

State Adoption of Transformative Technology: Early Railroad Adoption in China and Japan

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Steam locomotives, a transformative transportation technology, experienced quick and wide adoption among major Western powers in the nineteenth century. However, when this technology reached East Asia later in the century, Japan enthusiastically adopted it while China did not. Why was this the case? This article investigates the difference in railroad technology adoption between late Qing China and Meiji-era Japan. Through analysis of historical accounts as well as original source documents, we argue that variations in concern for internal and external security were important determinants of the distinct adoption decisions. The Qing Court's apprehension that technological change would lead to domestic social unrest and make China vulnerable to external threats deterred it from adopting railroads. In Japan, the Meiji leadership faced a less-pronounced internal and external threat environment. This allowed them to focus on the railroads' potential to drive economic growth, consolidate administrative rule, and mobilize military resources. Our results suggest that perceptions regarding a technology's expected effects may contribute more to technology adoption decisions than is suggested by the prevailing literature.

Introduction

National and local governments increasingly face adoption decisions for potentially transformative technologies such as autonomous vehicles, smart electricity grids, commercial drones, and the myriad technologies comprising the Internet of things. Each of these technologies has the potential to enhance the welfare of the societies into which they would enter. For example, driverless vehicles may reduce traffic fatalities, congestion, and the consumption of fossil fuels. Autonomous vehicles would also allow for the sharing of vehicles and thus decrease the proportion of time that a vehicle sits idle. Fewer idle vehicles should decrease the demand for parking, freeing up valuable real estate for more productive ends. We can construct similar stories of welfare and efficiency gains for each of the technologies mentioned above. Given the substantial expected material payoffs from the decision to adopt these technologies, one might predict that, upon reaching a threshold of feasibility, states and societies should quickly and widely adopt them. But are such expectations of technology adoption accurate? Do states and societies actually adopt transformative technologies "quickly and widely"?

This article addresses the topic of state adoption of transformative technologies by examining the difference in early adoption of railroad technology between two contemporaneous leaders in East Asia: late Qing China and Meiji-era Japan. During the nineteenth century, major Western powers widely adopted railroad technology. As

this technology reached East Asia in the 1850s, however, Japan enthusiastically and effectively adopted it, while China resisted foreign attempts to build rail lines and failed to support an indigenous domestic railroad industry. The history of railroad adoption in East Asia reveals that states vary drastically in terms of adoption approach upon being exposed to a novel transformative technology from a foreign source. What explains this variation? When are states likely to adopt a foreign technology, and when do they forgo or delay adoption?

We argue that two factors explain, at least in these cases, much of this variation in adoption. First, the relative concern from leaders about technology-induced domestic instability influences adoption decisions. The Qing leadership feared that technological change in general, and railroad construction in particular, would lead to social unrest or even overt rebellion. In Japan, concerns about technology-induced unemployment and internal revolt were less pronounced. When the Meiji government faced incipient popular movements, it acted quickly to address the grievances or strengthen policing.

Second, the way in which leaders perceive the influence of such technologies on their external security also influences adoption decisions. Officials in the Qing Court believed that the introduction of railroads would facilitate foreign invasion. This concern, which was less pronounced for Meiji Japan, pushed the Qing leadership to oppose railroad adoption. Specifically, the Qing Court worried that rail technology would reduce the security provided by China's natural terrain. Potential external security threats, combined with strong antiforeign sentiment, ensured that adoption was delayed in China.

This article also briefly addresses the claim that Confucian values played a significant role in shaping Chinese and Japanese attitudes toward Western influences and, thus, railroads. Some argue that the premium the Meiji government placed on the Confucian values of education, rationality, and family facilitated Japan's industrialization (Morishima 1984; Zhang 1998). In our judgment, this alternative explanation fails to account for the

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difference in railroad adoption in late-Qing China and Meiji Japan. We do not observe any significant difference in the extent to which Confucian values penetrated the societies—that is, the cases are roughly equivalent with respect to the appreciation and immersion of Confucianism.

Studying Chinese and Japanese railroad adoption matters for two main reasons. First, there is a lack of comparative analysis of these two important cases of state-level technology adoption decisions. While there are a handful of accounts dealing exclusively with Chinese or Japanese railroad adoption, we know of no English-language study that places these cases beside one another.¹ Thus, we synthesize these accounts in a single comparative frame.

Second, the cases in question offer an opportunity to evaluate prevailing theories of state-level technology adoption. Our investigation shows that theories of technology adoption that treat the technology and the adopting unit generically—without sensitivity to the anticipated impact of the technology or the internal characteristics of the adopting unit—fail to describe the difference in early railroad adoption experiences in China and Japan. As we discuss in greater detail later on, such theories tend to view adoption as a function of information flow or social pressure. Because China and Japan were exposed to railroad technology at approximately the same time, contagion and imitation theories of adoption suggest that the cases should see similar adoption outcomes. Instead, our research supports theories of adoption that emphasize perceptions regarding a technology's anticipated social and political impact.

The article proceeds as follows. Section two locates the empirical cases within the literature on technology adoption. Section three describes our study's methodology. Section four defines the study's dependent variable: the railroad adoption gap between Qing China and Meiji Japan. In section five, we elaborate our argument. Section six discusses the limits of cultural explanations, namely, the role of Confucian values, in influencing railroad adoption practices in the two cases. Section seven concludes.

The State and Technology Adoption

Theories of state-level technology adoption vary according to the specificity with which they handle the relevant technology and the adopting unit (Wejnert 2002, 297–98; Goldman and Eliason 2003, 11–18). Some scholars treat both the technology and adopting units as generic. In this approach, technologies are “goods” in the economic sense of being utility-providing to all would-be adopters, and the adopting units are internally undifferentiated. These assumptions lead to parsimonious models of technology diffusion that explain variation in adoption as a function of time, the flow of information about a technology, or the social pressure to adopt it. For example, the so-called epidemic or contagion theories of adoption (Mansfield 1961, 744–50; Angst, Agarwal, Sambamurthy, and Kelley 2010) explain variation in adoption as a function of differences in actors' awareness about a given technology. In such models, the flow of information across time and space determines adoption decisions; as awareness about a technology diffuses, adoption follows in turn. Similarly, Bass's (1969, 215–17) influential model of diffusion assumes generic technologies and adopting units. Bass (1969) posits that, with the exception of a few initial innovators, the

adoption decision will depend on the proportion of actors that have adopted a technology at a given time. Within such models, adoption is, at its essence, an act of imitation as actors are driven to adopt by “the pressures of the social system” (Bass 1969, 216). Traditional structural realist accounts of technology diffusion also conceptualize the adopter and adopted as generic. Waltz (1979, 127), for instance, predicts that as self-reliant states seek to maximize their security, they emulate one another in terms of military technology adoption, and this tendency causes “weapons of the major contenders ... to look much the same all over the world”. Treating the technology and the adopting units generically leads to the prediction that technologies will be quickly and widely adopted across societies.

A second group of scholars assumes homogeneous technologies but heterogeneous adopting units. Literature from this perspective often characterizes the technology in question as neutral or benign. Such accounts treat a technology's adoption as a desirable end and explain variations across states and societies as a function of their relative capability to realize this end. Illustrative of such models are studies finding that national variation in material, institutional, or policy conditions correlate with the adoption of Internet technologies (Hargittai 1999; Kiiski and Pohjola 2002).

Horowitz's (2010) adoption capacity theory exemplifies this second approach to technology adoption. In his discussion on the diffusion of military innovations across states, Horowitz (2010) explains international variation in diffusion as a function of two factors: the financial intensity of the adoption decision and the organizational capital required for adopting a given technology. Financial intensity is defined as the financial cost associated with a military technology's adoption relative to a state's means. Organizational capital refers to the reservoir of “intangible change assets” possessed by a state or military (Horowitz 2010, 10). Technologies differ with respect to the financial intensity and organizational capital requirements associated with adoption. All else constant, the probability that a state will adopt a given technology will vary inversely with the magnitude of either of these requirements. By recognizing that the anticipated disruptive consequences of an innovation influence adoption, Horowitz (2010) improves on adoption theories that treat technologies as universally desirable.

Our investigation of the historical record reveals that variation of the material and institutional character of the receiving state fails to accurately characterize the difference between Chinese and Japanese railroad adoption decisions. In addition, the technology was not “neutral” to these adopting states. As a foreign import, railroads carried different meaning for the Meiji and Qing leaderships. In particular, the Qing Court interpreted the technology as carrying significant domestic stability and external security ramifications. These anticipated consequences affected its adoption decision. This is not to say that China saw only the technology's disruptive potential. Both leaderships were aware of the economic boom that railways brought to the West. In Japan, the Meiji government justified the early adoption of railroad technology by appealing to the technology's economic modernization effects. Qing officials similarly understood the economic benefits that speedier transportation would bring China. By the time of emperor Guangxu's reign (1875–1908), many important court officials recognized the economic benefits of railroads (Wang 1986). Furthermore, during the process leading up to, and in the immediate aftermath of, the 1868 treaty review with foreign powers, the potential economic, security, and social benefits of railways had been discussed within the Qing Court.

