Labor Coercion and State Capacity: Evidence from Colonial Indonesia*

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Abstract

Fiscal modernization is key for long-run economic development. What then enables fiscal modernization? This is the first study to estimate the effect of state capacity expansion on labor coercion as taxation, a practice known as corvée labor. To do so, I construct a new database covering eighteen Javanese provinces over thirty-two years (1874-1905) during the period of Dutch colonial rule. I document the importance of corvée labor and find that national-level policy centralized state finances by gradually replacing corvée with a poll tax. At the same time, however, local state capacity expansion, primarily indigenous officials working as agents for the state, slowed the movement away from corvée. The relationship between state capacity expansion and fiscal modernization therefore depends on what part of the state is expanding. Opposing interests of different state actors can be key in understanding fiscal modernization and public labor coercion, so it is imperative to break open the black box of state capacity and analyze specific actors within the state.

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JEL: H27, J47, N35, N45

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1 Introduction

Fiscal modernization is thought to be key for long-run economic development (e.g. Dincecco 2009; He, 2013; Vries, 2015; Dincecco and Katz, 2016). Yet there are many aspects to this process which remain unclear. Prior to fiscal modernization, in-kind taxation in the form of corvée labor – an understudied type of labor coercion in which individuals were forced to work for the state without pay – was widespread.[1] From the state's perspective, such tax payments in labor suffered from several disadvantages as compared to tax payments in money in terms of fungibility, storability, and portability. However, limited monetization, labor productivity, and state capacity meant that states could not easily switch towards monetary taxation, at least, early in their development. As state capacity grew, so too did the ability to levy relatively information-intensive monetary taxes (e.g. Brewer, 1989; Besley and Persson, 2011, 2013, 2014; Johnson and Koyama, 2014, 2017; Dincecco, 2015). This would seem to have led to a reduction in corvée labor. However, the greater the state capacity, the greater the ability to effectively extract corvée labor, which would increase its prevalence all else equal. Moreover, we observe both forms of taxation side by side for long periods in countries' development. How, then, did state capacity affect the use of corvée labor overall and in relation to monetary taxes? Up until this point, the lack of large-scale corvée labor registers have kept us from understanding this key transition point in the process of fiscal modernization. I overcome this limitation by assembling a rich new panel of data for colonial Indonesia. With these data I present what is to my knowledge the first empirical study of corvée labor and state capacity.

Specifically, in this paper I ask what the effect of state capacity expansion is on corvée labor usage. I open the black box of state capacity by distinguishing between local and national state actors. Local officials to a large extent determined the level and allocation of corvée usage in Indonesia. Expansions of local state bureaucracies could thus increase corvée usage even as central state actors push for replacing corvée

[1] For example, it was used in ancient Egypt and Israel (Brown, 1994; Mendelsohn, 1962), the fifteenth-century Inca Empire (Mann, 2005), eighteenth-century England (Bogart, 2005), the nineteenth-century United States (Hunter, 1961), and twentieth-century British Africa (Frankema and Van Waijenburg, 2014), French Africa (Van Waijenburg, 2018) and China (Bernstein and Lü, 2003). Major projects such as the Great Pyramid of Giza and the Great Wall of China were partially built by corvée labor.

with higher monetary taxes. This tension between central and local state actors was accentuated by the differences between European officials, who aligned more with the national-level colonial bureaucracy, and indigenous officials, who were more rooted in local power structures and some of whom were local elites with a tradition of using coerced labor. The central colonial bureaucracy and the local officials were in a principal-agent relationship in which preferences and incentives were not necessarily aligned. In short, this paper posits two countervailing mechanisms: (i) higher state capacity entails higher administrative capacity that stimulates a shift into monetary taxation and thus a reduction of corvée labor; (ii) higher state capacity entails higher extractive capacity and thus an increase of corvée labor. The net effect is ultimately an empirical question.

I use primary colonial Indonesian records to construct a new dataset to empirically investigate this issue. I focus on the island of Java which contained the main population, administrative, and economic centers of the Dutch East Indies, modern-day Indonesia. Java is a good case study as unique province-level annual data on the actual usage of corvée labor, in addition to its legal maximum limits, have been preserved. Importantly, the colonial state on Java required hundreds of thousands of people to provide millions of labor days without pay. Moreover, the state relied on corvée labor differentially across space and time. The data show that in Java as a whole the use of corvée labor was declining, but with different timing and intensity across its provinces. At the same time, the use of a poll tax was increasing as it gradually replaced corvée.

I use a province-level panel data framework spanning thirty-two years (1874-1905) to test which effect of state capacity dominated. I proxy for local state capacity with the number of state officials in a province. Results show a positive and significant relationship between officials and corvée usage. Moreover, this positive relationship applies to indigenous officials, but not to European officials. These findings are robust across various specifications and standard error adjustments. State capacity proxies, such as counts of officials, may however be endogenous. To address endogeneity, I use an instrumental variables (IV) approach that exploits the differing importance, both across provinces and over time, of effective distance to the capital Batavia, modern-day Jakarta. The IV results

are consistent with the OLS results in that I find local state capacity expansion increased corvée labor use. Moreover, this effect is driven by indigenous officials. The results are robust to the choice of instrument and across various specifications and standard error adjustments. These findings are evidence in favor of the extraction hypothesis in which state capacity expansion increases corvée labor.

However, since the use of corvée labor was on a downward trend across Java, local state capacity expansion only slowed this decline. What explains the overall downward trend? I argue several factors are at work. National policy actively stimulated the reduction of corvée labor and its replacement by a poll tax. Such monetary taxation enhanced central control over both the level and the allocation of taxation. While local indigenous officials had significant leeway regarding the level and allocation of corvée, the level and allocation of the poll tax was determined by European officials to a much greater degree. Such a replacement, however, was conditional on sufficient information-collection capabilities of the state as well as productivity and monetization of local economies. The phasing out of labor duties was thus a gradual process. By 1916 the conditions were sufficiently met to enable the complete abolishment of the remaining corvée labor on Java. This part of the story is thus evidence in favor of the administrative capacity hypothesis in which state capacity expansion reduces corvée labor.

I argue that the interests of central state actors did not always coincide with those of local state actors regarding the revenue mix of the colonial state. National state actors favored centralization of taxation and viewed as key the replacement of labor duties with monetary taxation. Local state actors protected their position in the system by increasing the form of state-backed extraction over which they had most discretion: labor duties. These tensions between local and national state actors are key in understanding the countervailing forces underlying this facet of fiscal modernization.

This paper principally contributes to three literatures. First, by documenting the importance and patterns of corvée labor it contributes to the literature on labor coercion. While labor coercion is often studied in private and semi-private forms such as slavery, serfdom, and penal contracts (e.g. Nieboer, 1900; Domar, 1970; Nunn, 2008;

Dell, 2010; Acemoglu and Wolitzky, 2011; Naidu and Yuchtman, 2013; Markevich and Zhuravskaya, 2018; Buggle and Nafziger, 2020; Dippel et al., 2020; Saleh, 2020), corvée labor is relatively understudied (e.g. Okia, 2017; Van Waijenburg, 2018). The historically widespread use of corvée, and the conceptual differences between private and public labor coercion, make understanding the rise and fall of corvée fundamental for understanding labor coercion more broadly.

Second, by unpacking the relationships between state capacity, corvée labor, and monetary taxation this paper contributes to the literatures on state capacity and taxation (e.g. Karaman and Pamuk, 2010, 2013; Besley and Persson, 2011; Sng and Moriguchi, 2014; Dincecco and Katz, 2016; Johnson and Koyama, 2017) and agency problems within the state and taxation (e.g. Sng, 2014; Ma and Rubin, 2019; Hao and Liu, 2020). The results indicate that state capacity expansion need not necessarily induce fiscal modernization. Rather, the type of state capacity expansion (e.g. central versus local) matters. Furthermore, fiscal modernization is not necessarily undertaken for efficiency or equity reasons or to increase overall tax revenues, but can be undertaken to alleviate principal-agent problems within the state in the center's favor and increase the center's share of taxation. It is key to open the black box of state capacity and analyze specific actors within the state. While certain state actors might push toward fiscal modernization, other state actors might push for the status quo in taxation.

Third, by detailing the different relationships European and indigenous officials had with different forms of taxation, and by explaining the rationale for the colonial Indonesian state initially relying on corvée while later replacing it with monetary taxation, this paper contributes to the literature on colonialism, specifically regarding the political economy of public finance (e.g. Frankema, 2010, 2011; Gardner, 2012; Wahid, 2013; Frankema and Van Waijenburg, 2014; Van Waijenburg, 2018; Xu, 2018, 2019; Frankema and Booth, 2019; Cogneau, Dupraz and Mesplé-Somps, 2021). I find that the reliance of the Indonesian colonial state on a large body of indigenous officials impacted its usage of different forms of taxation. Moreover, my findings indicate that merely looking at monetary taxation can lead to a distorted picture of the evolution of fiscal capacity, especially

when such monetary taxation was partly replacing in-kind taxation such as corvée labor.

The next section sketches the historical and institutional context of corvée labor in Java. The third section introduces the data and describes the empirical patterns of corvée usage. The fourth section describes the methodology. The fifth section discusses the results. The final section concludes. The appendix describes the data construction and contains additional regression tables.

2 Background

Forced labor has a long history on Java. For example, the seventeenth-century sultanate of Banten used coerced labor to construct irrigation networks and canals (Boomgaard, 1990). The sultanate of Mataram, meanwhile, relied on labor duties as its main form of taxation (Moertono, 1963). In the eighteenth century the Dutch East India Company required villagers in the Preanger regencies to cultivate coffee and sell it at preset prices to the company (Breman, 2015). The company also used corvée laborers to dredge canals and unload large ships (Bosma, 2013; De Zwart and Van Zanden, 2015). In 1810 the Great Post Road, which today still runs across Java from west to east in the form of the North Coast Road, was mainly built by forced labor (Ten Horn-Van Nispen and Ravesteijn, 2009).

In the 1830s the Cultivation System was established (Fasseur, 1992; Van Niel, 1992). Under this system peasants throughout Java were required to set aside a given proportion of their land for the cultivation of cash crops such as coffee, sugar, and indigo. These export crops were subsequently sold to the state at fixed prices. State officials determined the type and quantity of the export crops in each village. The colonial state enlisted local indigenous elites for enforcement through a sharing arrangement. Village heads received a certain share of the revenues from the export crops in order to make sure the villagers put time and effort into the forced cultivations (*cultuurdiensten*, 'cultivation services'). The Cultivation System was phased out from the 1870s onward.[2] Viewed over the longer

[2]While the Cultivation System is estimated to have had long-run positive impacts on local economic development (Dell and Olken, 2020), it is also estimated to have increased contemporary mortality rates (De Zwart et al., 2020).

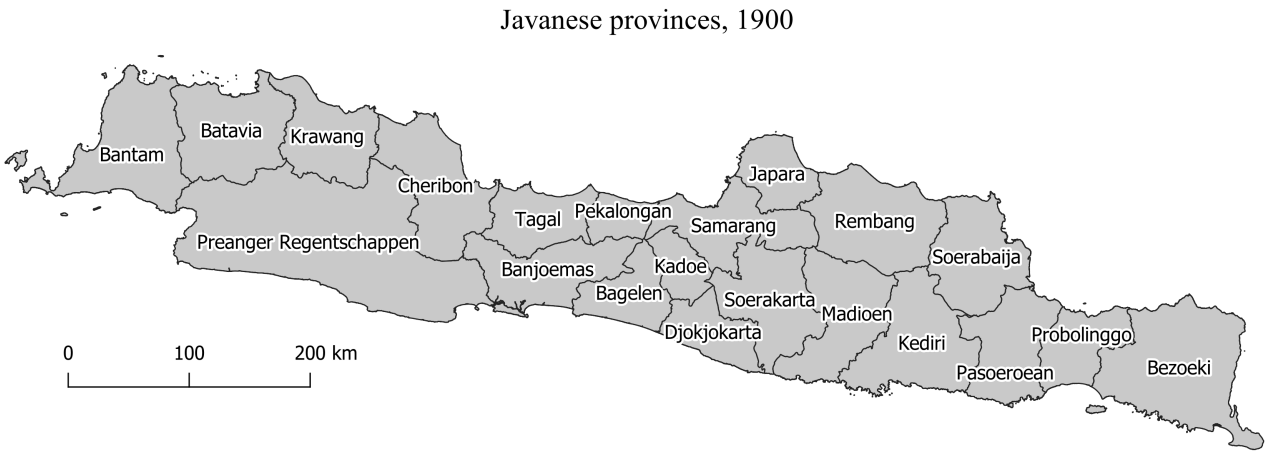


Figure 1

term, cultivation services were only one version of forced labor in Java. Corvée labor was another, more enduring, version.

Corvée labor (*heerendiensten*, 'lord's services') was commonly used in 1870 and remained in use in the centrally-governed provinces on Java until the 1910s. Moreover, in the two Javanese princely states and outside Java corvée labor was still used in the 1940s (Booth, 1980). I mainly rely on hand-collected quantitative and qualitative data from the annual Colonial Reports (*Koloniale Verslagen*, henceforth KV) to examine this type of labor coercion at the provincial level in Java as the secondary literature on corvée is sparse. Figure 1 displays the Javanese provinces in 1900.

Corvée labor was applied to five broad categories: maintenance duty, construction duty, guard duty, personal duties to the local indigenous officials, and other duties.[3] Maintenance and construction duties were related to local infrastructure projects. Work was performed on roads, bridges, travel lodges, water works, storage houses, guard houses, and prisons. Guard duty mainly consisted of guarding roads at night, but storage houses, water works, and prisons were guarded too. Other duties consisted of operating ferries, delivering letters and grass for mail horses, and escorting prisoners and state officials.

[3]Javanese corvée labor could thus not be used in mines or on plantations. However, the state could require laborers to work for sugar refineries for a set output-dependent wage payment if those refineries claimed they could not find enough wage labor. This was still prevalent in the 1860s, but was phased out in the early 1870s (e.g. KV 1871, p. 170; KV 1872, p. 160; KV 1873, p. 217).

A work day consisted of twelve hours. Each corvée laborer could be made to work a given maximum number of days per year. These maxima, as well as their legal bases, were regulated at the national level but differed across sub-provincial districts and across individuals. Usually this maximum depended on the type of land ownership, with owning rice paddies resulting in a higher assessment than, say, owning a garden would.[4] Over time the maxima were gradually reduced. The labor duties only applied to indigenous adult men of whom more than half were subject to such duties.

