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Reform, Rails, and Rice: Thailand's Political Railroads and Economic Development in the 20th Century

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Abstract

How do colonial threats influence a state's infrastructural development, and what are their consequences? In this paper, we look at Thailand's railroad projects in the late-nineteenth and early twentieth centuries as a primary example of a state's strategic response to colonial encroachment. By transporting government officials and establishing permanent administrative presence, the railways served to ensure Thailand's sovereignty over peripheral regions and bring them under direct governance. We find that while laid initially for nation-building, population and area cultivated in rice increased in areas that gained rail access. Our findings are consistent with other works in the literature showing that railways lead to more urbanization and higher economic welfare by improving access to markets in other regions.

Keywords: State Formation; Railroads; Centralization; Thailand; Colonization; Economic Development

Introduction

States under threat of colonization have implemented a series of reforms in order to maintain their sovereignty. During the Western colonial era in Southeast Asia, King Chulalongkorn and his government pursued several strategies to establish its sovereignty and gain territorial control in the peripheries. In this paper, we discuss the development of Siam's early railways as a part of a larger package of political reforms with a goal to thwart colonial territorial ambitions of the British and French in the late-19th and early 20th centuries. We investigate how these "political railroads" potentially had the unintended consequence of facilitating local economic development in northern and northeastern Thailand in the 20th century.

Previous work on transportation infrastructure development suggest that large infrastructure projects, such as railways, roads, and canals, have positive impacts on various local and national economic outcomes. In theory, the development of transportation networks increases market access and reduces the cost of transporting goods and people. Motivated by a theoretical trade model that predicts increased trade in areas that experience reduced trade costs due to access to transport networks, Donaldson (2018) finds in the case of colonial India that areas that gained direct access to railways during the colonial period saw decreased trade costs, which led to increased interregional and international trade. This mechanism is evident in nineteenth century United States as well. According to Donaldson and Hornbeck (2016), counties that gained better market access due to the expansion of the rail network led to increased agricultural land values in the United States. Research by Atack and Margo (2011) further shows that about one quarter of the increase in farmland in the American Midwest can be attributed to the building of the railways in the nineteenth century. Thus, increased market access through the development of railway systems has played an important role in the development of agriculture and trade in various country contexts.

The development of rail infrastructure has had lasting impacts on other economic activities as well. A study by Tang (2014) shows that the development of the rail system in Japan led to industrial development and agglomeration economies along the newly built rail lines. Banerjee, Duflo and Qian (2012) also find that during China's economic boom, new economic activities located along a highway system initially built to connect major cities. The development of transportation infrastructure not only led to more economic activity, but also led to productivity growth. Bogart and Chaudhary (2013) find that the colonial railways in India led to increased

total factor productivity between 1874 and 1912, and this can be largely explained by the complementarity between railways and industrial development.

Increased industrial activities and agricultural expansion then can lead to urbanization in areas previously with inferior transportation options. Recent work on urbanization by Berger and Enflo (2017) shows that areas that gained railways built by the government to connect areas for defense purposes saw more rapid population growth than areas that did not gain direct rail access. They further show that the increased relative population in areas with early rail access is likely due to shifts in economic activities from areas without access to areas with rail access. This current paper evaluates the impact of railway development for political purposes on population and agricultural activity in the Thai context, further adding to the literature on transportation infrastructure development, market access, and economic growth in a developing economy context.

Reform under Colonial Pressure

Up until the end of the nineteenth century, the governance system used in much of Southeast Asia, including Siam, was one of indirect control over and tributary relationships with areas far from a kingdom's administrative center. This type of governance structure—with strong control in the center and indirect control over the peripheries—is often referred to as a "mandala" system (Tambiah 1977; Wolters 1999). During the second half of the nineteenth century, Siam maintained tributary relationships with several distant kingdoms and principalities that came under Bangkok's influence towards the end of the eighteenth century, a time territorial expansion due to military conquest. These kingdoms and principalities include: Chiang Mai, Lampang, Lampun, Nan, and Phrae in the north; the Laotian kingdoms of Luang Prabang, Vientienne, and Champasak; the kingdom of Cambodia; and the southern sultanates of Pattani, Trengganu, Kelantan, and Kedah (Bunnag 1977). Although the tributary kingdoms maintained their own hereditary leaders, taxation, laws, and governance, they periodically sent tribute to Bangkok and provided soldiers when requested. The decentralized nature of the mandala system meant that smaller kingdoms in the periphery of Siam's influence were at risk of appropriation by the colonial French and British administrations. In fact, the French and British progressively annexed land in Southeast Asia on the edges of Siam's influence, including areas in present-day Myanmar, Malaysia, Vietnam, Laos, and Cambodia.

French and British colonial ambitions and progressive colonization of peripheral territories under Siam's influence led King Chulalongkorn to pursue several strategies to thwart further annexations. In particular: King Chulalongkorn pursued diplomatic avenues to maintain its status as a buffer state between French and British holdings (Jeshurun 1970); established territorial borders consistent with Western concepts of sovereignty and the nation-state (Winichakul 1994); and adopted several Western institutions (for example, the Torrens system of land administration based on cadastral survey) to gain legitimacy in the eyes of international actors (Larsson 2012). Possibly the most effective defense against colonial encroachment was the centralization of the Siam's government and the integration of the peripheral tributary polities into the centralized system.

Starting in 1892, King Chulalongkorn and the new Minister of Interior, Prince Damrong, called for the creation of new second-level administrative units called *monthon* (or "circles") under what became known as the *Thesapiban* (or "local government") system. One of the strategic responses to colonial encroachment was to group *mueang* (larger towns often at the center of principalities and kingdoms) into *monthon* and to assign commissioners from the government's newly formed Bangkok-based civil service to govern the areas. Siam, however, faced many challenges in its bid to centralize the government. Along with resistance to centralization by hereditary leaders (Bunnag 1977; Walker 2014), transportation to and communication with the peripheries posed a large practical problem to directly governing outside the Central Plain. Sending people and supplies to places that lacked canals or coastlines was exceedingly difficult, such as in the north and northeastern parts of the country. While waterways (canals and rivers) were the main forms of transportation in Siam throughout the nineteenth century, they were only navigable most of the year in the central region and not navigable at all during the dry season in the north and northeast. These regions with high mountainous terrains in particular had no navigable waterways allowing access to the rest of the country. The time-distances provided in figure 1 demonstrates the difficulties of travel from Bangkok to distant *mueang* in the north and northeast at the end of the nineteenth century.

[Figure 1. Time-distances from Bangkok in Dry Season for Various *Mueang* in North and Northeastern Siam, 1890]

Figure 1 indicates that travel to larger towns in the north took upwards of two months, much of it over land under man and animal power (Kakizaki 2005, 156-7). The inability of the

government to effectively directly govern distant *mueang* in addition to the need for better intelligence on French and British activities in the peripheries led to the decision to establish a railway network in Siam.