¹The only study we were able to uncover that directly compares Chinese and Japanese early railroad adoption is a Chinese-language source: Cai (2007). For single-country accounts, see Leung (1980), Huenemann (1984), Ericson (1996), and Free (2008).

However, the Qing Court did not evaluate the impact of railroads solely in terms of economic growth. The Chinese leadership anticipated that the introduction of railroads would also have significant negative consequences.

A handful of others have suggested that expectations about a technology's effects can influence state-level technology adoption decisions. Bussell (2011), for one, uses a time-series–cross-section regression approach to find that the adoption of e-government correlates with various indices of corruption. She interprets this finding as reflecting heterogeneity in the expected outcomes of implementing e-government between corrupt politicians and their less corrupt counterparts. In particular, Bussell (2011) contends that corrupt politicians forgo adoption because of their expectation that e-government diminishes opportunities to rent-seek. Similarly, Milner (2006) finds that the Internet diffuses readily to democracies and slowly to autocracies. Milner (2006, 178) attributes this correlation to the Internet's potential to destabilize nondemocratic regimes by “provid[ing] civil society with uncensored information, costless sharing of that information, and tools to overcome collective-action problems for organizing opposition.” Finally, Corrales and Westhoff (2006) also find Internet adoption relates positively to measures of democracy and political liberties. However, they find this effect to be less pronounced within high-income, market-based autocracies. According to the authors, the political leadership's ambivalence regarding the impact of the Internet explains this moderated effect: on one hand, leaders “fear the political consequences” of adoption, while on the other, they “welcome its economic payoffs” (Corrales and Westhoff 2006, 911). Our findings support interpretations of these correlational studies that underscore leaderships' anticipation of the negative consequences of adoption. Indeed, by analyzing the correspondence between high-level officials of the Qing Court, we provide direct evidence about *how* perceptions influence technology adoption decisions.

Some claim that perceptions of foreign technologies depend on cultural or civilizational factors. For instance, Cai (2007) posits that the railroad adoption gap between China and Japan reflects the countries' different attitudes regarding foreign cultures and civilizations. According to Cai (2007), Japan long had a positive attitude toward absorbing aspects of a foreign civilization, whereas China remained conservative and closed off (Cai 2007, 136). Cai (2007) attributes the countries' diverging attitudes to the international positions that they have historically occupied. Historically the center of the East Asian tributary system, China long served as a civilization and culture exporter. This dominant position, according to Cai (2007), led to China's entrenched concern for maintaining its civilizational integrity, making it less receptive to foreign ideas and technologies. Japan, on the other hand, has historically been on the periphery of the East Asian international system and has long maintained semiconnected relations to the dominant Chinese culture. In this position, Japan has traditionally been an importer of foreign culture and has assimilated foreign ideas more readily. From Cai's view,

[f]or “number-one” China, a complete absorption of Western civilization is to “yi yi bian xia” (using foreign ideas to change Chinese culture), which not only marked the abandonment of established customs of the ancestors, but it also implies a stripping of the pride of the “heavenly kingdom.” For Japan however, this [absorption of Western civilization] is

just a choice, and the only difference is that the object from which it learns changes from China to Western countries. (Cai 2007, 136)

Civilizational differences, in Cai's (2007) eyes, explain the different degrees of willingness to embrace foreign ideas and technologies. Civilizational and cultural beliefs, nevertheless, are resistant to change, and when change does occur, it proceeds slowly.² It is thus important to understand under these civilizational contexts how China and Japan made their adoption decisions and why, at least for China, such decisions changed toward the end of the nineteenth century. Our analysis nevertheless confirms that issues of perception—especially perception of foreigners—contributed to China's initial rejection of the technology.

While his focus is on railroad industrial policy rather than the adoption decision, Dobbin (1994) offers an explanation for state action in railway development that is rooted in national political cultures. According to Dobbin (1994), explanations of industrial policy based on national institutions fail to identify the antecedent cause: the underlying national political tradition, or *modus operandi*. Political cultures drive national institutional configurations, and the persistence of political cultures explains institutional stability. For example, the American political tradition of local rule led to a decentralized policy approach in which local governments subsidized initial railroad expansion and determined routes, but left operational decisions to firms. Political culture in France, in contrast, “demanded a strong center,” and as a consequence, the state not only provided funding and determined the location of rail lines, but it also forced a monopolistic market structure (Dobbin 1994, 23). Our finding that technologies and their impact can be interpreted differently depending on the prevailing perceptions and attitudes within societies supports Dobbin's (1994) argument.

In this article, we contend that technology adoption depends on the particular character of both the technology in question and the adopting unit.³ Adoption decisions vary according to the manner in which the technology is perceived. Perception, in turn, may be influenced by the historical context under which the technology's adoption is considered as well as the technology's origin. Applying this logic to the cases in question reveals two possible causes for the variation in railroad adoption decisions. First, the Qing Court was concerned that railroads would incite internal instability and threaten the court. The “alien” nature of the Qing Court, which

²The end of the nineteenth century and the early twentieth century was a period of great transformation in Chinese society. The increased exposure to and interactions with the West, which prompted the Self-Strengthening Movement, brought to China new ideas and technologies from the West. Although historians have sought to understand this period of change (Fairbanks 1983; Cohen 2010), the nature and the impetus for this decades-long transformation is subject to some debate. It is less controversial, however, that the change in China happened rather slowly (especially when compared to that of other countries like Japan) and that significant resistance to Western influences persisted for decades during this transition.

³In underscoring the varied nature of the meaning of railroads to the respective leaderships, our argument shares common ground with constructivist approaches to understanding state interests. For example, Wendt (1995) also observes that the national origin of a technology may play a role in determining its perceived threat, noting, “500 British nuclear weapons are less threatening to the United States than 5 North Korean nuclear weapons, because the British are friends of the United States and the North Koreans are not, and amity or enmity is a function of shared understanding” (Wendt 1995, 75).

increased the precariousness of its rule, exacerbated this concern. In sharp contrast, the Meiji government saw the state-led project of railroad development as a means to consolidate its rule. Second, the Qing Court's reluctance to embrace railroads was also rooted in its concern over external threats and distrust of foreign countries. China and Japan had different experiences in opening to foreigners. Whereas both countries were challenged by Western powers, China's humiliating experience during the Opium Wars significantly colored Qing officials' view of foreigners.⁴ In other words, as a foreign technology, railroads *meant* different things to the Meiji government and the Qing Court.

Data and Methodology

We use two sources of evidence in investigating our hypotheses: existing historical accounts and primary source documents. With regard to the former, we draw evidence both in support of and against the proposed argument from accounts of Chinese and Japanese railroad development. While there are a handful of accounts dealing exclusively with Chinese or Japanese railroad adoption, much of the relevant scholarship comes from the broader field of the history of economic modernization.

We also draw heavily on primary source documents. The titles of these sources can be found in the appendix. In the case of the Chinese-language documents, we translate the relevant portions into English. In the case of Japanese-language sources, we rely on the translations of other scholars. The primary sources examined include memorials and correspondence from the personal collections of key figures, newspaper reports, other historical records such as the *Draft History of the Qing Dynasty (Qing shi gao)*, and files from the Zongli Yamen (Foreign Ministry). Many passages relevant to railroad development are chronicled and compiled in Mi Rucheng's three-volume *Zhongguo jin dai tie lu shi zi liao [Records on the History of Modern Chinese Railroads]* (1984). This source comprises a diverse set of official historical records pertaining to railroad-related matters during the late Qing period. More than two hundred entries in this compilation were examined and evaluated. During the evaluation of these records, we assessed the arguments offered in favor of against railroad adoption, attitudes toward railroads and foreigners, the relevant historical context, and each author's background and position. We selected opinions or passages referenced in the discussion below based on the following considerations: (1) if the individual in question was a high-ranking official within the Qing Court; (2) if the individual's opposition to railroads is of particular interest because the individual was a key figure in the Self-Strengthening Movement and thus the opposition is counterintuitive and yields more analytical insight; or (3) if the individual's opinion was specifically referenced in imperial orders from the emperor. While the quoted and paraphrased materials do not provide a comprehensive

⁴This is not to say that Japan did not face Western military aggression. In response to the 1862 killing of a Briton (and the injuring of two), the British bombarded Kagoshima in 1863. During the following year, a joint Western fleet bombarded the Chōshū shore batteries in response to attacks on Western merchant vessels in the Shimonoseki Strait. However, compared to the two Opium Wars, Western aggression in Japan was less severe and was directed not at the state but rather at a feudal domain (Chōshū) that opposed the shogunate's open door policy. The Western bombardments also occurred during the end of the Tokugawa period, which allowed the Meiji government to attribute conflict with Westerners to the previous regime and foster support for the adoption of Western technology.

catalogue of opinions regarding railroad development, they do characterize the dominant perspectives on railroads during the early stages of adoption.

