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High-Value Work and the Rise of Women: The Cotton Revolution and Gender Equality in China*

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Abstract

This paper studies a unique historical experiment: the cotton revolution and its impact on the emergence of gender-equitable beliefs. The cotton revolution led to a prolonged phase (1300-1840 AD) of high productivity for women. I hypothesize that a substantial, long-standing increase in relative female income eroded a highly resilient cultural belief: women are less capable than men. I examine a period when economic gains from the cotton revolution faded. Using variation across 1,489 counties in cotton spinning and weaving, I find that the cotton revolution reduces sex selection. This result is supported by survey evidence on gender-equitable beliefs. I instrument cotton weaving with the range of relative humidity within which cotton yarn can be smoothly woven into cloth. I document an initial impact of the cotton revolution on widow suicides. To isolate the cultural channel, I examine the effects of the cotton revolution under post-1949 state socialism, where both genders had similar economic opportunities, political and legal rights, and show that pre-1840 cotton weaving predicts a higher probability for the wife to head the household. I document the distinctive role of high-value work in the perception of women. Low-value work performed by women, such as cotton cultivation, does not correct prenatal sex selection.

Keywords: Culture, relative female income, gender-equitable beliefs
JEL Codes: Z1 N35 J16 I1

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I Introduction

Gender equality is usually viewed as a modern phenomenon. Economists have proposed several explanations for the expansion of economic and political rights for women in the past 200 years (Doepke and Tertilt, 2009; Doepke, Tertilt, and Voena, 2012; Fernández-Villaverde, Greenwood, and Guner, 2014). In this paper, I provide an alternative account of the rise of women by examining a unique historical experiment: the cotton revolution in the phase of proto-industrialization of China—a phase during which women's productivity increased substantially and remained high relative to men's. By examining the impact of gender-asymmetric productivity revolution, this paper highlights the role of female labor productivity in the emergence of gender-equitable beliefs and its subsequent effect on gender equality.

I examine the impact of a one-time technological breakthrough in cotton textile production that took place after 1300 AD, the introduction of the multiple treadle-operated spindle-wheels. This device roughly doubled or tripled the productivity of female spinning operatives. By solving a crucial bottleneck in the production, in the area of spinning, the use of multiple treadle-operated spindle-wheels made weavers more productive. This breakthrough occurred in the context of a market economy and trading network and in the presence of political institutions that ensured that relative female income remained high for more than 500 years. In areas suitable for the spinning and weaving of cotton, women's labor productivity far exceeded that in traditional agrarian societies.

In reference to this cotton revolution, the historian of Chinese science, Joseph Needham noted that: "For more than 450 years Chinese cotton-spinning technology was therefore superior to the spinning methods used in any other country (Needham and Kuhn, 1988, p. 224). The cotton revolution was a substantial shock to the economic value of women's work. Compared with other episodes of expansion of labor market opportunities for women, and in other parts of the world, the significance of the cotton revolution is that it boosted women's incomes to a level comparable to or greater than those of their husbands.[1] The ability to produce cotton textiles enabled women to become the major household income earners (B. Li, 1997).

The adoption of new spinning and weaving technologies led to production surpluses, which served as a basis for market exchange on a large scale. During this period, China accounted for one-third of the world's population and between one-third and one-half of global GDP, and had a relatively well-integrated national and regional market economy (Shiue and Keller,

[1] An optimistic estimate in Pomeranz's 2002 work suggests that a woman who weaved could earn four times as much as does an unskilled male laborer.

2007). By 1840, cotton textiles accounted for 24.4% of the domestic trade.[2]

Before 1300, women spun and wove, but they worked with fabrics sourced from plants with lower average yields per unit of land and used less productive technologies. They also spent time in agricultural fields, but their productivity in the field was lower than that of men. Between 1300 and 1840, after which date mechanized cotton textiles flooded into China, women produced cotton textiles at home, and sold them to local, regional and national markets. This resulted in a "Golden Age" for female incomes. Women worked together with extended family groups and as in many traditional societies, weaving skills, along with the loom, were passed down across generations (Buckley and Boudot, 2017).

Anthropologist Marvin Harris postulates that male dominance was initially determined by male strength and their comparative advantage in warfare. Thus as warfare was taken over by professionals, inequalities between men and women became a matter of their relative contributions to economic production (Harris, 1993). In imperial China, when the cotton revolution took place around 1300 AD, it dramatically increased women's contribution to economic production, providing an ideal context for an empirical examination of this claim. I formulate the hypothesis that the tradition of holding men more highly than women is deeply rooted in women's relatively low contribution to economic production in the past. Society is used to assigning different values to different genders, and in many civilizations, there has been the perception that women are less capable than men and a culturally-determined belief that females are less valuable. I hypothesize that when women's contribution to economic production becomes close to or above that of men, gender-equitable beliefs will emerge.

To estimate the effects of the cotton revolution on gender inequality, I collect information about cotton textile production from county and prefecture gazetteers. Information available in those gazetteers allow me to construct a binary variable of cotton textiles at a county level for the period of 1300 to 1840. My main sample comprises a total of 1,489 counties. I link this data to my main outcome variable: sex ratio at birth, a revealed preference measure of cultural beliefs about women's worth. Examining variation across counties, I find a strong negative relationship between the cotton revolution and the skewdness of the sex ratio at birth. The baseline estimates suggest that the cotton revolution is associated with a reduction of 3.7 boys per 100 girls in sex ratio at birth, or a quarter of its standard deviation.

To ensure that my results are not driven by systematic differences between counties with and without cotton textiles (1300-1840), I use matched samples, cluster standard errors on different geographic units, address biases in gazetteer data, employ different subsamples and

[2] Table A.XVII shows a breakdown of trading goods just before 1840. Cotton textiles were the most traded textiles at the time—as much as 94,553,000 *tael* worth of cotton textiles were traded, second only to that of grain.

account for historical and modern confounders. I then check three different hypotheses raised in previous work: plough agriculture, the Neolithic Revolution and loamy soil as determinants of gender inequality. Finally, I include one of the most stringent controls—language fixed effects—to only use variation within populations speaking the same language.[3] Members of the same ethnic group, if exposed to the cotton revolution, would more likely develop gender-equitable beliefs.

China experienced a series of political and economic shocks in the past two centuries. Many of those shocks had a profound impact on the economy and on society. I account for these intermediating events and their interactions with cotton textile production in my analysis. Reassuringly, neither early industrialization, missionary activities, nor recent economic liberalization can explain away the effects of the cotton revolution.

To establish causality, I instrument cotton textile production with a relative humidity index pertaining to weaving suitability. Relative humidity (%) played a key role in the production of cotton textiles. For the successful manufacture of cotton textiles, the fibers must contain a suitable amount of moisture. Based on several sources, the range of relative humidity suitable for cotton weaving is between 60% and 85%.[4] Within this range, tensile strength increases in relative humidity (Lewis, 1913; Iqbal et al., 2012). The spinning and weaving of cotton, silk, hemp, wool and synthetics vary in their humidity requirements. Scientists and engineers have studied optimal humidity for each fabric (Stamper and Koral, 1979; Ananthanarayanan, 2013; Kut, 2014). I take the distance between actual and optimal humidity at a monthly level, and aggregate those values over months to build a Humidity-for-Weaving Index. Because relative humidity might affect conditions faced by women through other channels, I use the interaction between the Humidity-for-Weaving Index and distance to the center of national market as a second instrument to create a more exogenous source of variation. In both cases, IV estimates are comparable to the OLS estimates, with the second instrument providing an estimate closer to my OLS estimates, offering further assurance that the effects I find are causal.

In tracing the mechanisms, I first establish that there was an initial impact of the cotton revolution on women. Using data collected from historical gazetteers, I find evidence that cotton textile production prevented widow suicide in the Ming Dynasty (1368-1644). One interpretation of the results is that women who were able to survive on their own incomes coped better with widowhood than did those who relied on their husband for their livelihood. Widows who were weavers maintained a decent standard of living and were highly respectable

[3]Language fixed effects can also be included in other specifications. All the results carry through.

[4]A humid climate makes cotton fibers more pliable, lowers the chance of breakages in the yarn and reduces dust in the air (Lewis, 1913; Lander, 1914; Farnie, 1979; Ananthanarayanan, 2013).

in their communities. Compared to widows elsewhere in the world, who were often isolated and subject to assault and persecution, widows in parts of China were self-sufficient and economically independent.

I subsequently examine gender inequality after 1840 to provide further evidence on the cultural transformation brought about by the cotton revolution. I find that in early 20th century China, a higher share of industrial workers were female in places where there used to be cotton textile production, and that under state socialism, which leveled the playing ground for men and women both politically and economically, the probability of a wife heading the household was higher in places positively impacted by the cotton revolution.

This paper aims to understand the emergence of gender-equitable beliefs. There has been a shift in attitudes towards working mothers (Fernández, Fogli, and Olivetti, 2004) and attitudes towards premarital sex (Fernández-Villaverde, Greenwood, and Guner, 2014). However, certain aspects of gender norms and gender roles, such as the gender identity norm (Bertrand, Kamenica, and Pan, 2015), and in particular, a belief that women are less capable than men (Sarsons, 2015) have remained resilient.

This study shows that when the relevant shock is large enough, the more resilient aspects of gender norms and gender roles can change. It suggests that the economic value of female labor seems to be a major ingredient in how society assigns different values to different genders. However, the relationship between the economic value of female labor, and the perception of women being inferior, appears to be non-linear. For instance, low-value work women performed in the past, such as cotton cultivation, has no impact on sex ratio at birth today, whereas high-value work does. One interpretation is that the perception of women being inferior only changes when the economic value of female labor reaches a sufficiently high level. There exists a discontinuity in the correspondence between the value of women's work and the perception of them being inferior. This provides a possible explanation for why certain aspects of gender norms and gender roles have yet to adapt in spite of changing economic forces.

Qian's (2008) study finds a negative relationship between women's incomes and sex ratios. In Qian's framework, the economic effects of increasing female incomes improves survival rates for girls contemporaneously. In this paper I show that an exogenous, sizable increase in female incomes resulting from the cotton revolution led to the emergence of gender-equitable beliefs. The lag between the end of the treatment period and my main outcome—up to 160 years—is sufficiently long to enable me to disentangle the transitory effects of a change in relative female income—through an *economic* channel—from its lasting effects—through a *cultural* channel. Furthermore, since the relationship between past economic value of female labor and sex ratio at birth in 2000 is not linear. This further rules out a pure economic channel being the explanation of the correlation between the cotton revolution and sex ratio at birth in 2000. More specifically, when there is a small increase in historical relative female income, it does not reduce sex selection. I also show that gender-equitable beliefs emerged over the course of the cotton revolution, and that such beliefs can independently shape gender inequality after the economic effects of the cotton revolution are long gone.

One strength of this setting is that the cotton revolution was a highly specific treatment. It allowed women to earn a substantial income, and increased their share of the total household income. But it was not accompanied by the type of macroeconomic dynamics that say, the British Industrial Revolution, was associated with. Cotton was spun and woven in the homes of women; it was organized around their extended families and similar technologies were employed throughout the period. Wealth accumulation due to the cotton revolution was limited, and economic gains were eroded by population growth. State-merchant relations and capital formation in imperial China took a very different path than in the West—there was no movement towards factory organization. In the absence of widespread economic and political changes, the identification of the effects of the cotton revolution on women and related channel becomes more feasible.

Another strength of this setting is that there was a unified, centralized state in both historical and modern China, a feature highly useful for distinguishing the cultural channel from other possible channels. Constrained by centralized rule, formal institutions remained unchanged despite the cotton revolution. Also, the state eliminated local monopolies of violence as far as possible. This is a precondition for relative contributions to economic production, rather than physical strength, to take a central stage as the basis for gender inequality (Harris, 1993).

China's experience with state socialism in the 20th century can be exploited as a historical "laboratory" for isolating the role of culture. First, state socialism mandated labor force participation for both genders. This eliminated the explanatory power of economic differences in men and women. Next, given the high degree of centralization characteristic of state socialism, local economic and political institutions are not a function of voter preference. Hence, attitude towards women can only affect outcomes that are determined solely by private decisions. This allows me to measure the direct effects of more gender-equitable beliefs brought about by the cotton revolution.[5]

In comparison with modern field experiments, an advantage of this historical natural

[5]In a usual setting, attitudes towards women can directly shape gender inequality by affecting private decisions, as well as indirectly shape those outcomes by first shaping women's political and legal rights, educational and labor market outcomes.

experiment is that the cotton revolution took place on a larger scale (Figure I). Also, due to universal in-kind taxation, a high percentage of the households engaged in textile work, which eliminates concerns for sorting in the marriage market and other general equilibrium effects.

This paper is organized as follows. Section II sets forth the relations between my argument and the related literature. Section III explains the historical context. Section IV discusses data sources and variable constructions. Section V summarizes my baseline estimates, robustness checks and an instrumental variable analysis. Section VI presents survey evidence on gender-equitable beliefs and its effects under various economic and political conditions, including state socialism. In Section VII, I discuss the interpretations of the results and a few caveats. Section VIII concludes the paper.

II Related Literature

The recent literature on gender equality has paid increasing attention to the role of culture and identity in determining gender inequality (Fortin, 2005; Fernández, 2007; Fernández and Fogli, 2009; Gneezy, Leonard, and List, 2009; Alesina, Giuliano, and Nunn, 2013; Bertrand, Kamenica, and Pan, 2015). Fernández (2007) and Fernández and Fogli (2009) find that cultural proxies have significant explanatory power for the work and fertility behavior of second-generation American women. Other studies find that differences in psychological traits between men and women are in fact rooted in culture. Gneezy, Leonard, and List (2009) find that women compete less, but only in patriarchal societies.

Researchers have long been interested in how policy interventions can change gender norms. Few interventions have been shown to have a robust effect on gender norms. Both Beath, Christia, and Enikolopov (2012) and Windt, Humphreys, and Sierra (2018) find little or no evidence that placing women in leadership positions affects attitudes or behavior. This study focuses on an important aspect of gender-equitable beliefs, i.e. the perception of women being less capable, and shows that in the long run, high-value work opportunities can change such beliefs.

This study also contributes to the broader literature on the historical determinants of cultural norms and beliefs. Many of these document the persistent impact of a negative shock on cultural values such as Nunn and Wantchekon's (2011) work on the effects of the trans-Atlantic slave trade on corruption and trust today and Voigtländer and Voth's (2012) study on the persistence of antisemitic beliefs in Germany. My study is closely related to those papers that study how past economic factors have shaped contemporary gender norms such as that of Alesina, Giuliano, and Nunn (2013) who attribute conservative gender norms to the use of the plough which required upper body strength and Grosjean and Khattar

(Forthcoming) who examine conservative gender norms and its origins in historical marriage market conditions in Australia.[6] This study provides evidence that cultural norms persist under small and transitory shocks, but can indeed change in face of large and long-standing shocks.

Although the main focus of this paper is not sex ratio imbalances, my analysis contributes to the literature on sex ratio imbalances by identifying an cultural factor in the skewdness of sex ratios. Sex ratio imbalances, especially in India and China, have become an important topic of policy debate and have attracted scholarly attention. Sex selection on a large scale is held to be responsible for a great share of the "missing women".[7] Almond, H. Li, and S. Zhang (Forthcoming) shows that rural land reform in China led to an increase in sex ratios. Sex selection is also present in developed countries. Daul and Moretti (2008) and Almond and Edlund (2008) find evidence for sex selection in the United States. Edlund (1999) explicitly models sex ratios in relation to son preference. Scholars have identified relative adult female earnings (Rosenzweig and Schultz, 1982; Gupta, 1987; Duflo, 2003; Qian, 2008; Carranza, 2014) and biological factors (Oster, 2005) as causes of sex ratio imbalances. This study takes one step further by investigating the origins of a culture of son preference. In addition, by reviewing the history of widow survival in China, this paper adds to the literature on "missing unmarried women" (S. Anderson and Ray, 2015; Miguel, 2005).

III The Cotton Revolution and The Rise of Women

Before 1300, silk and hemp were the two main fabrics used for clothing. High-quality silk was the most valued fabric. It was produced in a small number of urban shops, and demanded only by a small elite.[8] Hemp was the predominant fiber for ordinary clothes. Wool was not available in China.

Following a one-time technology breakthrough in cotton textile production, cotton gradually replaced hemp and low-to-medium grade silk to become the dominant fiber for day-to-day clothes. Pre-existing political and economic institutions—such as the tax system—and existing cultural norms, all of which were uniformly present across China proper, meant that

[6] Other relevant studies include that of Jha (2013), who shows that cities in India that were medieval trading ports experienced significantly fewer religious riots between Muslims and Hindus in the period after 1850. Grosjean (2014) examines the persistence of a culture of honor among Americans of Scots-Irish descent. She finds that this culture of honor results in higher homicide rates among Scots-Irish in the US South and Mountain West but not elsewhere and argues that this culture has persisted only where formal institutions are comparatively weak.

[7] See Das Gupta and Mari Bhat (1997), Arnold, Kishor, and Roy (2002), Ebenstein (2010), and Lin, Liu, and Qian (2014)

[8] The production and consumption of high-quality silk involved a small and selected segment of the population. Silk accounted for 3% of the domestic trade, based on A.XVII. Only 7% of the Chinese population in Ming China was urban.

women, rather than men, were spinners and weavers. Moreover, this technological breakthrough took place in a society that had well-functioning markets and a developed trade network. As a consequence, women, working in their own homes and with family members, were able to produce cotton textiles on a large scale for the market thereby earning incomes that far exceeded those available in past agrarian societies. The incomes their earned from cotton textile production enabled them to became major income earners within the household (B. Li, 1997).

The production of cotton textiles, like that of other goods, was highly decentralized. Individual households owned the machinery, purchased raw cotton from the market, and sold finished cloth back to the market, which differed greatly from the British putting-out system (see Appendix F). Those households reaped most of the gains from their production.

Despite the rapid expansion of cotton textile production, the growth was Smithian. There was little further technological innovation (Elvin, 1972). The level of output per capita stagnated due to the offsetting Malthusian forces of rapid population growth.[9] China did not industrialize, or became a capitalistic economy, which is one of the most important stylized facts in economic history. China did not industrialize until at least 150 years after the British Industrial Revolution ("The Great Divergence"), and there has been a sizable literature in economic history investigating the causes of the Great Divergence.

After 1840 China opened up its market to the West after its defeat in the first Opium War. Mechanized cotton textiles from the British Empire began to replace cotton textile handicraft produced by Chinese households. Household cotton textile production only began to collapse in the period between 1870–1910 due to competition from imported manufactured textiles (Myers, 1965, p. 621). Appendix F details the market structure and features of decentralized production during that period.

A Initial Conditions

In China as in much of the preindustrial world, textile production was carried out by women "who spent every available moment spinning, weaving, and sewing" (Barber, 1991). Spinning and weaving were deemed as womanly skills. From the *Mianhua tu* (Pictures of Cotton [Cultivation and Weaving]), first published in 1765, that women had an essential role in cotton textile production (Mann, 1997, pp.165-68).

Women worked together in extended families. Spinning and weaving skills were transmitted intergenerationally, typically from mother to daughter. In those families, older women were weavers; younger women and girls were spinners. Through apprenticeship, younger

[9]For a discussion of macroeconomic conditions and Malthusian stagnation during that period, see Appendix F.

women learned essential skills for textile work from older women. Compared with spinning, weaving was higher-paying and demanded more skills.

The state was a major buyer for textiles through the economic institution of universal in-kind taxation. This institution mandated grain and textiles to be two major in-kind taxation items (Bray, 1997). Each household was responsible for producing both grain and textiles. Women specialized in producing textiles. Two main reasons for this were that (a.) women were far more productive in textile production than in plough-based grain production, for which male labor was essential; (b.) producing textiles complemented childcare duties, both of which took place within the home. By 1300 AD, when the cotton revolution took place, spinning and weaving had long been deemed as womanly skills.

B Technological Improvements in 1300

Around 1300, Huang Dao Po, a Shanghai native (1245-1330 AD), acquired new spinning and weaving technologies from an ethnic group, known as the Li, residing on Hainan Island and brought them back to mainland China.[10] The production of cotton textiles involves two processes: spinning and weaving. Raw cotton is spun into thread and yarn before cotton thread is woven into cloth. Due to the use of new spinning and weaving technologies, the production of cotton textiles on a large scale became feasible for the first time (Bray, 1997; G. Zhao, 1977).

Huang Dao Po introduced a new spinning wheel that had three spindles. Spinning wheels, for a long time, had just one spindle. The new spinning wheel increased productivity by allowing women to use both their hands and their feet to keep the wheel spinning. Its technical design was comparable to that of the Spinning Jenny, which was invented in 18th century England and a predecessor to subsequent technologies used in textile manufacturing. The adoption of the new spinning wheel in 14th century China dramatically increased spinning productivity.

This device roughly doubled or tripled the productivity of female spinning operatives. Workers using multiple treadle-operated spindle-wheels could produce between 500 and 1500 grams of yarn by operating up to five spindles at the time. Joseph Needham notes that until the British Industrial Revolution, "the technological standard of Chinese cotton manufacture had no parallel anywhere else in the world" (Needham and Kuhn, 1988, p. 223). Needham concludes that: "For more than 450 years Chinese cotton-spinning technology was therefore superior to the spinning methods used in any other country (Needham and Kuhn, 1988, p. 224).

[10]Contemporary Li people still use those technologies for textile production. Finished cloth can purchased by tourists who visit Hainan Island.

This resolved a bottleneck that previously prevented the the cotton textile industry from further increasing productivity–before the new spinning wheel was used, every weaver had to be matched with three to four spinners given the rate at which spinning took place. In addition, Huang also introduced new techniques for cotton fluffing and crushing and methods of weaving mixed cotton fabrics, colored fabrics and fabrics with mixed warp and weft fibers.

Following this one-time technological breakthrough, cotton textile production expanded rapidly in the following centuries. Due to its durability, cotton replaced hemp and began to dominate the everyday clothing market. Other attractive features of cotton cloth include being effective in the cold weather, and offering higher yields per unit of land. [11] Demand for cotton was kept high by government demand, especially military demand for uniforms, and by expanding urban markets (Myers, 1965). According to Pomeranz (2000, p. 338), cotton textile production in 1750 was only slightly before that of Britain's in 1800.

C Labor Market Responses

Given the importance of cotton textile production, and its immense scale, there should be strong labor market responses to increasing demand for cotton textiles, i.e. labor should be reallocated into the production of cotton textiles. Yet, such responses did not occur. Many characteristics of the imperial Chinese economy were responsible for a lack of labor market responses. Below I illustrate some of those characteristics. In Appendix F, I shed further light on those characteristics through a comparison with the British putting-out system.

Several factors may explain the lack of labor market responses to the cotton revolution. First, the level of technology favored household production. Hence there was minimal friction between demands from work and demands from family. This solidified the traditional division of labor between men and women, i.e. men plow and women weave. Second, labor mobility was low. The majority of Chinese families owned land. The majority of the population were small land owners throughout much of imperial Chinese history. Land ownership is commonly associated with low labor mobility.

Land ownership also raised the cost of men entering into cotton textile production. In plough-based agriculture, men performed tasks in the field, as they had the upper body strength to do so. This prevented them from being full-time textile workers. Women tended to be full-time textile workers. Due to the fixed cost of owning a spinning wheel and a loom, it made more sense to let the full-time worker have exclusive access to them.

Besides, to sustain political control, the imperial government restricted labor mobility. During much of the Ming Dynasty (1366-1644), occupational status was by inheritance and

[11]See Appendix F for a discussion of the impact of the cotton revolution on non-cotton textile producing regions.

individuals stayed where they were officially registered. A cultural factor for a lack of mobility was that individuals stayed with their extended families under the clan system.

As cotton weaving demanded a set of climatic conditions, there were geographical constraints on where cotton could be woven (Figure I). Finished cloth, on the other hand, was sold to everywhere in the country. Relative to the rest of China, areas where cotton weaving was feasible saw a varying degree of cotton textile boom and persistently higher productivity in the textile sector.

D *How Much Did Women Earn?*

Cotton textile producers, especially weavers, were high income earners. Historians provide various estimates of the actual incomes women received for producing cotton textiles. Allen's (2011) wage regressions indicate that textile workers earned a wage premium compared with workers in construction or agriculture. Allen (2009) shows that one day's work by a weaver in the late 17th century produced 7,684 calories, which was adequate to support a family. B. Li (1997) shows that a woman's year-round textile work was enough to feed 2.7 people. Pomeranz (2002) provides an even more optimistic estimate suggesting that a woman could earn four times as much as a man. The most conservative estimate is made by P. C. C. Huang (1990). He estimates that in an average household, a female cotton textile producer generated incomes that were about 77% of those of their husbands.