Siam's "Political Railways"

In order to achieve direct governance of strategic areas outside the immediate vicinity of Bangkok, the government decided to invest in a railway network to move people and information more efficiently across its territory. The French and British made proposals to Siam's government in the late nineteenth century to build railways that extended into territories that were under tenuous control by Bangkok in the east, northeast, and west. These requests and plans were summarily rejected even if they made economic sense. The main concern was that the French or British would gain firm control over these areas and the railway would in turn facilitate further appropriation of lands by the colonial powers. The French and British insistence on building railways through areas under Siamese control was another factor that pushed Siam to plan and build its own railways.

The three earliest major routes that the government chose to pursue in the 1890s—northeast to Khorat, north to Chiangmai, and south to the border with British Malaya—were largely of a strategic nature, aimed at facilitating the centralization of Siam's administration, strengthening its control over the periphery, and maintaining territorial integrity. The government considered several proposed routes that would have made economic sense, connecting Siam's natural resources (i.e. teak, tin, etc.) and agricultural output (rice in particular) not only to Bangkok, but also to other centers of trade, such as Saigon, Singapore, and Moulmein (Whyte 2010; Kakizaki 2012). Although the newly organized Royal Railway Department had multiple rail line proposals and two complete railway surveys to the north and the northeast in hand, the government chose to pursue the northeastern route to the Khorat Plateau first, terminating, not coincidentally, in the first established *monthon*, Nakhon Ratchasima. According to Whyte (2010, 12), this decision was made for two reasons: 1) to effectively extend Bangkok's reach towards areas under French threat and 2) to bring the Khorat Plataeu, which was one of the most difficult areas in Siam to reach by traditional overland modes of transport, into direct communication with Bangkok.

The routes not only terminated in strategically important places, the route itself was carefully considered. For example, Whyte (2010, 12) notes that the government opted to route the northern line through Phitsanulok rather than the important teak town of Tak to accomplish connecting Siam internally north to south without antagonizing the British. Concern over annexation of peripheral areas is why the early railways did not extend to the northeastern tributary states or the economically important city of Battambang in present-day Cambodia (Kakizaki 2012, 24-25). In other words, railway routes selected by Siam's government went out far enough to ensure Bangkok's consolidation of power in outer lying provinces and the ability to communicate and send human resources quickly to the frontier, but not far enough for the rails to be used strategically by France and Britain to facilitate the annexation of additional areas under Siamese influence.

Construction on major state-sponsored railways to the northeast, north, and south commenced in 1892, 1898, and 1900, respectively. As early as 1903, the existing railways were being called "political railways" by contemporary media and commentators (Kakizaki 2012, 29). In a speech at the opening of the Paknam Pho-Phitsanulok section of the northern line in 1908, King Chulalongkorn himself makes clear that one of the major objectives of establishing the railway system was to achieve centralization: "by bringing the different parts of a country within close communication the railway renders possible that close and beneficial supervision which is necessary to effective administration" (Graham 1924, 145). The importance of the early railways in facilitating the implementation of the centralized government administration was recognized early on. W. A. Graham, a former administrator and advisor to the Siamese government, notes that the economic returns to railway investments were still in question, but "[f]or 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, 152-3). In support of this point, a recent study by Potjanalawan (2016) found that a notable impact of opening the railway line in the northern town of Lampang was the facilitation of the movement of civil servants originating from Bangkok and other provinces to take up posts within the *Thesapiban* administration in Lampang and adjacent Phrae and Nan provinces. Furthermore, Graham notes 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, 124).

While the strategic and political importance of Siam's early railways are well recognized, the economic value of the railways has largely been in question by both contemporary commentators and economic historians alike. In terms of large-scale infrastructure investment, railroads were perceived as a suboptimal choice from an economic perspective. Homan van der Heide, a Dutch engineer, drew up extensive plans for irrigation canal development in the Central Plain at the turn of the twentieth century. Ultimately, the government decided to devote its limited resources to building the railway network rather than extend the canal network. Van der Heide (1906) forcefully argued that government spending on the expansion of irrigation would have increased Siam's paddy cultivation and international trade capacity, and thus would have made much more economic sense than building railways. Feeny (1982), in his treatise on the political economy of rice cultivation in Thailand, concurs with van der Heide's point. Ingram (1971), in his well-known economic history of Thailand, also downplays the economic importance of the railways in the development of rice agriculture. He notes that the railways encouraged rice cultivation for export only in areas beyond Phitsanulok in the north that previously had no access to affordable transportation to the ports near Bangkok (Ingram 1971, 86). However, he argues that the overall impact of the the railways on rice cultivation was small and that the expansion of the irrigation system would have been more beneficial (Ingram 1971, 87).

One author who has taken up the question of the economic importance of Thailand's early rails is Ichiro Kakizaki (2005). Kakizaki (2005) argues that the railways were extremely important for the development of intraregional trade. Taking issue with Ingram's (1971) conclusion that the railways had little impact on rice cultivation and trade, Kakizaki (2005) argues that the opening of the northern and northeastern lines in particular resulted in shifts in rice production and commodity flows. Contrary to earlier views that the railways were not important for transporting rice, official statistics indicate that paddy and processed rice made up a large proportion of overall freight carried on the northern and northeastern lines up through World War II, as depicted in figure 2.

[Figure 2. Rail Tonnage North and Northeastern Lines (Metric Tons), 1897-1944]

Kakizaki (2005, 181-85) concludes that the opening of the north and northeastern rail lines led to a significant amount of rice market integration and price convergence, and that the railways were the vehicle for overall economic development in these regions.

Transportation Infrastructure Investment Constraints

The expansion of the railway network between 1897 and 1995 is depicted in figure 3.

[Figure 3. Railway Network Expansion, 1897-1995]

One of the notable features from figure 3 is that after the initial phase of railway construction between 1897 and 1919, there was relatively little additional expansion of the system even though large portions of the country remained effectively unconnected. The previous discussion points to the success of the railways both in political and economic terms. Why, then, did the expansion of the railroad network slow significantly after the three main lines to the northeast, north, and south were (nearly) completed?

Railway investment is expensive. At the end of the nineteenth and beginning of the twentieth centuries, Siam's capacity to raise revenues through taxation was constrained on two fronts. First, Siam's decentralized mandala governance system still in existence in the 1890s meant that the Bangkok government did not tax the peripheries directly. Hereditary leaders taxed their own populace and often did not forward the required share of taxes to Bangkok (Bunnag 1977). Second, Bangkok could not raise significant funds from both internal and external trade because provisions in the 1855 Bowring Treaty with Britain limited import duties to 3 percent and exports could only be taxed once (i.e. inland tax, transit duty, or export duty) (Ingram 1971). The Bowring Treaty became a template for subsequent treaties with other external trade partners, effectively closing off trade as a lucrative source of government revenues. Part of the impetus for centralization was to centralize tax collection, thereby allowing the government to raise revenues domestically to fund the newly formed civil service and invest in needed transportation infrastructure. In fact, between the commencement of the centralization process in 1892 and 1898, Bangkok doubled its domestic tax revenues from 15,378,119 to 28,496,029 baht (Bunnag 1977, 118).

