The Effects of World War I on the Chinese Textile Industry: Was the World's Trouble China's Opportunity?

Cong Liu

This paper uses an unexpected trade disruption due to World War I to study how a temporary reduction of imports affects the entry of industrial firms. I construct a new transportation network to capture counties' exposure to this trade shock and compile panel data to examine the impact on China's manufactured textile industry. I find that counties with greater prewar exposure to international trade experienced more firm entry after the war. The effect was delayed because the war simultaneously hindered machinery imports. Better access to finance also contributed to firm entry after the trade shock.

World War I marked the end of the first wave of globalization. The war years witnessed dramatic increases in freight rates and reductions of traded commodities in the world market. Because developing countries imported manufactured products, the resulting trade barriers might have served as a shelter for their domestic industrial firms. Did this temporary and unexpected trade disruption successfully promote industrial development in these countries?[1]

The Journal of Economic History, Vol. 80, No. 1 (March 2020). doi: 10.1017/S0022050719000858

Cong Liu is Assistant Professor at the Institute for Economic and Social Research, Jinan University, No. 601 Huangpu Avenue West, Tianhe District, Guangzhou, Guangdong, China 510632. E-mail: congliu19@outlook.com.

I am indebted to Price Fishback for his invaluable guidance. I benefited from suggestions and comments from two anonymous referees and the editors, Ann Carlos and Bill Collins, as well as comments by Cihan Artunç, Shiyu Bo, Ting Chen, Yi Chen, Taylor Jaworski, Wolfgang Keller, James Kung, Ashley Langer, Nan Li, Peter Lindert, Debin Ma, James Markusen, Carol Shiue, Xin Wang, Mo Xiao, Yi Xu, and Se Yan, as well as conference and seminar participants at Arizona, BNU, Colorado–Boulder, CUFE, Jinan IESR, KDI, SUFE IBA, SWUFE, ShanghaiTech, the 4th AHEC, the 2015 Cliometrics Conference, the 2015 CES meetings, the 2nd BCCDS, the 2nd HED Workshop, the 3rd Quantitative Historical Symposium, and the 17th WEHC. I am grateful to Ting Chen for sharing the railroad data and Carl Kitchens for guiding the construction of the transportation network. I also thank my research assistants, Jiahong Cai, Yurong Li, Hang Luo, Aimin Wang, Jinlin Wei, Jing Yuan, and Yan Zhou, for their excellent work. This project was supported by the National Natural Science Foundation of China (No. 71803113), the Shanghai Pujiang Program (No. 18PJC042), and the Exploratory Travel and Data Grants by the EHA. All the remaining errors are my own.

[1] In related work, Tomlinson (1979) examines India's experience during WWI using aggregated data. Clark (1987) compares labor productivity across the world in 1910, and Wolcott and Clark (1999) compare and explain differences in the performance of textile industry across India and Japan.

This paper studies the impact of World War I (hereafter WWI) on China's manufactured textile industry. Textile production was among the first industrialized sectors in early twentieth-century China, and it accounted for 36 percent of Chinese industrial output by the 1930s (Rawski 1989). A closer look at the number of spindles, however, suggests that at first China did not have an advantage in this industry, nor did this industry grow at a constant speed. As Figure 1 shows, the number of spindles remained relatively stable from 1900 to 1914, started to grow during WWI, doubled from 1920 to 1923, and returned to a lower rate of growth in later years. Did trade disruptions from WWI contribute to the rapid growth around 1920? If so, why did the number of spindles increase after the war but not during the war? Apart from the trade shock, did other factors simultaneously affect firm entry?

China's experience during WWI and afterward is interesting to examine for three other reasons. First, the outbreak of WWI was exogenous to China's industrial growth, and most areas in China were not directly involved in warfare. Second, because China was unable to levy a protective tariff until 1928, the tariff remained at a low level during the entire period studied (Mitchener and Yan 2014). This implies that the changes in import prices were independent of policy makers' intentions. Third, Chinese counties had distinct conditions in access to trade and finance, and both factors were likely to affect firm entry. This setting provides useful variation to understand the pre-conditions for industrial growth.

I first show that the war can be viewed as a quasi-experiment that imposed an unexpected positive demand shock on China's textile industry. Aggregated trade data indicate that the war disrupted China's cotton yarn imports. With sharp increases in the international freight rate and reductions in the world supply, the import quantity of cotton yarn to China was reduced by half and its price doubled. The pattern of prices is consistent with the price series of cotton yarn in the world's major countries, whereas the domestic prices of other necessities in China, such as food, barely increased. Data on individual textile firms show that firms capitalized on this opportunity and earned sizable profits.

After establishing that the war reduced cotton yarn imports, I compile a county-level dataset from 1907 to 1925 and quantitatively examine whether this reduction generated textile firm entry. To capture the intensity of the trade shock, I construct a transportation network and calculate each county's transport cost to ports as a measure of exposure to international trade. Combining this measure with the WWI shock, I conduct a difference-in-differences analysis to compare whether counties facing

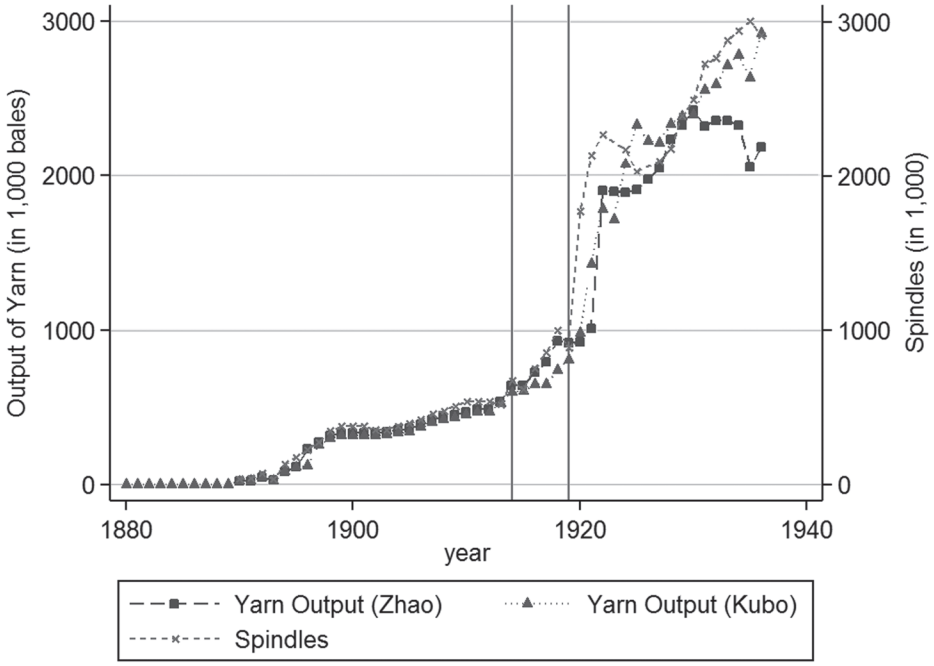

FIGURE 1
YARN OUTPUT AND NUMBER OF SPINDLES OWNED BY CHINESE FIRMS

Sources: The variables *Spindles* and *Yarn Output (Zhao)* are from the Appendix of Zhao and Chen (1997). *Output (Kubo)* is Kubo's revised estimation of Zhao and Chen, from Kubo (2004).

more intense shocks from international trade also had more textile firms during and after WWI. The results confirm the hypothesis but find that the greatest effect was around 1919 and 1920. The estimates are robust to multiple specifications and the choice of different datasets.

I then investigate the reason for this late entry. Combining information from firm archives, trade data, and British textile machinery transactions, I find that textile firms in China mostly relied on overseas machinery during this time. The war, while providing a profitable opportunity for these firms, also hindered the import of machinery. Data from Wright (2011) show that, while the Chinese firms still ordered textile machinery from Britain during the war, the actual shipment of the machinery was very limited until the war was over. This delay was undesirable for Chinese entrepreneurs, who complained about the resulting loss of potential revenue.

I also present suggestive evidence on the heterogeneous impact of local characteristics on firm entry, especially the role of access to finance. Narrative evidence suggests that the examined textile firms often faced

https://doi.org/10.1017/S0022050719000858 Published online by Cambridge University Press

capital constraints and relied on bank loans for daily operations and expansion. In addition, bank notes formed a network that reduced transaction cost and facilitated trade, which was particularly important for Chinese firms that operated using imported machinery from overseas and transported raw cotton from distant counties. The regression results show that the prewar distribution of financial institutions was positively correlated with the entry of new firms.

This paper closely relates to studies that evaluate the effect of trade protection policies, especially import substitution. The underlying theory of such policies is the "infant industry" argument that some industries have increasing returns to scale and that small domestic firms in the early stage are unable to compete with large foreign firms; temporary trade protection might provide these firms with an opportunity to reach an efficient scale. The literature has found mixed results regarding industrial policies grounded in this argument (Harrison and Rodríguez-Clare 2010; Hanlon 2017; Juhász 2018). Economic historians have taken advantage of war-led trade barriers to identify the impact of temporary trade protection on industrial growth or the direction of technological adoption (Tomlinson 1979; Irwin and Davis 2003; Irwin 2005; Hanlon 2015). A study that is closely related to this paper is that of Juhász (2018), who collected firm-level information and used trade blockades due to the Napoleonic War as an innovative exogenous shock to show that temporary trade protection had a positive and persistent effect on domestic industrial growth. What remains unclear in the literature is whether the policy would succeed in developing countries that often lack supportive institutions and upstream sectors for industrial growth (Rodrik, Arvind, and Francesco 2004). This paper provides new evidence in the context of a developing country without a domestic machinery sector or sufficient capital.

The location of industries has received increasing attention from both theoretical and empirical perspectives (Krugman 1991; Geroski 1995). Many discussions focus on the textile industry, which played a leading role in the Industrial Revolution (Allen 2009). Using newly compiled information for this industry in 1838, Crafts and Wolf (2014) find that geographic factors, a history of textile inventions, proximity to ports, and access to markets determined the location of textile firms in the United Kingdom. This paper shows that, in a developing country with an open market, exposure to international trade and intermediaries in finance were likely to facilitate firm entry. The finding that financial institutions contribute to industrial growth is consistent with other studies that have discussed the effects of financial institutions on local capital accumulation

(King and Levine 1993), new firm entry (Guiso, Sapienza, and Zingales 2004), and the formation of the manufacturing belt in the United States (Jaremski 2014).

Finally, this paper contributes to the literature on China's pre–World War II (WWII) industrial development by examining the nascent industrial sector in the 1910s. This is the period when most of China's modern industries were first established, but it has been largely overlooked in the literature due to limited available data.[2] Using a newly constructed transportation network and firm-level data, I show that WWI created favorable market conditions and promoted firm entry around ports. This conclusion echoes studies that justify the leading position of treaty ports, especially Shanghai, in China's industrialization or urbanization (Ma 2006, 2008; So and Meyers 2011; Keller, Li, and Shiue 2013; Jia 2014), but provides an explanation from the perspective of import substitution.

CHINA'S INTERNATIONAL TRADE AND COTTON YARN INDUSTRY BEFORE WWI

The handicraft textile industry prevailed in China for centuries before the arrival of manufactured yarn. When China adopted a more open trade policy in the nineteenth century, imported manufactured yarns demonstrated a clear advantage in price over handicraft ones and gradually took over the market. Efforts to build China's own manufactured textile firms began in the 1860s and initiated by officials, but the real boom of this sector waited until private firms entered the market around the 1900s.

China's International Trade

China implemented a set of highly restrictive international trade policies and remained relatively closed in the early nineteenth century. Trade with European countries was small compared to other economic activities and faced strict regulations. In 1840, conflicts between British merchants and local Chinese officials led to the outbreak of the Opium War. After losing the war, the Chinese Government in 1842 was forced to sign the

[2] Quantitative studies on China's industrial sector before WWII include growth accounting (Ou 2011; Ou and Wang 1946; Feuerwerker 1977; Liu and Yeh 1965; Chang 1969; Rawski 1989; Yuan 2007; Caruana-Galizia and Ma 2016) and evaluation of the impact of foreign power and different institutions (Hou 1961; Myers 1965; Perkins 1967; Feuerwerker 1970; Ma 2008; Keller, Li, and Shiue 2013). Studies specialized in the textile industry in pre-WWII China focus on development of this industry at different stages (Fang 2011; Yan 2011; Reynolds 1975; Chao 1977; Tokihiko 2010), firm performance (Zeitz 2013), commercial network (Brasó Broggi 2016), and comparison with Japan (Dong et al. 2015).

Treaty of Nanking, which reduced tariffs and opened five ports to international trade. Later, additional treaties were signed, which established more ports, a British-governed Maritime Customs Service, and a flat low tariff rate. By the beginning of the twentieth century, 45 ports were opened (Yan 2012). The real trade value stayed roughly the same from 1868 to 1900 and steadily grew afterward. In 1930, the real trade value was 7.72 times the value in 1900.[3]

Cotton yarn was among the first group of foreign commodities accepted by the Chinese. As early as 1880, "many parts of the Chinese Weavers prefer Foreign Cotton Yarn to the Chinese [ones]" (China Maritime Customs 1881, p. 24). Its import quantity increased steadily from 1880 to 1913, with an average annual growth rate of more than 9 percent.[4] It is estimated that approximately 64 percent of the cotton yarn consumed in China before WWI was imported (Fang 2011, p. 287).

