PATH TO CENTRALIZATION AND DEVELOPMENT
Evidence from Siam

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ABSTRACT

This article investigates the role of colonial pressure on state centralization and its relationship to subsequent development by analyzing the influence of Western colonial threats on Siam's internal political reform. Unlike other countries in the region, Siam remained independent by adopting geographical administrative boundaries and incorporating its traditional governance structures into a new, centralized governance system. The authors find that the order in which areas were integrated into the centralized system depended on the interaction between precentralization political structures and proximity to British and French territorial claims. The authors show that areas centralized early in the process had higher levels of infrastructure investment and public goods provision at the time the centralization process was completed in 1915 than those centralized later in the process. They also show that early centralization during the Western colonial era continued to be strongly associated with higher levels of public goods provision and economic development, and that this relationship persists today.

Introduction

WHAT is the lasting impact of colonial pressure on states under threat? Even in the absence of outright colonization and implementation of colonial institutions, external empires can still have significant influence on a state's internal politics for survival. Understanding the relationships between external threats, centralization processes, and subsequent economic development warrants various case studies at the state and regional levels, especially given the context-specific and path-dependent nature of the subject. Seminal works by Timothy Besley and Torsten Persson, and Charles Tilly, for example, look at modern state transformation in Europe and discuss state capacity-building as facilitated by both common interests and external threats.[1] Regarding

[1] Besley and Persson 2011; Tilly 1990. In related works, Gennaioli and Voth 2015 present cases of centralization in early modern Europe, and O'Brien 2011 finds that early centralization in England led to the state's successful building of fiscal capacity. Dincecco 2015 furthermore finds that in European history, the relationship between the state's capacity to collect taxes and its economic performance is strongly positive. Bardhan 2016 provides an overview of the complexities of looking at the role of the state in development with specific discussions on the potential trade-offs of state centralization.

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regions outside Europe, Nicola Gennaioli and Ilia Rainer, and Stelios Michalopoulos and Elias Papaioannou discuss the effect the lack of centralized governments in Africa had on the continent's colonization outcomes.[2] Noel Johnson and Mark Koyama offer a comparative discussion of Europe and Asia and the processes of state building and economic development as gradual and path dependent,[3] whereas Koyama, Chiaki Moriguchi, and Tuan-Hwee Sng discuss the divergence in development paths of China and Japan due to different centralization efforts under the threat of Western colonial powers.[4]

Siam, as Thailand was known in the nineteenth century, provides an invaluable study for centralization under colonial threat in Southeast Asia without outright conquest.[5] Unlike other countries in the region, such as modern-day Myanmar, Laos, Vietnam, and Indonesia, Siam remained independent throughout this period of colonial expansion. This independence was achieved by maintaining its status as a buffer state between the British and French,[6] establishing geographic administrative borders in accordance with Western practices[7] and transforming its highly decentralized governance system into a centralized state.[8] Colonial encroachment by the British and French precipitated political responses to maintain control of the peripheral population centers and to establish Siam's sovereignty in the Western sense.[9]

Siam's centralization effort provides an important structural break from traditional Southeast Asian statecraft,[10] which was primarily characterized by a tributary system known as the mandala state.[11] This

[2] Gennaioli and Rainer 2007; Michalopoulos and Papaioannou 2013.

[3] Johnson and Koyama 2017.

[4] Koyama, Moriguchi, and Sng 2018.

[5] Much scholarly interest on the rise of the West and the advent of the Industrial Revolution has led to a large body of work explaining, among many things, the role of colonies in the economic development of Europe (Skocpol 1979; Mokyr 1990; Pomeranz 2000; Acemoglu, Johnson, and Robinson 2002) and the institutional and modernization outcomes in European colonies as legacies of colonization and settlement (Sokolof and Engerman 2000; Acemoglu, Johnson, and Robinson 2001; Acemoglu, Johnson, and Robinson 2002; Bertocchi and Canova 2002; Lange 2004; Nunn 2007; Chaudhary and Garg 2015). The latter studies focus on the direct impact of Western institutions in colonized lands that have since adopted colonizers' governance structures and have diverged in their economic paths.

[6] Jeshurun 1970; Steinberg, et al. 1971.

[7] Winichakul 1994.

[8] Bunnag 1977.

[9] We present a standard narrative concerning the premodern polity system and colonial threats to peripheral regions under Siam's control (for example, Bunnag 1977). But we recognize that another common interpretation of Bangkok's presence in the peripheral regions is that of a colonizer (see for example, Winichakul 1994 and Englehart 2001). For this article, the interpretation of whether Siam was a relatively weak state fighting colonial encroachment or a competing colonizer is not crucial. What is important is that Siam responded to Western colonial ambitions in Southeast Asia by strengthening centralized control and demarcating boundaries in the peripheral areas.

[10] Ferrara 2015.

[11] Tambiah 1977; Wolters 1999.

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traditional structure involved a central polity maintaining tributary relations with the peripheries, loosely based on their locations in a circle of influence emanating from the central polity. Its emphasis on control of the people rather than the land and boundaries demarcated on maps, remained distinct from the territorial state system in Europe. Territories in Siam prior to centralization were locally administered by local hereditary leaders, often in a tributary relationship and with little direct control from the government in Bangkok.

Toward the end of the nineteenth century, King Chulalongkorn of Siam introduced efforts to install permanent Bangkok government representatives in Siam's peripheries, to develop a civil service system in the region, and to disseminate policy from Bangkok through the creation of second-level administrative units called *monthon* under the *Thesapiban* (local government) system that eventually reached all the provinces outside of Bangkok.[12] The implementation of the centralized Thesapiban system spanned a total of twenty-three years, from 1893 to 1915. Figure 1 presents the timing of monthon establishment.

As the centralization process unfolded, the central government invested in public goods and infrastructure in the newly centralized areas. But diplomatic concessions made to maintain Siam's independence limited the government's ability to raise revenues and resources over time, which resulted in substantial investments in the areas centralized early on and limited investments in the areas integrated later in the process. The effect was uneven long-run development outcomes across provinces in Thailand.

In this article, we first show that Siam's internal centralization process was mainly an outcome of external colonial pressure interacted with the preexisting mandala governance structure. Geographically, Siam benefitted from being a buffer state between British Burma and French Indochina, as well from being targeted for imperialist expansion a decade or two after Burma and French Indochina, essentially allowing King Chulalongkorn enough time to centralize the government.[13] Controlling for potential underlying economic factors, we find that both proximity to French or British territorial claims and position within the traditional polity system significantly influenced the timing of provinces' centralization. During the twenty-three-year centralization process, Siam centralized the core inner provinces closest to Bangkok first. On average, Siam took five years to centralize the inner provinces, nineteen years for the external provinces, and twenty-

[12] Bunnag 1977.
[13] Steinberg et al. 1971, 176.

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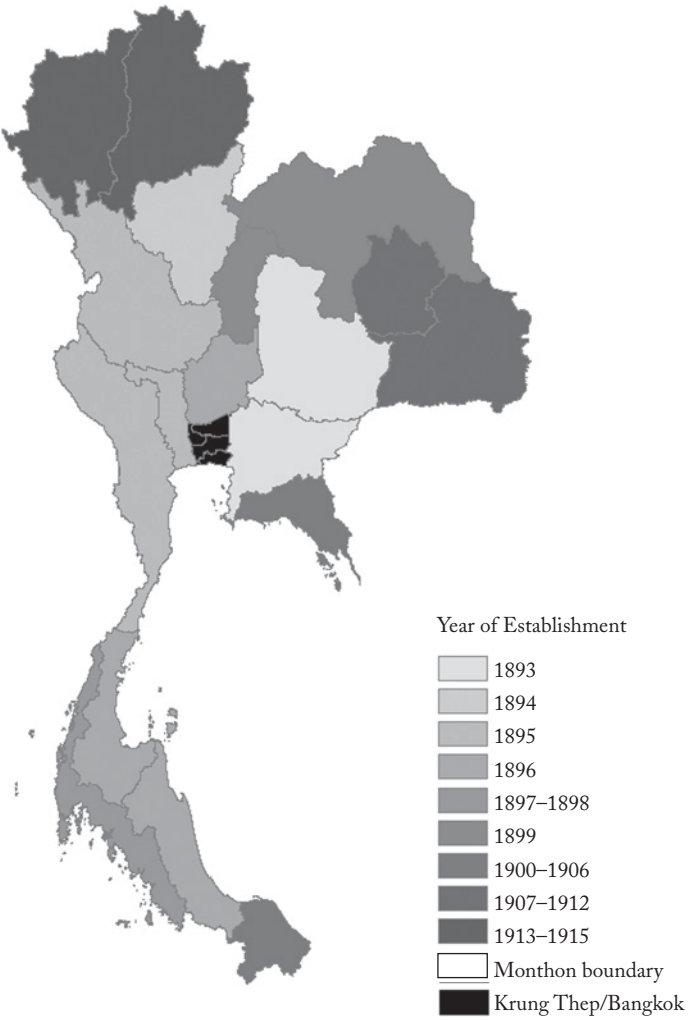


FIGURE 1
TIMING OF MONTHON ESTABLISHMENT

SOURCE: Bunnag 1977.

one years for the tributary states. Although the traditional governance structure and ease of integration clearly influenced the timing of centralization, among the external provinces, areas adjacent to colonial territorial claims were centralized on average nine years earlier than their counterparts were. Furthermore, we provide supporting historical narratives to show that the choice of areas to centralize early on critically depended on strategic, not economic, concerns.