Spending on railway construction comprised around 10 percent of government expenditures between 1897 and 1920 (Bureau of General Statistics 1933). To a large extent, Siam avoided foreign loans to finance infrastructure projects and maintained a balanced budget policy through the mid-1950s out of a desire to remain free of Western interference (Ingram 1971, 189-190, 299). While this approach was effective on the diplomatic front, it severely limited funds available to invest in additional infrastructure. According to Ingram (1971, 194), the

government limited capital investment to projects that would directly generate government revenues (such as railways) rather than projects that would promote economic growth, such as irrigation and roads. Government tax revenues, however, were not enough to finance all of the planned routes. Siam's scarce resources were allocated to building infrastructure in strategic areas integrated early into Siam's centralized administration, with plans for lines in areas integrated later, such as Chiangmai, Nongkhai, and Ubon Ratchathani, being substantially delayed or canceled completely due to budgetary constraints (Kakizaki 2012).

Constraints on government spending resulted in the slowing of rail infrastructure expansion after the 1920s, which meant that regions excluded from the early railways would largely remain without basic transportation infrastructure through the 1950s. The 1960s saw the beginning of large-scale investments in roads and highways, particularly in areas of the Northeast where railways did not extend. Hewison (1997) argues that Prime Minister Sarit Thanarat, who is known to be highly authoritarian, maintained power without widespread violence in the peripheries in part because he strategically invested in economic development projects – including roads – in the provinces. Investments in paved roads outside the central region picked up in the 1960s and accelerated significantly in the 1970s (Kakizaki 2012). The development of Thailand's highway system managed to fill in the gaps left by the incomplete railway network and connected these initially neglected areas with the rest of the country.

Data and Empirical Approach

We estimate the impact of rail infrastructure built during the colonial period on population and rice cultivation at the district level in 1947 and 1966. We scope our analysis to the northern and northeastern rail lines since the construction of these two lines was clearly motivated by political rather than economic aims during the colonial period, and the routes were determined in part by areas of British and French presence (Whyte 2010; Kakizaki 2012). The data are derived from several sources. First, the locations of rail stations and timing of construction are given in Whyte (2010). Various railway routes planned but not built by the British and French colonial governments and the Thai government are identified in Kakizaki (2012).

[Figure 4. Planned and Completed Railways Lines, 1897-1941]

The outcome variables are population and area under paddy cultivation at the district level. District population figures are collected for 1947 from the Thai census returns, and figures from 1966 are extracted from the first provincial-level statistical yearbooks published in 1966. The number of rai under paddy cultivation at the district-level is reported in the 1947 population census statistical reports. The 1966 rice figures cover the number of rai harvested and are extracted from the 1966 provincial statistical yearbooks. We also use a set of district-level geographical controls in order to capture the economic potential of a district based on its exogenous geographic characteristics: longitude, latitude, area (km^2), agricultural suitability, mean elevation (m), standard deviation of elevation, distance to nearest river (km), and distance to Bangkok (km). Summary statistics are presented in Table 1.[1]

[Table 1. Summary Statistics]

We run the following baseline OLS specification:

$$y = \beta_0 + \beta_1 NoRailN + \beta_2 NoRailNE + X'\gamma + \delta + \epsilon \quad (1)$$

The outcome variables, *y*, are the natural log of district-level population and rice cultivation/harvest measures in 1947 and 1966. The variables *NoRailN* and *NoRailNE* are dummy variables indicating that the northern line and northeastern line, respectively, *do not* cross-cut the district. The coefficient estimate can be interpreted as the average effect of a district not having direct access to the rail lines. Since we hypothesize that railway access is positively correlated with economic outcomes, we expect the sign of the coefficients on both dummy variables to be negative. We also include vector *X*, the set of district-level geographical controls described above, and δ is a set of provincial fixed effects.

We not only want to know whether being located directly on the railways matters, but also whether or not a district's distance from the nearest railway access point matters as well. The variables *DistRailN* and *DistRailNE* are the distance in kilometers from a district border to the northern line and northeastern line, respectively. We expect that the impact of the railways will

[1] Note that there are 310 districts in 1966 compared to 221 districts in 1947. It is common for the government to split periodically more populated districts into two or more districts during the mid-twentieth century.

be attenuated the further a district is located from a rail access point, thus the expected sign is negative.

$$y = \beta_0 + \beta_1 NoRailN + \beta_2 DistRailN + \beta_3 NoRailNE + \beta_4 DistRailNE + X'\gamma + \delta + \epsilon \quad (2)$$

Since the impact of distance from the rail line may be nonlinear, we also run the following specification:

$$y = \beta_0 + \beta_1 10kmRailN + \beta_2 20kmRailN + \beta_3 10kmRailNE + \beta_4 20kmRailNE + X'\gamma + \delta + \epsilon \quad (3)$$

The variables *10kmRailN* and *10kmRailNE* are indicator variables for districts located 10 to 20 kilometers from the respective railway access points. Likewise, *20kmRailN* and *20kmRailNE* are indicators for districts located more than 20 kilometers from each rail line. The excluded categories are districts located less than 10 kilometers from the north and northeastern lines. Given the lack of road infrastructure especially in the early period, it is expected that economic impacts of the railways are most pronounced within a few kilometers of the stations, thus the negative impact of distance is expected to be more pronounced for districts located more than 20 kilometers from rail access points.

Although the historical narrative strongly suggests that the rail lines were planned for political and not economic purposes, we are still concerned that the routes may still have been systematically chosen based on unobservable characteristics correlated to economic outcomes. To alleviate this concern, we run a series of placebo tests based on planned but not completed rail lines similar to Donaldson (2018). Two rail lines were proposed by the British and French governments in the nineteenth century to connect their holdings in Burma and French Indochina, respectively, with China. Both of these requests were seriously considered by the Siamese government but were ultimately denied due to security concerns (Kakizaki 2012). In addition to the lines proposed by foreign governments, the Thai government proposed additional lines in 1941 to better connect the north and northeast to Bangkok, and to connect Siam with neighboring countries (Kakizaki 2012). However, due to budget constraints and World War II, the building of these lines was not completed. We run the same regression specification as above, but add controls for the distance to two of the government proposed but

never built lines.[2] Non-significant coefficient estimates on the planned lines suggest that there are no systematic unobservable factors driving the placement of railways that could also be driving our main results.

Results

Table 2 presents results for the 1947 district population and rice cultivation outcomes.