Chinese Cotton Yarn Industry

Handicraft textile production was an important secondary activity for farmers across China by the nineteenth century. Indian Cotton (or Asian Cotton) was first introduced to South China before 500 BC and spread to North China in the thirteenth century. To produce a piece of cloth, a worker first cleaned the cotton to remove cotton seeds and dirt, and carded it for spinning. The second step was to make cotton yarn from the prepared cotton using spindles, and the third step was to weave cloth from cotton yarn using looms. The traditional handicraft sector required heavy labor inputs. To produce a piece of cloth with a width of 0.4 meters, length of 6.67 meters, and weight of 1 kilogram, a very skilled Chinese worker spent approximately six working days, with one, four, and one days for the three steps, respectively (Xu 1992, p. 51). Spinning was so costly partially because most handicraft spinning wheels only had a single spindle. Therefore, when textile machines allowed for multiple spindles at the same time, manufactured yarns easily demonstrated advantages

[3] The nominal trade value was 127,732 *Haikwan* taels (or 197,984 U.S. dollars) in 1868 and rose to 364,592 *Haikwan* taels (or 273,444 U.S. dollars) in 1900. It reached 2.2 million *Haikwan* taels (1 million U.S. dollars) in 1930 (Hsiao 1974). "*Haikwan* taels" is a special unit created to simplify transactions in international trade when China lacked a unified currency. One *Haikwan* tael equals 584 grains of silver of 992.3 fineness (Hsiao 1974). The exchange rate is reported by Hsiao (1974). One *Haikwan* tael equaled 0.73 U.S. dollars in 1905, and the rate remained similar until 1917, when silver started to depreciate relative to gold. I deflate the values using the Consumer Price Index from Officer and Williamson (2018). The real trade values in 1900 and 1930 are 161,525 and 1,247,793 in 1868 U.S. dollars, respectively.

[4] The import quantity was 152 piculs (or 20,261 pounds) in 1880 and 2,685 piculs (or 357,910 pounds) in 1913. Picul is a unit of weight. One picul equals 133.3 pounds. See Hsiao (1974, p. 19).

over the handicraft ones. In fact, Yan (2011) believes that productivity in the machinery yarn sector was 80 times that in the handicraft spinning sector when measured by output per labor, whereas productivity was only four times higher when using machinery looms to replace handicraft ones.

Facing shocks from imported manufactured yarn, the Chinese started to build their own manufactured textile industry during the second half of the nineteenth century. Early efforts came from the government, including setting up manufactured textile companies in Shanghai and Hubei (*Shanghai Jiqi Zhibuju* and *Hubei Zhibuju*) in the late 1880s. These factories faced difficulties in funding and management (Perkins 1967) or survived at the expense of prohibiting the entry of private firms (Institute of Shanghai Economy Studies 1958a); they had limited impact on the overall economy. In 1895, as the Treaty of Shimonoseki allowed foreigners to erect factories in China's ports, the resulting total number of foreign firms increased from 603 in 1895 to 1,006 in 1900 and 2,863 in 1911 (China Maritime Customs 1913). These firms brought foreign capital, technology, and management skills that stimulated the growth of the domestic industrial sector. The government also encouraged the entry of private enterprises during this time.[5]

As Figure 1 already suggests, the boom of the manufactured textile industry took place after 1913. From 1913 to 1930, Chinese yarn dramatically increased from 0.53 million bales to 2.4 million bales (Kubo 2004). Because most products were consumed by the local market, the ratio of yarn produced in China to domestic yarn consumption increased from 36 percent in 1913 to 102 percent in 1930 (Fang 2011, p. 287), indicating that China switched from being a yarn importer to a self-sufficient producer and even an exporter.

Along with the growth of total production, the location of textile firms also changed over time. Figure 2 depicts the distribution of ports and firms in 1907 and 1925. The triangles indicate the location of treaty ports, which remained the same during the study period.[6] The circles represent the textile firms, among which the darker ones suggest more firms. At the beginning of the period under study, textile firms were mostly located

[5] Several events suggest a gradual change of the attitude of the government to private businesses. The government established the Department of Commerce in 1903 and passed the "New Policies" to encourage entrepreneurships in 1905. The founding of the Republic of China (ROC) in 1912 also brought hope to Chinese entrepreneurs. For example, new social organizations and magazines were founded in Shanghai to advocate the importance of the industrial sectors during the early years of the ROC (Xu and Huang 1998).

[6] I consider the treaty ports officially listed by China Maritime Customs, which contributed most of China's international trade.

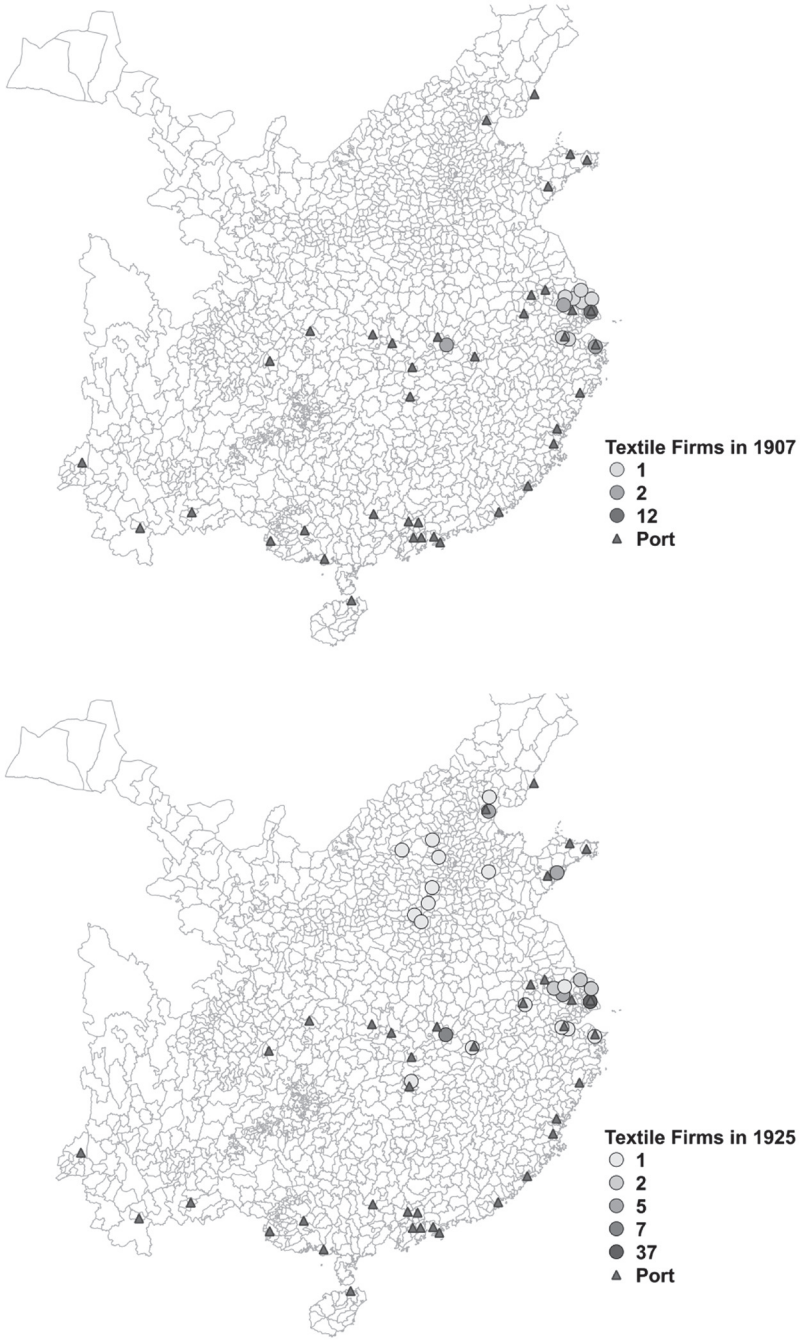

FIGURE 2
DISTRIBUTION OF TEXTILE FIRMS AND PORTS IN 1907 AND 1925

Sources: The number of textile firms is from Yan (2011). The name of ports is recorded by China Maritime Customs (1907). The base map is from the China Historical Geographic Information System, version 6 (2016).

https://doi.org/10.1017/S0022050719000858 Published online by Cambridge University Press

close to Shanghai. Ultimately, they spread to multiple other cities, especially the ones located close to ports. This is consistent with the hypothesis that shocks from international trade might have affected firm entry.

Local characteristics were likely to drive firms' locations as well. Textile firms in China heavily relied on intermediaries in finance and trade to acquire inputs, especially machinery and raw cotton. A survey in 1918 on textile firms in Jiangsu Province, where most firms located, showed that all textile machinery was imported, of which 90 percent was from Britain (Fang 2011, p. 97). Another major input for textile production was raw cotton, whose quality directly related to the quality of yarn. While some firms deliberately chose to locate in counties suitable for raw cotton growth, most raw cotton was not consumed locally in as early as the 1910s. Rather, the harvested raw cotton was transferred and sold to large cities by cotton brokers (*hua hang*) through well-functioning commercial networks. As a typical example, 80 percent of the raw cotton grown in a small county in North China was carried and transferred to large cities 100 to 150 miles away, leaving only 20 percent for local consumption.[7] Some firms also imported raw cotton from India or the United States. These transactions usually required financial institutions, which formed an exchange network of bank notes and provided credit.

Shortage of capital was another obstacle for the Chinese firms, one that haunted every stage in the growth of a textile firm. Entrepreneurs usually faced difficulties in fully collecting the required capital when starting a business. Once profits were earned, shareholders often requested dividends immediately rather than leaving sufficient reserves for future investments. For example, from 1902 to 1914, the textile firm *Dasheng* gave 64.7 percent of its profits to shareholders and 13.5 percent to staff, while only 16.8 percent was saved for the firm's development (Gu 2015, pp. 45–46). This firm had to rely on loans for activities involving large monetary transactions, including purchasing raw cotton and acquiring machinery. This was, in fact, a common practice for most textile firms, suggesting that intermediaries in finance were essential complements for firms' operations.[8] Figure 3 plots the location of textile firms in 1925 and banks in 1912. Dark areas indicate that the county had at least one textile

[7] The county in the example is Wuqiao County in Zhili Province. Half of its cotton was transferred to Jinan, the closest large city about 100 miles away, and 30 percent was sent to Tianjin, the largest port in the North about 150 miles away. This information is from a survey conducted by the Toa Dobun Shoin College in 1918. The original material was in Japanese and translated by Feng et al. (2012).

[8] In another example, when the firm *Shenxin* planned to expand its business in 1917, it borrowed 700,000 yen in total from the Japan Taiwan Bank in January and April and signed a contract with the Mitsui Trading Company in June and December to order new textile machines.

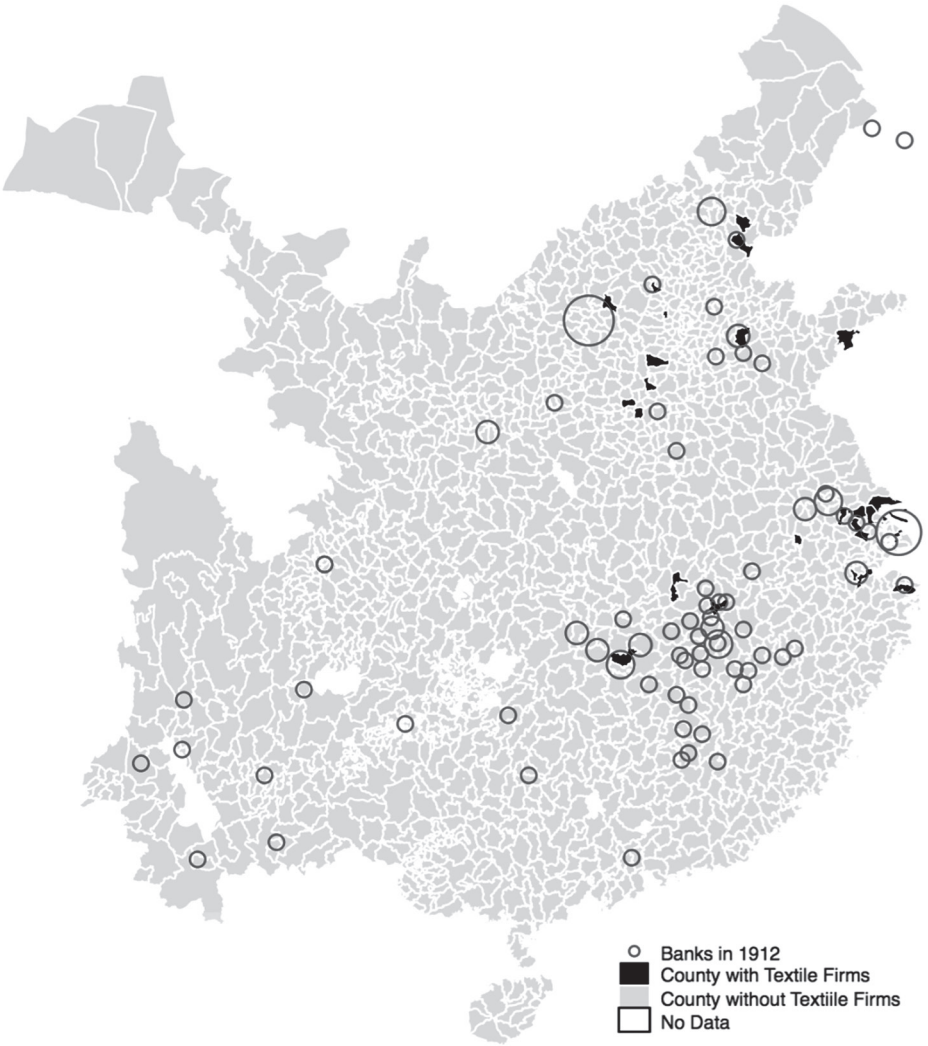

FIGURE 3
DISTRIBUTION OF TEXTILE FIRMS AND BANKS

Sources: The number of textile firms is from Yan (2011); banks were domestic banks with western institutions (in other words, domestic modern banks) from the *Nongshang tongji biao* (Reports of Statistics on Agriculture and Commerce). The base map is from the China Historical Geographic Information System, version 6 (2016).

firm and larger circles represent more banks. Counties with more banks before the war tended to have more textile firms at the end of the study period.

