_i + \varepsilon_{it}, \tag{1}$$

where $DirectRule_{it}$ is the proportion of *encomiendas* in district i that have been taken by the Crown and turned into *corregimientos* by year t; $lnPop_{it}$ is the log of the population of district i in year t; λ_t and γ_i represent year and district fixed effects; and ε_{it} is an error term. While the year and district fixed effects can account for common and time-invariant factors that may have influenced the adoption of direct rule, we also include a series of control variables that may have altered the time path of direct rule adoption. First, we include a vector of time-invariant controls (X_i) interacted with each year indicator to allow the trajectory of direct rule adoption to vary by these observable factors. These include political and geographic variables (elevation, surface area, whether the district is in a malarial zone, and distance to Mexico City) that may have had evolving impacts on the adoption of direct rule over time. We also include time-varying measures of climatic conditions (U_{it}) that may have influenced both population dynamics and direct rule adoption (mean and standard deviation of the Palmer Drought Severity Index over the time period, as discussed below). Our primary hypothesis posits that $\beta < 0$. To causally interpret $\hat{\beta}_{OLS}$, we must assume that $E(\varepsilon_{it}|lnPop_{it}, \Theta_t X_i, U_{it}, \lambda_t, \gamma_i) = 0$. This assumes in particular that the standard parallel trends assumption common to differences-in-differences models holds in this setting. We discuss the plausibility of this assumption in more detail below.

4.2 Differences-in-Differences Results

We report our differences-in-differences results in Table 1. The dependent variable is the district proportion of local *encomienda* holdings that the Crown has brought into direct rule by a given year. Reported are the point estimates of the coefficient on district-year population and the standard errors, which are clustered by district in all specifications. In Columns (1) and (2), we provide estimates using the full sample of observations. The first column presents our baseline estimates, including only district and year fixed effects. In the second column, we add our full set of time-varying and time-interacted control variables as discussed above. We repeat our analysis in columns (3) and (4) on the subset of observations that have available climate data to execute our instrumental-variables empirical strategy, described below. This reduces the size of our sample by a little under 10%.

Table 1: Indigenous Population Collapse and Direct Rule: Difference-in-Differences

	Direct Rule (% of District)			
	Full Sample		IV Sample	
	(1)	(2)	(3)	(4)
Population (log)	-0.092**	-0.095*	-0.088**	-0.095*
	(0.044)	(0.051)	(0.043)	(0.049)
Climate controls	No	Yes	No	Yes
Controls × Year FE	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Within-District Mean of DV	0.50	0.51	0.51	0.51
Within-District SD of DV	0.14	0.13	0.13	0.13
R sq.	0.86	0.85	0.83	0.84
Observations	350	319	296	296
Number of districts	158	137	114	114

OLS estimations. See equations (1) for the econometric specification. The unit-of-analysis is the district-year. Standard errors (clustered at the district level) in parentheses.

The estimates are negative and statistically significant at conventional levels across specifications. Moreover, they are of almost identical magnitude in all models. Taking the estimates of column (2), the results suggest that a one standard deviation decrease in within-district population increases the proportion of holdings that have transitioned to direct rule by 8.4 percentage points, or roughly two-thirds of the within-district standard deviation of this variable. This modest but sizable effect is consistent across all four specifications, including or excluding the vectors of time-interacted and time-varying control variables and examining the full or restricted subsample of observations.[8] Together, these results provide strong support for the theorized negative relationship between population and the adoption of direct rule.

4.3 Instrumental-Variables Estimation

The differences-in-differences results examined in the prior section provide strong evidence of the relationship between the population collapse and the transition to direct rule, but causally interpreting the parameter estimates requires that $E(\varepsilon_{it}|lnPop_{it}, \Theta_t X_i, U_{it}, \lambda_t, \gamma_i) = 0$. In particular, we must assume that the trend towards direct rule would have been the same in disease-affected and unaffected districts in the absence of the fall in population. This assumption would be violated if there were any omitted, time-varying factors that are related to both the population change and the adoption of direct rule. Another potential violation could be from reverse causality. This would arise if, for example, institutional arrangements directly influenced demographic change.

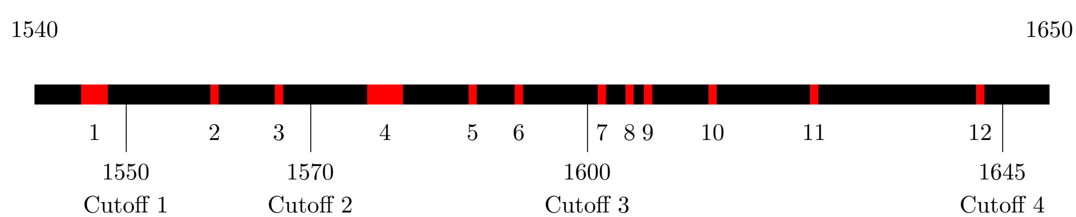
To address these and other concerns, we employ a second approach: an instrumental-variables empirical strategy based on the characteristics of a series of severe epidemics in the late sixteenth and early seventeenth centuries. The vast majority of population loss in the early colonial period was due to disease (Gibson 1964; Hassig 1985; Knight 2002). While some outbreaks—such as the famous smallpox of 1519–21—were caused by European diseases, numerous others have been traced to a virulent pathogen originating in the Americas. Known as "cocoliztli," this disease is believed to have been a rodent-transmitted pathogen similar to Hantavirus (Acuña Soto, Calderon Romero and Maguire 2000; Acuña Soto et al. 2002). Like Hantavirus and other rodent-transmitted diseases, cocoliztli outbreaks are climate-related. Specifically, cocoliztli tends to emerge during years of

[8] In the appendix, we replicate our findings using the same empirical specifications but using the data originally recorded in tributary units only (Section B.2). We also compute the Moran's I Index of spatial autocorrelation for the residuals of models 1 and 2 by year. Using standard inverse-distance weights, we only find evidence of spatial autocorrelation for one of the cross sections (the 1550 cross-section of model 1, where we can reject the null of no spatial autocorrelation at the 5% level). For the rest of the cross sections, including all cross-sections of model 2, we find no strong evidence of spatial autocorrelation.

above-average rainfall immediately following severe droughts. During periods of severe drought, disease-carrying rodents concentrate around limited water and food resources. This causes the pathogen to spread among the rodent population. When climatic conditions improve, the rodent population rebounds and spreads into agricultural fields and homes, where people are thought to contract the disease by inhaling the rodents' feces.

Using a similar approach to that of Sellars and Alix-Garcia (2017), we construct instruments for the decline in population by identifying districts that experienced the climate conditions associated with cocoliztli transmission. Figure 3 presents a timeline of noted cocoliztli outbreaks from Acuña Soto et al. (2002) (numbered) alongside the population cutoffs of the Gerhard data, as described above. To construct our instruments, we extract district-year measures of climate conditions around each of the epidemics using data from the North American Drought Atlas (Cook and Krusic 2004). This source provides an estimate of the annual Palmer Drought Severity Index (PDSI) for a grid of points in North America based on a network of overlapping tree-ring chronologies that have been linked with contemporary climate data. PDSI is measure of soil moisture relative to normal conditions at a given location, where negative values reflect drier-than-normal conditions. Using the Cook and Krusic (2004) grid, we interpolate a surface of estimated PDSI for each year, weighted by the inverse distance from the Atlas' grid points. We then extract the space-weighted average PDSI over the surface for each district-year in our sample.[9]

Figure 3: Population Observations and Cocoliztli Epidemics



We construct two instruments for the decline in population based on the climate conditions asso-

[9]Because of the lack of usable tree rings in southeastern Mexico and the Yucatan peninsula, we do not have climate data for the southeastern portion of the sample and drop these observations in the instrumental-variables estimations.

ciated with cocoliztli. The first instrument is an indicator for whether a given district experienced a severe, two-year drought ending 1–2 years prior to any outbreak of cocoliztli in the prior period. For example, the indicator would take the value 1 in a given district at the 1570 cutoff if that district had experienced a long drought ending just prior to the cocoliztli outbreaks of 1559 (2) or 1566 (3).[10] The second instrument we construct is the numeric difference between the peak severity of a pre-outbreak drought (i.e., the lowest PDSI recorded in the drought ending 1–2 years prior to the outbreak) and the PDSI of the first non-drought year. Where a district experienced more than one pre-outbreak drought in a given period, we use the largest swing between severe drought and rainfall. This instrument is based on the argument of Acuña Soto et al. (2002) that the swing from drought conditions to excess rainfall was conducive to the emergence and spread of cocoliztli.

Formally, our IV estimating equations are:

$$lnPop_{it} = \delta PDSI_{it} + \Omega_t X_i + +\Phi U_{it} + \eta_t + \alpha_i + \nu_{it} \tag{2}$$

$$DirectRule_{it} = \beta \widehat{lnPop}_{it} + \Theta_t X_i + +\Pi U_{it} + \lambda_t + \gamma_i + \varepsilon_{it}, \tag{3}$$

where the $PDSI_{it}$ is the instrument described above. All the other variables are defined as in the difference-in-differences estimating equation (1). A causal interpretation of β requires that the specific sequence of severe drought followed by excess rainfall that we highlight be relevant (i.e., δ predicts population dynamics) and conditionally exogenous. In other words, the sequence of severe drought followed by excess rainfall should not independently affect the adoption of direct rule and should not be correlated with other omitted variables that could influence institutional choice (i.e., $E(\varepsilon_{it}|PDSI_{it}, \Theta_t X_i, U_{it}, \lambda_t, \gamma_i) = 0$). We believe that these are reasonable assumptions in this context. Because the Palmer Drought Severity Index is standardized across space, year-on-year fluctuations in this measure are likely to be orthogonal to geographic or historical confounds, and it is unlikely that the specific shock we identify (severe drought followed by excess rain in specific years) would have an independent effect on colonial institutions. However, to account for the fact

[10] In table B.9 in the appendix, we compare average values of observables at the beginning of our panel (1550) between those districts that subsequently experienced at least one of these drought-rain shocks and those that did not. Only the distance to Mexico City is significantly different between these groups, with those affected by drought-rain shocks being somewhat farther away from the capital on average.

