Economic correlates of footbinding: Implications for the importance of Chinese daughters’ labor

The Harvard community has made this article openly available. Please share how this access benefits you. Your story matters

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Citable link</td>
<td><a href="http://nrs.harvard.edu/urn-3:HUL.InstRepos:37611514">http://nrs.harvard.edu/urn-3:HUL.InstRepos:37611514</a></td>
</tr>
<tr>
<td>Terms of Use</td>
<td>This article was downloaded from Harvard University’s DASH repository, and is made available under the terms and conditions applicable to Other Posted Material, as set forth at <a href="http://nrs.harvard.edu/urn-3:HUL.InstRepos:dash.current.terms-of-use#LAA">http://nrs.harvard.edu/urn-3:HUL.InstRepos:dash.current.terms-of-use#LAA</a></td>
</tr>
</tbody>
</table>
Title: Economic correlates of footbinding: Implications for the importance of Chinese daughters’ labor

Short title: Economic correlates of footbinding

Authors: Melissa J. Brown,1,* Damian Satterthwaite-Phillips2

Affiliations
1 Harvard-Yenching Institute, Cambridge, MA, USA
2 Independent Scholar
*Corresponding author
email: melbrown@fas.harvard.edu (MJB)

Key words
social research, China, human families, household economics, sexual and gender issues, socioeconomic aspects of health: footbinding
Abstract

Background

Three wide-spread assumptions about footbinding are: The custom was primarily related to beauty/sexuality and marriage prospects. Footbound girls and women were more of an economic burden on their families than those never bound. Government policies and missionary campaigns ended the practice.

Methods/ Objectives

We use regression and log likelihood tests, with bootstrapping for confirmation, to analyze which of a series of ethnographically and historically hypothesized variables significantly contributed to footbinding. We analyze two large datasets based on oral surveys with elderly women of the last footbound generations from 12 Chinese provinces.

Conclusions

Handicraft production, and particularly commercial handicraft production, correlates with whether Chinese girls were subjected to footbinding before 1950. While government prohibitions are commonly cited as ending the custom of footbinding, girlhood knowledge of such bans did not correlate with whether women were ever footbound. Spinning cotton thread for commercial purposes (sale, wage, direct exchange) correlated with greater daily production, with great variation at the county level in quantity produced. Moreover, Chinese commercial spinners labored more years before marriage than domestic spinners.
Implications

Chinese daughters—whether footbound or not—made important economic contributions to rural households, thus suggesting a need to revise our understanding of China’s gender and economic history. Our results also have contemporary relevance because models incorrectly assuming that the end of footbinding was independent of economic change are today used for interventions to end female genital cutting in Africa and proposed for interventions to end honor killings of girls and women in South Asia. The demonstrated economic correlates of footbinding suggest a need to reevaluate whether contemporary customs controlling and cloistering girls and women might also have economic correlates.

Introduction

Understanding footbinding (FB), a custom which ended in China by the mid-20th century, is important today for two primary reasons (see Figs 1–2). First, it is widely used to illustrate that cultural beliefs can override economic interests, from scholarly works to high school text books [e.g., 1–3]. More specifically, FB is said to show that cultural beliefs can disempower and cloister girls and women, despite economic hardships that result to families from the presumed loss or restriction of female labor contributions [e.g., 4–8]. Second, models based on the assumption that social-mobilization efforts ultimately halted the custom of FB are being promoted as a means to end contemporary practices of female genital cutting [9] and honor-killing of girls and women [2]. Thus, the evidence we present that FB had strong economic correlates suggests the need to re-evaluate the
complex relations among economic development, empowerment of girls and women, and cultural beliefs [cf. 10–13].

Fig 1. Comparison of Chinese Women’s Bound and Natural Feet, ca. 1902, in Guangzhou (Canton). The woman on the left shows a bare, never-bound foot; the woman on the right shows lotus (or lily) feet, the most extreme form of bound feet, with bindings on and off. Source: [14].

Fig 2. Older woman adjusting the bindings on a girl’s foot, 1917–1919, in Shilin, Zhejiang Province, China. The woman, possibly the girl’s grandmother, appears to be tightening the bindings on the girl’s right foot. Note that the woman’s shoed right foot, visible next to the girl’s shoed left foot, appears to be the same size as girl’s foot. Photo by Sidney D. Gamble, used with permission. Source: [15, cf. 16].

There are three long-standing assumptions of FB, all of which our evidence suggests are mistaken. First, reformers, scholars, and footbound women assumed FB was a custom derived from cultural beliefs about beauty (or sexuality) and related to girls’ marriage prospects in China’s patriarchal, patrilineal society where—in late imperial times as well as today—there was a demographic shortage of women on the marriage market [17]. Second, FB was long assumed to severely limit the ability of Chinese girls and women to contribute economically to their households [5–8, 18 –22]. Third, the social engineering efforts of reform-minded activists and political leaders, some Chinese and some Western, were assumed to have ended FB (see S1 Appendix: Historical
We have shown elsewhere [17] that the first assumption is false. For most women, most of the time during the early 20th century, FB made no significant difference in their ability either to marry at all or their ability to marry “up” to an economically better-off household. Moreover, FB ended despite women’s enduring but mistaken belief that FB would lead to a better marriage. Given previous work [17, 20, 21], we tested the following hypotheses: (a) premarital hand-labor, not an absence of prohibitions, correlates with FB; (b) the correlation between hand-labor and FB existed for multiple generations; and (c) handicraft production in rural homes for commercial purposes (sale, wage, or direct exchange of goods) correlates with the amount of labor a girl contributed to her premarital household. We refer to the models associated with these hypotheses as (a) “FB predictor,” (b) “generational,” and (c) “labor” models.

Data

The quantitative information about Chinese FB presented here comes from collaborative research using orally-administered structured interviews with 4973 women in 10 counties in Sichuan Province (gathered during the early 1990s, the “Sichuan dataset” [17, 21]; Fig 3) and 2710 women in 20 counties in 11 other northern, central, and southwestern Chinese provinces (gathered 2006–2011, the “BBG dataset” [17, 22]; Figs 4–6). Both
datasets provide information for each woman about: the wealth and education of her natal household; the labor she performed while living there, focusing on handicraft production and field agriculture; and her experience of footbinding. Handicrafts include spinning, weaving, and embroidering textiles; making shoes, clothes, nets, baskets, and mats; and raising silkworms. We defined hand labor as commercial if it produced goods for sale, wage, or direct exchange, and as domestic if it produced goods for use within the household. The BBG dataset differs from the Sichuan dataset by including additional information on FB prohibitions, each woman’s mother, and natal household spinning and weaving daily quantities and labor-years. (Data collection, ethics statement, datasets, variables, and regions are more fully explained in S2 Appendix: Detailed Materials and Methods.)

Fig 3. Map of Sichuan research sites in relation to macroregions and to shipping and trucking transport routes circa 1936. Map created by the Center for Geographic Analysis, Harvard University [based on 23–28].

Fig 4. Map of Northern research sites in relation to macroregions; to shipping, trucking, and rail transport routes; and to textile mills circa 1936. Map created by the Center for Geographic Analysis, Harvard University [based on 23–28].
Fig 5. Map of Central research sites in relation to macroregions; to shipping, trucking, and rail transport routes; and to textile mills circa 1936. Map created by the Center for Geographic Analysis, Harvard University [based on 23–28].

Fig 6. Map of Southwestern research sites in relation to macroregions and to shipping, trucking, rail, and caravan transport routes circa 1936. Map created by the Center for Geographic Analysis, Harvard University [based on 23–28].

Most women (in both datasets combined) were born between 1905 and 1942 and lived in rural communities most of their lives (some in Sichuan were born as early as the 1890s). 57.3 ± 1.1 percent (95% CI, n=7481) of women born before 1943 had ever had their feet bound, even for a brief time [29]. (CI were determined by treating percentages as the outcome of a binomial random variable, with \( \hat{p} = \frac{\text{successes}}{\text{failures}} \).) The percentage of women ever footbound (fb), although varying by county, generally declined from 1900 to 1950 (Figs 7–10). Women (born before 1943) reported their feet were bound at a mean age of 6.4 sui (岁) or approximately 5 years old (n=4231). 88.2 ± 1.0 percent of fb women reported their feet were bound by their mothers (n=3687).

Fig 7. Percentage of Chinese women ever footbound in 11 Northern rural counties, by birth cohort (n = 568; error bars indicate the 95% CI). Source: BBG interview data, women reporting on themselves and their mothers.
Fig 8. Percentage of Chinese women ever footbound in 6 Central counties, by birth cohort ($n = 780$; error bars indicate the 95% CI). See S2 Appendix for the equation to calculate CI. Source: BBG interview data, women reporting on themselves and their mothers.

Fig 9. Percentage of Chinese women ever footbound in 3 Southwestern rural counties, by birth cohort ($n = 350$; error bars indicate the 95% CI). See S2 Appendix for the equation to calculate CI. The spike in the 1920–1924 cohort is probably due to sampling error (only 12 women contributed data to this point, all of whom were footbound). Source: BBG interview data, women reporting on themselves and their mothers.

Fig 10. Percentage of Chinese women ever footbound in 10 Sichuan counties, by birth cohort ($n = 2489$; error bars indicate the 95% CI). See S2 Appendix for the equation to calculate CI. Source: Sichuan interview data, women reporting on themselves.

Modeling

To test our hypotheses, we performed regressions and log likelihood tests. In order to compare models with different underlying datasets, we used the adjusted $r^2$ as our goodness-of-fit criterion, with bootstrapping as additional verification. Model reduction
was done by iterative deletion and addition of predictors, and the best fitting models are presented here. All statistical analyses were conducted with R (version 3.0.2; 30). For logistic regression models, we computed $r^2$ according to the method in Nagelkerke [31], which we carried out in R via the nagelkerkeR2 function in the fmsb package [32].

For all the FB-predictor models (A1–A6) and all the labor models (C1–C6), we ran separate versions, one including all ever-fb women, and one excluding those who were bound for less than a year (this information was not available for the generational model, B1). Both versions yielded largely the same significant predictors (at $\alpha = 0.05$; S1 Table; 33). Here, we present the models for those fb one year or more because these models yielded the better fit (using the adjusted $r^2$ criterion). (The models using all ever-fb women are in the S3 Supplementary Information: Regional Results for the FB-Predictor model, which includes S1 Table. The variables for all models are explained in S2 Appendix: Detailed materials and methods.) The “fb-one-year” models better assess correlates of long-term FB status by excluding women who bound less than one year (n=404) (see also S2 Appendix).