In addition to access to inputs, political chaos and foreign concessions might have affected the location of firms. The examined period witnessed constant political turmoil that might have discouraged private investments.

https://doi.org/10.1017/S0022050719000858 Published online by Cambridge University Press

During this time, foreign concessions were enclaves managed by foreigners and under western institutions. They usually had better protection of property rights and attracted more industrial investments.[9] For example, the largest foreign concession, Shanghai, also contributed 41 percent of national manufacturing output in the 1930s and owned more than 50 percent of cotton spindles during the study period (Ma 2006, 2008).

MEASURES OF THE TEXTILE INDUSTRY, TRADE SHOCK, AND LOCAL CHARACTERISTICS

To examine the impact of import reduction due to WWI on the textile industry, I compile information on the development of the domestic textile industry, the trade shock, and local characteristics from archives and secondary sources. In addition, I construct a new transportation network before WWI to measure access to trade for the years 1907 to 1925. This period is chosen to avoid the surge of new firms due to the New Policies instituted in 1905 and the disruptive effects caused by the large-scale fighting between the Kuomintang and the warlords starting in 1926.

Measures of the Textile Industry

Limited information is available for the cotton textile industry in the 1910s because most surveys of this industry were conducted after 1919 (see Zeitz (2013) for a review). I collect records of firm entry and exit from a secondary source and aggregate the data to the county level. To check how sensitive the results are to data quality, I compare estimates using separately constructed records.

The baseline analysis relies on Yan's (2011) collection of entry, acquisition, merger, and exit of each mill. These data record the founding time, years of actual operation, changes in names, and year when each mill ceased operating. I aggregate the data to the county level and obtain the number of textile mills in operation each year. Because this dataset traces the entry and survival of individual textile firms, it captures the "extensive margin." There were 99 firms during the examined period. As an alternative measure of the textile industry, I also use the investments of new textile firms compiled by Du (1991) to ensure that the analyses are not sensitive to the choice of data source or outcome variable. Du (1991) independently collected information of industrial firm entry before 1927

[9] The years 1912 to 1927 are regarded as the "Warlord Era" by historians (Bergère 1983). Although most of warfare lasted for a short time and centered only in small regions, it discouraged entrepreneurs from investing.

TABLE 1
INFORMATION OF INDIVIDUAL FIRMS

Name	Owners	Location	Year Established	Initial Capital
Dasheng	Zhang Jian	Nantong	1899	20,000 spindles
Shenxin	The Rong Brothers	Shanghai	1916	12,376 spindles 250 looms

Sources: Yan (2011); Shanghai Social Science Academy (1980).

from official reports, Japanese surveys, and firms' archives. This dataset reports the name, year of establishment, location, initial capital invested, and founders of 109 textile firms.[10] Because it only observes firm entry and no exit, I use it as a robustness check.

In addition to using historical data, I also examine two individual firms' experience to provide qualitative evidence about the entrepreneurs' constraints and decision processes. These firms are chosen due to their rich archives and distinct background. Table 1 summarizes the owners, year established, and scale of the two firms. The first firm, *Dasheng*, was among the earliest domestic textile firms in China. Its founder, Zhang Jian, had a government-related background. This firm performed well before 1922 but experienced serious crises when the market was down from 1923. I cite Gu's (2015) detailed analysis of *Dasheng*'s economic archives. The second firm, *Shenxin*, was founded by two merchants, the Rong brothers, in Shanghai in 1916. It entered the market later but became the largest Chinese textile enterprise before 1937. Its archives, including account books, balance sheets, and entrepreneurs' diaries, are compiled and published by the Shanghai Social Science Academy (1980). I also supplement the qualitative analysis with descriptive studies of textile firms' daily operations (Fang 2011), financial constraints (Yan 2011), performance during the war (Tokihiko 2010), and commercial network (Brasó Broggi 2016).

The Trade Shock

I capture the trade shock using information on two dimensions. The time-series variation reflects fluctuations in the import of cotton yarn. I also exploit spatial variation, coming from differences in access to international trade at the county level.

The overall volume and quantity of traded cotton yarn are obtained from the annual reports of the China Maritime Customs Service (CMC), which was a government agency operated by British officers during the

[10] The full dataset includes more than 4,000 Chinese industrial firms and expands from 1858 to 1927.

examined period. Its main task was to collect tax revenues from China's international trade. The CMC published yearly reports on the quantity and value of each traded commodity, tax revenues, and trade value of each port. Every ten years, it published another series of reports, including a summary of economic conditions in each port and the average trade values of important commodities, including cotton products. These reports provide detailed information about international trade in pre-modern China, and they are acknowledged by scholars to have high-quality data.[11]

I collect data from the CMC to capture different dimensions of textile trade. For the world price, I digitize the import quantity and value of cotton products at the national and the port level and use the information to calculate the value per unit of yarn as a proxy for the yarn price. The analysis uses data at the national level, but as Online Appendix Figure 1 illustrates, the per unit value of imported yarn moved very closely across different ports.[12] I also collect the number of foreign vessels entering China to illustrate the impact of WWI on trading activities.

To measure access to international trade, I construct a transportation network for China by combining information on major transport routes, including rivers, railroads in 1913, and historical courier roads. The network of river and courier routes comes from the latest version of the China Historical Geographic Information System (CHGIS) (Harvard Yenching Library 2016).[13] The railroad network is digitized using the map by the United States Central Intelligence Agency (1954) and assigned the order of availability based on accomplishment times recorded in *Zhongguo tiedao jianshe shilue (1876–1949)* (A Brief History of Railroad Construction in China (1876–1949)) (Zhang 1997).[14]

[11] The national aggregate trade data calculated from the CMC reports have been widely used in the literature (Yang and Hou 1931; Hsiao 1974; Hamashita 2006). Recently, scholars performed quantitative analyses using subnational information (Yan 2008; Keller, Li, and Shiue 2011, 2012, 2013; Mitchener and Yan 2014; Keller Santiago, and Shiue 2017).

[12] I depict the price series of six ports across China: Jiaozhou, Shanghai, Hankou, Guangzhou, Chongqing, and Mengzi. The only price series that seems to have smaller fluctuations is the one for Mengzi, which was a far inland port in Yunnan; however, even the price there dramatically increased during WWI. The co-movements of price series also justify the hypothesis that none of the local markets in China were large enough to affect price changes in the world market during the examined period.

[13] The CHGIS is a research project conducted by the Harvard Yenching Library and Fudan University. It documents the locations of historical counties in China.

[14] For those that are not covered by any types of routes, I follow Jaworski and Kitchens (2018) to build "access road" by linking counties nearby using direct lines. I assign the rate of regular roads and rivers using records from Peng (2015). Specifically, the speed of rivers, major roads, and access roads were 150 km, 75 km, and 40 km per day. The speed of railroads was 1200 km per day. The assignment is mostly based on the speed transferring passengers and should be greater than the one for commodities. Online Appendix A provides a detailed discussion of the choice of transportation speed.

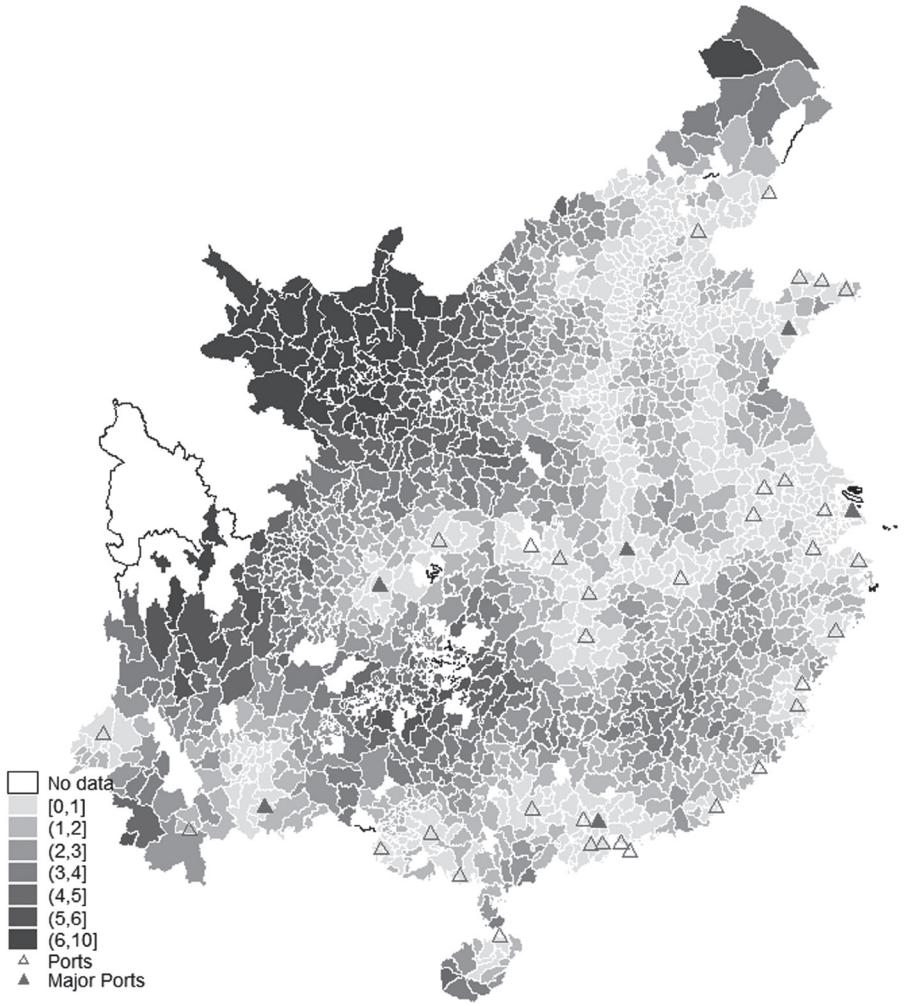

FIGURE 4
TRANSPORTATION COSTS TO PORTS (IN DAYS)

Sources: The road network is composed of four types of transportation mode: railroads, rivers, historical postal routes as a proxy for major roads, and access roads that are direct lines to connect counties not accessible using the first three transportation modes.
The assigned speeds per day of railroads, rivers, major roads, and access roads were 1,200 km, 150 km, 75 km, and 40 km, separately. Online Appendix A provides a more detailed discussion about the choice of the speed.

After combining all the routes and setting a transportation speed to each type of route, I calculate the transportation cost between a given county to all ports on the map and locate the port with the lowest cost in terms of time. This measure is similar to the "effective distance" used in Juhász (2018). Figure 4 depicts the cost to ports in days. More than 60 percent of the counties could access ports within three days.

https://doi.org/10.1017/S0022050719000858 Published online by Cambridge University Press

To address the concern that access to large ports might have had different effects than access to small ports, I also calculate the cost to six major treaty ports, selected based on their importance in cotton yarn trade. Located across China, these six ports together contributed more than 40 percent of yarn imports during this period. In fact, the import of cotton yarn was not dominated by an exceptionally large port but rather evenly distributed across at least 15 ports.[15] The dark triangles in Figure 4 represent the location of major ports.

Local Conditions

In addition to access to trade, local conditions were likely to affect firm entry. I collect data to quantify factors that entrepreneurs often considered when setting up a firm during this period. These factors are financial institutions, geographic suitability for textile production, and political chaos.

The first set of variables measures financial institutions. In this period, financial institutions were composed of traditional banks, Chinese banks structured under western institutions (hereafter modern Chinese banks), and foreign banks. Online Appendix B presents a brief discussion of their differences. The data on the first two types of banks come from the survey in 1912 by the Bureau of Agriculture and Commerce (1914), which reports capital for modern Chinese banks at the branch level and the number of traditional banks in each county. I use the data in 1912 because this is the only year where the branch information is available. The location of foreign banks' headquarters is collected from *Waiguo zaihua gongshang qiye cidian* (The Universal Dictionary of Foreign Business in Modern China) (Huang 1995). A benefit of using the cross-sectional distribution of financial institutions is to address the concern that the location of banks might have responded to firm entry. I check the correlation of bank capitals from 1912 to 1921 to ensure that banks' locations in 1912 are a valid proxy for the later locations.[16]

I control for whether a county's indigenous characteristics were suitable for textile production using two indicators. The first indicator is whether a county was a historical center of handicraft textiles. I use the location of handicraft textile centers in the eighteenth century presented

[15] The six major ports are Jiaozhou, Shanghai, Hankou, Guangzhou, Chongqing, and Mengzi. I alternatively define major ports as those with the largest trade volumes, including Shanghai, Tianjin, Hankou, Guangzhou, and Xiamen. The constructed trade costs are the same for most counties and the regression results are very similar.

