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Yingnan Xu

Among the major raw silk producing countries of the 20th century, handicraft production persisted in China alone. This study looks beyond the weakness of steam reeling cited by many scholars to examine the reasons that allowed for handicraft silk to persist on its own merits. Although the most advanced handicraft methods long predated steam filatures, mechanized reeling was still so capital and labor intensive that costs were often higher than hand-reeling. The generally superior uniformity and strength of filature silk meant that filature silk rightly displaced hand-reeled silk in export markets where uniformity was important for use with mechanical looms. However, in markets, such as the domestic Chinese market, where uniformity and quality was less important, weavers continued to hunger for the lower cost hand reeled silks and in the process insuring the survival of handicraft until the Second World War.

For thousands of years, silk has been an important traded commodity on the world markets. The first documented evidence of silk production dates back to between 2850 and 2650 B.C. in China. As early as the first millennium B.C., Chinese silks could be found as far as the Mediterranean basin.[1] After the Chinese lost their monopoly around 200-300 B.C., silk production spread throughout the world where it continued to be produced around the world using similar labor intensive methods until the nineteenth century. With the coming of the Industrial Revolution, the process of making silk became increasingly industrialized. As Giovanni Federico noted in his *Economic History of the Silk Industry*, "Silk production spearheaded industrialization in all the major producing countries in the nineteenth century."[2] By 1910, ninety-seven percent of Japanese and Italian workers in silk production worked in an industrial setting.[3] In the case of Japan, the export of raw silk financed "no less than forty percent of foreign machinery

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and raw material [purchases]"[4] and served as the "training school for Japanese industrialization."[5]

While steam reeled raw silk also played a leading role in China's industrialization during the late nineteenth and early twentieth century, hand-reeled silk continued to make up a large portion of total production well into the twentieth century. To explore this unique case among the world's major raw silk exporting countries, this paper seeks to examine the reasons behind the persistence of traditional raw silk production in China, despite the establishment of a large and strong modern reeling industry.[6]

While one may expect modern filatures to completely displace traditional hand-reeling in China as they had in the rest of the world, estimates suggest that from 1880-1930, more than half of all raw silk production in China continued to be hand-reeled. Traditionally reeled silk persisted in China as the result of the combination of two key factors. At least initially, steam reeling was not superior to hand reeling at all levels. The primary advantage of modern, mechanized silk-reeling lies in the superior uniformity and quality in the end product and not in any significant increases in productivity. Furthermore, the continued strength of traditionally reeled silk can also be attributed to demand from China's domestic market and a few peripheral markets where it was more suitable both in price and application. The combination of these two factors provided traditionally reeled silk a significant role in the marketplace that allowed it to avoid complete displacement by steam reeled silk.

To concentrate on the period of time when traditional and steam reeled silk directly competed in China, this paper focuses on the time period between 1880 and 1930. While the first filature in Shanghai started operations in 1861, steam filatures only began to contribute significantly to output in the 1880s. In fact, filature silk would not get its own category in export statistics from the Imperial Maritime Customs until 1894.[7] Meanwhile, the 1930s marked the beginning of the end for the Chinese silk industry. Not only did the Great Depression seriously affect world trade, the coming of the Sino-Japanese war in 1937 all but wiped out China's silk industry.[8] Instead of silk cloth, the product of

interest for this study is raw silk. Raw silk is the reeled silk strands that can be processed into threads suitable for weaving and is the first step in the production process for silk cloth. Because raw silk rather than silk cloth was produced industrially in China, it is the more appropriate product for comparison with traditional industry. While, the two major area of raw silk production in China were Jiangnan and Guangdong, Jiangnan will be the geographic focus of the paper because it was the silk producing of china with the most established traditional industry. While important, Guangdong will be less relevant for this paper because its silk industry developed largely to serve the needs of the export market and did not have a significant handicraft sector.