[Table 2. Population, Rice Cultivation, and Access to Railways, 1947]

All reported specifications include the full set of geographic controls and provincial fixed effects. The first three specifications estimate the impact of rail access on the natural log of district population. The first column includes only indicators for whether the district has no rail access. The coefficients for both the northern and northeastern lines indicate that districts with no direct rail access have on average around 40 percent lower population than those districts located on the railways. To understand how localized the impact of railways was, we add various measures of distance from the railway lines. In column (2), in addition the no rail indicators, we add the distance in kilometers. The coefficients on the dummy variables for no rail access change little and the distance variables are not statistically significant, which implies that direct access to railways is what matters. Column (3) reports the coefficients for a series of distance dummy variables to better understand the nonlinear impact of distance from the rail lines on population. For the northern railway, the coefficient on the indicator for districts located more than 20 kilometers from the rail line is -0.34 and statistically significant at the 5 percent level, suggesting that districts located within 20 kilometers of the northern rail line accrued more economic benefits. For the northeastern railway, the results suggest that only districts located within 10 kilometers of the rail line accrued positive economic benefits. These results are consistent with the early railways attracting economic opportunities and subsequent

[2] Although there are four railway lines included in the 1941 plan and largely remained unbuilt, we use only the Paklai and Chiang Saen lines for the placebo tests. This is because these two lines cut through areas without existing railways rather than being designed to connect existing rail lines and hence, are already "treated" for much of the planned route.

population growth, but at the same time indicates that the economic benefits of the railways were fairly localized.

Columns (4) through (6) repeat the same exercise for a different dependent variable, the natural log of the number of *rai* planted with rice in each district. The results from this analysis are remarkably similar the results for population, with direct access to railways being associated with around 37-39 percent more *rai* planted in paddy. The results in column (6) also allude the fact that the amount of land devoted to paddy cultivation drops by about 28 percent more than 20 kilometers from the northern rail line compared to districts within 20 kilometers. The drop in paddy cultivation area is more pronounced for the northeastern line, with an average decrease of 23 percent for districts 10 to 20 kilometers from the rail line, and a decrease of 33 percent for districts located more than 20 kilometers from the rail line. The results are consistent with Kakizaki's (2005) observation that the opening of the railways resulted in increased rice cultivation and trade along the newly established railways.[3]

As mentioned above, we are concerned that the routes may have been systematically chosen based on unobservables. To alleviate this concern we run a series of placebo tests (using the specifications in columns (2) and (5) from table 2) to see if we can replicate the results with controlling for the distance to planned but never built lines. The results of the placebo tests are in reported in table 3.

[Table 3. Placebo Tests, 1947]

For the population regressions, the coefficients on the distance to the planned but never built British and French lines from the nineteenth century, and the government planned Paklai and Chiang Saen routes from 1941 are statistically zero. For the rice regressions, the coefficients

[3] The analysis above includes all districts in the north and northeast. Although the routes of the rail lines were largely determined to meet political aims, the rail lines still pass through major regional population centers (i.e. the *amphoe muang* districts). Since we are concerned that the *amphoe muang* districts may drive the results, we exclude these districts from the analysis to see if the results still hold. Appendix tables 1 and 2 report results for 1947 and 1966, respectively, with the exclusion of the provincial centers. Regardless of whether the *amphoe muang* districts are included or excluded, we find similar results where districts off the rail lines have smaller populations and less rice cultivation.

for the French, British, and Chiang Saen lines are all zero. The coefficient for the planned Paklai line is statistically significant, but *positive*. The positive coefficient may be the result of the Paklai route sitting directly between the northern and northeastern lines. If we believe the results above, the northern and northeastern railways attracted more rice cultivation, which would mean that districts further away from the proposed Paklai line would have higher levels of rice cultivation. Overall, the placebo tests support our claim that the positive economic benefits accrued to districts located on the rail line is due to the presence of the railway and not some other unobservables.

[Table 4. Population, Rice Cultivation, and Access to Railways, 1966]

[Table 5. Placebo Tests, 1966]

The 1947 results support the supposition that the railways brought economic opportunity to the north and northeastern areas, resulting in population growth and increased rice cultivation in districts with direct access to Thailand's "political railways." Is this positive association between the railways and economic outcomes persistent? We next look at outcomes for 1966. We specifically chose 1966 as a benchmark year because it is during a period of alternative transportation development (namely roads and highways), but before the government made systematic efforts to promote regional economic development and structural transformation of the economy in the 1970s and 1980s. We run the same main regressions and placebo tests with 1966 district population and harvested area of rice as the dependent variables.[4] The results are reported in tables 4 and 5.

The results for population reported in table 4 show similar results to what was found in 1947. Columns (1) and (2) suggest that districts without direct access to the northern line had smaller populations by 38 to 44 percent, while districts without direct access to the northeastern line saw smaller populations by 27 to 30 percent. The results in column (3) indicate that the districts within 20 kilometers of the rail lines are more populous than districts beyond 20 kilometers. The results for rice harvest, however, are different. In 1966, there is little impact of the railways on the area harvested. The coefficients on the no rail dummies remain negative, but are not statistically significant. The only specification that suggests the railways still matter is reported

[4] The 1966 Provincial Statistical Yearbooks only report area of harvested paddy and not planted paddy.

in column (6), where districts more than 20 kilometers from the northern and northeastern lines have on average 33 and 29 percent less harvested *rai* rice than districts within 10 kilometers of the railways. The attenuation of the coefficients from 1947 is suggestive that rice cultivation may have been more responsive to additional transportation options, particularly highway development in the northeast. Finally, the placebo tests reported in table 5 show that the coefficients on the distance to planned but unbuilt rail lines remain statistically insignificant in all cases except for the planned rail line to France in column (1). This, however, may be due in part to the construction of the "Friendship Highway" that runs along a similar path to the French railway proposed in the nineteenth century. A part of larger plans to for regional economic development in the Northeast in the late-1950s and 1960s, the Saraburi-Khorat section of Thailand's first modern highway was completed in 1958, and the extension to Nong Khai was completed in 1965 (Kakizaki 2012).

Conclusions

Siam built its early "political railways" to the northeast, north, and south as a means to achieve centralization and defend itself against progressive territorial encroachment by the French and the British colonial administrations. Although the railways were built for political purposes, this paper shows that investments in the railways resulted in greater economic activity (proxied by population) and rice cultivation in 1947 for districts located on the railway lines. The results suggest that positive economic benefits of the railways were relatively localized, likely because of a lack of complementary transportation infrastructure such as roads. The results for 1966 show that the earlier positive impacts of the railways on population are persistent even with the introduction of the highway network. This same persistence is not seen with harvested rice area, likely because roads and highways represent new transportation options for trade.