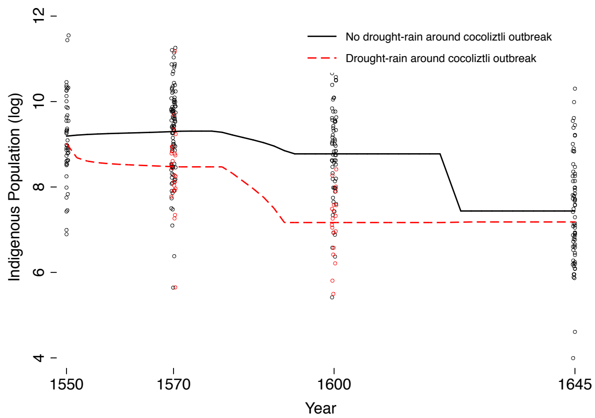
that certain locations may have had higher variability in PDSI during this time period, we include both the mean and standard deviation of PDSI in each period as control variables (as we do in the difference-in-differences estimations).

4.4 Instrumental-Variables Results

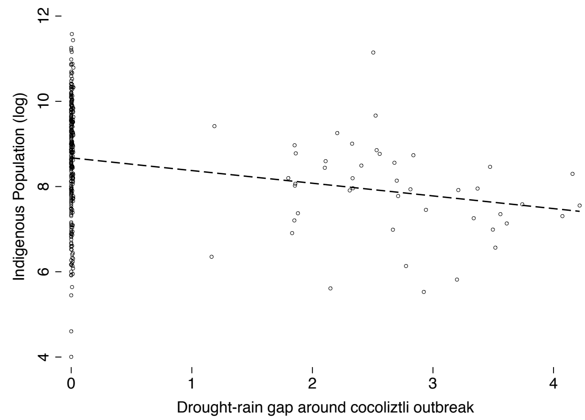
We begin by graphically examining first-stage and reduced-form evidence linking our climate instruments—the indicator for whether a district experienced a long drought followed by rainfall prior to a cocoliztli outbreak and the absolute change in PDSI between the severest point in the drought and the rebound in rainfall—with the population collapse and the adoption of direct rule, respectively. Figure 4 presents evidence on the first-stage relationship. In the left panel, we plot the trajectory of population over time in areas that experienced (dashed) and did not experience (solid) drought-rain shocks around the time of known cocoliztli outbreaks. Areas affected with a drought-rain shock at the right time show a significant decline in population relative to unaffected areas. The effect of the climate shock on the decline in population is especially pronounced between the 1570 and 1600 cutoffs, which corresponds with the most severe period of cocoliztli epidemics according to historical scholars (Acuña Soto et al. 2002). The right panel of Figure 4 relates logged district-year population with the swing in PDSI between the most severe point of the drought and the maximum post-drought rainfall. As indicated by the figure, areas that experienced a larger swing in drought conditions around cocoliztli outbreaks had a lower surviving population on average. This finding is in line with scientific work on the pathogen by Acuña Soto and others. We provide a more comprehensive analysis of first-stage estimates in Table 3.

Graphical evidence on the reduced-form relationship between the climate instruments and the adoption of direct rule is presented in Figure 5. The left panel of the figure plots the proportion of *encomiendas* that had been brought into direct rule by the Crown in districts that experienced (dashed) and did not experience (solid) cocoliztli-related climate conditions. As illustrated by the figure, more *encomiendas* had been taken under the Crown's control by each of the cutoffs in areas that had experienced drought-rain shocks favorable to cocoliztli. As in the first-stage relationships, the reduced-form impact is especially strong between the 1570 and 1600 cutoffs, which is not

Figure 4: Drought-Rain Around Cocoliztli Outbreaks and Indigenous Population



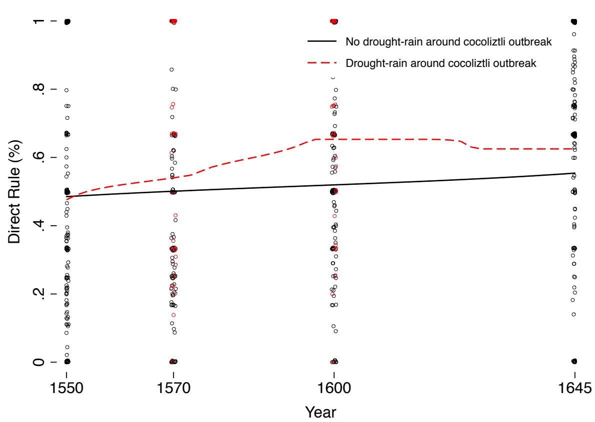
(a) Drought-Rain



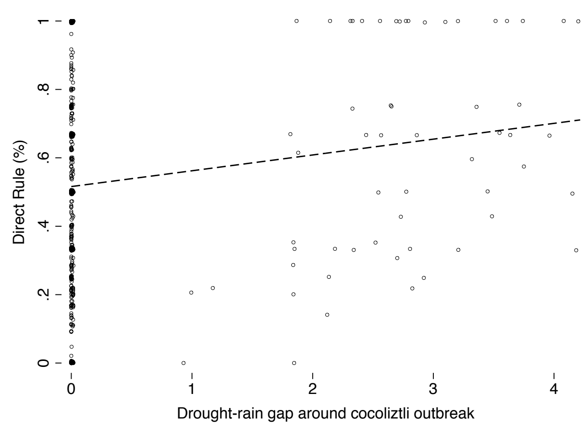
(b) Drought-Rain Gap

surprising given the severity of the late-sixteenth-century cocoliztli outbreaks. The right side of the figure illustrates the positive relationship between the magnitude of the climate shock and the adoption of direct rule. Population declined more precipitously in cocoliztli-affected areas, which enabled the adoption of direct rule in these areas.

Figure 5: Drought-Rain Around Cocoliztli Outbreaks and Direct Rule



(a) Drought-Rain



(b) Drought-Rain Gap

In Table 2, we present econometric evidence on these reduced-form relationships. The first two columns present reduced-form estimates using the gap between drought severity and rainfall as the climate measure, and the second two columns do the same with the indicator instrument. In Columns (1) and (3), we report baseline estimates, conditioning on year and district fixed effects only. In Columns (2) and (4) we also include the full set of time-varying and time-interacted controls. In all specifications, the coefficients on the climate variables are positive, indicating that districts experiencing climate conditions conducive to cocoliztli outbreaks saw an increase in the proportion of *encomienda* holdings that transition to direct rule by a given cutoff relative to those that did not. This provides additional evidence in support of the theory and the relevance of the climate instruments.

Table 2: Indigenous Population Collapse and Drought-Rain Around Cocoliztli Outbreaks: Reduced Form

	Drought-Rain Gap		Drought-Rain	
	(1)	(2)	(3)	(4)
Drought-rain around outbreaks			0.085	0.15*
			(0.063)	(0.083)
Drought-rain gap around outbreaks	0.036*	0.052**		
	(0.021)	(0.022)		
Climate controls	No	Yes	No	Yes
Controls × Year FE	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Within-District Mean of DV	0.51	0.51	0.51	0.51
Within-District SD of DV	0.13	0.13	0.13	0.13
R sq.	0.82	0.83	0.82	0.83
Observations	296	296	296	296
Number of districts	114	114	114	114

OLS estimations. The unit-of-analysis is the district-year. Standard errors (clustered at the district level) in parentheses.

We now move to our instrumental-variables estimates of the impact of population on the adoption of direct rule. Our main results are reported in Table 3. The results in the first four columns present first-stage (1 and 2) and two-stage-least-squares (3 and 4) estimates using the continuous climate measure (the gap in PDSI between drought severity and the rebound rainfall) as the sole instrument. First-stage estimates indicate that the drought-rain gap is robustly negatively related to population. The Wald F-statistic on the excluded instrument is 17.9 in the baseline specification (column 3) 14.5 in the specification including control variables (column 4), providing evidence of instrument relevance. Given the challenges of identifying weak instruments when errors are clustered (Cameron and Miller 2015), we also estimate β using the Anderson-Rubin method, which is robust to weak instruments (Appendix B.5).

Table 3: Indigenous Population Collapse and Direct Rule: Instrumental Variables

	Population (log)		Direct Rule (% of District)		Population (log)		Direct Rule (% of District)	
	First Stage: OLS		2SLS		First Stage: OLS		2SLS	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Population (log)			-0.26**	-0.33**			-0.26**	-0.34**
			(0.12)	(0.13)			(0.12)	(0.14)
Drought-rain gap around outbreaks	-0.14***	-0.16***			-0.20*	-0.11		
	(0.042)	(0.054)			(0.11)	(0.14)		
Drought-rain around outbreaks					0.19	-0.15		
					(0.38)	(0.43)		
Climate controls	No	Yes	No	Yes	No	Yes	No	Yes
Controls × Year FE	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within-District Mean of DV	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Within-District SD of DV	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Wald F statistic of excluded instruments			17.9	14.5			13.9	7.10
Hansen J statistic			.	.			0.011	0.090
Hansen J p-value			.	.			0.91	0.76
R sq.	0.93	0.94	0.22	0.19	0.93	0.94	0.22	0.17
Observations	296	296	296	296	296	296	296	296
Number of districts	114	114	114	114	114	114	114	114

See equations (2) and (3) for the econometric specifications. The unit-of-analysis is the district-year. Standard errors (clustered at the district level) in parentheses.

The IV estimates reported in Columns 3 and 4 indicate a strong effect of population decline on the adoption of direct rule, in line with our theoretical argument. In Columns 5–8, we repeat the analysis, instrumenting for log population using both climate-related measures described above: the drought-rain gap and the indicator for whether a district experienced a severe drought followed by rainfall around years of known cocoliztli outbreaks. First-stage F-statistics of the excluded instruments are slightly weaker than in the single-instrument regressions. P-values for Sargan-Hansen tests of IV overidentifying restrictions are 0.91 (baseline) and 0.76 (with covariates) respectively, which provides no evidence to reject the exogeneity of our instruments (under the assumption that one of the instruments is valid). Point estimates for the two-stage least squares results in Columns

7 and 8 are negative and of almost the same magnitude as in the single-instrument regressions.

The IV coefficient estimates are negative and of roughly the same magnitude across specifications. They are also somewhat larger than those of the OLS difference-in-differences models. The IV results in column (4), for instance, suggest that a within-district standard deviation decrease in population—a dramatic decrease of 0.9 log units—leads to an increase in the probability of direct rule of 29 percentage points, or roughly twice the within-district standard deviation of direct rule adoption. Substantively, these results are supportive of the key role that demographic collapse played in the transition to direct rule in this setting.