Women who had the skills to weave artisan cloth could earn an higher income. The production of artisan cloth was backed up by popular demand of weddings and funerals in premodern China. Greater skills and longer hours were involved in producing artisan cloth.

In summary, the historical evidence suggests that although before the cotton revolution, Chinese women were already doing productive work, the cotton revolution allowed women to produce a larger quantity of textiles to be sold to the national market. This enabled women to earn enough to support a family independently and to take on a new role as primary income earners in the household. By the late Ming period, women had begun to produce predominantly for the market, and in many cases their earnings became the main source of income for the household.

E *Highly Capable Women in Historical Narratives*

As stated before, the cotton revolution was a major shock to the value of women's work. That was a major changing force for the relative income status of husbands and wives, as reflected in many historical accounts. In a survey article (Man, 2011), Zheng paints a vivid image of female breadwinners being unwavering and dependable.[12]

[12] Zheng complies a list of historical sources: J. Chen et al. (1991), Gu (1995), and Xu (1987).

In many societies, there exists a gender identity norm that the husband earns more than the wife (Bertrand, Kamenica, and Pan, 2015). Based on theories of cultural evolution, because relative payoffs of cultural traits are crucial to the choice of behavioral rules (Boyd and Richerson, 1985), a shock to the value of women's work may lead to the breakdown of such norms. Under the circumstances in which men and women have the option of staying out of the marriage market, and no longer reproduce, those norms can stay intact.[13] However, because of the traditional emphasis on continuing the family line in China, men and women do not have the option of staying out of marriage.[14] Universal marriage, in conjunction with the ubiquitous increase in women's incomes following the cotton revolution, created conditions necessary for gender identity norm to break down.

For parents, as women became productive members of the economy in their own right, it became less financially costly and mentally stressful to have a daughter. Marriage laws in imperial times allowed men to freely exit marriage ("seven codes for divorcing wives"). This created a financial risk for the natal family as the daughter can become a financial burden on them upon her divorce. The prospect of daughters being self-sufficient lowered the cost of having them.

Economic independence can also have a positive impact on the self perception of women. In Xu (1987), a female proudly proclaimed that she single-handedly supported the family and was a "strong woman," a "she-husband." She declared that her husband was passionate about literary writing and painting and that was all he could do. In particular, she stressed that he was unhelpful in making ends meet. Anecdotal evidence suggests that women producing cotton textiles enjoyed greater autonomy and higher social status (c. Zhao, 2015).

F Other Episodes: Black Death, Proto-industrialization and Industrial Revolution

There were other historical episodes during which women's incomes rose relative to men's. The main differences are that (a.) these other historical episodes of increasing female incomes were not of as large a magnitude and not as long-lasting. (b.) the cotton revolution affected both married and unmarried women. (c.) a lack of coverture laws in China. In Appendix F, I discuss a comparison with the phase of proto-industrialization in England, as well as a comparison with female labor force participation after the Black Death.

From 1820 to 1850, in the industrialization of the American Northeast, female labor force participation was substantial, and the wages of women increased relative to that of men (Goldin and Sokoloff, 1982). In a letter, a New England farm girl was full of excitement when

[13] Bertrand, Cortés, et al. (2016) discuss the negative social attitudes towards working women and how they contribute to the marriage gap for skilled women.

[14] This has begun to change in the past 20 years. Now a substantial share of women in urban China stay single.

she began to work on well-paying jobs in textile mills (Dublin, 1993).[15] Ferree (1976) finds that working-class women are happier if are employed; they work for the money but they also gain a sense of competence, connectedness, and self-determination from their job. Similarly, at a community level, in India, work earns women money and respect.[16]

IV Data

I combine several gazetteer-based sources to construct my main variable, cotton textile production (1300-1840). For other historical variables, I use China Historical GIS (CHGIS), the digital map collection of Harvard University, the database of Chinese Gazetteers (*Zhongguo fangzhi ku*), the 1916 economic census and surveys conducted by Christian missionaries in the early twentieth century. For modern outcomes and controls, I use modern censuses and surveys, including the 2000 population census (county-level), the 1990 census (individual-level) from the IPUMS International, the 2004 Industrial Census from the China Geo Explorer, the Chinese City Statistical Yearbooks and Chinese General Social Surveys (2005, 2010). For climatic and geographic variables, I rely on data from the Climate Research Unit of University of East Anglia, FAO (GAEZ v3.0), NASA and NOAA. Appendix B provides details on sample construction, data sources, and variable constructions.

A *Cotton Textile Production (1300-1840)*

To obtain an estimate of the distribution of counties and prefectures where cotton textiles were produced between 1300 and 1840 across China today, I map historical locations of cotton textile production into modern counties.[17]

Historical gazetteers provide qualitative information on cotton textile production. My main interest lies in the spinning and weaving of cotton textiles, rather than the cultivation of raw cotton. Information on cotton spinning and weaving, as well as cotton cultivation, can be inferred from a section describing goods that were produced locally (*shihuo zhi*). I code cotton textiles (1300-1840) as one, if finished cotton cloth is mentioned in the gazetteer of a specific county or prefecture (*jibei bu* or *mian bu*). Both *mian* and *jibei* mean "cotton". *jibei* is just an alternative name to *mian*. *bu* means "cloth". I draw on several historical studies to construct my dataset. A key source I use is Wang (2006). More information on those historical studies are available in Appendix B.2.

[15] Dublin (1993) is a collection of letters from five women working in textile mills. Mary Paul said in a letter "I can earn more to begin with [at lowell] than anywhere about here." When she got paid, she expressed her excitement over buying new shoes "Last Tuesday we were paid. In all I had six dollars and sixty cents paid $4.68 for board. With the rest I got me a pair of rubbers and a pair of 50 cts shoes."

[16] http://www.nytimes.com/2016/01/31/world/asia/indian-women-labor-work-force.html?$_r = 0$.

[17] The year 1840 marks the end of the household production of cotton textiles. Section III provides detailed background information for the cotton revolution.

I rely on county and prefecture gazetteers (Figure A.V). For prefectures, their historical boundaries are known; but for counties, their exact boundaries before the year of 1911 are unknown. Based on my default method, a historical county is the "ancestor" county of a modern county, if the county seat falls into the boundary of a modern county. A value of one is assigned to a modern county if cotton textiles were produced in its "ancestor" county between 1300 and 1840; zero is assigned otherwise.[18] In addition, a value of one is assigned to a county with more than half of its area overlapping with a historical prefecture with cotton textile production, and zero to other counties. This yields a dummy variable of cotton textiles (1300-1840) for each county.

To account for boundary changes over time, I use time-series maps of prefectures and counties to identify precise historical locations of cotton textile production between 1300 and 1840. This allows me to use historical locations closely matched to sources. For example, when a record is taken from a prefecture-level gazetteer published in 1503, it is geocoded as in that particular prefecture with its boundaries in 1503.

I also code cotton textile production using alternative methods. I locate historical counties in a map from a later period (the earliest will be year 1911) when their boundaries became known. This method results in a continuous variable of cotton textile production, which yields highly similar estimates to the estimates based on the binary variable. Alternatively, I create a continuous variable based on the percentage of land area of each county that overlaps with a historical prefecture with cotton textile production. This also yields estimates highly comparable to those obtained with the binary explanatory variable. In Appendix B.2, I lay out the detailed procedure for constructing the main explanatory variable. In Appendix B.3, I describe how cotton textile production (1300-1840) is linked with modern outcomes. As a summary, Figure I shows the distribution of counties and prefectures that previously produced cotton textiles across China in 2000.

Historical gazetteers provide valuable information on cotton textile production between 1300 and 1840. However, two types of biases are present in gazetteer data: publication bias and survivorship bias (Appendix B.2). Wealthier counties published more gazetteers and at an earlier date. My solutions to this are as follows: first, I use a binary treatment variable constructed to avoid introducing spurious correlations between cotton textiles (1300-1840), stage of development and cultural beliefs about women's worth; second, in Table A.IX, I run several regressions based on the number of gazetteers available in a county. I show that my coefficient estimates are not sensitive to the frequency at which historical gazetteers were

[18] All gazetteers I use were published in the Ming and Qing Dynasty (1368-1840), because very few gazetteers were published before 1368. Here I assume that gazetteers published in the early Ming Dynasty would contain information on cotton textile production that began before 1368.

published, which suggests that “publication bias” and “survivorship bias” are unlikely to drive my results.

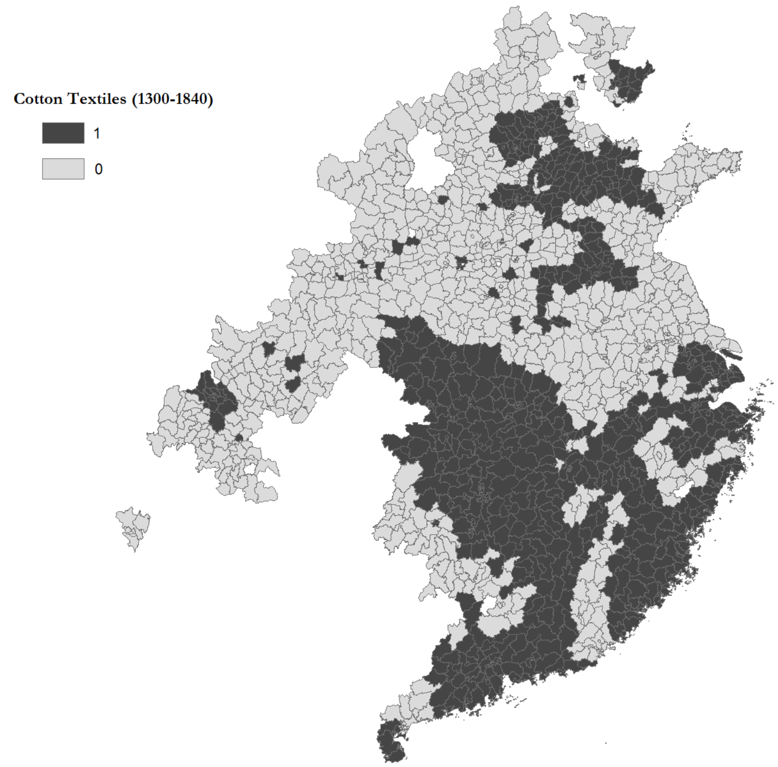


Figure I: Cotton Textile Production (1300-1840)

B Control Variables

In this section, I outline the set of control variables used for the county-level analysis in modern-day China. Additional controls are used in my analyses of other historical episodes of China and will be discussed in those sections.

My baseline controls include contemporary controls such as a county’s per capita GDP measured in 2000, share of urban population, share of agriculture workforce, share of service workforce, share of urban *hukou* (household registration), years of schooling (male), share of ethnic population, governance status and provincial capital status, historical controls such as agricultural suitability, population density in 1300, proximity to the Grand Canal or the Yangtze River and treaty port, as well as a set of geographic controls, such as ruggedness, distance to coast, latitude and longitude. To account for deep-rooted socio-cultural differences across regions, I include Skinner socioeconomic macroregion fixed effects, in addition to province fixed effects.

I obtain most of contemporary controls from the 2000 Census. Maps are from National Bureau of Statistics (2005). Skinner socioeconomic macroregion data are available at the G.W. Skinner Data Archive (Skinner, M. Henderson, and Berman, 2013). Historical controls include agricultural suitability, proximity to the Grand Canal or the Yangtze River and treaty port status. *Agricultural suitability* is downloaded from the FAO website. When more than one suitability measure is available for a particular type of crop, I use the suitability measure based on intermediate-level input under rain-fed conditions in the most recent version of the FAO database (GAEZ 3.0). *Proximity to the Grand Canal or Yangtze* is obtained from the China Historical GIS (CHGIS). *Distance to the nearest coast* and *ruggedness* are downloaded from the National Aeronautics and Space Administration (NASA) website.

For other types of work women engaged in, I include *cotton suitability*, *tea suitability* and *rice suitability* data from FAO, and historical production data on other types of textiles from historical gazetteers. Suitability maps are available in Appendix A. To assess the impact of large economic and political shocks, I control for treaty ports (Jia, 2014), density of communicants (Stauffer et al., 1922) and coastal China (National Bureau of Statistics, 2005). In addition, I check to see how three hypotheses examined in previous work hold up in this study. I obtain data on ancestral plough use from the Ethnographic Atlas (Murdock, 1967), information on Neolithic settlements (Chang, 1963) and soil texture from the Harmonized World Soil Database (Nachtergaele et al., 2008). Finally, I add language group as a control using data from the G.W. Skinner Data Archive.

Summary statistics are shown in Table A.I. Appendix B.4 provides the historical context for variables including proximity to the Grand Canal, treaty ports, density of communicants in early 20th century, pre-1300 commercial tax quota and historical courier routes.

V The Cotton Revolution and Sex Ratio at Birth: A County-Level Analysis

A *Determinants of Sex Ratio at Birth*

A wide range of factors shape sex ratios in the population, but sex ratios at birth are relatively clustered, typically from 103 to 107 boys per hundred girls. The perception of women being inferior can lead to female infanticide, child neglect and underinvestment in girls. When sex-selection technology is available, the manifestation of biases against women can shift towards an earlier stage of reproductive process: pre-natal sex selection.

It has been shown that pre-natal sex selection is an important source in the skewness of sex ratio at birth (Ebenstein, 2010).[19] In the 2000 Chinese Population Census, sex ratios at birth ranged from 92 to 193 boys per hundred girls.[20]

In a usual context, individuals simultaneously make decisions on fertility and sex selection. With the same attitude towards women, a population with a lower desired fertility can have a more skewed sex ratio at birth. Under the one-child policy, however, fertility became exogenously determined. This policy created a favorable condition for identifying the effect of the perception of women on the skewness of sex ratio at birth.

In the context of China in 2000, the main variation in sex ratio at birth comes from (a.) Economic payoffs to having a boy; (b.) Difficulty to having at least one boy, i.e. variation in the one-child policy and its enforcement; (c.) Culturally-determined preference for boys.

For (a.), the economic payoffs to having a boy are impacted by the stage of development and sectoral composition (Rosenzweig and Schultz, 1982). I include per capita GDP, share of agriculture workforce and share of service workforce as controls. Due to the setting of state socialism, differential economic payoffs to having a boy is unlikely driven by gender differences in labor force participation. China's female-to-male ratio in labor force participation rate was at 85% in 2000, one of the highest in the world.[21] In terms of (b.), the one-child policy further increased the difficulty to having at least one boy.[22] The policy varied by household registration (*hukou*). Those with urban *hukou* were subject to a stricter version of the one-child policy than their rural counterparts. Ethnic minorities were either not subject to or subject to a less strict version of the one-child policy. Besides, political characteristics such as how a county is governed and whether it is a provincial capital can affect the enforcement of the policy.[23] When it comes to (c.), the share of ethnic population is also an important determinant. The pace of modernization may also affect the taste. Average years of schooling

[19]Confucian values shaped traditional Chinese society in important ways. It strongly disfavored women, partly because it laid a particular emphasis on continuing the family line and held that only male offspring could fulfill this purpose. A further development in Confucianism, Song-Ming Neo-Confucianism, further disadvantaged women. Song-Ming Neo-Confucianism was first developed in the Song Dynasty (960–1279), which led to a series of negative changes for women, ranging from unfriendly inheritance laws and to remarriage being stigmatized. Appendix F has more details on Confucianism, Song-Ming Neo-Confucianism and status of women.

[20] This is after the exclusion of five autonomous regions where (a.) A large share of the population comprise ethnic minorities who were not exposed to Confucian norms and institutions; (b.) The one-child policy was not enforced or not to the same degree.

[21]http://hdr.undp.org/en/content/labour-force-participation-rate-female-male-ratio. Female-to-male labor force partipcation was 74.8% in the United States and 62.4% in Germany.

[22]Fertility decline predated the one child policy (Babiarz et al., 2018).

[23]Chinese prefectures and counties underwent institutional reforms after 1982. Governance status started to vary across counties. Governance status of the county takes one when it is governed by the prefecture-level government, two when it is self-governed, and three when it is governed by the province-level government.

is shown to be a good proxy for modernization.[24] (c.) is where I expect the effects of the cotton revolution enter.

The choice of sex ratio at birth in 2000 as the main outcome variable is motivated by the following facts: (a.) Sex selection technologies became widely available in the 1990s. By the mid-1990s, virtually all county-level hospitals, township-level clinics and local family planning agencies were equipped with ultrasound scanners (Anukriti, Bhalotra, and Tam, 2015). (b.) Before 2000, variation in the one-child policy was limited to urban versus rural *hukou*, Han Chinese versus ethnic minorities. After 2000, some counties began to experiment with a two-child policy for parents that were both the only child of their parents. (c.) Marriage remained near universal, and voluntary childlessness was relatively rare. This shuts down a possible channel flowing from the cultural beliefs about women's worth to sex ratio at birth that is not pre-natal sex selection. Selectivity into motherhood, if correlated with the cotton revolution and son preference, could be a confounder. (d.) Data quality of the 2000 census is one of the highest. After 2000, a floating population composed of 200-million temporary migrants affected the data quality of the population censuses.[25]

In Appendix C, I compare pre-natal with post-natal sex selection (Lin, Liu, and Qian, 2014; Hu and Schlosser, 2015) in Appendix C.1, demonstrate how the one-child policy induced pre-natal sex selection by manipulating fertility constraints in Appendix C.2 and show that access to ultrasound screening varied over time and became widespread by the late 1990s (Appendix C.3).

B Connections to Cultural Beliefs About Women's Worth

The President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavior Research of the United States in 1983 came to the conclusion that "in some cases, the prospective parents' desire to undertake the procedure (of sex selection) is an expression of sex prejudice. Such attitudes are an affront to the notion of human equality and are especially in an appropriate in a society struggling to rid itself of a heritage of such prejudices . . . Surveys of parents and prospective parents indicate, however, a preference for sons (especially as the first-born child). If it became an accepted practice, the selection of sons in preference to daughters would be yet another means of assigning greater social value to one sex over the other and perpetuating the historical discrimination against women." Like-

[24] It is common to use years of schooling as a proxy for modernization. I use years of schooling (male) instead of years of schooling in the population, because female education is influenced by differential parental investments.

[25] To deal with the challenge arising from tracking temporary migrants, the 2010 Census had to the recording method of "recording every individual encountered". It was not unusual to double count an individual in the place he worked (by current residence) and in his hometown (by household registration).

wise, American philosopher Mary Ann Warren (1985) considers sex selection to be ‘invariably motivated by sexist beliefs”.

In the United States, as ultrasound technology became widely available, fears emerged that sex selection might take place on a large scale—the 1970 National Fertility Study shows that the sex preference ratio is as high as 124 boys for every 100 girls for all women who intend to have more children (Westoff and Rindfuss, 1974).[26]

Legal and moral forces are important constraints on the use of sex selection to choose the gender of a newborn in a way consistent with underlying cultural beliefs about women's worth; such constraints are not equally present in China.[27] In the 1990s, as ultrasound screening became widespread, another crucial constraint on sex selection was lifted (Cloonan, Crumley, and Kiymaz, 2005; Y. Chen, H. Li, and Meng, 2013). During the window of a few years near 2000, China was close to being at the hypothetical setting where no meaningful constraints were placed on how sex selection was achieved and culture beliefs about women were uninhibitedly translated into sex ratio at birth through sex selection.[28] This motivates the use of sex ratio at birth in 2000 as a main proxy for culture beliefs about women.

C Baseline Results

Having constructed a county-level measure of cotton textile production, I can examine the relationship between cotton textiles (1300-1840) and modern outcomes.[29] I begin by examining variation at the county level. I test my hypothesis by estimating the following equation:

$$\text{Sex ratio at birth}_c = \alpha + \beta \text{cotton textiles (1300-1840)}_c + \mathbf{X}_c^H \boldsymbol{\Omega} + \mathbf{X}_c^G \boldsymbol{\Lambda} + \mathbf{X}_c^C \boldsymbol{\Pi} + \epsilon_c \;, \quad (1)$$

where c denotes a county. cotton textiles $(1300\text{-}1840)_c$ is cotton textile production for 1300-1840 at County c. $\mathbf{X}_c^H$ is a vector of historical controls, and $\mathbf{X}_c^G$ and $\mathbf{X}_c^C$ are vectors of geographical and contemporary controls respectively, each measured at the county level.

$\mathbf{X}_c^G$ and $\mathbf{X}_c^H$ are intended to capture geographic and historical characteristics that may have been correlated with cotton textiles (1300-1840) and may still affect present-day outcomes. I include in $\mathbf{X}_c^H$ agricultural suitability and estimated population density in 1300.

[26] Sex ratio imbalances on that scale, however, never actually occurred, though nearly a 20 percent “excess” of male births was initially projected to follow a technological breakthrough in sex selection technology.

[27] J. Lee, Campbell, and Feng (2002) and R. Lee and M. Anderson (2002) document widespread infanticide in premodern China; they consider the practice as part of the “preventative check” on the population. See Appendix C. A for more details on attitudinal differences in infanticide across societies. Also, like other communist countries, China destigmatized abortion.

[28] After 2000, there was some relaxation in the enforcement of the one-child policy in some regions.

[29] I can derive an alternative measure of sex ratio imbalances by taking the natural log of the deviation of sex ratio at birth from the normal sex ratio. Results are very similar when this alternative measure is used.

For an agrarian economy, agricultural productivity reflect economic fundamentals and shape social structures. Extreme poverty can cause individuals to pursue infanticide as a survival strategy (L. M. Li, 1991), which might affect modern outcomes through attitudes towards pre- or post-natal sex selection. It is also a rough proxy of historical male incomes given that men were primary agricultural workers at the time. Historical population density is a proxy for economic development and can shape the ancestral traits of modern populations (Putterman and Weil, 2010). Historical population data are scarce. I use estimated population density in 1300 from Goldewijk, Beusen, and Janssen (2010) and Klein Goldewijk et al. (2011). The distribution of cotton textiles (1300-1840) depended on the trade networks. I include a control for whether the county was on the Grand Canal or on the Yangtze River—the major trade networks at the time. To account for the impact of treaty ports established in the 19th century, I include treaty port status as a control. To control for geographic differences across counties, I include in $\mathbf{X}_c^G$ the natural log of distance to coast and the natural log of one plus ruggedness, latitude, longitude and their interaction.[30] To address norms such as patrilocality and concern for women's purity and other differences across those historically relatively autonomous regions, I include fixed effects corresponding to socioeconomic macroregions defined by Skinner, M. Henderson, and Berman (2013).[31] As an alternative, I can include language fixed effects, which would also account for large differences in culture and customs.[32]

The contemporary control variables include socioeconomic characteristics such as the natural log of a county's per capita GDP measured in 2000, share of urban population, share of agriculture workforce, share of service workforce, share of urban *hukou* (household registration), years of schooling (male), share of ethnic population, political characteristics including governance status and provincial capital status, and province fixed effects.

The OLS estimates show that in counties with cotton textile production between 1300 and 1840, fewer girls are missing today. The coefficient estimates are both statistically significant and economically meaningful. I begin my analysis with socioeconomic region fixed effects only (column 1), and then include both socioeconomic region fixed effects and province fixed effects (column 2). When I include the full set of controls in column 3, the size of the coefficient increases from -3.008 to -3.753. The cotton revolution is associated with a decrease of sex ratio at birth by 3.753 boys per 100 girls, which is 27% of the standard deviation of sex ratio

[30]Deng (1999) makes the point that in premodern China, people living in rugged terrain tended to net consumers of cotton textiles.

[31]Please refer to Appendix B.4 for a more detailed description of socioeconomic macroregions.

[32]Results using language fixed effects can be found in E. Language fixed effects can also be added to other specifications and results do not change.