In this article, we place greater analytical emphasis on the delayed adoption of railroads in China. There are two reasons for this. First, Japan's adoption decision presents less of a quandary than that of China. Japan was quick to adopt a technology that had demonstrated utility as a means of promoting industrialization, accelerating transportation, and even fostering a sense of national unity. Thus, the Japan case is not problematic to existing explanations of technology adoption, which suggest that states are likely to rapidly adopt such technologies. Thus, in comparing these two countries' experiences, the more intriguing question is this: why did China delay adoption? Second, for both of the variables that we propose as contributing to the difference in adoption decisions, the Japan case is largely characterized by the absence of "high" values. We argue that it is the *presence* of strongly perceived internal and external threats posed by railroad adoption that explains China's delayed adoption. In Japan, such perceptions are either absent or significantly less pronounced. Thus, in our treatment of the Japan case, we focus primarily on evaluating whether these factors were qualitatively distinct from China or of lesser concern than they were in China.

Railroad Adoption in China and Japan

This section demonstrates the early gap in railroad adoption between China and Japan through an examination of railroad construction data and adoption policies. We operationalize the construction gap using track construction data, measured in terms of miles of track completed for a given period. We supplement the construction data with some information on passenger volumes. This section demonstrates that during the period in question, railroad construction in China was low while that in Japan was high. Railroad construction in Japan also preceded that of China.

In addition, we provide evidence that the railway construction gap owes to differences in state support for the railroad industry. The Qing Court, during the period in question, did little to promote railroad industry growth and often actively opposed attempts to introduce railways. On the other hand, the robust role of the Meiji government, initially as a direct owner and operator of railroads and later as a provider of financing, guarantees, and technical expertise, led to rapid construction and utilization of railways in Japan.

The Construction Gap

China and Japan were exposed to Western railway technology at roughly the same time; by the end of the 1850s, both states were aware of the technology and its impact in the West. In March 1854, US Commodore Matthew Perry provided a demonstration of a one-quarter scale Norris locomotive to shogun representatives in Yokohama, Japan.⁵ In 1859, Kan Wang, one of the leaders of the Taiping Heavenly Kingdom, a rebel regime to the Qing Court, advocated the adoption of railroads because of their

⁵While Perry's demonstration is a vivid indication of the physical arrival of steam-powered railways to Japan, a year and a half earlier a Russian admiral demonstrated an alcohol-powered train to a handful of Japanese officials (Ericson 1996, 4). The shogunate knew of railways prior to Perry's demonstration through reports received from the Dutch trading post in Nagasaki.

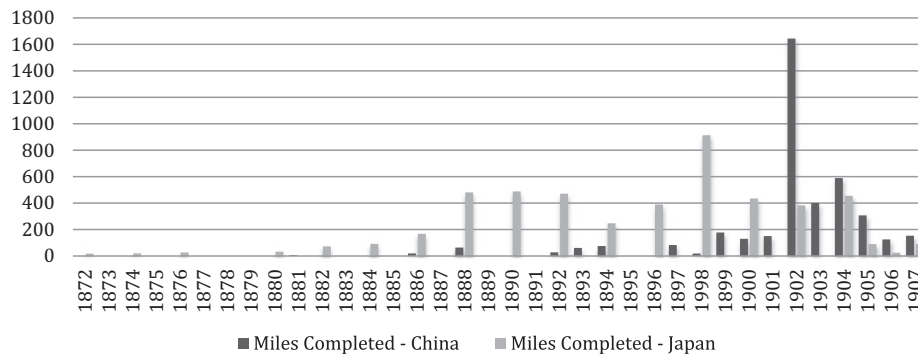


Figure 1. Japan vs. China, miles of track completed, annual (1872–1907)

Note. The data for China are aggregated by [Huenemann \(1984\)](#), and those for Japan come from [Ericson \(1996\)](#).

demonstrated capacity to accelerate transportation and improve communication ([Leung 1980](#)). However, while by 1872, Japan had already constructed its first steam-powered railroad segment, China did not complete a viable track until 1882. In the coming decades, this disparity grew.

Two observations powerfully demonstrate the railroad construction gap between China and Japan. First, by 1890, Japan had completed fourteen hundred miles of track compared to just ninety in China. Second, from 1878 to 1897, Japan added an average of eighty-four miles of track per year, while China added only nine per year. [Figure 1](#) depicts the number of miles completed in China and Japan from 1872 to 1907.⁶ Because China is far larger than Japan, the railroad construction gap is made starker by considering area-adjusted or railroad density figures. In 1897, railroad density in Japan was 17.18, while that of China was 0.07.⁷ A decade later, the gap remained significant; in 1907, railroad density in Japan was 33.57, while that of China was 1.04.

In Japan, adoption began earlier and proceeded more quickly. By 1872, the government of Japan had opened its first railroad segment, which linked Tokyo and Yokohama. By 1873 the line transported more than 1.2 million passengers and had made a profit ([Ericson 1996](#)). From 1878 to 1887, Japan added an average of thirty-seven miles of track per year. In the two following decades, the average number of miles constructed annually was 208 and 239, respectively.⁸ In contrast, during the 1890s, China only added approximately fifty-eight miles of track per year.

The Adoption Gap

As the subject of our study is the Chinese/Japanese gap in railroad *adoption* by the state, not merely the disparity in construction, it is critical to examine the actual adoption policies and practices of the two leaderships. While these concepts are related, construction data reflect a process of domestic technological diffusion while we use the term “adoption” to refer to the state actions to promote diffusion. The Qing Court policies and attitudes during this time ranged from *laissez-faire* to openly hostile toward railway industry development. In contrast, the Japanese state actively supported the industry’s growth. This section shows that: (1) the Meiji government participated directly

in the construction of railways and the ownership of railroad firms; (2) the Meiji government intervened to protect private railroad firms and ensure the industry’s viability; and (3) in contrast, the Qing leadership did little to support railroad construction.

MEIJI GOVERNMENT SUPPORT FOR THE RAILROAD INDUSTRY

The Japanese state perceived railroads as an industry critical to its larger development program. As a result, it either directly constructed track or purchased related technology, or indirectly provided support to the private sector.⁹ Besides direct market intervention, the Meiji government’s support for railroads is evidenced by the emperor’s attendance of the ceremony marking the opening of the Tokyo-Yokohama line in 1872 ([McClain 2002](#)). Regarding the importance of railroads in the overall Meiji development program, [Ericson](#) observes, “[f]or the Japanese of Meiji, as for their contemporaries in the West, the steam locomotive was the quintessential symbol of progress and civilization, the very epitome of modern industrial power” [Ericson \(1996, 3\)](#).

State involvement in early Japanese railroad development policy was characterized by two distinct stages: one of direct state construction and control (1869–1880) and one of indirect support for private Japanese industry (1880–1890) ([Ericson 1996, 97–122](#)). According to [Ericson \(1996\)](#), the state’s initial decision to construct and manage railways owes to both economic and political considerations. In terms of the economics of railroad construction, the Meiji government viewed the large capital outlay required for a commercially viable line as cost-prohibitive to private Japanese investors. In terms of politics, [Ericson \(1996\)](#) argues that the newly ascendant Meiji emperor sought to consolidate administrative control through energetic state action in railroad development.

Following this period of direct state control, in the 1880s, the Meiji government began to support railroad development by supporting local private investment ([Ericson 1996, 108](#)).¹⁰ Specifically, the government provided loans, guarantees, and technical expertise to support the industry’s development (108–22). It is during this

⁶Ericson’s data ends at 1907.

⁷Authors’ calculations based on data from [Ericson \(1996\)](#), [Huenemann \(1984\)](#), and the World Bank. Chinese data reflect total railway construction regardless of gauge or ownership (state or through concession). We define railroad density here as the ratio of miles of track to each 1,000 square miles of a country’s land area.

⁸Authors’ calculations based on data from [Ericson \(1996\)](#).

⁹Meiji support for early railroad development in Japan was not uniform. The opposition to railways in Japan, concentrated largely within the military leadership, viewed railroad construction as nonessential and preferred the use of state funds to purchase armaments ([Ericson 1996, 99](#)). However, in stark contrast to the Chinese opposition, the Japanese opponents of railways had little effect in postponing line construction or thwarting the overall Meiji policy of railway development.

¹⁰While the state continued to build railways during this period, private construction grew at a faster rate than public construction.

period that Japan began to rapidly increase the rate at which tracks were laid. From 1883 to 1893, the number of miles of track in Japan increased by more than tenfold.

Even following the shift from a policy of direct control to one of industry support, the Meiji government's involvement in railway development was robust. For instance, in 1897, when more than 75 percent of railways were under private sector control, total government subsidies for the industry reached its highest point (Ericson 1996). Further, following the 1890 financial crisis, the state provided the liquidity needed to prevent the four largest rail companies from going bankrupt. Additionally, the Bank of Japan expanded the assets it accepted as security to discount loans to include the shares of many private railroad companies (179–82). The Bank of Japan's new discount policy had the effect of increasing private railway firms' access to commercial lending (180).