The results of this study are consistent with previous work on the impact of large rail infrastructure projects on economic outcomes and trade in various country and temporal contexts (e.g. Atack and Margo 2011; Banerjee, Duflo and Qian 2012; Donaldson and Hornbeck 2016; Berger and Enflo 2017; Donaldson 2018). The study also provides complementary micro analysis to previous work by Paik and Vechbanyongratana (2019) that concluded that the colonial threat in the nineteenth century led to long-run uneven economic development across Thailand. Moving forward we plan to add additional data across different

time periods in order to generate an even a clearer picture of the persistent impact of colonial threats and the government's responses on uneven economic development across Thailand.

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Tables

Table 1. Summary Statistics for 1947 and 1966

Panel A. Summary Statistics, 1947

Variable	Sources	Mean	Std. Dev.
District Population 1947 ('000)	1947 Census	49.58	28.17
Planted Area of Rice 1966 (Rai)	1947 Census	114,848	86,286
No Northern Rail Access	Whyte (2010); Ministry of Transport	0.87	0.34
No Northeastern Rail Access	Whyte (2010); Ministry of Transport	0.90	0.31
Dist to NE 1941 (Km)	Ministry of Transport	136.45	142.10
Dist to N 1941 (Km)	Ministry of Transport	130.85	143.40
Dist to Railway Planned by British	Kakizaki (2012); Ministry of Transport	256.45	183.75
Dist to Railway Planned by French	Kakizaki (2012); Ministry of Transport	240.27	149.88
Dist to Proposed Paklai Line (Km)	Kakizaki (2012); Ministry of Transport	157.90	97.27
Dist to Proposed Chiang Saen Line (Km)	Kakizaki (2012); Ministry of Transport	261.53	161.40
Longitude	Ministry of Transport	101.39	1.84
Latitude	Ministry of Transport	16.51	1.57
Area (Km2)	Ministry of Transport	1,582	1,286
Agricultural Suitability	Ramankutty et al. (2002)	0.35	0.14
Elevation Mean	Ministry of Transport	250.27	223.05
Elevation STD	Ministry of Transport	102.01	108.40
Distance to River (Km)	Ministry of Transport	3.58	9.04
Distance to Bangkok (Km)	Ministry of Transport	350.68	167.24
Observations	221		

Panel B. Summary Statistics, 1966

Variable	Sources	Mean	Std. Dev.
District Population 1966 ('000)	1966 Provincial Statistical Year Books	60.78	37.38
Harvested Area of Rice 1966 (Rai)	1966 Provincial Statistical Year Books	102,012	108,405
No Northern Rail Access	Whyte (2010); Ministry of Transport	0.90	0.30
No Northeastern Rail Access	Whyte (2010); Ministry of Transport	0.90	0.30
Dist to NE 1941 (Km)	Ministry of Transport	137.47	143.98
Dist to N 1941 (Km)	Ministry of Transport	143.65	146.24
Dist to Railway Planned by British	Kakizaki (2012); Ministry of Transport	268.12	189.00
Dist to Railway Planned by French	Kakizaki (2012); Ministry of Transport	239.86	149.11
Dist to Proposed Paklai Line (Km)	Kakizaki (2012); Ministry of Transport	166.04	99.63
Dist to Proposed Chiang Saen Line (Km)	Kakizaki (2012); Ministry of Transport	271.87	163.31
Longitude	Ministry of Transport	101.47	1.88
Latitude	Ministry of Transport	16.49	1.56
Area (Km2)	Ministry of Transport	1,145	893
Agricultural Suitability	Ramankutty et al. (2002)	0.34	0.14
Elevation Mean	Ministry of Transport	252.62	217.40
Elevation STD	Ministry of Transport	98.52	105.05
Distance to River (Km)	Ministry of Transport	5.38	11.07
Distance to Bangkok (Km)	Ministry of Transport	357.91	165.93
Observations	310		

Table 2. Population, Rice Cultivation, and Access to Railways, 1947

	(1)	(2)	(3)	(4)	(5)	(6)
	Natural Log District Population 1947			Natural Log Paddy Planted (Rai)		
No Northern Rail Access	-0.407***	-0.405***		-0.374***	-0.404***	
	(0.100)	(0.103)		(0.131)	(0.137)	
Dist to N 1941 (Km)		-0.000			0.002	
		(0.002)			(0.003)	
No Northeastern Rail Access	-0.402***	-0.387***		-0.393***	-0.375***	
	(0.104)	(0.106)		(0.139)	(0.138)	
Dist to NE 1941 (Km)		-0.001			-0.002	
		(0.002)			(0.002)	
District 10-20km from Northern Railway			-0.096			-0.065
			(0.129)			(0.169)
District More than 20km from Northern Railway			-0.337**			-0.283*
			(0.143)			(0.163)
District 10-20km from Northeastern Railway			-0.308***			-0.233*
			(0.118)			(0.138)
District More than 20km from Northeastern Railway			-0.342**			-0.325**
			(0.138)			(0.159)
Constant	-3.681	3.369	-5.596	35.487	54.720*	33.628
	(16.314)	(20.943)	(16.793)	(24.406)	(29.921)	(24.033)
Provincial Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-Square	0.541	0.537	0.501	0.697	0.697	0.680
Obs.	221	221	221	221	221	221

Notes: *** p<0.01 ** p<0.05 * p<0.1; Robust standard errors in parentheses.

Table 3. Placebo Tests, 1947

	(1)	(2)	(3)	(4)
	Natural Log District Population 1947 ('000)		Natural Log Paddy Planted (Rai)	
No Northern Rail Access	-0.412***	-0.414***	-0.410***	-0.420***
	(0.105)	(0.104)	(0.141)	(0.138)
Dist to N 1941 (Km)	0.001	-0.001	0.004	-0.001
	(0.002)	(0.002)	(0.003)	(0.004)
No Northeastern Rail Access	-0.393***	-0.366***	-0.377***	-0.309**
	(0.107)	(0.111)	(0.138)	(0.140)
Dist to NE 1941 (Km)	-0.000	-0.002	-0.002	-0.005**
	(0.002)	(0.002)	(0.003)	(0.003)
Dist to Railway Planned by Britain (Km)	-0.003		-0.006*	
	(0.002)		(0.003)	
Dist to Railway Planned by France (Km)	-0.003		0.000	
	(0.002)		(0.002)	
Dist to Paklai Line (Km)		0.003		0.008**
		(0.003)		(0.004)
Dist to Proposed Chiang Saen Line (Km)		-0.002		-0.004
		(0.002)		(0.003)
Constant	8.483	-7.124	28.979	23.390
	(21.038)	(22.312)	(30.374)	(32.597)
Provincial Fixed Effects	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes
Adj. R-Square	0.544	0.535	0.699	0.702
Obs.	221	221	221	221

Notes: *** p<0.01 ** p<0.05 * p<0.1; Robust standard errors in parentheses.