Table I: Cotton Revolution and Sex Ratio Imbalances: OLS Results

	Dependent variable: sex ratio at birth in 2000					
	(1)	(2)	(3)	(4)	(5)	(6)
Mean of Dep. Var.	118.3	118.3	118.6	118.6	118.6	118.6
Cotton textiles (1300-1840)	-3.008***	-3.225***	-3.753***	-4.049***	-3.887***	-4.066***
	(0.668)	(0.713)	(0.731)	(0.775)	(0.777)	(0.773)
Log per capita GDP			-2.941***			
			(0.479)			
% in agriculture			0.245			
			(0.379)			
% in service			-0.538			
			(1.302)			
Years of schooling (male)			-2.485***			
			(0.724)			
% ethnic population			-0.718***	-1.118***		
			(0.249)	(0.253)		
Provincial capital			3.091***	0.0496	-0.221	
			(1.006)	(0.958)	(0.954)	
Self-governed			-2.882**	4.586***	5.484***	
			(1.364)	(0.890)	(0.861)	
Governed by province			-2.363*	3.436***	4.110***	
			(1.249)	(1.065)	(1.063)	
Historical controls	No	No	Yes	Yes	Yes	Yes
Geographic controls	No	No	Yes	Yes	Yes	Yes
Province FE	No	Yes	Yes	Yes	Yes	Yes
Socioeconomic Macroregion FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.150	0.231	0.368	0.314	0.306	0.288
Observations	1622	1622	1489	1489	1489	1489

Notes: The table reports the impact of cotton textiles (1300-1840) on sex ratio imbalances. The unit of observation is a county in 2000 Census. The dependent variable is sex ratio at birth. Column 1 reports estimates with only socioeconomic macroregion effects. Column 2 reports estimates with both socioeconomic macroregion and province effects. Column 3 includes all controls. "Historical controls" are treaty port status, agriculture suitability, and whether a county was on the Grand Canal or the Yangtze River (major trade networks). "Geographic controls" ar the natural log of one plus ruggedness, the natural log of distance to coast, latitude, longitude and their interaction. Column 4-6 sequentially drops potentially endogenous modern controls. The omitted category for governance status is being governed by the prefecture-level city government. Robust standard errors are used in all specifications. Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

at birth.[33] Column 3 contains the baseline specification for the rest of this study. Figure A.I in Appendix A shows a partial regression plot corresponding with column 3. It indicates that the coefficient estimate of cotton textiles (1300-1840) is not influenced by a small number of counties.

In column 4, the coefficient estimate remains similar when I omit logged per capita GDP, logged share of urban *hukou*, logged share of agricultural workforce and logged share of service workforce and years of schooling (male).[34] In column 5, in addition to controls omitted from column 4, I exclude the share of ethnic population.[35] In the last column, I exclude provincial capital status and governance status, and the coefficient estimate remains close to those in previous columns. These results can be replicated using the individual-level 2000 census (1% sample).

In Appendix Table A.XI, I examine alternative outcome variables from the 2000 census, such as sex ratios among other cohorts with exposure to the ultrasound technology. I look at individuals that were aged 1-4 and 5-9, and find very similar patterns. I find that women have a higher educational attainment in counties positively impacted by the cotton revolution. Given that opportunities to attend school, or to participate in the labor force, were made equal under state socialism, this difference is most likely driven by parental investment in education. It shows that parents in counties with a history of cotton textile production are more likely to invest in girls. [36] Men's educational attainment is not correlated with cotton textiles (1300-1840).

One concern is that counties with and without cotton textiles (1300-1840) differ in many dimensions and have very different unobservables. By comparing coefficient estimates and movement in R^2 across the columns, I show that my results are not driven by selection on unobservables. Table A.VII in Appendix E summarizes the test of selection on unobservables

[33] The specification is also robust to the inclusion of the squared term of log per capita GDP. Chung and Gupta (2007) suggests that sex ratios can change in nonlinearity through different stages of development. Results are robust to controlling for fertility; however, fertility is a "bad" control, as decisions are made simultaneously on fertility and sex selection [pp.64-68](Angrist and Pischke, 2008).

[34] Though large sex ratio imbalances are a relatively new phenomenon in China, the underlying cultural beliefs about women are not, and per capita GDP could have been negatively affected by past gender discrimination. Sex ratio imbalances *per se* can also affect GDP through increasing saving rates (Wei and X. Zhang, 2011). In either case, controlling for log per capita GDP will constitute the case of "overcontrolling".

[35] The share of ethnic population might have become endogenous to the dependent variable in the past few decades due to responses to the one-child policy. Under the one-child policy, ethnic minorities were allowed to have more children than were the Han Chinese. W. Huang and Zhou (2016) has documented that inter-ethnic marriages have become more common under one-child policy.

[36] These results can be replicated on the individual-level 2000 census (1% sample). The interaction term between cotton textiles (1300-1840) and female is positive for all cohorts starting from the 1930s but for the cohort of individuals born after 1990. Given the year of the year of the census, those who were born after 1990 would be under 10 and all have "less than primary education".

based on selection on observables (Altonji, Elder, and Taber, 2005; Oster, 2014).

To further ensure the robustness of the results, I conduct the following tests: (i.) clustering at different geographic units; (ii.) using matched samples; (iii.) addressing biases in gazetteer data; (iv.) using different subsamples (omitting the Yangtze Delta and omitting high net in-migration counties); (v) accounting for historical and modern confounders (pre-1300 commercial networks, historical state presence and modern industrial composition); (vi.) checking three main hypotheses in previous work: ancestral plough use (Alesina, Giuliano, and Nunn, 2013), Neolithic settlements (Hansen, Jensen, and Skovsgaard, 2015) and soil texture (Carranza, 2014);(vii) examining variation within populations speaking the same language only. Appendix E summarizes the results of the above tests.

D The Distinctive Role of High-Value Work

The adoption of better technologies increased the quantity of cotton textiles produced per unit of time. Labor productivities in producing cotton textiles were higher in regions suitable for cotton spinning and weaving. Through inter-regional trade, cotton textiles were "exported" from those regions to the rest of China. Due to restrictions on migration, and gender segregation in types of work (Section III.C), women in places positively impacted by the cotton revolution earned a sustained "wage" premium over long periods of time. This made cotton textile production exceptional.

The baseline analysis suggests that the economic value of female labor is related to the formation of cultural beliefs of women's worth. Is the relationship between the economic value of female labor linear? As one of the component of sex ratio at birth is the economic value of having daughters, a linear relationship between past economic value of female labor and the present value of daughters likely suggests a level of persistence in the skill and ability of women that could shape the decision of sex selection.

This is not what we find. Instead, we find a non-linear relationship between past economic value of female labor and sex ratio at birth in the present. One interpretation is that relative female income has to reach a threshold level for beliefs to update. This implies that cultural beliefs about women's worth are sticky and possibly binary.

Below I compare cotton textile production to other types of economic activities performed by women. Appendix F includes a comparison of the cotton revolution to the Black Death, after which female labor force participation increased but relative female income remained low.

D.1 Cotton Cultivation

Women participated in the cultivation of cotton ("raw cotton"). Raw cotton is first spun into yarn, yarn woven into cotton fabrics. The locations of cotton cultivation did not overlap with the locations of cotton spinning or weaving.[37] I do not find a significant relationship between cotton cultivation and sex ratio at birth (column 1). In column 2, I include both cotton textiles (1300-1840) and cotton cultivation, and use a dummy variable of raw cotton in column 3. In both cases, the coefficient estimate of cotton textiles (1300-1840) does not vary much from the baseline estimate.

D.2 Tea Production

Qian (2008) shows that a short-term increase in tea prices increases the share of surviving girls likely by enhancing women's household bargaining power. The extent to which tea picking involves female labor varies. Tea production is the most prevalent in southern provinces (See Appendix A for a map of tea suitability). I include tea suitability in column 4 and find no significant effects. In column 5, I include both cotton textile production and tea production, and find the coefficient estimate of cotton textiles (1300-1840) to be very similar to the baseline estimate. In column 6, I replace the continuous variable of tea production with a dummy variable, and find very similar results. In comparison with cotton textile production, tea production was more seasonal and occasional, and did not generate as a stable cash flow. This is consistent with the hypothesis that relative female income has to reach a threshold value to be able to transform cultural beliefs about women's worth.

D.3 Rice Cultivation

Women participated in rice cultivation. However, just like wheat agriculture, rice agriculture was plough-based and required male upper body strength. Overall, I do not find a significant relationship between rice suitability and sex ratio at birth (column 7). In column 8, I include both cotton textile production and rice suitability, which produces a coefficient estimate of cotton textile production that is highly similar to the baseline estimate. When a dummy variable is used, rice suitability has a negative and insignificant coefficient, and cotton textile production continues to have a coefficient estimate of -3.7. Wetland rice suitability in GAEZ v3.0 is used for this exercise, but results are robust to using other measures of rice suitability.[38]

[37]See Appendix A for a map of cotton suitability. Regions specialized in cotton cultivation or in spinning and weaving. The US South specialized in cotton cultivation, when the UK specialized in the manufacture of cotton. FAO provides cotton suitability data at the level of 5 arc-minute grid cells (10km*10km). Consistent with other suitability measures used in this study, I use "agro-climatically attainable yield for intermediate-input-level, rain-fed cotton for baseline period 1961-1990" as my measure of cotton suitability.

[38]GAEZ v3.0 has a composite measure for wetland rice. The map of wetland rice suitability closely matches the actual cultivation and the traditional rice-wheat border as shown in Figure A.IIIb. GAEZ v3.0 also has separate measures for indica dryland rice, indica wetland rice and Japonica wetland rice, among which Indica dryland rice has a suitability of zero in China under both irrigation and rain-fed conditions. In GAEZ v2.0, a measure of rice suitability, irrespective of specific types of rice, is available. When using this measure, the coefficient estimate of being in rice-suitable areas is negative but not significant. Following Alesina, Giuliano, and Nunn (2013), I define locations that obtain at least 40% of the maximum yield as suitable.

Table II: Low- vs. High-Value Work

	Dependent variable: sex ratio at birth in 2000										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Continuous	Continuous	Dummy	Continuous	Continuous	Dummy	Continuous	Continuous	Dummy	Dummy	Dummy
Mean of Dep. Var.	118.6	118.6	118.6	118.6	118.6	118.6	118.6	118.6	118.6	118.6	118.6
Cotton textiles (1300-1840)		-3.719***	-3.635***		-3.731***	-3.731***		-3.727***	-3.740***		-3.785***
		(0.740)	(0.741)		(0.735)	(0.735)		(0.734)	(0.737)		(0.806)
Raw cotton	-0.00177	-0.000492	-2.028								
	(0.00322)	(0.00322)	(1.654)								
Tea				0.000572	0.000798	0.215					
				(0.00589)	(0.00585)	(1.671)					
Rice							0.000103	0.0000652	-0.323		
							(0.000395)	(0.000390)	(1.491)		
Cotton/Silk/Hemp textiles										-1.695**	0.0832
										(0.822)	(0.896)
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Socioeconomic Macroregion FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.358	0.368	0.368	0.358	0.368	0.368	0.358	0.368	0.368	0.360	0.368
Observations	1484	1484	1484	1484	1484	1484	1484	1484	1484	1489	1489

The table reports the results of testing the effects of high-value work vs. low-value work. The unit of observation is a county in 2000 Census. The dependent variable is sex ratio at birth. Columns 1, 4 & 7 run regressions on various types of low-value work. Other columns regress sex ratio at birth on both cotton textile production and low-value work. Columns 2, 5 & 8 use continuous variables of cotton, tea and rice suitability. Columns 3, 6 & 9 use dummies. Baseline controls are those used in Column 3 of baseresults. Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

D.4 Lower-Value Textile Work

Compared to cotton textile production, silk and hemp textile production typically yielded a lower income. Hemp textiles both had a much lower unit value, and was produced in smaller quantities. Silk produced at home was low-ended and similarly produced in small quantities.[39] To separate the effects of high-value work from those of low-value work, I include a control for the production of all types of textiles.[40] I find that the production of textiles bears no relationship with sex ratio at birth (column 2), once after controlling for cotton textiles.

E Post-1840 Political and Economic Shocks

E.1 Early Industrialization

Early industrialization began in China after 1840. The effects of early industrialization could bias my results in the following ways: (a.) If counties positively impacted by the cotton revolution were more likely to experience early industrialization after 1840, my results would confound the effects of industrialization with those of the cotton revolution. One fact counting against this is that industrialization in China was on a limited scale (Fairbank, 1978). During the late Qing and Republican era, much of the rural and hinterland China continued to engage in household production and individuals maintained traditional lifestyles. In 1933, almost a hundred years after the first treaty port was established in Shanghai, the handicraft industry still made up for 61% of the total industry output. (b.) If women were more likely to be part of the industrial workforce when they already worked at home, I would not be able to disentangle the effects of the cotton revolution and the effects of female labor force participation after 1840.[41] Given that much of industrialization in 19th century China took place in treaty ports (Jia, 2014), I include treaty port status as a proxy for early industrialization, which is already in the baseline specification. Columns 1-3 of Table III show coefficients of interest after controlling for or omitting treaty ports. Being a treaty port in the 19th c. indeed has an impact on sex ratio at birth. The interaction term between treaty port status and cotton textiles (1300-1840) is close to zero and insignificant, suggesting that the cotton revolution has no differential impact on sex ratio at birth by treaty port status. I also drop all treaty ports in column 3 and this slightly increases the size of the main coefficient estimate.

[39] High-ended silk was produced at state-owned workshops in just a few urban areas. In these urban shops, the work force was predominantly male.

[40] To obtain information on other types of textiles, I construct a second variable from Wang (2006).

[41] Section VI.C provides evidence that women in provinces more exposed to the cotton revolution were more likely to work outside of the home at the onset of the industrialization. Goldin and Sokoloff (1982) documents a substantial involvement of women in the industrialization of the American Northeast and a wage increase for women relative to men.

E.2 Expansion of Christianity

As Christianity emphasizes the value of human life, expansion of Christianity in China might have influenced constituted a source of variation in willingness to conduct sex selection. In the 19th and early 20th century, missionaries went to China to spread Christianity. Christianity might have shaped both attitudes towards infanticide and gender-role attitudes. Although the share of Chinese populations that were ever converted was small, they had a disproportional influence on the rest of society (Bai and Kung, 2014).

To check the impact of Christianity, I first include the density of communicants in column 4. As expected, a greater share of communicants in the population is negatively associated with sex ratio at birth. The size of the coefficient of interest increases by one-fifth, suggesting that some of the effects of the cotton revolution might have been masked by missionary activities. Counties without cotton textiles (1300-1840) had a higher density of communicants. I interact the density of communicants with cotton textiles (1300-1840) in column 5. The coefficient is positive for the interaction term, but not statistically significant. This implies the effect of the cotton revolution is smaller for counties with a greater share of communicants, and likewise, the effect of Christianity is smaller for counties positively impacted by the cotton revolution. In column 6, I drop all counties with more than 10 communicants per 10,000 residents; the estimated coefficient slightly increases in size.

E.3 Post-1979 Economic Policies

A set of liberalization policies were implemented after 1979 to vitalize the economy. I estimate the impact of economic liberalization on sex ratio at birth by exploiting the fact that coastal regions had greater propensity for economic liberalization. Shortly after 1979, five special economic zones were approved and they were all located on the coast. The Yangtze Delta and the Pearl River Delta witnessed rapid export-led economic growth upon economic liberalization. Are those regions are the same regions that had cotton textile (1300-1840).[42] I already have per capita income in the baseline specification to control for the impact of economic development; to account for other effects of post-1979 economic liberalization, I add a control for the coastal region (column 7), interact the coastal region with cotton textiles (1300-1840) (column 8) and drop the coastal region from the sample (column 9). The estimated coefficient decreases, but only slightly, after the inclusion of the coastal region dummy. In column 9 the coefficient size of interest increases by about a third.

[42] Figure I suggests that both the Yangtze Delta and the Pearl River Delta are indeed associated with cotton textile production.

Table III: Post-1840 Political and Economic Shocks

	Dependent variable: sex ratio at birth										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		Early Industrialization			Christianity			Economic Liberalization		All	None
Mean of Dep. Var.	118.6	118.6	119.1	118.8	118.8	119.4	118.6	118.6	118.8	118.8	118.8
Cotton textiles (1300-1840)	-3.753***	-3.739***	-4.108***	-4.164***	-5.983***	-5.949***	-3.669***	-4.363***	-4.941***	-6.251***	-4.207***
	(0.731)	(0.764)	(0.766)	(0.883)	(1.415)	(1.021)	(0.730)	(0.783)	(0.798)	(1.413)	(0.881)
Treaty port	-3.943***	-3.863***		-3.248**	-3.364**	-7.366***	-3.673***	-4.010***	-7.008***	-2.732	-3.333**
	(1.043)	(1.292)		(1.468)	(1.459)	(1.997)	(1.061)	(1.060)	(1.414)	(2.045)	(1.463)
Cotton textiles (1300-1840) $\times$ Treaty port		-0.138								-0.817	
		(1.929)								(2.858)	
Christianity				-0.348	-0.852*					-0.802*	
				(0.382)	(0.487)					(0.480)	
Cotton textiles (1300-1840) $\times$ *Christianity*					1.121*					0.858	
					(0.666)					(0.675)	
Coastal							-2.288	-4.843***		-6.164**	
							(1.515)	(1.822)		(2.539)	
Cotton textiles (1300-1840) $\times$ coastal								4.620**		6.197**	
								(2.077)		(3.085)	
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Socioeconomic	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macroregion FE											
Adjusted R^2	0.368	0.368	0.392	0.359	0.360	0.379	0.369	0.370	0.366	0.362	0.360
Observations	1489	1489	1289	993	993	766	1489	1489	1260	993	993

Notes: The table reports the impact of Cotton textiles (1300-1840) on sex ratio at birth accounting for political and economic shocks. The unit of observation is a county in 2000 Census. The dependent variable is sex ratio at birth. Baseline controls are those used in column 3 of I. Christianity is measured by log (communicants per 10,000+1). "on the coast" refers to a county within 50 kilometers of the coast. Column 3 drops all treaty ports. Column 6 drops all counties with more than 10 out of 10,000 individuals being communicants. Column 9 drops all coastal counties. Column 10 include all interaction terms. Column 11 includes only baseline controls and uses the same sample as Column 10. As part of the baseline controls, treaty port status and provincial capital are controlled for in all specifications. Robust standard errors are included in all specifications. Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Lastly, I include controls for all three large political and economic shocks and interacted them with cotton textiles (1300-1840) in column 10. This results in a sample of 993 counties. I find that if those shocks can be taken as exogenous, the cotton revolution is associated with a reduction of sex ratio imbalances by 6.2 boys per 100 girls in places without exposure to any of the shocks. Using the same sample but without controlling for those shocks, the main coefficient estimate is 4.2 boys per 100 girls (column 11).

F Instrumental Variable Strategy

In spite of performing a number of robustness tests and accounting for large political and economic shocks, I cannot rule out all possible sources of omitted variable bias. Below I use an instrumental variable strategy that allow me to circumvent the problem of omitted variable bias. A potential concern with the OLS estimates is selectivity into the adoption of new textile technologies. If these counties had a highly level of gender equality, or more likely have accomplished gender equality later even in the absence of the cotton revolution, this would bias the OLS estimates away from zero. A set of variables (agricultural suitability, log population density, proximity to the Grand Canal or Yangtze, distance to the coast, ruggedness and socioeconomic macroregion fixed effects) have been included in the baseline specification, to account for factors such as economic geography. In addition, an instrumental variable strategy helps to address measurement error. Due to the nature of historical data, my estimates suffers attenuation bias due to measurement error in the explanatory variable.

F.1 Logic of the Instrument

A few factors are known to be crucial for cotton spinning and weaving, one of which is a suitable range of relative humidity. Scientists, engineers and industry experts highlight the importance of relative humidity in producing cotton textiles. Lewis (1913) devotes its entire length to physical testings of cotton yarns. An extended analysis is provided on how yarn-count, twist and tensile strength vary by relative humidity. In a report on the textile industry in China (1909), the word "humidity" occurs more than 100 times, suggesting the pivotal role of humidity in textile manufacturing. Cotton weaving depends crucially on a suitably wet climate. Lander (1914) provides a vivid account of how relative humidity makes a good day or a bad day for cotton weaving:

> "It is well-known fact that on certain days weaving is more difficult than on others, and this difficulty is generally associated with a dry, east wind. On such occasions weaving is difficult even with the bulbs in the factory showing a percentage humidity which would be considered ample on an average day".

When spinning and weaving is carried out in unfavorable climates, finished cloth is of much poorer quality. Low humidity has a substantially impact on high-ended cotton cloth; high-quality cotton cloth can only be produced when relative humidity is greater than 70%.

The possession of a spinning wheel or a weaving loom entails a fixed cost; it helps to justify the cost if the equipment is used frequently. Many parts of China have dry winters, which lowers cotton textile output for those months. Likewise, dry afternoons lower cotton textile output. Since the bulk of spinning and weaving was performed in the daytime, humidity in the daytime (rather than at night) matters the most. To capture seasonal and within-24-hour variance in weaving suitability, I use both monthly and hourly information on relative humidity.

The advantage of having a relative humidity index highly specific to cotton weaving is that I can avoid spurious correlations as relative humidity could be correlated with suitability for other economic activities. Also, because cotton textile output increases in the relative humidity index, it provides more precise information about women's productivity than the treatment variable used in OLS regressions, which is a binary variable.

F.2 Construction of the Instrument

I construct a relative humidity index pertaining to suitability for cotton weaving. The index is termed the "Humidity-for-Weaving" Index. The first set of data is the 30-year monthly average relative humidity series from the Climate Research Unit of University of East Anglia. Those data are available across 10 arc-minute by 10 arc-minute grid cells (20km*20km) globally. The second set of data is the 6-hour relative humidity series from the National Oceanic and Atmospheric Administration where relative humidity was measured four times a day (6am, 12pm, 6pm and 12am) from 1981 to 2010. This data is at a higher frequency but with a lower resolution (2.5 degree by 2.5 degree).

I take the following steps to construct the Humidity-for-Weaving Index: Step one, I compute the ratio between daytime humidity (6am, 12pm and 6pm) and full-day relative humidity using the low-resolution, high-frequency data. Step two, I back out monthly daytime humidity using the high-resolution data on monthly average relative humidity. Step three, I obtain the distance between monthly daytime humidity and optimal humidity for cotton weaving. Based on Stamper and Koral (1979) and Iqbal et al. (2012), cotton weaving is possible when relative humidity is between 60% and 85%.[43] I take the distance between daytime humidity and 85%. The maximum distance is therefore 25%. Suitability for cotton weaving decreases in the distance to optimal humidity. Step four, I aggregate obtained monthly values over twelve months. Step five, I take the inverse of the total to create a

[43]See Appendix D.1 for the range of sources on the relationship between relative humidity and cotton spinning and weaving.

Humidity-for-Weaving Index such that the index increases in suitability for cotton weaving, and multiple it by 1,000. The index values range from 3.379 to 15.124. Figure II shows the distribution of the Humidity-for-Weaving Index at a county level in eight quantiles. Darker shades represent higher relative humidity and hence, higher suitability for cotton weaving. Missing values are shaded white. The finer details of the construction procedure are available in Appendix D.1.

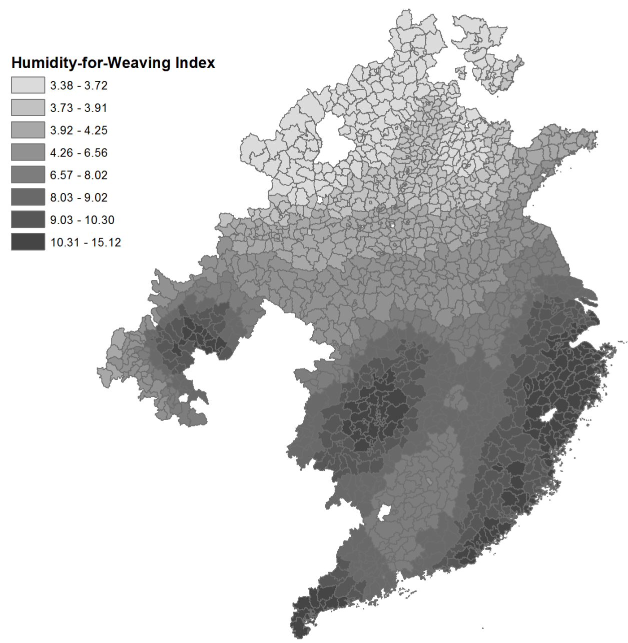


Figure II: Humidity-for-Weaving Index

F.3 Validity of the Instrument

For the instrumental variable strategy to work, the Humidity-for-Weaving Index has to affect long-run outcomes only through the cotton revolution. The Humidity-for-Weaving Index is intended to capture ideal conditions for cotton weaving. To ensure that relative humidity was not correlated with how productive it was to pursue other economic activities, I regress the Humidity-for-Weaving Index on other types of textiles. I show in Table IV that the instrument is strongly correlated with the spinning and weaving of cotton (column 1), but not with that of all types of raw material (hemp, silk and etc.) once controlling for cotton textiles (column 2). This is to be expected because the technical specifications for the production of other types pf textiles are very different. Silk is ideally weaved at a relative humidity of 60 to 70% (Stamper and Koral, 1979). The same source lists suggested ranges

Table IV: The Impact of the Humidity-for-Weaving Index on Other Activities

	(1) Cotton Textiles (1300-1840)	(2) Silk/hemp Textiles	(3) Raw cotton
Mean of Dep. Var.	0.478	0.784	0.555
Humidity-for-Weaving Index	0.0408***	-0.00204	-0.0185**
	(0.0109)	(0.00874)	(0.00857)
Baseline controls	Yes	Yes	Yes
Province FE	Yes	Yes	Yes
Socioeconomic Macroregion FE	Yes	Yes	Yes
Adjusted R^2	0.441	0.445	0.715
Observations	1483	1483	1478

Notes: The table reports falsification tests of the Humidity-for-Weaving Index. The unit of observation is a county in the 2000 Census. All controls in column 3 of Table I are included, with the exception of the one that is the dependent variable in that specification. Socioeconomic macroregion and province fixed effects are included in all specifications. Robust standard errors are included in all specifications. Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

of relative humidity for other types of textiles, such as 50 to 55% RH for weaving woolens and 55 to 70% RH for weaving worsteds. I also show that the Humidity-for-Weaving Index is negatively correlated with suitability for raw cotton (column 3).