Laborers could pay off their labor duties or let others perform their duties for them. Relatively affluent villagers paid off their complete annual duties in advance, while others resorted to hiring full or partial substitutes (KV 1873, p. 94; KV 1874, p. 77). Some substitutes accepted food and lodging in lieu of monetary payments (KV 1872, p. 64). Sometimes people coordinated in hiring substitutes (KV 1901, p. 68). State officials were not always pleased with the substitutes, as many were either old men or teenage boys (KV 1873, p. 95; KV 1882, p. 74).[5]

Corvée labor was only to take place within eight *paal*, approximately twelve kilometers, from the laborer's village so he could return home at the end of the day. Nonetheless, under certain circumstances laborers could be required to travel further and stay overnight, although this would have to be counted as a double work day (KV 1886, Appendix L, p. 1).[6] The laborer had to provide for his own meals, but when the labor was physically very demanding or when time was of the essence the local official was allowed to dispense food

[4]In 1880 in Java, for example, 1.8 million men had a maximum duty of fifty-two days, 0.3 million men had a maximum duty of twenty-six days, and 0.2 million men had a maximum duty of thirteen days. In the pre-colonial sultanate of Mataram the level of labor duties also differed according to land ownership (Moertono, 1963, Appendix II).

[5]While paying off duties was geographically widespread, the extent in number of days is unknown. From 1905 onward the system of paying off corvée duties was formalized as agreements for specific villages and for specific tasks could be made (KV 1906, p. 139). Unfortunately the KVs contain no records of the extent of such agreements in terms of persons, days, and money involved, so their importance remains uncertain. Since such agreements increased in number from 1905 onward, paying off duties likely increased in importance over time and thus foreshadowed the eventual complete replacement of corvée with monetary taxation. In the non-Javanese Outer Islands the importance of paying off corvée duties greatly increased in the late 1910s and 1920s (Hup, 2021).

[6]This was the case, for example, in Banjoewangi where the postal road between its main city and the border with the neighboring province of Bezoeki went through sparsely populated areas. The villages close to the road could not provide enough labor so villages further away than eight *paal* were also assigned to maintaining the road (KV 1877, p. 85). Eventually this issue was dealt with by stationing convict laborers at four places along the road to maintain the road and thereby reduce the burden on local villagers (KV 1882, p. 74).

reimbursements.[7] Laborers could not be made to work more than the given maximum number of days. Still, if a work project hit unforeseen adversity then the local European official could ask the colony's Governor-General for permission to temporarily extend the number of work days.

This hierarchical bureaucracy reached down to the village level, but local indigenous officials possessed a significant degree of autonomy in setting and allocating corvée labor duties. While corvée labor was regulated at the national level, crucially for the evaluation of state capacity, the implementation of corvée labor therefore varied across time and space. With regards to road maintenance, for example, indigenous officials were responsible for day-to-day supervision. Minor repairs and the collection of surface material such as gravel were overseen by the *controleur*, the local European official who oversaw multiple villages. Since such *controleurs* were thinly spread, however, the actual on-the-ground oversight they were able to muster was limited. This left much autonomy in the hands of local indigenous officials. For major repairs the *controleur* first had to ask permission of the *resident*, the European official in charge of the province. The *controleur* collected records of used corvée days from the indigenous officials and amalgamated them into a report, following a standardized layout, that he sent to the *resident* before the fifteenth day of the subsequent month (KV 1891, Appendix O, p. 3). The *resident*, or rather his team of secretaries, subsequently combined the reports from the *controleurs* inside the province and sent such an overview to the central authorities in the capital. These detailed records provide essential data for an analysis of corvée labor usage.

For managing the implementation of corvée, local indigenous officials were partially paid in the form of corvée. The officials could use this 'payment' in the form of personal duties as they saw fit. Forcing the indigenous population to work for the state thus partially solved the state's revenue problem as laborers paid part of their taxes in kind through labor duties. From mid-1882 onward a poll tax of one guilder per person per year, that only applied to the men who were subject to corvée labor duties, replaced

[7] There are also cases where compensation was given when localities were hit by tough economic times (KV 1890, p. 73; KV 1891, p. 79; KV 1897, p. 99). In general the compensation did not cover many tasks and did not amount to much.

certain duties and reduced the maximum number of work days (Day, 1900).

The initial enactment of the poll tax in 1882 mainly aimed to abolish personal duties to certain indigenous officials, thereby limiting their autonomy in setting corvée burdens.[8] In return the affected officials received higher salaries. Moreover, the poll tax incentivized officials through a sharing arrangement. Their collector's fee was set at a uniform 8% of poll tax revenues. Under regulation and exhortation from the central authorities in Batavia the use of corvée labor was further streamlined and reduced. The maximum days a Javanese laborer could generally be made to work gradually declined from fifty-two in 1870 to forty-two in 1882 to twenty-four in the 1890s and to zero by 1916. By 1916 the state had completely phased out the remaining corvée duties in return for an increased poll tax.[9]

The replacement of corvée labor with a poll tax benefited the central state authorities through the higher fungibility, portability, and storability of money. In contrast to corvée labor, poll tax revenues could be more easily transferred to, and stored in, provincial capitals and Batavia. This enabled the central authorities to more strictly control the aggregation and disbursement of revenues. For example, while the poll tax was collected by indigenous officials, they could not deviate from the centrally-set level of the poll tax and they subsequently had to hand in the funds at a designated site. The funds were generally under the control of the local European official, the *controleur* (KV 1896, p. 83).[10] The *controleur* also had to collect village-level assessment rolls, amalgamate them into district-level assessment rolls, and send these, along with explanatory notes on any potential increases or decreases, to the European official at the head of the province, the *resident* (Departement van het Binnenlandsch Bestuur, 1918). While the system of labor duties thus left significant control to local indigenous officials, the poll tax facilitated a

[8]However, village head services (*pantjendiensten*) that were part of village duties (*dessadiensten*) remained in place.

[9]However, outside Java more than 950,000 people were still obligated to work for the state for no pay. The use of corvée labor in the Outer Islands and in the two princely states on Java continued into the 1940s (Booth, 1980; Hup, 2021). The village services did continue on Java, but were also subject to tightening supervision and regulation from Batavia.

[10]In some places where the *controleur* was stretched over too large an area, part of the funds were managed by local indigenous officials such as district and sub-district heads. In such cases, the central bureaucracy aimed to "strictly watch the indigenous heads' actions, to ensure no abuse of the funds" (KV 1896, p. 83, own translation).

firmer grip over taxation levels and allocation by the European bureaucracy.

This not only appealed to the colonial state's central authorities due to its distrust of indigenous officials, who constituted the vast majority of state officials, but also because it enabled cross-province transfers. While corvée labor had to be used locally, poll tax revenues could theoretically be spent anywhere. Even though regulations stated poll tax revenues ought to be spent locally, the net revenues of the poll tax (i.e. revenues minus collection fees and spending on local works) quietly flowed into the central coffers (Fokkens, 1914). In 1902 this was formalized by declaring the poll tax a regular tax whose net revenues would flow to the central budget (KV 1902, p. 165). This played into the hands of officials in Batavia and at the head of the provinces who had long criticized local officials for wasting corvée labor on unproductive tasks and for allowing shoddy work (e.g. KV 1874, p. 76; KV 1890, p. 73).[11]

Moreover, if the laborers engaged in productive activities on the days they would otherwise have been performing corvée labor then the colonial Dutch state would also benefit through other taxes such as those on land and exports. In other words, the opportunity costs of corvée were born by the central authorities, who saw potential negative effects on other tax revenues, not by salaried local officials. Such an encompassing interest was openly acknowledged as an important rationale. After reducing labor duties in the province of Kadoe, for example, European officials who were part of a research group set up by the director of the civil service, contentedly noted villagers could now be more easily moved to work their fields in a regular and timely manner (KV 1891, p. 80). Similarly, the KVs care to report that in Pasoeroean the reduction in labor duties freed more labor to work on producing coffee and sugar and on constructing a nearby state railway (KV 1895, p. 99).

However, replacement of taxation in labor with taxation in money required local village economies to be sufficiently productive and monetized. Furthermore, to be able to levy and gradually increase the poll tax, the state first needed to collect local-level

[11] KV 1874, p. 77 relates the story of a corvée-built earthen dam in Krawang that broke at the first small flood. To improve the quality of dams, the report recommends expanding the department of hydraulic-engineering works so that dam construction can be performed under the guidance and supervision of qualified personnel.

information on villages' capacity-to-pay. The state was careful in not shifting out of labor duties too quickly. Field research in 1890 in Bagelen, for example, concluded that all local duties could be abolished if the poll tax was increased from one guilder to nearly three guilders, but that such an increase was not yet possible given the economic conditions (KV 1891, p. 80). Some officials also complained about the rigid uniformity of the poll tax as compared to the labor duties that could flexibly adjust to local conditions (KV 1881, p. 73). Eventually central authorities recognized this problem and allowed for local adjustments of the poll tax as long as such adjustments were pre-approved by the central authorities (KV 1893, p. 75). All these facets indicate that even though a poll tax has relatively low information requirements for the state in comparison to more complex taxes such as income taxes, it does require more information on the part of the central state than corvée labor duties do, for example on local currency usage and earning capacity.

A related thorny issue concerned the supply of wage labor. In the absence of labor duties, sufficient wage labor had to be available for the state to hire in order to be able to expand and maintain its network of roads and irrigation works. Moreover, the potentially large localized increases in wage labor demand due to abolishing corvée labor might drive up local wages. This would matter especially in areas where a significant part of the corvée laborers would not offer their labor on the wage labor market, at least not at the going wages. As an experiment in 1897, labor duties were further reduced in three districts in exchange for higher monetary taxation (KV 1898, p. 60). Wage labor was subsequently hired. However, wages rose to such an extent that the experiment was canceled in 1898 (KV 1899, p. 89). A few years later a compromise solution was decided on: certain corvée duties were abolished, but if not enough wage laborers were available at set wages then laborers who were subject to corvée duties could still be coerced to work. This work would now, however, be done at 'decent' wages (KV 1904, p. 175).

Lastly, the cancellation of the 1897 experiment was also due to two other reasons: the indigenous officials only cooperated minimally and the European official was stretched over too large an area to adequately monitor the wage labor. These last two issues illustrate the limits of colonial state capacity on Java. The corvée labor system relied on

thousands of indigenous officials for implementation. These officials in return were rewarded with salaries, labor duties for personal use and the power and prestige that comes with overseeing large labor projects involving fellow villagers. In the poll tax system, in contrast, indigenous officials were more akin to mere tax collectors while European officials were in tighter control of setting the level of taxation and of dispensing the funds. Even when the responsibility for certain public works was devolved to indigenous village governments, it was made clear that the poll tax funds they received to hire wage labor came from the central budget (KV 1908, p. 141).

The replacement of corvée by the poll tax occurred as the colonial state gradually enhanced its capabilities by expanding its bureaucracy. This state expansion was in turn enabled by improvements in communications and transportation through the introduction and spread of new technologies such as steams ships, railroads, and telegraph lines. Such improvements enabled the state to better manage an expanded bureaucracy, even in places far away from the capital or in the hinterlands. The state's bureaucratic expansion increased both its extractive capacity and its administrative capacity, its ability to gather and assess large amounts of information, and thereby enabled progress on fiscal modernization besides the poll-corvée replacement. For example, the state updated its Javanese land registry and applied it across Java, although spottily, by the 1910s. Moreover, it gathered detailed income statistics and levied the income tax from 1908 onward. By 1920 income tax coverage had expanded to a significant portion of the population. Contemporaneously, tax farming – the practice of leasing out collection of certain taxes to private parties – was generally phased out in favor of state-run tax collection (Wahid, 2013).

However, the replacement of the corvée system with a poll tax system was not merely about modernizing taxation, it was also about centralizing authority into the hands of a European bureaucracy that was more closely in tune with the wishes of Batavia. The dual character of Indonesia's colonial bureaucracy meant that European officials could potentially work their way up the European bureaucracy by faithfully implementing their superiors' wishes (Fasseur, 1993; Van den Doel, 1994). Local European officials were com-

peting with each other for promotions to a more hospitable posting with better amenities, potentially a provincial capital or even Batavia. Such career incentives were much less pronounced for indigenous officials (Sutherland, 1979). Geographic circulation of indigenous officials was rare and, when it did occur, almost never crossed ethnic boundaries (Kuipers, 2020). While both these groups thus consisted of officials on the state's payroll, the European officials were more enmeshed into the national bureaucracy and therefore more strongly incentivized to work towards the wishes of the bureaucracy's upper hierarchy, in this case towards fiscal modernization and centralization by replacing corvée with a poll tax.

The tensions within the bureaucracy between those who aligned more with the national-level bureaucracy and those who were more rooted in local power structures, raises the question of the effect of state capacity expansion on corvée labor use. The colonial Indonesian state bureaucracy was not a unitary actor, but instead consisted of a multiplicity of actors with potentially different preferences and incentives with regards to types of taxation. National-level officials may have supported replacing corvée with a poll tax because it enhanced central control over the level and allocation of taxation, while local-level officials may have resisted exactly because they possessed a high degree of autonomy in setting the level and allocation of corvée. The effect of state capacity expansion on corvée labor may therefore depend on what part of the state is expanding. This paper investigates these differences by examining both overall expansions of state bureaucracies and by splitting such expansions into a relatively center-aligned component – the European officials – and a relatively locally-rooted component – the indigenous officials.

3 Data

To empirically investigate corvée labor, I create the first dataset tracking actual usage in days across provinces. The dataset covers all Javanese provinces, except two indirectly-ruled princely states, and nearly five decades from 1870 to corvée's full replacement with a poll tax in 1916. Uniquely, the KVs contain province-level information on used

corvée in number of days worked. This usage data, that goes beyond information on legal maximum limits on corvée, enables an empirical investigation of what drove corvée usage, how it varied over time and space, and for what purposes it was used. In addition to the number of used corvée days, I also collect poll tax revenues and the number of state officials from the KVs.

The data included in the records may understate total labor duties. Firstly, officials possibly undercounted the actual number of days worked (KV 1880, p. 72).[12] Secondly, four Javanese provinces contained private estates on which the landowner, not the state, collected labor duties.[13] Thirdly, the figures cover central government corvée, but not so-called village duties (*dessadiensten*) imposed by local indigenous village governments on which no comprehensive data were recorded.[14] Fourthly, the colonial state did not oversee the corvée labor in the princely states of Djokjokarta and Soerakarta where indigenous elites directly managed the corvée labor system.[15]

Figure 2 displays the total days contributed by corvée labor on the nineteen directly-ruled Javanese provinces for the period 1870-1920. In 1880, about 34% of days were spent on maintenance duty, 28% on guard duty, 13% on construction duty, 19% on personal

[12]However, the *resident* of Madura, an island province next to Java, was skeptical of such undercounting (KV 1881, p. 75). He thought the officials were more likely exaggerating, rather than downplaying, the actual number of days. They had two reasons for this: (i) to reduce the burden on villagers; (ii) to signal their diligence. However, this seems to have been a minority view.