### A. FB Predictor Models (A1–A6)

We performed a logistic regression with FB status as the response variable (1 = bound at least one year, 0 = never bound). Commercial premarital hand-labor experience (yes/no) and domestic premarital hand-labor experience (yes/no) were the hypothesized correlates. We also included the following covariates in the complete models for the BBG dataset (A1) and the Sichuan dataset (A2): county, birth year, education (some/none), literacy...
(illiterate, half-literate, literate), mother’s and father’s education (some/none), premarital agricultural labor experience (yes/no), a natal-family wealth index (integer-values 0–4) [17; S2 Appendix]. For the FB-predictor models using the BBG dataset (A1, A3–A5), we also included mother’s fb status (yes/no), and knowledge in girlhood of a prohibition against FB (yes/no). FB-predictor models A3–A6 examine variation at the regional level, using the same variables as above except they distinguished three types of hand-labor. (Models A3–A6 are presented in S3 Supplementary Information.) Interaction terms were not considered due to insufficient degrees of freedom. In the final models for the BBG dataset (A1) and the Sichuan dataset (A2), we further assessed the contribution of different correlates by constructing bootstrapped estimates of the coefficients based on fitting the model to 10,000 re-samplings of the data with replacement.

For all the FB-predictor models, we included data only from women interviewed who were born before 1943 (n=7521) and fb before marriage (99.4 ± 0.2 percent of fb women born before 1943 were fb before marriage; n=3841). We limited the data this way in order to assess FB in women’s premarital households before the many changes implemented by the People’s Republic of China (PRC), largely begun in 1950 (see S1 and S2 Appendices).

**B. Generational Model (B1)**

We assessed the hypothesis that FB and spinning were not independent for one previous generation, asking whether the fb mothers of women interviewed were more likely to spin than non-fb mothers. We conducted a log-likelihood ratio (G) test on the
contingency table and calculated the expected values in each cell as the product of the marginal totals. In this generational model, mothers of all women in the (BBG) dataset were necessarily born before 1943. However, there was no way to know if mothers were bound before or after marriage.

C. Labor Models (C1–C6)

We tested whether commercial production correlated with the spinning-labor contributions a woman had made to her premarital household in two ways. We asked separately whether commercial production correlated with the daily amount of cotton spun (the “daily-labor” models, C1–C5) and whether it correlated with the total number of years that a girl spun in her premarital household (the “labor-years” model, C6). We defined commercial spinning as spinning (usually in the girls’ own home) that produced thread sold in local markets (usually by girls’ relatives), thread commissioned for a wage (usually by another villager), or thread exchanged directly for other goods (usually for salt, cooking oil, rice, finished cloth, and/or raw cotton). In contrast, we defined domestic spinning as producing thread used within girls’ own homes (i.e., to weave cloth; weaving was similarly defined as commercial or domestic). Some girls produced thread for both commercial and domestic purposes. For these labor models, we contrasted girls who did any commercial production (including those who did only commercial production and those who did both commercial and domestic production) with girls who did only domestic production (no commercial production at all).

For all the labor models (C1–C6), we restricted the sample from the BBG dataset to include only women who were married before 1950 in order to avoid the many labor-
related changes during the Maoist period (1950–1976). Under Maoism, commercial rural handicraft production was discouraged or banned outright [34–35]. Moreover, premarital labor-years increased for many women with implementation of the 1950 Marriage Law, requiring that all brides be at least 17. As with the FB-predictor models, we included only women who were fb before marriage.

**Daily-Labor Models (C1–C5)**

We modeled the amount of cotton spun per day as the response variable in a multiple linear regression with commercial production as the hypothesized correlate. In model C1, we included all the following covariates: county, commercial and domestic spinning (yes/no), other hand-labor experience (yes/no), age learned to spin (in sui), education (some/none), and whether or not the natal family owned a loom (yes/no). Models C2–C5 examine variation at the county level; they use the same variables as above but exclude “county” as a variable. (These models are presented in S4 Supplementary Information: County Results for the Daily-Labor Model (C2–C5), which includes S2 Table. The variables for these models are discussed in S2 Appendix.)

The distribution of the amount of cotton spun was right-skewed (Shapiro-Wilk test; \( p < 0.001 \)). Therefore, this variable was modeled with an exponential transformation, \( x' = \lambda \cdot x \), with \( \lambda \) optimized to maximize the \( p \) value in the Shapiro-Wilk test. Interaction terms were not considered due to insufficient degrees of freedom. As with the FB-predictor models A1 and A2, we further assessed model coefficients of the multiple-
county, daily-labor model (C1) by constructing bootstrapped estimates based on 10,000 re-samplings with replacement.

Labor-Years Model (C6)

To test the hypothesis that commercial spinners labored more years for their natal families than domestic spinners, we defined spinning labor-years as the difference between the age that a girl learned to spin and her age at marriage. The distribution of labor-years was significantly nonnormal (Shapiro-Wilk test; p<0.001). Being unable to normalize the distribution, we used a Wilcoxon rank sum test with continuity correction to test for a difference in labor-years between commercial spinners and spinners who spun for domestic use only.

Results

Our analyses suggest economic correlates to FB, going back at least one generation, and suggest a commercial benefit of girls’ production of handicrafts to their rural premarital households. We found repeated evidence of the importance of county-level variation and evidence of a decrease in FB over time.

A. FB-Predictor Models (A1–A6)

In both the BBG and Sichuan datasets overall (models A1 and A2 respectively), all the following variables were significant: county, birth year, natal family wealth, girlhood
commercial hand-labor experience, and some educational measure. Having heard of a prohibition against FB was not a significant predictor of FB status (model A1; $p=0.957$; 36). The bootstrap estimates confirmed the significance of all variables except commercial hand-labor (discussed below). A woman was less likely to have been fb, the later her birth year ($p < 0.001$ for both A1 and A2). The subsamples ($n$) meeting all restrictions and providing all variables were 1485 for model A1 and 4567 for model A2.

A woman was more likely to have been fb if her natal family was wealthier ($p = 0.014$ for A1; $p < 0.001$ for A2) and if she had commercial hand labor experience ($p = 0.020$ for A1; $p < 0.001$ for A2). Doing any kind of handicraft production was a significant predictor of FB (Fig 11). However, as presented in S3 Supplementary Information (which includes both explanatory text and S1 Table), there was regional variation in the importance of specific handicrafts and in commercial versus domestic production. In the Northern region (Fig 4), commercial spinning and domestic weaving were significant; in the Central region (Fig 5), domestic weaving; in the Southwest (Fig 6), other handicraft production (such as weaving reed baskets and mats); and in Sichuan (Fig 3), commercial spinning, domestic weaving, and other commercial handicraft production were all significant (see S3 Supplementary Information for models and results). We think this regional variation explains why the bootstrap estimates showed commercial hand-labor experience no longer significant in the BBG dataset (model A1, 95% CI for the coefficient [-0.004, 0.856]), though bootstrapping showed commercial hand-labor experience remained highly significant in the Sichuan dataset (model A2, 99.9% CI [0.239, 0.773]).
Fig 11. Fraction of women born 1887–1942 who were footbound in 20 counties in rural China ($n = 5373$; error bars indicate the 95% CI). Both natal household wealth and whether a girl performed commercial handicraft labor predicted the likelihood of the girl being footbound (in a logistic regression, both $p < 0.001$ when all data were pooled). The wealth index was scored as 2 points for family ownership of land, and 1 point each for ownership of a house or draft animal [17, S2 Appendix].

Which specific educational measure was significant differed between models A1 and A2, but both models showed a negative association between FB and education. In model A1 (the BBG dataset), women whose mothers had some education were less likely to be fb ($p = 0.029$); in model A2 (the Sichuan dataset), illiterate girls were more likely to be fb than literate ones ($p = 0.031$).

Model A1 (the BBG dataset) yielded three additional findings. Mothers who were fb were more likely to have daughters who were fb ($p < 0.001$). Women who produced handicrafts for domestics use (regardless of whether they also did commercial hand-labor) were more likely to have been fb ($p = 0.041$; see S2 Appendix for the distinction between domestic and commercial use). Although not significant, women with agricultural field labor experience (including planting, weeding, harvesting, and winnowing) were less likely to have been fb ($p = 0.078$).

B. Generational Model (B1)
We found a significant relationship between FB and spinning for the mothers of women in our BBG dataset (G=5.3824; p = 0.020). There were more mothers who both spun and were FB, and more mothers who were not FB and did not spin, than expected under the null hypothesis. For a subsample of the BBG dataset, there was information on whether their mothers were fb (n=2486) and spinners (n=997; for both n=956): 90.1 ± 1.2 percent of mothers were fb, and 74.8 ± 4.0 percent of mothers spun. We estimated mothers’ birth years as daughter’s birth year minus 25, resulting in a range of birth years from 1882 to 1931 for mothers with data on whether they were fb (see also Figs 7–10).

C. Labor Models (C1–C6)

Doing any commercial spinning (regardless of whether they also did domestic spinning) did predict women’s spinning-labor contributions to premarital households before 1950.

Daily-Labor Models (C1–C5)

In the multiple-county, daily-labor model (C1), both county and commercial spinning were significant (p<0.05 and p=0.002, respectively). Notably, FB did not predict lesser daily production (contra 5, 7–8, 18; neither did it predict greater daily production). The fitted model predicts that, at the median age of 12 sui (approximately 11 years old), commercial spinners spun 42 grams more per day than noncommercial spinners (Fig 12), although there was significant variation in the daily amount produced across counties (models C2–C5 examining county-level variation are presented in S4 Supplementary information). The BBG subsample (n) meeting all restrictions and providing all variables

submitted ms, 5/28/2017, page 16
was 137 (see S2 Appendix). The bootstrapped estimate confirmed commercial spinning as a significant predictor (99% CI for the coefficient [0.0004, 0.020]).

Fig 12. Amount of cotton spun daily by Chinese girls born 1907–1943 ($n = 137$), subdivided by whether they spun commercially, which was significant (multiple regression: $p = 0.002$) when other covariates were considered (model C1). Boxes indicate the interquartile range (IQR), and whiskers extend to the farthest point ≤ 1.5 times the IQR. Individual points beyond the whiskers are plotted as circles. Medians are marked by the horizontal bar, and means by “+”, for direct comparison with average spinning rates Thomas Jefferson reported for enslaved girls at his Monticello and Poplar Forest plantations, indicated by the dotted line [37–39].

Labor-Years Model (C6)

Commercial spinners labored more years before marriage than noncommercial spinners ($p = 0.028$). The first quartile was 0.4 years longer for commercial spinners, the median was 0.5 years longer for commercial spinners, and the third quartile was 1 year longer for commercial spinners. Maximum values were also greater for commercial spinners. The BBG subsample ($n$) meeting all restrictions and providing all variables was 136 for commercial spinners (97 of whom also spun for domestic use) and 229 for spinners who spun for domestic use only.