Table 4. Population, Rice Cultivation, and Access to Railways, 1966

	(1)	(2)	(3)	(4)	(5)	(6)
	Natural Log District Population 1966 ('000)			Natural Log Paddy Harvested (Rai)		
No Northern Rail Access	-0.441***	-0.375***		-0.162	-0.103	
	(0.109)	(0.111)		(0.198)	(0.202)	
Dist to N 1941 (Km)		-0.004***			-0.004	
		(0.002)			(0.003)	
No Northeastern Rail Access	-0.296**	-0.269**		-0.088	-0.047	
	(0.116)	(0.117)		(0.119)	(0.126)	
Dist to NE 1941 (Km)		-0.001			-0.003	
		(0.002)			(0.003)	
District 10-20km from Northern Railway			-0.164			-0.239
			(0.139)			(0.199)
District More than 20km from Northern Railway			-0.418***			-0.333*
			(0.115)			(0.201)
District 10-20km from Northeastern Railway			-0.168			-0.081
			(0.104)			(0.117)
District More than 20km from Northeastern Railway			-0.334***			-0.285**
			(0.122)			(0.137)
Constant	-27.948**	-30.441*	-26.866**	17.069	22.949	17.971
	(13.195)	(16.128)	(12.974)	(26.650)	(26.491)	(26.227)
Provincial Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	No	Yes	Yes
Adj. R-Square	0.493	0.504	0.482	0.557	0.559	0.563
Obs.	310	310	310	308	308	308

Notes: *** p<0.01 ** p<0.05 * p<0.1; Robust standard errors in parentheses.

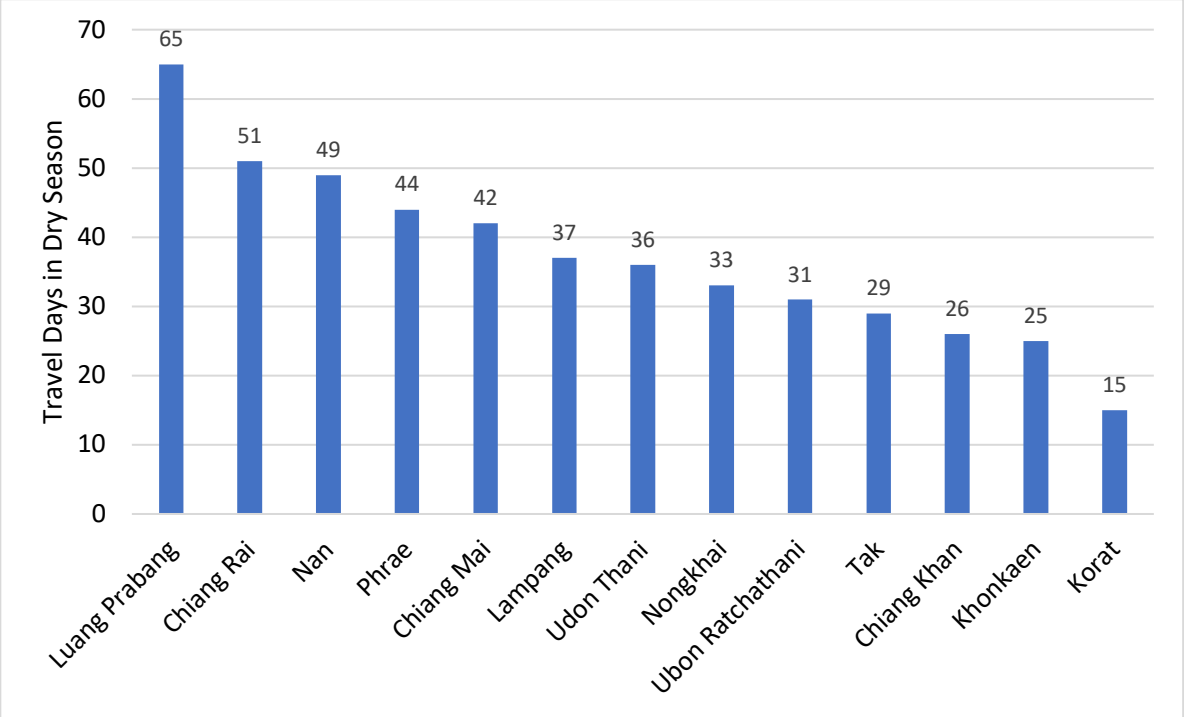
Table 5. Placebo Tests, 1966

	(1)	(2)	(3)	(4)
	Natural Log District Population 1966 ('000)		Natural Log Paddy Harvested (Rai)	
No Northern Rail Access	-0.387***	-0.368***	-0.118	-0.084
	(0.114)	(0.109)	(0.204)	(0.194)
Dist to N 1941 (Km)	-0.003*	-0.006***	-0.002	-0.008**
	(0.002)	(0.002)	(0.003)	(0.003)
No Northeastern Rail Access	-0.295**	-0.247**	-0.054	0.015
	(0.117)	(0.118)	(0.127)	(0.126)
Dist to NE 1941 (Km)	0.000	-0.003	-0.002	-0.007**
	(0.002)	(0.002)	(0.003)	(0.003)
Dist to Railway Planned by Britain (Km)	0.000		-0.005	
	(0.002)		(0.003)	
Dist to Railway Planned by France (Km)	-0.003**		-0.001	
	(0.002)		(0.003)	
Dist to Paklai Line (Km)		0.004*		0.012***
		(0.002)		(0.004)
Dist to Proposed Chiang Saen Line (Km)		-0.001		-0.004
		(0.002)		(0.003)
Constant	-11.102	-43.672**	9.128	-15.383
	(18.956)	(17.688)	(29.916)	(27.390)
Provincial Fixed Effects	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes
Adj. R-Square	0.510	0.505	0.560	0.572
Obs.	310	310	308	308

Notes: *** p<0.01 ** p<0.05 * p<0.1; Robust standard errors in parentheses.