A Brief Historiography

In the past fifty years, the development of silk production in China from 1880-1930 has generated a great deal of interest from scholars who had taken a variety of different approaches in examining this topic. This study draws most heavily upon the works of Li, Eng, Federico and Bell. Of the authors mentioned, the most comprehensive study of the Chinese silk industry was authored by Lillian Li in 1981 where she argued for institutional failures as explanation for the underwhelming performance of the Chinese silk industry.[9] Robert Eng's work took a different angle, highlighting the effects of imperialism on the silk industry's failure to modernize.[10] More recently, a book published by Linda Bell examined economic development of filatures in Wuxi "on its own term" as a complex interaction between peasants, elites and the state.[11] The use of these sources allowed for indirect access to a great deal of primary sources from Chinese, Japanese, and European authors that would otherwise be unavailable. These researchers have gathered a great deal of qualitative data, some of which is employed in this work. While individual estimates are often rough and varies from source to source, trends in production, prices, and exports are generally consistent across the spectrum and will be used extensively in this work.

The common theme of these studies is that they are highly focused on the modernizing aspect of this narrative. This approach is in

many ways desirable because it allows the scholars a natural segue into China's comparative failure to effectively modernize. Though much has already been written about the rise of steam reeling and the barriers to its growth in China, few scholars devote much focus to traditional reeling. A problem of focusing heavily on the traditional sector is that it lends itself less directly to the study of China's modernizing experience. However, the purpose of this paper is not to use the silk industry as a test case to understand the issues surrounding China's modernization. Rather, the continued strength of the traditional sector makes an interesting case study for the resilience of a handicraft when all other major producers trended towards almost full industrialization.

Competing Methods of Production

Sericulture, the raising of silkworms, had been an important part of the Chinese economy for thousands of years. Sericulture took advantage of seasonal changes in labor needs, allowing rural families to generate income before the spring rice crop was planted. Silk production was extremely labor intensive, and would frequently require the attention of the whole family, thus it could only be realistically performed when the opportunity cost was low.[12] As Lillian Li noted in her analysis, "sericulture was an ideal subsidiary occupation, but not an ideal primary occupation".[13] On average, even in areas where silk has been traditionally important, most rural households would only devote thirty to forty percent of their land to silk production, meaning less than half the land would be given over to mulberry trees[14].

Traditional methods of Chinese silk reeling practiced during the nineteenth century had persisted largely unchanged since the seventeenth century.[15] Traditionally, the Chinese (Jiangnan region) raised only two crops of silkworms, in the spring and in the summer. In most cases, only the spring crop was produced, as the summer crop was considered inferior.[16] Each year, right after *Qing-ming*, eggs either held over from last season or newly purchased were placed in baskets where they were hatched and fed mulberry leaves. After a month and a half of intensive around-the-clock care, the silkworms, now cocoons, are collected to begin the spinning process. The cocoons are then

immersed a pool of heated water, where the silk strands are loosened and wound onto a reel. Usually, the cocoons are spun immediately as they cannot be preserved without reducing their quality.[17] However, the advent of steam filatures brought about big changes when China started selling large quantities of its silk abroad during the 1800s.

While the Chinese have always exported silk, exports rose dramatically in the mid to late 1800s. The first step towards the formation of the global silk markets during the scope of this study occurred in the early nineteenth century, when the rapidly increasing manufacturing needs of France and northern Europe contributed to a steady demand for raw silk.[18] As these countries did not hold the requisite conditions for similar increases in domestic production, a permanent and growing stream of raw silk imports flowed in from Asia and China especially.[19] Pebrine or silkworm disease further complicated domestic European production. Until Louis Pasteur developed a method to control the disease, pebrine destroyed almost 75% of European cocoon output.[20] The silkworm disease in Europe was instrumental in increasing the importance of Asian imports and quickened the spread of European technology to China.[21] The first filature in China, for example, was managed by an English plant manager who had lost his job in Italy when his filature shut down due to the pebrine crisis.[22] Furthermore, the rapid growth of the US silk manufacturing after the Civil War further boosted demand. As US tariff policy actively promoted the importation of raw material, a domestic sericulture industry never developed.[23] As noted in table 2, since the 1820s, world trade in silk doubled or tripled every forty years. By the twentieth century, China and Japan together accounted for over a third of world silk production.