[16] The correlation of bank capital for headquarters between 1912 and 1921 is 0.76, suggesting that the banks are highly persistent. I will also check the robustness of estimations using the longitudinal data.

by Guo (1990) and identify approximately 50 counties as historical textile centers. The second indicator is geographic suitability for cotton growth. I collect this information from the Global Agro-Ecological Zones (GAEZ), a data portal developed by the Food and Agriculture Organization (FAO) (2012).[17] The original data report suitability in eight levels for a 50 × 50 km^2 cell, and I calculate the mean of all cells in a given county. The data show that northern counties are more suitable for raw cotton growing (Online Appendix Figure 2).[18]

The last set of control variables addresses political turmoil. The county-level locations of political chaos are constructed from *Zhonghua minguo junshishi* (The Military History of the Republic of China) (Jiang 2009), which describes the time, location, parties involved, and leaders of army battles in major domestic military conflicts since 1911.[19] The locations of foreign concessions, the peace shelters during chaos, are from Yan (2012), who provides a list of all foreign concessions in China.

Table 2 reports the summary statistics for the variables. The first panel presents the variables capturing industrial performance at the county level. The second panel lists the measure of the trade shock. The last two panels show the control variables, including county characteristics and indicators for political chaos and foreign concessions.[20]

IMPACT OF WWI ON TEXTILE TRADE

WWI began in July 1914 and lasted until November 1918. The war disrupted production of commodities in Europe and hindered commercial activities in the global market. Export data from Mitchell (1988, pp. 356–57, Textiles Table 16) show an apparent decline in the export quantity of British cotton yarn. As the world's largest industrialized economy and yarn producer, Great Britain's exports of twist and yarn averaged 217 million pounds from 1905 to 1913. The number dropped to 178 million in 1914 and continued to fall until it reached 102 million in 1918.

[17] Nunn and Qian (2011) use this information to capture suitability for the potato. Chen and Kung (2016) apply these data in a Chinese history context.

[18] This database divides the entire globe into 2.2 million grid cells, with each cell covering approximately 50 km × 50 km. The potential yield is calculated based on the average condition from 1960 to 2000. I choose an "intermediate" input level to measure the average level and "rain-fed" water supply to exclude the impact of artificial water projects after 1960 to 2000. The average number of cells covered by each county in China is 40. The potential yields are measured using eight classes, from "very high" to "not suitable." I use integers ranging from eight for very high to zero for not suitable, with digits used to denote each class.

[19] For example, for the Xinhai Revolution, it reports the time and location of fights in 19 counties.

[20] Data for the empirical analyses can be retrieved from Liu (2019).

TABLE 2
SUMMARY STATISTICS

Variable	Description	Source	Mean	Std. Dev.	*N*
Textile industry					
Log (# firms)	Number of firms	Yan (2011)	0.008	0.106	33,991
Log (capital)	New capital invested	Du (1991)	0.006	0.11	33,991
Trade shock					
Price	Log(Average unit value of imported yarn)	Calculated from Hsiao (1974)	3.578	0.372	33,991
τ	Trade cost to closest ports (in days) in 1914	Self-constructed	3.094	5.204	33,991
τ to major ports	Trade cost to closest major ports (in days) in 1914	Self-constructed	4.351	5.888	33,991
County characteristics (cross-sectional)					
Bank	Log(Capital of Chinese modern banks)	Bureau of Agriculture and Commerce (1914)	0.432	2.235	33,991
CHbank	Log(Capital of Chinese traditional banks)	Bureau of Agriculture and Commerce (1914)	2.728	4.584	33,991
Fbank	Number of foreign banks	Huang (1995)	0.084	0.791	33,991
Yanghang	Trading companies	Huang (1995)	0.236	6.398	33,991
Textile	Historical textile centers	Guo (1990)	0.026	0.158	33,991
Cotton	Standardized suitability for cotton production	FAO GAEZ	0	0.984	33,991
Political chaos					
Conflict	Whether there was domestic warfare	Jiang (2009)	0.003	0.057	33,991
Concession	Being a concession or not	Yan (2012)	0.008	0.091	33,991

Sources: Sources are provided in the table.

Meanwhile, international trade became more expensive. The real international freight rate index doubled from 1914 to 1915. From 1915 to 1917, the freight rate index further rose 60 percent per year and reached its peak from 1917 to 1918, which was approximately eight times the prewar level. The real freight rate rapidly decreased when the war was over and went back to the prewar level in 1924.[21] Consistent with this trend, the overall tonnage of vessels entering China decreased from

[21] Cited from Stopford (2009, pp. 754–58). The original nominal freight rate is compiled by Isserlis (1938). I cite the indices reported by Stopford (with the freight rate in 1741 equal to 100). The nominal freight rate index increased from 71 in 1914 to 795 in 1918 and dropped back to 519 in 1919. The real freight rate is calculated by Stopford, who uses the nominal rate derived by a composite price deflator, with the level in 2000 as the base. The calculated real freight rate index is 1,221 in 1914, increasing steadily until reaching its peak level 9,895 in 1917.

27.65 million in 1914 to 24.12 million in 1915. In 1918, the total tonnage reached its lowest level of 18.95 million, which was only 66 percent of the level in 1914. After the war ended, the total level of tonnage soon returned to the original level and kept growing, until the large domestic warfare from 1925 to 1926.[22]

With reductions in traded commodities and dramatic increases in freight rates, China's international trade gradually felt the impact of WWI. The Chinese Maritime Customs stated in the Reports of 1914: "…[T]he effects [of the outbreak of the Great War] were immediately felt in China. Later, when conditions became more settled and cargo was [offered], the German and Austrian flags had disappeared, much British and French tonnage had been engaged by their Governments, and neutral steamers had found more profitable employment elsewhere; so that there was such a scarcity of tonnage that in spite of willing buyers and sellers the cargo could not be accommodated" (China Maritime Customs 1915, p. 2, Part I). The influence persisted as the war continued. In 1916, when the political chaos inside China ended with a peaceful transition of power and the climate was "favorable," the Maritime Customs officer reported that "it may be safely said that it was only due to the conditions brought about by the [Great] [W]ar that trade was not exceedingly flourishing" (China Maritime Customs 1917, p. 1, Part I).

The share of textile products in China's total import value was 32 percent before WWI, much higher than other major imports.[23] As the war greatly reduced global supply of textile products and hindered trade, the import prices of these products increased in China.[24] Figure 5 plots the wholesale price indices of cotton yarn in Britain, the United States, and Japan, together with China's import price. The wholesale price indices around the world moved very tightly, with a relatively flat line from 1900 to 1915 and a sharp increase starting in 1916. When reaching their peaks around 1919, they had already tripled compared to the indices in 1914. The wholesale price indices then dropped in 1921. The Chinese import price of cotton yarn closely followed changes in the world market

[22] China Maritime Customs, Decennial Reports (1922–1931, p. 173). General Statistics, Table 4, "Synopsis of the External Trade of China, 1882–1931."

[23] Sundries rank second with a share of 23 percent, calculated from Hamashita's copy of the Decennial Reports (Hamashita (2006), Appendix).

[24] It is difficult to clearly disentangle whether the reduction of cotton yarn imports was due to reduced world supply or rising trade costs. One observation is that China's main trading partners were the Asian countries, with approximately 50 percent of the imports from Japan and 20 percent from British India. Imports from both countries dropped during the period. This implies that fluctuations in the international freight rate were probably the dominant factor. The Customs Report in 1918 also mentioned other possible causes, including exchange rate, the increased cost of production in Japan, and shortage of ships.

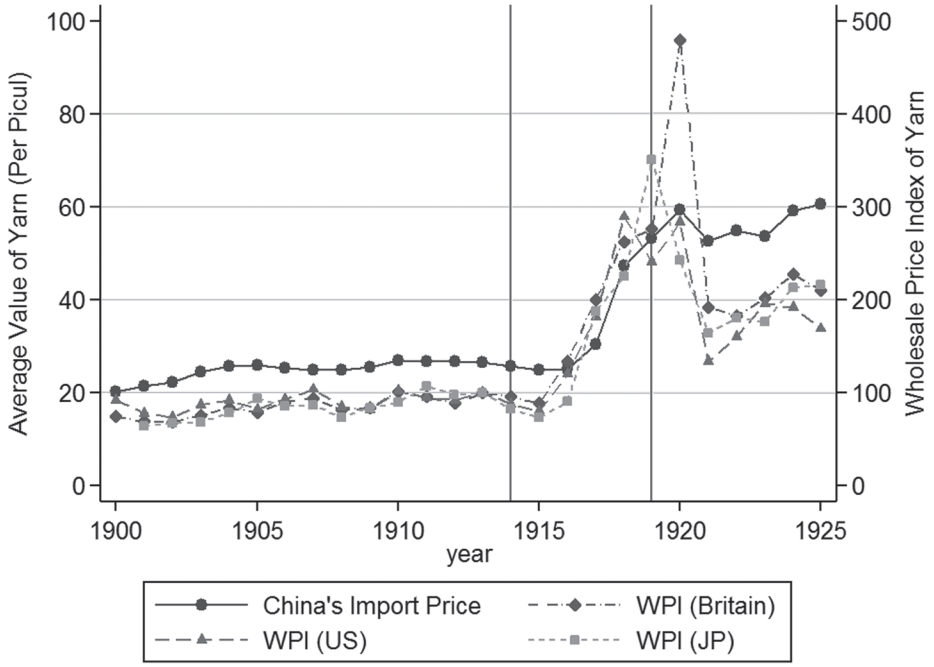

FIGURE 5
CHINA'S IMPORT PRICE AND OTHER COUNTRIES' WHOLESALE PRICE INDICES OF COTTON YARN

Note: Picul is a unit of weight; 1 picul is equal to 133.3 pounds.
Sources:
British price indices are from Mitchell (1988, p. 729, Prices 5, Panel B).
U.S. indices are from the Wholesale Price Index published by U.S. Department of Labor, Bureau of Labor Statistics (1927, No. 440, p. 114, Table 9); the subcategories are "White, mule-spun, northern, cones, 12/1" and "White, mule-spun, northern, cones, 22/1" under "Yarn, carded" and "Cloths and clothing."
The Japanese index is from Research and Statistics Department at the Bank of Japan (1999), "Tokyo Wholesale Price Index on October 1900 Base," available at https://www.imes.boj.or.jp/english/hstat/index.html.

before 1919 but remained high after 1920. The price increase was salient even after controlling for quality. I am able to find the price series for cotton yarn under the same brand in Tianjin. The domestic prices of both 10-count and 16-count yarn increased steadily from 1914 to 1919, with an average of 26.24 percent increase for the 10-count yarn and 33.92 percent for the 16-count yarn per year.[25] Meanwhile, domestic prices for other necessities, such as rice and wheat, were stable as long as they

[25] Data on the cotton price under the same brand are the prices of *Songhe* brand collected by the Nankai University, cited from Kong (1988, pp. 59–70, Section 1.3, Table 1). Because Chinese firms concentrated on producing low-quality cotton yarn, the average quality of imported cotton yarn did improve (Tokihiko 2010).

https://doi.org/10.1017/S0022050719000858 Published online by Cambridge University Press

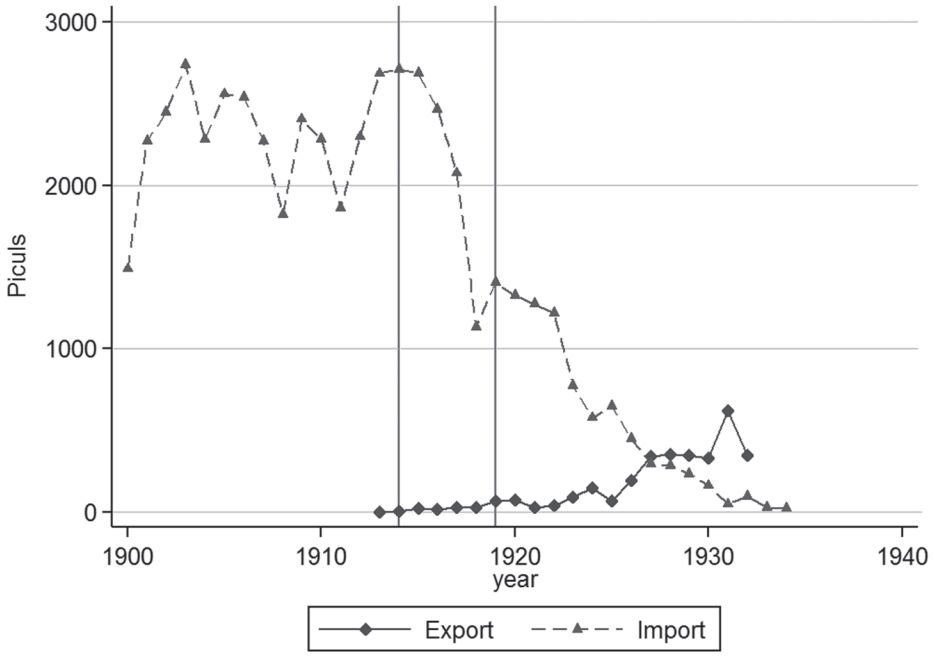

FIGURE 6
CHINA'S IMPORT AND EXPORT QUANTITY OF COTTON YARN

Note: Picul is a unit of weight; 1 picul is equal to 133.3 pounds.
Source: The data are from Hsiao (1974, p. 38, Table 2, "Cotton yarn").

mostly relied on domestic production. The wholesale price indices in Tianjin and Shanghai show that the prices of food in both places were quite stable during the war years. In sharp contrast, the price of cloth in Tianjin steadily increased by approximately 15 percent per year from 1914 to 1919, even before the international price of cotton products started to rise.[26]

Along with the rising price, the quantity of imported yarn dropped. Figure 6 depicts the import and export quantities. While the import quantity fluctuated from 1901 to 1914, which was probably caused by political chaos, its average level remained above 2,000 piculs (or 266,000 pounds). From 1915 to 1918, however, the quantity sharply decreased from 2,686 piculs (or 358,043 pounds) to 1,132 piculs (or 150,895 pounds). Besides yarn, the total amount of cotton goods was also decreasing: The quantity of the principal plain cotton products decreased from 193.6 million

[26] Shanghai's rice price series is from Institute of Shanghai Economy Studies (1958b, p. 120, Appendix Table 8). Tianjin's food and cloth price series are from Kong (1988, p. 7, Section 1.2, Table 1).

https://doi.org/10.1017/S0022050719000858 Published online by Cambridge University Press

pieces to 10.4 million pieces.[27] Figure 6 also suggests that this trend for cotton yarn did not reverse. When the war was over, the import of yarn recovered slightly but soon fell again, surpassed by exports after 1927.