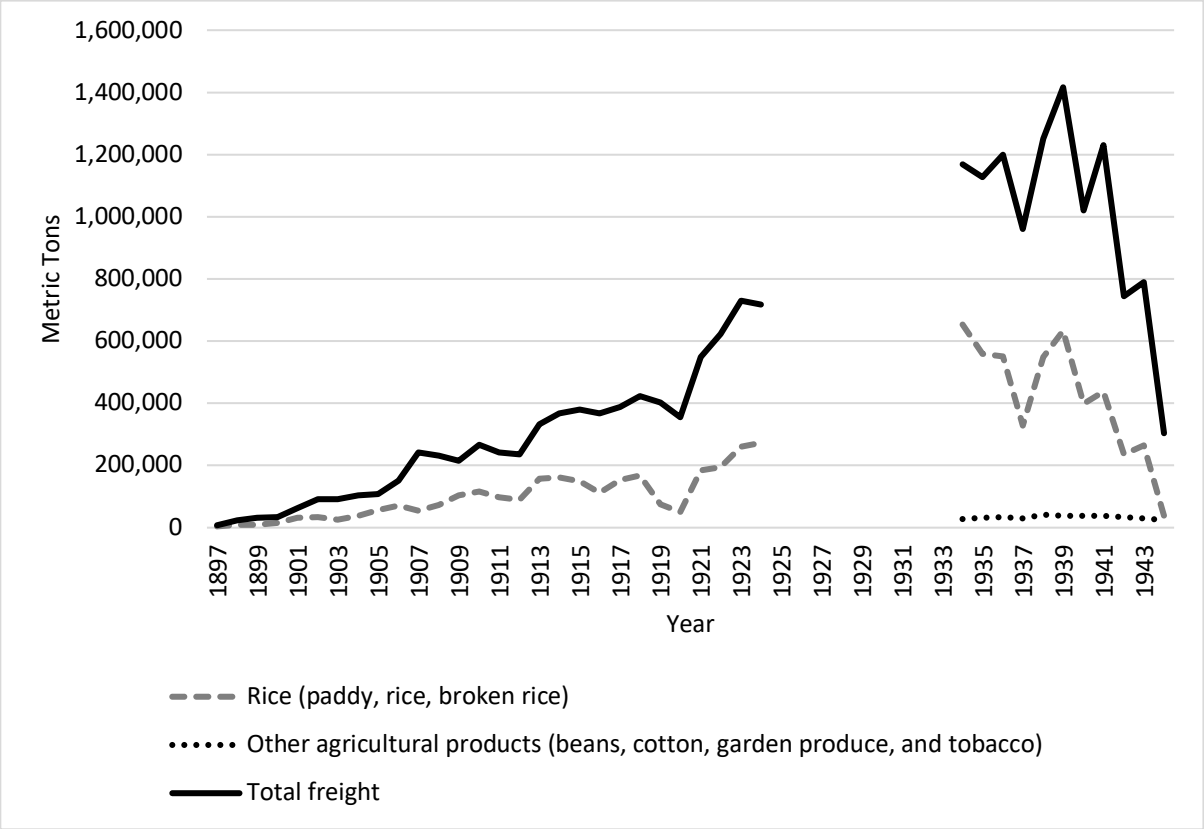
Figures

Figure 1. Time-distances from Bangkok in Dry Season for Various *Mueang* in North and Northeastern Siam, 1890



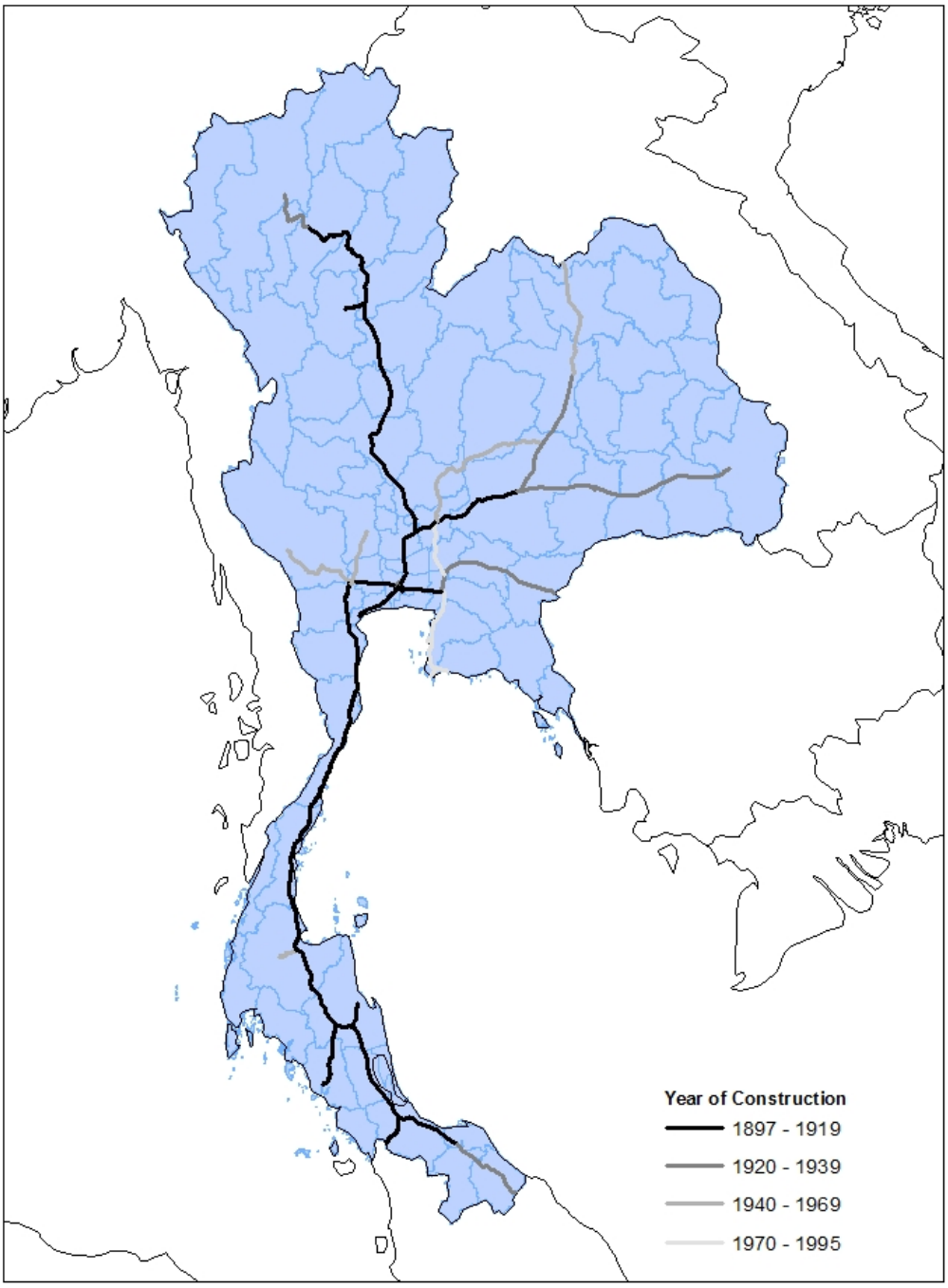
Source: Kakizaki 2005, 156-7.