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Second, we find that provinces centralized earlier enjoy better development outcomes decades later. In 1970, for example, a province centralized under the Thesapiban system ten years later than another province experienced on average a 6 percentage point lower proportion of homes with electrification, a 4 percentage point lower proportion of homes with access to piped water, and a 2 percentage point lower proportion of residents over the age of fourteen who completed primary school. For reference, the average proportion of homes with access to electricity and piped water in 1970 was 22 percent and 14 percent, respectively, while the average primary education attainment rate stood at 7 percent. These figures suggest a significant divergence in the levels of public infrastructure that is related to the timing of centralization during the colonial era. In an additional analysis we show that on average, a province centralized ten years later than another province saw 32 percent lower real gross provincial product (GPP) per capita in 1973. Third, in looking at the decades after the 1970s, we find the relationship persisted into the 2000s, suggesting a long-lasting legacy of Siam's internal political reforms on public goods and income levels.

In exploring the link between centralization and Thailand's uneven development in the long run, we find evidence of higher levels of public goods provision and infrastructure investment by the 1910s in the monthon that were centralized first. These early investment efforts were a response to colonial threats in the late-nineteenth and early-twentieth centuries. Due to the government's limited fiscal capacity and its prioritization of Bangkok over the provinces after the end of the colonial era, provinces that experienced early centralization would continue to see better long-run economic outcomes than provinces centralized later. The country would thus witness uneven development across its provinces for decades to come.

This study of Siam contributes to the growing literature on colonization as it offers a new testing ground for the effect of colonial threat on a state that maintains its sovereignty. In particular, our work sheds light on the colonization process in Southeast Asia, a region that experienced much colonization and has yet to be studied in depth in the literature.[14] Our research provides a telling example of centralization in

[14] A notable exception is Dell, Lane, and Querubin 2018, who compare the historical state conditions in North Vietnam versus South Vietnam and attribute their diverging economic development to the historical presence of a centralized state in the North versus a Khmer tributary state in the South. Their findings echo our own in that Siam's centralization efforts to replace the existing mandala system that relied on tributary relationships led to better public goods provision and economic development. Scott 2009 also discusses the limits to state centralization (rather than its consequences in the places in which it did take place) in the context of the Southeast Asian region.

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Asia as part of state building under external threats including colonization, adding to the literature that discusses centralization as a key determinant for diverging economic outcomes.

In the next section, we briefly describe the historical background of how the traditional Siamese governance structure differed from the Western system and how the impending imperialist threat of the British and the French pushed Siam to redefine its geographic boundaries, create centralized administrative units, and make productive investments. We draw a parallel comparison between the cases of Siam and Japan, both of which faced similar colonial threats and implemented centralization policies with varying outcomes. We explain why, relative to Japan, Siam was limited in expanding its fiscal capacity and witnessed uneven development outcomes across the country as a result. In the penultimate section, we present our main empirical results, followed by a discussion on potential caveats. We conclude by summarizing our findings and encouraging future scholarship on the region.

Historical Background

To understand how the impending imperialist threat of the British and the French pushed Siam to centralize its administration at the end of the nineteenth century, we must first understand the historical background, including how the traditional Siamese governance structure and concepts of administrative boundaries differed from the Western system. One of the challenges of protecting peripheral areas under Siamese authority was the mismatch between Siamese and Western concepts of space. Throughout much of the nineteenth century, boundaries in Siam were based on the mandala social hierarchy and tribute system, not on the Western concept of geography and boundaries.[15] In a mandala hierarchy, the periphery consists of satellite principalities in a tributary relationship with the core kingdom, and the political structure does not revolve around control of land by the core, but rather by its control of the population.[16] Importantly, geographical boundaries are not fixed, and the authority's influence on its peripheries expands roughly in concentric circles from the center.[17] Tej Bunnag notes that

[15] Bunnag 1977; Winichakul 1994; Larsson 2012.

[16] Tambiah 1977.

[17] Although the reach of direct authority by Bangkok generally attenuated with distance, Englehart 2001, 66–72, notes that there is significant regional variation in the degree of Bangkok's control in the peripheries due to geographic, climactic, and political factors. For a study on local identity formation around former tributary centers and modern civil violence in Thailand, see Paik and Vechbanyongratana 2018.

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even as late as 1892, officials in Siam's Ministry of Interior likely could not locate the towns they were governing on a map because location was conceptualized as a placement within the bureaucratic hierarchy rather than a geographic space.[18]

Bangkok, established as the capital of Siam in 1782 after the fall of Ayutthaya, maintained direct control over provinces adjacent to it (core inner provinces) and strong control over the rest of the inner provinces—areas in close geographic proximity to it that had formed the core of Siam since the fifteenth century.[19] Between the inner provinces and the Laotian tributary states were the *mueang*, or major towns with surrounding villages, which were designated as external provinces. The mueang maintained a degree of independence from Bangkok in terms of choosing leaders, tax collection, and the judiciary.[20] In the mid-nineteenth century, the tributary states included the Kingdom of Luang Prabang in the northeast; the principalities of Chiang Mai, Lampang, Lamphun, Phrae, and Nan in the north; the Kingdom of Cambodia in the east; and the sultanates of Pattani, Trengganu, Kelantan, and Kedah in the south.[21] The tributary states functioned independently of Bangkok. They chose their own royal families/hereditary leaders, governments, and laws, but they regularly paid tribute and ceremonially declared their loyalty to Bangkok. By 1909, with the exceptions of Pattani, Chiang Mai, and Siam's other northern principalities, all of the tributary states were colonized by Western powers. Figure 2 shows, within the modern borders of Thailand, the different province classes that existed in 1892, just before the government embarked on implementing the Thesapiban system.[22]

The 1855 Bowring Treaty between Britain and Siam, signed less than forty years before the centralization process began, proved pivotal in Siam's bid to remain independent. This treaty and subsequent similar treaties with other Western powers allowed the free entrance of foreigners into trade previously monopolized by the government, introduced low fixed import and export duties, abolished other duties related to trade, and introduced extraterritorial rights to foreign nationals residing in Siam. This effectively ended the royal monopoly on Siam's

[18] Bunnag 1977, 2.

[19] Bunnag 1977, 17. We follow Bunnag's province classifications but label class 4 provinces as "core inner provinces," and class 1, 2, and 3 provinces as "inner provinces."

[20] Bunnag 1977.

[21] Bunnag 1977, 18, 30.

[22] We recognize that other tributary states existed outside the modern boundaries of Thailand and as such, they are missing from Figure 2. In this article we are concerned with current development outcomes in Thailand and not in neighboring countries.

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FIGURE 2
SIAM'S PROVINCES PRIOR TO THE ESTABLISHMENT OF THE THESAPIBAN SYSTEM IN 1892[a]

SOURCES: Bunnag 1977; Kermel-Torrès 2004.
[a] Figure delineates pre-1892 governance within the modern Thai borders.

foreign trade and significantly reduced the government's ability to raise revenues.[23] Given Siam's decentralized governance structure, this lost revenue could not be easily replaced by other forms of taxation.

From the mid-nineteenth century, the French and the British ex-

[23] Ingram 1971, 27, 29.

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erted pressure on Siam internally through business interests and extraterritorial rights and externally by encroaching on nearby territories. Both colonial powers were interested in gaining access to Siam's natural resources, markets, and trade routes. The French encroached from the east, taking over Siamese territory in current-day Vietnam, Cambodia, and Laos, while the British claimed territory in the west and south in current-day Myanmar and Malaysia. Figure 3 indicates the extent and pattern of territorial gains by the French and British between 1867 and 1909.

To summarize, during the second half of the nineteenth century, several factors limited Siam's ability to assert itself against territorial encroachment by the French and British, including its traditional decentralized system of governance, diminished government revenue as a result of the Bowring Treaty, and poorly defined borders at its frontiers. In addition, Siam had no standing professional military and relied instead upon commoners who were obliged to serve when called to action by the government via their local patrons.[24] This situation was compounded by Siam's lack of transportation and communications infrastructure, which limited its capacity to gather intelligence and to quickly disseminate government representatives, troops, and supplies to frontier areas.

Against this backdrop, it is widely recognized in the literature that King Chulalongkorn introduced sweeping government reforms in 1892 to defend Siam against further colonial territorial encroachment.[25] The goals of these reforms were to: (1) increase tax revenues to finance a more costly centralized administration, the newly formed civil service, and infrastructure projects; (2) establish Bangkok representatives in provincial administrations; (3) implement policy dictated by Bangkok throughout Siam's territory; and (4) gain direct control over human resources for defense purposes. The king made official visits to areas remaining under Siam's influence to personally solicit loyalty and consolidate support from the periphery.[26] The centralization of Siam between 1893 and 1915 was a direct response to colonial threats and importantly, allowed Siam to increase its tax base, which in turn funded the expansion of the central administration into the peripheries and the infrastructure development critical for subsequent economic growth.

[24] Bunnag 1977, 14.

[25] Vella 1955; Wyatt 1969; Bunnag 1977; Winichakul 1994; Larsson 2012. King Chulalongkorn gradually introduced reforms and experimented with governance designs in the 1870s and 1880s, but due to internal and external political reasons, significant changes to the government structure were not introduced until 1892. Bunnag 1977.

[26] Bunnag 1977, 72–73.

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FIGURE 3
TERRITORIAL LOSSES OF SIAM, 1867–1909

SOURCE: Kermel-Torrès 2004.

This centralization process closely follows the steps discussed in theoretical and empirical works that uncover the link between fiscal capacity, investment in public goods, and economic growth.[27]

SIAM VERSUS JAPAN

In his highly influential work, Victor Lieberman discusses parallel chronologies of historical state formation and political integration for pol-

[27] Acemoglu 2005; Besley and Persson 2009; Dincecco and Katz 2014.