[13]These estates were relics of the eighteenth and early nineteenth century when the colonial state sold stretches of land, along with 'feudal' privileges with regards to the people living on those lands, in order to raise revenue (Van Zanden, 2010). Data on these private estates are listed separately in the KVs from 1896 onward, but the accuracy of these statistics is probably lower. Moreover, for earlier years these numbers were (partly) incorporated into the overall province-level statistics. Disentangling these is thus not possible, so I include these figures throughout. These statistics do indicate that the vast majority of such 'private' corvée, usually around 95% of the total, took place in Batavia province.

[14]These village duties were not strictly regulated by the central authorities apart from instructing local officials to ensure they 'stayed within proper limits' (KV 1877, p. 85). Some European officials argued the village corvée was more onerous on the indigenous population than the central corvée was (KV 1889, p. 84). Subsequent field research by the department of the interior supported such claims by finding that indigenous village governments could use up to thirty-five million village service days in 1893 (KV 1895, Appendix P). KV 1901, p. 67 clarifies this number refers to the maximum allowed number of days, not the actual used number of days. However, it also notes that the count excludes certain types of work that were also performed as village duties but were completely unregulated. Still, the maximum lies significantly below the corvée labor maximum of nearly ninety-eight million days. However, the used number of days of corvée labor was far below its maximum. Whether that was the case with village service days is unclear. Nonetheless, due to stricter regulation and supervision the village service days are believed to also be on a downward trend in this period.

[15]Booth (1980, Table 8) shows that as late as 1939 more than four million days of corvée labor were extracted by the indigenous elites in these two princely states.

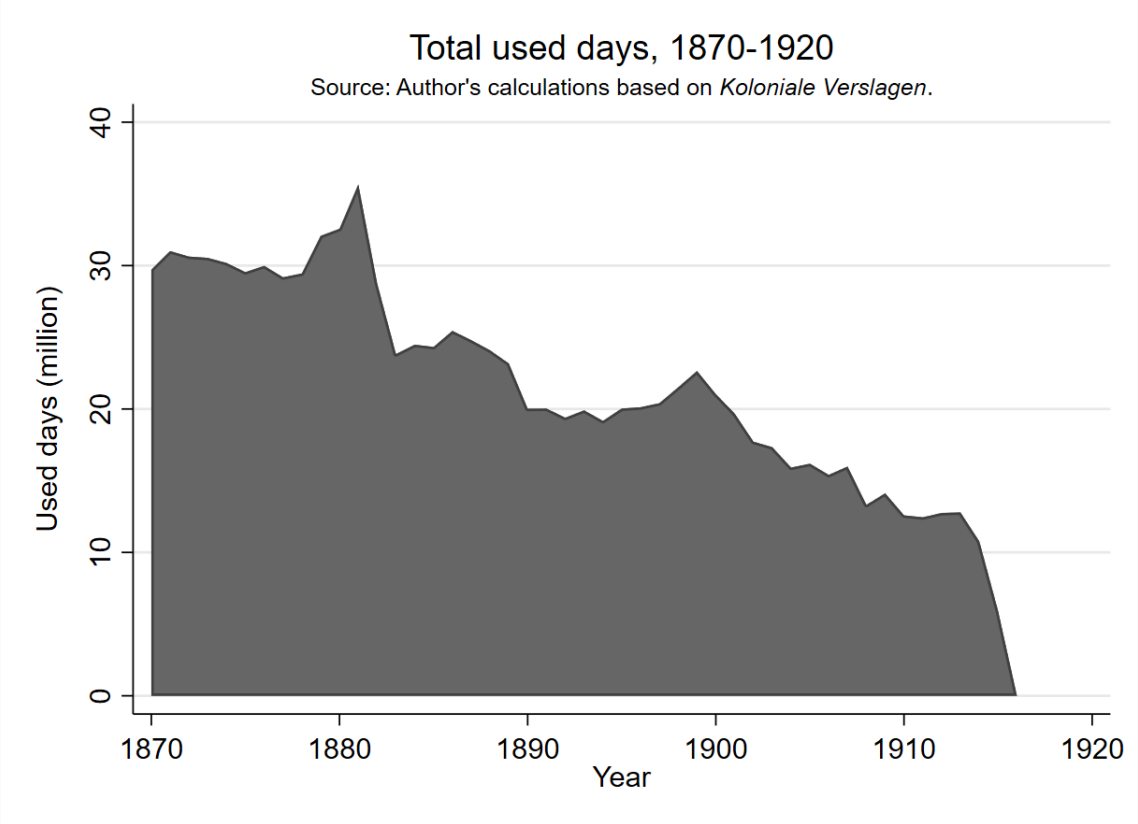


Figure 2

duties to the local indigenous officials, and the remaining 6% on other duties. Despite potentially representing a lower-bound estimate, Figure 2 shows that the use of corvée labor was an important component of state extraction as throughout the 1870s Javanese conscripts provided around thirty million days of labor. Valued at average unskilled labor wages the corvée labor equalled approximately a third of total tax revenues until 1882.[16] Alternatively, the thirty million days of labor is equivalent to around 120,000 people working for the state without pay twelve hours a day, five days a week, fifty weeks a year. With the adult indigenous male population in the directly-ruled Javanese provinces standing at about four million in 1870, this means 3% of this labor force was fully occupied by the corvée labor duties. In short, corvée labor represented both a sizable share of state revenues and of total labor usage.

Across approximately two million conscripts the thirty million labor days in the 1870s

[16]I base this on tax revenues from Mellegers (2004). Note that tax revenues do not include the substantial revenues from product sales and monopolies. I do not include those here as the costs of those revenue streams are large but unclear, wherefore net revenues likely differed considerably from gross revenues. Still, in the same period the value of corvée equalled approximately ten percent of all gross revenues.

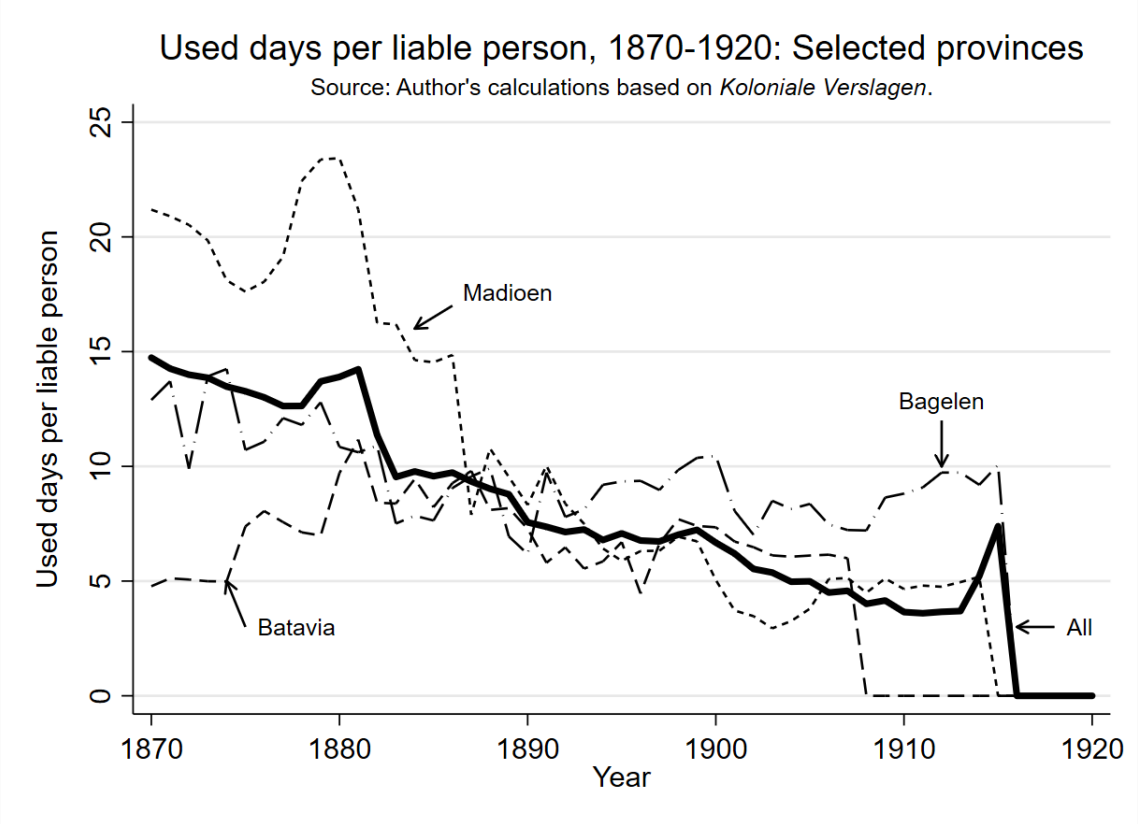


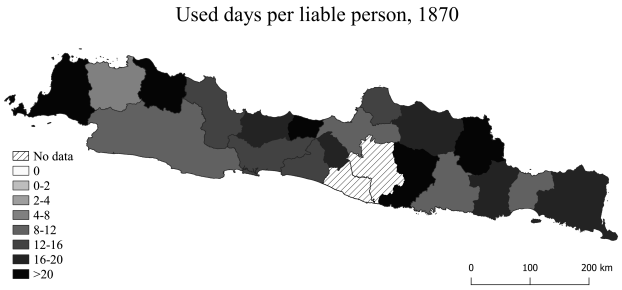
Figure 3

imply that the average conscript provided fifteen days per year. Across provinces, however, there was much variation in the number of days used per laborer (see Figure 3). While across all Javanese provinces the average conscript worked about fifteen days in 1870, the average conscript in Madioen worked more than twenty days. In comparison, in colonial French Africa in 1913-1937 the average ranged from four days in Senegal to fifteen days in Congo (Van Waijenburg, 2018, Table 1A and 1B). As the population grew but the corvée labor days declined, the share of the labor force fully involved in corvée labor fell over time. The speed of this decline varied across provinces (see Figure 4).

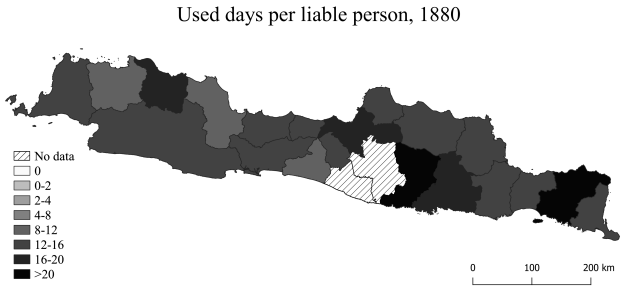
The poll tax, first implemented in mid-1882, gradually replaced corvée. Figure 5 graphs the substitution between corvée labor (valued at province-year-specific average unskilled wages) and the poll tax. Induced by the poll tax implementation, used days fell by 11.9 million from 35.8 million in 1881 to 23.9 million in 1883. Induced by a poll tax hike, used days fell from 12.8 million in 1913 to zero in 1916. These two abrupt declines in corvée usage, together adding up to 24.7 million days, represent 69% of used

Figure 4: Used days per liable person, 1870-1920
Source: Author's calculations based on *Koloniale Verslagen*.

(a)



(b)



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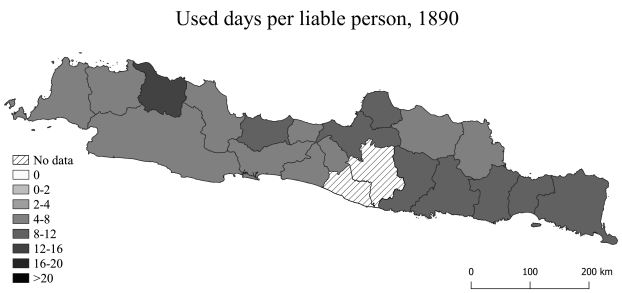
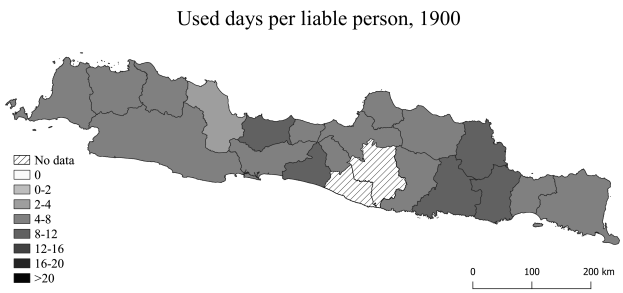
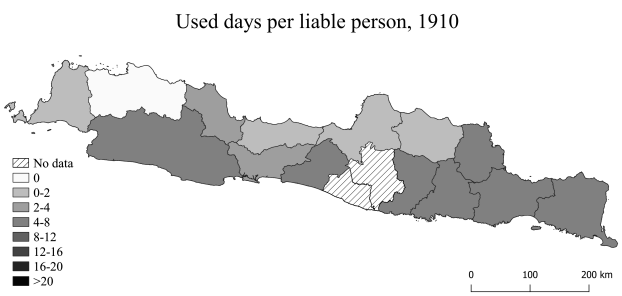


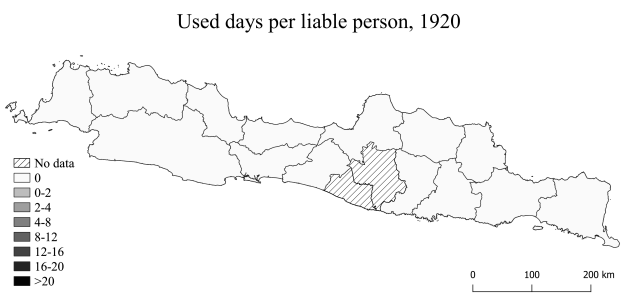
(d)



(e)



(f)