LACK OF STATE INVOLVEMENT IN CHINA

During a period in which the Meiji government was advancing a concerted, popular, and well-funded policy of railway development, the Qing leadership was alternately obstructionist or passive with regard to railroad development. Despite the urgings of the Self-Strengtheners, during the second half of the nineteenth century, the prevailing position within the Qing Court was one of opposition to modernization. Rozman attributes China's slow modernization in the later decades of the nineteenth century to a lack of state volition: "Had the court in the late 1860s committed itself to promoting modernization, a different pattern of economic development might of course have resulted" (Rozman 1981, 134). Failure to support an overall industrialization project resulted in limited state support for the railroad industry.

While the Qing Court lacked the volition to build tracks, Chinese railway firms lacked the capital. Lack of access to financing prevented the emergence of a domestic supply of railroad firms. From 1895 to 1911, only 10 percent of the newly opened miles of track in China were built by the Qing Court or domestic firms (Huenemann 1984). Foreign interests with greater access to capital often bought out Chinese owners. For example, the Chinese-owned Peking-Mukden (Beijing-Shenyang) line was forced to sell to British investors because of a lack of financing. This overall conservative approach led to little new railway construction following the completion of the initial and short-lived segment in 1876. According to Zhang, although "some minor lines were constructed by provincial authorities in the following years, the central government showed no interest in the development of a national rail network" (Zhang 1998, 112).

Early stagnation in Chinese railway development cannot be attributed to the absence of Western interest. Comparing the demand of British investors seeking to invest in Chinese railroads to that of other industries such as mining, Pelcovits observes, "[o]vershadowing everything, however, were dreams of a railway age, providing outlets for capital and means of penetrating the interior" (Pelcovits 1948, 134–35). He further explains, however, that British investors' attempts to convince the Qing leadership of the virtues of railroad technology were met with strong opposition. The state's dismantling of the Woosung railroad in 1877, which was built by English investors in Shanghai without the Qing Court's authorization, is but one example of such opposition.

Explaining the Railroad Gap: State Concerns of Internal Threats and State Perception of Foreign Threats

The data and discussion above document the distinctive railroad adoption approaches in China and Japan from the mid-1860s to the early 1910s. This section analyzes the two factors proposed in this article to explain the countries' divergent adoption paths. In our analysis, we pay particular attention to the documentary record from the time of the initial adoption decision—the period immediately following the introduction of railroad technology. It is during this period that the prevailing policies of adoption or opposition were set, and these early decisions persisted over the observed construction gap of the coming years.

State Concerns for Internal Threats

China and Japan's different adoption decision is partially the result of variation among the respective leaderships in concern for social unrest and domestic instability. While both leaderships expressed fear of revolt by individuals displaced by railways, these concerns were more pronounced and of a qualitatively different type in China. Further, the Meiji government took effective steps to ameliorate public unrest. This section looks first at the role of apprehension over railway-induced unrest in late-Qing China and then examines the distinct nature of such concerns in Japan.

THE QING COURT'S CONCERNS OF INTERNAL THREATS

Apprehension among high-level officials, that the construction of rail lines and the use of trains to transport goods would cause significant social and economic dislocation, contributed to the Qing leadership's opposition to railroad adoption. Qing officials feared that such dislocation would lead to domestic revolt. The court's ethnic minority status exacerbated its fear of technology-induced social unrest. That is, ethnic tension, caused by discrimination against the Han ethnic majority by the ruling Manchu, increased the Qing leadership's apprehension regarding the prospect of social unrest.

Our analysis of historical documents confirms that the Qing Court was concerned about railroad-caused social revolt. In an 1865 letter written to the Qing Foreign Ministry as a response to a ministry consultation request pertaining to foreigners' interests in building railroads, Shen Baozhen, the governor of Jiangxi at the time, warned of the potential of railways "to destroy country folks' graveyards" and thus "cause immediate disputes" (Mi 1984, 20).¹¹ We found this sentiment, that damaging the natural environment as well as perturbing the lives of civilians would lead to unrest, particularly among the rural peasantry, common in the official correspondence and Court documents of the period. We also find it important to note that such sentiment did not only come from the conservative elements in the court, for Shen later served as one of the key figures in the Self-Strengthening Movement—a group of officials that sought internal

¹¹Original document: Tongzhi Year 4, March 3 (1865). Letter to the Ministry from Shen Baozhen, Governor of Jiangxi, from *Qing zhong li ya men dang an*.

reform and in general showed more acceptance of foreign technology.

Another 1865 letter to the ministry under the same request, this one from Mao Hongbin, the viceroy of Liangguang,¹² echoes the concern that railroad construction would incite new conflict and reignite previous tensions:

Building the railroads necessitates the use of the trains in order to take advantage of the greater speed of travel it affords. Whether it is to drill through mountains, diverting rivers, occupying agricultural fields, or destroying burial grounds, it will be a harassment along the way, causing bittering toil to no end ... Furthermore, in the inner lands there are many bands of bandits that have yet to be eliminated, with many of them still hidden, if they were to see such a stunning and frightening situation, they would take the opportunity to incite trouble, cause obstructions, and generate disputes, and even those foreigners in China will not be immune from these troubles. (Mi 1984, 20)¹³

Mao, like Shen, had recent first-hand experience attempting to quell the Taiping rebellion (1850–1864). Their assessments on the state of internal stability at the time, thus, warranted the attention of the Qing Court.

Concerns within the Qing leadership that railroad construction would incite unrest among aggrieved groups—often referred to as “bandits” in official correspondence—are also found in an 1867 correspondence from Du Xing’a, the General of Shenyang. In a memorial to the court, General Du notes, “[a]t the current moment, the bandits are not fully eradicated and the population still feels unsettled, this can be highly impactful and therefore, it would seem that it [the allowance of construction of telegraph and railroad lines] should not be permitted” (Mi 1984, 23).¹⁴ In the same year, Chong Hou, Three Port Trade Minister, also makes the case against foreign construction of railroads and warns that, “the bandits have not been fully eradicated, and in several martial provinces, the strategic passes are still under martial law control” (Mi 1984, 25).¹⁵

Opponents of railroad adoption in China also worried that railways would create technological unemployment for transport workers. Historians note that the Qing leadership during this period was particularly concerned within the Qing leadership that railroad construction would incite unrest among aggrieved groups—often referred to as “bandits” in official correspondence—are also found in an 1867 correspondence from Du Xing’a, the General of Shenyang of the consequences of transportation workers becoming unemployed because of the participation by similar groups in the Red Turban Revolt (1854–1855), the Nien Rebellion (1853–1868), and the Taiping Rebellion (1850–1864) (Huenemann 1984; Wakeman 1997). When the Yangtze region was opened to trade following the end of

the first Opium War, the volume of commercial traffic through the Che-ling and Mei-ling Passes fell and caused a substantial loss of merchant and transportation jobs. A portion of the newly unemployed workers participated, first, in banditry in the Guangdong region and, later, in outright revolt by participating in the Red Turban Revolt. Huenemann (1984, 39) argues that the Nien Rebellion in Huaibei (today’s northern Anhui) can be partially attributed to increased unemployment caused by “changes in the salt and grain transportation regulations”. He also notes the appearance of language such as “loss of jobs” (*shih-yeh*) and “vagrant people” (*yu-min*) in the rhetoric used by those arguing against the construction of railroads during the late Qing period. Similarly, Wakeman (1997) cites the ease with which boat workers and other unemployed laborers were recruited into rebellion to be a critical factor in enabling the Taiping Rebellion (1850–1864). The strong precedent for revolt caused by displaced workers strengthened the position of opponents to railroad adoption.

Apprehension that railroad-induced economic dislocation would spur domestic revolt and the destruction of property is evident in an 1867 announcement from the foreign ministry, which states, “[t]he ministry ... justified our rejections [of telegraphs and railroads] on the grounds that it impacts the local businesses and people’s livelihood, which will certainly lead to opposition by the crowd, and people’s anger will be difficult to bear” (Mi 1984, 22).¹⁶ A correspondence from the same year by Ding Baozhen, the governor of Shandong, who later rose to the position of viceroy of Sichuan and was a prominent Self-Strengthener, is explicit in making this link between railroad-induced job loss and conflict. In a memorial to the Qing Court, Ding writes, “[t]hese things [telegraph and railroads] are so harmful that it will day in and day out erode our people’s livelihood, and that is just unthinkable. As I have put significant thought on this issue, it definitely cannot be allowed ... the local people will still definitely be angry and cause disputes” (Mi 1984, 23).¹⁷

Correspondence between Westerners at the time also reveals that the Qing Court’s concerns regarding the disruptive nature of railroads were known to those seeking concessions. In a US diplomatic correspondence, Samuel Wells Williams, the US chargé d’affaires in Beijing, communicates a summary of a translated secret communication between Zeng Guofan, a high-ranking viceroy, and the Qing Court. Williams’s explanations reveal the United States’ awareness of the Qing Court’s concerns of railroad-induced unrest:

When myriads of rustic, hard-fisted people, trained to a single line of labor, like boating or carting, are suddenly superseded by steamers or locomotives, their privations from such forced idleness may prove a serious calamity and real danger to their rulers ... These laborers are altogether too ignorant to understand the question, and go about to seek a livelihood in other directions, and here they find every other line of life occupied. (United States Department of State 1869, 516)

¹²During Qing dynasty, viceroys were the highest ranked regional officials and held military power. Liangguang refers to the provinces of Guangdong and Guangxi.