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ities found in the "protected zone," which were geographically isolated polities largely sheltered from external threats.[28] Areas in the protected zone, including mainland Southeast Asia and Japan, were generally sparsely populated, ruled by indigenous elites, adopted both cultural and political institutions from other major civilizations in the region (India and China in particular), and steadily achieved territorial consolidation before 1830.[29]

Prior to the nineteenth century there were broad similarities in historical state formation between Siam and Japan as states in the protected zone, but there were also major differences. For example, Siam's polity system differed markedly from the system developed in Japan, which, by its location and geography, was much more isolated and had clearly defined territorial boundaries. Against the historical similarities in state formation as polities in the protected zone and notable differences due to geography, it is instructive to compare the outcomes of Japan and Siam's nineteenth-century centralization efforts in response to Western colonial threats.

During the mid-nineteenth century, like Siam, Japan faced increasing colonial threats by Western powers. On the eve of signing unequal treaties with Western powers in 1858, Japan was a collection of autonomous local domains that were "fiscally and militarily fragmented."[30] The threat of Western colonial encroachment was the impetus to organize the population under a unified central government and in a sense, to pool resources to counter the foreign threat. That Japan was relatively compact, with naturally defined territorial borders and an existing road network that connected most of the territory, aided its centralization effort.[31]

Japan's centralization process led to fiscal innovation and increased fiscal capacity, which in turn led to administrative innovation and productive government investments. These investments included raising a strong, modern military equipped with Western weapons, establishing a public education system, instituting a domestic banking system, and pursuing import-substitution industrialization by investing in domestic industrial production.[32] Fiscal innovations, investments in infrastructure, and the provision of public goods as a result of centralization

[28] Lieberman 2009, 85. This is in contrast to polities in the "exposed zones," including South Asia, China, and Southwest Asia, which were areas that were often under threat of nomadic invaders.
[29] Lieberman 2009, 93.
[30] Koyama, Moriguchi, and Sng 2018, 7.
[31] Sng and Moriguchi 2014.
[32] Swan 2009; Koyama, Moriguchi, and Sng 2018.

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are credited with laying the foundation for Japan's unprecedented economic growth in the twentieth century.

To reiterate, Siam, like Japan, was a collection of semiautonomous polities in the mid-nineteenth century. The Bangkok-based government embarked on centralizing its administration as a response to external threat by Western powers.[33] At first glance, Siam's experience was similar to Japan's in several important ways. One of the primary objectives of the Siamese centralization program that started in 1892 was to centralize its fiscal administration.[34] Prior to that, taxation had been the domain of each locality, with most of the collected taxes going directly to the local nobility and a portion sent to Bangkok. The amount forwarded to Bangkok was often less than the amount agreed upon or was sent intermittently. By taking over taxation in the peripheries, Bangkok nearly doubled its domestic tax revenues in six years, growing from 15,378,119.19 baht in 1892 to 28,496,029.33 baht in 1898.[35]

Increasing government revenue and bringing the peripheries under a centralized administration were believed to be essential for Siam to maintain its territorial integrity. Increased tax revenue allowed the government to make significant transportation and communications infrastructure investments in the late-nineteenth and early-twentieth centuries. To illustrate the difficulties in communicating with the peripheries without telegraph, in 1890 it took forty-two days to travel 700 kilometers from Bangkok to Chiang Mai during the dry season.[36] Three of the early priorities of the Bangkok government were to invest in building railways that went toward frontier areas, to launch a domestic postal service, and to establish telegraph lines.[37] In addition, Siam introduced centralized, Western-style education with a curriculum dictated by Bangkok,[38] and modernized and centralized its military by procuring modern weaponry and instituting national conscription rather than relying on soldiers procured through the corvée system, in which Siamese men provided labor to the Siamese government for up

[33] Bunnag 1977.
[34] Bunnag 1977.
[35] Bunnag 1977, 118.
[36] Kakizaki 2012.
[37] Kakizaki 2012; Department of Post and Telegraph 1983. W. A. Graham, a former administrator and adviser to the Siamese government, claimed, "For purposes of administration the value of the railways cannot be overrated and, in fact, the present system of rural Government could hardly exist without them"; Graham 1924, 152–53. Furthermore, he noted that areas that did not have rail infrastructure and remained difficult to reach both physically and administratively "received nothing at all in the way of social, economic or administrative benefit from the State"; Graham 1924, 149.
[38] Wyatt 1969.

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to six months each year.[39] In addition, Siam overhauled and centralized much of its legal system,[40] introduced new property-rights laws, and adopted a Western-style land code with the goal of maintaining territorial integrity.[41]

Given that Siam and Japan had similar experiences in expanding fiscal capacity and making productive investments, Siam's resulting economic growth was notably less impressive than that of Japan and was largely uneven across the country. Why were Siam's economic outcomes different from those of Japan? Despite the increased ability of the government to raise domestic revenues through centralized tax collection in the peripheries, Siam faced challenges in raising revenues through other channels, such as foreign trade and borrowing. Provisions in the Bowring Treaty limited revenue from foreign trade. This and other treaties, signed in quick succession with other Western powers, set low tariff rates and abolished the government's former trade monopolies, thus severely limiting trade as a source of government revenues. In addition, Siam was wary of borrowing from abroad because debt to foreign powers—Britain and France in particular—may have put it at risk of outright colonization.[42] As such, it adopted a balanced-budget policy—a policy it maintained through the 1950s—that severely limited the investment capacity of the government.[43] By contrast, Japan did not face these constraints and was able to capture revenues from foreign trade and to use deficit financing to make productive investments.[44]

In Siam, restricted channels for raising revenue severely limited the funds available to the government to invest in infrastructure consistently over the long run. Given these constraints on government expenditures, public infrastructure expansion outside Bangkok slowed significantly after the 1920s. Regions excluded from the initial centralization phase remained without access to basic infrastructure and only experienced government investments starting in the 1960s and

[39] Bunnag 1977. Although Siam raised a professional military as a part of its centralization program, Anderson 2016 notes that the military was in a sense too little, too late, and not sufficient for defending against the much stronger colonial military powers. Thus, diplomatic avenues were pursued to maintain independence in lieu of military conquest. Anderson 2016, 99.

[40] Bunnag 1977.

[41] Larsson 2012. These centralization efforts echo Dincecco and Katz 2014, who suggest that concurrent development of fiscal and legal capacities provided a means to monitor state expenditures and to ensure productive government spending on administrative infrastructure (including ensuring secure property rights, market regulations, and enforcement) that would provide the right conditions for growth in Europe.

[42] Ingram 1971; Swan 2009.

[43] Ingram 1971.

[44] Swan 2009.

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accelerating significantly in the 1970s.[45] For these excluded regions, not receiving the benefits of early centralization inevitably hampered the ensuing provision of public services, as public schools, electricity, and piped water were all preconditioned on the expansion of both infrastructure and administrative capacity.[46] In the following section, we show that the uneven path to centralization, due to initial government investment followed by limited spending over time, led to a lasting divergence in development outcomes across Thailand's provinces.

Empirical Findings

Here, we show that external threats and the preexisting political structure in nineteenth-century Siam shaped the path of centralization and that these centralization efforts are strongly correlated with subsequent socioeconomic outcomes at the provincial level in Thailand. The province is currently the second-level administrative unit below the state itself. We chose the province as the unit of analysis because decisions on public goods provision and the allocation of public funds have been made at this level since 1933. Monthon, the second layer of the central administration for only a short time, were dissolved by the Provincial Administration Act of 1933, which devolved second-level administration to the provinces.

In all our regressions, we exclude Monthon Krung Thep, which comprises areas in and around Bangkok, including the present-day provinces of Bangkok, Nonthaburi, Pathum Thani, and Samut Prakan. These areas were always under centralized control and were not a part of the Thesapiban provincial administration introduced in 1892 under the Ministry of Interior.

Table 1 presents summary statistics for the seventy-two provinces in the data set and data sources.[47] During the twenty-three-year period of centralization from 1893 to 1915, the average year of monthon establishment was 1901, indicating that the integration process is skewed slightly toward the earlier period. At the start of centralization, in 1893,

[45] Kakizaki 2012. For example, the railways were mainly financed with revenue raised internally. Resources were allocated to build rail infrastructure in early monthon first, with plans to build lines in areas integrated later, such as Chiang Mai, Nong Khai, and Ubon Ratchathani, which ultimately were substantially delayed or canceled completely due to budgetary constraints.

[46] Wyatt 1969, 244, notes that an important determinant in the distribution of new, government-issued textbooks in areas other than Bangkok in 1899 was access to good communications infrastructure.

[47] Five provinces each split into two or three smaller provinces between 1970 and 2010. The analysis is based on the seventy-two provinces in existence in 2010. We assume that the levels of public goods and GPP per capita are constant across the provinces that split in earlier periods.