To create a more exogenous source of variation in cotton textiles (1300-1840), I use the interaction between the Humidity-for-Weaving Index and distance to the center of national market (Suzhou) as my second instrument. The construction of the second instrument follows Pearl (2000). The distance to the center of national market itself is not a perfect instrument, since distance to the center of national market could affect modern gender inequality through past development. According to Pearl (2000), however, the interaction term between non-instrumental variables can still be an effective instrument.

F.4 Instrumental Variable Results

I begin my IV estimation by testing the relationship between my instruments and cotton textiles (1300-1840). Because my treatment variable is binary, I use Probit-2SLS as my estimation strategy. Probit-2SLS is a three-stage procedure recommended in Wooldridge (2002, pp.623-626). It uses a Probit model for the first stage.[44] The purpose of using this estimation strategy is to properly model the relationship between the Humidity-for-Weaving Index and cotton textiles (1300-1840) in order to best mitigate the problem of weak instruments due to

[44] The full procedure is as follows: first, use Probit to regress the treatment on the instrument and exogenous variables; second, use the predicted values from the first step in the first stage of a regular 2SLS procedure, together with the exogenous variables; third, run the second stage as in a regular 2SLS procedure.

Table V: Cotton Revolution and Sex Ratio at Birth: Instrumental Variable Analysis

	(1) OLS	(2) IV	(3) OLS	(4) IV
	Humidity-for-Weaving Index		Humidity-for-Weaving Index (inverse) × log(dist. to Suzhou)	
	Panel A: 2SLS Dependent variable: sex ratio at birth in 2000			
Mean of Dep. Var.	118.7	118.7	118.7	118.7
Cotton textiles (1300-1840)	-3.800***	-6.368**	-3.991***	-4.757*
	(0.730)	(3.197)	(0.726)	(2.731)
Adjusted R^2	0.364	0.360	0.373	0.372
	Panel B: Probit Dependent variable: cotton textiles (1300-1840)			
Humidity-for-Weaving Index		0.255***		
		(0.553)		
Humidity-for-Weaving Index (inverse)				-3.3680***
× log(dist. to Suzhou)				(0.605)
Pseudo R^2		0.417		0.428
Humidity-for-Weaving Index	No	No	Yes	Yes
Log(dist. to Suzhou)	No	No	Yes	Yes
Baseline controls	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Socioeconomic Macroregion FE	Yes	Yes	Yes	Yes
Observations	1467	1467	1467	1467

Notes: The table reports Probit-2SLS estimates. The unit of observation is a county in the 2000 Census. The dependent variable is sex ratio at birth. The full procedure has three stages. First-stage (Probit) and third-stage (2SLS) results are summarized in the table. The second stage is to calculate the predicted probability of cotton textile production. Baseline controls are the same as in column 3 of Table I. Robust standard errors are included in all specifications. Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

omitted nonlinearity (D. J. Henderson and Parmeter, 2015).[45]

Panel A of Table V shows the estimates from the first stage: the instrument is positively correlated with cotton textiles (1300-1840). The second stage is to calculate the predicted probability of cotton textiles. The third stage is to regress sex ratio at birth on the predicted probability of cotton textiles. Third-stage results are reported in Panel B. Column 1 contains

[45]D. J. Henderson and Parmeter (2015) shows that instruments that may be strong in a nonlinear relationship with the treatment could be weak when a linear relationship is imposed upon. An alternative method to address nonlinearities is to use a nonparametric instrument. However, Newey (2013) shows that nonparametric IV estimation only works well when the instrument is very strong. When the reduced form R^2 is low, and a linear IV slope can be estimated, the variance of the coefficients of nonlinear terms will be very high.

my OLS estimates. Column 2 reports my IV estimate with the Humidity-for-Weaving Index being the instrument. My IV estimate is that a one-standard-deviation increase in cotton textiles (1300-1840) leads to a reduction of sex ratio at birth by 3.184 boys per 100 girls (3.184=6.368*0.49). In columns 3-4, I use the interaction term of the Humidity-for-Weaving Index and the natural log of the distance to Suzhou as the instrument and include all baseline controls as well as the main effect of the Humidity-for-Weaving index and that of the distance to Suzhou. The use of this instrument yields IV estimates that are highly comparable to OLS estimates (-4.757 and -3.991).

For robustness, I estimate the same regressions with (a.) a Humidity-for-Weaving Index constructed from full-day relative humidity and (b.) a Humidity-for-Weaving Index with a cutoff of 80% relative humidity (see Appendix D.3).

VI The Emergence and Persistence of Gender-Equitable Beliefs

A Modern Evidence on Gender-Equitable Beliefs

Having shown the relationship between the cotton revolution and a reveal preference measure of cultural beliefs about women's worth, I turn to more subjective measures. CGSS 2010 (Chinese General Social Surveys) is the first survey to contain questions directly related to gender-equitable beliefs.

The first measure of gender-equitable beliefs is constructed from each respondent's view of the following question: "Do you agree with the following statement: men are naturally more capable than women?" The second measure comes from the question: "Do you agree with the following statement: men should focus on career; women should focus on family?" The respondent can choose from a scale of 1 to 5 ranging from "completely disagree" to "completely agree". I create a measure from two questions on the subjective assessment of how many sons and daughters one wants to have. For those who answer they want more daughters than sons, *daughter preference* takes on the value of one. For those who are indifferent between sons and daughters, i.e. they want the same number of sons and daughters, and those who want more sons than daughters, *daughter preference* takes on the value of zero. In addition, the CGSS includes information on age group, gender, urban/rural site, marital status, education attainment, communist party member status and urban *hukou*. I restrict the sample to the same geographic coverage as in the main sample (Section V).

Table VI: Gender-Equitable Beliefs: Evidence from CGSS

	Men naturally more capable			Women focus on family			Daughter preference		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		OLS			OLS			Logit	
Mean of Dep. Var.	2.989	3.006	3.006	3.638	3.659	3.658	0.0983	0.0975	0.0975
Cotton textiles (1300-1840)	-0.165**	-0.244***	-0.239***	-0.175**	-0.195***	-0.183***	0.196***	0.182+	0.200*
	(0.066)	(0.061)	(0.057)	(0.073)	(0.068)	(0.061)	(0.064)	(0.116)	(0.120)
Individual controls	No	No	Yes	No	No	Yes	No	No	Yes
Contemporary controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Historical & Geographical controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Socioeconomic Macroregion FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2 /Pseudo R^2	0.0259	0.0287	0.102	0.0503	0.0535	0.127 0.012	0.014	0.030	
Observations	6455	6161	6146	6462	6168	6152	6399	6105	6084

Notes: The table reports the impact of cotton textiles production (1300-1840) on gender-equitable beliefs. The unit of observation is a survey respondent in CGSS 2010 (Chinese General Social Surveys). Contemporary, historical and geographical controls are the same as in column 3 of Table I. Standard errors are clustered at the county level. Standard errors in parentheses $^{+}p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

I regress cotton textiles (1300-1840) on answers to those questions with the same controls in column 3 of Table I. Table VI summarizes the results. I find that individuals in counties positively impacted by the cotton revolution are less likely to agree with the first two statements, and are more likely to have daughter preference. Results suggest that the cotton revolution is associated with more gender-equitable beliefs.

In Appendix Table A.XV, I show that the cotton revolution is not correlated with modern values such as attitudes towards same-sex couples, premarital sex or science. Nor is it correlated with attitudes towards abortion. There is no clear relationship between the cotton revolution and generalized trust. This seems to suggest that rather than producing modern values, the cotton revolution specifically shapes gender-equitable beliefs.

B Initial Impact: The case of widow survival, 1368-1644

The cotton revolution began around 1300. To shed light on the timing of this transition and the formative years of gender-equitable beliefs, I look into the historical case of window survival using data collected from gazetteers published in the Ming Dynasty.

The cotton revolution greatly improved the economic prospects of widows. Stable incomes derived from cotton textile production played a beneficial role in the survival of widows. With those incomes, widows were able to not only support themselves, to support their children and in-laws, but also to contribute to communities by charitable giving (Elvin, 1984; Zurndorfer, 1998; Sommer, 2000).

Historical data on the number of widows and their mortality in the universe do not exist. Records kept by counties and prefectures on "virtuous women", however, provide information on widow suicide. The "virtuous women" system is a state-sponsored institution that rewards widows for adhering to a strict moral code. In the spirit of Song-Ming Neo-Confucianism, women were praised for maintaining female chastity after their husband's death. Those women were called "virtuous women". Before 1300, among all "virtuous women", half of the women were "chaste widows" who provided for their in-laws and children for a number of decades, the other half were "heroic widows" who committed suicide upon their husband's death to demonstrate their exemplary character (Dong, 1979).[46]

Widow records are from local gazetteers. Only records on imperial testimonials of merit (*jingbiao*) proffered by the central government are used in this exercise so that estimates are unaffected by local standards for awarding "virtuous women" status. Using prefecture-level gazetteers published in the Ming Dynasty (1368–1644) and available on *zhongguo fangzhi ku, Series I (Chinese Gazetteer Database)*, I create a measure of widow suicide during the Ming

[46] For more details on Song-Ming Neo-Confucianism and "virtuous women", please refer to Appendix F.6.

Table VII: *jingbiao*: Widow Suicide

	Dependent variable: widow suicide					
	(1)	(2)	(3)	(4)	(5)	(6)
Mean of Dep. Var.	0.500	0.500	0.500	0.500	0.500	0.500
Cotton textiles	-0.338	-0.461^{+}	-0.594^{+}	-0.621^{+}	-0.665^{+}	-0.581^{+}
	(0.369)	(0.293)	(0.381)	(0.377)	(0.389)	(0.352)
Log (dist. to Qufu)		-0.722***	-0.712***	-0.814***	-0.756***	-0.242
		(0.172)	(0.172)	(0.196)	(0.183)	(0.420)
Pop. density in 1600			0.181	0.316	0.224	0.345
			(0.274)	(0.322)	(0.338)	(0.390)
Agriculture suitability				-0.106	-0.178	-0.177
				(0.0892)	(0.139)	(0.137)
Ruggedness	No	No	No	No	Yes	Yes
Latitude	No	No	No	No	No	Yes
Longitude	No	No	No	No	No	Yes
Latitude × Longitude	No	No	No	No	No	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.326	0.482	0.465	0.465	0.461	0.526
Observations	32	32	32	32	32	32

Notes: The table reports the impact of cotton textiles (1300-1840) on widow suicide. The unit of observation is a prefecture on the 1911 prefecture map. The dependent variable is the number of search records related to women's receiving the title of "virtuous woman"(*jingbiao* for committing suicide following their husband's death. Qufu is the birthplace of Confucius. A prefecture needed to have at least one *jingbiao* record to be included in the sample. Outliers in either widow suicide or chaste widowhood are not included in the sample. The explanatory variable is cotton textile production recorded in prefecture-level gazetteers published in the Ming period. Robust standard errors are used in all specifications. Standard errors in parentheses $^{+}$ $p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Dynasty.[47]

Table VII summarizes the results. Column 1 shows an unconditional relationship between cotton textiles and widow suicide with only province fixed effects. Column 2 includes the natural log of one plus distance to Qufu, population density in 1300. In the spirit of Kung and Ma (2014), I use distance from Qufu—the birthplace of Confucius—as a proxy for the cultural demand for "virtuous" behavior on the part of women. The coefficient estimates of cotton textiles are close to conventional cutoffs of statistical significance after controlling for distance to Qufu. In columns 3-7, I sequentially add population density in 1600, agricultural suitability, ruggedness, latitude, longitude and their interaction term. Across the columns, I find cotton textile production consistently predicts a lower number of "heroic widows".

[47] The sample is restricted to prefectures with at least one prefecture-level gazetteer composed in the Ming period. As prefectures can have different rules as to what materials to include in the gazetteer, a prefecture needed to have at least one *jingbiao* record to be included in the sample.

The above exercise provides some suggestive evidence that cotton textile production reduced widow suicide. Ideally, I would like to compare widow suicide rates before and after the cotton revolution (1300-1840). However, a very small number of gazetteers were published before the Ming period (1368-1644) and even fewer have been preserved to this day. Information on widow suicide before Ming is too scarce for the purpose of this exercise.

In Ming and Qing China, an unprecedented number of widows participated in a wide range of economic and social activities. A strong financial position elevated the status of a widow in the family of her deceased husband's, as well as in her own family of origin. Also, because cotton textiles enabled women to maintain a livelihood in the absence of their husband, from the perspective of parents, a daughter's ability to support herself under adverse circumstances reduced their mental and financial exposure to the fate of their daughter. This was especially relevant because premodern China was characterized by high levels of economic uncertainty.[48] Improvement in the conditions faced by widows contributed to women coming to occupy a more substantial space in society (Bray, 1997; Pomeranz, 2004; c. Zhao, 2015).

C *Female Labor Force Participation in a Market Economy*

To provide further evidence that the cotton revolution transformed the culture, I examine its effects after 1840. Data are quite scarce for this period. As a first approximation, I examine the share of female workers in the industrial workforce in the early 20th century.

There is no systematic data on the composition of the workforce for periods prior to the Republican Era (1911-1949). The 1916 Economic Census documented the number of male and female workers working in a factory by province and industry, with household production workers excluded. There was a lot of regional variation in female labor force participation. Table A.IV provides summary statistics. At the province-industry level, on average, roughly 19% of the workers were female. Women made up a sizable portion of the industrial workforce in Jiangsu, Zhejiang and Shanghai, where women even outnumbered men; in comparison, women rarely worked outside of home in Zhili, Shanxi and Shaanxi. This suggests that women had very different responses to industrial job opportunities at the onset of China's industrialization. Such different responses cannot be explained by a prior history of women working outside of home, since the vast majority of women in China did not work outside of home prior to this period. This is more likely due to the persistence in the role of bread-winning females: families that were used to women generating incomes would be more likely to let women take on industrial jobs, when these new jobs became the

[48] Bossler (2000) finds evidence for a continued relationship between a married woman and her natal family. Although a woman became a member of her husband's extended family upon marriage, her natal family could still be implicated in times of crisis. This included cases in which a widowed woman in poverty imposed a financial burden on her natal family.

Table VIII: Share of Female Workers: Evidence from the 1916 Economic Census

	Dependent variable: % female workers			
	(1)	(2)	(3)	(4)
Mean of Dep. Var.	0.197	0.197	0.197	0.197
Cotton textiles (1300-1840)	0.137^{**}	0.110^{*}	0.110^{*}	0.110^{*}
Log Total Population	No	No	No	Yes
Industry dummies	No	No	Yes	Yes
#clusters	14	14	14	14
Adjusted R^2	0.0244	0.267	0.262	0.340
Observations	170	170	170	170

Notes: The table reports the impact of cotton textiles (1300-1840) on the share of female workers before state socialism. The unit of observation is an province-industry pair. The dependent variable is the share of female workers. Column 4 accounts for the number of clusters and report p-value (0.068) based on the empirical distribution of t-statistics using a wild cluster bootstrap-t procedure. Standard errors are clustered at the province level and in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

high-paying jobs at the time.

For this period, no information is available for outcome variables commonly examined in the modern literature, such as sex ratio at birth, female education attainment, or indicators of spousal relations. Disaggregated data did not exist.

I regress cotton textiles (1300-1840) on the share of female workers in the industrial workforce. Table VIII suggests that in provinces with a higher share of population exposed to the cotton revolution, a higher share of women worked in factories. The results are not affected by whether I add industry dummies or control for provincial populations. It is conceivable that women were employed more often because there was persistence in specific skills, i.e. women who could produce textiles at home had an advantage in industrial production of textiles. However, I find that the share of female workers was not only higher in textile manufacturing but also higher in other industries. Cotton textiles (1300-1840) are positively correlated with the share of female workers in most industries, with the exception of fur making. These results are consistent with the hypothesis that there was a permanent change in gender-equitable beliefs, and that the change remained in place after the economic effects of the cotton revolution gradually faded.

D *Under the Microscope of State Socialism: 1949-1990*

Next I examine the effects of the cotton revolution under state socialism. One main shortcoming of relying on the share of female workers to investigate the effects of the cotton revolution is that many economic, political and social factors are at play in the decision to participate in the labor force. Exploiting the setting of state socialism, where many political, economic and social forces were heavily regulated by the state, I am able to isolate the channel through which the cotton revolution influence modern outcomes. In addition, due to centralized rule, cultural norms could not easily influence local economic, political and legal institutions at a local level. This allows me to distinguish the effects of the cotton revolution through gender-equitable beliefs from other channels such as human capital and local development.

From 1949 to the early 1990s, the state tightly controlled and centralized most political, economic and social domains, such as property ownership and labor force participation. Chinese women gained the same legal status as men. Marriage laws were passed in 1950 to grant women the right to free marriage and the right to divorce, inherit property and have custody over their children. China also mandated equal entry to the labor market and instituted equal pay for equal work for men and women (Hannum and Xie, 1994; Yang, 1999; Entwisle and G. Henderson, 2000).

Despite the tight control of the state, the state was not able to intervene in every decision made by individuals. Even at the peak of state socialism (1949-1990), families were allowed to decide whether the husband or the wife would become the head of the household. Using the 1990 Population Census, I turn to a micro-level analysis that examines variation in the identity of the head of the household. Parallel to US Census before 1980, population censuses in China have a variable "Head of household" and a second variable "Relationship to head of household".[49] The first categories of the"Relationship to head of household" are "self" and "spouse". I code "Head of household" as one when"Relationship to head of household" is listed as "self", zero when"Relationship to head of household" is listed as "spouse". In most cases, the husband assumes the role of the head of the household, but there is plenty of regional variation: depending on the prefecture, anywhere from 1 to 20% of the heads of the households were wives. During this period, men and women had equal rights, and private property did not officially exist. For those reasons, being the head of the household status did not reflect underlying property relations, nor did it entitle one to a different set of legal rights. The head of the household status became a cultural symbol that had the connotation that whoever in that position led and ran a family. For most people, the idea of having a wife as the head of the household is unthinkable—only 5% of married couples decided to have the wife be the head.

Table A.II describes the main sample based on the 1990 Census. Only married individuals

[49]In the United States, the census switched to "Person 1" and "Relationship to first person listed on the questionnaire" just before 1980. https://www.census.gov/history/www/through_the_decades/index_of_questions/1980_population.html

are included. Each observation is an individual who is the head of the household. The sample is restricted to Han Chinese. I use the same geographic coverage as in the main sample in Section V.[50] Approximately 47% of the total population lived in a prefecture positively impacted by the cotton revolution. By the time of the census, migration rates were still low; many individuals lived in the same town as their ancestors.

My estimation equation is

$$\text{Wife}_{i,p} = \alpha + \beta \text{cotton textiles (1300-1840)}_p + \mathbf{X}_p^H \mathbf{\Omega} + \mathbf{X}_p^G \mathbf{\Lambda} + \mathbf{X}_p^C \mathbf{\Pi} + \mathbf{X}_i^I \mathbf{\Gamma} + \epsilon_{i,p} , \quad (2)$$

where p denotes a prefecture.[51] My outcome variable is whether the head of the household is the wife. Cotton textiles $(1300\text{-}1840)_p$ is cotton textile production between 1300 and 1840 in Prefecture p.[52] If the cotton revolution was effective in transforming cultural beliefs about women, β should be positive and significant. $\mathbf{X}_p^H$, $\mathbf{X}_p^G$ and $\mathbf{X}_p^C$ are the same controls as in the county-level analysis.[53] $\mathrm{X}_i^I \mathbf{\Gamma}$ denotes individual-level controls: age group and family size. Robust standard errors are clustered at the prefecture level for all specifications.

Estimates based on Logit regressions are reported in Table IX.[54] Column 1 includes all baseline controls together with controls for age group and family size. In column 2, I restrict the sample to women over 30. In column 3, I include additional individual-level controls, such as educational attainment, occupation and migration status, which are possibly endogenous to gender-equitable beliefs. In column 4, I include the natural log of population density in 1820. My coefficient estimates are highly stable across the columns. In prefectures positively impacted by the cotton revolution, the probability of a wife's being the head of the household increases by 1.7%, which is 29% of the average probability for women to head the household (5.89%). Estimates in column 4 suggest that the past population density is not a main channel through which the cotton revolution affects present-day gender inequality.[55] This

[50]To be included, the territory of a prefecture has to be entirely contained in the geographic coverage of the main sample.

[51]In the IPUMS 1990 census data, individual residence is only recorded at the prefecture level.

[52]See Appendix B.3 for more details as to how this variable is constructed. Small boundary changes occurred over time. To reduce measurement error, I construct a binary variable such that prefectures with more than 90% of the territory with cotton textile production are coded as one; prefectures with less than 10% of the territory with cotton textile production are coded as zero. The difference between the dummy and the continuous variables is, however, small (See Table A.II).

[53]$\mathbf{X}_p^C$ are county-level census data aggregated to the prefecture level weighted by county population. For $\mathbf{X}_p^C$ most controls from the census year 2000 are replaced with controls from the census year 1990. GDP per capita 2000 is replaced by GDP per capita 1989.

[54]For cotton textiles (1300-1840), a binary variable is used in all regressions. The continuous variable, however, yields similar results.

[55]In Appendix F I discuss macroeconomic consequences of the cotton revolution. From 1300 to 1840, the total population increased eightfold. Historians attribute part of the population increase to a greater ability to produce textiles.

Table IX: Wife Heading the Household : 1990 Census

	Dependent variable: wife			
	(1)	(2)	(3)	(4)
Mean of Dep. Var.	0.0589	0.0647	0.0589	0.0589
Cotton textiles (1300-1840)	0.332*	0.316*	0.355*	0.339*
	(0.179)	(0.176)	(0.183)	(0.179)
Marginal effects	0.017*	0.018*	0.017**	0.018$^+$
	(0.010)	(.0104)	(0.009)	(0.011)
Age >30	No	Yes	No	No
Education	No	No	Yes	No
Occupation	No	No	Yes	No
Pop. density in 1820	No	No	No	Yes
Age group	Yes	Yes	Yes	Yes
Family size	Yes	Yes	Yes	Yes
Baseline controls	Yes	Yes	Yes	Yes
Socioeconomic macroregion FE	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
# cluster	88	88	88	88
Pseudo R^2	0.067	0.062	0.195	0.067
Observations	701263	555282	701263	701263

Notes: The table reports the impact of cotton textiles (1300-1840) on the probability of wife heading the household. The unit of observation is a individual in the 1990 Census. The dependent variable is a binary variable that equals one when an individual is a wife. The sample is restricted to individuals who are the head of the household, married and Han Chinese. All estimates are based on Logit regressions. Baseline controls are the same as in column 3 of Table I, except that contemporary controls here are replaced by variables from the 1990 census. Robust standard errors are clustered at the prefecture level. Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

lends more confidence to the main hypothesis that the cotton revolution led to the emergence of gender-equitable beliefs.

The above analysis shows the impact of the cotton revolution remains under state socialism. The coefficient estimates of cotton textiles (1300-1840) should be interpreted as the direct effect, rather than the total effect, of the cotton revolution through the channel of cultural beliefs about women's worth. In other words, if the cotton revolution was able to freely shape local political and legal institutions through aggregated preferences, the magnitude of those estimates would be greater.

It is possible that state socialism promoted gender-equitable beliefs. To demonstrate the impact of state socialism on gender-equitable beliefs, I show results of a cohort analysis in Appendix E.8.

VII Interpretations and Caveats

This section discusses the external validity and policy implications of this study. The study shows that it is possible to change the perception of women being less capable than men. However, several conditions were necessary for such a change to occur. One important condition was that the production of cotton textiles did not require the overhauling of the entire social structure and therefore, did not meet much social resistance. Due to the nature of at-home work, women generated market income without having to reduce their investment in their families. Women continued to produce textiles after they became married, and there has never been a Chinese equivalent of "marriage bars" restricting employment of married women.

Another favorable condition was that the underlying productivity of cotton textile production was easy to ascertain. In contrast to modern firms, which often have a multi-layer managerial structure, the monitoring of output in home production of cotton textiles was straightforward. Cotton textiles were produced at home and the value of women's work was revealed when these textiles were sold in the market. The fact that the production was easily measured and not subject to ambiguous standards of interpretation reduced opportunities to exercise discrimination, which tends to arise when evaluation is more difficult, as described in critiques of the comparable-worth hypothesis (Deaux, 1985; McArther, 1985).