As Chinese silks began to feature more prominently in western markets, western technology, in turn, began to take hold in Asia.[24] Federico notes that as Asian producers saw their market share increase during the 1860s due to the European pebrine crisis, they began to adopt European methods in order to compete, in anticipation of the European silk industry's eventual recovery and resumption of full production.[25] The most prominent of these western innovations was steam reeling. Invented by a Frenchman in the early nineteenth

Attrib. to Huizong of Song, *Women Prepaing Silk*, 12th century. Indian ink and color on silk. Museum of Fine Arts, Boston.

century, steam was first used to heat the water in the basin, and later to power the machinery. By centralizing the heating process, the first steam filatures were designed to move the fire away from the water basin, and thus eliminated the pollution of the silk threads by soot.[26] However, most of the work in silk reeling remained too delicate to be done by machine. Steam filatures therefore often required a workforce comparable to that required by traditional methods of reeling.[27]

Existing Theories

While most scholars do not directly address hand-reeling, it can be inferred from their extensive work on filatures that they believed the comparative weakness of Chinese filatures allowed for the persistence of hand-reeling. Li and Eng, especially, have blamed various institutional barriers to industrial growth in China for the weakness of filatures and, as corollary, the continued strength of hand-reeling. Since their work is highly detailed, only the most basic points will be presented here. Robert Eng cited the "monopolistic controls" of cocoon brokers who drafted protectionist regulation as a major barrier to filature silk.[28] In particular he noted that scholars and contemporary observers alike often attributed the *likin* tax on cocoons as a major impediment to filatures.[29] While Li agreed that the *likin* was much more onerous when compared to cocoon taxes in Japan, often totaling at three to eight percent of the price of dried cocoons, which was the largest single cost for filatures, it did not present an insurmountable obstacle to mechanized Chinese silk production.[30] Instead, Li contended that the scarcity of capital weakened filature production. Because the Chinese elites were more interested in short term, high yield investments like pawnshops and real estate, capital for long term, high-risk modern enterprises were lacking. Therefore, large vertically integrated companies never developed to rival those of Japan.[31] From their work, one can deduce that, due to these institutional barriers, Chinese filatures were not able to reach their full potential and thus handicraft did not encounter as much supply-side pressure as it would have if China's silk industry modernized as quickly as Japan's.

While the weakness of filatures may have been a factor, it alone is

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far from sufficient to explain the persistence of hand reeling. For one thing, sericulture could have expanded to accommodate both forms of production. In reality, it did. Cocoon production almost doubled from 1880 to 1926 to serve both sectors and it may well have been possible for it to grow even faster had demand necessitated such growth.[32] Indeed, a geographic dichotomy developed after the introduction of filature silk. Many areas that produced silk before the 1860s continued to produce silk using traditional methods on cottage industry basis. Meanwhile, steam filatures generally purchase their cocoons from areas that did not traditionally produce silk. [33] Areas like Wuxi in Jiangnan and the country side of Guangdong rose to prominence as major supply points for filature silk.[34] In comparison, traditional silk producing regions of Zhejiang sent only twenty-six percent of their cocoons to filature as late as 1926.[35] For hand-reeled silk to maintain its strength as it did, other, demand-side factors must play an important role.

Limitations of Steam Reeling

It is always tempting when comparing traditional and modern techniques of production to look down on traditional techniques as backwards and inefficient. In reality, traditional techniques of silk production in China were surprisingly advanced. While industrial silk reeling did eventually surpass traditional reeling in productivity and quality, traditional manufacturing continued to be a viable enterprise. [36] In terms of economic viability, handicraft silk benefited from the relatively small efficiency gap that existed between filature and hand reeled silks. While mechanization often suggests great increases in productivity and efficiency over traditional handicrafts in terms of pure output, for silk this was not necessarily true. Lillian Li noted that, according to Min and Qing agriculture manuals, a skilled silk-reeler could produce twenty to thirty *liang* (equivalent to 40 g.) per day. While these figures may have been exaggerated by their sources, twentieth century hand-reelers generally produced somewhere around twelve to sixteen *liang* per day. Meanwhile, Chinese filature workers around 1910-1920, could only produce ten to twelve *liang,* and sometime as

little as eight.[37] If we accept Federico's assessment that Italian workers, the world leaders in productivity, were twice as productive as Chinese workers, we can place the world maximum at somewhere between twenty to twenty four *liang* a day.[38] Even when compared to the maximum, the productivity advantage of the filature in terms of labor was not particularly impressive when the capital needed to build and run a silk filature is taken into account.