Figure 2. Rail Tonnage North and Northeastern Lines (Metric Tons), 1897-1944



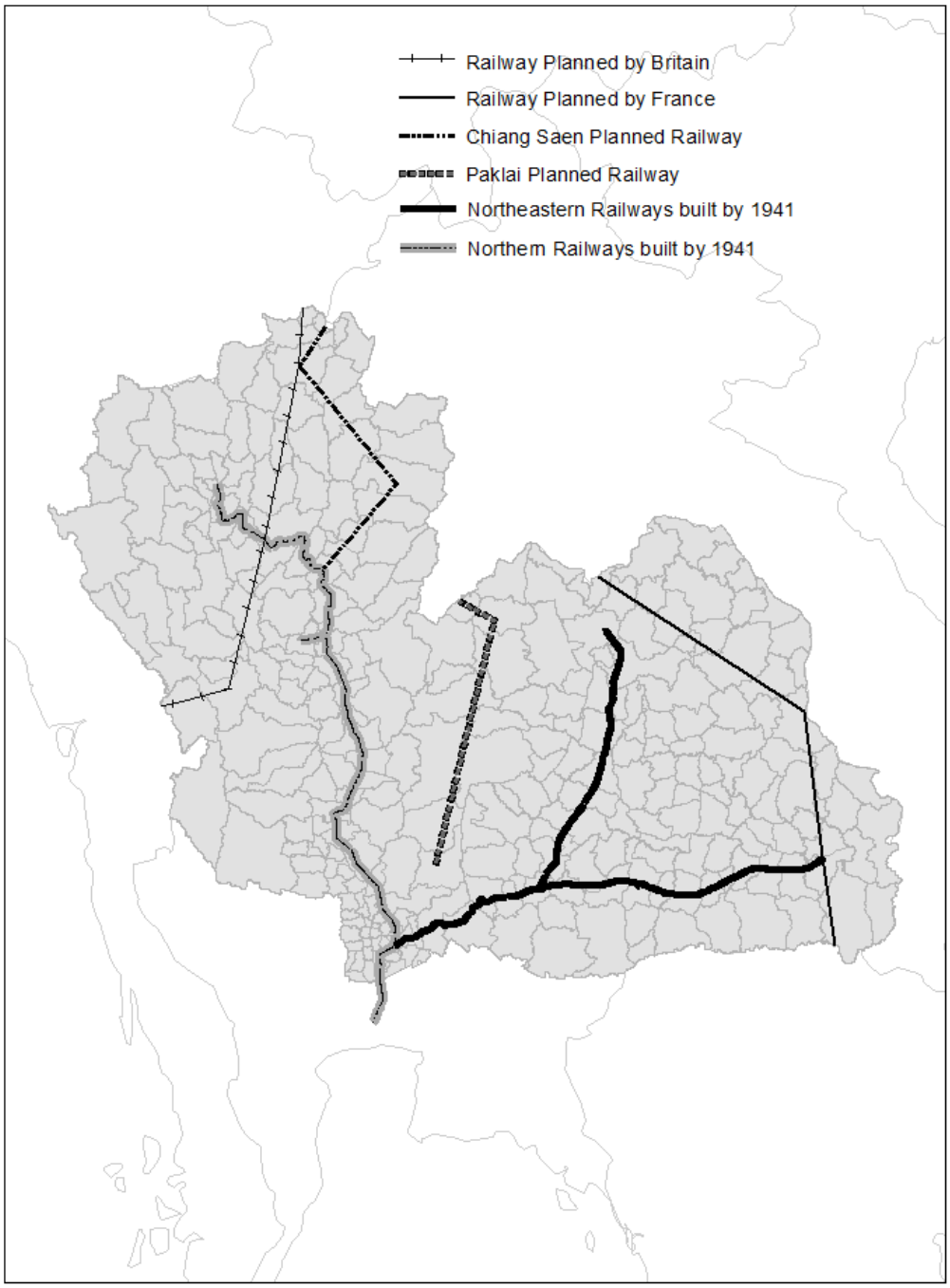
Sources: Statistical Year Book of the Kingdom of Siam (1924-25); Statistical Year Book-Siam (1935-1937); Statistical Year Book Thailand (1937-1939); Statistical Year Book Thailand (1939-1944).

Figure 3. Railway Network Expansion, 1897-1995



Source: Whyte 2010.

Figure 4. Planned and Completed Railways Lines, 1897-1941



Source: Kakizaki (2012)

Appendix

Appendix Table 1. Population, Rice Cultivation, and Access to Railways, 1947 (No *Amphoe Mueang* Districts)

	(1)	(2)	(3)	(4)	(5)	(6)
	Natural Log District Population 1947 ('000)			Natural Log Paddy Planted (Rai)		
No Northern Rail Access	-0.322***	-0.323***		-0.226	-0.234	
	(0.100)	(0.103)		(0.138)	(0.142)	
Dist to N 1941 (Km)		-0.000			0.001	
		(0.002)			(0.003)	
No Northeastern Rail Access	-0.318***	-0.302***		-0.434***	-0.421***	
	(0.113)	(0.114)		(0.140)	(0.142)	
Dist to NE 1941 (Km)		-0.001			-0.001	
		(0.002)			(0.003)	
District 10-20km from Northern Railway			-0.106			-0.098
			(0.146)			(0.181)
District More than 20km from Northern Railway			-0.256*			-0.257
			(0.144)			(0.175)
District 10-20km from Northeastern Railway			-0.288**			-0.325**
			(0.121)			(0.128)
District More than 20km from Northeastern Railway			-0.209			-0.310*
			(0.146)			(0.170)
Constant	-2.269	5.365	-3.624	31.393	39.854	27.915
	(16.568)	(21.491)	(16.552)	(25.493)	(31.714)	(25.054)
Provincial Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-Square	0.504	0.498	0.474	0.709	0.705	0.699
Obs.	179	179	179	179	179	179

Notes: *** p<0.01 ** p<0.05 * p<0.1; Robust standard errors in parentheses.

Appendix Table 2. Population, Rice Cultivation, and Access to Railways, 1966 (No *Amphoe Mueang* Districts)

	(1)	(2)	(3)	(4)	(5)	(6)
	Natural Log District Population 1966 ('000)			Natural Log Paddy Harvested (Rai)		
No Northern Rail Access	-0.268***	-0.206**		-0.165	-0.109	
	(0.097)	(0.101)		(0.219)	(0.224)	
Dist to N 1941 (Km)		-0.004***			-0.004	
		(0.002)			(0.003)	
No Northeastern Rail Access	-0.146	-0.127		0.019	0.056	
	(0.106)	(0.107)		(0.132)	(0.143)	
Dist to NE 1941 (Km)		-0.001			-0.002	
		(0.002)			(0.003)	
District 10-20km from Northern Railway			-0.208			-0.373*
			(0.129)			(0.203)
District More than 20km from Northern Railway			-0.322***			-0.327
			(0.110)			(0.209)
District 10-20km from Northeastern Railway			-0.060			0.047
			(0.093)			(0.127)
District More than 20km from Northeastern Railway			-0.227*			-0.214
			(0.118)			(0.145)
Constant	-24.614*	-32.045**	-24.466*	17.439	18.977	18.747
	(12.990)	(15.653)	(12.718)	(27.716)	(27.939)	(27.119)
Provincial Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	No	Yes	Yes
Adj. R-Square	0.476	0.491	0.486	0.540	0.542	0.550
Obs.	268	268	268	266	266	266

Notes: *** p<0.01 ** p<0.05 * p<0.1; Robust standard errors in parentheses.