Though the difference between our OLS and IV estimates is sizable, we believe that there are several plausible reasons why the OLS estimates might understate the effect of the demographic collapse on direct rule adoption. First, the private *encomienda* had direct harmful consequences on the indigenous population, and there is some evidence that it may have exacerbated mortality. The abuses of *encomenderos* toward the populations under their control are widely documented in the historical literature, including forcing the population into slavery-like work conditions, imposing restrictions on internal movement, and depriving villages of food through the "over-extraction" of tribute (e.g., Gibson 1964; Zavala 1973; Knight 2002; Reséndez 2016). Any of these factors on their own could increase mortality, especially in the challenging drought and disease environment of the early colonial period. If the private *encomienda* exacerbated the population collapse, this would introduce a negative countervailing relationship between population and the survival of indirect rule (which are positively related in our theory), leading to attenuation in the OLS point estimates.

Measurement error provides an additional reason that OLS estimates may be attenuated toward zero. Though there is strong evidence that the Gerhard data do capture meaningful variation in local population,[11] measurement error remains a significant concern given the low-information environment of early colonial Mexico and given the peculiarities of the tribute system, which exempted certain segments of the population from paying tribute and thus from being counted in the *relaciones* (e.g., Gibson 1964; Cook and Borah 1971; Gerhard 1993*a*). There are reasons to believe

[11] See Sellars and Alix-Garcia (2017), Appendix A.2 for a detailed analysis of these data.

that the mis-measurement of the population variable could induce significant attenuation bias in our OLS estimates,[12] which alone could account for much of the difference in magnitude.

Finally, the IV estimates could be larger because the local average treatment effect of the population collapse in the places affected by our instrument is larger than the general average treatment effect in the entire sample. Our instrument leverages differences in the disease environment to identify the effect of population loss, focusing on the fall in population size due to cocoliztli. The pattern of mortality in these epidemics was distinctive in that it disproportionately targeted healthy young people as opposed to the elderly or sick (Gibson 1964; Hassig 1985, p. 180–5). Because the biggest threat of rebellion arguably came from this subpopulation, the effect of the population decline due to cocoliztli on the transition to direct rule may be therefore be greater than the effect of demographic collapse on the population as a whole. A final potential reason for the differences in magnitude between OLS and IV specifications is that elite outside options may have been greater in cocoliztli-affected areas than in areas that experienced population loss for other reasons. For example, the regions that were most affected by the climate shocks in the 1570 to 1600 period (the time of a particularly virulent epidemic) tended to be in the area north of Mexico City. In this area, mining activities had improved elite outside options, potentially magnifying the effect of the fall in population on the adoption of direct rule. We evaluate potential heterogeneity of the effect of the population collapse in the following subsection.

4.5 Additional empirical evidence

Our theory predicts that areas experiencing a more precipitous population collapse should transition to direct rule faster because a rapid decline in population makes it more attractive and less costly for the Crown to centralize power. We can also derive several additional empirical implications from our theory, as discussed in Section 1. First, the effect of the population collapse on the transition to direct rule should be magnified where the latent threat of rebellion was higher (Hypothesis 2). This is because the mollifying effects of disease on revolt should be especially salient in areas where

[12] Card (2001) and Hausman (2001) show that attenuation bias of OLS estimates may exceed 30% due to measurement error in estimations of the impact of education in labor economics, and there is reason to believe that the signal-to-noise ratio of our population measures may be even smaller than in that context.

the Crown feared rebellion and potentially had the most to gain from relying on indirect rule. Our theory also predicts that both the causal effect of the collapse (Hypothesis 3) and the overall level of direct rule adoption (Hypothesis 4) should be higher where elites had more attractive outside earnings options. This is because local elites become less willing to invest in putting down rebellion and to resist Crown attempts to centralize power in places where they could amass wealth through other means.

To provide evidence on these auxiliary hypotheses, we adapt our difference-in-differences estimation strategy to examine heterogeneity in the effect of the population collapse. Specifically, we amend equation 1 to estimate:

$$DirectRule_{it} = \beta_1 lnPop_{it} + \beta_2 lnPop_{it} M_i + \Theta_t X_i + \Pi U_{it} + \lambda_t + \gamma_i + \varepsilon_{it}, \tag{4}$$

where M_i is a district-level measure of either the population's ability to coordinate rebellion (for Hypothesis 2), or the value of *encomenderos'* outside earning options (for Hypotheses 3 and 4). Because we do not have a suitable instrument for M_i, we cannot adopt the instrumental-variables strategy outlined in the prior section. However, the difference-in-differences approach still enables us to provide suggestive evidence on heterogeneity, controlling for time-invariant and time-varying district characteristics and common temporal trends across districts. We therefore include the same vector of time-varying and time-interacted controls as in the baseline models.

We measure the potential to organize a rebellion using two variables: the number of indigenous languages spoken in district i, and the number of towns present in that district in 1786.[13] These measures were digitized from Gerhard (1993*a*;*b*;*c*). We argue that threat of rebellion should be higher where coordination is not complicated by the existence of numerous unintelligible languages or a large number of dispersed settlements. This argument is supported by historical work on our

[13] We note that, if interpreted causally, the estimates of equation 4 could be subject to post-treatment bias when including the number of towns in 1786 given that our measure was recorded after the population collapse. There is a strong correlation in the overall concentration of population across districts before the collapse and following the recovery of Mexico's indigenous population in the 17th century (Sellars and Alix-Garcia 2017). However, this subsection is intended to provide suggestive evidence on the theory, and the results should be interpreted causally with caution.

context (e.g., Katz 1988; Gerhard 1993*a*), and by a broader literature on homogeneity, population density, and collective action (e.g., Homer-Dixon 1999; Salehyan and Gleditsch 2006). From hypothesis 2, we therefore expect that $\beta_2 > 0$ when M_i measures the number of languages or towns.

Table 4: Heterogeneous Effect of Indigenous Population Collapse on Direct Rule, by Rebellion Potential: Difference-in-Differences

	Direct Rule (% of District)					
	(1)	(2)	(3)	(4)	(5)	(6)
Population (log)	-0.12**	-0.14**	-0.13**	-0.16***	-0.15**	-0.23***
	(0.057)	(0.063)	(0.051)	(0.054)	(0.062)	(0.071)
Population (log) × Num. of languages	0.0095	0.015			0.0086	0.018*
	(0.0095)	(0.011)			(0.0094)	(0.011)
Population (log) × Num. of towns (1786)			0.0048	0.0074*	0.0048	0.0089**
			(0.0034)	(0.0038)	(0.0033)	(0.0040)
Climate controls	No	Yes	No	Yes	No	Yes
Controls × Year FE	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Within-District Mean of DV	0.51	0.51	0.50	0.51	0.51	0.51
Within-District SD of DV	0.14	0.13	0.14	0.13	0.14	0.13
R sq.	0.85	0.85	0.86	0.86	0.85	0.86
Observations	332	317	350	319	332	317
Number of districts	143	136	158	137	143	136

OLS estimations. See equation (4) for the econometric specification. The unit-of-analysis is the district-year. Standard errors (clustered at the district level) in parentheses.

Our results evaluating Hypothesis 2 are presented in Table 4. In the first column, we use the number of languages spoken in the district as a measure of the difficulty of collective action. We present estimates of the heterogeneous effect of the population collapse on the adoption of direct rule, including district and year fixed effects. In the second column, we repeat the analysis including the full set of control variables. Columns (3) and (4) estimate analogous models using the number of settlements in 1786 as the proxy for the difficulty of collective action. In columns (5) and (6), we use both the number of languages and the number of settlements. In all models, districts with fewer obstacles to coordination—those where fewer languages are spoken and where the population is distributed into fewer distinct towns—the effect of a decline in population on direct rule adoption is magnified. The estimates of heterogeneous effect are consistent in magnitude across models, though they are only precisely estimated in columns (4) and (6). Taken together, however, these results provide additional evidence in support of the mechanisms suggested by the theory.

To assess Hypotheses 3 and 4 on heterogeneity by the availability of outside earnings options for *encomenderos*, we digitized and geocoded information on the placement of mines in 1600 from UNAM (2007). Mining was arguably the engine of New Spain's economy and represented one of the major sources of income for elites (Knight 2002). We code whether a district contains a mine as a measure of possible opportunities for wealth extraction from this sector. Our theory holds that an *encomendero* should be less likely to invest in defending his district from rebellion or resisting the Crown's attempts to centralize power as the value of his outside option increases. Because of this, the Crown should be more willing and able to establish direct rule in areas with mines. This suggests that $\beta_2 < 0$ when M_i measures mining presence in the district. To evaluate Hypothesis 4, which states that more valuable outside options should increase the likelihood of direct rule, we simply interact the mine indicator with each year indicator to examine the relative level of direct rule adoption in mining and non-mining districts in each year. Our theory predicts that the coefficient on that interaction term should be positive for all years.

We now examine the empirical evidence on outside options. The first two columns in Table 5 present suggestive evidence on Hypothesis 3, which holds that the effect of a decline in population on the transition to direct rule should be larger in the presence of better outside options. As predicted, our estimates suggest that the effect of a decline in population was greater in mining areas, though this heterogeneous effect is not precisely estimated. Columns (3) and (4) provide supportive evidence on Hypothesis 4, which addresses the overall level of direct rule adoption. As expected, districts with mines are more likely to adopt direct rule in every period, conditional on covariates. This pattern is visible in Figure 6, which plots the differential trajectory of direct rule adoption in districts with and without mines.