Discussion
Our results indicate that the commonly held assumption that FB limited female economic contributions to households is wrong. Rather, handicraft production—both commercial and domestic—was a significant factor in FB for at least the last two generations of FB rural Chinese women. Natal families held onto girls with commercially valuable handicraft skills longer, suggesting that the economic contributions from their higher daily production were important to women’s premarital households. Additionally, our evidence challenges assumptions that government prohibitions ended FB. Girlhood knowledge of FB prohibitions was irrelevant to whether women were FB, a result we take as an indirect indicator that FB prohibitions were not effective (see S1 and S3 Supplemental information).

The negative correlation between birth year and FB status (models A1–A6) is not surprising, given that we know FB was ending as a custom beginning from the mid-19th century ([5–6, 8–9, 17], Figs 7–10). The significance of county-level differences (models A1–A6, C1) may be understood from the great variability in local-level transportation networks in early 20th-century China in combination with the correlation of FB to commercial handicraft production (Figs 3–6 and 11, see S3 and S4 Supplementary Information). These findings—in conjunction with the lack of significance of girlhood knowledge of FB prohibitions and qualitative reports by elderly men who had been medium- to long-distance traders before 1950—strongly suggest that FB ended when railroads, dredged waterways, or improved roads allowed transport of thread, cloth, and other goods produced in distant urban factories into rural, county markets so cheaply that these factory goods undersold rural home-produced commercial handicrafts [22]. When raw cotton sold for more than homespun cotton thread did in a local rural market [40–42],
hand-spinning became worthless. This economic explanation fits the mosaic pattern of FB’s demise across rural China.

Whether a woman’s mother was fb had a lot of predictive power in the BBG dataset (model A1), which sampled 20 counties across 11 provinces. It made a larger contribution to FB than one year’s difference in birth, one unit of change in our rural wealth index, or commercial hand-labor experience. Since this predictor was not available in the Sichuan dataset, we are somewhat less confident in the results for model A2. The significance of a woman’s mother being fb might be due to vertical cultural transmission of a practice based on a belief [cf. 43, but see 11–12, 44]. However, such interpretation is complicated by the necessity of knowing how to bind feet [45] in order to transmit the custom. Some women explained never having been bound because of their mother’s absence from death or remarriage [46]. FB had health risks: 24.3 ± 1.3 percent of fb women (n=4151) reported their feet became infected. Because the women interviewed survived to be included in our study, we cannot know whether the presence of a fb mother reduced a girl’s risk of survival due to infection from FB.

We find a complex relation between wealth and FB (models A1 and A2; Fig 11). Families ranked higher on our rural wealth index were more likely to bind daughters’ feet. Handicraft production required initial capital [47; cf. 7, 41–42]. Spinning required raw cotton (or other fiber) and a spinning wheel; weaving cloth required thread, fuel and water to boil and soften the thread, and a loom; weaving mats required reeds; etc. Some women rented a loom or wheel for a portion of the product, but that required finding a wheel or loom not in use. Some households could not afford to purchase or produce even
footbinding cloth [48]. We suggest that rural families needed sufficient capital to fund handicraft production to encourage FB.

However, a different type of wealth indicator – female education/literacy – decreased the likelihood of FB. We suggest this difference can be understood because female education indicated not only greater wealth than our rural wealth index captures but also urban wealth. Female education was more likely in cities [49–50]. Circa 1930, Buck estimated sufficient literacy to read a letter in rural China at 30 percent for men and only 1 percent for women [7]. FB thus appears inversely correlated to urban wealth, for FB ended earlier in China’s urban centers than in its rural areas, whether because factory-produced goods wiped out urban handicraft production earlier, as we think likely [17, 22], because FB prohibitions were more effective in cities, or because urban families abandoned FB early in pursuit of “modern” lifestyles [2, 5].

The most important results of the study show FB was not an economically disinterested custom in which families gave up daughters’ labor to promote their marriageability [51]. Using median values for birth year and household wealth, and median coefficients for categorical values, the fitted FB-predictor models (A1 and A2) indicate that girls producing commercial handicraft were 1.24 times more likely to have been footbound than girls not producing commercial handicraft across China (model A1, BBG dataset), and 1.05 times more likely in Sichuan (model A2). Footbound girls’ hand-labor earned cash and goods for their premarital households. Furthermore, the significant correlation between mothers’ FB status and mothers’ labor as spinners (generational model, B1) corroborates evidence from the Sichuan regional FB-predictor model (A6, see
S3 supplementary information) that the economic contributions of FB women go back at least to the 1880s.

Initial comparison to early 19th-century US spinning shows that assessment of Chinese daughters’ economic contributions to their households before marriage is complex. Based on the fitted values of the daily-labor model (C1), Chinese commercial spinners who learned to spin at the median age (about 11 years old) produced 1.4 times as much per day as girls with no commercial spinning experience: 139 versus 96 grams (Fig 12). Daily labor predictors and rates varied by county (models C2–C5), and FB apparently did boost production in some locales (model C3; S2 Table in S4 Supplementary Information). In some counties, Chinese girls produced more than the 217 grams per day that was the average daily amount spun by African American girls enslaved at Thomas Jefferson’s Monticello and Poplar Forest plantations (circa 1800) using comparable technology [37–39]. That Chinese girls could produce as much or more per day as enslaved girls with self-interested overseers suggests that Chinese daughters’ economic contributions to their natal families were potentially substantial (see S3 Appendix: Comparing Labor Coercion via Slavery and Footbinding).

FB has been used [2, 9] as a model for ending female genital cutting and honor killings because all these customs have been assumed to have no economic correlation. Evidence presented here that families had economic interests for FB and that government prohibitions against FB had no significant effect on whether girls were fb suggests a need to re-evaluate whether economic interest may also influence these other customs.
Acknowledgments:

The BBG data were collected 2006–2011 by Melissa J. Brown, Laurel Bossen, and Hill Gates as part of a (human-subjects approved) research project run by Brown. MJB collected data for sites 1501, 2001, 2002, 2101, 2102, 2301, 2302, and 3103 with the collaboration of Xu Wu; LB for 1101, 1102, 1901, 1902, 2701, 2702, and 3102; HG for 1701, 1702, 2801, 2802, 2902, and 2903. The Sichuan data (sites BX, DZ, EM, JJ, LQ, LZ, MS, NC, SN, ZG) were collected during the early 1990s under the direction of Hill Gates with funding from the Harry Frank Guggenheim Program on Violence and Aggression against Women and the cooperation of the Sichuan Women’s Federation.

We thank Lucia Stanton, Shannon Senior Historian Emerita at the Thomas Jefferson Foundation at Monticello, for sharing and explaining the Monticello and Poplar Forest plantation data. We also thank Ian Robertson and Marcus W. Feldman for comments on the manuscript. We are grateful to Hill Gates, Laurel Bossen, Xu Wu, and our many research collaborators and assistants in China and North America and especially to the thousands of rural Chinese women who shared information about their lives.

References and Notes


14. Graves CH. The so-called “Lily feet” contrasted with the natural feet of Chinese women. George Grantham Bain Collection, Prints and Photographs Division, US Library of Congress; accessible online under the digital ID cph.3a49263.


29. $n$ indicates the number of women who answered the relevant question(s).


33. For differences at the regional level (models A3–A6) and county level (C2–C5), see the discussion in the S3 and S4 Supplementary Information, respectively.


35. Daily hand labor was greatly reduced for girls and young women during the Maoist period. Most women interviewed reported doing agricultural labor all day for work
points and spinning, weaving, or doing other hand labor at night because they
received no work points for their hand labor.

36. Because models were reduced using iterative deletion and only the best-fitting models
are presented, variables that were not significant—including the FB prohibition
variable—dropped out of models A1, A3 – A5. We ran the best-fitting models again
with the insertion of the FB prohibition variable in order to assess whether its p-
values in any of the models was near significance. They were not (those p-values are
recorded in the main text and S3 Supplementary Information text); nor did the
addition of that variable alter the significance of other variables.

37. Lucia Stanton, Shannon Senior Historian Emerita at Monticello, personal
communication, letter of October 29, 2013.

from: http://www.masshist.org/thomasjeffersonpapers/farm/index.html


40. For example, as qualitatively reported by interviewed women, IDs 1701036 and
2702066.


46. Qualitative reports: IDs 2301008, 3103131.

47. Qualitative reports: IDs 1901021, 2702076, 2902050, 3102012.

48. Qualitative reports: IDs 1101010, 1501023, 2001004, 2701031, 2801128, 3102036.


51. FB has been portrayed as economically disinterested [1–8] because it was assumed to severely limit female labor. Although families usually received a “body price” (身價), or brideprice, at a daughter’s marriage, it was not perceived as offsetting the financial burden of raising a daughter. [See Sommer, Matthew H. 2015. Polyandry and Wife-Selling in Qing Dynasty China: Survival Strategies and Judicial Interventions. Oakland: University of California Press.] Moreover, most fb women did not marry to wealthier families [17], so there is no reason to expect families received greater brideprices for fb brides than never-bound brides.


60. Fielde AM. Pagoda Shadows. Londong: T. Ogilive Smith, 1887.

**Availability of Data:**
The data set containing the BBG information used in the models presented here is available online. Names of individuals and subcounty locations have been removed to meet confidentiality requirements. For availability of the Sichuan data set, contact Dr. Hill Gates <hill42gates@gmail.com>. Many research materials on Thomas Jefferson are available online (http://www.monticello.org/site/research-and-collections/researching-thomas-jefferson-introductory-guide), including a facsimile of the *Farm Book* (http://www.masshist.org/thomasjeffersonpapers/farm/index.html) and much of his correspondence (http://founders.archives.gov/).

**Supplementary Information titles and captions:**

S1 Appendix: Historical Context

S2 Appendix: Detailed Materials and Methods

S3 Appendix: Comparing Labor Coercion via Slavery and Footbinding

S1 Supplementary Information: Spinning, Weaving & Cloth Images
S1 Fig. Women Demonstrating Use of Single-Spindle Wooden Spinning Wheels.

S2 Fig. Woman Demonstrating Use of a Wood-Framed Loom.

S3 Fig. Examples of Homespun, Home-Woven Cloth.

S2 Supplementary Information: FB Images

S4 Fig The “Lotus” (蓮) Feet of an Elderly Chinese Woman.

S5 Fig The “Half-Sloping” (半坡) Foot of an Elderly Chinese Woman.

S3 Supplementary Information: Regional Results for the FB-Predictor Model (A3–A6)

S1 Table. Comparison of Adjusted $r^2$ and Significance Levels of the FB-Predictor Models, by Whether Women Who Were Footbound (fb) Less than a Year Were Included.