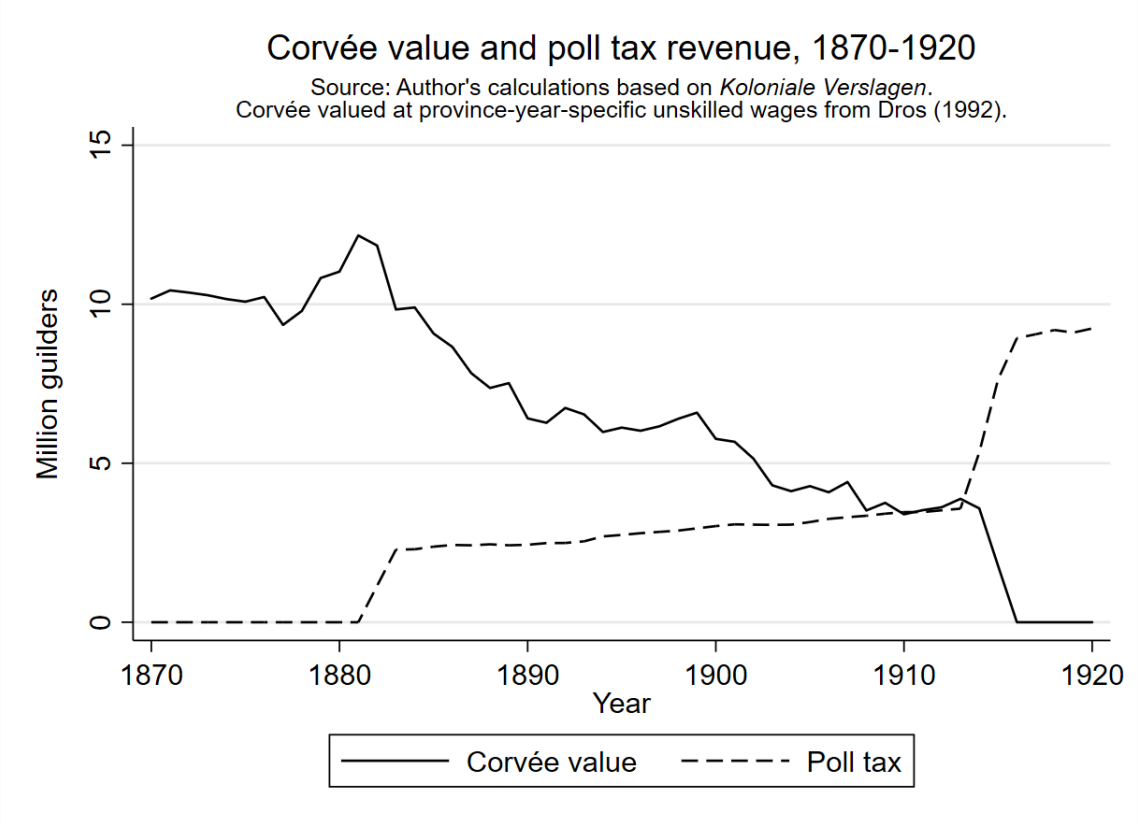


Figure 5

days in 1881 and indicate the direct impact of the centrally-pushed poll tax on corvée usage. From 1883 to 1913 corvée usage fell by another 11.1 million days, partly due to further minor restrictions on corvée tasks financed by poll tax surpluses, but spread out over thirty years. In terms of monetary value, corvée usage dropped by 2.3 million guilders (1881-83), 6.0 million guilders (1883-1913), and 3.9 million guilders (1913-16). Contemporaneously, poll tax revenues rose by 2.3 million guilders (1881-83), 1.6 million guilders (1883-1913), and 5.4 million guilders (1913-16).

The poll-corvée replacement occurred as the colonial state enhanced its information-collection and -analysis capabilities by expanding its bureaucracy. Figure 6 shows that between 1874 and 1905 the number of officials in the eighteen provinces roughly doubled. While the number of European officials grew by nearly 90%, the number of indigenous officials more than doubled. Over the same period the indigenous population grew by about 60%. The density of officials thus increased. Figure 6 graphs this increasing density as a decrease in the number of adult indigenous men per official. A higher density of

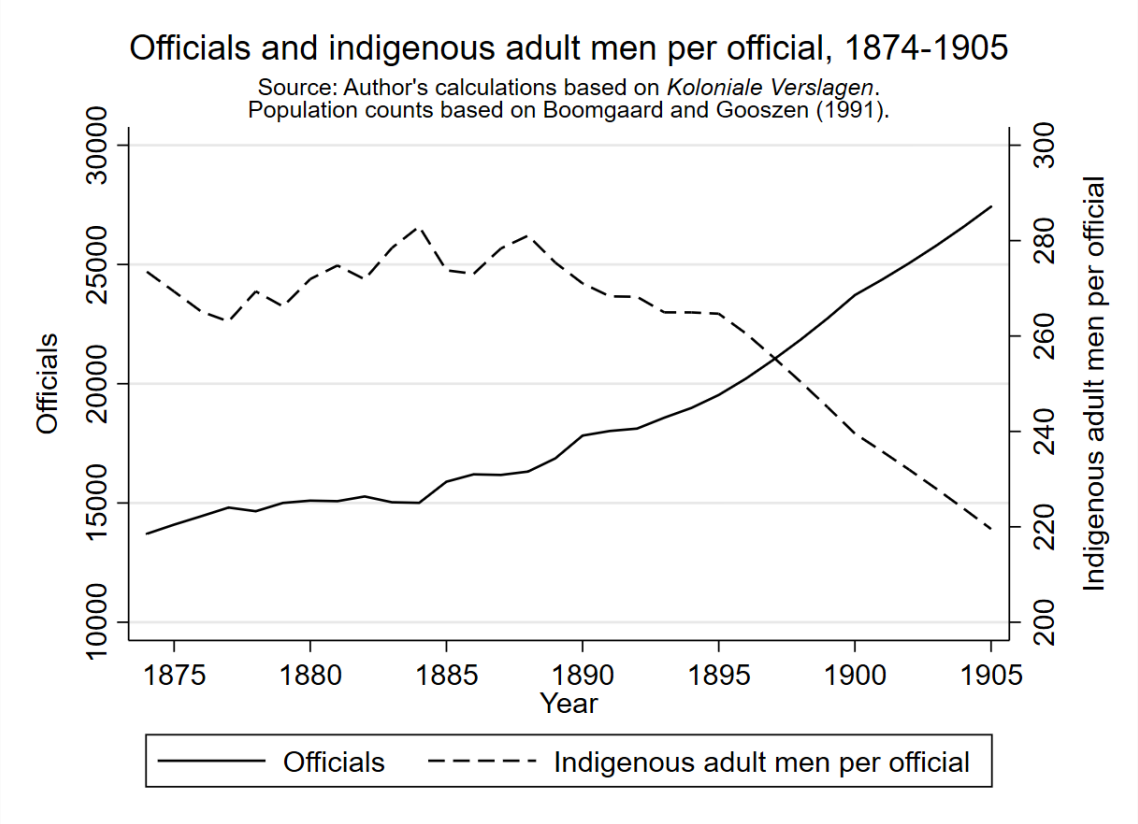


Figure 6

officials increased both the state's extractive capacity and its administrative capacity, its ability to gather and assess large amounts of information, and thereby enabled progress on changes in the tax structure such as the poll-corvée replacement, the updating of land registries, the levying of an income tax, and the replacement of tax farming with state-run tax collection.

The count of officials consists of both European and indigenous officials stationed in a province. The indigenous officials constituted the vast majority of officials in the provinces, hovering around a share of 85%.[17] Here, 'indigenous' refers to the state's racial classification of the officials. These indigenous officials thus do not signify indirect rule as

[17]State-appointed indigenous heads above the village level are amongst the indigenous officials, but indigenous village heads are not for two main reasons. Firstly, the number of village heads is largely determined by the number of villages, irrespective of state policy. The small growth in their number of less than sixteen percent between 1883 and 1905, while the number of other indigenous officials nearly doubled, reflects this. Secondly, from 1883 on the KVs report a single number for both village heads and village council members. As village councils differed in size and roles across villages, often according to local customs, this raw number does not capture state size and capacity well. Moreover, from 1883 onward the KVs report indigenous heads above the village level and other indigenous officials as a single number. This indicates the state viewed these latter two groups similarly and viewed them as distinct from village heads and village council members.

was practiced in the two Javanese princely states, Djokjokarta and Soerakarta, that are not included in the analysis due to a lack of data on corvée labor. All the included officials are on the payroll of the colonial state and part of its bureaucracy. They performed a wide variety of essential tasks including, but not limited to, collecting taxes, enforcing law and order, and overseeing public works projects.

4 Methodology

To disentangle the potentially countervailing forces within the state, I use a panel data framework of eighteen Javanese provinces across thirty-two years (1874-1905). To capture the national-level push, common across provinces, towards phasing out corvée in favor of a poll tax, I include year fixed effects. To proxy for local state capacity I use the number of state officials in a province. To also capture national-local tensions within state bureaucracies in each province, I separate the local officials into European and indigenous officials.

To investigate the relationship between state capacity and corvée labor, I thus estimate the following models:

$$Log(Days_{it}) = Log(Officials_{it})\beta + X'_{it}\gamma + \alpha_i + \lambda_t + \epsilon_{it} \quad (1)$$

And:

$$Log(Days_{it}) = Log(EuropeanOff_{it})\beta_1 + Log(IndigenousOff_{it})\beta_2 + X'_{it}\gamma + \alpha_i + \lambda_t + \epsilon_{it} \quad (2)$$

Where for province i and year t: $Days_{it}$ = used days of corvée labor, $Officials_{it}$ = number of officials, $EuropeanOff_{it}$ = number of European officials, $IndigenousOff_{it}$ = number of indigenous officials, X'_{it} = set of controls, α_i = province fixed effects, and λ_t = year fixed effects. I use logged variables in order to interpret the coefficients as elasticities and because provinces varied widely in used days of corvée labor and number of officials. The impact of one added official thus likely differed across provinces,

so percentage changes are more suitable. In model (1), a positive coefficient estimate on the number of officials would indicate local state capacity expansion is related to increased corvée usage. In model (2), a larger positive coefficient on indigenous officials as compared to on European officials would provide further evidence that the type of state capacity expansion matters for corvée usage and that within the state bureaucracy different actors can have different preferences over types of taxation and therefore over fiscal modernization.

The set of controls consists of certain factors that may be related to both state capacity and corvée labor use. For example, the expansion of industrial agriculture increased productivity and stimulated private demand for wage labor. At the same time, this industrialization was partly conditional on a strong state presence protecting European property rights as the majority of the involved capital came from Europe. To control for this channel I include the amount of privately-owned land-based steam power. Population growth, agricultural expansion and wage growth were also related to marginal labor productivity and wage labor supply as well as the provision of public goods such as law and order. To control for these factors I include population figures, the extent of rice paddies (*sawah*), and average unskilled daily wages. Lastly, province fixed effects control for unobserved heterogeneity across provinces (e.g. geography, pre-colonial institutions) and year fixed effects control for common developments across time (e.g. national-level policies, technological advances).

To permit valid inference in the presence of potential within-state and within-year (i.e. geographic) correlation in the errors, I use two-way (province and year) clustered Driscoll-Kraay standard errors (Driscoll and Kraay, 1998; Cameron et al., 2011). To correct potential downward bias in the cluster-robust standard errors due to the small number of clusters, I apply a small-sample correction. Following Cameron and Miller (2015), I further check for the potential problem of few clusters by using the wild cluster bootstrap method. Since shocks could be spatially dependent with decaying dependence across space, I follow Conley (1999) and Colella et al. (2019) by allowing for arbitrary

dependence of the errors across provinces and years.[18] Results are robust to the wild cluster bootstrap method and to spatial correction of errors. The findings are thus not affected by the exact method of computing standard errors. To avoid attributing undue influence to the effects observed in small provinces, I weight observations by the number of indigenous adult males. Results are robust to using no weights. Results are also robust to transforming variables into per capita terms and to using the value of used days as dependent variable.

Potential endogeneity troubles a causal analysis of the impact of state capacity on corvée labor usage. For example, the use of corvée labor for such public goods as security and infrastructure could in turn strengthen state capacity. Such a feedback loop raises the issue of reverse causality. Alternatively, if the state expands its ranks of officials in areas where it intends to modernize tax collection and phase out corvée labor, then this selection into treatment would introduce negative bias into the estimates. To address such issues I use an instrumental variables (IV) estimation in addition to an ordinary least squares (OLS) estimation. I exploit the differing importance, both across provinces and over time, of distance to the capital Batavia. I calculate the distance from the centroid of each province to the centroid of Batavia. Key is that while each province's distance from the capital is fixed, the practical importance of this distance varied over time.

Due to technological advancements and the spread of steam ships, railways, and telegraphs, the practical importance of distance shrank. While time is a rough proxy for advancement in technology and transportation, the number of steam ships and the number of steam ship passengers provide a more accurate reflection. To gauge robustness to the choice of instrument I thus instrument for the number of officials with three different instruments: the distance to Batavia divided by the year, the distance to Batavia divided by the number of Javanese steam ships, and the distance to Batavia divided by the number of steam ship passengers. The numerator varies cross-sectionally and the de-

[18] To implement this I use Colella et al.'s (2019) `acreg` Stata package. The distance matrix uses the longitude and latitude of each province's centroid. I set the spatial and temporal thresholds (i.e. distance and lag cutoffs) at 1,000 kilometers and ten years, respectively. Based on manually trying out different cutoff values for the basic specification, these cutoff values are more conservative (i.e. larger standard errors) while at the same time being the largest practical distance cutoff value as the largest centroid-to-centroid distance is approximately 900 kilometers.

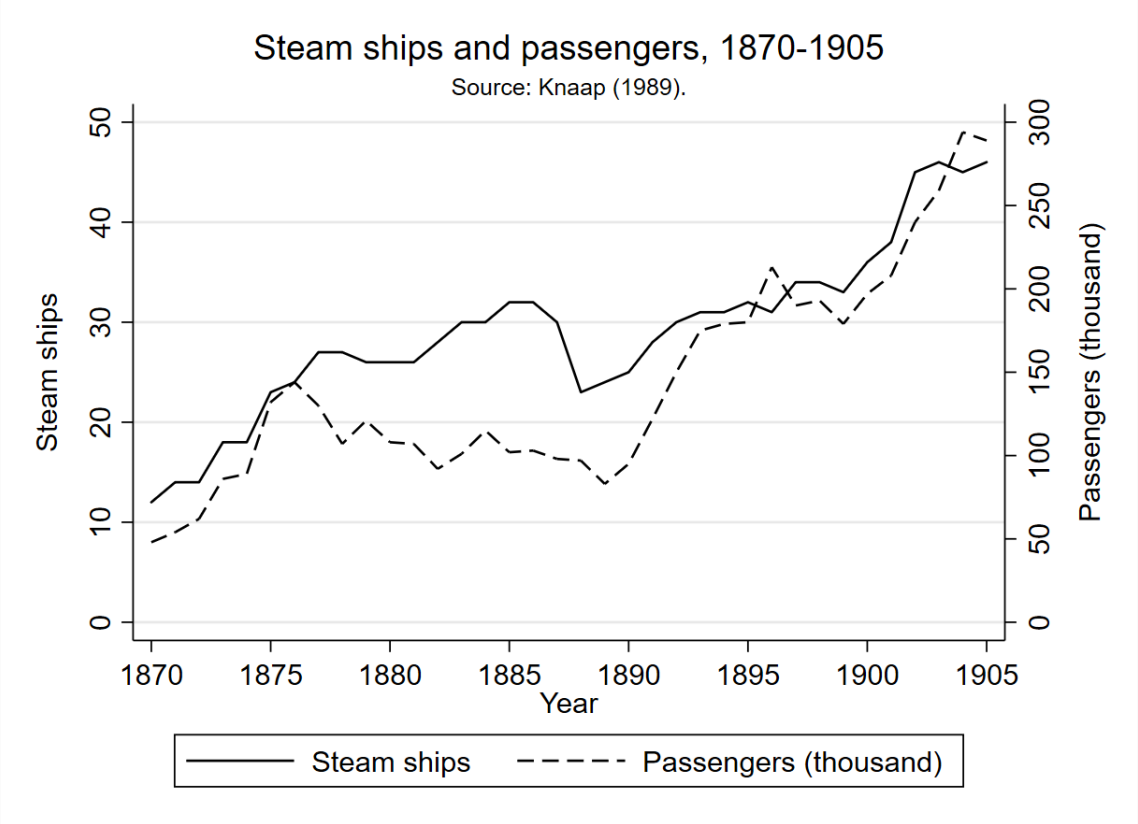


Figure 7

nominator varies temporally. I use ratios as these three variables all shrink the effective distance. The further time progresses, the more steam ships are active and the more passengers are ferried about, the further effective distance shrinks. Figure 7 graphs the increasing use of packet-boat service steam ships in Java. These ships were mainly concerned with transporting passengers and postal packets, rather than goods, and therefore especially relevant for the transport of and communication with officials scattered across Java (Knaap, 1989).