Textile firms benefited from the favorable market and earned sizable profits, especially from 1916 to 1919. Archival information of two individual textile firms, *Dasheng* and *Shenxin,* suggests that these firms had a similar experience: Both of their profit-to-capital ratios increased from less than 10 percent in 1916, to around 40 percent in 1917, and ranged from 74 to 108 percent in 1918.[28] Cross-sectional data on profits for 23 textile firms in 1919 show that the average profit-to-capital ratio was over 100 percent, with the least profitable firm able to reach a ratio of 60 percent.[29] In addition, the lucrative market incentivized the entry of new firms, especially in major ports. When reviewing ports' experience from 1912 to 1921, the Customs officer pointed out that the port cities witnessed increases in both the number of domestic firms and the varieties of domestic manufactured products. In Tianjin, shortages in market supply due to the reduced imports of cotton products were "largely filled by increasing imports of native gray goods and by the local production of cotton yarn and cloth."[30] In Shanghai, the expansion of domestic industries originally "need[ed] time and patience," but "a great and unlooked-for impetus was given to the movement by the Great War. The world's trouble was China's opportunity."[31]

ECONOMETRIC ANALYSES OF TRADE SHOCKS AND COTTON TEXTILE INDUSTRY

In this section, I conduct econometric analyses to examine the impact of the import reduction during WWI on the expansion of the cotton textile industry in China. Case studies indicate that the war reduced world supply and increased the demand for domestic cotton products, which led to a surge in profits for existing firms. I first use a difference-in-differences model to evaluate how the entry of new firms responded to the trade shock and whether the effects varied by access to trade. The trade shock is captured using the war dummies and the value of per unit imported cotton yarn. Access to international trade is measured using the cost of

[27] China Maritime Customs, Returns of Trade and Trade Reports (1918, p. 8, Part I).

[28] *Dasheng*'s data are from Gu (2015, p. 42). *Shenxin*'s data are from Shanghai Social Science Academy (1980, p. 58).

[29] Tokihiko (2010, pp. 146–48, Table 3-15).

[30] China Maritime Customs, Decennial Report, vol. 1 (1912–1921, p. 141).

[31] China Maritime Customs, Decennial Report, vol. 2 (1912–1921, p. 26).

each county to its closest port. I then explain the timing of firm entry. The final part of this analysis provides suggestive evidence on the impact of local characteristics on firm entry, especially the role of access to finance. The data cover the years 1907 to 1925.

For county i at year t, the full baseline regression equation is

$$y_{it} = \beta_0 + \beta_1 WWI_t \times \tau_i + \beta_2 PostWWI_t \times \tau_i + \mu_i + \sigma_t + \varepsilon_{it}, \qquad (1)$$

where y_{it} is the number of firms in the textile industry plus one in natural log form; τ_i indicates the calculated transportation cost (in time) from a county to its closest port (I use the natural log of transportation cost plus one); and WWI_t and $PostWWI_t$ are dummy variables, with WWI_t equal to one from 1914 to 1919 and zero otherwise and $PostWWI_t$ equal to one for the years 1920 to 1925 and zero otherwise. When τ_i is equal to zero, a county included a port in its territory.

Table 3 reports the results of multiple specifications. Standard errors are clustered at the provincial level. In Column 1, I show the results using WWI_t and $PostWWI_t$ instead of annual year dummies and without interacting the trade cost measure τ_i. This regression aims to capture the simple time trend of firm entry after controlling for county fixed effects. Both the coefficient estimates of WWI_t and $PostWWI_t$ are positive, but the one of $PostWWI_t$ is much greater and statistically significant, indicating that many more firms entered after the war.

Column 2 reports the results after adding the interaction terms $WWI_t \times \tau_i$ and $PostWWI_t \times \tau_i$. These terms capture whether ports with more difficult access to international trade responded differently during and after the war. The coefficient estimates of the war dummies show that the number of firms in port counties rose by 0.19 percent during the war and 2.02 percent after the war; the later coefficient is statistically significant. When comparing the estimated coefficients of the interaction terms $WWI_t \times \tau_i$ and $PostWWI_t \times \tau_i$, the results suggest that, compared with the port counties, a 1 percent increase in transportation cost of counties to ports reduced the positive effect on firm entry by 0.0122 percent after the war. Combined with the coefficient estimate on $PostWWI_t$, this suggests that the overall effect on postwar firm entry was still positive until the logged transportation cost to the closest port increased to 1.66, which was approximately 5.07 days. This range covers more than 80 percent of the counties. Column 3, which corresponds to Equation (1), reports the results after replacing the war dummies with year fixed effects, aiming to control for additional national shocks during the examined period. The coefficients on the interaction terms barely change.

https://doi.org/10.1017/S0022050719000858 Published online by Cambridge University Press

TABLE 3
IMPACT OF WWI AND ACCESS TO TRADE ON THE NUMBER OF TEXTILE FIRMS IN CHINA, 1907–1925

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	Log(# Firms)	Log(# Firms)	Log(# Firms)	Log(# Firms)	Log(# Firms)	Log(# Firms)	Log(# Firms)
WWI	0.000539	0.00186			0.00201		
	(0.000420)	(0.00136)			(0.00135)		
PostWWI	0.00670***	0.0202***			0.0233***		
	(0.00236)	(0.00609)			(0.00647)		
WWI × τ		–0.00119	–0.00119	–0.000794			
		(0.000910)	(0.000910)	(0.00108)			
PostWWI × τ		–0.0122***	–0.0122***	–0.0110**			
		(0.00435)	(0.00435)	(0.00399)			
WWI × τ *in major ports*					–0.00106	–0.00106	–0.000587
					(0.000710)	(0.000710)	(0.00101)
PostWWI × τ *in major ports*					–0.0119***	–0.0119***	–0.0105***
					(0.00380)	(0.00380)	(0.00335)
Observations	33,991	33,991	33,991	33,972	33,991	33,991	33,972
R^2	0.005	0.012	0.013	0.012	0.012	0.013	0.012
Number of counties	1,789	1,789	1,789	1,788	1,789	1,789	1,788
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	No	Yes	Yes	No	Yes	Yes
Exclude Shanghai	No	No	No	Yes	No	No	Yes

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors, reported in parentheses, are clustered at the provincial level. The regression covers the period from 1907 to 1925. The dependent variable is the numbers of textile firms (plus one and raised to the natural log form). *WWI* and *PostWWI* are dummy variables. τ is constructed travel time (in days) from a county to its closest port (plus one and raised to the natural log form). The variable τ *to major ports* captures the travel time (in days) from a county to one of the six major ports in yarn trade (plus one and raised to the natural log form). These ports (from North to South) are Jiaozhou, Shanghai, Hankou, Chongqing, Guangzhou, and Mengzi.
Source: Author's calculations from Yan (2011) and CHGIS (2016).

It is possible that the results above may have been driven by the performance of one single city, Shanghai. As the largest port and foreign concession, Shanghai was a shelter for many industrial firms during political chaos. As a result, in 1933, it owned 50 to 60 percent of the spindles in China (Ma 2008). During the examined period, the estimated production of the manufactured cotton yarn industry experienced a rapid growth in Shanghai: From 1895 to 1911, the total production value increased from 16.14 million yuan to 47.40, with the per year growth rate only 7 percent; but the growth rate from 1911 to 1925 increased to 11.87 percent, with the production value in 1925 reaching 227.82 million yuan (Xu and Huang 1998, Appendix Table 1). To address the concern that the results were only driven by this industrial center, I drop Shanghai and re-run the regression. Column 4 in Table 3 reports the results. The estimated coefficient of $PostWWI_t \times \tau_i$ decreased by 11 percent but remains statistically significant.

Another concern is that some small ports had much fewer trading activities than the large ones, so including all ports may have overestimated the level of access to international trade for some counties that located close to small ports but far from large ports. Columns 5–7 report the results using the recalculated trade costs to six major ports only instead of to all ports. The estimated coefficients are quite similar.

Because the data in the baseline analysis only address the number of firms, I use an alternative dataset from Du (1991). This dataset records the initial capital of new firms, which measures increases of investments in the textile industry. Although these two datasets were largely based on similar original archives, they were constructed independently. Online Appendix Table 1 reports the results using the logged initial capital of the new firms. The estimated coefficient of $PostWWI_t \times \tau_i$ remains negative and statistically significant.

The results above may be biased if counties with better access to trade displayed different growth paths before the war. To address this concern, I check the pre-trends by replacing the war dummies with year dummies interacted with the cost to ports. Figure 7 shows the coefficient estimates of the interaction terms, which are a measure of the difference between the growth of firms in port counties and non-port counties in each year. The trend in prewar years after controlling for county dummies was flat and close to zero, indicating that counties had similar growth paths before the war. Starting from the war years, however, the firm growth in the port and the non-port counties started to diverge and the disadvantage of the non-port counties enlarged after the war.

I also use an alternative specification to further establish the relationship between international trade and textile firms. The war dummies in

https://doi.org/10.1017/S0022050719000858 Published online by Cambridge University Press

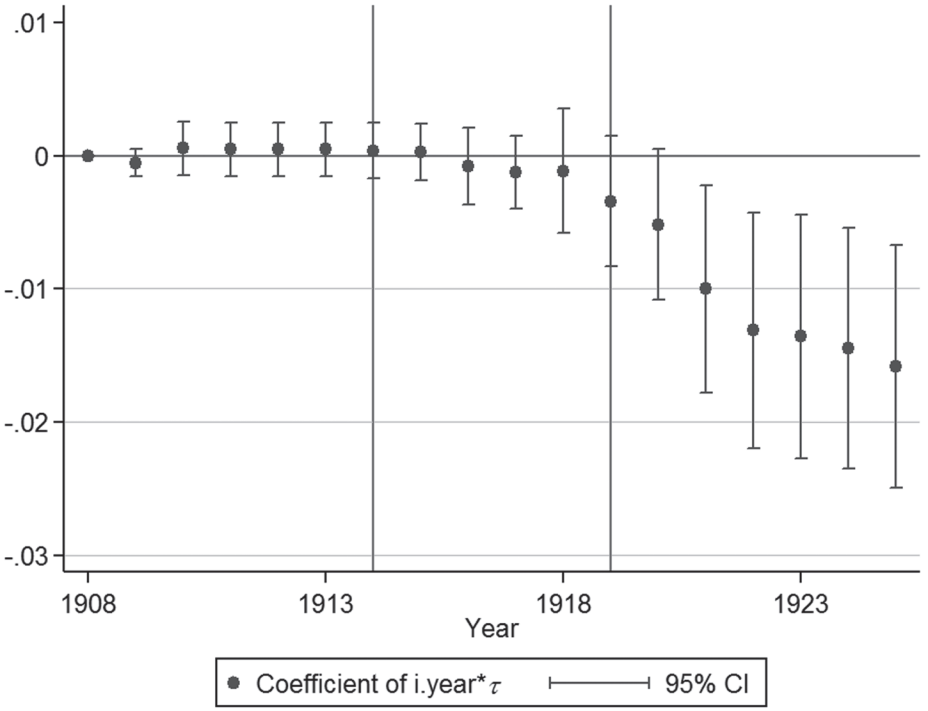

FIGURE 7
IMPACT OF ACCESS TO TRADE ON NUMBER OF FIRMS

Source: The data are from the author's calculations.

the baseline regression capture firm entry during and after the war, but as time dummies, they also include the impact of other nationwide shocks, especially when China was experiencing transitions in its political institutions.[32] To quantify the trade shock more precisely, I replace the war dummies with the constructed import price in the regression. The regression equation is

$$y_{it} = \beta_0 + \beta_1 Price_t \times \tau_i + \mu_i + \sigma_t + \varepsilon_{it} \quad (2)$$

where $Price_t$ is measured using the logged per unit value of imported cotton yarn, calculated from the reported total trade value and total import quantity. I use the national values to avoid potential adverse effects of local shocks on yarn imports.