The fact remains that filatures were still extremely labor intensive. While full automation may not have been beyond the reach of contemporary technology, the delicate work of automating the handling cocoons remained elusive. Just as with traditional reelers, filature production continued to be dependent on highly trained workers; estimates showed that an inexperienced worker may produce up to twenty percent less than an experienced hand.[39] Even by the 1920s, the height of the global silk market, most advanced equipment used by all producing countries still relied on great deal of manual labor. It would not be until the 1950s before the Japanese succeeded in building a truly automatic reeling machine.[40] By then, however, synthetic fibers captured silk's crown in the marketplace.

Because the value of industrialization only accounts for around fifteen to twenty percent of the total value of raw silk, cocoon costs make up the majority of the final price of silk. Had filatures been able to increase cocoon yields, the cost benefits would have been huge. Unfortunately for filatures, the cocoon to raw-silk yield of filature silk was similar to and in some cases lower than traditional reeling. Since the seventeenth century, one unit of hand-reeled silk generally required ten to thirteen units of cocoons to reel. In comparison, it can take anywhere from ten to eighteen units cocoons to yield one unit of filature silk. [41] Even in the case of "improved"[42] cocoons, yields did not improved significantly, allowing the filature to covert twelve units of cocoons to one unit of silk.[43] In reality the, the high yields were difficult to achieve as the supply of high quality improved cocoons were limited.[44] As steam reeling required high quality cocoons and did little to increase yields, filature silk often cost more than hand-reeled silk to produce.

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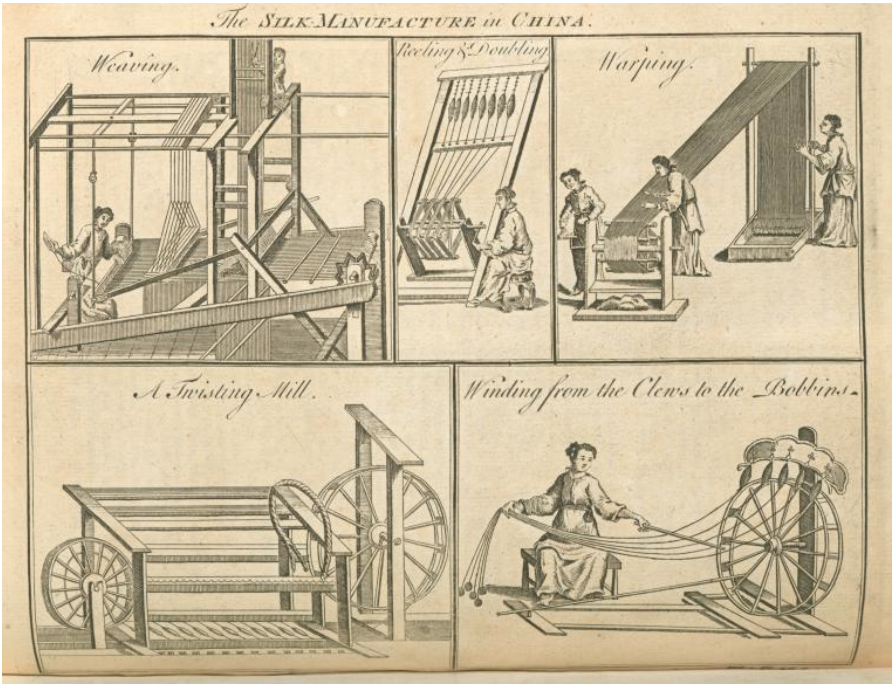
The limitation of these estimates on productivity is that they were often location specific and sometimes converted from their original using generalized formulas. The scarcity of complete estimates and the lack of accuracy make any conclusive judgment difficult. Nevertheless, it is very plausible that hand-reeling compared well with machine reeling at least until the 1920s. Given the amount of capital required to set up a filature, hand-reeling appears to have more than an equal footing with filature silk. However, compared to the best technology of the 1920s, Chinese hand-reeling still lagged in productivity per worker. With productivity increases in Italy and Japan that occurred by the 1930s[45], it is possible that 1920s may have been the watershed of Chinese handicraft silk. Sadly, the productivity of Chinese filatures became increasingly less relevant in after 1933 as production declined[46] and completely so after 1937 as military conflict overtook most silk producing regions of China.[47]