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TABLE 1
SUMMARY STATISTICS [a]

Variables	*Source*	*Obs.*	*Mean*	*Std. Dev.*
Provincial Economic Outcomes				
Mean provincial electrification, 1970	IPUMS	72	0.218	0.122
Proportion of households with piped water, 1970	IPUMS	72	0.144	0.088
Provincial primary school completion rate, 1970	IPUMS	72	0.070	0.037
Mean provincial electrification, 1980	IPUMS	72	0.373	0.151
Proportion of households with piped water, 1980	IPUMS	72	0.119	0.060
Provincial primary school completion rate, 1980	IPUMS	72	0.169	0.050
Mean provincial electrification, 1990	IPUMS	72	0.865	0.092
Proportion of households with piped water, 1990	IPUMS	72	0.219	0.121
Provincial primary school completion rate, 1990	IPUMS	72	0.362	0.062
Proportion of households with piped water, 2000	IPUMS	72	0.520	0.188
Provincial primary school completion rate in 2000	IPUMS	72	0.509	0.067
Per capita GPP 1973 (11 categories) (2010 baht)	NESDB 1977; WB 2017	72	36,814	30,697
Per capita GPP 1975 (11 categories) (2010 baht)	NESDB 1978; WB 2017	72	31,939	18,689
Per capita GPP 1980 (11 categories) (2010 baht)	NESDB 2017; WB 2017	72	39,683	33,940
Per capita GPP 1985 (11 categories) (2010 baht)	NESDB 2017; WB 2017	72	36,663	22,142
Per capita GPP 1990 (11 categories) (2010 baht)	NESDB 2017; WB 2017	72	51,721	36,482
Per capita GPP 1995 (16 categories) (2010 baht)	NESDB 2017; WB 2017	72	79,601	85,754
Per capita GPP 2000 (16 categories) (2010 baht)	NESDB 2017; WB 2017	72	75,492	89,878
Per capita GPP 2005 (16 categories) (2010 baht)	NESDB 2017; WB 2017	72	97,186	113,899
Per capita GPP 2010 (16 categories) (2010 baht)	NESDB 2017; WB 2017	72	119,136	125,757
Controls				
Year monthon established	Bunnag 1977; Kermel-Torrès 2004	72	1900.639	7.684
Core inner province	Bunnag 1977; Kermel-Torrès 2004	72	0.264	0.444
Inner province	Bunnag 1977; Kermel-Torrès 2004	72	0.181	0.387
External province	Bunnag 1977; Kermel-Torrès 2004	72	0.389	0.491
Tributary state	Bunnag 1977; Kermel-Torrès 2004	72	0.167	0.375
Monthon located on frontier	Bunnag 1977; Kermel-Torrès 2004	72	0.833	0.375
Distance to Bangkok (hundreds of km)	MoT n.d.	72	3.857	2.212
Provincial center of monthon	Bunnag 1977	72	0.250	0.436
Provincial population density per 10km^2, 1915	DCS 1917	72	2.478	2.843
Fraction of land suitable for agriculture	Ramankutty et al. 2002	72	0.355	0.105
Mean provincial elevation (km)	MoT n.d.	72	0.213	0.175
Provincial area (thousands of km^2)	MoT n.d.	72	7.099	4.689
Coastline (hundreds of km)	MoT n.d.	72	0.356	0.673
Number of industrial estates, 1990	IEAT 2017	72	0.181	0.613
Number of industrial estates, 1995	IEAT 2017	72	0.222	0.791
Number of industrial estates, 2000	IEAT 2017	72	0.292	1.027
Number of industrial estates, 2005	IEAT 2017	72	0.333	1.199
Number of industrial estates, 2010	IEAT 2017	72	0.389	1.400

[a] IPUMS (Integrated Public Use Microdata Series); NESDB (National Economic and Social Development Board); WB (World Bank); MoT (Information and Communication Technology Center, Office of the Permanent Secretary, Ministry of Transport [Thailand]). DCS (Department of Commerce and Statistics, Ministry of Finance); IEAT (Industrial Estate Authority of Thailand).

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Siam had nonexistent or very low levels of development in terms of our outcome variables of interest, including household electrification, access to piped water, and completed primary education. As stated above, by the 1970s, the mean household electrification at the provincial level stood at 22 percent, the mean proportion of households with access to piped water was 14 percent, and completed primary education remained low, with an average of 7 percent. By 2000, the mean proportion of households with piped-water access increased to 52 percent and the mean proportion of completed primary education increased significantly to more than 50 percent.[48] Real per capita GPP also increased over a forty-year period from 36,814 baht in 1973 to 119,136 baht in 2010.[49]

We argue that Siam's decision to centralize a province earlier or later through the Thesapiban system was determined by whether the region was under the direct threat of colonial encroachment by Western powers due to its location and its precentralization political relationship with Bangkok. Skirmishes with the French in 1892–1893 that culminated in the Paknam Incident resulted in the loss of a large swath of land in present-day Laos and Cambodia, and hastened the need for Bangkok to gain direct control not only over frontier areas bordering French claims, but also over areas bordering British claims. In addition, precentralization governance structure, or class of province, likely influenced the timing of centralization; provinces varied in terms of the reach of Siam's rule over them, which in turn determined the extent to which Siam could implement centralization.

To explore whether colonial threat was critical to the timing of monthon establishment and how it had differential effects across different types of provinces, we regress the year that the province became part of the Thesapiban system on a relevant set of determinants. We run the following ordinary least square (OLS) regression:

$$MonthonYr = \alpha_0 + \alpha_1 Frontier + Class\beta + (Frontier * Class)\gamma + X\delta + \varepsilon. \quad (1)$$

The variable *MonthonYr* is the year that the province was assigned to a monthon and its government structure was fully incorporated into the Thesapiban system.[50] The variable *Frontier* is a dummy variable

[48] Statistics on electrification in 2000 are unavailable because the public good had become universally available and the census stopped collecting information on its provision.

[49] All real figures reported in 2010 baht.

[50] It is important to note that the timing of centralization is determined by the full integration of the region into the Thesapiban governance system and not necessarily by the assignment of a commissioner by the government in Bangkok. For example, although Chiang Mai was the first area in the

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with a value of 1 for provinces located in monthon adjacent to French and British claims in 1893. The vector *Class* contains indicators for the precentralization province classes, including core inner province, inner province, external province, and tributary state, with core inner province being the excluded category. We categorize the provinces that comprised the Chiang Mai Kingdom, for example, as belonging to a tributary state. Although economically important due to their thriving teak trade and threatened by their location along the border between Siam and British holdings (and hence, considered frontier), the provinces in this kingdom were the last to be fully centralized (in 1915) because Siam's control over Chiang Mai was not absolute and aggressive centralization efforts would have jeopardized their relationship.[51] At the same time, the core inner provinces were considered easiest to integrate given that much of the government structure was already under Bangkok's centralized control. Geographically, inner provinces lay beyond the core inner provinces, but much of their government structure was also under centralized control. By the 1890s, external provinces largely formed Siam's periphery. These provinces had been more recently (seventeenth century) incorporated into the Siamese Kingdom and Bangkok's reach was limited by the existence of independent governments, distance, and naturally difficult terrain.

The vector X includes controls associated with economic potential, such as fraction of land suitable for agriculture, provincial population density in 1915, distance from province centroid to Bangkok, provincial area, provincial mean elevation, and length of coastline. Fertile regions for agriculture, the main economic activity in Siam throughout most of the twentieth century, with large populations would have been likely targets for early centralization due to their importance to the kingdom's economy and its desire to establish sovereignty over its subjects. It is also plausible that the timing of centralization depended on a province's commercial viability, especially in terms of its size and connectivity to Bangkok. Large provinces that were closer to Bangkok were more likely to be commercially viable, and those located at a low elevation had wa-

frontier region assigned a commissioner (1874) and was assigned to Monthon Phayap in 1902, the governance structure was not fully integrated into the system and under the direct control of Bangkok until 1915. Thus, we consider Phayap, which includes Chiang Mai, to have been centralized in 1915. We follow the timing from Bunnag 1977, 268–69.

[51] Although it would seem plausible in theory for the Chiang Mai state to side with the British instead of Siam due to British and elite business interests and dealings, the Bangkok-based government went to some lengths to ensure Chiang Mai remained under Siam's sphere of influence. This strategy included assigning a commissioner from Bangkok in 1874, taking over diplomatic issues involving the British, and arranging a marriage between the Chiang Mai royal family and King Chulalongkorn. Bunnag 1977; Ongsakul 2005.

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terways that were more navigable and that provided the main transportation means throughout Siam. Table 2 reports the regression results.

Table 2, column 8, with a full set of economic covariates as controls, shows that relative to core inner provinces under the direct control of Bangkok (our baseline category), tributary, external, and inner provinces were more likely to witness delays in centralization by twenty-one, nineteen, and five years, respectively. Throughout different specifications, we also find that relative to other external provinces, those located in areas adjacent to colonial territorial claims were in general likely to have been centralized nine years earlier.[52] Importantly, the frontier effect interacted with the external province class appears to be statistically significant throughout different specifications that include various indicators of economic potential. Furthermore, except for the distance to Bangkok, none of these variables have an impact on the timing of monthon establishment. The results suggest that a province's economic and commercial viability during this period was unlikely to be the main determinant of the timing of incorporation into the centralized system.

In addition to the findings in Table 2, we present further support of our argument in the historical narrative. It suggests that the decision to establish a monthon was not driven by factors that are likely to be correlated with subsequent public goods provision or economic development. Bunnag claims that the order in which territories were organized as monthon was mainly based on the strategic location of territories vis-à-vis colonial advances by France in the east and northeast, and Britain in the north, northwest, and south, as well as on the political relationship between Bangkok and its territories before 1893.[53] While the French and British had economic interests in the Siamese territories, the colonial powers first targeted areas adjacent to their existing holdings rather than the most economically important areas of Siam, which were arguably in the central rice-growing region. Figure 3 indicates the extent and pattern of territorial gains by the French and British between 1867 and 1909, which shows the natural encroachment of lands along Siam's frontiers over time.

For further contextual evidence, we note that directly following the Paknam Incident, which resulted in significant territorial losses in present-day Laos and Cambodia, Bangkok endeavored to gain direct control over areas bordering French holdings. Thus, in 1893, Nakhon

[52] In our sample, there is no differential frontier effect for tributary states because all the provinces in this category are also located in the frontier.