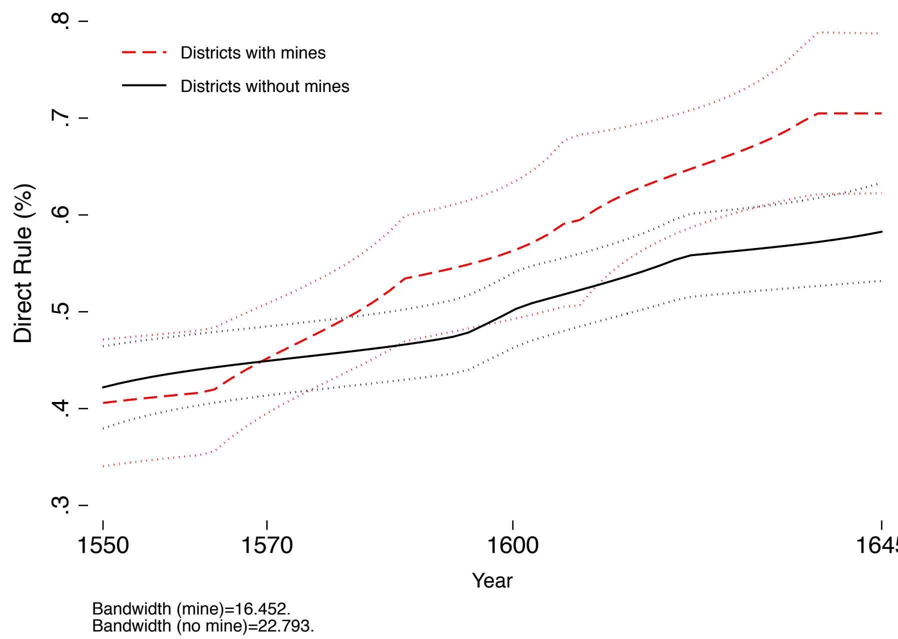
In the appendix (Section B.6), we assess our theory in light of other arguments about the design of the *encomienda* and the transition to direct rule in colonial Mexico. In particular, we show that the specific pattern of direct rule adoption observed in colonial Mexico cannot be explained by

Table 5: Heterogeneous Effect of Indigenous Population Collapse on Direct Rule, by Outside Encomendero Options: Difference-in-Differences

	Direct Rule (% of District)			
	(1)	(2)	(3)	(4)
Population (log)	-0.066*	-0.072		
	(0.038)	(0.048)		
Population (log) × Any mine	-0.067	-0.070		
	(0.050)	(0.051)		
Any mine × 1570			0.18	0.21
			(0.13)	(0.14)
Any mine × 1600			0.20	0.22
			(0.14)	(0.14)
Any mine × 1645			0.23	0.25*
			(0.14)	(0.14)
Climate controls	No	Yes	No	Yes
Controls × Year FE	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Within-District Mean of DV	0.50	0.51	0.50	0.51
Within-District SD of DV	0.14	0.13	0.14	0.13
R sq.	0.86	0.86	0.86	0.85
Observations	350	319	350	319
Number of districts	158	137	158	137

OLS estimations. See equation (4) for the econometric specification. The unit-of-analysis is the district-year. Standard errors (clustered at the district level) in parentheses.

Figure 6: Indigenous Population and Direct Rule, by Elite Outside Options



alternative theories that highlight institutional choice as a simple revenue-maximization problem for the Crown (we see faster centralization in less populous and wealthy areas), emphasize differences in direct rule adoption in frontier and central jurisdictions (our results condition on governorship and distance to Mexico City, focusing on within-region differences in institutional transition), or focus solely on efforts to reign in the most powerful local elites (indirect rule persisted in places like the Yucatan, where local elites were powerful but the threat of rebellion remained high). Taken as a whole, the empirical results are strongly supportive of the importance of domestic conflict on the adoption of direct rule and the role that the demographic collapse played in ameliorating this conflict. The transition to direct rule happened faster in areas experiencing a larger decline in population, and this effect was amplified where the threat of rebellion from below was higher and where local elites had more profitable outside options.

5. Conclusion

Numerous scholars have documented the perverse consequences of indirect rule. Relatively less is known about how, when, and why rulers are able and willing to centralize power, thereby enhancing state capacity and setting the stage for future development. Building on scholarship on indirect rule and the development of fiscal capacity, our theory highlights the central role of domestic conflict. Under many indirect rule arrangements, local elites are charged with maintaining political order in exchange for a share of tax revenues. As long as the threat of rebellion and the resistance of elites remain high, the ruler is willing to forego the economic benefits of centralization to maintain control over the population at a relatively low cost. When such threats are diminished, such as following a sharp decline in local population, this reduces the risks associated with centralizing power, facilitating the transition to direct rule.

We provide empirical support for these ideas with evidence on the transition from *encomienda* to *corregimiento* in colonial Mexico. This transition took place during a severe population collapse in large part due to disease, which undermined the power of local elites and reduced the generalized threat of rebellion in much of the country. Exploiting subnational variation in the disease environment, we show that the transition to direct rule occurred more quickly in areas that lost more population in the early colonial period. We further show, in line with our theory, that this effect was magnified in areas with a greater latent threat of rebellion and in places that offered more profitable outside earnings opportunities for elites. Though fiscal authority was centralized in some areas within a generation of the Conquest, indirect rule arrangements persisted for over 200 years in others. The uneven political development of colonial Mexico (e.g., Knight 2002) was shaped by the demographic collapse, which dramatically altered the threat of revolt among the population and the relationship between local elites and the Crown.

Past work has offered a number of theories on the uneven implementation of colonial rule in different places. The decisions of colonial authorities to govern through direct or indirect rule have been explained by differences in the ruling philosophy of European powers, the availability of different technologies of tax collection, and variation in initial demographic conditions (Mamdani 1996; Boone 2003; Lange 2004; Cederman and Girardin 2010; Acemoglu et al. 2014). In line with these explanations, the initial adoption of the *encomienda* in colonial Mexico was driven both by demographic priors and by historical precedent. However, these factors do not explain the observed variation in the survival of this institution across space and time. By focusing on the strategic interaction between the Crown and local elites, mediated by the threat of rebellion from below, we call attention to the importance of internal conflict in this institutional transition. Moreover, our theory shows that, in a strategic setting like this one, population scarcity can aid rather than impede the centralization of state authority through undermining the bargaining power of local elites and reducing the threat of generalized conflict. This contributes to our understanding of colonial institutional development and political demography more generally.

The political institutions adopted during the colonial period had long-reaching consequences for development, both in Mexico and beyond. The persistent effect of direct and indirect rule arrangements on subsequent political and economic development has been established in numerous contexts across the world (e.g., Migdal 1988; Boone 1994; Mamdani 1996; Lange 2004; Hariri 2012; Acemoglu et al. 2014). In Mexico, a longer history of colonial direct rule is associated with more present-day postal and public prosecutor offices, which suggests a persistent legacy of colonial centralization on state presence (see table B.11 in the appendix).

The implications from these findings also extend beyond understanding Mexican development or the effects of colonial-era institutions. Building state capacity remains a central challenge in much of the world today. Moreover, indirect rule is not a uniquely historical phenomenon. Many modern states continue to rely on similar institutional arrangements, delegating the responsibility for maintaining political control to local elites or traditional authorities in places where the reach of the state might otherwise be unable to extend (Boone 2003; Gerring et al. 2011; Naseemullah and Staniland 2016). Today, as in the colonial era, this institutional bargain often entails ceding considerable political and economic power to these elites, which has been shown to have adverse consequences for development. While a demographic collapse of the level seen in colonial Mexico has been fortunately rare, this paper provides theory and evidence on how and why efforts to centralize political authority might succeed in other places. Interventions that reduce the threat of local conflict or the relative benefits of indirect rule for local elites increase the feasibility of, and incentives for, political centralization.

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Appendix

Contents

A. Model

A.1 Domestic Conflict and the Transition to Direct Rule

We present a two-period model that considers the strategic interaction between a ruler and a local potentate. The model begins under indirect rule, where the potentate maintains order in the region in exchange for a share of tax revenue. We show that if both tax revenue and the risk of rebellion are increasing in local population, as we argue was the case in early colonial Mexico and in other settings, a precipitous decline in population will lead to a higher likelihood of a transition to direct rule. Furthermore, we show that the effect of the population decline is amplified in regions where collective action and rebellion are easier (as this raises the value of indirect rule) and where elites have more profitable outside options (which decreases elite incentives to contest the centralization of fiscal authority).

Actors and timing: Consider two actors, a ruler (R) and a representative local elite (E), who interact in a two period game, $s = \{1, 2\}$. In each period, the potentate raises taxes from the subjects in his district, T. He keeps an exogenous portion $\gamma \in (0, 1)$, and transfers the rest to the ruler. The local population, in response to extractive taxation, can rebel in the second period with an exogenous probability $W \in [0, 1]$. This probability is an increasing function of the total number of subjects (T) and the ease of local collective action (α): $p(W = 1) = \omega(T, \alpha)$, with $\omega_\alpha(T, \alpha) > 0$ and $\omega_T(T, \alpha) > 0$. The assumption that the probability of rebellion is increasing in T is supported by both Mexico-specific literature on unrest in the colonial period (e.g., Taylor 1979; Katz 1988) and by a broader literature linking population density with conflict (e.g., Boserup 1965; Homer-Dixon 1999; Goldstone 2002). Some factors that may facilitate local collective action include sharing a common language, which can enhance the population's ability to coordinate.

In the first period, the ruler can choose to implement direct rule (decision D) at a direct administrative cost C_D, and strip the potentate of his formal rights. If successful, this initiative leads to direct rule in the second period, which allows the ruler to capture all of the revenue in the region,

T, without losing a fraction γ to the potentate. We normalize the tax revenue to 1 unit per local taxpayer.

The local potentate, in turn, makes two decisions in period one. First, he decides whether to pay a cost, C_G, to guard his region against rebellion (decision G). Second, after observing any attempt by the ruler to establish direct rule, the potentate can select a share of his first-period income to resist the ruler's efforts to centralize power, $r \in [0, 1]$. The potentate's income is a function of the local tax-paying population, γT. The probability that an attempt to displace the potentate fails is given by the concave function $\rho(r\gamma T) \in [0, 1]$, which is increasing in the intensity of his resistance against the ruler, $r\gamma T$. For simplicity, we assume a specific functional form, $\rho(r\gamma T) = \frac{\sqrt{r}\gamma T}{\bar{T}}$, where $\bar{T}$ is a finite upper bound for population in the region. In the appendix, we characterize the results using a general form for $\rho(\cdot)$.

In period 1, the ruler receives:

$$U_1^R = \begin{cases} (1-\gamma)T & \text{if } D = 0 \\ (1-\gamma)T - C_A & \text{if } D = 1, \end{cases}$$

where T are the capitation taxes levied from the population, and C_A is the administrative investment cost necessary to attempt to establish direct rule in the second period.

Second-period payoffs depend critically on the probability of local rebellion. Whether this rebellion occurs depends on whether the potentate has decided to guard his region. For simplicity, we assume that the probability of rebellion is greater than zero when there is no protection, and zero when the region is protected by the potentate. In the second period, then, the ruler's expected payoff is:

$$E(U_2^R) = \begin{cases} (1-\gamma)T - \omega(T,\alpha)C_R & \text{if } D = 0 \text{ and } G = 0 \\ (1-\gamma)T & \text{if } D = 0 \text{ and } G = 1 \\ \big[1-\rho(r\gamma T)\big](T - \omega(T,\alpha)C_R) + \rho(r\gamma T)\big[(1-\gamma)T - \omega(T,\alpha)C_R\big] & \text{if } D = 1 \text{ and } G = 0 \\ \big[1-\rho(r\gamma T)\big](T - \omega(T,\alpha)C_R) + \rho(r\gamma T)\big[(1-\gamma)T\big] & \text{if } D = 1 \text{ and } G = 1, \end{cases}$$

where $\omega(T, \alpha)$ is the probability of rebellion in the second period in the absence of potentate protection, and $C_R > 0$ is an exogenous cost to putting down the rebellion.