Each province differs in distance to Batavia, the administrative center, and this impacts the costs and benefits of employing officials. Shrinking distance directly impacts the costs of sending officials back-and-forth, of communication, and of monitoring. For example, officials far removed from the influence emanating from Batavia might be tempted to extract more corvée labor despite general proclamations calling for the gradual abolishment of labor duties. On the other hand, being distant from the capital, and its support in case of trouble, may also limit the official's extractive power vis-à-vis the population.

The costs and benefits of corvée labor are mainly determined by local conditions such as population density, industrialization, and labor productivity. While such factors could be affected by shrinking distance to the capital, my identifying assumption is that the model controls for them through including controls for population, land-based steam power, rice paddies, and wages in addition to province and year fixed effects. The instrument is plausibly excludable conditional on including the controls.

I loosen the assumption of conditional excludability by using Nevo and Rosen's (2012) Imperfect Instrumental Variable (IIV) procedure. The IIV procedure replaces the zero correlation assumption between the IIV and the unobserved error term with an assumption related to the sign of the correlation. Specifically, it assumes the IIV's correlation with the error term has the same sign as the endogenous variable's correlation with the error term. I assume the sign of the endogenous variable's correlation with the error term to be negative as I consider state bureaucratic expansion for the sake of fiscal modernization, and thus the phasing out of corvée labor, to be the most serious identification issue. Such selection into treatment would introduce negative bias into the OLS estimates. The IIV procedure also assumes the IIV's correlation with the error term is smaller than the endogenous variable's correlation with the error term. These two assumptions enable identification of bounds, instead of point estimates, for the parameters of interest.

The panel consists of eighteen Javanese provinces across thirty-two years. The capital province Batavia is excluded for three reasons: (i) its special status as administrative center for the whole colony; (ii) its poor data on corvée labor due to large private estates;[19] and (iii) to keep the OLS and IV panels comparable as Batavia's zero distance to itself means it cannot be included in the IV estimation. The two indirectly-ruled princely states, Djokjokarta and Soerakarta, are not included due to a complete lack of data on corvée labor. I use the provincial boundaries of 1882 to 1900. I thus merge the provinces of Bezoeki and Banjoewangi, which were separate until 1882, and separate five provincial mergers that took place in 1901. The time coverage is limited to 1874-1905 due to data limitations on the province-level number of officials.

[19] As noted in footnote 9, the vast majority of 'private' corvée took place in Batavia. Furthermore, it was the only province in which 'private' corvée vastly outweighted regular corvée.

Besides the number of used corvée days, poll tax revenues, and state officials, I also collect the number of privately-owned land-based steam power from the KVs. For population figures I use the number of adult indigenous men as only this group was subject to labor duties. These figures are based on Boomgaard and Gooszen (1991). The extent of rice paddies is from Boomgaard and Van Zanden (1990). Average unskilled daily wages are from Dros (1992). The number of steam ships and steam ship passengers are from Knaap (1989). The appendix contains details on the data construction.

5 Results

Columns 1 and 2 in Panel A of Table 1 show the results of the main OLS regression using the number of used corvée labor days as the dependent variable and the number of officials as the main explanatory variable. Columns 3 and 4 separate the officials into European and indigenous officials. Each specification includes province and year fixed effects. Controls for indigenous adult males, land-based steam power, rice paddies (*sawah*), and unskilled average daily wages are added in columns 2 and 4.[20] The results are consistent across specifications: more officials are associated with more forced labor. This implies that for local state capacity expansion the extractive channel dominates the administrative channel. Every one percent increase in officials is associated with a 0.71 percent increase in corvée labor days. Moreover, this positive elasticity between officials and corvée runs through the indigenous officials. Panel B shows the results are robust to transforming variables into per capita terms.

[Table 1 about here.]

Table 2 shows the IV results for the three different instruments. Panel A uses all officials, while Panel B uses only indigenous officials. Each specification includes province and year fixed effects. Controls are added in columns 2, 4, and 6. For the preferred specifications with controls, the first-stage F-statistics range from 18 to 29, suggesting

[20]Since province-years without privately-owned land-based steam power exist, I add one to the amount of steam power to enable the logarithm.

the estimates do not suffer from the weak instrument problem (Stock and Yogo, 2005). The IV estimates are qualitatively consistent with the OLS estimates, and robust to the choice of instrument, but the impact of officials on corvée labor days is larger: a one percent increase in officials increases corvée labor days by 1.40 to 2.08 percent. Again, this effect runs through the indigenous officials. Table 3 reports the IIV lower and upper bounds and the 95% confidence intervals for the same specifications. Since none of the confidence intervals contain zero, the IV results are robust to loosening the conditional excludability assumption.

[Table 2 and Table 3 about here.]

Both the OLS and the IV results are also robust to using used corvée value as dependent variable (Table A4 and Table A5), using wild cluster bootstrap standard errors (Table A6 and Table A7), using spatial correction of standard errors (Table A8 and Table A9), using no population weights (Table A10 and Table A11), and excluding provinces one at a time (results not reported).

Given the results, three main questions require answering. First, what are the mechanisms underlying the positive impact of local state capacity expansion on corvée labor? Second, why are the IV estimates larger than the OLS estimates? Third, how to reconcile the finding of a positive effect with the gradual decline of corvée? To help answer these questions, the relationship between local officials and the revenues of the poll tax, corvée's replacement, needs to be explored first.

Table 4 and Table 5 contain estimates of the relationship between officials and poll tax revenues. Using OLS, Table 4 shows a small positive, but statistically insignificant, relationship between officials and poll tax revenues. Columns 3 and 4 show no strong relationship is detected when separating European and indigenous officials. Using IV, while Table 5 shows a weakly significant positive relationship for two of the instruments, this result disappears when only looking at indigenous officials.

[Table 4 and Table 5 about here.]

Table 4 and Table 5 show that the economically large and statistically significant

relationships between local officials and corvée usage do not exist between local officials and poll tax revenues. These results support the notion that an important part of the rationale behind the poll tax was to restrict local officials', and particularly local indigenous officials', autonomy in setting and allocating taxes. Note that Table 1 indicates only local indigenous officials are related to increased corvée usage. Table 4 shows the poll tax replacement exactly thwarted such a relationship. Since local officials had much less leeway in setting the level of the poll tax, as compared to corvée, we would expect a smaller coefficient. Finding a coefficient statistically indistinguishable from zero means that the poll tax was successful in limiting local officials' autonomy in setting the level of this type of taxation.

In between the 1882 enactment and the 1914-1916 full replacement, Figure 5 also shows little annual variation in poll tax revenues. As intended with a uniform one guilder poll tax charge per laborer, poll tax revenues mainly tracked population growth and left less leeway for local officials, be they European or indigenous. Even local changes in the distribution of the poll tax burden across villages or individuals first had to go through a bureaucratic procedure requiring the approval of the province's top European official, the *resident* (Departement van het Binnenlandsch Bestuur, 1918). In other words, the poll tax was partly used as a tool of fiscal centralization. Another way of gauging this is to estimate the relationships that European and indigenous officials had with corvée usage before and after the 1882 poll tax implementation.

[Table 6 about here.]

Table 6 reports estimates of regressions of used corvée days on officials in which the variables of interest are interacted with a poll tax dummy that switches on in 1883, the first full year of the poll tax after implementation in mid-1882. For all local officials together, although the point estimate on the interaction term is negative, columns 1 and 2 indicate no statistical evidence for a post-1882 change in the positive relationship between officials and corvée. Separating the local officials into European and indigenous officials, as in columns 3 and 4, shows that this apparent overall lack of change hides two countervailing changes. While European officials' relationship with corvée becomes more

positive, indigenous officials' relationship becomes less positive. Importantly, after the poll tax the strength of the relationship with corvée is weakened for both European and indigenous officials. In column 4, the preferred specification, European officials' coefficient estimate changes from -0.17 to 0.01 and indigenous officials' coefficient estimate changes from 0.91 to 0.40. While the changes are in opposite directions, in absolute size both coefficients are smaller after the poll tax is implemented.

This is further evidence for the poll tax aiding fiscal centralization. Not only is there no relationship between local officials and poll tax revenues, after the poll tax is implemented the relationship local officials had with corvée usage is also weakened. The explanation for this lies in poll tax regulations explicitly replacing certain corvée duties with wage labor paid for by poll tax revenues. For example, besides replacing personal duties to indigenous officials with salary raises, the 1882 poll tax implementation also reduced the maximum number of days any laborer could be made to provide corvée from fifty-two to forty-two and abolished several other corvée duties, such as those regarding building and maintaining prisons and transporting officials (KV 1882, p. 72). In an effort to spread knowledge of these changes to the corvée laborers, European officials were instructed to publicize the changes at meetings with indigenous chiefs and village councils and to ensure that several corvée laborers themselves were present too (KV 1882, p. 73). Use of corvée for purposes that were now prohibited also was to be punished. For example, a district head and a sub-district head were fired for such transgressions while another sub-district head was put on trial (KV 1884, p. 70). After the reductions and replacements local officials thus had less avenues to increase corvée duties, hence the weakened relationship after 1882.

What then are the mechanisms underlying the positive impact of local state capacity expansion on corvée labor? Between 1874 and 1905 the number of officials doubled while the indigenous population grew by about 60%. The density of officials therefore increased. Throughout this period declarations from Batavia instructed provincial officials to reduce usage of corvée labor (e.g. KV 1895, p. 98). Such instructions were passed on down the bureaucratic hierarchy, but in the end it was up to local officials to decide whether to use

coerced labor or wage labor to accomplish their goals. If no wage labor was available for hire at the wage the local official was willing to pay, then he could resort to corvée labor. Given such an opportunity, and considering the tight budgets many officials operated with, coercion was often preferred. By its nature, as a tax in the form of labor, corvée also had limited room for spatial and temporal transfers, particularly in comparison to monetary taxation. While corvée duties tended to be restricted to projects in and around the laborers' and officials' villages, poll tax revenues could be more easily siphoned off by the center. This indeed happened with the net poll tax revenues that flowed into Batavia's coffers. By the early 1900s such accumulated net poll tax revenues since 1882 summed up to about six million guilders, equivalent to more than two years of average annual poll tax revenues (Fokkens, 1914). While the central authorities thus benefited from phasing out corvée, local authorities saw benefits in continuing, and even expanding, corvée usage.

Corvée labor also built on pre-colonial tax practices and was enmeshed in local patronage systems in which officials could decide on who had to perform the labor. Individual exemptions were handed out, presumably in return for favors, increasing the burden on the remaining laborers (KV 1874, p. 77). Contemporaneous observers also stressed another advantage: corvée labor can immediately be used to solve urgent local problems (Rose, 1879). If heavy rains washed away roads or damaged irrigation networks, for example, the local state official could appoint villagers to come out for emergency repairs without being constrained by limited supply of wage labor, by lack of funds to hire wage labor, or by slow bureaucratic procedures. Along with the decline of corvée, local officials partly lost such flexibility. The 8% collector's fee officials received for collecting the poll tax supports the notion that these officials lost something of value to them with the phasing out of corvée labor and that they needed to be compensated in some fashion in order to implement the new system.

In short, increasing the number and density of state officials enlarged both the abilities and the ambitions of the state. Corvée labor was a flexible lever for local officials to use in accordance with their preferences. In and around provincial capitals, for example,

laborers often had to work a number of days approaching their legal maximum (KV 1882, p. 74). The province of Banjoemas experienced a particularly egregious example of this in the 1870s when so many officials were located in the sparsely-populated capital district that most of the allowed corvée days of local villagers were spent on personal duties to certain indigenous officials. Corvée laborers from the neighboring district subsequently had to be called in to complete the required maintenance of roads and bridges. Problematically, many of these workers had to walk more than twenty kilometers to arrive at their designated work places (KV 1873, p. 95). This was in defiance of the central bureaucracy in Batavia which circumscribed a maximum work radius around a worker's village of about twelve kilometers. The higher burden in and around places with a high density of state officials also led to the use of convict laborers in such places to lighten the labor imposition on villagers (KV 1896, p. 82).

Given the positive coefficient estimates, why are the IV estimates larger than the OLS estimates? I argue two main potential reasons underlie this difference. First, there could be negative bias in the OLS estimates due to the bureaucracy being expanded where the state intends to modernize taxation. Second, the IV estimates could be larger than the OLS estimates due to heterogeneous treatment effects. Table 4 and Table 5 indicate that the first explanation is likely not highly relevant. Nonetheless, the small positive coefficients do indicate a weak positive relationship between local officials and poll tax revenues, thus indicating there might be minor negative bias in the OLS estimates due to this.