Despite their questionable superiority in efficiency over traditional reeling, Steam filatures had one unassailable advantage. The greater strength and uniformity of filature silk meant that it was uniquely suited to be used in the power-loom. Mechanical looms required large amounts of raw silk that were of the same quality, color, and thickness.[48] The irregularity of hand reeled silk meant that the weaver would have to constantly adjust to each batch of raw material, wasting time and resources. [49] The productivity increase that accompanied the use of high quality filature silk was substantial. One estimate contends that a worker using low quality, presumably hand-reeled silk could only weave eight pounds of cloth a day; using higher quality filature silk, the same worker could weave thirty to forty pounds.[50]

European and American buyers were willing to pay anywhere between a fifty to an eighty percent premium for filature silk.[51] As Leo Duran wrote in his 1913 guide for American purchasing agents,

> Thirty or forty years ago, raw silks were brought from the interior in irregular bunches or hanks… Today some grades are still sold in this way, but they are relatively in small quantities, in comparison with silks spun expressly for export purposes.
> The silks of the steam filatures are reeled according to foreign



John Greene and Thomas Astley, "The Silk Manufacturing in China," c. 18th cent. Engraving. New York Public Library Collection.

fashions, using the latest improvements.[52]

As can be seen from Duran's comments, Chinese filature silk were manufactured with the demands of the international market in mind. It was not the ability of filatures to manufacture silk cheaply and efficiently that led the rapid growth of filatures in China.[53] Instead, international demand for higher quality silk that led to the development of filature. However, this meant that the growth of filature silk does not necessarily intrude on the markets for hand-reeled silk. Indeed, hand-reeled silk continued to show strength domestically well into the twentieth century.

Markets for Hand-reeled Silk

Although the market share of filature silk increased rapidly in the late nineteenth and early twentieth century and hand-reeled silk's market share declined, in absolute terms, hand-reeled silk continued to maintain consistent sales and was far from threatened with complete replacement by its machines manufactured counterpart. Primarily, hand-reeled silk remained strong in its traditional markets as the raw material of choice for hand-loom weavers, a market where they held some distinct advantages over filature silk. Furthermore, developments in the export of handicraft silk fabric actually led to the establishment of new opportunities for hand-reeled raw silk. Even in the export market, where filature silk came to dominate, hand-reeled products were able to find a niche where they could still compete by re-reeling the threads to make them more regular. Rather than being replaced by filature silk in the marketplace as other handicraft textiles were replaced by their machine produced brethren, demand for handicraft raw silk remained surprisingly strong.

A comparatively low price was an important factor in the competiveness of handicraft silk. The consensus among scholars is that hand-reeled silks enjoyed a price advantage over filature silk throughout the nineteenth and twentieth century.[54] Filature silks could cost up to eighty percent more in some years. Linda S. Bell noted in her study of Wuxi Filatures that in-addition to certain tax disadvantages, the geographic limitation Chinese filatures in cities meant that the labor

hired was considerably more expensive than the labor expanded in the household production of hand-reeled silk.[55] Also given that filatures required considerable investments to build and maintain, and that it provided little to no gains in efficiency in terms of raw materials, Chinese filatures likely had much higher costs than hand-reelers. In circumstances where uniformity of quality was not strictly necessary, handicraft silk came out as the clear winner.

For all the quality advantage filature silk enjoyed over hand-reeled silk, traditionally reeled silk was crucial to the hand-weaving industry for more reasons than price. Raw silk produced by filatures is actually more brittle that hand reeled silk since the natural gum in the filament is removed during the steaming process. While this less problematic for modern power looms, it made filature silk less suitable to be hand-woven.[56] Hand reeled silk thus achieved a symbiotic relationship with the hand-loom. While hand-reeled silk benefited from the dependence of traditional weavers, the weavers in-turned received a competitive advantage from lower prices, a fact that had important implications in the domestic Chinese markets.