The ruler can receive a higher share of the region's revenue if he successfully removes the potentate and sets up direct rule. This replacement, however, leaves the region unprotected against potential rebellion, captured by the non-zero probability $\omega(T, \alpha)$. An attempt to establish direct rule (i.e., $D = 1$) can also prompt a reaction from the potentate, who can choose to resist the ruler's initiative by setting $r > 0$. Resistance can improve the potentate's chances to keep his indirect-rule rights, which happens with probability $\rho(r\gamma T)$. On the other hand, if the ruler does not try to establish direct rule ($D = 0$), he keeps receiving a smaller share the taxes, $(1 - \gamma)T$. If, additionally, the potentate decides to set up a costly defense for the region ($G = 1$), the risk of rebellion disappears. The tradeoff for the ruler is clear: the possibility of higher future revenue comes with an increased risk of rebellion.

For the local potentate, the payoff in the first period is:

$$U_1^E = \begin{cases} (1-r)\gamma T & \text{if } G = 0 \\ (1-r)\gamma T - C_D & \text{if } G = 1, \end{cases}$$

where r is the share of his first-period income devoted to resist any attempt by the ruler to remove him, and C_D is the cost of preparing the defense of the region against rebellion in the next period. The potentate's expected payoff in the second period is:

$$E(U_2^E) = \begin{cases} (1-\omega(T,\alpha))\gamma T & \text{if } D = 0 \text{ and } G = 0 \\ \gamma T & \text{if } D = 0 \text{ and } G = 1 \\ \rho(r\gamma T)(1-\omega(T,\alpha))\gamma T + [1-\rho(r\gamma T)]\underline{\mathrm{u}} & \text{if } D = 1 \text{ and } G = 0 \\ \rho(r\gamma T)\gamma T + [1-\rho(r\gamma T)]\underline{\mathrm{u}} & \text{if } D = 1 \text{ and } G = 1, \end{cases}$$

where $\underline{\mathrm{u}}$ is the potentate's outside option if direct rule is successfully implemented. The potentate only gets his share of tax revenue in the second period if no rebellion breaks out, and if the ruler decides not to establish direct rule (or the attempt is successful resisted.)

In short, the ruler decides whether to attempt to establish direct rule, while the potentate makes two choices in response: first, whether to resist the ruler's attempt, and whether to set up a defense against rebellion. The timing of the game is:

1. Parameters are given, first-period incomes are realized.
2. The ruler decides whether to attempt to establish direct rule (decision D)
3. The local potentate chooses the share of income used to resist direct rule, r, and decides whether to guard the region against rebellion (decision G).
4. If the ruler tried to establish direct rule, his attempt fails with probability $\rho(\cdot)$, and succeeds with probability $1 - \rho(\cdot)$.
5. If the local potentate chose not to guard the region or if the ruler successfully establishes direct rule, rebellion breaks out with probability $\omega(T, \alpha)$. Second period incomes are realized.

Solution. We employ subgame perfection as a solution concept. We solve by backward induction, starting first with the local potentate's choice of whether to set up a costly defense against rebellion in his region (decision G). His decision simply weighs the benefits of protecting the region, given the risk of rebellion, against the cost of defending it. He chooses to defend if:

$$C_D \leq \begin{cases} \omega(T,\alpha)\gamma T & \text{if } D = 0 \\ \rho(r\gamma T)\omega(T,\alpha)\gamma T & \text{if } D = 1. \end{cases} \tag{A1}$$

That is, the potentate guards the region if the cost of defense is smaller than his expected share of future taxes, weighed by the risk of rebellion and the probability of successfully resisting any attempt by the ruler to remove him to set up direct rule. Note that, when the ruler does not attempt to establish direct rule (i.e., $D = 0$), the potentate will have an incentive to protect his region even for higher defense costs.

Now we turn to the optimal choice of resistance, r^*, which is chosen simultaneously by the potentate. When the ruler decides not to establish direct rule, the potentate does not need to resist, and thus

$r^* = 0$. When his rights are challenged by the ruler, however, the potentate's optimal resistance is given by

$$r^* = \begin{cases} \left[\frac{1}{2\bar{T}}[(1-\omega(T,\alpha))\gamma T - \underline{\mathrm{u}}]\right]^2 & \text{if } G = 0 \\ \left[\frac{1}{2\bar{T}}[\gamma T - \underline{\mathrm{u}}]\right]^2 & \text{if } G = 1, \end{cases} \tag{A2}$$

which emerges from the potentate's utility maximization problem.[14]

The ruler, in turn, anticipates the potentate's actions and decides whether to establish direct rule. He attempts to implement direct rule if:

$$C_A \leq \begin{cases} \left[1 - \rho(r_{G=0}\gamma T)\right]\left[\gamma T\right] & \text{if } G = 0 \\ \left[1 - \rho(r_{G=1}\gamma T)\right]\left[\gamma T - \omega(T,\alpha)C_R\right] & \text{if } G = 1. \end{cases} \tag{A3}$$

In deciding whether to attempt to establish direct rule, the ruler weighs the costs and benefits given the expected reaction from the potentate. A successful establishment of direct rule enables the ruler to capture a higher share of the tax revenue. On the other hand, the costly attempt to set up direct rule can be sabotaged by the potentate with some probability, and, even if it succeeds, direct rule potentially exposes the region to rebellion.

Comparative statics. We now consider how a fall in population affects the establishment of direct rule in equilibrium. We focus on dramatic demographic shocks, such as the one experienced in the Americas following the Conquest. In Section A.3 of the appendix, we characterize how the equilibrium changes with smaller demographic shifts.

Large shock to population. Consider a decline in population that shifts the equilibrium from one in which condition (A1) is met and the local potenate decides to guard the region against rebellion to one in which this is no longer preferred. This discontinuity occurs because there is a population threshold, $\underline{T}$, below of which the potentate will no longer pay to defend his district as both the risk of rebellion and his own expected share of future tax revenue are declining in population. Because

[14] In section A.2 of the appendix, we characterize the potentate's equilibrium behavior using a more general form for $\rho(\cdot)$.

all of the terms on the right hand side of condition (A1) are declining in population—the risk of rebellion, the potentate share of tax revenue, and the likelihood of successfully resisting political centralization—this condition will necessarily be satisfied if the population declines enough.

Note that the probability of successful resistance to the attempted establishment of direct rule, $\rho(r^*\gamma T)$, includes not only the resources available to the potentate, γT, but also the intensity of his opposition to direct rule, r^*. When the population threshold $\underline{T}$ is crossed and the potentate swiches from guarding his region ($G = 1$) to leaving it exposed to rebellion ($G = 0$), there is a discontinuous reduction in his equilibrium resistance to direct rule (i.e., $r^*_{G=1} > r^*_{G=0}$), as illustrated by condition (A2). This generates a discontinuity in the probability of successfully stopping the ruler's attempt to establish direct rule, $\rho(r^*_{G=1}\gamma T) > \rho(r^*_{G=0}\gamma T)$.[15]

Given this discontinuous change in the potentate's behavior, the ruler has a greater incentive to attempt to establish direct rule because of the increased likelihood that such an effort will succeed. This expands the range of administrative costs at which the ruler is willing to seek the establishment of direct rule. To see this directly, consider the maximum administrative cost that the ruler is willing to disburse to establish direct rule (condition (A3)) at population threshold $\underline{T}$. This cost is higher when the potentate stops defending his region if:

$$\left[1 - \rho(r^*_{G=0}\gamma\underline{T})\right]\gamma\underline{T} \geq \left[1 - \rho(r^*_{G=1}\gamma\underline{T})\right]\left[\gamma\underline{T} - \omega(\underline{T}, \alpha)C_R\right],$$

which simplifies to

$$C_R \geq \frac{\gamma\underline{T}}{\omega(\underline{T}, \alpha)}\left[\frac{\rho(r^*_{G=0}\gamma\underline{T}) - \rho(r^*_{G=1}\gamma\underline{T})}{1 - \rho(r^*_{G=1}\gamma\underline{T})}\right]. \tag{A4}$$

This condition is always met, and it implies that for a given administrative cost of establishing direct rule, the ruler is more likely to seek a transition to direct rule when the population threshold $\underline{T}$ is crossed.[16]

[15] Specifically, optimal potentate resistance implies that $\rho(r^*\gamma T) = \frac{1}{2\bar{T}^2}[\gamma T - \underline{\mathrm{u}}]$ if $G = 1$, and $\rho(r^*\gamma T) = \frac{1}{2\bar{T}^2}[(1 - \omega(T, \alpha))\gamma T - \underline{\mathrm{u}}]$ if $G = 0$. Thus, a discontinuous decline in potentate resistance from $r^*_{G=1}$ to $r^*_{G=0}$ leads to a

Figure A.1: Direct Rule Adoption in Equilibrium

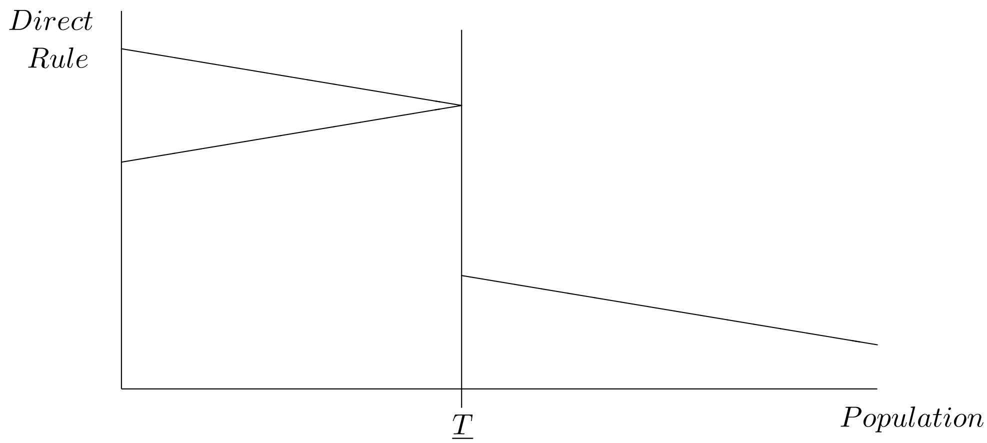


Figure A.1 illustrates the direct rule outcome in equilibrium as a function of population. Above the population threshold $\underline{T}$, marginal decreases in population lead to a higher likelihood of direct rule; below the threshold, the marginal effect of population is ambiguous (see section A.3 of the appendix for a characterization of these results). As population declines and crosses the threshold, there is a discontinuous jump in the likelihood of adopting direct rule.