A more likely reason, however, lies in heterogeneous treatment effects making the IV estimator identify a weighted average of local average treatment effects (LATEs) instead of the average treatment effect (ATE) (Imbens and Angrist, 1994). Shrinking effective distance could mainly impact relatively faraway provinces. For example, provinces near the capital Batavia are well-served by 'old' technologies (e.g. horse and carriage), while the faraway provinces become much closer due to the introduction and spread of new technologies (e.g. steam ships, railroads, telegraph communications). As such new technologies mainly reduce the costs of stationing officials far from the center, they chiefly

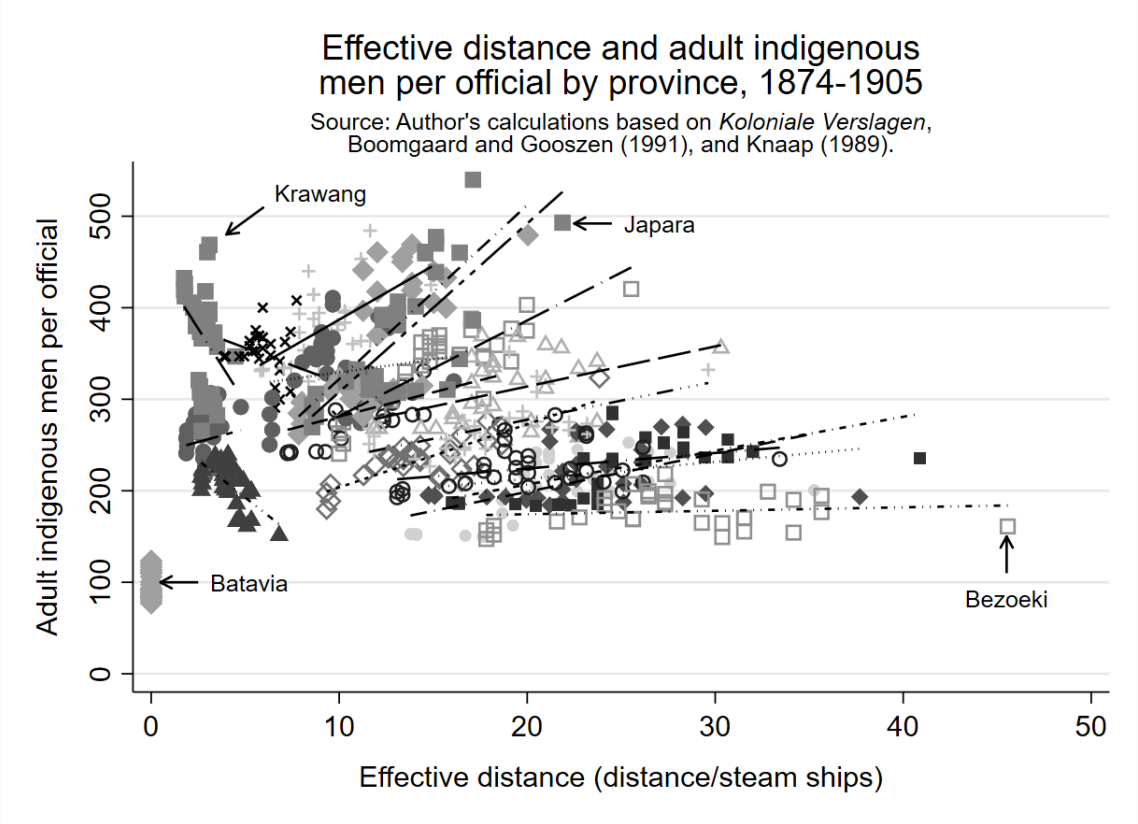


Figure 8

affect state capacity in distant places. Moreover, adding officials in distant places might have a relatively large positive impact on corvée labor as monitoring and control by the center is still less than in places near the capital.

Shrinking effective distance mainly stimulating official density in relatively faraway provinces is corroborated by Figure 8 which, for each province, graphs the number of adult indigenous men per official and effective distance as measured by the ratio of distance and number of steam ships. As effective distance shrinks, provinces move leftward on the graph. As the number of adult indigenous men per official falls (i.e. density of officials increases), provinces move downward. All provinces move leftward, but not all provinces move downward. Figure 8 shows that the faraway places mainly show increasing (e.g. Japara) or constant (e.g. Bezoeki) official density as distance shrinks, while the only three provinces that experience decreasing official density (e.g. Krawang) are relatively close to the capital. In these latter three provinces growth in population outpaced growth in the number of officials.

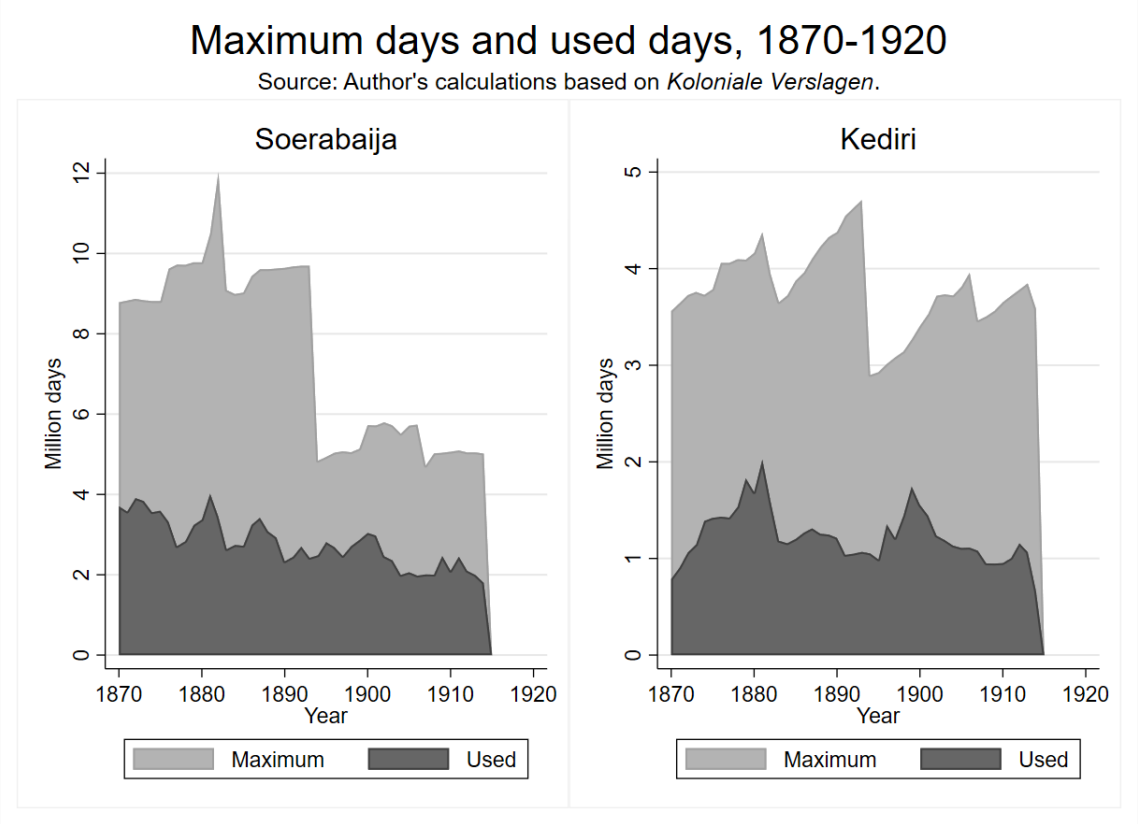


Figure 9

Lastly, how to reconcile the finding of a positive effect with the gradual decline of corvée? As illustrated by Figure 2 and Figure 5, the use of corvée labor decreased and it was eventually completely phased out. However, most of this decline was common across the provinces and is picked up by the year fixed effects. There was thus a general shift out of corvée labor, but this was not directly due to the expanding local bureaucracies. Rather, this was due to national state policy both boosting and adjusting to such changes as deepening monetization, expanding trade opportunities, and spreading industrialization while at the same time purporting to reel in local officials and enhancing central control over taxation. Including year fixed effects enables disentangling the national-level push towards abolishment from the local-level push towards increased usage. Table A2 and Table A3 report OLS and IV estimates without including year fixed effects. Without year fixed effects and controls, the relationship between officials and corvée is negative and statistically significant in certain specifications. When including controls most of these estimates become statistically indistuingishable from zero. Not

including year fixed effects thus entails the countervailing national-level and local-level pushes cannot be distinguished from each other, leaving a net zero effect.

From the early 1890s on the central authorities viewed the labor duties as temporary, to be abolished once local conditions allowed for further poll tax increases to replace the remaining corvée (KV 1894, p. 78). Batavia, in conjunction with the top provincial officials who were deeply enmeshed in the European bureaucracy, periodically reduced the maximum number of days local officials could extract per conscript. However, such legal changes did not always have an impact on the actual use of corvée labor. Figure 9 illustrates this by graphing maximum days and used days for the provinces Soerabaija and Kediri. Maximum days in both these provinces were decreased in the 1890s, but used days did not respond. Ultimately, Batavia used a poll tax hike to abolish corvée on Java to get rid of the remaining nearly thirteen million days still being used by 1913. In the end, the tendency of local officials to use corvée labor could only temporarily stem the tide towards full replacement with monetary taxation. Along the path of fiscal modernization they lost some power and prestige and became more dependent on the center for transfers of funds.

6 Conclusion

Using a newly-constructed province-level database for colonial Java, this study makes visible the importance of corvée labor, shows corvée's gradual phaseout, and finds that different parts of the state had countervailing effects on corvée usage. The downward trend in corvée usage was due to national policy actively stimulating the reduction of corvée labor and its replacement by a poll tax. Such monetary taxation enhanced central control over both the collection and the allocation of revenue as local officials, who had significant leeway regarding the level and use of corvée, were more constricted regarding the poll tax. Such a replacement, however, was conditional on sufficient information-collection capabilities of the state as well as productivity and monetization of local economies. The phasing out of labor duties was thus a gradual process. By 1916 the conditions were

sufficiently met to enable the complete abolishment of the remaining corvée labor on Java.

Over the same time period, local state capacity expansion increased the use of corvée labor. A one percent increase in local state officials increased corvée labor use by more than one percent. This effect runs through indigenous officials, who were more rooted in local power structures, not through European officials, who aligned more with the national-level colonial bureaucracy. In short, the interests of central state actors did not always coincide with those of local state actors regarding the revenue mix of the colonial state. State capacity expansion at the national level induced movement out of corvée labor while state capacity expansion at the local level simultaneously slowed the shift away from corvée labor. National state actors favored centralization of taxation and viewed as key the replacement of labor duties with monetary taxation. Local state actors protected their position in the system by increasing the form of state-backed extraction over which they had most discretion: labor duties.

The tensions between local and national state actors are key in understanding the countervailing forces underlying this facet of fiscal modernization and indicate that increasing state capacity need not necessarily induce fiscal modernization. The relationships between state capacity and taxation levels, between state capacity and fiscal modernization, may depend on the internal workings of the state bureaucracy and on the type of state capacity expansion. Moreover, increasing monetary tax revenues may hide falling in-kind tax revenues. Alternatively, increasing monetary tax revenues for the central state may hide falling in-kind tax revenues for local state actors. Measurements of tax revenues per capita that solely rely on taxes that end up in central coffers may thus be problematic in certain settings. The historically widespread use of corvée labor and other in-kind taxes helps to give this study's findings wider resonance. Opening the black box of state capacity and analyzing specific actors within the state is thus important to understand the co-evolution of state capacity, public labor coercion, and fiscal modernization.

7 Main Text Tables

Table 1: OLS regression estimates, used days

	(1)	(2)	(3)	(4)
Panel A: DV: Log(Days)				
Log(Officials)	0.71***	0.71***		
	(0.17)	(0.16)		
Log(European Officials)			-0.02	0.01
			(0.09)	(0.11)
Log(Indigenous Officials)			0.66***	0.62***
			(0.13)	(0.13)
Adjusted R^2	0.86	0.87	0.86	0.87
Panel B: DV: Log(Days PAM)				
Log(Officials PAM)	0.74***	0.77***		
	(0.20)	(0.18)		
Log(European Officials PAM)			-0.05	0.02
			(0.07)	(0.11)
Log(Indigenous Officials PAM)			0.67***	0.67***
			(0.16)	(0.14)
Adjusted R^2	0.84	0.84	0.84	0.84
Controls	No	Yes	No	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	576	576	576	576

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

DV means dependent variable. PAM means per indigenous adult male. Controls consist of the log of, respectively, indigenous adult males (not used in panel B), steam power, rice paddies, and wages. Standard errors are two-way (province and year) clustered Driscoll-Kraay standard errors with a bandwidth of three. Small sample correction is applied due to small number of clusters (18 province clusters, 32 year clusters). Observations are weighted by the number of indigenous adult males. Implemented using Baum et al.'s (2010) `ivreg2` Stata package.

Table 2: IV regression estimates, used days

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A1 Second Stage: DV: Log(Days)						
Log(Officials)	2.08***	1.84***	1.61***	1.40***	1.78***	1.56***
	(0.60)	(0.40)	(0.36)	(0.34)	(0.50)	(0.42)
Panel A2 First Stage: DV: Log(Officials)						
Instrument	-81.99***	-90.87***	-0.03***	-0.03***	-0.08***	-0.08***
	(23.20)	(17.88)	(0.01)	(0.01)	(0.02)	(0.01)
First-stage F	12.49	25.84	22.84	27.11	13.90	29.42
Panel B1 Second Stage: DV: Log(Days)						
Log(Indigenous Officials)	1.57***	1.47***	1.25***	1.14***	1.37***	1.27***
	(0.37)	(0.34)	(0.28)	(0.29)	(0.36)	(0.36)
Panel B2 First Stage: DV: Log(Indigenous Officials)						
Instrument	-108.30***	-114.12***	-0.04***	-0.04***	-0.10***	-0.10***
	(26.89)	(26.33)	(0.01)	(0.01)	(0.03)	(0.02)
First-stage F	16.21	18.79	20.13	19.12	15.12	18.33
Controls	No	Yes	No	Yes	No	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	576	576	576	576	576	576
Instrument	Distance/Year		Distance/Ships		Distance/Passengers	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

DV means dependent variable. Controls consist of the log of, respectively, indigenous adult males, steam power, rice paddies, and wages. Standard errors are two-way (province and year) clustered Driscoll-Kraay standard errors with a bandwidth of three. Small sample correction is applied due to small number of clusters (18 province clusters, 32 year clusters). Observations are weighted by the number of indigenous adult males. First-stage F is the Kleibergen-Paap rk Wald F statistic. Regarding the instruments, distance is in kilometers and passengers is in thousands. Implemented using Baum et al.'s (2010) `ivreg2` Stata package.