¹³Original document: Tongzhi Year 4, March 19 (1865). Letter to the Ministry from Mao Hongbin, Viceroy of Liangguang, from *Qing zhong li ya men dang an*.

¹⁴Original document: Tongzhi Year 6, November 17 (1867). Memorial from Du Xing’a, General of Shenyang, from *Chou ban yi wu shi mo*, Tongzhi chao, vol. 52, p. 22.

¹⁵Original document: Tongzhi Year 6, November 26 (1867). Memorial from Chong Hou, Three Port Trade Minister, from *Chou ban yi wu shi mo*, Tongzhi chao, vol. 54, pp. 18–19.

¹⁶Original document: Tongzhi Year 6, September 15 (1867). Announcements from the Foreign Ministry, from *Chou ban yi wu shi mo*, Tongzhi chao, vol. 50, pp. 32–33.

¹⁷Original document: Tongzhi Year 6, November 19 (1867). Memorial from Ding Baozhen, Governor of Shandong, from *Chou ban yi wu shi mo*, Tongzhi chao, vol. 52, p. 27.

Concerns regarding the railroads' impact on internal stability continued during the immediate aftermath of the construction of the Woosung railroad in the mid-1870s. According to a report in *Shen Bao*, a major business newspaper, villagers sought to obstruct the line's construction by various means, including removing railroad stakes (Mi 1984, 39).¹⁸ The newspaper reports another incident during which hundreds of villagers protested an alleged house fire caused by train sparks by attempting to impede a train (Mi 1984, 40).¹⁹ In response to popular opposition, the Qing Court bought out the Woosung railroad and dismantled it in 1877.

The popular view of railroads as disruptive, whether because of construction, operation, or economic dislocation, persisted into the 1880s. When Liu Mingchuan, formerly an army general in Zhili, submitted a memorial in 1880 detailing what became regarded as the first policy proposal on railroad development, a debate reemerged among Qing officials.²⁰ Among the routes in Liu's proposal was a direct line from Qingjiang (Huai'an) to Beijing, the construction of which was vigorously opposed by Cabinet Secretariat Zhang Jiaxiang:

From the Qingjiangpu to Beijing, it is one thousand and several hundred miles; would there not be any farm fields, houses, graveyards, or bridges that block the access for railroad construction? If the railroads are built, are they going to level to the ground anything that blocks its way? Or do we expect the people to move? ... The train travels at such a high speed that it is likely to cause conflicts that would harm the people. (Mi 1984, 88)²¹

Opposition of this sort was sufficiently effective for Emperor Guangxu to task Li Hongzhang (viceroy of Zhili) and Liu Kuenyi (viceroy of Jiangxi) to study the proposal in detail.²² Despite the support from Li Hongzhang and Liu Kuenyi in their study, which included proposals for financing the construction and standardizing taxation for the transportation of goods,²³ the opposition prevailed, and the emperor decided against Liu Mingchuan's proposal in his directives and quelled further discussion on the subject (Mi 1984, 102–3). In summary, Qing officials, experienced in dealing with rebellions caused by shifts in employment, anticipated that the construction of railroads would lead to social unrest, and these officials successfully lobbied the Qing Court against adoption.

MEIJI CONCERNS OF INTERNAL THREATS

In contrast to China, where the perceived threat of railroad-induced unrest contributed to a policy of nonadoption, in Japan such concerns were moderate and insufficiently salient to delay adoption. Three factors likely explain this difference: (1) social unrest in Japan during this period was qualitatively different from that of China; (2) the Meiji state was particularly adept at handling nascent rebellions; and (3) the project of railroad development was seen as a stability-enhancing means of consolidating Meiji rule. First, in Meiji Japan, the likely source of social unrest was different from that in China. In particular, early on, the Meiji government's primary rival was displaced elites rather than peasants. For example, the Shōgitai—a group of a few thousand warriors who were the elite corps of the shogunate—were defeated in Edo shortly after Emperor Meiji assumed power (Hane 1992). Samurai, displaced under the new socioeconomic system established by the Meiji government, participated in multiple uprisings during the 1870s (Beasley 1972). Nevertheless, because the threat of unrest in Japan was largely located in the elite classes and the elite did not hold jobs as transport workers, the threat of railway-induced technological unemployment was less severe in Japan.

The Meiji government was also particularly skillful in quelling nascent unrest among the elite. Another potential challenge to the early Meiji regime were the residual feudal lords (*daimyo*) that still populated the countryside and retained autonomy over their domains. However, following the example set by four of the most powerful *daimyo*, these feudal lords returned their land to the emperor in exchange for debt forgiveness and an annual stipend equal to one-tenth of their former income (Hane 1992). By 1870, these potential rivals to Meiji primacy had all returned their estates to the emperor.

The Meiji government was also adept in suppressing popular revolt. While less common than in China, peasant uprisings occurred during the early years of the Meiji rule. However, these actions in Japan were met by a rapid and effective response from the government. During the 1870s and 1880s, there were numerous agrarian revolts caused by opposition to newly imposed military conscription, high land rents, and land tax increases. In Okayama in 1871, three thousand individuals marched in demand for a reduction in taxes and the reinstatement of their feudal lord (McClain 2002). In response, the Meiji government decreased the land tax by 20 percent and shifted public sentiment by “explaining its motives more clearly” (McClain 2002, 164). The state further dampened agrarian unrest by incorporating the rural sectors into the modernization process. Rural participation was particularly high in the flourishing silk and cotton industries (McClain 2002). Beasley (1972) argues that conscription, while an initial source of unrest, ultimately strengthened the central government's ability to prevent internal rebellion by increasing its policing capacity.

Intriguingly, the effective national policing that was characteristic of the Meiji period owed largely to the leadership's policy of emulation of foreign ideas and its welcoming attitudes toward foreign technologies. Westney (1987, 34) explains that the Meiji government explicitly modeled its national police force after that of France. However, as was typical, Japan made improvements to the imported Western technologies and organizational structures. In the case of the Japanese police force,

¹⁸Original document: *Shen Bao* (Tongzhi Year 11 [1872] December 23).

¹⁹Original document: *Shen Bao* (Guangxu Year 2 [1876] September 7).

²⁰See Mi (1984, 86–87) for the proposal by Liu Mingchuan. Original document: *Liu Zhuangsu gong zou yi*, vol. 2, pp. 1–3.

²¹Original document: Jiao tong bu, Jiao tong shi bian cuan wei yuan hui, *Jin dai jiao tong shi quan bian: jiao tong shi lu zheng bian*, vol. 1, pp. 20–21.

²²See Mi (1984, 87) and also *Qing shi gao* (*Draft History of Qing*), zhi 124, vol. 149, sec. 8.

²³See Mi (1984, 96–97). Original document: *Liu Kuenyi yi ji*, pp. 598–600. The studies by Li Hongzhang and Liu Kuenyi also highlighted issues regarding state capacity in the development of railroads. Discussion of capacity was largely absent from the early documentary record. The increased prominence of views by Self-Strengtheners like Li Hongzhang and the continued lack of military success against foreign threats (such as the Qing military's difficulties during the Sino-French War) contributed to the eventual changing attitude on the railroads toward the end of the 1880s, but large-scale railroad construction expansion still did not occur until following the Sino-Japanese War in 1895.

improvements included the utilization of the nascent telegraph system to coordinate policing, the development of formal police training programs, and the establishment of local *kōban* (police boxes) to extend the force's reach into individual neighborhoods (58).

As opposed to the Qing leadership who viewed railroad adoption as internally destabilizing, the Meiji government saw railway development as means of consolidating their rule and promoting a sense of national unity. Morris-Suzuki (1994) argues that, for the Meiji government, the development of railways and telegraphs signaled the state's country-wide reach and ensured its ability to rule remote regions. For Japan's Ministry of Industry, "the new infrastructure was not merely an economic necessity, it was also a visible representation of the centralized state, capable of conveying the government's writ to remote parts of the country, and (if necessary) of conveying soldiers to ensure that the writ was enforced" (73). Ericson (1996) also finds evidence that the newly ascendant Meiji emperor viewed railroad construction as an instrument for consolidating his rule, noting that the emperor "realized that a railway system would promote administrative centralization, a pressing concern for the fledgling government". According to Ericson (1996, 92), the emperor was aware that railroads helped erode subnational differences in the West and sought railroads, in part, based on the hope for a similar effect in Japan.