Condition (A4) also suggests that the discontinuous jump in the maximum cost that the ruler is willing to spend in establishing direct rule is increasing in the baseline probability of rebellion, $\omega(\underline{T}, \alpha)$. To see this, note that the right hand side of condition (A4) declines with $\omega(\underline{T}, \alpha)$. For a given cost of putting down a rebellion, C_R, this implies a larger difference between the maximum administrative cost of direct rule, c, in condition (A3) when the potentate guards against rebellion, $G = 1$, as compared to when he does not, $G = 0$. Since $\omega(\cdot)$ is increasing in α, if a region's characteristics facilitate collective action (i.e., the region has higher α), the effect of the population collapse on the implementation of direct rule will be magnified.

The value of the potentate's outside option. We can draw one additional implication from the model related to the availability of an outside earnings option for the potentate. A more valuable outside option reduces the potentate's optimal level of resistance to any attempt by the ruler to establish direct rule. This is because being stripped of power becomes relatively less painful (see

discontinuous drop in the probability of successful resistance to direct rule, from $\rho(r^*_{G=1}\gamma T)$ to $\rho(r^*_{G=0}\gamma T)$.

[16]This is the case because the cost to put down a rebellion, C_R, is always positive by assumption, and the right hand side of the inequality must be negative (because $\rho(r^*_{G=1}\gamma T) > \rho(r^*_{G=0}\gamma T)$).

condition (A2)). Simultaneously, the potentate is less likely to defend the region for a given cost of defense (see condition (A1)). These changes in the potentate's behavior, make it more likely that the ruler will seek to establish direct rule. This is due both to the lower expected resistance from the potentate and the reduced likelihood that the potentate will provide an effective defense against local rebellion.

Observable implications. To summarize, we derive the following observable implications of the model:

(i) As population declines precipitously, the ruler is more likely to establish direct rule.

(ii) The effect of population collapse on the likelihood of direct rule is increasing in the rebelliousness of the region.

(iii) The effect of population collapse on the likelihood of direct rule is increasing in the value of the outside option available to the potentate.

(iv) More valuable outside options for the potentate lead to a higher likelihood of direct rule in equilibrium.

A.2 General Form for the Probability of Successful Potentate Resistance, $\rho(\cdot)$

Leaving $\rho(\cdot)$ in a general form delivers the main results described in the text. As established above, when the ruler decides not to establish direct rule, the potentate will not resist (i.e., $r^* = 0$). When the ruler attempts to strip the potentate's rights, however, the optimal resistance is the result of the following optimization problem solved by the potentate:

$$max_{\{r\}} \begin{cases} (1-r)\gamma T + (1-\rho(r\gamma T))\underline{\mathrm{u}} + \left[\rho(r\gamma T)\right]\left[(1-\omega(T,\alpha))\gamma T\right] & \text{if } G=0 \\ (1-r)\gamma T + (1-\rho(r\gamma T))\underline{\mathrm{u}} + \left[\rho(r\gamma T)\right]\left[\gamma T\right] & \text{if } G=1. \end{cases}$$

We assume that $\rho(\cdot)$ is concave and increasing in r. Making no further functional form assumptions about $\rho(\cdot)$, the optimal level of resistance is implicitly given by the optimality condition:

$$\frac{\partial}{\partial r}\rho(r^*\gamma T) = \begin{cases} \dfrac{1}{(1-\omega(T,\alpha))\gamma T - \underline{\mathrm{u}}} & \text{if } G=0 \\ \dfrac{1}{\gamma T - \underline{\mathrm{u}}} & \text{if } G=1. \end{cases} \tag{A5}$$

This equilibrium behavior by the potentate is affected in the same way by a large shock to population when using a more general form for $\rho(\cdot)$. When the population threshold $\underline{T}$ is crossed, so that the potentate switches from guarding his region ($G = 1$) to leaving it exposed to rebellion ($G = 0$), there is a discontinuous reduction in his equilibrium resistance (i.e., $r^*_{G=1} > r^*_{G=0}$), which is visible in condition (A5). Note that as long as the potentate defends his region ($G = 1$) and the cost of putting down a rebellion are large enough (i.e., $C_R \geq \frac{\gamma}{\omega_T(T)}$), a marginal reduction in the population leads to an increase in the value of condition (A2). This implies that the level of resistance, r^*, which is implicitly defined in condition (A2), has to decline, since $\rho(\cdot)$ is a concave function of r. When the population threshold $\underline{T}$ is reached, the condition discontinuously increases in value, which implies a similarly discontinuous reduction in resistance; thus, $r^*_{G=1} > r^*_{G=0}$. In turn, lower potentate resistance discontinuously reduces the probability of stopping the ruler's attempt to establish direct rule, $\rho(r^*_{G=1}\gamma T) > \rho(r^*_{G=0}\gamma T)$. The rest of the results attained using the specific functional form for $\rho(\cdot)$ then follow.

A.3 Marginal Changes in Population

In this section, we examine the how the optimal level of resistance by the local potentate changes with marginal changes to population. Consider the case in which the potentate decides to guard his region against rebellion (i.e., $G = 1$). In this case, the optimal level of resistance decreases with population. This can be seen from condition (A2), which increases as T decreases. Since $\rho(\cdot)$ is concave in r (i.e., $\rho_{rr} < 0$), a higher value of $\rho_r(r^*\gamma T)$ can only be attained when r^* is smaller.

When the potentate guards his region and the cost for the ruler to put down a rebellion is large enough—that is, when $C_R \geq \dfrac{\gamma}{\omega_T(T)}$—then a decline in local population increases the probability that the ruler decides to establish direct rule. This can be seen from condition (A3), which unambiguously increases as population declines. This means that the ruler is willing to establish direct rule for a larger range of values of the investment/administrative cost of deploying direct rule, C_D.

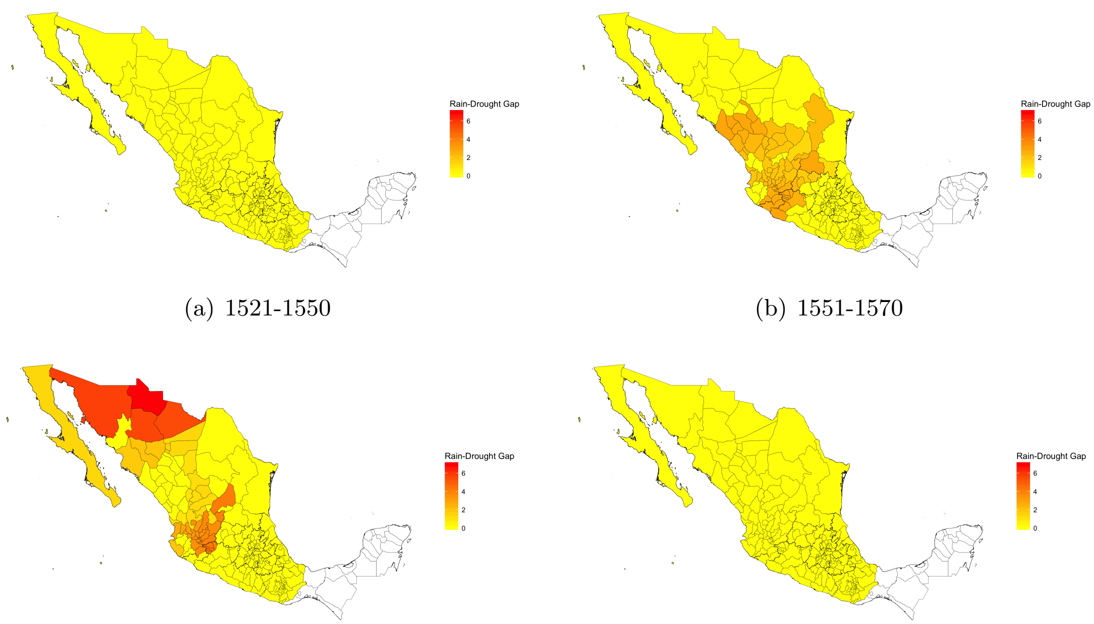
We now turn to the case in which the potentate chooses not to guard the region against rebellion (i.e., $G = 0$). In this case, the effect of increasing population becomes ambiguous. Now condition (A2) either increases or decreases its value depending on whether a decrease in population reduces the risk of rebellion more than it reduces the expected tax revenue that the potentate keeps (this can be seen in the denominator of condition (A2)). If the latter dominates, for example, then condition (A2) increases its value, and the optimal resistance by the potentate is less intense as population declines.

The effect of local population changes on the probability that the ruler decides to establish direct rule is also ambiguous, and can be examined in condition (A3). If the local potentate does not guard against rebellion (i.e., $G = 0$), then the ruler does not consider the probability of rebellion when deciding whether to set up direct rule, and expects less tax revenue as population declines. Even if a local drop in population reduces the resistance of the potentate and thus increases the probability of successfully instituting direct rule, capturing all the available tax revenue will not necessarily compensate for the absolute decline in the amount collected. Thus, a marginal decline in population when the potentate chooses not to guard his region has an ambiguous effect on the likelihood of direct rule.

B. Additional Empirical Evidence

B.1 Geographic Distribution of Drought-Rain Shocks

Figure B.1: Drought-Rain Gap Around Cocoliztli Outbreaks



(a) 1521-1550

(b) 1551-1570

(c) 1571-1600

(d) 1601-1645

B.2 Empirical Analysis with Tributaries

Table B.1: Tributary Collapse and Direct Rule: Difference in Differences

	Direct Rule (% of District)			
	Full Sample		IV Sample	
	(1)	(2)	(3)	(4)
Tributaries (log)	-0.083*	-0.100*	-0.081*	-0.100*
	(0.044)	(0.054)	(0.043)	(0.052)
Climate controls	No	Yes	No	Yes
Controls × Year FE	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Within-District Mean of DV	0.51	0.51	0.51	0.51
Within-District SD of DV	0.14	0.14	0.14	0.14
R sq.	0.84	0.85	0.83	0.84
Observations	321	311	289	289
Number of districts	140	135	113	113

OLS estimations. See equation (1) for the econometric specification. The unit-of-analysis is the district-year. Standard errors (clustered at the district level) in parentheses.