Table 4 reports the results. Column 1 displays the specification without controlling for year fixed effects. The results show that, when the price of

[32] Through the transition process, major shocks include the establishment of the Republic in 1912, President Yuan's attempt to restore the monarchy in 1916, and political fragmentation afterward.

https://doi.org/10.1017/S0022050719000858 Published online by Cambridge University Press

TABLE 4
IMPACT OF IMPORT PRICES AND ACCESS TO TRADE ON THE NUMBER OF TEXTILE FIRMS IN CHINA

Variables	(1) Log(# Firms)	(2) Log(# Firms)	(3) Log(# Firms)	(4) Log(# Firms)	(5) Log(# Firms)	(6) Log(# Firms)
price	0.0220***			0.0253***		
	(0.00672)			(0.00706)		
price × τ	–0.0133**	–0.0133**	–0.0121**			
	(0.00480)	(0.00480)	(0.00448)			
price × τ *in major ports*				–0.0129***	–0.0129***	–0.0114***
				(0.00413)	(0.00413)	(0.00376)
Constant	–0.0183**	0.0530***	0.0472***	–0.0183**	0.0635***	0.0554***
	(0.00749)	(0.0168)	(0.0156)	(0.00704)	(0.0182)	(0.0164)
Observations	33,991	33,991	33,972	33,991	33,991	33,972
R^2	0.010	0.012	0.011	0.010	0.012	0.010
Number of counties	1,789	1,789	1,788	1,789	1,789	1,788
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	Yes	No	Yes	Yes
Exclude Shanghai	No	No	Yes	No	No	Yes

Notes: *** p < 0.01, ** p < 0.05, * p < 0.1. Standard errors, reported in parentheses, are clustered at the provincial level. The regression covers the period from 1907 to 1925. The dependent variables are the numbers of textile firms in county *i* at time *t* (plus one and raised to the natural log form). The variable *price* is the average value of yarn per piece at each port in natural log form. τ is constructed travel time (in days) from a county to its closest port (plus one and raised to the natural log form). τ *to major ports* captures the travel times (in days) from a county to one of the six major ports in yarn trade (plus one and raised to the natural log form). These ports (from north to south) are Jiaozhou, Shanghai, Hankou, Chongqing, Guangzhou, and Mengzi.
Source: Author's calculations from Yan (2011), Hsiao (1974), and CHGIS (2016).

yarn increased by 1 percent, the port counties experienced a 0.0220 percent increase in the number of cotton yarn firms, suggesting a tight connection between the price of cotton yarn and the number of the new textile firms. However, when the transportation cost increased by 1 percent, the positive effect of a 1 percent rise in price was reduced by 0.0133 percent. Given that the price level in 1919 was 90 percent higher compared to the prewar level, the estimation suggests that the average number of yarn firms increased by 1.98 percent at counties with ports, but a 1 percent higher trade cost discouraged the entry by 0.012 percent. The calculated effect has a similar size as the one using dummy variables in Table 3. The coefficient estimate of $Price_t \times \tau_i$ remains after controlling for year fixed effects, as the estimation result in Column 2 shows. Dropping Shanghai in Column 3 slightly reduces the size of the coefficient estimate to 0.0121, but it remains statistically significant. Columns 4–6 show that using transportation costs to major ports barely changes the estimates.

Explaining Patterns in Firm Entry

Rawski (1989) and Reynolds (1975) observe that there were lower capital formation and slower domestic textile industry growth during WWI compared with the period after the war. The econometric analysis of this paper supports this statement and finds that firm entry was greater after WWI than during the war. What was the reason for this delayed boom?

I first address the conjecture that the pattern was driven by foreign investments. China was open to foreign investments during the examined period and there was a surge in the number of Japanese textile firms after 1921 (Tokihiko 2010). It is possible that the later entry of firms was driven by foreign investments that paused during the war and flooded in after the war was over. To consider the entry of foreign firms, I divide the sample by firm nationality and re-run the regression. The first three columns of Table 5 report the estimations using a full sample of counties for the Chinese firms and the ones after dropping Shanghai. Because most foreign firms clustered in Shanghai, I only report the full sample results for the Japanese and the British firms in Columns 4–7. The postwar coefficient estimates are statistically significant for the Japanese firms and not for the British firms, but in both cases, the absolute values are much smaller than the ones for the Chinese firms, suggesting that foreign investments were not the driving forces for late entry.

In fact, the reason for the postwar rather than in-war entry was likely due to the postponed arrival of machinery. China was unable to produce textile machinery and relied heavily on imports from overseas, especially

TABLE 5
IMPACT OF WWI AND ACCESS TO TRADE ON THE NUMBER OF TEXTILE FIRMS IN CHINA, BY NATIONALITY

Variables	(1) Chinese	(2) Chinese	(3) Chinese	(4) Japanese	(5) Japanese	(6) British	(7) British
WWI	0.00209			0.000641		0.000325	
	(0.00129)			(0.000620)		(0.000314)	
PostWWI	0.0191***			0.00449*		0.000901	
	(0.00626)			(0.00238)		(0.000871)	
WWI × τ	–0.00135	–0.00135	–0.000794	–0.000422	–0.000422	–0.000214	–0.000214
	(0.000883)	(0.000883)	(0.00108)	(0.000414)	(0.000414)	(0.000210)	(0.000210)
PostWWI × τ	–0.0116**	–0.0116**	–0.00997**	–0.00276*	–0.00276*	–0.000593	–0.000593
	(0.00442)	(0.00442)	(0.00379)	(0.00156)	(0.00156)	(0.000582)	(0.000582)
Constant	0.00509***	0.00517***	0.00417***	0.000701**	0.000614*	0.000828***	0.000775***
	(0.000687)	(0.000794)	(0.000889)	(0.000270)	(0.000334)	(0.000103)	(0.000156)
Observations	33,991	33,991	33,972	33,991	33,991	33,991	33,991
R^2	0.012	0.013	0.011	0.003	0.003	0.002	0.002
Number of counties	1,789	1,789	1,788	1,789	1,789	1,789	1,789
County fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exclude Shanghai	No	No	Yes	No	No	No	No

Notes: *** p < 0.01, ** p < 0.05, * p < 0.1. Standard errors, reported in parentheses, are clustered at the provincial level. The regression covers the period from 1907 to 1925. The dependent variables are the numbers of textile firms in county *i* at time *t* by nationality (plus one and raised to the natural log form). *WWI* and *PostWWI* are dummy variables. τ is constructed travel time in days (plus one and raised to natural log form) from a county to its closest port.
Source: Author's calculations from Yan (2011) and CHGIS (2016).

from the United Kingdom (Fang 2011, pp. 96–100). Firms' archives show that, while the shipping of machines from Europe to China already took substantial time, the war further stalled machinery arrival. In 1917, when *Shenxin* intended to expand production by purchasing new machines, difficulties caused by the war hindered the business. Rong Desheng, the owner of *Shenxin,* wrote in his diary, "In 1918 … [we] intended to increase spindles, but we could not find a company to purchase from … Mu Ouchu (the owner of another textile firm) obtained machines with 25,000 spindles from the US, but their arrival was also delayed. [The planned] *ShenXin II* ordered 10,000 spindles from the Great Britain, and these spindles came after the war. In preparation for the arrival of new machines, we uninstalled the old machines and waited, which led to considerable lost opportunities" (Shanghai Social Science Academy 1980, p. 59). Similarly, Zhang Jian ordered machines from the British firms for a new factory, *Dasheng III*, in 1915, but the machines did not arrive until 1921 (Gu 2015, p. 175).

The trade statistics suggest that many firms might have faced similar difficulties. Figure 8 presents the total number of orders with the British manufacturers and the import values of textile machinery in each year. The dashed line shows the total number of orders with the British manufacturers, constructed based on Wright's (2011) records of textile machinery transactions. These data recorded individual transactions involving major textile machinery producers in Britain, with codes for major supplies, trading countries, firm identifiers, number of frames and spindles, and order and shipping times (Saxonhouse and Wright 2010). I select the ones with China. Because Britain was the main producer of textile machinery in China during this time, these orders serve as a good proxy for the general demand for textile machinery from firms in China. The total number of orders surged in 1909, 1914, and 1920.[33] The dotted line depicts the import values of textile machinery. Starting from a low level, the import values doubled from 1918 to 1919, still less than 2,000 *Haikwan* taels, and surged to more than 30,000 *Haikwan* taels in 1922. While the number of orders mostly parallels the trend of the machinery importation, there were relatively more orders from 1914 to 1919, compared to the actual machinery shipped.

In Wright's (2011) transaction-level data, a subsample of transactions with Platt, a major supplier of textile machinery to the Chinese firms, also records the order time and the shipping time of each order.[34] I calculate

[33] The pattern is similar if using the total number of spindles ordered.

[34] The data do not report the specific name of the producers nor the names of ordering firms. I am able to identify most of the manufactures by matching the records from Fang (2011, p. 97). The identified manufacturers are Asa Lees, Dobson and Barlow, Platt, as well as Tweedale and Smalley.

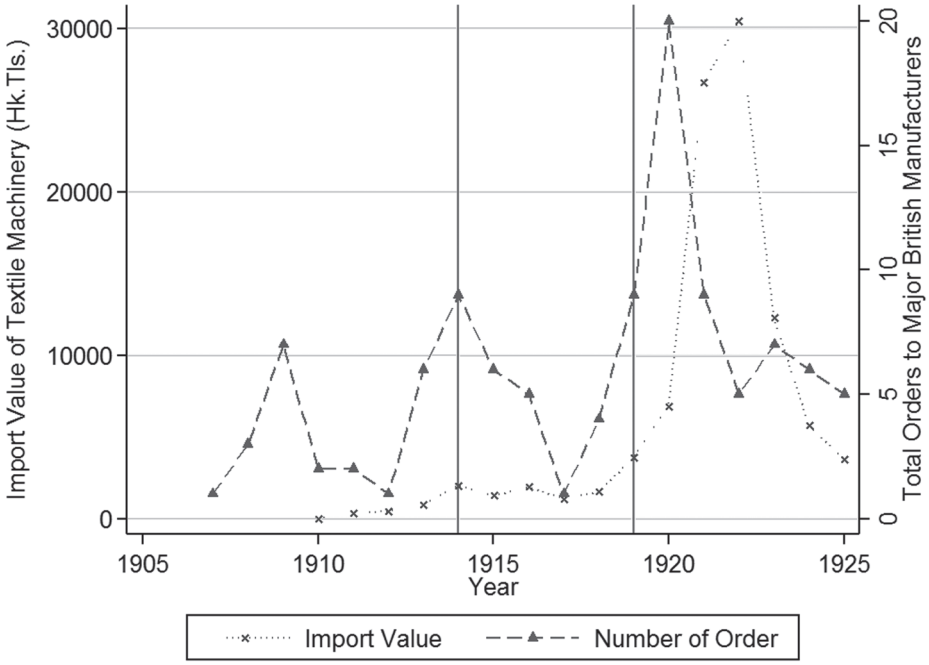

FIGURE 8
THE IMPORT VALUE AND ORDERS OF TEXTILE MACHINERY

Sources: The import value is from Hsiao (1974, p. 47, Table 2, "Textile Machinery"). The British orders are from Wright (2011).

the gap between the two times for these transactions. The lag was very long when China just started its textile industry in 1889. It fell to less than one year according to the only order containing this information from 1900 to 1914. However, the several transactions with this information from 1914 to 1919 on average were delayed by more than three years, except for one order that was shipped within a year. The average lag was around two years for transactions from 1918 to 1920 and gradually dropped to around one year after 1921.

I also collect firm-level capital and the actual inputs of the Chinese textile firms for the years 1916 to 1921.[35] The capital remained the same from 1916 to 1917 and increased steadily from 1917 to 1920, with an average annual rate of approximately 21 percent. In contrast, the number

[35] The data are from the special survey of the Reports of Statistics on Agriculture and Commerce. For each firm, the survey reported information about its location (province and county), name, rough address, paid capital, power source, power, coal consumption, number of spindles, number of workers (male and female), maximum and minimum wages for workers, workdays, working hours per day, raw cotton consumed (quantity and value), and output (quantity and value).

https://doi.org/10.1017/S0022050719000858 Published online by Cambridge University Press

of spindles remained the same until 1920. Online Appendix Figure 3 plots capital invested and spindles at the firm level each year. This suggests that, although firms increased investments during the war, the textile machinery did not change until the war was over.

Suggestive Evidence on the Role of Finance

The previous section established the relationship between the war-inducing trade shock and the entry of textile firms. This section provides suggestive evidence of the additional conditions for firm entry, including access to finance and trading companies, geographic suitability for raw cotton, a history of handicraft textile production, and political conflicts. I especially emphasize the importance of access to financing, which facilitated trade and provided capital for the textile firms.