There is no denying that several historical contingencies enabled women to reap the benefits of the cotton revolution and to earn such high incomes. (a.) Imperial China had a "quasi-socialist" state. The traditional division of labor in which men worked in the fields and women produced textiles, was partly caused by the state in-kind taxation system. (b.) Men's labor productivity stagnated as with high rates of land ownership and high demand for male labor in plough-based agricultures, the labor of most men could not be freed up easily. (c.) Female involvement in textile work, often as early as in their pre-teen and teen years, did not crowd out their educational attainment.[56]

Historical contingencies were critical in enabling women to earn high incomes for such a long period. For women to earn high incomes in today's world, however, it is not necessary to have identical conditions to those in Imperial China. With advances in technology and changes in institutions, economic opportunities favoring women provide a richer variety of ways for women to earn high incomes today. Likewise, in this historical experiment, it took hundreds of years of high relative female income for the perception of women to change. This

[56]This is because in premodern China, women were almost universally illiterate, regardless of when and where they first engaged in work. In contrast, interventions in increasing economic opportunities for women would not necessarily result in higher life-time incomes for women in the contemporary world, due to competing claims on time by workforce participation and human capital investments (Shah and Steinberg, 2015).

could explain why modern experiments have not been overly successful in changing gender norms, but this does not mean that it will take equally long to see such changes in a modern context.

There are a few other caveats regarding the external validity of this study: (a.) Population mobility was low in premodern China due to the combined forces of state policies and cultural traditions. Because the communist state continued to restrict population mobility, migration rates remained low after 1949; (b.) An important feature of Chinese culture is that parents have substantial power over children, which may have facilitated the vertical transmission of cultural values. For that reason, and consistent with the theoretical reasoning of Bisin and Verdier (2001), the persistence of beliefs seen in China could be stronger than in other places; (c.) The lack of development of local legal systems and political institutions means that individuals can neither coordinate on reforms, nor can they coordinate to block progress. (d.) Past decades of state socialism might have weakened cultural values through both progressive laws and propaganda. In the absence of state socialism, the impact of the cotton revolution on modern outcomes might have been greater.

It is worth noting that despite a tradition of Confucianism and patrilocality, there have been many outstanding Chinese women. Chinese women who go to top business schools demonstrate more competitive inclinations than their US counterparts.[57] This paper reconciles the phenomenon of ambitious and successful professional women in China, with the conservative past of the country, by highlighting the unique role of high-value work opportunities in changing the perception of women being inferior.

VIII Concluding Remarks

Using a historical experiment, the cotton revolution (1300-1840 AD), this paper examines the hypothesis that high-value work opportunities for women can lead to the emergence of gender-equitable beliefs. When women began to earn an income close to or higher than that of men, a shift in culture occurred. It switched from an equilibrium in which women were seen as less capable than men in part because they contributed less to household production to one in which they could achieve value and esteem as a result of engaging in high-value work.

[57]Among MBAs or undergraduates at top programs, 65 percent of the women consider themselves "very ambitious", compared with 36 percent of their U.S. counterparts; 76 percent aspire to a top job versus 52 percent of Americans. Female candidates are found to be as competitive, if not more so, than their male counterparts.http://iveybusinessjournal.com/publication/ambitious-educated-women-and-their-key-role-in-solving-chinas-talent-crunch/. Two-thirds of the richest self-made women in the world are active in China. http://qz.com/529508/china-is-home-to-two-thirds-of-the-worlds-self-made-female-billionaires/.

I show that a sizable portion of the variation in sex ratio at birth in present-day China can be linked to the cotton revolution. The cotton revolution is also associated with more investment in girls' education. These results are robust to clustering at different geographical levels, matched samples, addressing biases in gazetteer data, different subsamples, accounting for historical and modern confounders, the inclusion of deep determinants of gender norms as raised in previous literature, and an instrumental variable strategy. I find that high-value work has a distinctive role in transforming cultural beliefs about women's worth. Accounting for large political and economic shocks after 1840, the effects of the cotton revolution remain.

This finding is complemented by survey evidence: the production of cotton textiles between 1300 and 1840 predicts gender-equitable beliefs. I show an initial impact of the cotton revolution on women that occurred as early as 1600: places positively impacted by the cotton revolution had lower rates of widow suicide. The effects of the cotton revolution have been manifested under various political and economic conditions. When China began to industrialize, more women worked in the industrial sector in places positively impacted by the cotton revolution. Under post-1949 state socialism, gender-equitable beliefs operated in the private domain when the public domain became highly centralized and tightly controlled by the government.

Societies lacking high-value work opportunities for women in the past, through the perception of women being less capable than men, can continue to discourage women today. Those beliefs can be reflected in both discrimination against women and negative self-evaluation or self-stereotyping by women, and potentially, in gender differences in terms of both preferences and psychological traits. Risk attitudes, attitudes toward competition, attitudes toward negotiation and other psychological traits have been shown to be different for men and women, and scholars have shown that this difference can be at least partly explained by nurture and cultural attitudes.[58] To change the perception of women, technologies and institutions that facilitate the creation of high-value work opportunities for women might be highly beneficial. In addition, this study also suggests that it is possible for women to become more equal to men even in traditional societies. Given that a large number of developing countries have remained agricultural and traditional, this study is highly relevant for our understanding of how to improve gender equality in traditional societies.

[58] Gneezy, Leonard, and List (2009) find that the social environment, namely, whether a society is patriarchal or matrilineal, is key to women's competitive inclinations. Y. J. Zhang (2015) similarly finds a cultural component in competitive inclinations.

References

Alesina, Alberto, Paola Giuliano, and Nathan Nunn (2013). "On the Origins of Gender Roles: Women and the Plough". In: *The Quarterly Journal of Economics* 128.2, pp. 469–530.

Allen, Robert C. (2009). "Agricultural productivity and rural incomes in England and the Yangtze Delta, c.1620–c.1820". In: *Economic History Review* 62.3, pp. 525–550.

Allen, Robert C et al. (2011). "Wages, prices, and living standards in China, 1738–1925: in comparison with Europe, Japan, and India". In: *The Economic History Review* 64.s1, pp. 8–38.

Almond, Douglas and Lena Edlund (2008). "Son-biased sex ratios in the 2000 United States Census". In: *Proceedings of the National Academy of Sciences* 105.15, pp. 5681–5682.

Almond, Douglas, Hongbin Li, and Shuang Zhang (Forthcoming). "Land reform and sex selection in China".

Altonji, Joseph G, Todd E Elder, and Christopher R Taber (2005). "Selection on Observed and Unobserved Variables: Assessing the Effectiveness of Catholic Schools". In: *Journal of Political Economy* 113.1, pp. 151–184.

Ananthanarayanan, PN (2013). *Basic refrigeration and air conditioning*. Tata McGraw-Hill Education.

Anderson, Siwan and Debraj Ray (2015). *Missing Unmarried Women*. Tech. rep. National Bureau of Economic Research.

Angrist, Joshua D and Jörn-Steffen Pischke (2008). *Mostly harmless econometrics: An empiricist's companion*. Princeton university press.

Anukriti, S, Sonia Bhalotra, and Hiu Tam (2015). "Missing Girls: Ultrasound Access and Excess Female Mortality". In:

Arnold, Fred, Sunita Kishor, and TK Roy (2002). "Sex-Selective Abortions in India". In: *Population and development review* 28.4, pp. 759–785.

Babiarz, Kimberly Singer et al. (2018). *The Limits (and Human Costs) of Population Policy: Fertility Decline and Sex Selection in China under Mao*. Tech. rep. National Bureau of Economic Research.

Bai, Ying and James Kai-sing Kung (2014). "Diffusing knowledge while spreading God's message: Protestantism and economic prosperity in China, 1840–1920". In: *Journal of the European Economic Association*.

Barber, Elizabeth JW (1991). "Prehistoric textiles". In: *The development of cloth in the Neolithic and Bronze Ages with special reference to the Aegean*, pp. 223–243.

Beath, Andrew, Fotini Christia, and Ruben Enikolopov (2012). *Empowering women: evidence from a field experiment in Afghanistan*. The World Bank.

Bertrand, Marianne, Patricia Cortés, et al. (Feb. 2016). *Social Norms, Labor Market Opportunities, and the Marriage Gap for Skilled Women*. Working Paper 22015. National Bureau of Economic Research.

Bertrand, Marianne, Emir Kamenica, and Jessica Pan (2015). "Gender Identity and Relative Income within Households". In: *The Quarterly Journal of Economics*.

Bisin, Alberto and Thierry Verdier (2001). "The economics of cultural transmission and the dynamics of preferences". In: *Journal of Economic theory* 97.2, pp. 298–319.

Bossler, Beverly Jo (2000). "" A Daughter is a Daughter All Her Life": Affinal Relations and Women's Networks in Song and Late Imperial China". In: *Late Imperial China* 21.1, pp. 77–106.

Boyd, Robert and Peter J. Richerson (1985). *Culture and the Evolutionary Process*. Chicago, IL: University of Chicago Press.

Bray, Francesca (1997). *Technology and gender: Fabrics of power in late imperial China*. University of California Pr.

Buckley, Christopher D and Eric Boudot (2017). "The evolution of an ancient technology". In: *Royal Society Open Science* 4.5, pp. 170–208.

Carranza, Eliana (2014). "Soil endowments, female labor force participation, and the demographic deficit of women in India". In: *American Economic Journal: Applied Economics* 6.4, pp. 197–225.

Chang, Kwang-chih (1963). *The archaeology of ancient China*. New Haven: Yale University Press.

Chen, Jinhao et al. (1991). *Songjiang qu ge (Poetry of Songjiang)*. Zhong hua shu ju.

Chen, Yuyu, Hongbin Li, and Lingsheng Meng (2013). "Prenatal Sex Selection and Missing Girls in China: Evidence from the Diffusion of Diagnostic Ultrasound". In: *Journal of Human Resources* 48.1, pp. 36–70.

Chung, Woojin and Monica Das Gupta (2007). “The decline of son preference in South Korea: The roles of development and public policy”. In: *Population and Development Review* 33.4, pp. 757–783.
Cloonan, K, C Crumley, and S Kiymaz (2005). “The historical, scientific, cultural, and economic aspects of gender preselection”. In: *Developmental Biology*.
Das Gupta, Monica and PN Mari Bhat (1997). “Fertility decline and increased manifestation of sex bias in India”. In: *Population studies* 51.3, pp. 307–315.
Daul, Gordon B. and Enrico Moretti (Oct. 2008). “The Demand for Sons”. In: *Review of Economic Studies* 75.4, pp. 1085–1120.
Deaux, Kay (1985). “Sex and gender”. In: *Annual review of psychology* 36.1, pp. 49–81.
Deng, yibing (1999). “The Trade of Cotton and Cotton Textiles in early Qing”. In: *Shi Xue Yue Kan (History Monthly)* 3, pp. 41–45.
Doepke, Matthias and Michèle Tertilt (Nov. 2009). “Women’s Liberation: What’s in It for Men?” In: *The Quarterly Journal of Economics* 124.4, pp. 1541–1591. URL: http://ideas.repec.org/a/tpr/qjecon/v124y2009i4p1541-1591.html.
Doepke, Matthias, Michèle Tertilt, and Alessandra Voena (July 2012). “The Economics and Politics of Women’s Rights”. In: *Annual Review of Economics* 4.1, pp. 339–372.
Dong, Jiazun (1979). “A Statistical Analysis of Virtuous Women by Dynasty”. In: *Zhongguo funv shilunji (A collection of essays on women in Chinese history)*.
Dublin, T. (1993). *Farm to Factory: Women’s Letters, 1830-1860*. Columbia University Press.
Duflo, Esther (2003). “Grandmothers and Granddaughters: Old-Age Pensions and Intrahousehold Allocation in South Africa”. In: *The World Bank Economic Review* 17.1, pp. 1–25.
Ebenstein, Avraham (2010). “The “missing girls” of China and the unintended consequences of the one child policy”. In: *Journal of Human Resources* 45.1, pp. 87–115.
Edlund, Lena (1999). “Son preference, sex ratios, and marriage patterns”. In: *Journal of Political Economy* 107.6, pp. 1275–1304.
Elvin, Mark (1972). *The High-level Equilibrium Trap: The Cause of the Decline of Invention in the Traditional Chinese Textile Industries*. Stanford, Calif. : Stanford University Press.
— (1984). “Female virtue and the state in China”. In: *Past and Present*, pp. 111–152.
Entwisle, Barbara and Gail Henderson (2000). *Re-drawing boundaries: work, households, and gender in China*. Vol. 25. Univ of California Press.
Fairbank, John King (1978). *The Cambridge History of China: Late Ching, 1800-1911, pt. 2*. Cambridge University Press.
Farnie, D.A. (1979). *The English Cotton Industry and the World Market: 1815-1896*. Oxford University Press.
Fernández-Villaverde, Jesús, Jeremy Greenwood, and Nezih Guner (2014). “From shame to game in one hundred years: An economic model of the rise in premarital sex and its de-stigmatization”. In: *Journal of the European Economic Association* 12.1, pp. 25–61.
Fernández, Raquel (2007). “Alfred Marshall Lecture Women, Work, and Culture”. In: *Journal of the European Economic Association* 5.2-3, pp. 305–332.
Fernández, Raquel and Alessandra Fogli (2009). “Culture: An Empirical Investigation of Beliefs, Work, and Fertility”. In: *American Economic Journal. Macroeconomics* 1.1, p. 146.
Fernández, Raquel, Alessandra Fogli, and Claudia Olivetti (2004). “Mothers and sons: Preference formation and female labor force dynamics”. In: *The Quarterly Journal of Economics* 119.4, pp. 1249–1299.
Ferree, Myra Marx (1976). “Working-class jobs: Housework and paid work as sources of satisfaction”. In: *Social Problems*, pp. 431–441.
Fortin, Nicole M (2005). “Gender role attitudes and the labour-market outcomes of women across OECD countries”. In: *Oxford Review of Economic Policy* 21.3, pp. 416–438.
Gneezy, Uri, Kenneth L Leonard, and John A List (2009). “Gender differences in competition: Evidence from a matrilineal and a patriarchal society”. In: *Econometrica* 77.5, pp. 1637–1664.
Goldewijk, Kees Klein, Arthur Beusen, and Peter Janssen (2010). “Long-term dynamic modeling of global population and built-up area in a spatially explicit way: HYDE 3.1”. In: *The Holocene*.
Goldin, Claudia and Kenneth Sokoloff (1982). “Women, children, and industrialization in the early republic: Evidence from the manufacturing censuses”. In: *The Journal of Economic History* 42.04, pp. 741–774.

Grosjean, Pauline (2014). "A history of violence: The culture of honor and homicide in the US south". In: *Journal of the European Economic Association* 12.5, pp. 1285–1316.

Grosjean, Pauline and Rose Khattar (Forthcoming). "It's raining men! Hallelujah? The long-run consequences of male-biased sex ratios".

Gu, Yanwu (1995). *Zhao yu zhi:Jiangnan, Volume 9*. reprint. Xu xiu si ku quan shu. Shanghai Ancient Books Publishing House.

Gupta, Monica Das (1987). "Selective discrimination against female children in rural Punjab, India". In: *Population and development review*, pp. 77–100.

Hannum, Emily and Yu Xie (1994). *Trends in educational gender inequality in China: 1949-1985*. University of Michigan.

Hansen, Casper Worm, Peter Sandholt Jensen, and Christian Volmar Skovsgaard (2015). "Modern gender roles and agricultural history: the Neolithic inheritance". In: *Journal of Economic Growth*, pp. 1–40.

Harris, Marvin (1993). "The evolution of human gender hierarchies: A trial formulation". In: *Sex and gender hierarchies*, pp. 57–79.

Henderson, Daniel J and Christopher F Parmeter (2015). *Applied Nonparametric Econometrics*. Cambridge University Press.

Hu, Luojia and Analıa Schlosser (2015). "Prenatal Sex Selection and Girls' Well-Being: Evidence from India". In: *The Economic Journal* 125.587, pp. 1227–1261.

Huang, Philip C. C. (1990). *The peasant family and rural development in the Yangzi Delta, 1350-1988*. Stanford: Stanford University Press.

Huang, Wei and Yi Zhou (2016). "Impact of One-Child Policy on Inter-ethnic Marriage in China".

Iqbal, Mansoor et al. (2012). "Textile Environmental Conditioning: Effect of Relative Humidity Variation on the Tensile Properties of Different Fabrics". In: *Journal of Analytical Sciences, Methods and Instrumentation* 2.02, p. 92.

Jha, Saumitra (2013). "Trade, Institutions, and Ethnic Tolerance: Evidence from South Asia". In: *American Political Science Review* 107.04, pp. 806–832.

Jia, Ruixue (2014). "The legacies of forced freedom: China's treaty ports". In: *Review of Economics and Statistics* 96.4, pp. 596–608.

Klein Goldewijk, Kees et al. (2011). "The HYDE 3.1 spatially explicit database of human-induced global land-use change over the past 12,000 years". In: *Global Ecology and Biogeography* 20.1, pp. 73–86.

Kung, James Kai-sing and Chicheng Ma (2014). "Can cultural norms reduce conflicts? Confucianism and peasant rebellions in Qing China". In: *Journal of Development Economics* 111, pp. 132–149.

Kut, David (2014). *Warm Air Heating: International Series of Monographs in Heating, Ventilation and Refrigeration*. Elsevier.

Lander, Cecil Howard (1914). *Ventilation and humidity in textile mills and factories*. Longmans, Green.

Lee, James, Cameron Campbell, and Wang Feng (2002). "Positive Check or Chinese Checks?" In: *The Journal of Asian Studies* 61.2, pp. 591–607.

Lee, Ronald and Michael Anderson (2002). "Malthus in state space: Macro economic–demographic relations in English history, 1540 to 1870". In: *Journal of Population Economics* 15, pp. 195–220.

Lewis, Walter Scott (1913). *Physical testing of cotton yarns*. Govt. Print. Off.

Li, Bozhong (1997). ""Men farms and women weaves" and the formation of the role of "half the sky" of women in peasant family economy: a study of women's work in Jiangnan during the Ming-Qing times". In: *Researches in Chinese Economic History* 3, p. 001.

Li, Lillian M (1991). "Life and death in a Chinese famine: infanticide as a demographic consequence of the 1935 Yellow River flood". In: *Comparative Studies in Society and History* 33.03, pp. 466–510.

Lin, Ming-Jen, Jin-Tan Liu, and Nancy Qian (2014). "More missing women, fewer dying girls: the impact of sex-selective abortion on sex at birth and relative female mortality in Taiwan". In: *Journal of the European Economic Association* 12.4, pp. 899–926.

Man, Cheng Oi (2011). "Socioeconomic History of the Ming and Qing Dynasty from a gender perspective: the histories of agriculture, textile, commerce, and consumers." In: *Journal of Chinese Studies* 52.01, pp. 95–127.

Mann, Susan (1997). *Precious records: Women in China's long eighteenth century*. Stanford University Press.

McArther, Leslie Zebrowitz (1985). “Social Judgement Biases in Comparable Worth Analysis”. In: *Comparable Worth: New Directions for Research*. Ed. by Heidi I Hartmann et al. National Academies Press.
Miguel, Edward (2005). “Poverty and Witch Killing”. In: *Review of Economic Studies* 72.4, pp. 1153–1172.
Murdock, George Peter (1967). *Ethnographic atlas*. University of Pittsburgh Press.
Myers, Ramon H. (1965). “Cotton Textile Handicraft and the Development of the Cotton Textile Industry in Modern China”. In: *The Economic History Review* 18.3, pp. 614–632.
Nachtergaele, Freddy et al. (2008). “Harmonized world soil database”. In: *Food and Agriculture Organization of the United Nations*.
National Bureau of Statistics (2005). *China County Population Census Data with Maps : 1953, 1964, 1982, 1990, 2000*. Beijing: All China Marketing Research Co. ; Ann Arbor, MI: Distributed by University of Michigan, China Data Center.
Needham, J. and D. Kuhn (1988). *Science and Civilisation in China: Volume 5, Chemistry and Chemical Technology, Part 9, Textile Technology: Spinning and Reeling*. Science and Civilisation in China. Cambridge University Press. ISBN: 9780521320214. URL: https://books.google.com.mx/books?id=qsKPrgEACAAJ.
Newey, Whitney K (2013). “Nonparametric instrumental variables estimation”. In: *The American Economic Review* 103.3, pp. 550–556.
Nunn, Nathan and Leonard Wantchekon (Dec. 2011). “The Slave Trade and the Origins of Mistrust in Africa”. In: *American Economic Review* 101.7, pp. 3221–52.
Oster, Emily (2005). “Hepatitis B and the Case of the Missing Women”. In: *Journal of Political Economy* 113.6, pp. 1163–1216.
— (2014). “Unobservable selection and coefficient stability: Theory and evidence”. In: *University of Chicago Booth School of Business Working Paper*.
Pearl, Judea (2000). “Causality: models, reasoning, and inference”. In: *Cambridge University Press*. 28.
Pomeranz, Kenneth (2000). *The Great Divergence: China, Europe, and the making of the modern world economy*. Princeton University Press.
— (2002). “Beyond the East-West binary: Resituating development paths in the eighteenth-century world”. In: *The Journal of Asian Studies* 61.02, pp. 539–590.
— (2004). “Women’s work, family, and economic development in Europe and East Asia: long-term Trajectories and contemporary comparisons”. In: *The resurgence of East Asia: 500, 150 and 50 year perspectives*. Ed. by Giovanni Arrighi, Takeshi Hamashita, and Mark Selden. Routledge.
Putterman, Louis and David N Weil (2010). “Post-1500 population flows and the long run determinants of economic growth and inequality.” In: *Quarterly Journal of Economics* 125.4.
Qian, Nancy (2008). “Missing Women and the Price of Tea in China: The Effect of Sex-Specific Earnings on Sex Imbalance”. In: *The Quarterly Journal of Economics* 123.3, pp. 1251–1285.
Rosenzweig, Mark R and T Paul Schultz (1982). “Market opportunities, genetic endowments, and intrafamily resource distribution: Child survival in rural India”. In: *The American Economic Review* 72.4, pp. 803–815.
Sarsons, Heather (2015). *Gender Differences in Recognition for Group Work*.
Shah, Manisha and Bryce Millett Steinberg (2015). *Workfare and Human Capital Investment: Evidence from India*. Working Paper 21543. National Bureau of Economic Research.
Shiue, Carol H. and Wolfgang Keller (Sept. 2007). “Markets in China and Europe on the Eve of the Industrial Revolution”. In: *American Economic Review* 97.4, pp. 1189–1216.
Skinner, G.W., Mark Henderson, and Merrick Lex Berman (2013). “Socioeconomic Macroregions of China”. In: *Harvard Dataverse, V1*.
Sommer, Matthew Harvey (2000). *Sex, law, and society in late imperial China*. Stanford University Press.
Stamper, Eugene and Richard L Koral (1979). *Handbook of Air Conditioning, Heating, and Ventilating*. Industrial Press Inc.
Stauffer, Milton Theobald et al. (1922). “Christian occupation of China”. In:
Textile World Record (1909). v. 37. Lord & Nagle Company.
Voigtländer, Nico and Hans-Joachim Voth (2012). “Persecution Perpetuated: The Medieval Origins of Anti-Semitic Violence in Nazi Germany”. In: *The Quarterly Journal of Economics* 127.3, pp. 1339–1392.
Wang, Zengyu (2006). “Silk, Linen and Cotton in Ancient China”. In: *Wen Shi*.

Warren, M.A. (1985). *Gendercide: the implications of sex selection*. New feminist perspectives. Rowman & Allanheld. ISBN: 9780847673308. URL: https://books.google.com/books?id=xCqNAAAAIAAJ.

Wei, Shang-Jin and Xiaobo Zhang (2011). "The Competitive Saving Motive: Evidence from Rising Sex Ratios and Savings Rates in China". In: *Journal of Political Economy* 119.3, pp. 511–564.

Westoff, Charles F and Ronald R Rindfuss (1974). "Sex preselection in the United States: some implications." In: *Science*.

Windt, Peter van der, Macartan Humphreys, and Raul Sanchez de la Sierra (2018). "Gender quotas in development programming: Null results from a field experiment in Congo". In: *Journal of Development Economics* 133, pp. 326–345.

Wooldridge, Jeffrey M (2002). *Econometric analysis of cross section and panel data*. MIT press.

Xu, Xiangqin (1987). *Epitaph of Dong, wife of Xu Zhanzhong*. Shanghai Ancient Books Publishing House.

Yang, Mayfair Mei-hui (1999). *Spaces of their own: women's public sphere in transnational China*. Vol. 4. U of Minnesota Press.