THE EXACERBATING ROLE OF ETHNIC TENSION

The cross-case disparity in the level of concern for technology-induced social unrest was amplified by the difference in the ethnic composition of the respective leaderships. The Manchu Qing leadership was an ethnic minority that enjoyed a significant advantage in socioeconomic and legal status over the majority Han Chinese. This unequal relationship led to ethnic tension and social cleavages that complicated China's undertaking of a national project of modernization. In Japan, the Meiji was an indigenous leadership, which facilitated building a unified national sense of purpose. The foreign and indigenous nature of the leaderships thus provided different sociopolitical backdrops against which the two countries considered the issues of railroads and other foreign technology. In short, the alien nature of the Qing leadership heightened its concerns over internal stability, which in turn, shaped its perception regarding the adoption of railroads.

In China, the Manchu—a nomadic population from northeast Asia that represented roughly 2 percent of the total Chinese population—seized Beijing in 1644, marking the beginning of the Qing dynasty. Upon assuming leadership, the Manchu adopted many of their Han Chinese predecessors' political, economic, and social institutions. For instance, the Manchu adopted an overt policy of nondiscrimination and appointed Han Chinese to official positions (Zhang 1998). Because of their alien status, the Manchu put particular emphasis on retaining tradition and ensuring continuity from the Ming Dynasty.

However, beneath these measures, tension between the two ethnic groups based on a power differential and the unequal treatment of Han Chinese persisted. The majority of the Manchu had the status of banner people (military personnel), while the majority of Han Chinese was assigned the lower civilian designation (*minren*) (Li 2008). These statuses were heritable, fixed, and associated with significant differences in privilege, status, and pay.

The Manchu, occupying a military class, were generally forbidden from participating in agriculture or trade and were given a tax-exempt stipend and rice allotment by the state (Li 2008). Even the application of policies of nondiscrimination was uneven and applied only to certain positions in the capital. For example, a Manchu could fill an official position designated for Han Chinese, but in practice the reverse was not true (Zhang 1998, 103). Similarly, while positions in the civil bureaucracy were nominally available to both Manchu and Han Chinese, in practice, the Manchu could obtain employment and advancement much more readily than their Han counterparts (Rhoads 2000).

The alien nature of the Qing leadership and its discriminatory practices created social fragmentation and prevented consolidation of political support for a nation-level modernization agenda. As industrialization is associated with potential changes in income distribution, power, and even the ability to mobilize against the state, the threat of modernization was particularly worrisome to an ethnic minority leadership. Of the Qing's reluctance to pursue policies that would shift the internal power balance, Zhang (1998) writes, "[i]f the Manchus modernized (militarized) China, the Manchu dynasty could not be maintained since the Han Chinese armed with modern weapons would hardly be loyal to the corrupt Manchus".

While the contribution of the alien nature of Qing leadership to societal tension declined by the end of the nineteenth century, this issue nevertheless left a legacy of social fragmentation and concern over domestic instability. Ultimately, the primary effect of ethnic tension in Qing China may have been to delay the emergence of a sense of national purpose. While the demonstrated technological acumen of the West might, in other circumstances, have served to unite China behind an effort to modernize, domestic fragmentation and the insular focus of the Qing leadership delayed the emergence of such a movement. Of the lack of national purpose during this period, Beasley notes, "[d]espite widespread antiforeign feeling among gentry and officials, Chinese continued to behave, at least until the end of the nineteenth century, as a people defending a civilization that was threatened, not a nation defending a country that was under attack" (Beasley 1972, 413).

Whereas the Qing dynasty was headed by a Manchu minority and marked by discrimination and domestic fragmentation, the indigenous character of the Meiji government facilitated the emergence of a sense of national purpose in Japan (Totman 1982). Indeed, one historian notes that a national groupism, developed and popularized through the scholarship of Inoue Tetsujirō and Hozumi Yatsuka, characterized Meiji Japan (Zhang 1998). Regarding the shared sense of national solidarity and mission, Zhang writes, "[o]nce the Japanese had chosen the nation as a focus for group identity, and identified the group's goal—to catch up to the West by learning from it—the hard working and rational-oriented Japanese would perform splendidly in achieving the group purpose" (Zhang 1998, 74).

State Perceptions of Foreign Threats

In addition to concerns of domestic uprising caused by railway's discontents, a second factor, the perception of foreign threats, contributed to the Chinese/Japanese railway adoption gap. The documentary record reveals that the Qing Court's opposition to railroad adoption was partially based on concerns that railways would make China

vulnerable to further foreign penetration into China proper. In particular, the Qing leadership was acutely concerned that railroads would erase the protection provided by China's natural barriers by creating a fast and direct means of traveling within the country. In the case of Japan, concerns regarding foreign invasion were less pronounced; while external threats were sufficient to alter route selection, they did not fundamentally affect the adoption decision.

An 1865 letter from the foreign ministry makes explicit this link between foreign threats and opposition to railroad adoption in China. In particular, the letter articulates a concern that the construction of rail lines would give a foreign power a strategic advantage in traversing Chinese terrain: "If allowed to build the railroads, the foreigners will be able to travel freely . . . and this matters for larger, strategic concerns. Therefore this ministry has continued to vehemently reject such efforts" (Mi 1984, 19).²⁴ Similarly, in an 1867 memorial, Three Port Trade Minister Chong Hou articulates his unequivocal opposition to railroad adoption and conveys to the foreign minister his concern that railroads would diminish the protective utility of natural barriers: "they [railroads] have absolutely no benefit to China, but can cause significant harm in the long term . . . the Imperial Minister has already rejected them on the grounds that it will lead us to lose our barriers" (25).²⁵ Even Shen Baozhen, who had a more favorable view toward foreign technology and supported self-strengthening, underscored, in an 1865 letter to the Ministry, that railroads would diminish the effectiveness of China's terrain in providing security: "with regard to the railroads, there are many stifling factors: to level natural barriers such as mountains and rivers will lead to future problems" (20).²⁶ Contrary to the prevailing scholarship that tends to understand the national security ramifications of railroads in terms of their defensive utility, railroads were viewed by the Qing leadership as means of facilitating foreign aggression.

The Qing's concern over foreign threats is also apparent in the reignited railroad construction debate of the early 1880s. In an 1881 memorial, Liu Xihong, an advisor in the Office of Transmissions who also served as ambassador to England and Germany, remarked that, "[t]he way to guard the country, other than the collective of the people, relies on terrain; if we do not have greater military power than others, then holding on to our critical barriers may be sufficient to secure ourselves . . . If we were to build the railroads, then not only are we not setting barriers but we are leveling them ourselves . . . even one person with sufficient force can have direct access [into the inner lands]." (Mi 1984, 101)²⁷

The prospect that railroad adoption may facilitate foreign invasion is also evident in the counter arguments of railroad proponents. In an 1880 memorial in support of railroad construction based on the Liu Mingchuan proposal, Li Hongzhang attempts to carefully refute the

opposition's claim that railroads would make China vulnerable to foreign invasion:

There were also concerns that if the railroads were built, our enemies will invade us in an instant . . . For all those countries that have railroads, we have only heard that they have all been able to mobilize against threats, and we hear none about the railroads being coopted by the enemies. Why is this so? The reason is that railroads are built on our inner lands and where they are attached to the border, there would be guards, in which case how can others just randomly gain access? Even if there are special cases of emergencies, if we destroy just a small section of the tracks and detain the trains, the road would be of no use and the entire route would be inaccessible. (Mi 1984, 91)²⁸

While the Sino-French War (1884–1885) helped draw attention to the value of railroads for military transport, opposition to railways based on external threats persisted throughout the 1880s.²⁹ An 1887 Ministry of Navy proposal to extend the Kaiping railroad to the Port of Dagou failed due to concerns that the segment would provide foreign forces proximate access to Beijing. In particular, in an 1888 memorial, Tu Renshou, a royal inspector opposing the new segment, argued that by selecting an alternative route that does not directly link Beijing to a port city with a significant foreign presence, "the foreign bandits would not be enticed to have ulterior motives, and the emperor can rest easy" (Mi 1984, 148).³⁰ Ultimately, the opposition to this segment prevailed; the emperor accepted a different route from Wuhan to Luzhou that did not link the capital to a port city with strong foreign presence.