I control for the prewar level of these factors and conduct a triple-difference analysis:

$$y_{it} = \beta_0 + \beta_1 WWI_t \times \tau_i + \beta_2 WWI_t \times Char_i + \beta_3 WWI_t \times \tau_i \times Char_i + \beta_4\ PostWWI_t \times \tau_i + \beta_5 PostWWI_t \times Char_i + \beta_6 PostWWI_t \times \tau_i \times Char_i + \mu_i + \sigma_t + \varepsilon_{it},$$

where the war dummies, τ_i, μ_i, and σ_t, have the previous interpretations. $Char_i$ is a vector that includes a set of local characteristics that did not vary with time. The interactions of the war dummies and $Char_i$ measure how local characteristics were correlated with heterogeneous effects of the trade shock on port counties during and after the war. The triple-interaction terms $WWI_t \times \tau_i \times Char_i$ and $PostWWI_t \times \tau_i \times Char_i$ capture how the heterogeneous effects of associated local characteristics varied with trade cost. The coefficients of the triple-interaction terms, β_3 and β_6, indicate whether the association with local factors differed when firms had different access to international trade.

The local characteristics include financial institutions in 1912, historical textile centers in the eighteenth century, a proxy for suitability for cotton production, and measures for political stability. Because the financial sectors and the industrial sectors were often coincident, the regression provides more suggestive evidence rather than a causal interpretation. I check the pre-trend to show that regions with different access to banks had no clear differences in the growth paths. Online Appendix Figure 4 shows that, after controlling for national time trends and county fixed effects, counties with and without banks had similar pre-trends in terms of firm entry.

https://doi.org/10.1017/S0022050719000858 Published online by Cambridge University Press

Financial institutions might have promoted firm entry through facilitating trade or providing capital. To shed light on the mechanisms, I also collect the location of trading companies that served as brokers during international commodity transactions. If financial institutions promoted firm entry through trade solely, the coefficient should shrink dramatically after controlling for these trading companies.

Table 6 reports the regression results. Column 1 shows the estimates without controlling for the trading companies. The interaction terms between the bank variable and the war dummies are positive and statistically significant, suggesting that, when counties were located at ports, those with more financial institutions had more firm entry than those without financial institutions. The coefficient estimates show that a 1 percent increase in bank capital at the county level was associated with 0.00467 percent more entry of firms during the war and 0.0226 percent after the war. The triple-interaction terms are negative, showing that higher transportation cost reduced the positive effect on firm entry due to access to financial institutions. Specifically, a 1 percent increase in cost to ports reduced the previous positive effect by 0.00397 percent during the war and 0.0186 percent after the war. The result suggests that the positive effect from exposure to international trade and access to finance would decrease to zero after the logged value of trade cost is greater than approximately 1.2, which is about 3.3 days.

Columns 2–4 report the results after controlling for trading companies. The interaction terms of trading companies and the war dummies are positive, suggesting that these companies were positively associated with firm entry. As expected, the coefficient estimates of interaction terms between the bank variable and the war dummies decrease, but they mostly remain statistically significant. This implies that at least part of the banks' function was probably to provide capital. The results are robust if I replace the war dummies with per unit value of cotton yarn, as reported in Online Appendix Table 2. I also use longitudinal data from 1912 to 1920 instead of the cross-sectional data in 1912 to measure bank distribution in Online Appendix Table 3, and the results are similar.

Firms entering the market after the war had missed the golden years and suffered from the market downturn in the 1920s. In 1919, the market price for yarn was even higher than during the war years, and firms continued to enjoy the profitable markets. Starting in 1922, however, the price of yarn fell and raw cotton became expensive. During this market downturn, debts and interest became increasingly burdensome. According to *Dasheng*'s account book, the share of interest in its total costs and fees

TABLE 6
IMPACT OF WWI AND LOCAL CHARACTERISTICS ON THE NUMBER OF TEXTILE FIRMS

	(1)	(2)	(3)	(4)
Variables	Log(# Firms)	Log(# Firms)	Log(# Firms)	Log(# Firms) (τ in Major Ports)
WWI × τ	0.000347	0.000853	0.000855	0.00108
	(0.000712)	(0.000600)	(0.000546)	(0.000644)
PostWWI × τ	–0.00482**	0.00331	0.00339	0.00225
	(0.00213)	(0.00230)	(0.00224)	(0.00250)
WWI × *bank*	0.00467*	0.00222**	0.00222*	0.00190
	(0.00246)	(0.00106)	(0.00120)	(0.00112)
PostWWI × *bank*	0.0226***	0.0146***	0.0142***	0.0131**
	(0.00606)	(0.00398)	(0.00390)	(0.00500)
WWI × *bank* × τ	–0.00397*	–0.00186*	–0.00186*	–0.00115
	(0.00215)	(0.000918)	(0.00104)	(0.000751)
PostWWI × *bank* × τ	–0.0186***	–0.0120***	–0.0116***	–0.00816**
	(0.00526)	(0.00327)	(0.00322)	(0.00354)
WWI × *trading company*		0.0521*	0.0520	0.0415*
		(0.0259)	(0.0529)	(0.0205)
PostWWI × *trading company*		0.0314	0.00513	0.0101
		(0.0752)	(0.143)	(0.0779)
WWI × *trading company* × τ		–0.0871*	–0.0890	–0.00802
		(0.0489)	(0.0860)	(0.0165)
PostWWI × *trading company* × τ		–0.268	–0.270	–0.0411
		(0.254)	(0.315)	(0.0593)
Observations	33,991	33,991	33,972	33,991
R^2	0.105	0.195	0.161	0.211
Number of counties	1,789	1,789	1,789	1,789
County fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Controls	No	Yes	Yes	Yes
Exclude Shanghai	No	No	Yes	No

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors, reported in parentheses, are clustered at the provincial level. The regression covers the period from 1907 to 1925. The dependent variables are the numbers of textile firms plus one in natural log form in county *i* at time *t*. *WWI* and *PostWWI* are dummy variables. τ is constructed travel days from a county to its closest port (plus one and raised to the natural log form). The variable *bank* is the bank capital in 1912 plus one and raised to the natural log form. I also control for the distribution of foreign banks, traditional Chinese banks, concessions, suitability for cotton production, and warfare that occurred in a county in a given year.
Source: Author's calculations from Bureau of Agriculture and Commerce (1914), CHGIS (2016), Huang (1995), Yan (2011, 2012), Guo (1990), and Jiang (2009).

https://doi.org/10.1017/S0022050719000858 Published online by Cambridge University Press

was nearly 10 percent during the first several years, and it soon surged to more than 20 percent. In 1920, 30 percent of the firm's expenditures were interest payments, which led to a major crisis when the firm failed to pay its loans in 1924 (Gu 2015, p. 35). *Dasheng*'s experience was not unique. In fact, the pressure of debts forced many entrepreneurs to sell their firms to large enterprises, banks, or other merchants. Among the 99 firms established before 1925, in Yan's (2011) record, at least 54 of them changed ownership, with 21 taken over by banks, 10 by Japanese merchants, 2 by British merchants, and the rest sold or rented to other owners (Yan 2011, Appendix 1). Firms' experience suggest that, while the trade shock increased the total number of spindles in China, more than half of the firms failed to survive. Most small firms finally became part of the large enterprises.

CONCLUSIONS

The impact of WWI reached far beyond Europe. This paper focuses on the effect of the war on the global economy through international trade. Trade data suggest that the war caused shortages in the world supply of manufactured products and increased international freight rates. Although these disruptions were undesirable for global trade, they might have provided industries in the importing countries an opportunity to grow.

This paper examines China's experience to assess the impact of trade disruptions on industrial growth during and after WWI. It adds to the literature that uses exogenous trade disruptions to evaluate the effect of reductions in imports on domestic industrial growth. I collect trade statistics and find that the war decreased the quantity of cotton products imported and dramatically increased import prices. Using county-level data compiled from multiple sources and newly constructed estimates of domestic transportation costs to treaty ports, I show that counties that had more exposure to the trade disruptions experienced greater development in the manufactured textile industry.

The textile industry initiated industrialization in countries around the world, but the industry's performance varied across countries (Clark 1987). Although the Chinese had noticed the advantage of manufactured yarn over the handicraft ones, the domestic manufactured textile sector was quite small before WWI. Firm-level information suggests that the trade disruptions during WWI created sizable profits for firms and contributed to the expansion of the manufactured textile industry. Although there were further adjustments within this industry, it is fair

to say that the textile industry took this opportunity and became China's largest industry in the 1930s.

Further examinations show that the expansion was delayed. In fact, few Chinese firms were able to acquire machinery in a timely manner. Combining data from both Chinese and British sources, I find that this was mostly due to the delay in the arrival of imported textile machinery. Thus, trade disruptions during the war served as a double-edged sword for Chinese firms that competed with manufactured products from overseas but also depended on the supply of inputs from the world market.

The last part of the empirical analyses provides suggestive evidence on the role of local characteristics in firm entry. I find that access to financial institutions was positively associated with new firm entry in early twentieth-century China. The firm archives further suggest that there were two possible mechanisms for financial institutions to facilitate the establishment of new firms. First, these institutions provided loans for firms, which often lacked sufficient funding to organize their production process or expand their business. This is consistent with findings from the economics literature that, in developing countries with high financial frictions, the availability of finance facilitated firm entry (Guiso, Sapienza, and Zingales 2004). In addition, the textile firms heavily relied on trade networks to acquire machinery and raw cotton. In this case, bank notes largely facilitated capital transfer.

REFERENCES

Allen, Robert C. "The Industrial Revolution in Miniature: The Spinning Jenny in Britain, France, and India." *Journal of Economic History* 69, no. 4 (2009): 901–27.

Bergère, Marie-Claire. "The Chinese Bourgeoisie, 1911–37." In *The Cambridge History of China*, edited by John K. Fairbank and Denis Twitchett, 721–825. New York: Cambridge University Press, 1983.

Brasó Broggi, Carles. *Trade and Technology Networks in the Chinese Textile Industry: Opening Up before the Reform*. Basingstoke: Palgrave Macmillan, 2016.

Bureau of Agriculture and Commerce. *Nongshang tongji biao* (Reports of Statistics on Agriculture and Commerce). Nongshang Bu Zongwu Ting Tongji Ke, 1914–1917, 1919, 1920, 1922–1924.

Caruana-Galizia, Paul, and Ye Ma. "Chinese Regions in the Great Divergence: Provincial Gross Domestic Product per Capita, 1873–1918." *Australian Economic History Review* 56, no. 1 (2016): 21–45.

Chang, J. K. *Industrial Development in Pre-Communist China: A Quantitative Analysis*. A Monograph of the Committee on the Economy of China of the Social Science Research Council. Chicago: Aldine Publishing Company, 1969.

Chao, Kang. *The Development of Cotton Textile Production in China*. Cambridge MA: Harvard University Press, 1977.

Chen, Shuo, and James K. Kung. "Of Maize and Men: The Effect of a New World Crop on Population and Economic Growth in China." *Journal of Economic Growth* 21, no. 1 (2016): 71–99.

China Maritime Customs. *Returns on Trade at the Treaty Ports for the Year 1880*. Shanghai: The Statistical Department of the Inspectorate General of Customs, 1881.

———. *Decennial Reports, 1902–1911*. Shanghai: The Statistical Department of the Inspectorate General of Customs, 1913.

———. *Returns of Trade and Trade Reports, 1914*. Shanghai: The Statistical Department of the Inspectorate General of Customs, 1915.

———. *Returns of Trade and Trade Reports, 1916*. Shanghai: The Statistical Department of the Inspectorate General of Customs, 1917.

———. *Returns of Trade and Trade Reports, 1918*. Shanghai: The Statistical Department of the Inspectorate General of Customs, 1919.

———. *Decennial Reports, 1912–1921*. Shanghai: The Statistical Department of the Inspectorate General of Customs, 1924.

———. *Decennial Reports, 1922–1931*. Shanghai: The Statistical Department of the Inspectorate General of Customs, 1933.

Clark, Gregory. "Why Isn't the Whole World Developed? Lessons from the Cotton Mills." *Journal of Economic History* 47, no. 1 (1987): 141–73.

Crafts, Nicholas, and Nikolaus Wolf. "The Location of the UK Cotton Textiles Industry in 1838: A Quantitative Analysis." *Journal of Economic History* 74, no. 4 (2014): 1103–39.

Dong, Baomin, Jiong Gong, Kaixiang Peng, and Zhongxiu Zhao. "Little Divergence: Evidence from Cotton Textiles in Japan and China 1868–1930." *Review of Development Economics* 19, no. 4 (2015): 776–96.

Du, Xuncheng. *Minzu zibenzhuyi yu jiuzhongguo zhengfu, 1840–1937* (Domestic Capitalism and Old Chinese Government, 1840–1937). Shanghai: Shanghai Shehui Kexueyuan Chubanshe, 1991.

Fang, Xianting. *Zhongguo zhi mianfangzhi ye* (The Textile Industry in China). Shanghai: Shangwu Yinshuguan, 2011.

Feng, Tianyu, Bolin Liu, and Shaojun Li, eds. *Dongya tongwen shuyuan zhongguo diaocha ziliao xuanyi* (Selected Translation of Surveys by the Tung Wen College). Beijing: Shehui Kexue Wenxian Chubanshe, 2012.

Feuerwerker, Albert. "Handicraft and Manufactured Cotton Textiles in China, 1871–1910." *Journal of Economic History* 30, no. 2 (1970): 338–78.

———. *Economic Trends in the Republic of China, 1912–1949*. Ann Arbor: Center for Chinese Studies, University of Michigan, 1977.