Table B.2: Tributary Collapse and Direct Rule: Instrumental Variables

	Tributaries (log)		Direct Rule (% of District)		Tributaries (log)		Direct Rule (% of District)	
	First Stage: OLS		2SLS		First Stage: OLS		2SLS	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tributaries (log)			-0.31**	-0.37**			-0.30**	-0.37**
			(0.15)	(0.16)			(0.13)	(0.16)
Drought-rain gap around outbreaks	-0.13***	-0.15***			-0.24**	-0.10		
	(0.041)	(0.056)			(0.11)	(0.15)		
Drought-rain around outbreaks					0.34	-0.16		
					(0.39)	(0.46)		
Climate controls	No	Yes	No	Yes	No	Yes	No	Yes
Controls × Year FE	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within-District Mean of DV	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Within-District SD of DV	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Wald F statistic of excluded instruments			16.0	12.1			14.0	5.92
Hansen J statistic			.	.			0.0085	0.000032
Hansen J p-value			.	.			0.93	1.00
R sq.	0.93	0.95	0.12	0.12	0.93	0.95	0.13	0.12
Observations	289	289	289	289	289	289	289	289
Number of districts	113	113	113	113	113	113	113	113

See equations (2) and (3) for the econometric specifications. The unit-of-analysis is the district-year. Standard errors (clustered at the district level) in parentheses.

Table B.3: Heterogeneous Effect of Tributary Collapse on Direct Rule, by Rebellion Potential: Difference-in-Differences

	Direct Rule (% of District)					
	(1)	(2)	(3)	(4)	(5)	(6)
Tributaries (log)	-0.11*	-0.14**	-0.12**	-0.16***	-0.14**	-0.23***
	(0.057)	(0.067)	(0.053)	(0.054)	(0.064)	(0.073)
Tributaries (log) × Num. of languages	0.0090	0.015			0.0083	0.018*
	(0.0095)	(0.011)			(0.0093)	(0.011)
Tributaries (log) × Num. of towns (1786)			0.0040	0.0068*	0.0039	0.0082**
			(0.0033)	(0.0037)	(0.0033)	(0.0039)
Climate controls	No	Yes	No	Yes	No	Yes
Controls × Year FE	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Within-District Mean of DV	0.51	0.51	0.51	0.51	0.51	0.51
Within-District SD of DV	0.14	0.13	0.14	0.14	0.14	0.13
R sq.	0.84	0.85	0.84	0.85	0.84	0.86
Observations	318	309	321	311	318	309
Number of districts	138	134	140	135	138	134

OLS estimations. See equation (4) for the econometric specification. The unit-of-analysis is the district-year. Standard errors (clustered at the district level) in parentheses.

Table B.4: Heterogeneous Effect of Tributary Collapse on Direct Rule, by Outside Encomendero Options: Difference-in-Differences

	Direct Rule (% of District)			
	(1)	(2)	(3)	(4)
Tributaries (log)	-0.064	-0.080		
	(0.039)	(0.050)		
Tributaries (log) × Any mine	-0.060	-0.065		
	(0.054)	(0.057)		
Any mine × 1570			0.18	0.21
			(0.13)	(0.14)
Any mine × 1600			0.20	0.22
			(0.14)	(0.14)
Any mine × 1645			0.23	0.25*
			(0.14)	(0.14)
Climate controls	No	Yes	No	Yes
Controls × Year FE	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Within-District Mean of DV	0.51	0.51	0.50	0.51
Within-District SD of DV	0.14	0.14	0.14	0.13
R sq.	0.85	0.85	0.86	0.85
Observations	321	311	350	319
Number of districts	140	135	158	137

OLS estimations. See equation (4) for the econometric specification. The unit-of-analysis is the district-year. Standard errors (clustered at the district level) in parentheses.

B.3 Empirical Analysis with 10-Year Window for Cutpoints

Table B.5: Indigenous Population Collapse and Direct Rule: Difference-in-Differences

	Direct Rule (% of District)			
	Full Sample		IV Sample	
	(1)	(2)	(3)	(4)
Population (log)	-0.12***	-0.093*	-0.089**	-0.093*
	(0.039)	(0.049)	(0.044)	(0.047)
Climate controls	No	Yes	No	Yes
Controls × Year FE	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Within-District Mean of DV	0.47	0.51	0.51	0.51
Within-District SD of DV	0.13	0.13	0.13	0.13
R sq.	0.86	0.85	0.83	0.84
Observations	400	327	307	307
Number of districts	158	137	117	117

OLS estimations. See equation (1) for the econometric specification. The unit-of-analysis is the district-year. Standard errors (clustered at the district level) in parentheses.

Table B.6: Indigenous Population Collapse and Direct Rule: Difference-in-Differences with Tributary Measure

	Direct Rule (% of District)			
	Full Sample		IV Sample	
	(1)	(2)	(3)	(4)
Tributaries (log)	-0.086*	-0.10*	-0.084*	-0.10*
	(0.045)	(0.052)	(0.044)	(0.051)
Climate controls	No	Yes	No	Yes
Controls × Year FE	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes
Within-District Mean of DV	0.51	0.51	0.51	0.51
Within-District SD of DV	0.14	0.13	0.13	0.13
R sq.	0.84	0.85	0.83	0.84
Observations	328	318	299	299
Number of districts	140	135	116	116

OLS estimations. See equation (1) for the econometric specification. The unit-of-analysis is the district-year. Standard errors (clustered at the district level) in parentheses.

Table B.7: Indigenous Population Collapse and Direct Rule: Instrumental Variables

	Population (log)		Direct Rule (% of District)		Population (log)		Direct Rule (% of District)	
	First Stage: OLS		2SLS		First Stage: OLS		2SLS	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Population (log)			-0.25**	-0.34**			-0.25**	-0.35**
			(0.12)	(0.15)			(0.12)	(0.16)
Drought-rain gap around outbreaks	-0.14***	-0.14**			-0.19*	-0.087		
	(0.041)	(0.057)			(0.11)	(0.14)		
Drought-rain around outbreaks					0.14	-0.19		
					(0.37)	(0.42)		
Climate controls	No	Yes	No	Yes	No	Yes	No	Yes
Controls × Year FE	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within-District Mean of DV	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Within-District SD of DV	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Wald F statistic of excluded instruments			19.3	10.7			14.0	5.24
Hansen J statistic			.	.			0.071	0.045
Hansen J p-value			.	.			0.79	0.83
R sq.	0.93	0.94	0.23	0.14	0.93	0.94	0.22	0.13
Observations	307	307	307	307	307	307	307	307
Number of districts	117	117	117	117	117	117	117	117

See equations (2) and (3) for the econometric specifications. The unit-of-analysis is the district-year. Standard errors (clustered at the district level) in parentheses.

Table B.8: Tributary Collapse and Direct Rule: Instrumental Variables with Tributary Measure

	Tributaries (log)		Direct Rule (% of District)		Tributaries (log)		Direct Rule (% of District)	
	First Stage: OLS		2SLS		First Stage: OLS		2SLS	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tributaries (log)			-0.33**	-0.40**			-0.32**	-0.39**
			(0.16)	(0.17)			(0.14)	(0.18)
Drought-rain gap around outbreaks	-0.12***	-0.14**			-0.23**	-0.084		
	(0.040)	(0.058)			(0.11)	(0.15)		
Drought-rain around outbreaks					0.33	-0.17		
					(0.39)	(0.46)		
Climate controls	No	Yes	No	Yes	No	Yes	No	Yes
Controls × Year FE	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within-District Mean of DV	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Within-District SD of DV	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Wald F statistic of excluded instruments			15.4	9.80			13.2	4.78
Hansen J statistic			.	.			0.017	0.00030
Hansen J p-value			.	.			0.90	0.99
R sq.	0.94	0.95	0.055	0.053	0.94	0.95	0.074	0.054
Observations	299	299	299	299	299	299	299	299
Number of districts	116	116	116	116	116	116	116	116

See equations (2) and (3) for the econometric specifications. The unit-of-analysis is the district-year. Standard errors (clustered at the district level) in parentheses.

B.4 Balance on Observables in 1550

Table B.9: Balance on Observables in 1550 Between Districts Affected and Unaffected by Drought-Rain Shocks

	No Drought-Rain		Drought-Rain		Difference	P-value	t-statistic
	N	Average	N	Average			
Direct Rule (%)	31	0.40	15	0.48	-0.07	0.52	-0.65
Population (log)	31	9.19	15	9.08	0.11	0.73	0.35
Tributaries (log)	31	8.16	9	8.01	0.14	0.73	0.35
Num. of languages	31	2.77	15	3.07	-0.29	0.60	-0.53
Any mine	31	0.26	15	0.33	-0.08	0.61	-0.52
Malarial zone	31	0.74	15	0.60	0.14	0.34	0.97
Distance to Mexico City	31	229.19	15	477.45	-248.26	0.00	-4.87
Avg. elevation	31	1466.36	15	1299.62	166.74	0.40	0.85
Surface area (log)	31	7.56	15	7.61	-0.05	0.91	-0.11

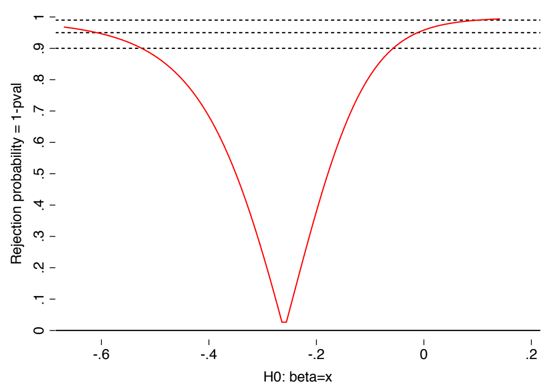
B.5 Weak-Instrument Robust Inference

Though first-stage Wald F-statistics are above typical thresholds for concern over weak instruments, these rules of thumb, as well as the standard cutoffs developed in Stock and Yogo (2005), are based on iid errors and may not be appropriate when errors are clustered. Clustering may compound bias due to weak instruments (Cameron and Miller 2015).[17] To address this possibility, we also estimate our models using the Anderson-Rubin (AR) method, which is robust to weak instruments and can be generalized for cluster-robust inference (Cameron and Miller 2015). The $(1-\alpha)\%$ AR confidence interval is constructed by inverting the AR weak instrument test of size α and identifying the values of β^* for which the joint null of $\beta = \beta^*$ and $E(Zu) = 0$ cannot be rejected (e.g., Stock and Yogo 2005). In all four of our IV specifications (one and two instruments with and without the vector of controls), the 90% AR confidence intervals contain strictly negative values. In the 95% case, this is true in all but one specification. This adds to our confidence that the coefficient on population is negative, as suggested by the theory.