Table 3: Imperfect Instrumental Variable (IIV) regression estimates, used days

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: DV: Log(Days)						
Log(Officials)	(0.67, 1.99)	(0.65, 1.83)	(0.90, 1.55)	(0.86, 1.41)	(1.01, 1.71)	(1.00, 1.64)
	[0.48, 3.13]	[0.39, 2.83]	[0.53, 2.43]	[0.47, 2.27]	[0.62, 2.63]	[0.61, 2.55]
First-stage F	7.69	15.11	20.44	18.90	16.73	22.09
Panel B: DV: Log(Days)						
Log(Indigenous Officials)	(0.62, 1.78)	(0.58, 1.61)	(0.80, 1.40)	(0.74, 1.25)	(0.89, 1.52)	(0.86, 1.46)
	[0.46, 2.71]	[0.38, 2.45]	[0.50, 2.20]	[0.44, 2.00]	[0.56, 2.37]	[0.54, 2.29]
First-stage F	7.50	12.85	15.40	14.51	13.71	14.43
Controls	No	Yes	No	Yes	No	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	576	576	576	576	576	576
Instrument	Distance/Year		Distance/Ships		Distance/Passengers	

Estimates based upon Nevo and Rosen's (2012) Imperfect Instrumental Variable (IIV) procedure. First line reports the lower and upper bound. Second line reports the 95% confidence interval's lower and upper bound. Implemented using Clarke and Matta's (2018) `imperfectiv` Stata package. DV means dependent variable. Controls consist of the log of, respectively, indigenous adult males, steam power, rice paddies, and wages. First-stage F is the Kleibergen-Paap rk Wald F statistic. Regarding the instruments, distance is in kilometers and passengers is in thousands. The first line's upper bound and the first-stage F-statistic differ from those reported in Table 2 as several adjustments are lacking here. No population weighting is applied and standard errors are one-way (province) clustered without Driscoll-Kraay and small sample adjustments.

Table 4: OLS regression estimates, poll tax revenues

	(1)	(2)	(3)	(4)
Panel A: DV: Log(Poll Tax)				
Log(Officials)	0.14	0.14		
	(0.23)	(0.22)		
Log(European Officials)			0.06	-0.03
			(0.08)	(0.06)
Log(Indigenous Officials)			0.08	0.09
			(0.20)	(0.20)
Adjusted R^2	0.96	0.96	0.96	0.96
Panel B: DV: Log(Poll Tax PAM)				
Log(Officials PAM)	0.17	0.21		
	(0.18)	(0.19)		
Log(European Officials PAM)			-0.07	-0.06
			(0.09)	(0.08)
Log(Indigenous Officials PAM)			0.12	0.15
			(0.15)	(0.16)
Adjusted R^2	0.83	0.84	0.83	0.84
Controls	No	Yes	No	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	414	414	414	414

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

DV means dependent variable. PAM means per indigenous adult male. Controls consist of the log of, respectively, indigenous adult males (not used in panel B), steam power, rice paddies, and wages. Standard errors are two-way (province and year) clustered Driscoll-Kraay standard errors with a bandwidth of three. Small sample correction is applied due to small number of clusters (18 province clusters, 23 year clusters). Since the poll tax was first levied in mid-1882, the time coverage starts at 1883, the first full year. Observations are weighted by the number of indigenous adult males. Implemented using Baum et al.'s (2010) `ivreg2` Stata package.

Table 5: IV regression estimates, poll tax revenues

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A1 Second Stage: DV: Log(Poll Tax)						
Log(Officials)	0.94	0.94*	0.55	0.59	0.92	0.94*
	(0.60)	(0.52)	(0.41)	(0.39)	(0.58)	(0.51)
Panel A2 First Stage: DV: Log(Officials)						
Instrument	-105.98***	-109.51***	-0.03***	-0.03***	-0.07***	-0.07***
	(31.48)	(24.99)	(0.01)	(0.01)	(0.02)	(0.01)
First-stage F	11.34	19.20	19.75	18.58	15.36	24.39
Panel B1 Second Stage: DV: Log(Poll Tax)						
Log(Indigenous Officials)	0.70	0.75	0.42	0.49	0.70	0.78
	(0.47)	(0.43)	(0.33)	(0.33)	(0.47)	(0.45)
Panel B2 First Stage: DV: Log(Indigenous Officials)						
Instrument	-142.86***	-136.38***	-0.04***	-0.04***	-0.09***	-0.09***
	(38.00)	(33.57)	(0.01)	(0.01)	(0.02)	(0.02)
First-stage F	14.13	16.51	18.20	15.13	15.21	15.77
Controls	No	Yes	No	Yes	No	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	414	414	414	414	414	414
Instrument	Distance/Year		Distance/Ships		Distance/Passengers	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

DV means dependent variable. Controls consist of the log of, respectively, indigenous adult males, steam power, rice paddies, and wages. Standard errors are two-way (province and year) clustered Driscoll-Kraay standard errors with a bandwidth of three. Small sample correction is applied due to small number of clusters (18 province clusters, 23 year clusters). Since the poll tax was first levied in mid-1882, the time coverage starts at 1883, the first full year. Observations are weighted by the number of indigenous adult males. First-stage F is the Kleibergen-Paap rk Wald F statistic. Regarding the instruments, distance is in kilometers and passengers is in thousands. Implemented using Baum et al.'s (2010) `ivreg2` Stata package.

Table 6: OLS regression estimates, used days and poll tax dummy interaction

	(1)	(2)	(3)	(4)
DV: Log(Days)				
Log(Officials)	0.78***	0.76***		
	(0.19)	(0.17)		
Poll Tax=1 × Log(Officials)	-0.08	-0.10		
	(0.15)	(0.13)		
Log(European Officials)			-0.10	-0.17*
			(0.08)	(0.10)
Poll Tax=1 × Log(European Officials)			0.18***	0.18***
			(0.06)	(0.05)
Log(Indigenous Officials)			0.94***	0.91***
			(0.14)	(0.15)
Poll Tax=1 × Log(Indigenous Officials)			-0.43**	-0.51***
			(0.16)	(0.16)
Controls	No	Yes	No	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	558	558	558	558
Adjusted R^2	0.86	0.87	0.87	0.88

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

DV means dependent variable. Controls consist of the log of, respectively, indigenous adult males, steam power, rice paddies, and wages. Standard errors are two-way (province and year) clustered Driscoll-Kraay standard errors with a bandwidth of three. Small sample correction is applied due to small number of clusters (18 province clusters, 31 year clusters). Observations are weighted by the number of indigenous adult males. The year 1882 is omitted as the poll tax was implemented in mid-1882. Implemented using Baum et al.'s (2010) `ivreg2` Stata package.

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9 Appendix

9.1 Data Construction

Table A1 lists the variable definitions and sources. I collect days, poll tax revenues, officials, and steam power from the Colonial Reports (*Koloniale Verslagen*, henceforth KV). Days are the 'performed daily services' (*gepresteerde dagdiensten*). I value used days at province-year specific average unskilled daily wages from Dros (1992). See below for details on the wages.

The regressions' time period is limited to 1874-1905 as the KVs do not report the number of officials in each province before 1873 and after 1905. Due to the incomplete data on officials for 1873, I do not include that year. For some provinces in some years the number of officials is not reported or misreported. In those cases I estimate in one of two ways: (i) adjustment by using notes in the KVs, or; (ii) interpolation by using the previous known year, the next known year, and a geometric growth rate. For the period 1873-1895 the KVs report the number of officials each year. For the period 1896-1905, however, the KVs only report it every five years. Therefore I interpolate the years 1896-1899 and 1901-1904. I also interpolate the number of European officials for Soerabaija in the years 1876-1880 and the number of indigenous officials for Samarang 1881 and Soearabaija 1883. Lastly, I adjust the number of indigenous officials for Bantam 1883, Tagal 1880, and Bagelen 1874.

The KVs list European officials as 'persons in the civil service and paid by the government' (*personen in 's lands burgerlijken dienst en door het Gouvernement bezoldigd*). For the period 1874-1882, the KVs list indigenous officials as 'paid heads of standing', 'government-appointed but unpaid heads of standing', and as 'paid officials' (respectively *hoofden van rang, bezoldigd*, *hoofden van rang, door het Gouvernement aangesteld maar niet bezoldigd*, and *bezoldigde beambten*). From 1883 on the KVs list indigenous officials as 'heads of the populace and officials in the government's service' (*hoofden der bevolking en ambtenaren of beambten in dienst van het Gouvernement*). As described in the text, my count of the number of indigenous officials does not include village heads and village

Table A1: Variable definitions and sources

	Definition	Source
Outcome variables		
Days	Used days of corvée labor.	*Koloniaal Verslag*, various issues.
Days Value	Value of used days of corvée labor.	Author's calculation.
Poll Tax	Poll tax revenues.	*Koloniaal Verslag*, various issues.
Main explanatory variable		
Officials	Number of European and indigenous state officials.	*Koloniaal Verslag*, various issues.
Control variables		
Adult Males	Number of adult indigenous males.	Boomgaard and Gooszen (1991).
Steam Power	Amount of privately-owned land-based steam power.	*Koloniaal Verslag*, various issues.
Sawah	Arable rice paddies in thousand hectares.	Boomgaard and Van Zanden (1990).
Wages	Average unskilled daily wages in cents.	Dros (1992).
Instrumental variables components		
Distance	Kilometers between province's centroid and Batavia's centroid.	Author's calculation.
Ships	Number of Javanese steam ships.	Knaap (1989).
Passengers	Number of passengers on Javanese steam ships in thousands.	Knaap (1989).

council members (*hoofden van dessa's of kampongs, zoomede de nog in functie zijnde leden van het dessa- of kampong-bestuur*).

My count of steam power concerns the amount of heated surface area in square meters produced by privately-owned land-based steam boilers (*stoomketels*). For the years 1888-1896 the KVs do not list land-based steam power for each province separately from ship-based steam power. The Java-wide total ship-based steam power, however, is given. Moreover, for 1897 both land- and ship-based steam power are listed for each province. I assume provinces without ship-based steam power in 1897 also had none in 1888-1896. I therefore only estimate the land-based steam power in 1888-1896 for each province that had non-zero ship-based steam power in 1897. I do so by using the land-based steam power in 1887 and 1897 and a geometric growth rate. This applies to Cheribon, Tagal, Pekalongan, Samarang, Soerabaija, Pasoeroean, Probolinggo, and Bezoeki. I adjust Bezoeki 1884 for an error in the KV.

I estimate the number of adult indigenous males using indigenous population figures from Boomgaard and Gooszen (1991, Tables 2, 4, and 5). I assume a quarter of the total indigenous population consisted of adult males. I base this on population figures for 1895 which show adult males constituted a quarter of the total indigenous population on Java (KV 1897, Appendix A, p. 32). Since Boomgaard and Gooszen (1991) do not list the indigenous population for the years 1896-1899, 1901-1904, and 1906-1911, I interpolate these years using the previous known year, the next known year, and a geometric growth rate.

The extent of arable rice paddies (*sawah*) in thousand hectares is from Boomgaard and Van Zanden (1990, Tables 3A.1 and 3A.2).

The average unskilled daily wages in cents are those for plantation coolies from Dros (1992, Table 5.4). Dros (1992) lists the minimum and maximum observed wage in a given province-year. I take the average of both. Due to missing observations I estimate for all provinces in 1874 and 1896 and for the following province-years: Bantam 1891; Krawang 1901-1902; Tagal 1877, 1888, 1901-1902; Samarang 1878, 1901-1902; Japara 1888-1890, 1901-1902; Rembang 1877, 1893, 1895; Pasoeroean 1893-1895; Probolinggo 1890, 1901-

1902; Bagelen 1887, 1901-1905, and; Kediri 1894. I also adjust Samarang 1889 since the reported minimum and maximum, around three times those in the previous and the next year, seem like reporting errors. In all these cases, except for 1874, I use the arithmetic average of the previous known and next known wage. For 1874 I use the 1875 wages. Note that there are cases in which the minimum and maximum wages in a particular province did not change from one year to the next.

I calculate the distance in kilometers between a province's centroid and Batavia's centroid. I take the number of steam ships and steam ship passengers from Knaap (1989, Tables 6A and 6B). The steam ships belonged to the packet-boat service companies Netherlands-Indies Steamboat Company (until 1890) and Royal Packet-boat Service Company (from 1891 on).

I use the provincial boundaries of 1882 to 1900. I thus merge the provinces of Bezoeki and Banjoewangi, which were separate until 1882, and separate five provincial mergers that took place in 1901. The merged pairs concern Batavia-Krawang, Pekalongan-Tegal, Samarang-Japara, Pasoeroean-Probolinggo, and Kadoe-Bagelen. To separate the mergers I assign to each province in a pair the share of that province in the pre-merger pair's total of days, steam power, adult males, and *sawah* in 1898-1900.

Since the KVs report Krawang's used corvée days separately, I do not use this share assignment for Batavia-Krawang. Boomgaard and Van Zanden (1990), however, list only one *sawah* figure for Batavia and Krawang for the whole period 1874-1905. For 1874-1880 they label it Krawang and for 1880-1905 Batavia. I take the difference in 1880, the year of overlap, to be Batavia's *sawah* and assume it to be fixed. I then estimate Krawang's *sawah* for 1874-1905 by subtracting Batavia's estimate from the given total.

To separate the number of officials I use each province's share in 1893-1895 as officials in 1900 are only reported in the post-merger status. This is due to the 1900 numbers being reported in KV 1902, at which time the mergers had already taken place.

For wages in the merged Bezoeki-Banjoewangi province pre-1882, I average the minimum and maximum of both provinces. For days, officials, adult males, steam power, and *sawah* in pre-1882 Bezoeki-Banjoewangi, I add both provinces' figures.

9.2 Additional Regression Tables

Table A2 and Table A3 report OLS and IV estimates without including year fixed effects. Table A4 and Table A5 report OLS and IV estimates with used corvée value as dependent variable. Table A6 and Table A7 report OLS and IV estimates with wild cluster bootstrap standard errors. Table A8 and Table A9 report OLS and IV estimates with spatial correction of standard errors. Table A10 and Table A11 report OLS and IV estimates with no population weights.

Table A2: OLS regression estimates, used days, no year FE

	(1)	(2)	(3)	(4)
Panel A: DV: Log(Days)				
Log(Officials)	-0.68***	0.09		
	(0.19)	(0.20)		
Log(European Officials)			-0.41***	-0.09
			(0.13)	(0.19)
Log(Indigenous Officials)			-0.31*	0.10
			(0.16)	(0.16)
Adjusted R^2	0.73	0.77	0.74	0.77
Panel B: DV: Log(Days PAM)				
Log(Officials PAM)	-0.63	0.40		
	(0.48)	(0.33)		
Log(European Officials PAM)			-0.62	-0.13
			(0.38)	(0.24)
Log(Indigenous Officials PAM)			-0.41	0.36
			(0.45)	(0.27)
Adjusted R^2	0.22	0.58	0.27	0.58
Controls	No	Yes	No	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	No	No	No	No
Observations	576	576	576	576

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

DV means dependent variable. PAM means per indigenous adult male. Controls consist of the log of, respectively, indigenous adult males (not used in panel B), steam power, rice paddies, and wages. Standard errors are two-way (province and year) clustered Driscoll-Kraay standard errors with a bandwidth of three. Small sample correction is applied due to small number of clusters (18 province clusters, 32 year clusters). Observations are weighted by the number of indigenous adult males. Implemented using Baum et al.'s (2010) `ivreg2` Stata package.