Food and Agriculture Organizations. Global Agro-Ecological Zones v3.0. http://www.fao.org/nr/gaez/en/, 2012.

Geroski, Paul A. "What Do We Know About Entry?" *International Journal of Industrial Organization* 13, no. 4 (1995): 421–40.

Gu, Jirui. *Dasheng fangzhi jituan dangan jingji fenxi* (An Economic Analysis on Dasheng Textile Group). Tianjin: Tianjin Guji Chubanshe, 2015.

Guiso, Luigi, Paola Sapienza, and Luigi Zingales. "Does Local Financial Development Matter?" *Quarterly Journal of Economics* 119, no. 3 (2004): 929–69.

Guo, Moruo. *Zhongguo shigao dituji* (Collected Maps for Historical China). Vol. 1. Beijing: Zhongguo Ditu Chubanshe, 1990.

Hamashita, Takeshi (translated by Shujuan Gao and Bin Sun). *Zhongguo jindai jingjishi yanjiu: qingmo haiguan caizheng yu tongshang kouan shichangquan* (Economic History of Modern China: Maritime Customs Finance and Open Port Market Zones in Late Qing China). Nanjing: Jiangsu Renmin Chuebanshe (Trans.), 2006.

Hanlon, W. Walker. "Necessity Is the Mother of Invention: Input Supplies and Directed Technical Change." *Econometrica* 83, no. 1 (2015): 67–100.

———. "Temporary Shocks and Persistent Effects in Urban Economies: Evidence from British Cities after the US Civil War." *Review of Economics and Statistics* 99, no. 1 (2017): 67–79.

Harrison, Ann, and Andrés Rodríguez-Clare. "Trade, Foreign Investment, and Industrial Policy for Developing Countries." *Handbook of Development Economics* 5 (2010): 4039–214.

Harvard Yenching Library. *China Historical Geographic Information System*. Cambridge, MA: China Historical GIS, 2016. Available at http://www.fas.harvard.edu/chgis/.

Hou, Chi-Ming. "The Oppression Argument on Foreign Investment in China, 1895–1937." *Journal of Asian Studies* 20, no. 4 (1961): 435–48.

Hsiao, Liang-Lin. *China's Foreign Trade Statistics, 1864–1949*. Cambridge, MA: Harvard University East Asian Research Center, 1974.

Huang, Guangyu. *Waiguo zaihua gongshang qiye cidian* (The Universal Dictionary of Foreign Business in Modern China). Chengdu: Sichuan Renmin Chubanshe, 1995.

Institute of Shanghai Economy Studies, China Academy of Science. *Hengfeng shachang de fasheng fazhan yu gaizao* (The Establishment, Development, and Transformation of Hengfeng Textile Company). Shanghai: Shanghai Renmin Chubanshe, 1958a.

———. *Shanghai jiefang qianhou wujia zhishu ziliao huibian, 1921–1957* (Archives on Shanghai Price Index: 1921–1957). Shanghai: Shanghai Renmin Chubanshe, 1958b.

Irwin, Douglas A. "The Welfare Cost of Autarky: Evidence from the Jeffersonian Trade Embargo, 1807–09." *Review of International Economics* 13, no. 4 (2005): 631–45.

Irwin, Douglas A., and Davis Joseph H. "Trade Disruptions and America's Early Industrialization." NBER Working Paper No. 9944, Cambridge, MA, September 2003.

Isserlis, Leon. "Tramp Shipping Cargoes, and Freights." *Journal of the Royal Statistical Society* 101, no. 1 (1938): 53–146.

Jaremski, Matthew. "National Banking's Role in US Industrialization, 1850–1900." *Journal of Economic History* 74, no. 1 (2014): 109–40.

Jaworski, Taylor, and Carl Kitchens. "National Policy for Regional Development: Historical Evidence from Appalachian Highways." *Review of Economics and Statistics*, 2018. Available at https://www.mitpressjournals.org/doi/abs/10.1162/rest_a_00808.

Jia, Ruixue. "The Legacies of Forced Freedom: China's Treaty Ports." *Review of Economics and Statistics* 96, no. 4 (2014): 596–608.

Jiang, Kefu. *Minguo Junshi Shi* (Military History of the Republic of China). Chongqing: Chongqing Chubanshe, 2009.

Juhász, Réka. "Temporary Protection and Technology Adoption: Evidence from the Napoleonic Blockade." *American Economic Review* 108, no. 11 (2018): 3339–76.

Keller, Wolfgang, Ben Li, and Carol H. Shiue. "China's Foreign Trade: Perspectives from the Past 150 Years." *World Economy* 34, no. 6 (2011): 853–92.

———. "The Evolution of Domestic Trade Flows When Foreign Trade Is Liberalized: Evidence from the Chinese Maritime Customs Service." In *Institutions and Comparative Economic Development*, edited by Masahiko Aoki, Timur Kuran, and Gérard Roland, 152–72. International Economic Association Series. London: Palgrave Macmillan, 2012.

_____. "Shanghai's Trade, China's Growth: Continuity, Recovery, and Change Since the Opium Wars." *IMF Economic Review* 61, no. 2 (2013): 336–78.

Keller, Wolfgang, Javier Andres Santiago, and Carol H. Shiue. "China's Domestic Trade during the Treaty-Port Era." *Explorations in Economic History* 63, (2017): 26–43.

King, Robert G., and Levine Ross. "Finance and Growth: Schumpeter Might Be Right." *Quarterly Journal of Economics* 108, no. 3 (1993): 717–37.

Kong, Min. *Nankai jingji zhishu ziliao huibian* (Complied Economic Statistics and Indices by Nankai University). Beijing: Zhongguo Shehui Kexue Chubanshe, 1988.

Krugman, Paul. "Increasing Returns and Economic Geography." *Journal of Political Economy* 99, no. 3 (1991): 483–99.

Kubo, Toru. *Chinese Cotton Industry in the 20th Century*. Paper presented at the 5th Global Economic History Network Conference, Osaka, December 2004.

Liu, Cong. "Replication: The Effects of World War I on the Chinese Textile Industry: Was the World'sTrouble China's Opportunity?" Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 2019-11-29. https://doi.org/10.3886/E115822V1.

Liu, Ta-Chung, and Kung-Chia Yeh. *The Economy of the Chinese Mainland: National Income and Economic Development, 1933–1959.* Princeton: Princeton University Press, 1965.

Ma, Debin. "Shanghai-Based Industrialization in the Early 20th Century: A Quantitative and Institutional Analysis." Working Papers of the Global Economic History Network (GEHN) 06, no.18, London School of Economics and Political Science, London, 2006.

———. "Economic Growth in the Lower Yangzi Region of China in 1911–1937: A Quantitative and Historical Analysis." *Journal of Economic History* 68, no. 2 (2008): 355–92.

Mitchell, Brian R. *British Historical Statistics*. New York: Cambridge University Press, 1988.

Mitchener, Kris James, and Yan Se. "Globalization, Trade, and Wages: What Does History Tell Us about China?" *International Economic Review* 55, no. 1 (2014): 131–68.

Myers, Ramon H. "Cotton Textile Handicraft and the Development of the Cotton Textile Industry in Modern China." *Economic History Review* 18, no. 3 (1965): 614–32.

Nunn, Nathan, and Nancy Qian. "The Potato's Contribution to Population and Urbanization: Evidence from a Historical Experiment." *Quarterly Journal of Economics* 126, no. 2 (2011): 593–650.

Officer, Lawrence H., and Samuel H. Williamson. "The Annual Consumer Price Index for the United States, 1774 to Present." MeasuringWorth, 2018.

Ou, Pao-San. *Zhongguo guomin suode (yi jiu san san nian)* (China's National Income, 1933). Shanghai: Shangwu Yinshu Guan, 2011.

Ou, Pao-San, and Foh-Shen Wang. "Industrial Production and Employment in Pre-War China." *Economic Journal* 56, 223 (1946): 426–34.

Peng, Kaixiang. *Cong jiaoyi dao shichang: chuantong zhongguo minjian jingji mailuo shitan* (From Transactions to Markets: Exploring Traditional Civil Chinese Economy). Hangzhou: Zhejiang Daxue Chubanshe, 2015.

Perkins, Dwight H. "Government as an Obstacle to Industrialization: The Case of Nineteenth-Century China." *Journal of Economic History* 27, no. 4 (1967): 478–92.

Rawski, Thomas G. *Economic Growth in Prewar China*, Vol. 245. Berkeley: University of California Press, 1989.

Research and Statistics Department at the Bank of Japan. *Hundred-Year Statistics of Wholesale Price Indexes in Japan*. Bank of Japan, 1999. Available at https://www.imes.boj.or.jp/english/hstat/index.html (accessed 16 August 2018).

Reynolds, Bruce Lloyd. *The Impact of Trade and Foreign Investment on Industrialization: Chinese Textiles, 1875–1931*. Ph.D. thesis, University of Michigan, 1975.

Rodrik, Dani, Subramanian Arvind, and Trebbi Francesco. "Institutions Rule: The Primacy of Institutions over Geography and Integration in Economic Development." *Journal of Economic Growth* 9, no. 2 (2004): 131–65.

Saxonhouse, Gary R., and Gavin Wright. "National Leadership and Competing Technological Paradigms: The Globalization of Cotton Spinning, 1878–1933." *Journal of Economic History* 70, no. 3 (2010): 535–66.

Shanghai Social Science Academy. *Rongjia qiye shiliao: maoxin, fuxin, shenxin xitong* (Archives of the Rong Enterprises). Shanghai: Shanghai Renmin Chubanshe, 1980.

So, Billy, and Ramon H. Meyers. "Treaty Port Economy in Modern China: Empirical Studies of Institutional Change and Economic Performance." In *Treaty-Port Economy in Modern China: Empirical Studies of Institutional Change and Economic Performance*, edited by Billy K.L. So and Ramon H. Myers, 218–21. Berkeley, CA: Institute of East Asian Studies, 2011.

Stopford, Martin. *Maritime Economics.* London: Routledge, 2009.

Tokihiko, Mori (translated by Yuan Guangquan). *Zhongguo jindai mianfang zhiye shi yanjiu* (Study on Chinese Cotton Textile Industry). Beijing: Shehui Kexue Wenxian Chubanshe (Trans.), 2010.

Tomlinson, J. D. "The First World War and British Cotton Piece Exports to India." *Economic History Review* 32, no. 4 (1979): 494–506.

United States Central Intelligence Agency. *Railroads in China, December*. Washington, DC: Central Intelligence Agency, 1954. Map. https://www.loc.gov/item/2007627280/.

United States Department of Labor, Bureau of Labor Statistics. *Wholesale Price Index*. Bureau of Labor Statistics Bulletin No. 440, 1927.

Wolcott, Susan, and Gregory Clark. "Why Nations Fail: Managerial Decisions and Performance in Indian Cotton Textiles, 1890–1938." *Journal of Economic History* 59, no. 2 (1999): 397–423.

Wright, Gavin. "Cotton Spinning Machinery Orders, British Textile Machinery Firms, 1878–1933." ICPSR27141-V1. Ann Arbor, MI: Inter-University Consortium for Political and Social Research [Distributor], 11–18, 2011.

Xu, Xinwu. *Jiangnan tubu shi* (History of Nankeens in the Yangzi Delta). Shanghai: Shanghai Shehui Kexueyuan Chubanshe, 1992.

Xu, Xinwu, and Hanmin Huang. *Shanghai jindai gongye shi* (History of the Industrial Sector in Pre-Modern Shanghai). Shanghai: Shanghai Shehui Kexueyuan Chubanshe, 1998.

Yan, Se. *Real Wages and Wage Inequality in China, 1860–1936*. Ph.D. thesis, University of California Los Angeles, 2008.

Yan, Zhongping. *Zhongguo mianfangzhi shigao* (History of Chinese Cotton Textile Industries). Shanghai: Shangwu Yinshuguan, 2011.

———. *Zhongguo jindai jingjishi ziliao xuanji* (Selected Collections of Archives in Pre-Modern Chinese Economic History). Beijing: Zhongguo Shehui Kexue Chubanshe, 2012.

Yang, Duanliu, and Houpei Hou. "Liushiwu nian lai zhongguo guoji maoyi tongji" (Trade Spastics for the Past Sixty-Five Years). *Guoli zhongyang yanjiuyuan shehui kexue yanjiusuo zhuankan* (National Research Institute of Social Sciences Academia Sinica Monograph), no. 4 (1931): 1–189.

Yuan, Weipeng. *Jujiao yu kuosan: zhongguo jindai gongye buju* (Concentration and Diffusion: The Spatial Location of Pre-Modern Chinese Industries). Shanghai: Shanghai Caijing Daxue Chubanshe, 2007.

Zeitz, Peter. "Do Local Institutions Affect All Foreign Investors in the Same Way? Evidence from the Interwar Chinese Textile Industry." *Journal of Economic History* 73, no. 1 (2013): 117–41.

Zhang, Yucai. *Zhongguo tiedao jianshe shilue (1876–1949)* (A Brief History of Railroad Construction in China (1876–1949)). Beijing: Zhongguo Tiedao Chubanshe, 1997.

Zhao, Gang, and Zhongyi Chen. *Zhongguo mianfangzhi shi* (History of Cotton Textile in China). Beijing: Zhongguo Nongye Chubanshe, 1997.