In China, xenophobia among the Qing leadership further amplified the perceived threat posed by railroad technology. This kind of antiforeign sentiment is evident in an 1866 memorial from Guan Wen. In a memorial sent to the Qing Court, Guan contends that the motives of foreigners can be split into two varieties: "the easily observable parts are their attempts to monopolize on the profit, and the less obvious parts are their harboring of evil intentions" (Mi 1984, 16).³¹ For Guan, foreigners "believe that they have the right to profit from the entire world," and "[t]his is the true intent of the foreigners, and nothing else" (16).³²

The 1867 memorial from Zeng Guofan, referenced by Williams as discussed above, also reveals a deep distrust of foreigners:

Since the foreigners . . . arrived in China . . . the people have suffered. Now if . . . we listen to them and establish the telegraphs and the railroads, then our carriages will get run over by them and inns and porters would lose their livelihood . . . with other things

²⁴Original document: Tongzhi Year 4, January 17 (1865). Letter from the Foreign Ministry Main Office, from *Qing zong li yamen dang an*.

²⁵Original document: Tongzhi Year 6, November 26 (1867). Memorial from Chong Hou, Three Port Trade Minister, from *Chou ban yi wu shi mo*, Tongzhi chao, vol. 54, pp. 18–19.

²⁶Original document: Tongzhi Year 4, March 3 (1865). Letter to the Ministry from Shen Baozhen, Governor of Jiangxi, from *Qing zhong li ya men dang an*.

²⁷Original document: *Qing chao xu wen xian tong kao*, vol. 312, Postal Communications 3, pp. 18–35.

²⁸Original document: *Li Wenzhong gong quan shu*, zou gao, vol. 39, pp. 20–26.

²⁹See *Qing shi gao (Draft History of Qing)*, zhi 124, vol. 149, sec. 11.

³⁰Original document: *Tu Guanglu zou shu*, vol. 4, pp. 14–16.

³¹Original document: Tongzhi Year 5, April 10 (1866). Memorials from Guan Wen, Viceroy of Huguang, from *Chou ban yi wu shi mo*, Tongzhi chao, vol. 41, pp. 41–42.

³²Original document: Tongzhi Year 5, April 10 (1866). Memorials from Guan Wen, Viceroy of Huguang, from *Chou ban yi wu shi mo*, Tongzhi chao, vol. 41, pp. 41–42.

like steamboat and railroad, if the foreigners do it, then the foreign countries will profit from having access to the inner lands; if it is done by the Chinese who agree with foreigners, then it will be the rich exploiting the poor. In neither case should it be done. (Mi 1984, 24)³³

Besides revealing that the Qing officials were concerned that railroads could threaten China's security, the language used in these correspondences demonstrates a belief, held by some prominent court officials and local leaders, that the actions of Westerners were motivated by greed.

Antiforeign sentiment is also evident in the opposition to Liu Mingchuan's 1880 proposal for nationwide railroad development. Such bias is evident in communications opposing the use of foreign loans to finance the proposed construction. For instance, Liu Xihong, in addition to his 1881 memorial opposing Liu Mingchuan's proposal, sent a secret memorial in which he recounts his experience returning from Europe with British Envoy Thomas Francis Wade:

When I returned from Germany I happened to be on the same ship with Wade . . . Wade claimed that England would be willing to offer the finance . . . Upon hearing this I sneered and argued that they harbor bad intention for doing so and told him that they cannot fool China. His face turned red. I then discussed history with him and argued that the survival of a country is not based on power but on the virtues . . . with the hope to stop his trickeries. Wade then discussed about benevolence and human nature . . . in order to cover the mistake of his ill intentions. Thus, with regard to railroads, it is what the foreigners rely on to harm China, and we should absolutely not fall for it. (Mi 1984, 102)³⁴

Other court documents reveal a similar distrust of the intentions of foreigners. For instance, Zhang Tingliao, a royal inspector to Shaanxi, argued in 1884 that "once the trains are running, the foreigners will be coveting them. At first they will pretend to be helpful by offering finance, which will be hard to turn down, and then they will use that as the justification to occupy the railroads, which we will not be able to eliminate, and it is inevitable that they will station foreign troops in all trading provinces" (Mi 1984, 106).³⁵ Yan Mao, vice minister of imperial transportation, expressed a similar view in 1885 stating, "to build the railroads will require hiring foreigners and purchasing foreign materials, and the yearly maintenance will be administered by the foreigners, thus the profits from and the authority over the railroad projects will all go to foreigners, this is a hidden concern for China" (108).³⁶

Chinese officials' xenophobic attitudes toward foreigners are likely the result of engagements with foreigners

earlier in the century that ended in humiliating defeats. For one, the railroad concessions sought by Westerners were based on the highly unequal treaties that were signed following the two Opium Wars. Furthermore, as is clear from the passages above, the Qing officials, even those that held key positions in the Self-Strengthening Movement, sought to protect their interests by maintaining the status quo. As a result, the Qing officials distrusted ideas and technologies that may threaten the foundations of Chinese feudal society.

In comparison, although Japan also opened itself as a result of coercive Western efforts, including the signing of unequal treaties, it did not engage in protracted interstate conflict with Western countries. That is, the opening of Japan did not lead to the kind of large-scale military defeats that challenged the national pride and caused resentment toward the West in China. Furthermore, in Japan, the development of railroads took place during a period in which the political power was restored to the emperor from the Tokugawa shogunate that embodied the feudal system in Japan. Since it was under the declining power of the bakufu that the country was forced by Westerners to open, the Meiji government, which overturned the bakufu, was able to advance reform with a degree of independence from the previous leadership. In other words, the Meiji government, in overturning the feudal system under the shogunate, was able to attribute failures in Japan's early engagements with Westerners to the failures of the previous regime.

Different perceptions of foreign intentions thus shaded the context under which railroad adoption was considered in China and Japan. In the case of the former, beliefs about the aggressive intentions of foreigners amplified the Qing Court's concern that railroads would ease penetration into the interior of China. In Japan, the absence of recent large-scale military conflict with the West left less distrust of foreigners and foreign technology.³⁷ Furthermore, during the initial railroad adoption period, the notion of *jōi* (expel the barbarians) had largely dissipated from Japanese political rhetoric.

This is not to say that perceptions of foreign threats were absent from the Meiji railroad policy calculus. Rather, Japan's historical experience did not result in the kind of amplification of this factor that occurred in China. The process by which the Meiji government undertook route selection for the Tokyo-Kyoto line is illustrative of this distinction. In constructing this critical artery linking the former and the new capitals, the government was faced with two route options: one coastal (the Tokaido route) and one internal (the Nakasendō route). Eventually, as Ericson (1996, 44) explains, the Meiji selected the internal route because it was thought to be less vulnerable to foreign attack. Thus, while external security concerns were able to tilt the balance in favor of a particular route, such concerns were not sufficient to delay adoption.

Finally, the difference between the warrior ethos of the Meiji leadership—constituted of former samurais—and the scholar-based Qing leadership likely contributed to the difference in their perception regarding foreign threats.³⁸ The Meiji government primarily sought to

³³Original document: Tongzhi Year 6, November 23 (1867). Memorial from Zeng Guofan, Viceroy of Liangjiang, from *Chou ban yi wu shi mo*, Tongzhi chao, vol. 54, pp. 1–4.

³⁴Original document: *Jing ji yan jiu suo chao dang*, lu dian yo hang lei, vol. 4.

³⁵Original document: *Jing ji yan jiu suo chao dang*, lu dian yo hang lei, vol. 4.

³⁶Original document: *Jing ji yan jiu suo chao dang*, lu dian yo hang lei, vol. 4.

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³⁷Importantly, the embrace of foreign technology did not extend to foreign borrowing. The Meiji government was loath to incur foreign debt and borrowed little from the West (Lindert and Morton 1989, 54).

³⁸The authors wish to thank an anonymous reviewer for highlighting this point. For additional discussion, see also Ikegami (1997).

defend against territorial threats, while the Qing Court sought protection from both territorial and civilizational ones. Thus, the Meiji leadership likely perceived adoption of foreign technology as means of defending its borders, while the Qing officials also saw its potential to erode Chinese civilization.

A Cultural Explanation? A Look at the Potential Contribution of Confucianism

The following section briefly assesses an alternative factor that has been proposed by scholars to explain early railroad development in China and Japan. Confucianism, it is argued, accelerated industrialization in Japan by infusing values conducive to the modernization program (Morishima 1984; Zhang 1999). It has also been argued, that Confucian values played a role in shaping China's economic modernization program (Huenemann 1984; Zhang 1999). Analyzing the cases side-by-side, however, reveals that the impact of Confucianism on railroad development is indeterminate. First, members of the Qing and Meiji leaderships used Confucianism to justify *both* the adoption and nonadoption of railroads. Second, because both countries have roughly the same level of cultural penetration of Confucian values, we contend that Confucianism cannot explain the large *variation* in railroad adoption.³⁹

Scholars of the Meiji restoration sometimes claim that Confucianism or Confucian values played a critical role in Japan's rapid process of industrialization (Mehl 2000).⁴⁰ Morishima (1984), for one, argues that Japan's readiness to adopt foreign technologies and Western thinking can be explained by Confucian rationalism. Zhang, in addition, posits that the high value placed by the Meiji government on education owes to the proliferation of Confucian values. In particular, he notes that two Confucian scholars—Nishimura Shigeki and Motoda Eufu—began to influence policy in the Ministry of Education, which led to an expansion of the educational system. Regarding the role of Confucianism in Japan's economic modernization, Zhang writes, "Japan's swift adoption to modern civilization owes much to its taste for Confucianism and rational Western ideas" (Zhang 1999, 7).