Zhang, Y Jane (2015). "Culture, institutions, and the gender gap in competitive inclination: evidence from the communist experiment in china". In: *The Economic Journal*.

Zhao, cuili (2015). *Hidden modernity-social life and romantic experience of Ming and Qing women*. Beijing: Zhishi chubanshe.

Zhao, G. (1977). *The Development of Cotton Textile Production in China*. Harvard East Asian monographs. East Asian Research Center, Harvard University. ISBN: 9780674200210.

Zurndorfer, Harriet Thelma (1998). *Chinese women in the imperial past: new perspectives*. Vol. 44. Brill.

For Online Appendix

A Additional Figures and Tables

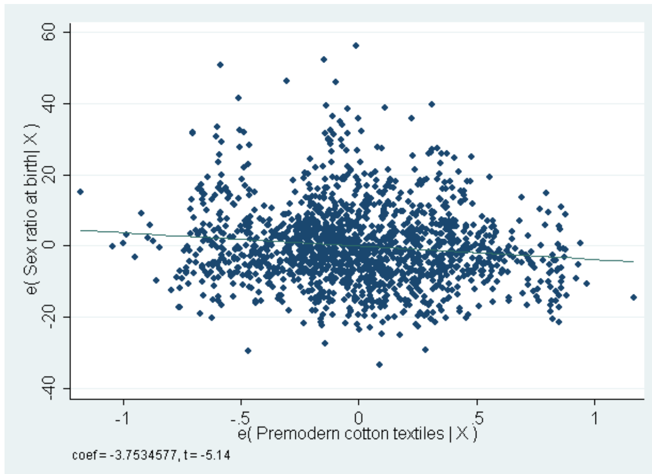


Figure A.I: Partial Regression Plot

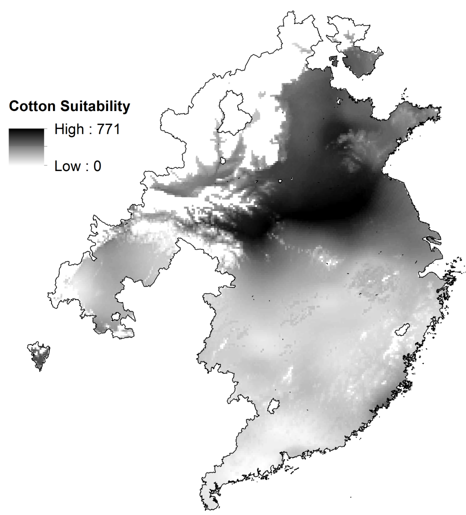


Figure A.II: Agro-Climatically Attainable Yield (kg DW/ha) for Immediate-Input-Level, Rain-Fed Cotton

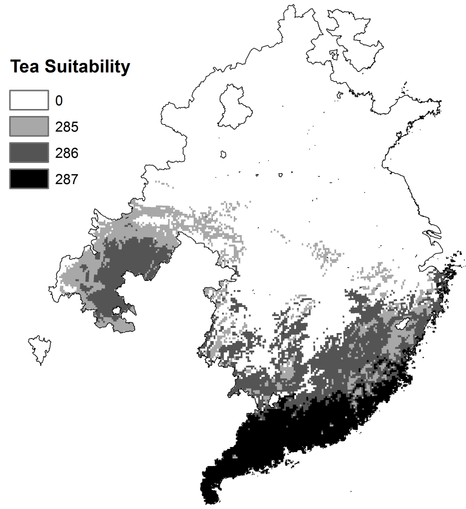
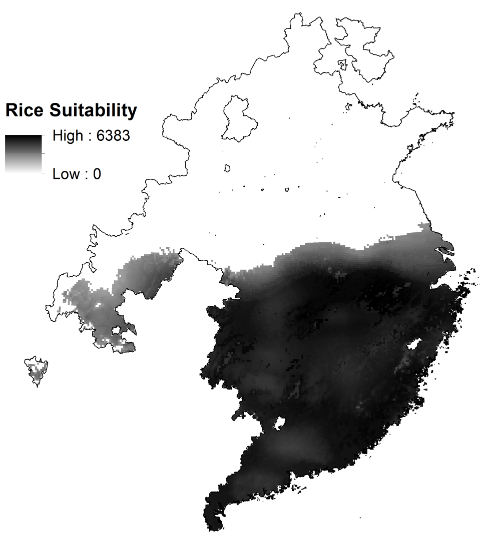
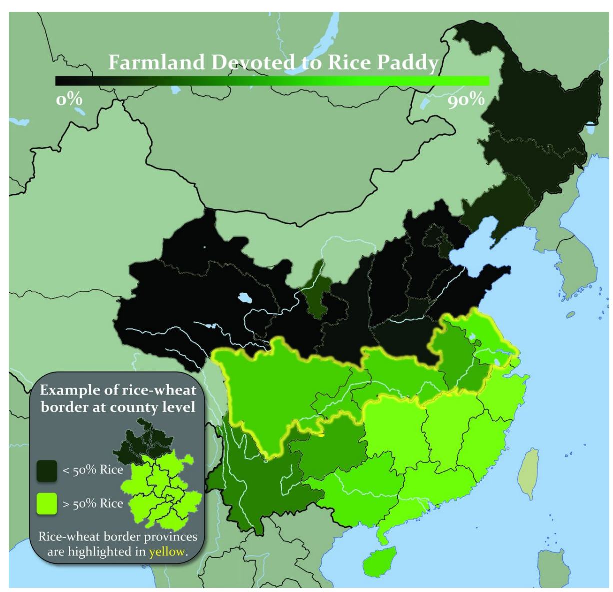


Figure A.III: Agro-Climatically Attainable Yield (kg DW/ha) for Immediate-Input-Level, Rain-Fed Tea



a: Agro-Climatically Attainable Yield (kg DW/ha) for Immediate-Input-Level, Rain-Fed Wetland Rice



b: Farm Land Devoted to Rice Paddy. Source: **talhelm14**

Figure A.IV: Rice Cultivation

Table A.I: Summary Statistics: County-Level Analysis

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Sex ratio at birth	118.306	13.956	91.622	193.16	1622
Cotton textiles (1300-1840)	0.467	0.499	0	1	1622
Log share of ethnic minorities	-0.925	1.49	-4.605	4.544	1620
Log per capita GDP	9.102	0.74	6.251	12.073	1528
Log share of agriculture workforce	-0.925	1.49	-4.605	4.544	1620
Log share of service workforce	2.838	0.637	0.940	4.572	1622
Log share of urban household registration	2.939	0.766	1.105	4.554	1622
Log share of urban population	-1.243	0.816	-4.443	0	1622
Men's years of schooling	8.279	0.979	6.09	12.49	1622
Provincial capital	0.119	0.324	0	1	1621
Governance status:					
Governed by the prefecture-city government	0.309	0.462	0	1	1622
Self-governed	0.539	0.499	0	1	1622
Governed by the provincial government	0.152	0.359	0	1	1622
Treaty port	0.136	0.343	0	1	1622
Agricultural suitability	4.789	2.071	1	8	1585
On the Grand Canal or Yangtze	0.091	0.287	0	1	1622
Log population density in 1300	3.476	1.194	-0.432	6.645	1603
Log (ruggedness+1)	1.144	0.797	0.078	3.083	1622
Log distance to coast	5.329	1.398	0.083	7.07	1615
Latitude	31.962	4.632	20.42	43.728	1622
Longitude	114.494	4.338	101.584	125.414	1622
Humidity-for-weaving index, daytime	6.743	2.889	3.379	15.124	1612
Humidity-for-weaving index, full-day	8.079	3.864	3.548	23.428	1618
Humidity-for-weaving index, full-day, 80%	19.743	17.784	4.508	270.27	1618
Log distance to Suzhou	6.272	0.616	2.82	7.433	1622
Yangtze Delta	0.054	0.225	0	1	1622
Net in_migration	0.021	0.314	-0.293	4.733	1621
Sex ratio, aged 5-9	114.577	9.797	95.035	165.582	1622
Sex ratio, aged 1-4	121.076	16.147	91.655	204.068	1622
Women's years of schooling	7.189	1.13	4.48	11.28	1622
Men's years of schooling	8.279	0.979	6.09	12.49	1622
Years of schooling	7.748	1.038	5.520	11.85	1622
Cotton suitability	408.127	198.45	0	768	1600
Rice suitability	2555.093	2695.73	0	6326	1600
Rice suitability, binary	0.489	0.5	0	1	1600
Tea suitability	83.5	130.101	0	287	1600
Tea suitability, binary	0.292	0.455	0	1	1600
All textiles	0.773	0.419	0	1	1622
Log (commercial tax quota+1)	2.51	3.715	0	10.837	1622
#courier routes	0.434	0.836	0	6	1622
Log (#textile companies+1)	2.829	1.659	0	7.87	1622
Plough	0.848	0.359	0	1	1622
Late Neolithic settlements	0.651	0.477	0	1	1622
Early Neolithic settlements	0.517	0.5	0	1	1622
Fraction in slit (%)	33.289	10.175	0	50	1589

Fraction in clay (%)	23.055	8.779	0	49.316	1589
Soil texture:					
Clayey soil	0.195	0.397	0	1	1566
Loamy soil	0.680	0.467	0	1	1566
Sandy soil	0.125	0.33	0	1	1566
Language group:					
Mandarin supergroup	0.562	0.496	0	1	1622
Jin group	0.099	0.298	0	1	1622
Wu group	0.092	0.29	0	1	1622
Gan group	0.065	0.247	0	1	1622
Xiang group	0.037	0.189	0	1	1622
Min supergroup	0.061	0.239	0	1	1622
Yue group	0.041	0.199	0	1	1622
Hakka group	0.033	0.178	0	1	1622
Hui group	0.008	0.089	0	1	1622
Residual	0.002	0.043	0	1	1622
#county-level gazeteers	0.834	1.058	0	7	1622
Log (communicants per 10,000+1)	1.558	1.099	0	5.254	1054
Coastal	0.168	0.374	0	1	1615

Table A.II: Summary Statistics: 1982 Census

Variable	Mean	Std. Dev.	Min.	Max.
Cotton textiles (1300-1840)	0.47	0.486	0	1
Cotton textiles (1300-1840), binary	0.476	0.499	0	1
Wife	0.059	0.236	0	1
Family size	4.216	1.491	1	20
Age group:				
0 to 4	0	0	0	0
5 to 9	0	0	0	0
10 to 14	0	0	0	0
15 to 19	0.001	0.031	0	1
20 to 24	0.05	0.217	0	1
25 to 29	0.135	0.342	0	1
30 to 34	0.144	0.351	0	1
35 to 39	0.164	0.37	0	1
40 to 44	0.124	0.329	0	1
45 to 49	0.094	0.292	0	1
50 to 54	0.087	0.282	0	1
55 to 59	0.076	0.266	0	1
60 to 64	0.057	0.231	0	1
65 to 69	0.037	0.19	0	1
70 to 74	0.019	0.138	0	1
75 to 79	0.008	0.091	0	1
80+	0.003	0.055	0	1
Education attainment:				
Less than primary completed	0.275	0.447	0	1
Primary completed	0.59	0.492	0	1
Secondary completed	0.128	0.334	0	1
University completed	0.007	0.086	0	1
Occupation:				
Legislators, senior officials and managers	0.033	0.18	0	1
Professionals	0.015	0.121	0	1
Technicians and associate professionals	0.039	0.193	0	1
Clerks	0.027	0.163	0	1
Service workers and shop and market sales	0.027	0.161	0	1
Skilled agricultural and fishery workers	0.624	0.484	0	1
Crafts and related trades workers	0.1	0.3	0	1
Plant and machine operators and assemblers	0.033	0.179	0	1
Elementary occupations	0.02	0.139	0	1
Other occupations, unspecified or n.e.c.	0	0.015	0	1
NIU (not in Universe)	0.081	0.273	0	1
Migration status (5 years):				
Same major, same minor administrative unit	0.985	0.121	0	1
Same major, different minor administrative unit	0.01	0.099	0	1
Different major administrative unit	0.005	0.069	0	1
Abroad	0	0.004	0	1
Prefecture-level characteristics:				
Log share of ethnic population	0.404	0.511	0	2.368
Log per capita GDP	7.385	0.441	6.472	9.622
Log share of agricultural work force	4.225	0.284	2.317	4.519

Log share of urban population	2.808	0.475	1.912	4.104
Provincial capital	0.124	0.33	0	1
Prefecture-level city	0.71	0.454	0	1
Prefecture or league	0.29	0.454	0	1
Treaty port	0.188	0.391	0	1
Agricultural suitability	-3.829	1.696	-7	-1
On the Grand Canal or Yangtze	0.343	0.475	0	1
Log(1+ruggedness)	1.242	0.758	0.091	2.854
Log distance to coast	5.212	1.282	0.822	7.056
Log population density in 1600	4.07	0.772	2.167	5.669
Latitude	115.457	4.279	101.732	121.426
Longitude	31.734	3.928	21.845	40.712

Notes: Ths table provides summary statistics on 701,263 individuals in 88 prefectures.

Table A.III: Summary Statistics: Widow Suicide

Variable	Mean	Std. Dev.	Min.	Max.	N
Cotton textiles (1300-1840)	0.587	0.476	0	1	32
Widow suicide	0.5	0.718	0	2	32
Chaste widow	4.172	4.559	0	17	32
Log(dist. to Qufu)	6.327	0.645	4.305	7.436	32
Agricultural suitability	4.563	2.154	2	8	32
Log (ruggedness)	3.378	2.623	0.103	8.569	32
Longitude	117.094	3.054	110.092	121.409	32
Latitude	29.667	3.004	20.862	36.588	32

Table A.IV: Summary Statistics: Female Employment in 1916

Variable	Mean	Std. Dev.	Min.	Max.	N
Province-level characteristics:					
Cotton textiles (1300-1840)	0.528	0.327	0.032	0.993	14
Log (population size)	17.832	0.369	17.173	18.321	14
Province-industry-pair characteristics:					
%female workers	0.197	0.258	0	1	170
Industry:					
Textiles—cotton	0.076	0.267	0	1	170
Textiles—linen	0.029	0.169	0	1	170
Textiles—wool	0.041	0.199	0	1	170
Textiles—knitting	0.041	0.199	0	1	170
Textiles—attire	0.065	0.247	0	1	170
Dyeing	0.076	0.267	0	1	170
Copper	0.076	0.267	0	1	170
Ceramics	0.076	0.267	0	1	170
Glass	0.076	0.267	0	1	170
Porcelain	0.076	0.267	0	1	170
Chemistry— Match	0.059	0.236	0	1	170
Chemistry—Gunpowder	0.047	0.212	0	1	170
Chemistry—Pharmaceuticals	0.041	0.199	0	1	170
Chemistry—misc	0.076	0.267	0	1	170
Food	0.071	0.257	0	1	170
Food—misc	0.071	0.257	0	1	170

B Data

B.1 Sample Construction

Contemporary China has 23 provinces and 5 autonomous regions. The autonomous regions are Guangxi, Neimenggu (Inner Mongolia), Ningxia, Xizang (Tibet) and Xinjiang. In this study, I restrict my sample to China proper. China proper includes territories within the Great Wall, under the governance of both Ming and Qing China (1368-1911). It typically refers to the "Eighteen Provinces" system of the Qing dynasty. I also do not include ethnic regions (provinces, prefectures and counties) in my sample, as many ethnic minority groups were outside of the Chinese territory or at least maintained a great degree of autonomy. There are substantial differences in laws and customs between ethnic minorities and Han Chinese. Systematic information about the history of many of those regions is unavailable.

To construct my sample I went through the following steps: (a.) locate 18 provinces within China Proper. (b.) exclude frontier provinces (Gansu, Guizhou, Shaanxi and Yunnan), (c.) exclude ethnic autonomous provinces, prefectures and counties, and (d.) exclude Beijing, the capital city of Ming, Qing and contemporary China. I do this because the population in Beijing during the Qing Dynasty was mainly composed of ethnic minorities, including the Manchu royal family and Manchu and Mongolian troops. This leaves me with a sample of 13 provinces plus Shanghai, 193 prefectures and 1,622 counties. The baseline regression uses a sample of 1,489 counties due to missing values in control variables.

B.2 Cotton Textile (1300-1840)

In collecting information on cotton textiles (1300-1840), I draw on several historical studies. A key source I use is Wang (2006). The author surveys the production of various textiles during the Ming Dynasty (1368-1644) across gazetteers composed during that period. He surveys a wide range of gazetteers to record information on all types of textiles (cotton, silk, hemp . . .), by prefecture or by county. A second source I rely on is Deng (1999), which is a compilation of all sources concerning the cotton textile market in early Qing.[59] dengyibing99 similarly relies on gazetteers for information on cotton textile production. One advantage of this particular source is that it encompasses additional areas that only began to produce cotton textiles after 1644. In contrast, late adopters are likely not represented in Wang's study given the period he focuses on. To further enhance the completeness of information on cotton textile production, I do a search among all gazetteers available on *zhongguo fangzhiku* from 1368 to 1840 for additional information on cotton textile production.

The type of data contained gazetteers imposes a few limitations: (a.) The scarcity of

[59] In the historical literature on regional and national markets in the Qing Dynasty, early Qing often refers to period before the Opium War (1644-1840). This is consistent with the scope of this study.

local gazetteers prior to the Ming Dynasty (1368-1644) contributes to the choice of 1368 AD as the starting point for my data collection. (b.) "Publication bias". Some places likely began to publish gazetteers much later than other places do. The frequencies with which gazetteers were published can vary from place to place too. (c.) 'Survivorship bias". For all sorts of reasons, some places might have been less able to preserve gazetteers.

My key source, Wang (2006), is based on a comprehensive survey of nearly all gazetteers first composed during the Ming period that can be found today. The near-universal coverage of historical gazetteers makes Wang (2006) a highly desirable source for this study. However, "publication bias" and "survivorship bias" likely remain given his approach. Both "publication bias" and "survivorship bias" may result in an uneven distribution of gazetteers by time and space.

To mitigate "publication bias", I refrain from exploiting the timing or intensity of cotton textile production when constructing my treatment variable. Instead, I use a binary variable to indicate whether or not a location ever had any cotton textile production prior to 1840. By coding cotton textiles (1300-1840) as an indicator variable, my estimates are less affected by the timing of the first gazetteer, or by the frequencies of gazetteers being published. Provided that no gazetteer was published in a prefecture until 1800, but cotton textile production appeared far before 1800, using a binary variable for cotton textiles (1300-1840) will minimize the bias that may be generated by trying to use the timing of the first record or the total number of records on cotton textiles. If production was not reversed, a gazetteer in later years would adequately reflect the historical presence of cotton textile production. A likely exception is Fujian Province. Fujian is a coastal province that is rugged and mountainous. It relied heavily on ocean trade. While the cotton textile industry thrived in earlier times, cotton textiles became less common in Fujian after the Ming Dynasty, after the suspension of sea-based trade.

A similar logic applies to "survivorship bias". Gazetteers published in later years were more likely to have survived. For earlier years, some places were exposed to more negative shocks, or less equipped to cope with shocks, and hence, have fewer historical gazetteers preserved. By discarding the timing dimension, I can reduce "survivorship bias". Although my current coding methods already minimize possible biases due to the use of gazetteer sources, it does not remove the bias. If frequencies of gazetteers are both correlated with the cotton revolution and cultural beliefs about women, my estimates can be biased. In Appendix E.4, I show results based on different samples of counties with varying frequencies of gazetteers.

B.3 Linking the Past to the Present

I first identify locations of historical prefectures and counties. A general rule I employ is to use the historical location of a prefecture most closely aligned with the period mentioned in the source. Time-series maps showing the evolution of prefectural boundaries are available for parts of China, but not for the entirety of it. Year 1820 is the first year in CHGIS where information on boundaries are known for all prefectures. For my main source—a source based on gazetteers composed during the Ming Dynasty—I use the portion of time-series maps corresponding with the Ming period wherever possible. For prefectures for which there are not adequate time-series maps, I use the map for historical boundaries in 1820 instead. By doing so, I can account for historical boundary changes to the greatest extent without losing observations. For information extracted from Deng (1999), I match them to the portion of time-series maps corresponding with the early Qing period; when a match is not found, I use the map for year 1820 instead.[60] For information found in other sources, I use their historical boundaries for the most relevant time period. In the event a match is not found, boundaries in 1820 will be used by default. Figure A.V shows historical locations of cotton textile production derived from prefecture- and county-level sources.

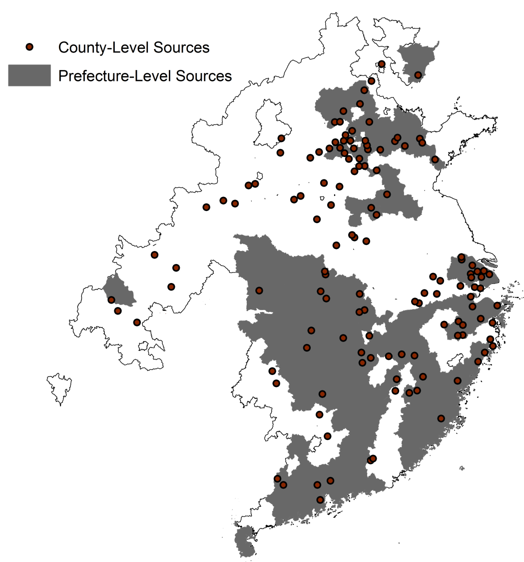


Figure A.V: Cotton Textiles (1300-1840):
County- and Prefecture-Level Sources

Counties in China enjoyed a great degree of political autonomy (Qu, 2003, pp.11-15, 179–201, 248–255). This was conducive to the formation of an independent tradition. Such

[60] The Early Qing, as a time period, has no precise cutoffs for timing. In this study, I use 1644-1700 as the time period.

autonomous counties also had relatively stable boundaries. Given those features of county and county boundaries, with regard to county-level sources, I match a historical county to its modern descendant.

In comparison, prefecture boundaries evolved over time. An important source of time-varying changes in prefecture boundaries is that specific counties governed by a prefecture-level government tend to change. It was and is still common for a prefecture to be assigned new counties or to be disassociated with existing counties every now and then. Given the transient nature of the governing territory of a prefecture, an "area size" rule is applied to linking past prefectures to modern counties. If a historical prefecture takes the value of one, one is assigned to the entire geographic area. The value of cotton textiles (1300-1840) for a modern administrative unit depends on the percentage of area associated with cotton textile production. One is assigned to counties with more than half of their area overlapping with a historical prefecture that had cotton textile production, and zero to counties with less than half or none of their area ever exposed to cotton textile production. This method could produce non-independent observations within a historical prefecture. I address the problem by clustering at the historical prefecture level in Table A.VI.

In the baseline analysis, I link historical counties to modern counties in 2000 and map historical prefectures into modern counties by area size. From the 1980s onwards, central and provincial governments began to create prefecture-level cities. Each of those cities contain several districts. Due to their lack of historical significance, and the geographic size of each district being small, I assign the same value to all districts within the prefecture-level city for my main explanatory variable. This could produce a cluster of non-independent observations within a central district. I address the problem by clustering at the central district level in Table A.VI.

In Section VI.B, I map historical counties and prefectures into prefectures in 1990 by area size. My preferred variable form is a binary variable where a prefecture with more than half of the land exposed to cotton textile production takes the value of one, and zero otherwise. But for robustness, I also construct a continuous variable based on the percentage of land being exposed to cotton textile production. In Section VI.C, I also link historical counties and prefectures to the province level by area size. Results are robust to using population-weighted measures of cotton textiles (1300-1840).

B.4 Control Variables

Socioeconomic Macroregions Socioeconomic macroregions as defined by G. Skinner, Henderson, and Berman (2013) comprise historically relatively autonomous regions. Those macroregions are not a simple addition of provinces. This is evident in Figure A.VI, where macroregions bisect provincial boundaries in several instances. Skinner argues that China was neither a single national economic system, nor a set of separate provincial economies, but rather, consisted of a number of macroregions of trade, commerce, and population activity. He also emphasizes the social and cultural consequences of these regional patterns of trade and commerce.