The biggest market for hand-reeled silk was domestic consumption. While the western importers, like those in the United States, would only buy filature silk, hand-reeled silk dominated the raw silk market in China. While handloom operators naturally gravitated toward hand-reeled silk, operators of power looms in China often also had to rely on handicraft raw silk. With the exception of those mills that operated their own filatures, which only some of the largest in Weichang and Shanghai could, the Chinese weaving factories were poorly integrated with local filatures and had difficulty buying from them. Instead, they mainly sourced their raw materials from traditional reelers. Overall, less than ten percent of filature silk from Shanghai was consumed domestically, leaving the lion share of the domestic market to traditional reelers.[57]

The continued strength of hand-reeled raw silk therefore strongly depended on the strength of the domestic market for silk cloth. Although the early twentieth century brought competition from a myriad of materials like rayon and fine cottons, silk cloth continued to do well domestically.[58] Though sales in China were generally not

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recorded, estimates hovered around one million piculs from 1880-1926. This translates to about as much as the amount of silk exported in 1880 and half of the amount exported in 1926.[59] Though the domestic market for silk neither grew nor decline in size, it did change. While silk used to represent the height of luxury, silk sales of the early twentieth century shifted in favor of lower quality products that emulated western styles.[60] Well-to-do consumers in treaty ports, for example, would often opt to buy cheaper hand-woven silks to keep up with the fashion of their foreign neighbors.[61] For those weavers that learned to adapt to the new styles, the Chinese domestic markets remained large and lucrative. While some traditional weaving centers that specialized in high quality satins and brocades like Nanjing and Suzhou did decline with the onset of western competition for markets and raw materials in the late nineteenth century, weavers in Hangzhou, Huzhou and Shaoxing maintained or increased their prosperity because they adapted to changing tastes.[62] The continued well-being of these weaving centers in turn contributed to steady demand for hand reeled silk.

The viability of hand-reeled silk was also supported by the continued viability of hand-looms over power looms abroad. Though power weaving was a compelling technology for a great variety of silk products, mechanized silk manufactures of the early twentieth century failed to fully serve two key segments of the market: high-end and low–end market for silk cloth. In these, hand weaving held a competitive advantage and continued to dominate.[63] In particular, hand-reeled silks had an important customer in French weavers of high-end silk fabrics. Since the early nineteenth century, the French weavers had imported silk of superior quality from China to make their best works[64]. These silk cloths of the highest grade were usually produced from a combination of several varieties of raw silks. As such, these highly fine cloths must be woven with a hand-loom under the utmost care.[65] Because handicraft silk is easier to work on a hand-loom and because the best Chinese silk was still superior to filature silk, the French weavers of Lyon continued to import Chinese hand-reeled silk well into the 1920s.[66]

With heavy competition from filatures in raw silk, merchants of handicraft silk products worked to develop new markets in inexpensive silk cloth for export. Although exports of hand-reeled raw silks dropped significantly, from 1910 onwards, exports of silk cloth actually saw a significant increase. In a span of forty years from 1870 to 1910, Chinese exports of silk cloth increased tenfold.[67] New weaving center sprang up in cities like Huzhou and Danyang , where a hand-loom industry developed to take advantage of the relative low price of hand-reeled silk to produce cloth of lower quality for export. Also during this time, yellow silk from Shangdong and Manchuria gained in popularity abroad. Woven into a washable cloth called the pongee, these cheap and easily produced silk fabrics gained a moderately sized market and furthered the position of handicraft silk.[68] While many of these hand woven products would not have satisfied the tastes of consumers in America and Europe, their lower price made them more competitive with higher quality European products in lower income markets such as Hong Kong, Singapore, India and the Middle East. [69]

Even raw silk destined for mechanical looms in the west was not entirely composed of filature silk. While most silk exported were indeed filature made, the heavily cited 1934 statistic on White silk exports by H.D. Fong missed a critical portion of hand-reeled exports—re-reeled silk.[70] Performed after the silk has been reeled, re-reeling was a process introduced in Italy during the early 1800s to clean the silk filaments by running it through a fork at high speed. By removing the knots and loose thread, re-reeling allowed silk threads to be even more uniform.[71] In fact, according to Liang-lin Hsiao's work on Chinese exports, re-reeled raw silk consistently constituted around ten to twenty percent of silk exports from 1910-1930.[72] By the twentieth century, domestically reeled silks destined for the western markets were customarily re-reeled to better compete with filature silks.[73] Of course, re-reeled silks were not as expensive as filatures silk; they did fetch a considerably better price in export markets than hand-reeled silk that was not re-reeled.[74] Although Federico noted that only about half of the exports were re-reeled in the late 1920s as evidence of the slowness of Chinese merchants to adopt the practice,[75] it was likely that many of the low-

grade exports destined for the looms of India and other non-western markets were not re-reeled out of concerns for cost. The existence of the re-reeled handicraft market not only add to the fact that demand for handicraft goods continued well into the twentieth century, but also suggests that handicrafts technology could be economically viable even in filature silk's strongest markets. If handicrafts could be reeled then re-reeled and still compete at a lower price than filature silk in the West, albeit at a lower but apparently acceptable quality, then it makes the case of handicraft silk even stronger in markets where no re-reeling is necessary.