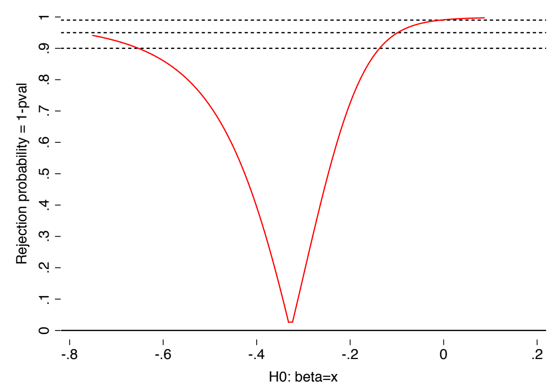
Graphs of the 90%, 95%, and 99% AR confidence intervals are presented in Figure B.2. Plotted are the rejection probabilities of the joint null described above. The dotted lines represent the appropriate cutoffs for the three confidence levels. The AR confidence interval is the region where this line lies below the appropriate cutoffs.

[17] Asymptotics are in the number of clusters rather than the number of observations in this case (Cameron and Miller 2015).

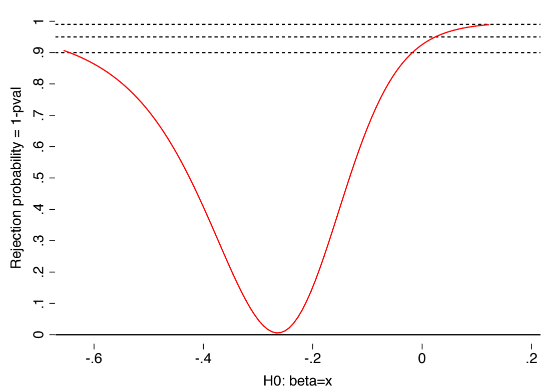
Figure B.2: Anderson-Rubin Test Confidence Intervals



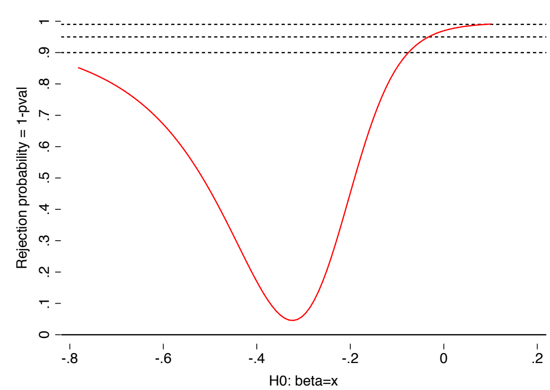
(a) Single instrument, no controls



(b) Single instrument, controls



(c) Two instruments, no controls



(d) Two instruments, controls

B.6 Additional Empirical Evidence

As a final way of building support for our theory, we briefly consider alternative theories about the design of the *encomienda* and the transition to direct rule in colonial Mexico. In a notable debate, Yeager (1995) and Pastore (1998) present competing theories about the institutional design of the encomienda in the Americas. As in our argument, Yeager places a central emphasis on the Crown's security concerns in explaining both the design of the *encomienda* and the transition from *encomienda* to *corregimiento*. His emphasis is, however, somewhat narrower than ours. He argues that the major threat to Crown security came primarily from elites—the *encomenderos*—and that royal officials therefore chose to absorb the holdings of the most powerful *encomenderos* first to undermine their threat to rule.[18] Because tribute wealth was directly linked to population, he predicts that the Crown should begin with the most populous holdings in the transition to direct rule. Using data from Gibson (1964), Yeager shows that this pattern held in the area around Mexico City: the largest *encomiendas* in population were brought under direct rule first. We replicate Yeager's findings in Table B.10.

Table B.10: Additional Evidence: Replication of Yeager (1995)

	Year of Direct Rule Full Sample (1)	Year of Direct Rule Non-Perpetual (2)
1560 Tribute Population	-0.0095***	-0.0087***
	(0.0013)	(0.0012)
Constant	1656.5***	1638.3***
	(14.1)	(10.6)
R sq.	0.24	0.39
Observations	36	33

OLS estimations. The unit of analysis is the *encomienda*. Huber-White robust standard errors in parentheses. Data from Gibson (1964) and Yeager (1995).

Our work shows that the transition to direct rule happened faster where the population declined more precipitously, whereas Yeager argues that more populous holdings were brought under direct rule by the Crown first. Given the different role of population in our theories and these potentially contradictory empirical findings, it is worth discussing how Yeager's work relates to ours. Several

[18] In our theory, we emphasize *encomiendero* resistance but also the threat of rebellion from below.

features of Yeager's analysis differ from ours. First, Yeager exclusively examines holdings in the central area of Nueva España near what became Mexico City. As discussed in Section 2, Mexico City was the heart of Spanish power in the Americas, and this region was among the first to be brought under solid Spanish control. The costs of pacification were therefore much lower in this region relative to others, obviating the need to rely on local elites to secure political control. Yeager's analysis therefore examines an area where the attractiveness of indirect rule would be especially low under our theory: there are few gains from outsourcing the costs of providing security to elites, while the potential benefits to absorbing the holdings are high. We condition on both distance to Mexico City and district by year in our analysis in part to address this concern. However, the broader regional trends in the transition to direct rule are poorly explained by Yeager's elite-centered argument. The transition to direct rule was very slow in regions like Nuevo Leon and the Yucatan where elite power and extraction were especially high. We argue that the high threat of rebellion from below in these regions can explain why the Crown continued to rely on indirect rule in these regions. As Pastore (1998) notes, while the *encomenderos* could pose a security threat to the Crown, royal officials seemed more concerned about the threat of generalized rebellion from or security threats from other empires. This explains why indirect rule lasted the longest in strategically important and difficult to subdue frontier areas throughout the Empire (p. 513–4).

An additional difference between our work and that of Yeager is the unit of analysis. Yeager's analysis was conducted at the level of the holding or *encomienda*, whereas ours is conducted at the level of the district. It would be impossible to conduct our analysis at a lower level of aggregation given that panel data on population are unavailable below the district level except in very few areas. We also believe that the district is the correct unit of analysis to assess our theory, which hinges on the changing threat of rebellion from below in areas that lose population. Each district typically contained numerous *encomiendas*—sometimes well over a dozen—of differing sizes. Most holdings mapped onto a single village or a handful of villages, and some cut across villages to specific neighborhoods or sections of settlements, especially in the Yucatan. Any uprising large enough to worry the Crown would therefore have to cut across several individual holdings. For these reasons, we believe that the threat of rebellion is best assessed at the district level.

Nonetheless, Yeager's finding that the largest *encomiendas* within a region were taken under direct rule first does not itself contradict our theory. Assuming, as we do, that the central ruler seeks to maximize revenue for the Crown, he should choose to seize the most profitable (and therefore the most populous) holdings within a given district once political control has been established. This is broadly consistent with the pattern seen in Mexico: in areas that had been brought under solid Crown control, the largest *encomiendas* seem to have transition into direct rule first (Gibson 1964; Zavala 1973; Garcia Bernal 1979). Taken together, our findings at the district level and Yeager's at the *encomienda* level help to rule out common alternative explanations for the pattern of transition to direct rule. Pastore (1998), for example, notes that Yeager's theory is observationally equivalent with a simple revenue maximization story given that both predict that populous indirect-rule holdings would be absorbed by the Crown first. However, both our findings and broader regional trends in Mexico are not consistent with this simple account of revenue maximization. Conversely, Yeager's finding that the Crown targeted larger *encomiendas* within districts, confirmed qualitatively by Gibson and Zavala, is inconsistent with the story that the Crown targeted "underperforming" districts for absorption. Our theory emphasizing the tradeoff between maximizing revenue collection and maintaining political control, however, is consistent with both of these findings.

A few other alternative explanations for our findings are worth considering as well. First, a potential concern is that areas that had been brought under Crown control may have disproportionately suffered from epidemics, inducing a relationship between the population collapse and the transition to direct rule. It is not the case that areas under solid control experienced the worst declines in population in these epidemics. For example, the worst-hit areas for the severe 1570–6 cocoliztli epidemic were in sections of what is now Durango and far southern Michoacan and Jalisco states, which were frontier areas at this time (Acuña Soto, Calderon Romero and Maguire 2000; Acuña Soto et al. 2002). In addition, because we include district-by-year controls in our empirical models, we are examining differential trends toward direct rule within regions. A final concern is that areas suffering from epidemics during the 1550–1645 period may have had a different prior experience with disease, potentially contaminating our analysis. Given uncertainty about the characteristics of cocoliztli, it is not clear whether prior exposure should lead to increased later mortality (because certain areas are more susceptible to disease) or decreased later mortality (because susceptible populations had been affected in the earlier epidemics). However, the instrumental-variables empirical strategy we adopt leverages differences in the climatic conditions associated with cocoliztli rather than data on the epidemics themselves. This, along with our fixed-effects estimation strategy helps to avoid potential confounds with mortality before the 1550 period.

B.7 Persistent Effects of Early Direct Rule

Table B.11: Present-Day State Presence and Exposure to Early Direct Rule

	Number of Postal Offices		Number of Offices of the Public Prosecutor	
	(1)	(2)	(3)	(4)
Years under direct rule (1521-1645)	0.0022^{**}	0.0026^{***}	0.010	0.012^{*}
	(0.0011)	(0.00097)	(0.0073)	(0.0072)
Population in 2015 (log)		0.54^{***}		2.38^{***}
		(0.077)		(0.63)
Surface area (log)		-0.099^{**}		-0.78^{**}
		(0.049)		(0.38)
Geographic controls	Yes	Yes	Yes	Yes
State indicators	Yes	Yes	Yes	Yes
Mean of DV	0.59	0.59	1.16	1.16
SD of DV	1.31	1.31	8.87	8.87
Mean of years under direct rule	64.0	64.0	64.0	64.0
SD of years under direct rule	31.1	31.1	31.1	31.1
R sq.	0.28	0.45	0.048	0.12
Number of Municipios	1908	1907	1908	1907

OLS estimations. The unit-of-analysis is the municipio. Huber-White robust standard errors standard errors in parentheses. The number of years under direct rule is weighted the proportion of *encomiendas* brought under direct rule in each cutoff. We weight by surface area when aggregating to the municipio level. Data from postal offices from Correos de México (2017); data from the Public Prosecutor's offices and agents from INEGI (2016).