S4 Supplemental Information: County Results for the Daily-Labor Model (C2–C5)
S2 Table. Comparison of the Daily-Labor Model Results China-wide (model C1) and in Four Counties (models C2–C5), by Whether Women Who were Footbound (fb) Less than a Year Were Included.

S1 Dataset
Fig 1. Comparison of Chinese Women’s Bound and Natural Feet, ca. 1902, in Guangzhou (Canton). The woman on the left shows a bare, never-bound foot; the woman on the right shows lotus (or lily) feet, the most extreme form of bound feet, with bindings on and off. Source: [14].
Fig 2. Older woman adjusting the bindings on a girl’s foot, 1917–1919, in Shilin, Zhejiang Province, China. The woman, possibly the girl’s grandmother, appears to be tightening the bindings on the girl’s right foot. Note that the woman’s shoed right foot, visible next to the girl’s shoed left foot, appears to be the same size as girl’s foot. Photo by Sidney D. Gamble, used with permission. Source: [15, cf. 16].
Fig 3. Map of Sichuan research sites in relation to macroregions and to shipping and trucking transport routes circa 1936. Map created by the Center for Geographic Analysis, Harvard University [based on 23–28].
Fig 4. Map of Northern research sites in relation to macroregions; to shipping, trucking, and rail transport routes; and to textile mills circa 1936. Map created by the Center for Geographic Analysis, Harvard University [based on 23–28].
Fig 5. Map of Central research sites in relation to macroregions; to shipping, trucking, and rail transport routes; and to textile mills circa 1936. Map created by the Center for Geographic Analysis, Harvard University [based on 23–28].
Fig 6. Map of Southwestern research sites in relation to macroregions and to shipping, trucking, rail, and caravan transport routes circa 1936. Map created by the Center for Geographic Analysis, Harvard University [based on 23–28].
Fig 7. Percentage of Chinese women ever footbound in 11 Northern rural counties, by birth cohort \((n = 568; \text{ error bars indicate the 95\% CI})\). See S2 Appendix for the equation to calculate CI. Source: BBG interview data, women reporting on themselves and their mothers.
Fig 8. Percentage of Chinese women ever footbound in 6 Central counties, by birth cohort (n = 780; error bars indicate the 95% CI). See S2 Appendix for the equation to calculate CI. Source: BBG interview data, women reporting on themselves and their mothers.
Fig 9. Percentage of Chinese women ever footbound in 3 Southwestern rural counties, by birth cohort (n = 350; error bars indicate the 95% CI). See S2 Appendix for the equation to calculate CI. The spike in the 1920–1924 cohort is probably due to sampling error (only 12 women contributed data to this point, all of whom were footbound). Source: BBG interview data, women reporting on themselves and their mothers.
Fig 10. Percentage of Chinese women ever footbound in 10 Sichuan counties, by birth cohort ($n = 2489$; error bars indicate the 95% CI). See S2 Appendix for the equation to calculate CI. Source: Sichuan interview data, women reporting on themselves.
Fig 11. Fraction of women born 1887–1942 who were footbound in 20 counties in rural China ($n = 5373$; error bars indicate the 95% CI). Both natal household wealth and whether a girl performed commercial handicraft labor predicted the likelihood of the girl being footbound (in a logistic regression, both $p < 0.001$ when all data were pooled). The wealth index was scored as 2 points for family ownership of land, and 1 point each for ownership of a house or draft animal [17, S2 Appendix].
Fig 12. Amount of cotton spun daily by Chinese girls born 1907–1943 ($n = 137$), subdivided by whether they spun commercially, which was significant (multiple regression: $p = 0.002$) when other covariates were considered (model C1). Boxes indicate the interquartile range (IQR), and whiskers extend to the farthest point $\leq 1.5$ times the IQR. Individual points beyond the whiskers are plotted as circles. Medians are marked by the horizontal bar, and means by “+”, for direct comparison with average spinning rates Thomas Jefferson reported for enslaved girls at his Monticello and Poplar Forest plantations, indicated by the dotted line [36–38].
S1 Appendix: Historical Context

FB probably began as a custom no earlier than the 10th century [5, 19] and ended at different times in different parts of China between the mid-19th and mid-20th centuries [17, 22]. There were many efforts to end footbinding (FB). For example, Qing-dynasty official and reformer Kang Youwei in conjunction with Liang Qichao and others persuaded the Guangxu emperor to officially ban FB in 1898, arguing that FB shamed China before the West and handicapped China in the competition of nations by removing or reducing women’s economic contributions (the ban was soon rescinded but reinstated in 1905). The reformer Liang Qichao was so influential that his “image of women with bound feet as parasites, beasts, and slaves [became] the standard view” [5]. Christian missionaries from the US and Europe banned their converts and students from FB, and Mrs. Archibald Little founded the Natural Foot Society in 1898. During the Republican period (1911–1949), FB was banned repeatedly by different regimes, including the Nationalist government and warlords Yan Xishan (who ruled Shanxi Province) and Feng Yuxiang (who controlled Hebei, Henan, and parts of adjacent provinces during the 1920s and early 1930s). All these authorities sent soldiers to suppress FB and/or inspectors to levy fines on families with footbound (fb) girls or women [16, 22, 42]. The Chinese Communist Party discouraged FB in areas under their influence, though warfare (resistance to the Japanese invasion and occupation as well as the civil war against the Nationalists) limited their anti-FB efforts before the 1949 founding of the PRC. Today FB exists only among a rapidly diminishing number of elderly Chinese women.

Handicraft production, especially of textiles, continued in rural China for decades beyond the industrialization of textile production in China’s urban centers [7, 16, 22, 34, 42]. Between
1900 and 1950, many parts of China experienced rapid expansion of transportation lines in the form of railroads, rivers or dredged waterways capable of carrying large cargo ships, and paved or packed-dirt roads capable of carrying cargo trucks. Such transport routes gave easy access to industrialized urban centers, where cloth-producing and thread-producing textile mills sprang up during the early 20th century ([22, 25–26, 52–53] Figs 3–6). Most of our research sites, however, were sufficiently removed from such transport routes that mechanized technologies for handicrafts (such as multi-spindle spinning jennies and iron-loom frames) were rare. For example, during the 1930s and 1940s, county 2001 was a two-day walk from the major urban center of Wuhan, yet women there reported using single-spindle spinning wheels (S1 Fig in S1 Supplemental Information) and wood-frame looms (S2 Fig in S1 Supplemental Information) at least through 1949 (and often much later). Thus, at the township and county level, transport conditions to and from markets affected the demand for homespun thread and home-woven cloth ([7], S3 Fig in S1 Supplemental Information).

Home-based textile production was affected by the availability of raw materials. During the 1930s, cotton production fluctuated not only due to climatic influences but also due to policy impacts (for example, cultivation of opium competed with cotton in Shaanxi) and war [52, 54]. Some women in areas where cotton was not grown—especially Yunnan province (counties 3102, 3103)—reported buying raw cotton to spin. Some also reported scavenging thread from old clothing to re-spin and re-weave into cloth (e.g., ID 3103201). In 15 of the 20 BBG counties, cotton was such a common crop that at least 35 percent of women interviewed there reported their premarital families growing cotton (S2 Table, which is discussed in S4 Supplementary information; data on crops grown were not collected in Sichuan). In 13 of those 15 counties, at
least 45 percent of households had unmarried daughters picking cotton. In these counties, cotton
was readily available for local spinners to use.
S2 Appendix: Detailed Materials and Methods

Ethics approval for use of the previously collected Sichuan data and for collection of the BBG data, including use of oral consent by human subjects, was granted by IRB no. 349 (panel 2) at Stanford University (protocol no. 83622, 2006–2011).

Sites and sampling

Interview sites are distributed in inland rural China (see Figs 3–6). There are no sites in China’s southeast, coastal, or major cities because footbinding (FB) stopped so much earlier in these locales that we could not expect to find many living women who had experienced FB. Each “site” includes several natural villages, within a single township (乡) when it was possible, but certainly within the administration (at the time of interviewing) of a single county, small city, or rural district of a large city (县, 市, 区). Sites are referred to as “counties” in the main text. At every BBG site (except two), approximately 100–200 women were interviewed. In each natural village, we requested interviews with all mentally capable women living in the village who were old enough that some women of their generation had experienced footbinding (FB); most women agreed to be interviewed. We included as many natural villages as necessary to interview 100–200 women. At site 2802, in Shandong Province, 55 women were interviewed. At site 1702 in Hebei Province, 63 women were interviewed, but since this site is within the same county as site 1701, sites 1701 and 1702 were pooled as a single site in the analyses. At each Sichuan site, 490–500 women were interviewed.
Regions

We classified sites into regions based on G. W. Skinner’s well-accepted definitions of China’s historic macroregions (23, 55–56 but see 57). Our Northern region combines 8 sites in Skinner’s North region and 3 sites in Skinner’s Northwest region (Fig 4), with a total of 1080 women born before 1943 [17, 22, 52, 54]. All 6 sites in the Central region fall within Skinner’s Middle Yangzi region (Fig 5) and contribute a total of 1062 women born before 1943 [17, 22]. Although today Sichuan, Yunnan, and Guizhou provinces as well as the provincial-level city of Chongqing are considered part of China’s multi-ethnic southwest, we follow Skinner in dividing them into two regions: our Southwest region (Skinner’s Yungui region; Fig 6), totaling 404 women born before 1943, and our Sichuan region (Skinner’s Upper Yangzi; Fig 3), totaling 4973 women, all born before 1930 [cf. 17, 21, 41, 42]. All sites in both these regions are ethnically Han (i.e., China’s ethnic majority, considered “ethnic Chinese” elsewhere in the world).

The maps (Figs 3–6) were constructed from historical maps of China available in Harvard University collections and online [22–28]. All historical base maps were geo-referenced and digitized by Harvard’s Center for Geographic Analysis and are archived there.

Data-generating interviews

The interviews covered a wide range of questions for each woman’s natal household. Most women had vivid memories of their natal family from the time just before they left in marriage or just before the 1949 founding of the PRC (if they married later than that). However, not all women answered every interview question. “I don’t know” and “I don’t remember” were acceptable responses, and some questions depended on others. For example, who bound a
woman’s feet could only be asked of women who had once been footbound (fb). Consequently, the number of data points differs across the models and descriptive statistics. The BBG interviews gathered some information not included in the Sichuan interviews, indicated by “BBG only.” For example, the labor-years model (C6) uses the BBG data \((n=890)\) because the Sichuan data does not include the age at which women learned to spin.