[53] Bunnag 1977, 101–102.

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TABLE 2
DETERMINANTS OF CENTRALIZATION TIMING

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Year Monthon Established							
Tributary state	17.242***	17.402***	17.285***	22.199***	16.950***	15.880***	17.024***	20.891***
	(1.718)	(1.754)	(1.700)	(2.159)	(1.802)	(2.483)	(1.680)	(3.374)
External province	16.375***	16.632***	15.666***	19.398***	15.940***	15.718***	16.320***	18.944***
	(0.180)	(0.362)	(1.167)	(1.301)	(0.613)	(0.711)	(0.167)	(1.745)
Inner province	3.375***	3.929***	2.977***	5.138***	2.329	1.920	3.320***	4.766***
	(0.180)	(0.674)	(0.696)	(0.779)	(1.401)	(1.525)	(0.167)	(1.727)
Frontier area	−1.534***	−1.320***	−1.972**	−1.174**	−1.859***	−2.094***	−1.069*	−1.124
	(0.364)	(0.452)	(0.839)	(0.506)	(0.583)	(0.697)	(0.560)	(0.915)
Frontier monthon × external province interaction	−8.986***	−9.039***	−8.433***	−8.899***	−8.714***	−8.531***	−8.955***	−8.658***
	(1.341)	(1.336)	(1.798)	(1.383)	(1.491)	(1.518)	(1.383)	(1.826)
Frontier monthon × inner province interaction	−2.633***	−2.910***	−2.230**	−1.952**	−1.932*	−1.328	−2.529***	−1.571
	(0.471)	(0.576)	(0.863)	(0.851)	(1.121)	(1.473)	(0.728)	(1.649)
Provincial population density per 10km² 1915		0.116						0.212
		(0.134)						(0.169)
Fraction arable land			−3.223					−0.011
			(5.146)					(4.324)
Distance to Bangkok (km)				−0.010**				−0.008**
				(0.004)				(0.004)
Area (thousands of km²)					0.109			0.029
					(0.144)			(0.210)
Mean elevation (km)						4.901		2.873
						(5.100)		(7.495)
Coastline (hundreds of km)							−1.131	−0.298
							(0.847)	(0.725)
Constant	1895.625***	1894.996***	1897.214***	1896.553***	1895.318***	1895.418***	1895.680***	1895.098***
	(0.180)	(0.757)	(2.552)	(0.468)	(0.452)	(0.284)	(0.167)	(2.448)
Observations	72	72	72	72	72	72	72	72
Adjusted R-squared	0.652	0.648	0.648	0.674	0.651	0.655	0.657	0.655

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; robust standard errors in parentheses

Ratchasima and Prachinburi were established as the first two monthon due to their militarily important locations on the eastern frontier.[54] The third monthon, Phitsanulok, was established in 1894. It was located on the northern frontier and, according to Bunnag,[55] strategically closed the gap between the Principality of Chiang Mai and Udon, the latter having gained administrative importance after the French attained control of the left bank of the Mekong River under the provisions of the Franco-Siamese Treaty signed in 1893 following the Paknam Incident.[56] Nakhon Sawan and Ratchaburi formed the next two monthon in 1895 to demarcate and close the western frontier with British Burma.

In comparison, areas with relatively independent local governments were generally integrated more slowly, even when located on land bordering British and French holdings. For example, although the Principality of Chiang Mai directly bordered the frontier with British holdings in the northwest, Bangkok did not immediately target it for full integration into the Thesapiban system. Since Chiang Mai had its own independent government, Bangkok was concerned that overtures to take direct control would result in open rebellion. This gradual approach was also used in the external provinces of Nongkhai and Ubon Ratchathani because there was a need to integrate the existing governments into the new Bangkok structure without alienating the hereditary nobility.[57] In sum, the order in which monthon were created appears to have been dictated by a balance of strategic location and ease of integrating the prevailing traditional government system into the new, centralized system dictated by Bangkok.

The next part of the analysis attempts to identify whether the timing of integration into the centralized Thesapiban system correlates with public goods development and economic indicators at the subnational level over the following century. Our hypothesis is that early exposure to the centralized institutional structure and accompanying infrastructure investments has a consistent and lasting association with better public goods provision and economic performance in the long run. To determine whether this is the case, we first explore infrastructure and public goods provision in the years just after the centralization process was completed in 1915. Due to data limitations in terms of development measures and disaggregated data at the provincial level, we

[54] Bunnag 1977, 102.
[55] Bunnag 1977, 102.
[56] Bunnag 1977, 91.
[57] Bunnag 1977, 64–68.

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first compare public goods provision and infrastructure development between monthon that were centralized prior to 1901 and those that were centralized after 1901, where 1901 is the mean year of centralization. Specifically, we analyze the mean differences in the proportion of government-provided schools and teachers in the monthon in 1917, as well as the difference in the proportion of monthon that gained a rail line by 1916. Table 3 presents the tests of mean and proportional differences across the three measures.

The simple *t*-tests of mean and proportional differences show that monthon that were centralized earlier had significantly higher proportions of central government–funded schools and teachers in 1917 (as opposed to locally funded secular or religious education), and were much more likely to have gained a rail line before 1916.[58] These results are consistent with our supposition that areas integrated into the centralized governance system early benefitted from an initial injection of government spending on public goods and infrastructure.

Next, we regress provincial-level development indicators—specifically, household electrification, household access to piped water, primary education attainment rates, and GPP—measured at various intervals between 1970 and 2010 on the year the provinces were integrated into monthon. For the long-run outcomes, we specifically look at early 1970s levels of development as a benchmark. Prior to the 1970s, economic development initiatives had largely been focused on Bangkok. Starting in the late-1970s and early-1980s, the Thai government actively pursued economic development targeted at the outlying regions. In particular, the Fourth National Economic and Social Development Plan (1977–1981) was the first plan to specifically emphasize the development of infrastructure outside the central region to facilitate economic development in rural areas and regional urban centers.[59] The Fifth National Economic and Social Development Plan (1982–1986) specifically spells out development goals in underdeveloped areas outside of Bangkok and the Central Plain, including the eastern seaboard,

[58] We also show that this relationship holds in a regression framework. When regressing the proportion of government schools, proportion of government teachers, and an indicator for the monthon having a rail line in 1916 on the year of centralization, the resulting coefficients are consistently negative and statistically significant, even with the inclusion of standard economic controls. The regression results are reported in Appendix Table A1. To further support our claim that public goods provision was divergent from an early date, we also regress primary education attainment of an older cohort (from the 1970 Minnesota Population Center's Integrated Public Use Microdata Series (IPUMS) sample), born in the 1920s and 1930s, on the year of centralization. We find that provinces that were centralized early-on indeed witnessed higher primary education attainment in the early periods. Appendix Table A2 presents the results for the older-cohort analysis.

[59] NESDB Office of the Prime Minister, Government of Thailand 1977.

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TABLE 3
TESTS OF MEAN AND PROPORTIONAL DIFFERENCES FOR PUBLIC GOODS AND INFRASTRUCTURE MEASURES AT THE TIME OF CENTRALIZATION [a]

Variables	*Mean for Monthons Centralized before 1901*	*Mean for Monthons Centralized after 1901*	*Difference*	*Std. Error*	*Obs.*
Government school share 1917	0.218	0.073	0.145**	0.049	17
Government teacher share 1917	0.317	0.135	0.182***	0.060	17
Monthon gained railway by 1916	0.750	0.167	0.583**	0.197	18

SOURCES: Department of Commerce and Statistics, Ministry of Finance 1919; Whyte 2010.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
[a] Monthon Phetchabun was reported with Monthon Phitsanulok in 1917, resulting in only seventeen monthon observations.

the western region, the lower northeast, three upper northern provinces, and the southern border provinces.[60]

Thailand also began to pursue export-led growth in the mid-1980s, which was a departure from its traditionally agrarian economy. This shift resulted in the rapid development of manufacturing and the establishment of industrial zones in provinces outside Bangkok, especially from the late-1980s through the first decade of the twenty-first century. We argue that development outcomes before 1977 are the result of a highly centralized provincial government system that can trace its origins directly to the Thesapiban system implemented between 1893 and 1915, while outcomes in the later years are influenced by recent government development policies targeting areas outside Bangkok.

For the empirical analysis, we employ the following regression to test the relationship between the timing of centralization and recent public goods provision:

$$PublicGood = \alpha_0 + \alpha_1 MonthonYr + Class\beta + Location\gamma + Z\delta + \varepsilon. \quad (2)$$

The variable *PublicGood* is one of various measures of provincial-level infrastructure and human capital development in 1970, including the proportion of households with electrification and access to piped water, and the proportion of individuals over fourteen years old who have completed primary school. These provincial-level development indi-

[60] NESDB Office of the Prime Minister, Government of Thailand 1981.

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cators are constructed using Thailand's 1970 census microsamples archived in the Minnesota Population Center's Integrated Public Use Microdata Series.[61]

The main variable of interest is *MonthonYr*. To understand why a difference of only twenty-three years in exposure to state centralization may lead to long-run disparities across provinces, we note that it is the order of centralization rather than the short time span that matters for long-run development outcomes. As explained above, the need to centralize within a short time span due to colonial threats combined with Siam's fiscal constraints meant that Siam had limited capacity to fund its centralization efforts. Thus, the centralization process and subsequent government investments were prioritized based on ease of integration and the most urgent need for direct rule.