Table A3: IV regression estimates, used days, no year FE

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A1 Second Stage: DV: Log(Days)						
Log(Officials)	-0.81***	-0.26	-0.76***	-0.21	-0.72***	-0.12
	(0.21)	(0.46)	(0.18)	(0.31)	(0.22)	(0.39)
Panel A2 First Stage: DV: Log(Officials)						
Instrument	-167.78***	-95.19***	-0.05***	-0.02***	-0.15***	-0.06***
	(16.00)	(10.81)	(0.01)	(0.00)	(0.03)	(0.01)
First-stage F	109.98	77.53	44.51	24.45	32.82	21.11
Panel B1 Second Stage: DV: Log(Days)						
Log(Indigenous Officials)	-0.77***	-0.21	-0.72***	-0.18	-0.67***	-0.10
	(0.22)	(0.39)	(0.18)	(0.27)	(0.21)	(0.34)
Panel B2 First Stage: DV: Log(Indigenous Officials)						
Instrument	-177.48***	-114.63***	-0.06***	-0.03***	-0.15***	-0.07***
	(19.30)	(19.73)	(0.01)	(0.01)	(0.03)	(0.02)
First-stage F	84.55	33.75	37.20	18.29	29.52	15.93
Controls	No	Yes	No	Yes	No	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No	No
Observations	576	576	576	576	576	576
Instrument	Distance/Year		Distance/Ships		Distance/Passengers	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

DV means dependent variable. Controls consist of the log of, respectively, indigenous adult males, steam power, rice paddies, and wages. Standard errors are two-way (province and year) clustered Driscoll-Kraay standard errors with a bandwidth of three. Small sample correction is applied due to small number of clusters (18 province clusters, 32 year clusters). Observations are weighted by the number of indigenous adult males. First-stage F is the Kleibergen-Paap rk Wald F statistic. Regarding the instruments, distance is in kilometers and passengers is in thousands. Implemented using Baum et al.'s (2010) `ivreg2` Stata package.

Table A4: OLS regression estimates, used corvée value

	(1)	(2)	(3)	(4)
Panel A: DV: Log(Corvée Value)				
Log(Officials)	0.69***	0.64***		
	(0.20)	(0.19)		
Log(European Officials)			0.16	0.13
			(0.12)	(0.14)
Log(Indigenous Officials)			0.54***	0.51***
			(0.15)	(0.15)
Adjusted R^2	0.86	0.87	0.86	0.87
Panel B: DV: Log(Corvée Value PAM)				
Log(Officials PAM)	0.63***	0.64***		
	(0.18)	(0.17)		
Log(European Officials PAM)			0.11	0.13
			(0.12)	(0.13)
Log(Indigenous Officials PAM)			0.51***	0.52***
			(0.14)	(0.14)
Adjusted R^2	0.87	0.87	0.87	0.87
Controls	No	Yes	No	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	576	576	576	576

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

DV means dependent variable. PAM means per indigenous adult male. Controls consist of the log of, respectively, indigenous adult males (not used in panel B), steam power, and rice paddies. Standard errors are two-way (province and year) clustered Driscoll-Kraay standard errors with a bandwidth of three. Small sample correction is applied due to small number of clusters (18 province clusters, 32 year clusters). Observations are weighted by the number of indigenous adult males. Implemented using Baum et al.'s (2010) `ivreg2` Stata package.

Table A5: IV regression estimates, used corvée value

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A1 Second Stage: DV: Log(Corvée Value)						
Log(Officials)	1.74***	1.70***	1.16**	1.13**	1.41**	1.37***
	(0.49)	(0.38)	(0.44)	(0.41)	(0.52)	(0.47)
Panel A2 First Stage: DV: Log(Officials)						
Instrument	-81.99***	-91.22***	-0.03***	-0.03***	-0.08***	-0.08***
	(23.20)	(17.66)	(0.01)	(0.01)	(0.02)	(0.01)
First-stage F	12.49	26.67	22.84	29.26	13.90	29.93
Panel B1 Second Stage: DV: Log(Corvée Value)						
Log(Indigenous Officials)	1.31**	1.35***	0.90**	0.91**	1.08**	1.11**
	(0.47)	(0.42)	(0.41)	(0.38)	(0.49)	(0.45)
Panel B2 First Stage: DV: Log(Indigenous Officials)						
Instrument	-108.30***	-115.16***	-0.04***	-0.04***	-0.10***	-0.10***
	(26.89)	(27.20)	(0.01)	(0.01)	(0.03)	(0.02)
First-stage F	16.21	17.93	20.13	18.91	15.12	17.52
Controls	No	Yes	No	Yes	No	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	576	576	576	576	576	576
Instrument	Distance/Year		Distance/Ships		Distance/Passengers	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

DV means dependent variable. Controls consist of the log of, respectively, indigenous adult males, steam power, and rice paddies. Standard errors are two-way (province and year) clustered Driscoll-Kraay standard errors with a bandwidth of three. Small sample correction is applied due to small number of clusters (18 province clusters, 32 year clusters). Observations are weighted by the number of indigenous adult males. First-stage F is the Kleibergen-Paap rk Wald F statistic. Regarding the instruments, distance is in kilometers and passengers is in thousands. Implemented using Baum et al.'s (2010) `ivreg2` Stata package.

Table A6: OLS regression estimates, used days, wild cluster bootstrap

	(1)	(2)	(3)	(4)
Panel A: DV: Log(Days)				
Log(Officials)	0.71	0.71		
	(0.002)	(0.002)		
	[0.43, 0.97]	[0.39, 1.02]		
Log(European Officials)			-0.02	0.01
			(0.852)	(0.950)
			[-0.24, 0.20]	[-0.27, 0.27]
Log(Indigenous Officials)			0.66	0.62
			(0.003)	(0.001)
			[0.43, 0.88]	[0.37, 0.89]
Panel B: DV: Log(Days PAM)				
Log(Officials PAM)	0.74	0.77		
	(0.011)	(0.015)		
	[0.31, 1.18]	[0.34, 1.18]		
Log(European Officials PAM)			-0.05	0.02
			(0.542)	(0.890)
			[-0.26, 0.15]	[-0.26, 0.27]
Log(Indigenous Officials PAM)			0.67	0.67
			(0.010)	(0.005)
			[0.32, 1.03]	[0.32, 0.99]
Controls	No	Yes	No	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	576	576	576	576

Wild cluster bootstrap p-values in parentheses and wild cluster bootstrap 95% confidence intervals in square brackets. The bootstrap is based on the regressions in Table 1. Implemented using Roodman et al.'s (2019) `boottest` Stata package. DV means dependent variable. PAM means per indigenous adult male. Controls consist of the log of, respectively, indigenous adult males (not used in panel B), steam power, rice paddies, and wages.

Table A7: IV second-stage regression estimates, used days, wild cluster bootstrap

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A Second Stage: DV: Log(Days)						
Log(Officials)	2.08	1.84	1.61	1.40	1.78	1.56
	(0.014)	(0.025)	(0.020)	(0.021)	(0.010)	(0.022)
	[0.54, 4.08]	[0.77, 3.27]	[0.56, 2.69]	[0.42, 2.57]	[0.70, 3.28]	[0.47, 2.80]
Panel B Second Stage: DV: Log(Days)						
Log(Indigenous Officials)	1.57	1.47	1.25	1.14	1.37	1.27
	(0.014)	(0.027)	(0.025)	(0.027)	(0.014)	(0.035)
	[0.68, 2.60]	[0.57, 2.67]	[0.41, 2.21]	[0.20, 2.36]	[0.54, 2.39]	[0.32, 2.41]
Controls	No	Yes	No	Yes	No	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	576	576	576	576	576	576
Instrument	Distance/Year		Distance/Ships		Distance/Passengers	

Wild cluster bootstrap equal-tailed p-values in parentheses and wild cluster bootstrap 95% confidence intervals in square brackets. The bootstrap is based on the regressions in Table 2. Implemented using Roodman et al.'s (2019) `boottest` Stata package. DV means dependent variable. Controls consist of the log of, respectively, indigenous adult males, steam power, and rice paddies. Regarding the instruments, distance is in kilometers and passengers is in thousands.

Table A8: OLS regression estimates, used days, spatial correction of standard errors

	(1)	(2)	(3)	(4)
Panel A: DV: Log(Days)				
Log(Officials)	0.71***	0.71***		
	(0.12)	(0.13)		
Log(European Officials)			-0.02	0.01
			(0.07)	(0.08)
Log(Indigenous Officials)			0.66***	0.62***
			(0.10)	(0.10)
Panel B: DV: Log(Days PAM)				
Log(Officials PAM)	0.74***	0.77***		
	(0.15)	(0.15)		
Log(European Officials PAM)			-0.05	0.02
			(0.07)	(0.08)
Log(Indigenous Officials PAM)			0.67***	0.67***
			(0.13)	(0.12)
Controls	No	Yes	No	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	576	576	576	576

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Estimator allows for arbitrary dependence of the errors across provinces and across years. Implemented using Colella et al.'s (2019) `acreg` Stata package. Standard errors are heteroskedastic- and autocorrelation-consistent (HAC) with a linear decay in distance (Bartlett). Distance matrix is based on the longitude and latitude of each province's centroid. Distance cutoff is 1,000 kilometers. Time lag is ten years. DV means dependent variable. PAM means per indigenous adult male. Controls consist of the log of, respectively, indigenous adult males (not used in panel B), steam power, rice paddies, and wages. Observations are weighted by the number of indigenous adult males.

Table A9: IV regression estimates, used days,
spatial correction of standard errors

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A1 Second Stage: DV: Log(Days)						
Log(Officials)	2.08***	1.84***	1.61***	1.40***	1.78***	1.56***
	(0.45)	(0.33)	(0.32)	(0.29)	(0.36)	(0.32)
Panel A2 First Stage: DV: Log(Officials)						
Instrument	-81.99***	-90.87***	-0.03***	-0.03***	-0.08***	-0.08***
	(15.43)	(13.84)	(0.01)	(0.01)	(0.01)	(0.01)
First-stage F	28.31	41.90	35.82	38.61	29.97	43.29
Panel B1 Second Stage: DV: Log(Days)						
Log(Indigenous Officials)	1.57***	1.47***	1.25***	1.14***	1.37***	1.27***
	(0.30)	(0.27)	(0.25)	(0.24)	(0.28)	(0.27)
Panel B2 First Stage: DV: Log(Indigenous Officials)						
Instrument	-108.30***	-114.12***	-0.04***	-0.04***	-0.10***	-0.10***
	(17.47)	(17.21)	(0.01)	(0.01)	(0.02)	(0.02)
First-stage F	27.51	34.67	29.63	31.94	24.56	30.17
Controls	No	Yes	No	Yes	No	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	576	576	576	576	576	576
Instrument	Distance/Year		Distance/Ships		Distance/Passengers	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Estimator allows for arbitrary dependence of the errors across provinces and across years. Implemented using Colella et al.'s (2019) `acreg` Stata package. Standard errors are heteroskedastic- and autocorrelation-consistent (HAC) with a linear decay in distance (Bartlett). Distance matrix is based on the longitude and latitude of each province's centroid. Distance cutoff is 1,000 kilometers. Time lag is ten years. DV means dependent variable. Controls consist of the log of, respectively, indigenous adult males, steam power, rice paddies, and wages. Observations are weighted by the number of indigenous adult males. First-stage F is the Kleibergen-Paap rk Wald F statistic. Regarding the instruments, distance is in kilometers and passengers is in thousands.

Table A10: OLS regression estimates, used days, no weights

	(1)	(2)	(3)	(4)
Panel A: DV: Log(Days)				
Log(Officials)	0.66***	0.64***		
	(0.16)	(0.16)		
Log(European Officials)			-0.00	-0.01
			(0.08)	(0.09)
Log(Indigenous Officials)			0.61***	0.58***
			(0.14)	(0.13)
Adjusted R^2	0.87	0.88	0.87	0.88
Panel B: DV: Log(Days PAM)				
Log(Officials PAM)	0.61***	0.66***		
	(0.18)	(0.17)		
Log(European Officials PAM)			-0.05	-0.01
			(0.08)	(0.10)
Log(Indigenous Officials PAM)			0.57***	0.60***
			(0.15)	(0.14)
Adjusted R^2	0.82	0.82	0.82	0.82
Controls	No	Yes	No	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	576	576	576	576

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

DV means dependent variable. PAM means per indigenous adult male. Controls consist of the log of, respectively, indigenous adult males (not used in panel B), steam power, rice paddies, and wages. Standard errors are two-way (province and year) clustered Driscoll-Kraay standard errors with a bandwidth of three. Small sample correction is applied due to small number of clusters (18 province clusters, 32 year clusters). Observations are not weighted. Implemented using Baum et al.'s (2010) `ivreg2` Stata package.

Table A11: IV regression estimates, used days, no weights

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A1 Second Stage: DV: Log(Days)						
Log(Officials)	1.99***	1.83***	1.55***	1.41***	1.71***	1.64***
	(0.63)	(0.54)	(0.45)	(0.44)	(0.48)	(0.46)
Panel A2 First Stage: DV: Log(Officials)						
Instrument	-68.75**	-76.51***	-0.03***	-0.03***	-0.07***	-0.07***
	(24.03)	(18.33)	(0.01)	(0.01)	(0.02)	(0.02)
First-stage F	8.19	17.41	18.78	17.69	15.33	20.21
Panel B1 Second Stage: DV: Log(Days)						
Log(Indigenous Officials)	1.78***	1.61***	1.40***	1.25***	1.52***	1.46***
	(0.53)	(0.44)	(0.40)	(0.37)	(0.44)	(0.42)
Panel B2 First Stage: DV: Log(Indigenous Officials)						
Instrument	-76.87**	-87.04***	-0.03***	-0.03***	-0.08***	-0.08***
	(27.63)	(22.69)	(0.01)	(0.01)	(0.02)	(0.02)
First-stage F	7.74	14.71	13.46	13.90	12.55	13.80
Controls	No	Yes	No	Yes	No	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	576	576	576	576	576	576
Instrument	Distance/Year		Distance/Ships		Distance/Passengers	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

DV means dependent variable. Controls consist of the log of, respectively, indigenous adult males, steam power, rice paddies, and wages. Standard errors are two-way (province and year) clustered Driscoll-Kraay standard errors with a bandwidth of three. Small sample correction is applied due to small number of clusters (18 province clusters, 32 year clusters). Observations are not weighted. First-stage F is the Kleibergen-Paap rk Wald F statistic. Regarding the instruments, distance is in kilometers and passengers is in thousands. Implemented using Baum et al.'s (2010) `ivreg2` Stata package.