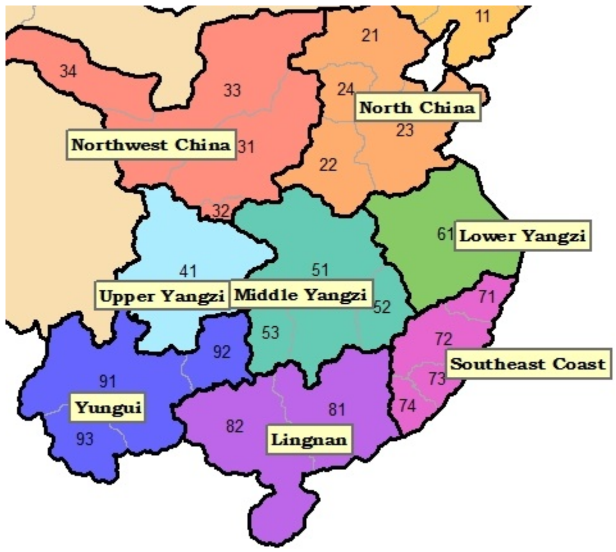


Figure A.VI: Socioeconomic Macroregions
Source: G. Skinner, Henderson, and Berman (2013, p.215)

The Grand Canal Water transport played an important role in the premodern world. The Grand Canal and the Yangtze River formed the major trade network in premodern China. Women were able to derive a high income from cotton textile production because they were able to sell cotton textiles to non-local markets (Please see Section III). But this is a desirable for all tradable goods. To account for the economic benefit of being close to the major trade network, I control for whether a county is by the Grand Canal or the Yangtze River.

The Grand Canal was first established in the Sui Dynasty (581-618 AD). Due to congestion in the river bed and the impact of natural disaster, the course of the canal changed in small ways over the centuries. In comparison to under previous dynasties, the Grand Canal was very well-maintained during the Ming Dynasty. This may be due to the need to transport tribute cloth to Beijing. To avoid potential endogeneity, I use the course of the Grand Canal in the previous Yuan Dynasty (pre-1368).

Treaty Ports Treaty ports are highly correlated with early industrialization, modernization and Western influence. Treaty ports were established after 1840 in four waves. Jia (2014) finds a long-lasting impact of treaty ports established in the 19th century on economic growth in contemporary China. To account for the possible effects of treaty ports on China's economic growth, local institutions and cultural values, I add a dummy to account for the the impact of treaty ports. Following Jia (2014)'s approach, I assign one to the modern descendant of the historical prefecture where a treaty port was created.

Communicants in Early 20th Century Christianity and traditional Chinese religions differ in their emphasis on the value of human life. As described in Appendix C, infanticide became illegal in the Christianized Roman Empire as early as the fourth century. From the 19th century to the first half of the 20th century, China saw an expansion of Christianity. To capture the effects of Christianity on the intensity of sex selection, I include the number of communicants per 10,000 as a control. Data are taken from Stauffer et al. (1922), the same source as used in Bai and Kung (2014).

Pre-1300 Commercial Networks Song China (960-1279) is known to have had a vibrant commercial economy. According to Bao's (2001) estimates, commercial taxes in 1077 made up 13.9% of the state revenues. Data on commercial taxes for the year of 1077, at a county level, are recorded in *Song huiyao jigao* (Song, 1957), and have been digitized by Peter Bol (CHGIS, 2007). Despite continuing debates on those data, scholars have used the data to study Song trade patterns and regional variance in trade, as well as measure the size of the market in preindustrial China (Balazs, 1960; Perkins et al., 1969). For a survey on the literature on trade in the Eleventh Century, please see W. G. Liu (2015, Chapter 4).

Historical Courier Routes Imperial China had a system of courier routes and courier stops. Conveyors and messengers, who were typically state employees, used those routes to deliver urgent news (Yang, B. Huang, and Cheng, 2006). G.W. Skinner and Zumou Yue complied spatial information for imperial courier routes and courier stops in the Late Qing (1800-1893). Those data are available at the G.W. Skinner Data Archive. http://www.gis.harvard.edu/services/products/gis-data-portals/g-w-skinner-data-archive.

C Sex Ratio at Birth in 2000

C.1 Sex Selection

Two forms of sex selection exist: prenatal and postnatal sex selection. A predecessor to present-day prenatal sex selection is female infanticide—a form of postnatal sex selection. Both forms of sex selection are linked to gender bias. According to the Encyclopedia of Death and Dying, "Female infanticide is a problem rooted in a culture of sexism throughout antiquity" (Howarth and Leaman, 2003).

Historically, in some parts of the world, infanticide was prohibited. In the Roman Empire, infanticide was punishable by the death penalty by the end of the 4th century, and it was illegal for parents to fail to provide for their offspring. In other parts of the world, attitudes towards infanticide are more fluid. Infanticide was sometimes justified under the belief that newborns were not full humans (Howarth and Leaman, 2003). In the latter case, as was true in much of Asia, female infanticide was often common. When sex-selection technology became readily available, prenatal sex selection superseded infanticide. Son preference began to manifest itself in prenatal sex selection.

Lin, J.-T. Liu, and Qian (2014) and Hu and Schlosser (2015) find evidence that prenatal and postnatal selection are substitutes. Postnatal sex selection includes the neglect of girls and the sex-biased allocation of household resources. Instead of discriminating against females in different stages of their life, prenatal sex selection discriminates against females in a way that makes no future discrimination possible. In the case of prenatal sex selection, the manifestation of cultural beliefs about women's worth is highly concentrated in this one-time action. This study takes advantage the one-time feature of pre-natal selection, and argues that it is a likely better measure of underlying cultural beliefs about women's worth.

C.2 The One-Child Policy

The one-child policy in China was introduced in 1979 and abolished in 2015.[61] As the state imposed a limit on family size, China shifted towards a low-fertility regime from the 1980s onwards. The effects of lowering fertility on sex ratio are well-documented. (Das Gupta and Mari Bhat, 1997) illustrates the relationship between fertility decline and increased manifestation of sex bias in India. If a couple wishes to have six children, there is a 99% chance they will get at least one son, but if they want only two children, this chance is merely 76%. The lower chance to have a son naturally increases the likelihood of sex selection. This relationship produces a confounder in estimating sex bias from sex ratio at birth. Progressive norms, which would otherwise be correlated with lower sex bias, can appear to be positively correlated with sex selection by lowering fertility. The one-child policy lowered fertility to the same level for every Chinese, conditional on their urban/rural status and ethnicity. The usual channel from differential fertility to varying manifestation of sex bias is therefore blocked.

The one-child policy applied to the entire Han Chinese population, but with some variation. The main policy variation was based on *hukou* (household registration status). Urban *hukou* corresponded with a strict form of the one-child policy, whereby each couple was only allowed to have one child. Rural *hukou* corresponded with a weak form of the one-child policy, whereby a second child was permitted under certain circumstances, such as when the first child was a girl. I control for share of urban *hukou* in my baseline specification to account

[61] The one-child policy was discontinued on October 29, 2015. http://www.bbc.com/news/world-asia-34665539

for this policy variation.

This is not to say there was no further heterogeneity in the one-child policy. During the entire period the one-child policy was in place, the enforcement in rural China was highly variable in 1980, and became more uniformly restrictive in 1990s. In urban China, the policy was strictly enforced from 1980 onwards, but began to adapt and evolve after 2000. Couples who were both only-child themselves, for example, were allowed to have two children instead of one. The policy was at its most stable and uniform from the 1990s to early 2000s. By focusing on the census year 2000, I can minimize exposure to the heterogeneous enforcement of the one-child policy.

C.3 Ultrasound Screening

The widespread use of fetal ultrasound began in the 1970s. Ultrasound imaging can be used to identify the gender of the fetus. Countries like China and India saw worsening sex ratios at birth with the diffusion of ultrasound technology. By identifying variation in access to ultrasound technology, Chen, H. Li, and Meng (2013) estimates that prenatal sex selection is responsible for 40% to 50% of the increase in sex imbalances at birth in China during the 1980s. (Anukriti, Bhalotra, and Tam, 2015) similarly documents the role of ultrasound technology in the substitution of postnatal discrimination with prenatal sex selection.

In China, ultrasound scanners came into use at hospitals and clinics from the early 1980s. The number of scanners available at each county, however, remained small. By 1987, an average county only had six scanners, for over half a million people. The tipping point occurred in early 1990s, from which point scanners came to be produced domestically at a much lower cost—the equivalent of four additional machines per year for each county. This dramatically improved the coverage of ultrasound technology and lowered the cost for prenatal sex selection.

As the ability to conduct prenatal sex selection depends on access to prenatal sex determination technologies, differential access to ultrasound screening can bias my estimates if there is a correlation between cotton textiles (1300-1840) and local access to ultrasound scanners. Almond, H. Li, and Zhang (Forthcoming), for instance, shows that in the 1980s, proximity to provincial hospitals predicted access to ultrasound scanners. However, this is not a major concern for my study, since I only look at sex ratio at birth after the period of rapid expansion in ultrasound technology. According to Chu (2001) and Chen, H. Li, and Meng (2013), by the mid-1990s, "all county hospitals and clinics, and most township clinics and family planning services, were equipped with ultrasound devices that could be used for prenatal sex identification".

D Instrumental Variable Strategy

D.1 Humidity-for-Weaving Index

To derive an exogenous source of variation in cotton textiles (1300-1840), I use a Humidity-for-Weaving Index to proxy suitability for spinning and weaving. A number of studies have been conducted to estimate optimal suitability for cotton weaving. Most of the estimates fall between 60% and 85% RH. . Iqbal et al. (2012) tests the effect of relative humidity on the tensile properties of different fibers and shows that for cotton, the gain from higher humidity continues until at least 85% (Figure A.VII). Stamper and Koral (1979) lists two sources regarding suitable ranges of relative humidity in cotton weaving: one is 70%-80%; the other, 70%-85%. Cotton spinning can be done with slightly less moisture in the fiber. A relative humidity of 60 to 70% is still required based on Stamper and Koral (1979).

I take the fellowing steps to construct the Humidity-for-Weaving Index. As the first step, I back out daytime humidity from full-day humidity. NOAA has data on relative humidity from 1980 to 2010 at a frequency of four times a day, and day by day. Data, however, are at a low resolution (2.5 degree by 2.5 degree, or roughly, 250km by 250km grid cells). For full-day relative humidity at a monthly level, I have data on a resolution of 5 arc-minute (10km by 10km). To make full use of both data sources, I extrapolate relative humidity at each coordinate pair to the nearby area with a radius of 250km. I then take the mean of relative humidity measured at 6am, 12pm and 6pm and convert it into a daytime humidity measure, calculate the ratio of daytime humidity to full-day humidity, and multiply its monthly mean with average full-day relative humidity at the monthly level. As the high-resolution relative humidity data are only available at the monthly level, I take the monthly mean of daytime-to-full-day ratios that are available at the daily level. I use this full-day relative humidity measure and multiply it by the monthly mean of ratios of daytime humidity to full-day humidity to obtain a measure of daytime relative humidity.

Secondly, I use the following equation to compute the distance between actual (daytime) humidity and optimal humidity for spinning and weaving month by month. For each county, if relative humidity equals or exceeds 85%, a value of zero is assigned. As air becomes drier, a higher value is assigned to denote the longer distance between the actual humidity and optimal humidity. A less suitable county should get a higher value due to longer distances to optimal humidity for spinning and weaving. The maximum value for a county to receive for a particular month is 25. This is based on the knowledge that spinning and weaving cannot be performed normally when relative humidity is below 60%. Results are robust to setting cutoffs just above or below 60% and 85% (Appendix D.3).

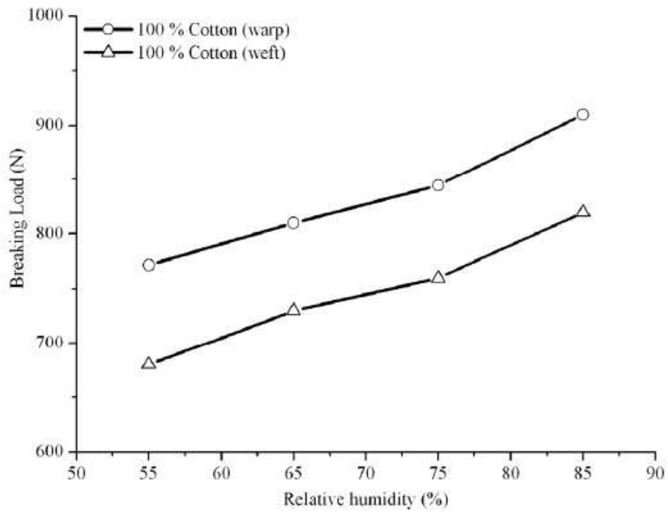


Figure A.VII: Tensile Strength of Cotton at Different Relative Humidity Values.
Source: Iqbal et al. (2012)

$$\text{Distance to Optimal RH} = \begin{cases} 25\% & \text{if RH} \leq 60\% \\ \text{RH} - 60\% & \text{if } 60\% < \text{RH} < 85\% \\ 0\% & \text{if RH} \geq 85\% \end{cases}$$

Thirdly I aggregate monthly values over twelves months at a county level. Lastly, I take the inverse of the total aggregated value to construct my Humidity-for-Weaving Index and multiply it by 1000. [62]

D.2 Access to the National Market

The incomes of cotton textile producers were dependent on their ability to sell for output in the marketplace. Proximity to the market and lower transportation costs played an important role in enabling cotton textile producers to realize their productivity in terms of higher incomes. There were both regional and national markets. Although it is debatable whether China had a well-integrated national market, and how important the national market was compared to regional markets, it was still beneficial to be be able to access the national market. Higher transportation costs and other barriers to accessing the national market could therefore lower the likelihood of cotton textile production.

The city of Suzhou was the center of the national market (Fun, 1993). Figure A.VIII illustrates the structure of the national market in Qing China. Fun (1993) uses concentric

[62]This assumes being close to optimal humidity is particularly valuable, which is consistent with industrial research on this topic.

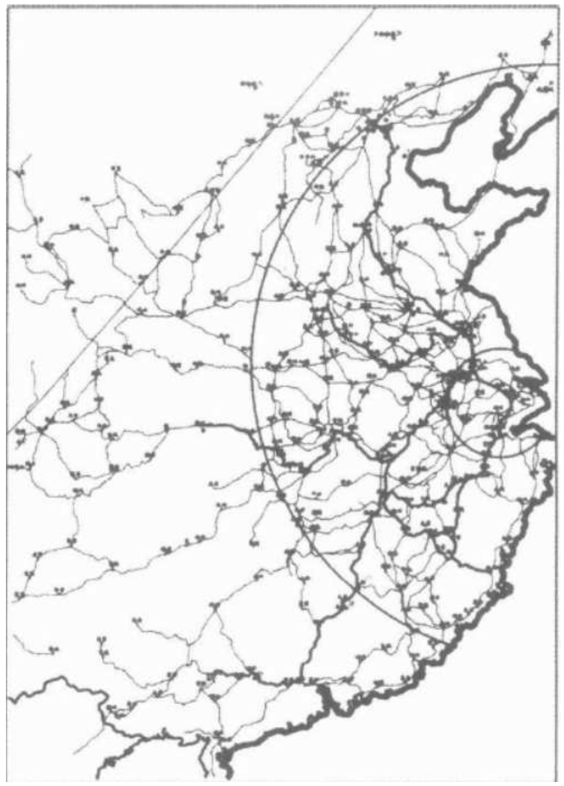


Figure A.VIII: National Market in Late Imperial China.
Source: Fun, 1993

circles to make the point that counties farther away from Suzhou were less integrated into the national market. While the distance to the center of itself might be correlated with various economic and social indicators, the interaction term between the distance measure and the relative humidity index is plausibly exogenous.

I compute the distance between Suzhou and each county, and interact it with the Humidity-for-Weaving index. I take the natural log of the inverse of the Humidity-for-Weaving Index. Suitability should decrease as the inverse of the index increases. As the greater distance from Suzhou, and the greater the distance from optimal humidity, the less likely it should be that a county gets cotton textile production. With the assumption that proximity and suitability are complementary, the interaction term should be negatively correlated with cotton textiles (1300-1840).

D.3 Alternative Humidity-for-Weaving Indices

In my main Humidity-for-Weaving Index, I construct the variable to reflect the higher importance of daytime relative humidity in cotton textile production weaving. One concern is how realistic the assumption is that only daytime relative humidity matters. Textile producers in premodern China are known to be industrious. Historical records suggest some women

Table A.V: Instrumental Variable Analysis: Allternative Humidity-for-Weaving Indices

	(1) Default	(2) Full-day	(3) 80%	(4) Full-day, 80%
	Panel A: 2SLS Dependent variable: sex ratio at birth			
Mean of Dep. Var.	118.7	118.7	118.7	118.7
Cotton textiles (1300-1840)	-6.368**	-7.723**	-6.211**	-9.565***
	(3.197)	(3.497)	(3.086)	(3.461)
Adjusted R^2	0.360	0.353	0.360	0.341
Cotton textiles (1300-1840)	Dependent variable: cotton textiles (1300-1840)			
Humidity-for-weaving	0.255***	0.094***	0.077***	0.019***
	(0.553)	(0.033)	(0.015)	(0.006)
Pseudo R^2	0.417	0.401	0.421	0.412
Baseline controls	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Socioeconomic Macroregion FE	Yes	Yes	Yes	Yes
Observations	1467	1467	1467	1467

Notes: The table reports IV estimates with alternative humidity-for-weaving indices. The unit of observation is a county in the 2000 Census. The dependent variable is sex ratio at birth. First-stage (Probit) and third-stage (2SLS) results are summarized in the table. The second stage is to calculate the predicted probability of premodern cotton textile production. Baseline controls are the same as in column 3 of Table I. First-stage Kleibergen-Paap F-statistics are reported. Robust standard errors are included in all specifications . Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

worked at night as well as during the day. In addition, cotton fibers are hygroscopic. They are able to absorb water vapor from a moist atmosphere and release it in a dry atmosphere. Such properties of cotton fibers suggest that a moist atmosphere at nighttimes might have better prepared cotton yarns for next-day production. To account for the difference made by nighttime relative humidity, I use full-day relative humidity in replace of daytime humidity in constructing my Humidity-for-Weaving Index.

Another aspect of the Humidity-for-Weaving Index is the cutoff point beyond which increasing relative humidity ceases to contribute to the quantity and quality of cotton textile production. The cutoff point can be be 85% or 80%, depending on the sources (Stamper and Koral, 1979). I use 85% in the main analysis, but there is a chance that 80% is a more relevant cutoff. I experiment with a 80% relative humidity cutoff and show results in Table A.V. Daytime relative humidity is used in this exercise to be consistent with the baseline IV estimation.

Table A.V summarizes results use the above two alternative Humidity-for-Weaving indices. IV estimates remain similar to baseline IV estimates, whether I use the Humidity-for-Weaving Index (columns 1 and 2), or use the interaction term between the Humidity-for-

Table A.VI: Clustering at the Socioeconomic Macroregion, province, prefecture and prefecture-level city level.

	Dependent variable: sex ratio at birth in 2000					
	(1)	(2)	(3)	(4)	(5)	(6)
Mean of Dep. Var.	118.6	118.6	118.6	118.6	118.6	118.6
Cotton textiles (1300-1840)	-3.762*	-3.762***	-3.753**	-3.753*	-3.753***	-3.753***
Historical controls	Yes	Yes	Yes	Yes	Yes	Yes
Geographic controls	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Socioeconomic macroregion FE	Yes	Yes	Yes	Yes	Yes	Yes
#clusters	8	8	15	15	187	1304
Observations	1489	1489	1489	1489	1489	1489
Adjusted R^2	0.369	0.369	0.368	0.368	0.368	0.368

Notes: The table reports the impact of cotton textiles (1300-1840) on sex ratio imbalances with standard errors being clustered at different geographic levels. The unit of observation is a county in 2000 Census. The dependent variable is sex ratio at birth. In columns 1 and 2, standard errors are clustered at the socioeconomic macroregion level. Columns 3 and 4 cluster standard errors at the province level. Column 5 clusters at the prefecture level. Column 6 clusters at the prefectual-level city level or county level. Columns 1, 3, 5 & 6 report robust standard errors not adjusted by the number of clusters. Columns 2 and 4 account for the number of clusters and report p-values based on the empirical distribution of t-statistics using a wild cluster bootstrap-t procedure. P-avlues are 0.004 and 0.084 for column 2 and column 4 respectively. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Weaving Index (inverse) and the natural log of distance to Suzhou (columns 3 and 4).

E Additional Empirical Results

E.1 Clustering at the Socioeconomic Macroregion, Province, Prefecture and Prefecture-Level City Level

As described in Appendix B.2, I assign the same value for cotton textiles (1300-1840) to all districts inside of a prefecture-level city. To deal with correlations between those observations, in column 6, I cluster standard errors at the county- and prefecture-city level. In case there are other types of correlations between observations at a higher geographic level, I also cluster the standard errors at prefecture level (column 5), province level (columns 3 and 4) and socioeconomic macroregion level (columns 1 and 2).

A wild cluster bootstrap-t procedure can be used to improve inferences with clustered errors in cases where only a small number of clusters are present, i.e. clustering at the level of socioeconomic macroregion (eight clusters) or province (fifteen clusters). Cameron, Gelbach, and Miller (2008) show that this procedure performs quite well even when the number of clusters is as few as six. Across the columns, I show that my results are not sensitive to at what geographic level standard errors are clustered.

Table A.VII: Selection on Observed and Unobserved Variables

Varying Controls, R_{max}=1.3$\tilde{R}$							
	Baseline Effect [R^2]		Controlled Effect [R^2]		Null Reject	δ	Identified Set
Col. 1 of Table I	-3.361	[0.156]	-3.753	[0.386]	Yes	[<0]	[-3.946, -3.753]
Col. 2 of Table I	-3.611	[0.245]	-3.753	[0.386]	Yes	[<0]	[-3.868, -3.753]
Col. 4 of Table I	-4.049	[0.331]	-3.753	[0.386]	Yes	4.165	[-3.753,-3.149]
Col. 5 of Table I	-3.887	[0.322]	-3.753	[0.386]	Yes	10.041	[-3.753,-3.552]
Col. 6 of Table I	-4.067	[0.303]	-3.753	[0.386]	Yes	5.723	[-3.753,-3.326]

Notes: The table estimates the degree of selection on unobservables that is required to explain away the effects of premodern cotton textile production. Column 3 of Table I has the maximum number of controls."Controlled effect" refers to the estimate obtained where all controls in Column 3 of Table I are included. "Baseline effect" refers to estimates obtained when controls in more restricted sets are included. Those controls, from Row 1 to Row 5, correspond with controls included in columns 1, 2, 4, 5 & 6 of Table I. δ shows the magnitude of selection on unobservables relative to selection on observables needed to produce a treatment effect of zero under R_{max}=1.3$\tilde{R}$. Negative δ indicates a positive correlation between observables and the outcome variable, suggesting that unobservables bias my estimates towards zero (if the unobservables share covariance properties with the observables). "Identified set" shows estimated treatment effects under the assumption of equal selection on observables and unobservables.

E.2 Selection on unobservables based on selection on observables

To estimate the degree of selection on unobservables, I use the approach suggested by Altonji, Elder, and Taber (2005) and Oster (2014). The results of this analysis suggest that the ratio of selection on unobservables relative to selection on observables has to be four to ten times larger to explain away my results. Based on the reasoning outlined by Altonji, Elder, and Taber (2005) that unobservables should not be more important than observables in explaining the treatment, it is highly unlikely that unobservables are biasing my results.

Table A.VII shows δ and the range of coefficients corresponding with δ under $R_{max} = 0.5$. $R_{max} = 0.499$ is based on the cutoff suggested by Oster (2014): $R_{max} = 1.3\tilde{R}$. δ is the ratio of selection on unobservables relative to selection on observables required to produce a treatment effect of zero. The identified set of coefficients is coefficients estimated between two extreme cases: the case there is no selection on unobservables and the case the ratio of selection on unobservables relative to selection on observables is δ. In each column, I compare estimates with a full set of controls ("controlled effect") with estimates with a limited set of controls ("baseline effect"). The set of controls in each column is identical to the set of controls used in the corresponding column of Table {baseresults. In columns 1-2, the limited set of controls is socioeconomic macroregion fixed effects and socioeconomic macroregion fixed effects plus province fixed effects respectively. The R^2 moves from 0.156 to 0.386 in column 1, and from 0.245 to 0.386 in column 2, suggesting the additional observables account for a sizable share of overall variation. δ is negative in both columns, indicating that the full set of control variables has a positive correlation with the outcome variable, and a positive correlation with cotton textiles (1300-1840), in which case unobservables bias my estimates towards zero if they share covariance properties with the observables. In columns 3-5, ratio of selection on unobservables relative to selection on observables has to be two to twelve times larger to explain away my results. When the ratio of selection on unobservables is four times as large as selection on observables, the coefficient estimate is still far away from zero (-3.149), which is the case in column 3.