Prereform political relationships in each area may also have had long-term effects on the levels of public goods provision independent of the timing of centralization. Such can be the case if, for example, after centralization there continues to be internal resistance against the central administration from the peripheral regions that historically were associated with tributary states and external provinces. The vector *Class* controls for this possibility. The vector *Location* is a set of controls for a province's proximity to the frontier, Bangkok, and the center of monthon administration. The frontier variable is the same as in equation (1); provinces in former frontier monthon may continue to witness different levels of public goods provision relative to other provinces for reasons other than centralization, such as a higher likelihood of interstate competition and increases in trade across borders. The distance to Bangkok captures the distance from the central administration and access to the country's main commercial center. In addition, whether the province was designated as the administrative center of a monthon may continue to matter for the level of public goods provision in the long run. Finally, Z is a vector of standard location and geographic controls that capture economic potential. These include provincial population density in 1915, fraction of arable land, area, mean elevation, and length of coastline. We report the results for the public goods regression in Table 4.

The results in Table 4 indicate that the timing of centralization is negatively correlated with the levels of all three development indicators in 1970. Controlling for the full set of precentralization polity types and

[61] See https://international.ipums.org. Measures for household electrification are not available in the 2000 microsample because electricity was available in most households by that time.

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TABLE 4
OLS REGRESSIONS: CENTRALIZATION AND PUBLIC GOODS PROVISION, 1970

	Proportion of Households with Electricity 1970				*Proportion of Households with Piped Water 1970*				*Proportion of 14+ Population with Elementary Education 1970*			
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*
Year monthon established	−0.005***	−0.008**	−0.006*	−0.006*	−0.005***	−0.004**	−0.004*	−0.004	−0.001***	−0.003***	−0.003***	−0.002***
	(0.001)	(0.003)	(0.003)	(0.003)	(0.001)	(0.002)	(0.002)	(0.002)	(0.000)	(0.001)	(0.001)	(0.001)
Tributary state		0.045	−0.060	−0.082		−0.045	−0.037	−0.086		0.036**	0.006	0.021
		(0.073)	(0.102)	(0.101)		(0.051)	(0.077)	(0.075)		(0.016)	(0.027)	(0.024)
External province		0.035	−0.028	−0.001		−0.029	−0.024	−0.049		0.015	−0.003	0.012
		(0.051)	(0.070)	(0.065)		(0.035)	(0.052)	(0.050)		(0.015)	(0.021)	(0.019)
Inner province		−0.081***	−0.136***	−0.103***		−0.032	−0.034	−0.054		−0.017*	−0.031***	−0.016
		(0.023)	(0.043)	(0.038)		(0.027)	(0.034)	(0.034)		(0.009)	(0.011)	(0.010)
Frontier area			0.042	0.049			0.018	0.013			0.005	0.005
			(0.032)	(0.033)			(0.031)	(0.033)			(0.007)	(0.007)
Distance to Bangkok (hundreds of km)			0.011	0.007			−0.003	−0.001			0.004	0.001
			(0.013)	(0.013)			(0.008)	(0.008)			(0.003)	(0.003)
Monthon provincial headquarters			0.060*	0.083**			0.025	0.047**			0.010	0.012
			(0.032)	(0.034)			(0.017)	(0.019)			(0.009)	(0.009)
Provincial pop. density per 10km^2 1915				0.001				−0.010**				0.002
				(0.006)				(0.004)				(0.002)
Fraction arable land				0.139				0.001				0.014
				(0.124)				(0.114)				(0.035)
Mean elevation (km)				0.236				0.103				0.022
				(0.141)				(0.102)				(0.042)
Area (thousands of km^2)				−0.009**				−0.006**				−0.001
				(0.004)				(0.003)				(0.002)
Coastline (hundreds of km)				0.030				−0.002				0.015**
				(0.020)				(0.014)				(0.007)
Constant	9.121***	15.243**	12.403*	11.228*	10.277***	7.978**	7.925*	7.036	2.602***	5.605***	4.916***	4.623***
	(2.506)	(6.157)	(6.268)	(6.039)	(1.853)	(3.750)	(4.548)	(4.590)	(0.749)	(1.573)	(1.659)	(1.545)
Observations	72	72	72	72	72	72	72	72	72	72	72	72
Adjusted R-squared	0.074	0.130	0.160	0.192	0.207	0.193	0.178	0.211	0.063	0.124	0.117	0.153

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; robust standard errors in parentheses

economic indicators, a province that was centralized under the Thesapiban system ten years later than another experienced on average a lower proportion of homes with electrification by 6 percentage points, a lower proportion of homes with access to piped water by 4 percentage points, and a lower proportion of residents over the age of fourteen who completed primary school by 2 percentage points. At first glance these differences may seem small, but the magnitudes compared to the mean levels of public goods provision in 1970 are large. For comparison, as reported above, in 1970 the mean levels of electrification, piped-water access, and completed primary schooling were 22 percent, 14 percent, and 7 percent, respectively.

To investigate whether the timing of centralization still matters for public goods provision after government-pursued provincial development initiatives from the late-1970s onward, we replicate the previous public goods regressions for the years 1980, 1990, and 2000. In addition to the controls outlined above, we add a control for the number of industrial estates under the Industrial Estate Authority of Thailand for the 1990 and 2000 regressions. This variable represents province-specific, targeted, economic-development projects pursued as a part of Thailand's export-led growth strategy of the 1980s and 1990s that could have affected the provision of infrastructure and the supply of education. The eastern seaboard province of Rayong, for example, saw the establishment of seven industrial estates between 1989 and 2001 alongside complementary infrastructure development, including a deep-sea port and a railway line. Table 5 reports the public goods regression results for 1980, 1990, and 2000.

Table 5 shows that the impact of centralization timing remains negative in most cases, although the magnitudes (compared to the means) and statistical significance decrease over time. These results suggest that targeted provincial development has led to convergence of public goods provision but that the negative impact of late centralization persists.

Our next analysis determines whether the timing of centralization is related to long-run provincial economic performance. The unit of observation is the province and the dependent variable is the natural log of real per capita GPP measured in 1973.[62] The following regression relates the timing of centralization to per capita GPP, with the same set of control variables as in equation (2):

[62] GPP figures come from NESDB 1977; NESDB 1978; and NESDB 2016. Note that the GPP series used for 1973 to 1990 is based on eleven output categories, while the series used for 1995 to 2010 is based on sixteen output categories. Nineteen seventy-three is the earliest year for which we could find the income measure at the province level.

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TABLE 5
OLS REGRESSIONS CENTRALIZATION AND PUBLIC GOODS PROVISION, 1980–2000

	(1) *Proportion of Households with Electricity 1980*	(2) *Proportion of Households with Piped Water 1980*	(3) *Proportion of 14+ Population with Elementary Education 1980*	(4) *Proportion of Households with Electricity 1990*	(5) *Proportion of Households with Piped Water 1990*	(6) *Proportion of 14+ Population with Elementary Education 1990*	(7) *Proportion of Households with Piped Water 2000*	(8) *Proportion of 14+ Population with Elementary Education 2000*
Year monthon established	−0.004	−0.003*	−0.001	0.000	−0.005*	−0.002**	−0.006	−0.002*
	(0.003)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.004)	(0.001)
Tributary state	0.040	−0.004	−0.062	0.045	0.085	−0.080*	0.074	−0.047
	(0.132)	(0.054)	(0.041)	(0.062)	(0.113)	(0.040)	(0.145)	(0.038)
External province	−0.063	−0.013	−0.034*	−0.022	−0.028	−0.034	0.084	−0.012
	(0.066)	(0.030)	(0.019)	(0.043)	(0.062)	(0.024)	(0.091)	(0.023)
Inner province	−0.081	−0.034	−0.028*	−0.073*	−0.063	−0.049**	0.108	−0.053**
	(0.051)	(0.023)	(0.016)	(0.037)	(0.049)	(0.020)	(0.085)	(0.021)
Frontier area	0.007	0.007	0.010	−0.026	−0.066	−0.020	−0.065	0.004
	(0.035)	(0.021)	(0.012)	(0.019)	(0.042)	(0.017)	(0.071)	(0.019)
Distance to Bangkok (hundreds of km)	−0.016	−0.008	0.008	0.000	−0.012	0.016***	−0.035**	0.015***
	(0.011)	(0.005)	(0.005)	(0.009)	(0.012)	(0.006)	(0.015)	(0.005)
Monthon provincial headquarters	0.067*	0.026**	0.024	0.027	0.035	0.022	0.008	0.037**
	(0.035)	(0.013)	(0.016)	(0.017)	(0.032)	(0.019)	(0.050)	(0.016)
Provincial pop. density per 10km^2 1915	0.019***	−0.000	0.007***	0.007***	0.003	0.002	0.012	0.003
	(0.004)	(0.002)	(0.002)	(0.002)	(0.004)	(0.002)	(0.008)	(0.002)
Fraction arable land	0.067	0.093	0.071*	−0.030	0.128	−0.016	0.051	−0.054
	(0.121)	(0.074)	(0.042)	(0.096)	(0.136)	(0.068)	(0.218)	(0.066)