Because the BBG survey spanned five years and these interviews represented the only possibility of gathering information on FB in relation to labor from women who experienced FB, some questions were added at later sites based on preliminary analyses. The generational and daily-labor models (B1 and C1–C5) use such added questions. The generational model (B1) uses data from women in 5 counties (2002, 2102, 2301, 2302, 3103) systematically asked who spun in their natal household, which allowed us to identify mothers who spun; women in another 5 counties (1501, 2001, 2902, 2903, 3102) occasionally volunteered this information, for a total of 956 women who provided data. The daily-labor models (C1–C5) use data from women in 8 counties (1501, 2001, 2002, 2101, 2102, 2301, 2302, 3103) systematically asked to recall the amount of cotton thread that they regularly spun per day; women in 8 other counties (1101, 1102, 1701+1702, 1901, 1902, 2902, 2903, 3102) occasionally volunteered this information, for a total of 463 spinners (born before 1943) who provided data. (However, only 137 women fit all the restrictions and had all the necessary variables to be included in the multiple-county daily-labor model, C1.) As far as we are aware, these are the only existing data on daily amount of cotton spun by individual Chinese handicraft producers before 1950. (Quantities were usually given in terms of “big ounces” [两, 37.7 grams] or “catties” [市斤, 603.3 grams], but sometimes “spindles” or other local measures [团, 锭, etc.]. Only those quantities that could be converted to grams were used.) Because these models included only a subset of the data from the Central and
Southwest regions, we recognize that the results may not generalize to the Northern and Sichuan regions.

We examine FB in relation to women’s premarital work and natal family conditions because almost all women were fb before marriage. Thus, our models use the following information collected: birth year; whether married before 1950; education and literacy levels of the woman interviewed, her mother, and her father; a natal-family wealth index; whether the woman herself had spun cotton or other materials (including spinning hemp or ramie, or reeling silk) before marriage, and if so, for domestic or commercial use; the age at which she learned to spin (BBG only); whether the woman’s natal family had a loom (BBG only); whether the woman had woven any fiber into cloth (including cotton, hemp, ramie, or silk) before marriage, and if so, for domestic or commercial use; whether each woman did any other premarital handicraft work, and if so, whether for domestic or commercial use. We explain these variables below.

Women’s ages

Chinese traditional reckoning of years and ages required adjustment to international standards (based on Western reckoning). Women’s birth years were told to them most often in terms of the 12-year, lunar-based zodiac cycle. Moreover, Chinese traditionally reckoned age as 1 sui (岁) at birth with age added at the lunar new year. Thus, ages given in sui differ from the Western calculation of age (0 at birth, accruing age on one’s birth date) usually by 1 but sometimes by 2. Models use ages given in sui; the approximate Western age equivalent is noted in the text. In order to calculate precise birth years, women interviewed were asked both their age in sui at the time of the interview and their zodiac animal (属).
Restrictions by birth year and marriage year

We restricted all models except the generational model to data from women interviewed who were born before 1943 for the following reason. We looked at the median and interquartile range of ages at which FB first occurred for women in “majority” cohorts, 5-year birth cohorts in which 50 percent or more of the women were ever footbound [17]. The median age was $6.3 \text{ sui} \pm 0.1$ (about 5 years old) and the 75th percentile was $8.0 \text{ sui}$, (about 7 years old; n=3439). By restricting models to women born before 1943, we ensured that the youngest women (born 1942) would have an age within the 75th percentile for FB by 1949, when the founding of the PRC dramatically changed the political economy and FB. This restriction removed 0 women from the Sichuan data set and 189 women from the BBG data set, leaving a total of 7521 women for consideration in the models. (Data that were used in the generational model related to the mothers of women interviewed, who were necessarily born before 1943.)

As explained in the main text, the labor models (C1–C6) were also restricted to women who married before 1950, in order to avoid Maoist-period influence [35]. Because the generational model (B1) included the mothers of women interviewed, they were necessarily married before 1950. The FB-predictor models (A1–A6), however, did not include this marital restriction because of the extreme loss of data, once all the variables were included. Moreover, because these models examined whether any hand-labor was done, not quantity produced, they were less affected by Maoist-period influence. Girls and women still produced homespun cloth and other handicrafts throughout the Maoist period, though they were not able to do as much
(given their increased agricultural labor; [35]); there was also a black market during the Maoist period where rural people sold or exchanged goods privately, especially textiles [34, 52, 58].

**Education**

Women, their mothers, and their fathers were defined as having some education if reported to have *any* education prior to 1950 or, for mothers and fathers, if reported half- or fully literate. To read a Chinese newspaper with ease requires knowledge of 2000 to 3000 Chinese characters, to read a letter, about 1200 characters; before 1950, the ability to read a letter counted as literacy in rural China [49–50]. Women, their mothers and fathers were defined as half-literate if they could read a little, for example, enough to understand a business sign.

**Rural Wealth Index**

The rural wealth index used (MMI) has an integer value between 0 and 4, depending on whether the woman’s natal family *owned*: any land at all (+2), a house (+1), or a draft animal (+1). Explained in more detail elsewhere (17), the weighting in this index is based on the primary importance to rural households of owning land (as opposed to renting it). It also recognizes that a house, which could serve as a workshop or business, or a draft animal, which could transport produce or goods, contributed significantly to rural household income.

**Production for domestic versus commercial use**
Domestic use was defined as consumption within the household, for example, cloth used for clothing worn by family members. Commercial use was defined as sale, wage, or direct exchange between households. Handicraft production for direct exchange between households was underreported in the interviews, because some women interviewed perceived such exchanges between households as domestic use (e.g., county 1101).

**Types of labor**

Production tasks were classified as hand labor if they fell into the predefined categories of spinning, weaving, embroidery, making shoes, making clothes, making bedding, sorting tea, raising silkworms, or processing opium. There was also an open-ended “other” handicraft category of any additional labor task that women themselves defined as handwork. In our models, we focus on only three distinct categories of hand labor: spinning, weaving (cloth only), and other. The “other hand labor” category in the models includes, not only tasks predefined as hand labor, but also the other tasks that women themselves volunteered. In addition to the examples listed above, this “other” category includes twisting fibers into rope; weaving of fishnets, mosquito nets, reed baskets, and reed mats; as well as sewing, twisting grass (for fuel), and carding cotton.

Our agricultural field labor category includes only crop labor: planting, plowing, weeding, pruning, harvesting, hauling crops from the field, threshing, flailing, drying, winnowing, fertilizing, and watering. This category did not include other farm-labor tasks that girls and women did—most commonly, herding, and raising pigs or chickens. (Other types of
nonagricultural labor that women commonly reported were collecting firewood or wild plant foods, housework, cooking, and childcare.)

Footbinding variables

The BBG and Sichuan datasets are the only known quantitative sources of the following information used here: whether a woman herself was ever footbound (fb), even briefly; if so, who bound her feet, and the duration of binding; whether she herself had heard of FB prohibitions as a girl (BBG only); and whether the woman herself knew from her own experience that her mother was fb (BBG only).

Variation existed in the FB process, the size of feet produced, and whether it was possible to stop binding. To achieve the most extreme and much-lauded “lotus” (连) form (with feet approximately 10 cm long) was a painful process that required bending the toes under the foot and toward the heel, forcing the arch upward, and tightly binding with a cloth [6, 8, 59]. Over time, FB led to pressure breaks and sometimes the loss of toes (Fig 1, S4 Fig in S2 Supplementary Information); women whose arch had been broken could never be completely unbound or they could not walk [8, 60]. A less extreme FB process forced the small toes under the sole of the foot, breaking the toes but not the arch [17]. Many women with this “cucumber” (黄瓜) or “half-sloping” (半坡) form experienced FB as a phase of their lives, because as long as the bones of the arch were intact, let-out feet (S5 Fig in S2 Supplementary Information) would—after a painful transition period—return to a form that functioned much as never-bound feet [8, 17].
We classified a woman as ever-fb if she was bound, even for one day: 57.3 percent (± 1.1, 95% CI) of women born before 1943 were ever fb. In assessing the percentage of Chinese women in our sample ever fb (Figs. 7–10), the approximate 95-percent confidence intervals for proportion footbound (\( \hat{p} \)) in each region were calculated as observed proportion, \( p_{observed} \), ± 1.96 \( (SE_{smooth}) \), clipped to the range [0, 1], where \( SE_{smooth} \) uses a Laplacian smoother of 0.5 to allow for estimates when observed proportions were 0 or 1:

\[
SE_{smooth} = \sqrt{\left( p_{smooth} (1 - p_{smooth}) / (n + 1) \right)}, \text{ where } p_{smooth} = (p_{observed} + 0.5) / (n + 1).
\]

When we added the restriction of considering only women married before 1950 (as well as born before 1943), the percentage of ever-fb women increased to 66.0 (± 0.1).

We initially ran the FB-predictors models (A1 and A2, including the regional models, A3–A6) as well as the labor models (C1–C6) using ever-fb women. However, because most ever-fb women reported unbinding their feet, at least for a time, we ran the models again with women whose footbinding duration was roughly a year (the duration of 1 \( sui \)) or more. As stated in the main text, for models where data across all available sites were included (A1, A2, C1, C6), using all ever-fb women and using the year-plus FB restriction resulted in largely the same significant correlates (at \( \alpha = 0.05 \); S1 Table, discussed in S3 Supplementary Information).

However, at the regional level (models A3–A6) and county level (C2–C5), there were interesting differences (discussed in S3 and S4 Supplementary Information, respectively). We report models including the year-plus restriction in the main text because they systematically obtained a better fit (higher adjusted \( r^2 \)). Only in the daily-labor models at the individual county level where the low numbers were a factor (C3, C5), did using all ever-fb women (i.e., no restriction on the duration of being footbound) obtain a better fit (S2 Table, discussed in S4 Supplementary Information).
Although we sought to know whether and when women permanently unbound their feet, qualitative analysis of the unbinding data showed the responses to be problematic. Many qualitative reports of unbinding refer to temporary unbinding—that is, removal of the binding cloth, allowing the feet to “let out,” and then later rebinding (e.g., ID 3102017). Women’s remarks sometimes indicated resistance to FB by surreptitiously unbinding their feet at night only to be beaten and rebound the next day (e.g., ID 2903030; see also [17]). Remarks also indicated temporary unbinding during a lengthy illness or in anticipation of a visit from pre-1949 FB inspectors (IDs 2001046, 3102041). Given the conflation of temporary and permanent unbinding in women’s reports, we could not accept data in the survey category of “age of permanent unbinding” at face value.