Competitive Until the End

While it would be interesting to see how these factors change as filatures became more productive as technology advanced, unfortunately, that was not to be. The coming of the Great Depression in 1929 and war from 1937 onward dashed the prospects of the Chinese silk industry. When the Japanese entered China in 1937, they caused irreparable damage by destroying filatures and cutting down millions of mulberry trees.[76] The revolution that followed and the invention of synthetic fibers meant that the Chinese silk industry never recovered its former prominence.

Before the untimely demise of the Chinese silk industry, filature and hand-reeled silk continued to be produced side-by-side. Hand-reeled silk persisted in China not only because the technology of steam reeling failed to achieve absolute superiority in both efficiency and quality but also because a large market existed, largely domestic, that continued to hunger for lower priced silk. Hand-reeled silk remained strong because the advantages of filature production were subjective to the needs of the market rather than absolute in terms of productivity. Filature silk rightly displaced hand-reeled silk in export markets where mechanized weaving was dominant. However, when applied to markets where hand looms dominated, the advantage of filatures was greatly diminished and the lower price of hand-reeled silk made it a more attractive alternative. This was exactly the case in the Chinese domestic market, which was largely inaccessible to filature silk due to hand-

reeled silk's synergy with handlooms and its low price. Beyond China, hand-reeled silk's low price sometimes afforded it some unique niches in western colonial possessions like Hong Kong and India. Finally, re-reeling shows that despite the flaws of handicraft silk, hand-reeled silk could be profitably processed to be used in western factories and thus compete with filatures on their own market.

Individually, these factors would probably not have been enough to keep hand-reeling viable, but the combination that existed in china proved to be decisive. Lillian Li was right to point out that the existence of large markets that tolerated less standardized products did not necessarily explain the persistence of handicraft.[77] If steam reeling was able to produce silk that was not only of a better quality but was also cheaper as due to efficiency in terms of both labor and raw material inputs then filature silk would have dominated both the domestic and the export markets. On the other hand, if a large domestic market for hand-reeled silk had not existed, as in the case of Japan, then raw silk production would have been geared entirely towards export. In such a case, the demand of the western importers would have dictated the production of filature silk regardless of efficiency. Due to the fact that technology and domestic demand came together in China, handicraft silk survived alongside modern filature silk, while elsewhere in the world it did not.

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[1] Giovanni Federico, *An Economic History of the Silk Industry, 1830-1930* (Cambridge, UK: Cambridge University Press, 1997), 3.
[2] Ibid., 18.
[3] Ibid., 19
[4] William C. Lockwood, The Economic Development of Japan (Princeton: Princeton University Press, 1954), 94.
[5] Lillian M. Li, *China's Silk trade: Traditional Industry in the Modern World 1842-1937* (Cambridge, MA.: Harvard University Press, 1981), 198.
[6] Raw silk is the reeled silk strands that can be processed into threads suitable for weaving.
[7] Robert Y. Eng, *Economic Imperialism in China: Silk Production and Exports 1861-1932* (Berkeley: Institute of East Asian Studies, 1986), 37.