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	(1) *Proportion of Households with Electricity 1980*	(2) *Proportion of Households with Piped Water 1980*	(3) *Proportion of 14+ Population with Elementary Education 1980*	(4) *Proportion of Households with Electricity 1990*	(5) *Proportion of Households with Piped Water 1990*	(6) *Proportion of 14+ Population with Elementary Education 1990*	(7) *Proportion of Households with Piped Water 2000*	(8) *Proportion of 14+ Population with Elementary Education 2000*
Mean elevation (km)	0.105	0.051	0.087	−0.144	0.235*	0.044	0.361	−0.101
	(0.156)	(0.058)	(0.052)	(0.126)	(0.122)	(0.056)	(0.224)	(0.070)
Area (thousands of km^2)	−0.009**	−0.002	−0.004**	0.000	−0.004	−0.002	−0.007	−0.001
	(0.004)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.006)	(0.002)
Coastline (hundreds of km)	−0.009	0.007	0.020**	−0.034**	0.019	0.034***	−0.079**	0.020**
	(0.020)	(0.009)	(0.008)	(0.017)	(0.021)	(0.013)	(0.030)	(0.009)
Number of industrial estates 1990				0.022*	0.028	0.030**		
				(0.012)	(0.030)	(0.014)		
Number of industrial estates 2000							0.001	0.021***
							(0.019)	(0.005)
Constant	8.043	5.144**	2.431	0.259	9.087*	3.896**	11.422	3.966*
	(6.290)	(2.516)	(1.628)	(3.243)	(4.680)	(1.579)	(7.396)	(2.062)
Observations	72	72	72	72	72	72	72	72
Adjusted R-squared	0.500	0.254	0.435	0.336	0.265	0.446	0.257	0.531

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; robust standard errors in parentheses

$$lnpcgpp = \alpha_0 + \alpha_1 MonthonYr + Class\beta + Location\gamma + Z\delta + \varepsilon. \quad (3)$$

Regions that were incorporated into monthon early in the centralization process experienced better infrastructure development and an earlier introduction of central administration–mandated modern educational institutions, which presumably would lead to better conditions for economic development. A negative coefficient on *MonthonYr* would therefore suggest that earlier centralization (over a century ago) had positive lasting impacts on provincial-level economic performance, as measured by real per capita GPP. Table 6 presents the association between monthon timing and log per capita GPP in 1973.

The results indicate that provinces that were centralized later, holding all else constant, have lower levels of real per capita GPP. In fact, the coefficient estimate from the fully controlled specification suggests that on average, a province centralized ten years later than another experienced 32 percent lower GPP per capita in 1973.

We replicate the GPP analysis for the years 1975 to 2010 in five-year intervals to see whether the relationship between centralization timing and GPP per capita holds in subsequent years after the government introduced targeted development projects that complemented the government's economic liberalization strategy outlined in the five-year economic and social development plans. The establishment of industrial estates in the provinces to attract manufacturing firms was one such targeted policy. To account for this policy, we add a control for the number of government-sponsored industrial estates for the relevant years, 1990 to 2010. We report the results in Table 7.

Like the results for 1973, the coefficient on *MonthonYr* remains negative and statistically significant in most years with a magnitude falling from 3.2 to 1.2 percent for a one-unit change over the period of 1975 to 2010.[63]

Discussion

Our empirical study is first and foremost limited by the relatively few observations in our data. As is common in other studies looking at historical processes in Southeast Asia, we are also limited in finding data for potential confounders. In place of these shortcomings, we supple-

[63] The increase in magnitude and statistical significance of the timing effect between 1990 and 1995 can be attributed to changes in the method used to calculate GPP rather than a reversal in attenuation.

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TABLE 6
OLS REGRESSIONS: CENTRALIZATION AND GROSS PROVINCIAL PRODUCT, 1973

	(1)	*(2)*	*(3)*	*(4)*
	Log per Capita GPP, 1973			
Year monthon established	−0.031***	−0.041***	−0.038***	−0.032***
	(0.006)	(0.012)	(0.012)	(0.011)
Tributary state		0.122	−0.123	−0.171
		(0.211)	(0.437)	(0.456)
External province		−0.160	−0.307	−0.202
		(0.202)	(0.306)	(0.278)
Inner province		−0.478***	−0.610***	−0.513**
		(0.081)	(0.214)	(0.215)
Frontier area			0.052	0.064
			(0.107)	(0.138)
Distance to Bangkok (hundreds of km)			0.032	0.001
			(0.064)	(0.063)
Monthon provincial headquarters			0.158	0.270
			(0.159)	(0.188)
Provincial pop. density per 10km^2 1915				−0.024
				(0.017)
Fraction arable land				0.867
				(0.536)
Mean elevation (km)				0.731
				(0.612)
Area (thousands of km^2)				−0.037
				(0.025)
Coastline (hundreds of km)				0.198*
				(0.103)
Constant	69.991***	88.668***	83.506***	71.950***
	(11.057)	(22.590)	(23.340)	(20.801)
Observations	72	72	72	72
Adjusted R-squared	0.191	0.274	0.263	0.365

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; robust standard errors in parentheses

ment our analysis with the qualitative evidence and relevant historical anecdotes presented below.

A criticism of our findings may be that the colonial threat led to divergent development outcomes across Thailand through channels other than centralization. Two alternative channels through which colonial threat led to uneven development outcomes in Thailand have been discussed in the literature. These include the colonization of the Siamese economy through forced integration into the global colonial economy and the colonization of political structures through the adoption and selective implementation of Western institutions. Chris Dixon

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TABLE 7
OLS REGRESSIONS: CENTRALIZATION AND GROSS PROVINCIAL PRODUCT, 1975–2010

	(1) Log per Capita GPP, 1973	(2) Log per Capita GPP, 1975	(3) Log per Capita GPP, 1980	(4) Log per Capita GPP, 1985	(5) Log per Capita GPP, 1990	(6) Log per Capita GPP, 1995	(7) Log per Capita GPP, 2000	(8) Log per Capita GPP, 2005	(9) Log per Capita GPP, 2010
Year monthon established	−0.032***	−0.021**	−0.023**	−0.017*	−0.017**	−0.028***	−0.024***	−0.018**	−0.012
	(0.011)	(0.010)	(0.011)	(0.009)	(0.007)	(0.010)	(0.009)	(0.008)	(0.008)
Tributary state	−0.171	−0.013	−0.303	0.049	−0.124	0.146	−0.097	−0.281	−0.064
	(0.456)	(0.414)	(0.457)	(0.460)	(0.330)	(0.391)	(0.411)	(0.376)	(0.380)
External province	−0.202	−0.204	−0.364	−0.143	−0.148	−0.146	−0.288	−0.454*	−0.214
	(0.278)	(0.259)	(0.267)	(0.291)	(0.176)	(0.232)	(0.232)	(0.245)	(0.250)
Inner province	−0.513**	−0.357*	−0.520**	−0.277	−0.261*	−0.373**	−0.421**	−0.467**	−0.289
	(0.215)	(0.213)	(0.212)	(0.220)	(0.156)	(0.180)	(0.204)	(0.219)	(0.218)
Frontier area	0.064	−0.050	−0.047	0.025	0.061	0.012	0.013	0.055	0.054
	(0.138)	(0.131)	(0.135)	(0.118)	(0.118)	(0.156)	(0.163)	(0.160)	(0.177)
Distance to Bangkok	0.001	−0.035	−0.003	−0.057	−0.003	−0.022	−0.017	−0.002	−0.030
(hundreds of km)	(0.063)	(0.046)	(0.054)	(0.066)	(0.051)	(0.054)	(0.060)	(0.045)	(0.043)
Monthon provincial	0.270	0.128	0.191	0.106	0.236	0.428***	0.471**	0.436***	0.365**
headquarters	(0.188)	(0.149)	(0.173)	(0.141)	(0.154)	(0.158)	(0.177)	(0.156)	(0.157)
Provincial pop. density	−0.024	−0.037**	−0.029	−0.023*	−0.004	0.001	0.008	−0.007	−0.011
per 10km^2 1915	(0.017)	(0.017)	(0.017)	(0.014)	(0.014)	(0.015)	(0.018)	(0.018)	(0.020)
Fraction arable land	0.867	0.788	0.661	0.833*	1.276**	1.810***	1.307**	1.188**	0.897
	(0.536)	(0.541)	(0.554)	(0.461)	(0.501)	(0.575)	(0.547)	(0.528)	(0.614)

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	(1) Log per Capita GPP, 1973	(2) Log per Capita GPP, 1975	(3) Log per Capita GPP, 1980	(4) Log per Capita GPP, 1985	(5) Log per Capita GPP, 1990	(6) Log per Capita GPP, 1995	(7) Log per Capita GPP, 2000	(8) Log per Capita GPP, 2005	(9) Log per Capita GPP, 2010
Mean elevation (km)	0.731	0.951*	1.286**	0.481	0.889*	0.601	0.882	0.626	0.326
	(0.612)	(0.476)	(0.571)	(0.471)	(0.447)	(0.536)	(0.560)	(0.511)	(0.497)
Area (thousands of km^2)	−0.037	−0.024	−0.034	−0.020	−0.025	−0.028	−0.036*	−0.030*	−0.029
	(0.025)	(0.022)	(0.025)	(0.018)	(0.019)	(0.021)	(0.021)	(0.017)	(0.017)
Coastline (hundreds of km)	0.198*	0.290***	0.411***	0.286***	0.217**	0.363***	0.346***	0.310***	0.273***
	(0.103)	(0.091)	(0.126)	(0.100)	(0.084)	(0.093)	(0.096)	(0.082)	(0.075)
Number of industrial estates 1990					0.417***				
					(0.072)				
Number of industrial estates 1995						0.494***			
						(0.083)			
Number of industrial estates 2000							0.408***		
							(0.076)		
Number of industrial estates 2005								0.343***	
								(0.068)	
Number of industrial estates 2010									0.251***
									(0.073)
Constant	71.950***	50.412**	54.711**	42.873**	42.575***	62.667***	56.385***	44.794***	33.652**
	(20.801)	(19.150)	(21.144)	(17.164)	(13.718)	(18.112)	(16.593)	(15.612)	(14.975)
Observations	72	72	72	72	72	72	72	72	72
Adjusted R-squared	0.365	0.342	0.364	0.359	0.537	0.684	0.701	0.697	0.603

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; robust standard errors in parentheses

and Michael Parnwell argue that although Siam was not colonized, the Bowring and related nineteenth-century treaties caused the kingdom's economy to develop similarly to colonies, in the sense that it increasingly concentrated on primary product exports, especially rice, teak, and tin.[64] This integration into the global economy in turn had uneven impacts on economic development across Siam.