We created a binary (yes/no) variable indicating whether a woman was fb a year or more before any kind of unbinding took place. This variable is inconsistent. As described above, ages were generally reported in sui, and the conversion to years is approximate. Additionally, people “are” an age for a year, so if binding was at the end of one age and unbinding at the beginning of the next age, actual time bound would be less than a full year. Nevertheless, this variable was given a “yes” value if the woman reported being bound for the duration of at least one sui. Thus, we eliminated women (n=404) from consideration who bound very briefly in order to improve our assessment of long-term FB status.

We asked women whether they had heard of FB prohibitions as girls (before marriage) and before the founding of the PRC, when the government finally had the power to fully implement a FB ban [cf. 22]. (Note that FB rates did begin to decrease in our sites before 1949; see Figs 7–10 in the main text). By 2006, it was only possible to interview women subjected to FB (in the BBG sample); it was not possible to ask the older generation(s) who had decided
whether to bind the feet of these women as girls. (In the Sichuan sample, women were not asked about prohibitions or about deciding to bind daughters’ feet.) Thus, we can only indirectly assess the efficacy of FB prohibitions. We reason that, if government prohibitions effectively prevented families from binding girls’ feet, then those never-bound girls would be more likely to have heard of the prohibition—and remember the prohibition, since it helped them avoid such a painful process—than girls whose feet were bound. Women’s knowledge of FB prohibitions during their girlhood is therefore used as an indirect indicator of the efficacy of pre-1949 prohibitions against FB.

226

**Daily quantity of cotton spun**

Women who spun cotton were asked how much they spun per day for their natal household. Because women were asked to recall the circumstances of their natal households just before they left it (usually in marriage, sometimes in adoption), these quantities generally represent the daily quantity produced by accomplished spinners.
S3 Appendix: Comparing Labor Coercion via Slavery and Footbinding

Although the county-level results (presented in S4 Supplementary Information) are certainly affected by small numbers, they nevertheless show the wide range of local variation, hence the persistent significance of county as a correlate across models. With regard to footbinding (FB), these results show that FB could serve as a form of labor coercion (in county 2102, model C3) but did not necessarily serve that function everywhere. Nevertheless, it is highly suggestive that the greatest estimated daily production values anywhere in our study come from footbound (fb) and uneducated girls in county 2102. Moreover, their estimated daily production values (252, 260, 320 grams) are considerably larger than the estimated amount from enslaved African American girls (217 grams [37–38]) or than the estimated amount from Chinese girls (undistinguished with regard to FB) during the early 1930s in a cotton-growing county across the river from our county 2702 (200 grams [52, 54]).

Comparative evaluation of FB as labor coercion is possible because Thomas Jefferson recorded textile production, including spinning, for his Monticello and Poplar Forest plantations. Between 1790 and the summer of 1812, when spinners were using a single-spindle wheel, Jefferson estimated that enslaved girls, aged 10–16 years old, spun an average of 7.67 ounces (217 g) of cotton per day, with work varying from 9 to 14 hours per day, depending on available sunlight [37–39]. Enslaved spinners were immediately supervised by older enslaved women, who spun or wove in addition to their other responsibilities; spinners had periodic oversight by Jefferson’s daughters, granddaughters, granddaughters-in-law, or an overseer’s wife, and they appear to have had daily quotas, possibly measured by “giving each [spinner] a certain weight of
fiber first thing in the morning” [37]. Enslaved girls who failed to produce high enough quality textiles were threatened with shifting to full-time agricultural labor [37]. Oversight was intended to maximize labor outputs, approaching humanly possible maximums given the available technology. That the greatest daily production estimates for Chinese girls came from county 2102, where FB and lack of female education were significant correlates of the amount of cotton spun per day, is highly suggestive of FB as a form of labor coercion.
S1 Fig. Women demonstrating use of single-spindle wooden spinning wheels. The larger type (S1A) was commonly used at research site 2001, photographed in July 2009, and the smaller type was commonly used (S1B) at research site 2902, photographed in April 2011. Women at site 2001 reported that girls had to be about 12 years old, which they considered older than usual, for their arms to be long enough to spin on such a large wheel.
**S2 Fig. Woman demonstrating use of a wood-framed loom.** This type of loom was commonly used at research site 2902. Photographed in April 2011, these images show (S2A) the loom overall, (S2B) the reach needed to work the foot pedals, (S2C) pushing the shuttle, which carries the weft thread, through the warp threads, and (S2D) the warp threads strung on the loom frame.
S3 Fig. Examples of homespun, home-woven cloth. These images, photographed in April 2011, are from research site 2101 (S3A–S3B) and research site 2902 (S3C–S3D). The cloth shown in S3A was reportedly woven decades previously and was in use as a bottom sheet. The remaining cloth (S3B, S3C, and S3D) was woven more recently and not in daily use.
S4. S4 Fig. The “lotus” (蓮) feet of an elderly Chinese woman. This 102-year-old woman (ID 2001100, born 1907, photographed in July 2009) was footbound as a child and throughout her life in the extreme “lotus” form. Her toes are still folded under the bottom of her feet and her arch is broken. This woman had to continue to bind her feet in order to be able to walk; she only loosened the bindings when she became bedridden in her 90s.
S5 Fig. The “half-sloping” (半坡) foot of an elderly Chinese woman. This 87-year-old Chinese woman (ID 2001021, born 1922, photographed in July 2009) was footbound as a child and teenager in the less-extreme, “half-sloping” form. Her toes are still folded under the bottom of her feet, and she wraps the toes lightly for comfort (S5A, viewing the bottom of her foot). The arch of her foot was never broken (S5B, viewing her foot from above). This woman’s feet were “let out” (unbound) during the 1940s; she was still physically active at the time of the photograph.
S3 Supplemental Information: Regional Results for the FB-Predictor Model (A3–A6)

Given the long-standing acceptance of distinct macroregions in China [23, 49, 55–56], we examined correlates of footbinding (FB) by region. We use the same variables described in the main text (for models A1 and A2) for each region, except that we divided hand labor into (i) spinning, (ii) weaving cloth, and (iii) other handcraft. A brief description of each region, model results, and interpretations follow, organized by region. Here, we include a discussion of the differences between using the year-plus FB restriction versus using all ever-footbound women (compare S1A Table and S1B Table).

S1 Table. Comparison of Adjusted $r^2$ and Significance Levels of the FB-Predictor Models, by Whether Women Who Were Footbound (fb) Less than a Year Were Included.

<table>
<thead>
<tr>
<th></th>
<th>Model A1</th>
<th>Model A2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>China-wide (all 20 counties)</td>
<td>Sichuan (all 10 counties)‡</td>
</tr>
<tr>
<td>no FB restriction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$(n = 1759)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FB $\geq$ 1 year</td>
<td>$(n = 1485)$</td>
<td>$(n = 4758)$</td>
</tr>
<tr>
<td>Adjusted $r^2$</td>
<td>0.599</td>
<td>0.297</td>
</tr>
<tr>
<td></td>
<td>0.652</td>
<td>0.323</td>
</tr>
</tbody>
</table>
**S1B Table** shows this comparison regionally (models A3–A6).

<table>
<thead>
<tr>
<th>model</th>
<th>Model A3 Northern sites</th>
<th>Model A4 Central sites</th>
<th>Model A5 Southwest sites</th>
<th>Model A6 Sichuan sites$^\ddagger$</th>
</tr>
</thead>
<tbody>
<tr>
<td>FB restriction?</td>
<td>no ($n=777$)</td>
<td>≥ 1 year ($n=676$)</td>
<td>no ($n=932$)</td>
<td>no ($n=4773$) ($n=4582$)</td>
</tr>
<tr>
<td>Adjusted $r^2$</td>
<td>0.605</td>
<td>0.654</td>
<td>0.477</td>
<td>0.523</td>
</tr>
<tr>
<td>significant correlates$^\dagger$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>county$^\ddagger$</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>birth year</td>
<td>*** (-)</td>
<td>*** (-)</td>
<td>*** (-)</td>
<td>*** (-)</td>
</tr>
<tr>
<td>mother FB</td>
<td>***</td>
<td>***</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>mother any education</td>
<td>NS</td>
<td>*(-)</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>woman literate</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>wealth indicator</td>
<td>**</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>any commercial hand labor</td>
<td>**</td>
<td>*</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>county††</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>birth year</td>
<td>***(-)</td>
<td>***(-)</td>
<td>***(-)</td>
<td>***(-)</td>
</tr>
<tr>
<td>any agricultural field labor</td>
<td>*(-)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mother FB‡‡</td>
<td>*</td>
<td>**</td>
<td>***</td>
<td>**</td>
</tr>
<tr>
<td>mother any education</td>
<td>*(-)</td>
<td>**(-)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>woman literate</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>wealth indicator</td>
<td>*</td>
<td>**</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>any commercial spinning labor</td>
<td>*</td>
<td>*</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>any domestic spinning labor</td>
<td>*</td>
<td>**</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>any</td>
<td>**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>commercial weaving labor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>any domestic weaving labor</td>
<td>**</td>
<td>**</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>other commercial hand labor</td>
<td></td>
<td>*(−)</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>other domestic hand labor</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

With no FB restriction, all ever-fb were included as fb. With the year-plus restriction (FB ≥ 1 year), only women fb for a year or more were included as fb. (All never-fb women were included regardless of FB restriction.)

**p ≤ 0.001; **p ≤ 0.01; * p ≤ 0.05; NS (in S1A) or a blank cell (in S1B) means p > 0.05; (−) indicates negative correlation; NA means the variable was not tested in the model.

Notes to S1 Table:

† Other data restrictions were: women born before 1943, women footbound before marriage, and women married before 1950 (described in S2 Appendix).
††When any pairwise difference between counties shows up as significant, $p < 0.05$ for “county” overall.

‡Both the main and regional models for Sichuan (models A2 and A6) use all available data from all 10 counties in Sichuan. In the main model (A2), spinning, weaving (cloth), and other handicraft work are combined into a single “handicraft labor” variable. In the regional model (A6), they are three separate variables.

‡‡This variable did not exist in the Sichuan dataset.

Northern region

In the Northern region (Fig 4 in the main text), 10 counties fall within one of China’s winter-wheat zones, which are dry both summer and winter [7, 28]. During the early 20th century, winter wheat was grown with sorghum in the low-lying and flood-prone eastern part of the region, while millet was grown in the western part where elevations were over 1000 meters. Cotton grew well in the southwestern and eastern parts of this Northern region [7]. County 1102 falls into the wetter Yangzi rice-wheat zone, but we classified it in our Northern region because it fell inside Skinner’s North China region [23]. By 1936, this Northern region had more railroads, a greater density of urban areas, and more textile mills than the other regions in our study (compare Figs 3–6), but especially in the west, most village transport was by carrying or draft animal (few roads could accommodate carts) [7, 52].