[8] Ibid., 162.
[9] Li, *China's Silk trade*, 201.
[10] Eng, *Economic Imperialism in China: Silk Production and Exports 1861-1932*, 181-182.
[11] Lynda S. Bell, *One Industry, Two Chinas* (Stanford: Stanford University Press, 1999) 3, 181.
[12] Lillian M., Li "Silk by Sea: Trade, Technology, and Enterprise in China and Japan," The Business History Review 56, No. 2 (1982), 200.
[13] Li, *China's Silk trade*, 148.
[14] Ibid., 149.
[15] Ibid., 11.
[16] Ibid., 18-19
[17] Ibid.,24-30
[18] Eng, *Economic Imperialism in China*,25.
[19] Federico, *An Economic History of the Silk Industry, 1830-1930,* 4.
[20] Ma, "The Modern Silk Road: The Global Raw-Silk Market, 1850-1930," 332.
[21] Li, *China's Silk trade*, 194.
[22] Shannon R. Brown, "The Ewo Filature: A Study in the Transfer of Technology to China in the 19th Century," *Technology and Culture* 20, No. 3 (1979), 554.
[23] Eng, *Economic Imperialism in China*, 27-28.
[24] Ibid, 118. Robert Y. Eng, *Economic Imperialism in China*, 38-41.
[25] Federico, *An Economic History of the Silk Industry, 1830-1930,* 119.
[26] Ibid., 104.
[27] Li, *China's Silk trade*, 29.
[28] Eng, *Economic Imperialism in China*, 114-115.
[29] Ibid., 115.
[30] Li, *China's Silk trade*, 184.
[31] Li, *China's Silk trade*, 182-187.
[32] Ibid., 98.
[33] Ma, "The Modern Silk Road: The Global Raw-Silk Market, 1850-1930," 334.
[34] Li, *China's Silk trade*, 46.
[35] Bell, *One Industry, Two Chinas,* 47.

[36] Federico, *An Economic History of the Silk Industry, 1830-1930,* 124.
[37] Li, *China's Silk trade*, 30-32.
[38] Federico, *An Economic History of the Silk Industry, 1830-1930,* 131.
[39] Ibid., 20.
[40] Ibid., 109.
[41] Li, *China's Silk trade*, 32.
[42] Cocoons raised from eggs that were inspected to be disease free. Pebrine disease had by then spread to China.
[43] Ibid., 30.
[44] Brown, "The Ewo Filature: A Study in the Transfer of Technology to China in the 19th Century," 559.
[45] Federico, *An Economic History of the Silk Industry, 1830-1930,* 132.
[46] Li, *China's Silk trade*, 76.
[47] Eng, *Economic Imperialism in China*, 162.
[48] Ibid., 35,
[49] Li, *China's Silk trade*, 30.
[50] Bell, *One Industry, Two Chinas,* 44.
[51] Li, *China's Silk trade*, 82. (table 14)
[52] Leo Duran, Raw *Silk: A Practical Hand-book for the Buyer* (New York: Silk Publishing Company, 1921) 117.
[53] Bell, *One Industry, Two Chinas,* 49.
[54] Federico, *An Economic History of the Silk Industry, 1830-1930,* 122; Lynda S. Bell, *One Industry, Two Chinas,* 48; Lillian M. Li, *China's Silk trade*, 82.
[55] Bell, *One Industry, Two Chinas,* 49.
[56] Eng, *Economic Imperialism in China*, 150.
[57] Ibid., 157.
[58] Li, *China's Silk trade*, 103.
[59] Ibid., 100.
[60] Ibid., 126.
[61] Bell, *One Industry, Two Chinas,* 47.
[62] Eng, *Economic Imperialism in China*, 154; Lillian M. Li, *China's Silk trade*, 121.
[63] Ma, "The Modern Silk Road: The Global Raw-Silk Market, 1850-1930," 342.

[64] Li, *China's Silk trade*, 83.
[65] Ma, "The Modern Silk Road: The Global Raw-Silk Market, 1850-1930," 342.
[66] Li, "Silk by Sea: Trade, Technology, and Enterprise in China and Japan," 196.
[67] Bell, *One Industry, Two Chinas,* 47.
[68] Li, *China's Silk trade*, 79.
[69] Bell, *One Industry, Two Chinas,* 46-47.
[70] See Eng, *Economic Imperialism in China*, 54; Li 79 ,Li cautions the reader on omitting re-reeled silk in their analysis
[71] Federico, *An Economic History of the Silk Industry, 1830-1930,* 108.
[72] Hsiao, *China's Foreign Trade Statistics*, 103.
[73] Li, *China's Silk trade*, 31.
[74] Hsiao, *China's Foreign Trade Statistics*, 103.
[75] Federico, *An Economic History of the Silk Industry, 1830-1930,* 126.
[76] Eng, *Economic Imperialism in China*, 162.
[77] Li, "Silk by Sea: Trade, Technology, and Enterprise in China and Japan," 198.