Although rice quickly became Siam's dominant export after opening its economy to global trade, the rice trade largely affected only Bangkok and surrounding rice-growing areas in the Central Plain, much of which was included in Monthon Krung Thep and thus excluded in our analysis. This contention is supported in recent work by Thanyaporn Chankrajang,[65] which shows that households outside the Central Plain were largely not integrated into the export rice market, which spared them from much of the negative effects of the Great Depression in the early 1930s. Other primary export products found outside of the central region, such as teak and tin, were progressively controlled by British firms, but Dixon and Parnwell argue that the development of these enclave industries had little impact on the local economies.[66] Thus, the integration of Siam's economy into the colonial economy contributed to divergent development paths between Bangkok and the periphery, but cannot explain varying levels of development between areas outside of Bangkok.

The adoption and uneven implementation of Western institutions has also been recognized as a source of uneven development in Thailand. A clear example discussed extensively by David Feeny and Tomas Larsson[67] is the implementation of the 1901 Land Title Deed Act. This act bestowed full private property rights to owners who held deeds issued through the newly implemented Torrens system, a Western land-titling code. The land act also restricted landownership by foreign nationals, a stipulation seen as a political response to the growing issues surrounding extraterritoriality rights.[68] Although the adoption of Western land institutions was a political response to colonial threat and was credited with helping Siam to maintain its sovereignty, implementation was uneven across the kingdom. In fact, by 1909, only 10 percent of the surveyed land was located outside of Bangkok and the central region.[69] Peter Vandergeest and Nancy Peluso argue that the

[64] Dixon and Parnwell 1991.
[65] Chankrajang 2017.
[66] Dixon and Parnwell 1991.
[67] Feeny 1982; Feeny 1989; Larsson 2012.
[68] Larsson 2012.
[69] Feeny 1982, 96.

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uneven implementation of the land code led to ambiguity and property rights insecurity outside the center.[70] Land rights insecurity as a result of uneven and incomplete implementation of the Torrens system is a factor related to the economic underdevelopment in areas other than Bangkok, as demonstrated by Gershon Feder and colleagues and Chankrajang.[71] The conclusion here is that again, the impact of imperfectly adopting a Western land code explains some of the differences in economic development between Bangkok and the rest of the country, but not differences between provinces outside Bangkok.

Conclusion

The threat of colonization by the British and the French during the second half of the nineteenth century led Siam's King Chulalongkorn to adopt the Thesapiban system—a centralized government structure—as a defensive strategy. Under the traditional system, the government in Bangkok had little direct control over territories located outside the center, and limited ability to select local rulers, collect taxes, and implement policies. With increasing colonial pressures in the frontier areas, it was necessary to create a centralized government system that would allow the administration in Bangkok to appoint its own government officials, to gain control over tax revenues, and to develop infrastructure to help move people and information between the frontier and Bangkok. The degree of colonial threat combined with the ease of political integration meant that some areas were integrated into the centralized system sooner than others were. The central government's fiscal constraints also meant that the areas integrated earlier received significant initial injections of infrastructure investment and public goods provision compared with areas integrated later. In this article, we explore whether the timing of centralization implementation is associated with long-term development outcomes in Thailand.

The results of this study show that an area's historical political relationship with Bangkok and the threat of colonial encroachment in the late nineteenth century indeed have long-run associations with uneven development across several measures at the provincial level between 1970 and 2010, including infrastructure, human capital, and GPP. Although the Thesapiban system and the monthon were disbanded by the 1930s, the legacy of Siam's centralization strategy survives through the

[70] Vandergeest and Peluso 1995.
[71] Feder et al. 1988; Chankrajang 2012; Chankrajang 2015.

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varying levels of public infrastructure provided at the monthon level in the early twentieth century. The direct influence of centralization appears to persist even after concerted efforts by the government, starting in the late-1970s, to develop the outlying regions through targeted government development projects and economic liberalization policies. These efforts have partly overcome the long-run effects of unequal distribution of infrastructure and exposure to centralized government policy, but the results of Siam's strategic response to colonial threats in Southeast Asia remain.

Siam's modernization endeavors through the adoption of a centralized governance structure made it possible to maintain its sovereignty through the decades of Western colonial threat. Its unique history as the only country in Southeast Asia to never have been formally colonized draws much interest from scholars in social sciences, and yet the literature finds few empirical works on the country's transformation from a mandala state to a modern state. Given the rising interest in the impact of colonization and dynamics of modern state formation, further studies are warranted for Thailand, and more broadly for Southeast Asia, a region that offers rich ground for testing existing hypotheses and exploring new ones.

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Appendix

Table A1

OLS Regressions: Divergence in Government-Provided Public Goods and Infrastructure at the Time of Centralization[a]

Centralization Timing and Share of Government Schools in Monthon, 1917 (a)								
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
	Government School Share							
Year monthon established	−0.009***	−0.009***	−0.007***	−0.008***	−0.008**	−0.009***	−0.008***	−0.008***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)
Frontier area		−0.068						
		(0.062)						
Distance to Bangkok from monthon headquarters			−0.000					
			(0.000)					
Monthon population density 1919				−0.001				
				(0.001)				
Fraction arable land					0.256			
					(0.354)			
Monthon mean elevation (km)						−0.016		
						(0.340)		
Monthon area (km^2)							−0.000	
							(0.000)	
Monthon coastline (hundreds of km)								0.004
								(0.011)
Observations	17	17	17	17	17	17	17	17
Adjusted R-squared	0.315	0.324	0.302	0.350	0.295	0.266	0.345	0.273

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TABLE A1 *cont.*

Centralization Timing and Share of Government Teachers in Monthon, 1917 (b)								
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
	Government Teacher Share							
Year monthon established	−0.011***	−0.011***	−0.010***	−0.010***	−0.009**	−0.011***	−0.010***	−0.010***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.004)	(0.003)	(0.003)
Frontier area		−0.052						
		(0.057)						
Distance to Bangkok from monthon headquarter			−0.000					
			(0.000)					
Monthon population density 1919				−0.001*				
				(0.001)				
Fraction arable land					0.488			
					(0.521)			
Monthon mean elevation (km)						0.123		
						(0.431)		
Monthon area (km^2)							−0.000	
							(0.000)	
Monthon coastline (hundreds of km)								0.015
								(0.013)
Observations	17	17	17	17	17	17	17	17
Adjusted R-squared	0.340	0.315	0.317	0.409	0.362	0.295	0.362	0.344

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Centralization Timing and Monthon Railway Construction by 1916 (c)								
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
	Monthon Gains Railway by 1916							
Year monthon established	−0.036**	−0.036**	−0.034*	−0.037**	−0.029*	−0.044***	−0.038**	−0.036**
	(0.015)	(0.015)	(0.018)	(0.016)	(0.017)	(0.010)	(0.014)	(0.015)
Frontier area		0.087						
		(0.231)						
Distance to Bangkok from monthon headquarters			−0.000					
			(0.000)					
Monthon population density 1919				0.002				
				(0.001)				
Fraction arable land					2.161*			
					(1.141)			
Monthon mean elevation (km)						2.360		
						(1.908)		
Monthon area (km^2)							0.000	
							(0.000)	
Monthon coastline (hundreds of km)								0.000
								(0.049)
Observations	18	18	18	18	18	18	18	18
Adjusted R-squared	0.269	0.226	0.225	0.231	0.323	0.284	0.246	0.220

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; robust standard errors in parentheses

[a]Phetchabun was reported with Phitsanulok in 1917, resulting in only seventeen monthons; monthon population density in 1919 from Department of General Statistics, Ministry of Finance 1921.

TABLE A2
CENTRALIZATION TIMING AND PRIMARY EDUCATION ATTAINMENT IN THE 1920–1939 BIRTH COHORT

	(1)	(2)	(3)	(4)
	Proportion of 1920–1939 Birth Cohort with Elementary Education, 1970			
Year monthon established	–0.001*	–0.001***	–0.001**	–0.001**
	(0.000)	(0.001)	(0.001)	(0.001)
Tributary state		0.021**	0.007	0.008
		(0.010)	(0.017)	(0.016)
External province		0.017*	0.009	0.012
		(0.010)	(0.014)	(0.013)
Inner province		–0.005	–0.012*	–0.008
		(0.006)	(0.007)	(0.008)
Frontier area			0.007*	0.003
			(0.004)	(0.005)
Distance to Bangkok (hundreds of km)			0.001	0.000
			(0.002)	(0.002)
Monthon provincial headquarters			0.006	0.008
			(0.005)	(0.005)
Provincial population density per 10km^2 1915				0.000
				(0.001)
Fraction arable land				–0.010
				(0.025)
Mean elevation (km)				0.028
				(0.032)
Area (thousands of km^2)				–0.001
				(0.001)
Coastline (hundreds of km)				0.011***
				(0.004)
Constant	1.067*	2.868***	2.416**	2.306**
	(0.560)	(1.000)	(1.096)	(1.038)
Observations	72	72	72	72
Adjusted R-squared	0.016	0.070	0.054	0.068

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; robust standard errors in parentheses

DATA

Replication data for this article is available at https://doi.org/10.7910/DVN/AE2FHZ.

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