In model A3 to identify FB correlates in the Northern region, we found county, birth-year, wealth, whether mother was footbound (fb), and a commercial handicraft all to be significant, and knowledge of FB prohibitions not to have significance, all in agreement with the
larger China-wide model (A1; see S1 Table, A&B). Girls performing commercial spinning were more likely to have been fb ($p = 0.018$), girls from wealthier natal families were more likely to have been fb ($p = 0.003$), and girls whose mothers were fb were more likely to have been bound ($p = 0.010$). In addition, agricultural field labor and a domestic handicraft, which were not significant in the China-wide model (A1), were significant in the Northern region (model A3) with the year-plus restriction. Girls who wove domestically before marriage were more likely to be fb ($p = 0.005$), and women who did crop labor in their natal households were less likely to be footbound than those who did no crop labor ($p = 0.035$). These latter two variables, however, were not significant FB correlates when all ever-fb women were included.

It is particularly important that knowledge of prohibitions did not correlate to an absence of footbinding (neither ever-footbinding, $p=0.296$; nor footbinding for a sui or more, $p=0.260$; 26), despite the extent of anti-FB efforts in this region. 75.3 ± 3.9 percent of Northern women who married before 1950 (n=461) had heard of such prohibitions as girls (before the founding of the PRC). Many mentioned warlords Yan Xishan or Feng Yuxiang by name when asked about prohibitions (e.g., IDs 2902088, 1901033; see also [22]), yet 66.7 (± 4.1) percent of Northern women married before 1950 (n=496) were ever fb and 41.9 (± 4.3) percent were fb a year or more. That is, 86.0 (± 4.4) percent of Northern ever-fb women were bound for a year or more (n=242).

It is also noteworthy that commercial spinning was still important in the Northern region with so many 1930s-era textile mills and such an expanse of railroad, because it emphasizes the relative economic isolation of Northern rural villages. Girls could still make economic contributions to their families by commercial spinning [22, 42, 52, 54]. This result makes the significance of domestic weaving, and not commercial weaving, somewhat puzzling. As
mentioned in the main text, the domestic correlation could reflect erroneous reporting of
production for direct exchange between households (a commercial use) as domestic use. Such
underreporting applies particularly to the Northern region because we know that such
misreporting occurred extensively in Anhui county 1101. However, it is also possible that, in that
time and place, handspun thread was primarily being bought by those weaving for domestic use
(rather than weavers intending to sell or exchange the cloth they made). Because the production
of cloth required much more time spinning (using a single-spindle spinning wheel) than weaving
(using a simple wooden-frame shuttle loom [13, 42]), even weavers with multiple spinners in the
household often needed to purchase thread, so domestic weavers may have been creating the
commercial demand for homespun thread.

In any case, families benefited substantially from domestic weaving, by saving the cost of
clothing and bedding. According to Gates [20], missionary Adele Fielde—writing during the
late 19th century about Fujian Province on China’s much warmer Southeast Coast where the
mean January temperature circa 1930 was 14.8°C [7]—calculated the value of all clothing and
bedding as equivalent to the cost of all agricultural tools and resources, except the land itself. In
the Northern climate, where the mean January temperature circa 1930 was 1.6°C [7], we can
expect that cost—and hence the savings from domestic weaving—would be greater.

Central region

In the Central region, 4 sites are located in the rice-tea zone, a wetter environment lying below
1000 meters [7, 28]. These 4 sites, on China’s central plains, enjoyed relatively easy water
transport during the early 20th century, with county 2302 on the Yangzi River itself, one of
China’s major east-west transport lines (Fig 5). County 2001 is located in the wet Yangzi rice-wheat zone, against the low mountains separating the Middle Yangzi region from North China; it was two day’s walk from the major urban center of Wuhan during the 1940s. Cotton grew at all the Central counties except county 2002, in the mountainous Sichuan rice zone, where maize (grown on slopes) was the main staple crop and dry-field rice grew on flat patches. Long-distance traders interviewed said that it took 4–5 days to cross into Sichuan to market local goods, but it was an easier journey than dropping 1500 meters in elevation to the city of Yichang. There were four major urban centers with large textile mills in the Central region, and one medium-distance trader from county 2302 reported a small mill in the city of Fuzhou, Jiangxi Province being in existence by 1919. Fuzhou was a day and a half journey, using a combination of small water transport and walking, which made bringing factory-produced cloth back from Fuzhou expensive enough that it was usually reserved for wedding clothes.

In model A4 to identify FB correlates in the Central region, we found county, birth-year, and mother’s FB status to be significant, and knowledge of FB prohibitions was not significant \( p = 0.869; \) \( p = 0.308; \) \( p = 0.002 \). However, in a departure from models A1 and A3, wealth was not a significant correlate of FB. As in the Northern region, when the year-plus restriction was included, domestic weavers were significantly more likely to be fb \( (p = 0.001) \). Interestingly, when all ever-fb women were included, commercial weaving was a significant correlate rather than domestic weaving (S1B Table). Again, it is important that knowledge of prohibitions did not correlate with an absence of FB, despite the fact that much of this region was controlled by the Nationalist government prior
to Japan’s 1937 invasion of China. Nationalist efforts at anti-FB prohibitions were apparently less effective than those of the Northern warlords, since only 60.3 (± 5.6) percent of Central women (married before 1950: n=295) reported they had heard of FB prohibitions as girls. Even in county 2302, which was close enough to a town where Nationalist troops were quartered before 1937 that people reported soldiers stealing from them, only 53.3 (± 11.3) percent of women had heard of FB prohibitions (n=75). Fewer women may have heard of FB prohibitions in the Central than in other regions because FB ended earlier here (Figs 7–10): only 45.9 ± 5.4 percent of Central women (married before 1950: n= 329) were ever-fb and only 25.7 ± 5.0 percent were fb for a year or more (n=292). That is, 65.8 (± 8.7) percent of Central ever-fb women were bound for a year or more.

The importance of domestic weaving along with the lack of importance of wealth as correlates to FB may reflect the greater commercialization of the Central region than other regions in our sample [7]. It may also reflect an underreporting of weaving for direct exchange of goods as commercial (there is some limited qualitative evidence suggesting that some such underreporting may have occurred). Moreover, given mean January temperatures of 5.3°C in the rice-tea zone and 3.8°C in the Yangzi rice-wheat zone [7], domestic weaving provided real savings to household economies on the costs of clothing and bedding. However, that commercial weaving was significant when the year-plus FB restriction was removed suggests that the difference in likelihood of being fb whether doing commercial or domestic weaving is small and there are too few data points to detect that small difference.

Southwest region
In the Southwest region (Fig 6), all counties fall within the southwest rice zone, which had elevations of 2000 meters or more and grew rice on the flat lands, especially alluvial plains and near lakes, and grew maize and opium poppy on the hillsides; cotton had to be imported [7, 28, 41]. The only major city in the region, Kunming, was not an industrial center prior to World War II (which began in 1937 in East Asia).

In model A5 to identify FB correlates in the Southwest region, as in the China-wide and other regional models (A1, A3, A4), we found county, birth-year, and whether mother was fb to be significant, and knowledge of FB prohibitions not significant (ever-fb $p=0.398$; fb1yr $p=0.311$). Mother’s education was significant, as in the China-wide model (A1), but not in other regional models (A3, A4). Mothers with at least some education were less likely to have fb daughters ($p = 0.004$). As in the Central region (model A4), wealth was not a significant correlate of FB. In the Southwest region, domestic handicraft production was again significant: both spinning and our “other” category, which includes all handicrafts other than spinning and weaving cloth.

It is important that knowledge of prohibitions again did not correlate with absence of FB. Nationalist prohibitions of FB were better known here than in the Central region: 70.7 (± 7.3) percent of Southwest women (married before 1950, n=150) reported hearing of FB prohibitions as girls, and many women referred to household inspections and fines if FB was discovered. Nevertheless, FB lingered long here: 79.4 (± 6.4) percent of Southwest women (married before 1950; n=155) were ever-fb and 50.0 (± 9.0) percent were fb for more than a year. That is, 68.6 (± 9.8) percent of SW ever-fb women were bound for a year or more.

It is unclear why it is (again) domestic handicraft production that is significant, unless it reflects underreporting of direct exchange as commercial. Moreover, with the year-plus
restriction, domestic spinning was a positive correlate of FB ($p = 0.018$), as was our “other” domestic handicrafts category ($p = 0.041$). Without that restriction (i.e., with all ever-fb women included), other commercial handicrafts were a negative correlate of FB ($p = 0.035$): girls doing commercial handicrafts other than spinning and weaving cloth were less likely to be fb than girls not doing other commercial handicrafts. Domestic spinning continued to be a positive correlate ($p = 0.008$).

Sichuan region

The 10 Sichuan counties all fall within the Sichuan rice zone, a basin close to 1000 meters elevation nestled in mountains that begin the approach to the Himalayas [7, 28]. The Sichuan counties span the range of accessibility and commercialization during the early 20th century, from Sichuan county MS (Mingshan), which was mountainous and remote, to counties BX (Ba Xian) and LQ (Longchuanyi Qu), which were rural hinterlands of the river-port city of Chongqing and the provincial capital, Chengdu, respectively (Fig 3). Although somewhat drier than the southwest rice zone, the Sichuan rice zone also grew rice, maize, and opium poppy and had to import cotton [7]. Prior to WWII, neither Chongqing nor Chengdu were major industrial centers.

Treating Sichuan as a region in which to identify correlates of FB (model A6)—by which we mean that hand labor was broken down into spinning, weaving cloth, and other handicrafts—conformed to the China-wide model (A1) and the main Sichuan model (A2, where different types of handicrafts were not distinguished): we found county, birth-year, wealth, and commercial handicraft production to be significant regardless of whether the year-plus restriction
was included or not, and an educational measure to be significant when the year-plus FB restriction was included. (As in the Sichuan main model [A2], this regional Sichuan model [A6] does not consider whether a woman’s mother was fb or whether she had heard of FB prohibitions as a girl as correlates, since these data were not collected in Sichuan.) Two kinds of commercial handicraft production were significant (regardless of whether the year-plus restriction was included): commercial spinning ($p < 0.001$) and “other” commercial handicraft labor ($p = 0.022$).

Additionally, as in the Northern and Central regions (models A3 and A4), domestic weaving was significant ($p = 0.033$) when using the year-plus FB restriction, but not significant when the restriction was not used (S1B Table).

As in the main Sichuan model (A2), a woman’s literacy level was significant when using the year-plus FB restriction: illiterate girls were more like to have been bound than literate ones ($p = 0.024; n=4580$). (There was no one in the half-literate category in the sample of the Sichuan data that met all our restrictions and had information for each of the examined variables.) Among the regional models, only the Southwest (model A5) and Sichuan had a significant educational correlate (and only in the Southwest was it significant regardless of whether the year-plus FB restriction was included; S1B Table).