Indeed, even prominent advocates of Western-style modernization were strongly influenced by Confucian scholarship. For example, Meiji statesman Nakae Chomin was instrumental in bringing American political theory into Japan. However, Nakae's political philosophy—especially with regard to freedom and equality—was also strongly influenced by the writings of Confucian philosopher Itō Jinsai (Rozman 1981). Similarly, while Japanese observation envoys to Western countries generously praised the American and British technologies witnessed during their trips, they also wrote

³⁹The qualifier "roughly" warrants brief attention. It could be argued that when compared to scholarly officials of the Qing Court, the Meiji government was influenced by a mix of Confucianism and Western classical liberalism. Our contention is that this variation in the respective leaderships' adherence to Confucian principals is of insufficient magnitude to explain such a large variation in the technology adoption decision.

⁴⁰While this section examines the potential effect of Confucianism on the adoption of railways, the mere fact that Confucianism was an import for Japan may be illustrative of Japan's greater tolerance for foreign ideas. That is, rather than being a causal mechanism for railway development, the mere presence of a foreign belief system in Japan may reveal a contributing factor for the Chinese/Japanese railroad gap: the overall national attitude toward foreign ideas, technology, and methods. This factor echoes what Cai (2007) has argued in terms of the civilizational differences between China and Japan, but, further research would be required to draw firmer conclusions.

harshly about the lack of filial piety and the deference afforded to women that they observed in the West.

However, a closer look at the historical record reveals the overall place of Confucianism within Meiji Japan to be ambivalent vis-à-vis modernization. During the initial push to modernize according to Western commercial models, many proponents of modernization viewed Confucian practices as deleterious to progress (Rozman 1981; Hane 1992). Fukuzawa Yukichi, author and proponent of a Western-style enlightenment in Japan, argues that Confucianism supports a feudal socioeconomic structure and criticizes prominent Confucian scholars' attitudes about women. For example, the bakufu-funded schools that taught Zhu Xi Confucianism during the Tokugawa Period (1615–1868) were reformed by the Meiji government into institutions that more closely resembled Western-style schools (Rozman 1981). In sum, the intellectual vanguard in Meiji Japan was ambivalent in its attitudes toward Confucianism; it contained scholars such as Nakae, who owed much of his political thinking to Confucian scholars, and others such as Fukuzawa, who was critical of Confucian values.

The overall impact of Confucianism on Chinese modernization is also unclear. Scholars such as Rozman (1981) contend that Confucian values prevented the modernization of the education system in late Qing China. However, he argues that the influence of Confucian beliefs in other spheres of life was limited. In making this argument Rozman states, "Confucianism did not rule the marketplace or even the magistrate's *yamen* [the office of a Chinese government official]" (Rozman 1981, 186). Zhang (1999) observes that the Manchu were particularly resistant to ideas, literature, or art that may subvert traditional Confucian ideals or disturb national unity. While he does not refer explicitly to railroad adoption, it is reasonable to assume that the adoption of a disruptive foreign technology would fit into this subversive category. According to Zhang, "The Manchus used Confucianism as a tool to produce blindly obedient and routinely working people" (Zhang 1999, 104).

As in Japan, both opponents and proponents of railroads used Confucianism to advance their arguments in China. For example, Zhang Zhidong—who held posts of viceroy of Liangguang and governor of Shanxi and played an important role in incorporating Western military training and equipment into the Chinese military—argues that railway construction did not violate Confucian principles (Teng 1979). On the other hand, Wo Jen, a conservative official and Confucian scholar that occupied the position of vice president of the board of ceremonies at Mukden and grand secretary, opposed the adoption of Western learning in all areas but military affairs (Huenemann 1984).

In summary, in neither country is the contribution of Confucianism to railroad adoption unambiguous. In both countries, Confucianism was used to advance the program of railroad adoption as well as to advance the case for conservatism. In addition, because Confucianism was present in both cases, it alone cannot explain the railroad gap. This does not mean, however, that Confucian values did not play some role in railroad development in the cases, but merely that the other factors proposed here constitute stronger explanations for the difference in Chinese and Japanese railroad policy.

Conclusion

Through analysis of scholarship on the history of railroad development and examination of primary source

evidence, we endeavored to explain the substantial difference in Chinese and Japanese railroad adoption from 1870 to 1911. We argued that at least two factors contribute to the observed variation in railroad adoption: first, the difference in the level of state concern for railroad-induced civil unrest and, second, variation in how leaders perceived their external threat environment. Finally, we found little support for a specific cultural explanation, that Confucianism contributed to railroad adoption in China and Japan.

Our study sheds light on the process by which contemporary cases of technology adoption may proceed. Based on our findings, we believe that current transformative technologies, even ones with large expected positive economic impacts, will not likely see uniform adoption across states. While this prediction tracks with existing understandings of technology adoption that underscore heterogeneity in the adopting units, our research highlights several additional factors that warrant consideration.

First, our research suggests that future adoption decisions may depend on the anticipated impact of a technology's adoption. While transformative technologies almost always carry with them adverse domestic employment and national security consequences, the magnitude of these effects will vary with respect to the state and technology in question. Where these effects are large, we expect delayed adoption.

Second, although the existing literature on technology adoption suggests that adoption depends primarily on the institutional or material character of the adopting society, this article suggests that the decision to adopt foreign technology also depends on how the receiving states *perceive* the technology. Furthermore, state perceptions regarding the intentions of a technology's exporters can affect a country's willingness to adopt. We provided evidence that China's decision to delay railroad adoption is partially attributable to how the Qing leadership understood Western technology and the intentions of Westerners. It follows that nonmaterial concerns, such as the national origin of a foreign technology, may influence adoption.

For example, France (Parrot) and China (DJI) host the largest firms within the commercial drone sector. We see good reasons to expect that the American political leadership will perceive commercial drones manufactured in China differently from those produced in France. Indeed, DJI's acquiescence to the Chinese government's requests to turn over data obtained during flights has already raised concerns in the United States. Since perception of the external threat posed by a technology's exporter can influence a country's willingness to adopt a foreign technology, future studies should pay particular attention to the strategic and security context under which technology adoption takes place.

Third, our research contributes to the effort to globalize the field of international relations as advocated by Acharya (2014) in his 2014 Presidential Address at the International Studies Association annual conference. The railroad adoption decisions of Japan and China undermine certain understandings of modernization, often based on the Western Industrial Revolution, that treat technology as static, materially defined, and value-neutral (Mansfield 1961; Angst et al. 2010). Our analysis shows the need for a more fluid and interpretative conceptualization of a technology's meaning to a society.

Finally, a society's historical experience in the context of its interactions with the global system can color its understanding of foreign ideas, norms, and artifacts. A growing literature examines the impact that historical memory has on state decisions, most often in the realm of foreign policy (He 2007; Wang 2008; Cui 2012). Our study adds to this

literature by revealing that historical memory can also result in the rejection of trends of assimilation and emulation across societies. Furthermore, our research suggests that less tangible aspects of a regime, such as its legitimacy and its relationship to the society it governs, can influence its policy decisions. Understanding the differences between the Qing Court and the Meiji government in their comprehension of railroads as a foreign technology thus yields insight into how perceptions and identities matter for technology adoption and diffusion in the international system.

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Appendix

Appendix 1. Origin of primary source documents

Document Title	Chinese Title	Translation
<i>Chou ban yi wu shi mo</i>	籌辦夷務始末	The Whole Course of Making Preparations for Foreign Affairs
<i>Jin dai jiao tong shi quan bian</i>	近代交通史全編	Complete Collection on the Contemporary History of Transportation
<i>Jing ji yan jiu suo chao dang</i>	經濟研究所抄檔	Copied Files from the Institute of Economics
<i>Li Wenzhong gong quan shu</i>	李文忠公全書	Whole Collection on Sir Li Wenzhong (Li Hongzhang)
<i>Liu Kuenyi yi ji</i>	劉坤一遺集	Posthumous Collection of Writings by Liu Kunyi
<i>Liu Zhuangsu gong zou yi</i>	劉壯肅公奏議	Memorials from Sir Liu Zhuangsu (Liu Mingchuan)
<i>Qing chao xu wen xian tong kao</i>	清朝續文獻通考	Continued Comprehensive Examination of Literature of the Qing Dynasty
<i>Qing shi gao</i>	清史稿	Draft History of Qing Dynasty
<i>Qing zhong li ya men dang an</i>	清總理衙門檔案	Files from the Foreign Ministry, Qing Dynasty
<i>Shen bao</i>	申報	Shen Newspaper
<i>Tu Guanglu zou shu</i>	屠光祿奏疏	Selections of Memorials from Tu Guanglu (Tu Renshou)