The importance of commercial spinning and other commercial handicraft in early 20th-century Sichuan, prior to industrialization and for a sample of women born 1887–1930, suggests that the relationship between FB and commercial handicraft production may extend further back into China’s late imperial period. This regional finding further supports our finding in the generational model (B1) that women’s mothers, born 1882–1931, were more likely to be spinners if they were fb. The significance of domestic weaving, and not commercial weaving, may again reflect underreporting of cloth exchange as commercial. In any case, as in the
Northern and Central regions, domestic weaving must have provided important savings on the costs of clothing and bedding in Sichuan, where the mean January temperature circa 1930 was 7.0°C [7].
S4 Supplemental Information: County Results for the Daily-Labor Model (C2–C5)

To explore correlates of the daily quantity of cotton thread produced at the level of individual counties, we examined 4 counties where 25 or more women (who married before 1950) reported the amount of cotton they spun per day. Note that the numbers drop below 25 when other data restrictions were imposed. We ran models C2–C5 as described in the main text, except that we removed “county” as a variable. Significant correlates of quantity produced, adjusted $r^2$ values, and predicted values of daily amount of cotton spun by the average girl of 12 sui (the median age of learning to spin) in terms of county, data restrictions imposed, and number of data points are reported in S2 Table (compare S2A Table and S2B Table).

Table S2. Comparison of the Daily-Labor Model Results China-wide (model C1) and in Four Counties (models C2–C5), by Whether Women Who Were Footbound (fb) Less than a Year Were Included.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C2. site 2001</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C3. site 2102</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C4. site 2302</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C5. site 2902</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FB restriction?</td>
<td>no</td>
<td>≥ 1 yr</td>
<td>no</td>
<td>≥ 1 yr</td>
<td>no</td>
</tr>
<tr>
<td>----------------</td>
<td>----</td>
<td>--------</td>
<td>----</td>
<td>--------</td>
<td>----</td>
</tr>
<tr>
<td>(n=15)</td>
<td>(n=13)</td>
<td></td>
<td>(n=16)</td>
<td></td>
<td>(n=26)</td>
</tr>
<tr>
<td>≥ 1 yr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(n=15)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 1 yr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(n=13)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Adjusted $r^2$ | 0.122 | 0.142 | 0.123 | 0.324 | 0.249 | 0.181 | 0.412 | 0.425 | 0.442 | NA |

**significant correlates**

<table>
<thead>
<tr>
<th>county††</th>
<th>*</th>
<th>*</th>
<th>NA</th>
<th>NA</th>
<th>NA</th>
<th>NA</th>
<th>NA</th>
<th>NA</th>
<th>NA</th>
<th>NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>commercial spinning</td>
<td>***</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>domestic weaving or other hand labor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*(-)</td>
</tr>
<tr>
<td>woman ever fb</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>woman any education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>**(-)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>age learned to spin‡</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td>***(-)</td>
<td></td>
</tr>
<tr>
<td>family</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>***(-)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
S2B Table examines predicted values (in grams) of the daily amount of cotton spun by an average girl.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>FB restriction?</td>
<td>no (n=15 3)</td>
<td>≥ 1 yr (n=16 7)</td>
<td>no (n=26</td>
<td>≥ 1 yr (n=19)</td>
<td>no (n=14 (n=13 7)</td>
</tr>
<tr>
<td>Adjusted $r^2$</td>
<td>0.122</td>
<td>0.123</td>
<td>0.249</td>
<td>0.181</td>
<td>0.412</td>
</tr>
</tbody>
</table>

presence of significant correlates

<p>| no significant correlates | 207.3 | 207.2 | 175.7 |
| commercial spinning = no  | 97.0  | 96.2  |       |</p>
<table>
<thead>
<tr>
<th>commercial spinning = yes</th>
<th>148.9</th>
<th>138.6</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>FB=no &amp; education=none</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>259.8</td>
</tr>
<tr>
<td>FB=no &amp; education=some</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>202.6</td>
</tr>
<tr>
<td>FB=yes &amp; education=none</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>319.5</td>
</tr>
<tr>
<td>FB=yes &amp; education=some</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>251.5</td>
</tr>
<tr>
<td>age at learning to spin = 8 sui</td>
<td></td>
<td></td>
<td></td>
<td>171.7</td>
<td>177.3</td>
<td>247.8</td>
</tr>
<tr>
<td>age at learning to spin = 12 sui</td>
<td></td>
<td></td>
<td></td>
<td>119.3</td>
<td>119.3</td>
<td>160.1</td>
</tr>
<tr>
<td>age at</td>
<td></td>
<td></td>
<td></td>
<td>61.9</td>
<td>68.2</td>
<td>70.6</td>
</tr>
<tr>
<td>learning to spin</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>family loom = yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>84.8</td>
<td></td>
</tr>
<tr>
<td>woman’s education=some</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>249.7</td>
<td></td>
</tr>
<tr>
<td>weaving or other hand labor = yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>122.2</td>
<td></td>
</tr>
<tr>
<td>households growing cotton</td>
<td>36.4%</td>
<td>36.4%</td>
<td>44.8%</td>
<td>40.1%</td>
<td>61.2%</td>
<td></td>
</tr>
</tbody>
</table>

21 With no FB restriction, all ever-fb were included as fb. With the year-plus restriction (FB ≥ 1 year), only women fb for a year or more were included as fb. (All never-fb women were included regardless of FB restriction.)

25 *** ≤ 0.001; ** ≤ 0.01; * ≤ 0.05; a blank cell means $p > 0.05$; (-) indicates negative correlation;

26 NA means the variable was not tested in the model. Unless otherwise stated, the predicted values use the median age of learning to spin: 12 *sui* or approximately 11 years old.
Notes to Table S2:

†Other data restrictions were: women born before 1943, women footbound before marriage, and women married before 1950 (described in S2 Appendix).

†† When any individual county shows up as significant, $p < 0.05$ for “county” overall.

‡For model C3, the correlate is positive and the transforming exponent in the model is negative.

For model C5, the correlate is negative and the transforming exponent in the model is positive.

Thus, for both models, the younger the age at which a woman learned to spin, the more cotton that she spun per day just before she left her natal household for marriage.

‡‡ For site 2902, with no FB restrictions, there were four significant correlates (age at learning to spin, family loom, woman’s education, and weaving or other hand labor). Quantities in this column show all correlates as “no” except for the single correlate in that row. For example, the correlates in the row “age at learning to spin = 12 $sui$” are: age at learning to spin = 12 $sui$, family loom = no, woman’s education = none, weaving or other hand labor = no. The year-plus restriction was not run at site 2902 because these 27 women did not provide information allowing calculation of footbinding duration.

Hubei County 2001 (model C2)

In county 2001 (model C2), in our Central region, with only 15–16 women who provided data on all the necessary variables, we found no significant correlates of daily production quantity (regardless of whether the year-plus FB restriction was included). The predicted value of cotton spun daily was 207 grams.
Hunan County 2102 (model C3)

In county 2102 (model C3), in our Central region, finding any of the correlates significant varied with the FB restriction. Note that using the year-plus FB restriction reduced the number of women with data for all the variables. When all ever-fb women were included (n=25) (i.e., there was no restriction), both FB and educational status were significant: ever-fb girls spun more cotton per day than never-fb girls (p=0.036), and girls with no education spun more than girls with some education (p=0.006). Moreover, predicted values of daily cotton spun by girls with one or both of these significant variables were much higher than the 217 grams spun daily by enslaved African American girls at Thomas Jefferson’s plantations: 252 grams for girls who were footbound and had some education, 260 grams for never footbound and no education, and 320 grams for footbound with no education. With the year-plus FB restriction imposed (n=19), there were no significant variables, and the predicted value of cotton spun by the average girl dropped to 176 grams. This is the only occasion where we found the year-plus FB restriction to yield a poorer goodness of fit (adj. $r^2=0.181$) than using all ever-fb women without restriction (adj. $r^2=0.249$). These differences are almost certainly due to small numbers.

Jiangxi County 2302 (model C4)

At county 2302 (model C4), in our Central region, with only 13–14 women providing data, there was a single significant correlate of daily production: the age at which a girl learned to spin ($p = 0.011$). This result obtained regardless of whether imposing the year-plus FB restriction. The younger a girl’s age when she learned to spin, the more she spun per day (at the end of her time in her premarital household). Predicted values of daily quantity range from 177 grams, for
someone who learned to spin at 8 sui, to 68 grams, for someone who learned at 18 sui. Girls who learned at the median age of 12 sui (about 11 years old) have a predicted daily value of 119 grams.

Shanxi County 2902 (model C5)

At county 2902 (model C5), in our Northern region, it was not possible to include the year-plus restriction because so few women reported the age at which they were fb that, once other restrictions on the data were included (e.g., married before 1950), there were not sufficient data available on how long women’s feet were bound. Using ever-fb women, we found 4 significant correlates: the age at which a girl learned to spin, whether a woman’s premarital family had a loom, whether the woman had some education prior to 1950, and whether a girl did any domestic handicraft other than spinning (S2B Table). Here, as in county 2302 (model C4), the younger a girl’s age when she learned to spin, the more she spun per day. Unexpectedly, girls with some education spun more than girls with no education ($p = 0.008$). The remaining variables were both negative correlates: girls spun less if their families had a loom ($p < 0.001$) and if they were doing a domestic handicraft other than spinning (weaving cloth, or any other handicraft; $p = 0.045$). These results are suggestive that at this site, in families with looms, girls specialized in weaving, presumably acquiring cotton by direct exchange or purchase. Predicted values of daily quantity vary by whether girls had any or more than one of these significant variables. A girl’s education and whether her family had a loom were comparable, as correlates, to the age at which a girl learned to spin and were more important than whether a girl did any domestic handicraft other than spinning. Using the median age at learning to spin of 12 sui (about 11 years old), a girl with none of the other significant variables (no education, no family loom, and no other domestic
handicrafts) had a predicted value of 160 grams per day. A comparable girl (no education, no
family loom, and no other domestic handicrafts) who learned to spin at 8 sui (about 7 years old)
had a predicted value of 248 grams per day, while a comparable girl who learned to spin at 18 sui
(about 17 years) had a predicted value of 71 grams. A girl with some education but none of the
other significant variables (no family loom, no other domestic handicrafts, and who learned to
spin at the median age of 12 sui), had a predicted value of 250 grams per day, while a girl with a
family loom (but no education, no other domestic handicrafts, and who learned to spin at the
median age) had a predicted value of 85 grams per day. (See S3 Appendix for a discussion of the
implications of these county-level results.)