E.3 Matched Samples

Table A.VIII: Cotton textiles (1300-1840) and Sex Ratio Imbalances: Matching

	Dependent variable: sex ratio at birth in 2000					
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Matching estimates					
ATT	-3.381***	-4.006***	-3.901***	-4.329***	-4.541***	-5.590**
	(1.184)	(1.350)	(1.181)	(1.446)	(1.685)	(2.486)
ATE	-2.894***	-3.828***	-3.678***	-4.182***	-4.633***	-4.984**
	(1.012)	(1.226)	(1.037)	(1.330)	(1.515)	(2.272)
	Panel B: Regression estimates on matched samples					
	-2.793***	-4.283***	-4.123***	-3.900***	-4.803***	-3.143**
	(0.905)	(1.029)	(0.920)	(1.079)	(1.180)	(1.583)
Propensity score range	All	All	All	[0.1-0.9]	[0.1-0.7]	[0.3-0.7]
Caliper size	0.005	0.001	0.01	0.001	0.001	0.001
Adjusted R^2	0.499	0.468	0.490	0.485	0.518	0.594
Observations	565	426	591	394	318	201

Notes: This table reports results on matched samples. Panel A reports nonparametric matching estimates taking the difference of sex ratios at birth of a matched pair. Both average treatment effects (ATE) and average treatment effects on the treated (ATT) are provided. Bootstrapped standard errors (1000 interations) are used in all columns. Panel B reports regression estimates based on regressions run on the matched samples. Baseline controls, province FE and socioeconomic macroregion FE are included in all regressions. Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

One concern is whether counties self-selected into cotton textile production possessed certain traits that would predict today. By matching counties on their pretreatment characteristics, I can ensure counties were as comparable as possible in 1300.

I use a propensity score matching method to match counties with and without cotton textiles. Matching covariates include agricultural suitability, whether on the major trade network, population density in 1300, ruggedness, distance to coast, longitude, latitude, province and socioeconomic macroregions. In columns 1-6 of Table A.VIII, I vary matching criteria by the caliper size and the range of propensity scores. A tighter caliper is less biased but usually less precisely estimated, due to reduced sample sizes. In Panel A, I show nonparametric estimates that summarize the differences in sex ratios at birth between a county and its nearest neighbor with respect to their propensity scores. To account for the fact that propensity scores are estimated, I use bootstrapped standard errors as opposed to regular standard errors. In Panel B, I show regression estimates run on the matched samples.

On average, matching estimates are slightly larger than regression estimates based on matched samples. This could indicate the "true" effect of the cotton revolution is even larger than my OLS estimates. In columns with a tighter caliper or a narrower range of propensity scores, sample sizes are significantly smaller, but results remain highly robust. R^2 increases for columns 5-6, suggesting a better fit is achieved on a more homogeneous sample. And it is reassuring to see matching estimates are also bigger in size for those two columns.

Overall, a matching exercise indicates that selection on pretreatment characteristics is unlikely to be a threat to my identification. If anything, there seems to have been some negative selection on preexisting gender inequality, i.e. counties with more gender inequality in the counterfactural are more likely to have been positively impacted by the cotton revolution.

Table A.IX: By Gazetteer Frequency

	Dependent variable: sex ratio at birth in 2000						
	(1)	(2)	(3)	(4)	(5)	(6)	
multicolumn1c(7)							
Mean of Dep. Var.	118.0	119.1	118.0	119.0	118.6	118.6	119.2
Cotton textiles (1300-1840)	-3.891***	-3.478***	-4.208**	-3.647***	-3.646***	-3.799***	-4.077***
	(1.089)	(1.007)	(1.679)	(0.778)	(0.739)	(0.900)	(0.876)
# county-level gazetteers					-0.360	-0.465	
					(0.274)	(0.417)	
Cotton textiles (1300-1840)						0.178	
×# county-level gazetteers						(0.534)	
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Socioeconomic Macroregion FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.354	0.372	0.375	0.368	0.369	0.368	0.384
Observations	708	781	320	1388	1489	1489	1163

Notes: The table reports the impact of cotton textiles (1300-1840) on sex ratio imbalances varying by frequencies of gazetteers. The unit of observation is a county in 2000 Census. The dependent variable is sex ratio at birth. Column 1 includes counties with no county-level gazetteer. Column 2 includes counties with at least one county-level gazetteer. Column 3 includes counties with at least two county-level gazetteers. Column 4 includes counties with no more than two county-level gazetteers. In column 5 the number of county-level gazetteers is included as a control. In column 6, an interaction term between number of Cotton textiles (1300-1840) and county-level gazetteers is added. Column 7 restricts the sample to counties with identifiable sources in Wang (2006).Robust standard errors are used in all specifications. Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

E.4 Biases in Gazetteer Data

Although I control for a range of indicators for past development in the baseline regression, as well as show estimates based on the matched sample, one might still think there exists a spurious correlation between cotton textiles (1300-1840) and present-day outcomes through the intricate relationships between past development and modern development. This concern rises to higher importance given the uneven distribution of gazetteers across time and space as discussed in Appendix B.2. If the frequency of gazetteers is correlated with past development, I might be picking up a lack of economic development rather than a lack of cotton textiles in my main treatment variable.

To address this concern, I restrict my samples to counties with a varying number of gazetteers based on the gazetteer database *zhongguo fangzhi ku*. Granted that a prefecture-level gazetteer often contains ample information on a governed county, I focus on county-level gazetteers in this exercise as it is more tied to local development. Table A.IX summarizes the results.

In column 1, I restrict my sample to counties with no county-level gazetteer in the gazetteer database.[63] In columns 2-4, I includes counties with at least one county-level gazetteer, at least two county-level gazetteers, or with no more than two county-level gazetteers. The sample size changes dramatically across columns, ranging from 320 to 1388 observations. Coefficient estimates do change somewhat, but only within the range of -3.478 to -4.208.

In column 5 the number of county-level gazetteers is included as a control. In column 6, an interaction term between cotton textiles (1300-1840) and the number of county-level gazetteers is added. In both cases, coefficients of interest remain similar to baseline estimates. The interaction term is not significant. Column 7 restricts the sample to counties with a description on textile production from gazetteers in Wang (2006). Within that set, every county has known information on textile production, either from its historical equivalent, or from the historical prefecture that governed more than half of the land of the modern county. This eliminates any county coded as zero due to a lack of historical sources. With this new sample, the size of the coefficient estimate increases slightly, possibly due to the reduction of measurement errors.

E.5 Subsamples: Past Development and Modern Migration

My results are robust to other subsamples varying on the level of past or modern development as well. The Yangtze Delta was and has continued to be of special importance to Chinese economy (G. W. Skinner, 1980; B. Li and P.-C. Li, 1998). In Table A.X, I test to see

[63] To note, information on cotton textiles (1300-1840) remains possible for counties with no county-level gazetteer, as such information can usually be found in prefecture-level gazetteers.

Table A.X: The Yangtze Delta and Net In-Migration

	Dependent variable: sex ratio at birth					
	(1)	(2)	(3)	(4)	(5)	(6)
	Yangtze Delta			Net in-migration		
Mean of Dep. Var.	118.6	118.8	119.1	118.6	118.6	120.8
Cotton textiles (1300-1840)	-3.733***	-4.249**	-3.912***	-3.708***	-3.455***	-4.898***
	(0.731)	(1.709)	(0.776)	(0.730)	(0.710)	(1.094)
Yangtze Delta	-3.982***	-6.625***				
	(1.536)	(1.491)				
Cotton textiles (1300-1840) × Yangtze Delta		3.110**				
		(1.285)				
Net in-migration				-1.274*	-13.61	
				(0.705)	(8.432)	
Cotton textiles (1300-1840) × Net in_migration					12.46	
					(8.432)	
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Socioeconomic macroregion FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1489	1511	1409	1489	1489	841
Adjusted R^2	0.370	0.313	0.366	0.369	0.369	0.378

Notes: The table reports the impact of cotton textiles (1300-1840) on sex ratio at birth excluding places with high levels of past development or modern migration. The unit of observation is a county in the 2000 Census. Baseline controls are the same as in column 3 of Table I. Column 3 omits all yangtze Delta provinces. Column 6 omits all counties with positive net migration. Robust Standard errors are used in all specifications. Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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if my results are robust to the control or the omission of the Yangtze Delta. The interaction term in column 2 suggests that the effect of the cotton revolution is actually far smaller for the Yangtze Delta. This is likely due to being more gender equitable in 1300, and a higher level of development throughout the history. This is indicated by the negative and significant coefficient estimate of the Yangtze Delta dummy. In addition, I look at counties with different rates of migration. In historical China, labor was less mobile due to the long-standing clan system. From the 1990s on, the speed of migration has increased. The perception of women being inferior in the less developed regions of China could become more entrenched if more progressive individuals are more likely to move to more developed areas. Hence my results could be biased if cotton textiles (1300-1840) are correlated with unobserved characteristics of counties that are now home to migrants. For robustness, I control for net in-migration, omit counties with positive net in-migration, and control for cotton textiles (1300-1840) interacted with the extent of net in-migration. My results continue to hold when controlling for net in-migration or omitting counties with positive net in-migration, and the interaction term in column 5 is not significant.

Table A.XI: Child Sex Ratio: Age 1-4 and 5-9

	Dependent variable: sex ratio in 2000		
	(1)	(2)	(3)
	Aged 5 to 9	Age 1 to 4	At birth
Mean of Dep. Var.	114.8	121.5	118.6
Cotton textiles (1300-1840)	-2.036***	-3.031***	-3.753***
	(0.582)	(0.840)	(0.731)
Baseline controls	Yes	Yes	Yes
Province FE	Yes	Yes	Yes
Socioeconomic macroregion FE	Yes	Yes	Yes
Observations	1489	1489	1489
Adjusted R^2	0.301	0.435	0.368

Notes: The table reports the impact of cotton textiles (1300-1840) on sex ratio at birth among older cohorts. The unit of observation is a county in the 2000 Census. Baseline controls are the same as in column 3 of baseresults. Robust standard errors are included in all specifications. Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

E.6 Alternative Outcomes

Child Sex Ratio In the main analysis, I focus on sex ratio at birth in the 2000 Census. A natural question arises whether the same pattern holds for slightly older cohorts subject to similar conditions, including the strict enforcement of the one-child policy and widespread ultrasound screening, or it is just one-time phenomenon for 2000. Based on 2000, I construct two additional variables from the 2000 Census: sex ratio of individuals aged 1-4, sex ratio of individuals aged 5-9. I find in Table A.XI, coefficient estimates are of a similar percentage of the mean of the sex ratio at birth. Overall, I find that the cotton revolution predicts a less skewed sex ratio among cohorts born after 1990. From that point on, ultrasound screening became widely available. The size of the coefficient increased as sex ratio at birth rose. This is consistent with the continuing expansion of ultrasound technology and declining fertility in the 1990s. The relationship between the cotton revolution and sex ratio at birth revealed by the 2000 census is unlikely just a fluke or a mere artifact of underreporting of female newborns.[64]

Female and Male Education Table A.XII examines alternative outcomes from the same census. I find that the cotton revolution is also positively associated with female educational attainment. As gender-specific economic opportunities are already controlled for in the regression, as well as made equal under state socialism, I interpret this mainly as evidence for

[64]Underreporting happens when parents conceal the identity of newborns and leave them unregistered. A share of such female children with concealed identity will recover their identity at school age and thereafter, they will be recorded in the census. To note, underreporting, albeit not equal to sex selection, is still a reflection of differential treatment based on gender. Unregistered individuals have limited access to most public goods, such as education and medical services.

Table A.XII: Female and Male Education

	Dependent variable: years of schooling		
	(1)	(2)	(3)
	Female	Female	Male
Mean of Dep. Var.	7.141	7.141	8.236
Cotton textiles (1300-1840)	0.0695**	0.0850***	-0.0153
	(0.0303)	(0.0193)	(0.0241)
Men's years of schooling	No	Yes	No
Baseline controls	Yes	Yes	Yes
Province FE	Yes	Yes	Yes
Socioeconomic macroregion FE	Yes	Yes	Yes
Observations	1489	1489	1489
Adjusted R^2	0.822	0.941	0.842

Notes: The table reports the impact of cotton textiles (1300-1840) on women's years of schooling. The unit of observation is a county in the 2000 Census. Baseline controls are the same as in column 3 of baseresults. Column 1 include all baseline controls but men's years of schooling. Column 2 control for men's years of schooling. Column 3 uses men's years of schooling as a placebo. Robust standard errors are used in all specifications. Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

underinvestment in girls' education by their parents influenced by the perception of women being inferior. In 2000, the cotton revolution is associated with an increase of 0.0695 years of schooling for women. The coefficient estimate remains virtually the same and in fact, increases slightly to 0.085, after controlling for years of schooling (male). In column 3, I replace women's years of schooling with men's years of schooling, and I do not find a correlation. This shows that the correlation between the cotton revolution and female educational attainment is not driven by omitted variables such as a higher level of development or greater provision of schooling.

E.7 Historical and Modern Confounders

Pre-1300 Commercial Networks Prior to the cotton revolution, Song China (960-1279) had a highly developed commercial society. It is possible that economic development and commercialization could have led to both cotton textile production and gender equality. I include pre-1300 commercial tax quota in column 1 of Table A.XIII. The pre-1300 commercial tax quota have been used to proxy for the size of the market in Song China (see Appendix B.4). I find a small increase in the size of coefficient of interest. The coefficient estimate of pre-1300 commercial tax quota is insignificant. In contrast to Bertocchi and Bozzano (2015), I do not find that past commerce *per se* improved the status of women.

Historical State Presence Historically, the state played a key role in the association of women and textile production. Women's specialization in textile work was partly induced by the system of state in-kind taxes (Section III.A.2). One might suspect that there is a degree of

Table A.XIII: Historical and Modern Confounders

	Dependent variable: sex ratio at birth		
	(1)	(2)	(3)
Mean of Dep. Var.	118.6	118.6	118.6
Cotton textiles (1300-1840)	-3.770***	-3.729***	-3.695***
	(0.740)	(0.730)	(0.733)
Pre-1300 commerce	0.0257		
	(0.0960)		
# courier routes		-0.387	
		(0.369)	
Modern textile industry			-0.431
			(0.279)
Baseline controls	Yes	Yes	Yes
Province FE	Yes	Yes	Yes
Socioeconomic Macroregion FE	Yes	Yes	Yes
Adjusted R^2	0.368	0.368	0.369
Observations	1489	1489	1489

Notes: The table reports the impact of cotton textiles (1300-1840) on sex ratio at birth accounting for historical and modern confounders. The unit of observation is a county in 2000 Census. The dependent variable is sex ratio at birth. Baseline controls are those used in column 3 of I. Pre-1300 commerce is measured by log (1+commercial tax quota in 1077). # courier routes refers to number of imperial courier routes passing a county. Robust standard errors are included in all specifications. Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

persistence in state presence, and historical state presence might have influenced both cotton textiles (1300-1840) and modern state capacity. Modern state capacity can influence gender inequality.[65] I include the number of imperial courier routes through a county as a proxy for historical state presence, which is a similar idea to Acemoglu, Garca-Jimeno, and Robinson (2015). In column 2 of Table A.XIII, I find that greater historical state presence does improve relative outcomes of women, but the coefficient of interest does not change much. For the historical role of imperial courier routes, please refer to Appendix B.4.

Modern Textile Industry One possibility is that the cotton revolution could shape gender inequality through persistence in industrial composition. Equipped with modern humidification technologies, textile manufactures are no longer exclusively located in humid areas. In addition, skills developed from at-home work might be transferable to industrial production. In both cases, the cotton revolution would have a direct impact on modern textile industry. In column 3 of Table A.XIII, I include the number of textile manufacturers as a control. I find that the scale of modern textile production is negatively correlated with sex ratio at birth, but the size of the coefficient of interest falls by as 0.1 only. This suggests that the impact of the cotton revolution on sex selection is partially mediated by modern textile industry.

[65]For example, historical state presence could affect the enforcement of state policies in modern China, such as the one-child policy or the compulsory education reform launched in 1986.

E.8 Plough, Neolithic Settlements and Soil Texture

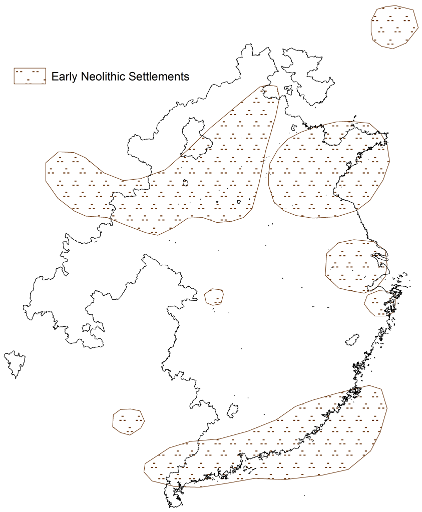
Ancestral Plough Use Alesina, Giuliano, and Nunn (2013) proposes that the plough has shaped gender roles and gender norms. In addition, the plough might have affected the production of cotton textiles by being a highly productive technology. Cotton textiles were likely to be produced in order to offset lower productivity associated with the absence of the plough. If that is true, I might be picking up the effects of not using the plough, rather than the effects of producing cotton textiles. Historically, the plough was widely used in much of China proper, but there was still some variation. Following Alesina, Giuliano, and Nunn (2013), I use a 200km radius to identify the territory of each ethnic group in the Ethnographic Atlas, and assign one to areas within the 200km radius of an ethnic group that used the plough. In column 1, I include ancestral plough use as my control. I find ancestral plough use is indeed associated with a more skewed sex ratio at birth, but that only leads to a small decrease in my coefficient of interest.

The Neolithic Revolution The intensification of agriculture is considered to have led to the deterioration of women's status (Hansen, Jensen, and Skovsgaard, 2015). *Years since the Neolithic Revolution* is often used to proxy for exposure to intensification of agriculture but is only known at the country level or above. I use Neolithic settlements to proxy for exposure to advanced agriculture. I do not find Neolithic settlements to be correlated with a more skewed sex ratio, whether settlements during the Early or Late Neolithic Period. This is likely due to the migration from Neolithic settlements to more peripheral regions over thousands of years. My coefficient of interest remains close to the baseline estimate. Data on early and late Neolithic settlements are originally produced by Chang (1963). Figure A.IX are digitized maps available at the digitized map collection of Harvard University.

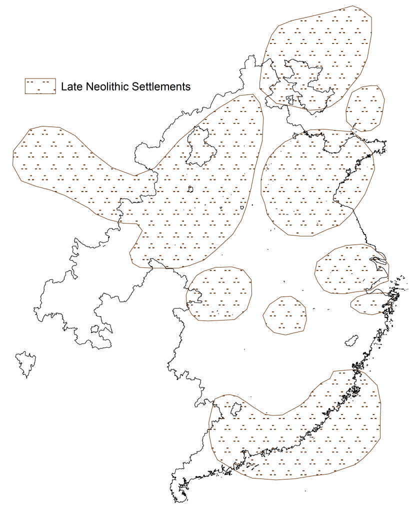
Table A.XIV: Plough, Neolithic Settlements and Soil Texture

	Dependent variable: sex ratio at birth										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Mean of Dep. Var.	118.6	118.6	118.6	118.6	118.6	118.6	118.6	118.6	118.6	118.6	118.6
Cotton textiles (1300-1840)		-3.533***		-3.691***		-3.690***		-3.632***	-3.514***	-3.158***	
		(0.732)		(0.734)		(0.731)		(0.740)	(0.740)	(0.752)	
Plough	4.614***	3.900**									
	(1.578)	(1.579)									
Early Neolithic					-1.862**	-1.660*					
					(0.937)	(0.932)					
Late Neolithic			-2.185**	-2.061**							
			(0.911)	(0.899)							
Slit%							0.00334	-0.00272			
							(0.0371)	(0.0368)			
Clay%							-0.0171	-0.00952			
							(0.0496)	(0.0487)			
Clayey									-2.040		
									(1.316)		
Loamy									-1.746		
									(1.120)		
USDA soil texture class	No	No	No	No	No	No	No	No	No	Yes	No
Language group	No	No	No	No	No	No	No	No	No	No	Yes
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Socioeconomic Macroregion FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Adjusted R^2	0.363	0.371	0.362	0.371	0.360	0.369	0.360	0.368	0.364	0.371	0.377
Observations	1489	1489	1489	1489	1489	1489	1474	1474	1458	1474	1489

Notes: The table checks the role of ancestry plough use, Neolithic settlements and soil texture. The unit of observation is a county in 2000 Census. The dependent variable is sex ratio at birth. Baseline controls are those used in column 3 of baseresults. Robust standard errors are included in all specifications. Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$



a: Early Neolithic Settlements



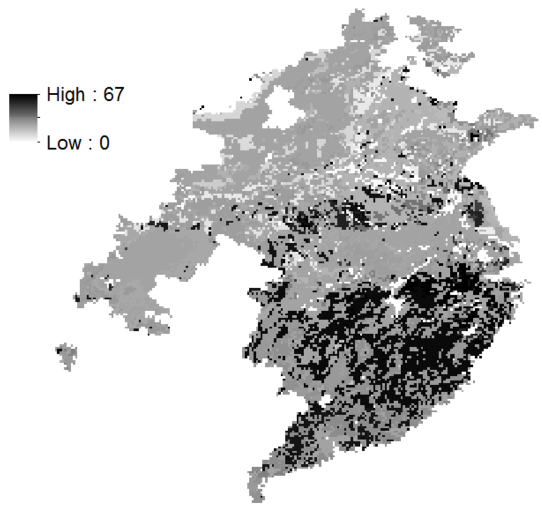
b: Late Neolithic Settlements

Figure A.IX: Neolithic Settlements

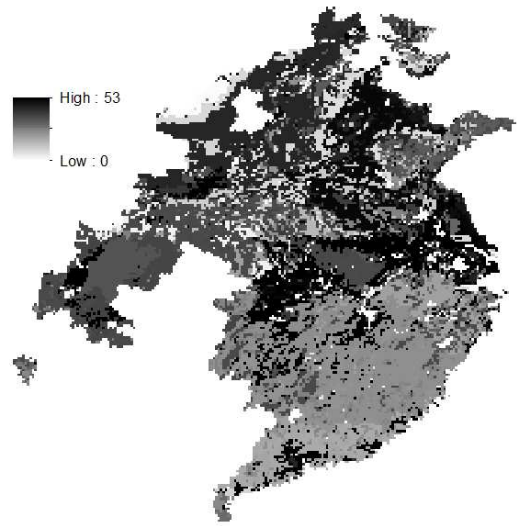
Soil Texture Carranza (2014) highlights the impact of soil texture on female infanticide in rural India. She proposes that clayey and loamy soil can affect the survival rates of girls due to differential demand for female labor. In rural China, soil texture can affect demand for female labor as well. Following Carranza (2014), I use two variables from the Harmonized World Soil Database (Nachtergaele et al., 2008)—fraction in clay and fraction in slit (loam)—to estimate the effects of clayey and loamy soils on sex ratio at birth. Data are available at a resolution of 5 arc-minute (10km*10km grid cells).

In column 7, I regress these two variables on sex ratio at birth with all controls. Following Carranza (2014), I subtract the coefficient on clay from the coefficient on slit. The magnitude of the difference is small (-0.013), which is small compared to Carranza (2014).[66] In column 8, I add my treatment variable and find the coefficient of interest to be highly similar to my baseline estimate. For robustness, I use alternative formulations of soil texture variables. I construct a categorical variable from the variable *USDA soil texture classes* to indicate clayey and loamy soils. Based on the dominant soil—the raster point that appears most frequently in a county—I link a county to a soil class defined by USDA. From Class 1 to 4, the categorical variable takes the value of one (clayey soils). From Class 5 to 9, the categorical variable takes the value of two for soils that are more loamy. The rest are sandy soils. The categorical variable take the value of three for sandy soils. I run a regression on this categorical variable

[66]One unit change in the difference between fractions in clay and fraction in slit corresponds with a reduction of sex ratio of 20 girls per 1,000 boys in Carranza (2014).



Fraction in Clay (%)



Fraction in Slit (%)

Figure A.X: Soil Texture

with all baseline controls. Column 9 suggests loamy soils are indeed associated with a slightly more skewed sex ratio, but the coefficient is small (0.294) and insignificant. In column 10, I control for soil texture using a categorical variable encompassing all twelve soil classes, which reduces my coefficient of interest somewhat (from -3.753 to -3.514). But the magnitude of the reduction is rather small and there is no change in the level of statistical significance.

The lack of correlation between soil texture and sex ratio at birth is not overly surprising. First, it is likely that soil texture only affects sex selection through the economic channel, i.e. the economic value of female labor, as emphasized in Carranza (2014). Second, a higher demand for female labor might not be sufficient to dissuade parents from choosing a boy over a girl. Even on clayey soils, men are still responsible for preparing the land; so it is unlikely that women have more economic value than men. The cultural valuation of women would still be negative had there been a cultural channel for clayey soils. Under the one-child policy, assuming away all costs and constraints, parents likely would only choose a girl if their cultural valuation of women is the same as or more positive than that of men. Indeed, China's female labor force participation was one of the highest in the world, when mass sex selection was taking place.

Common Language To further account for differences in ancestral environments and traits, I include a control for common language. Although my sample is restricted to areas historically inhabited by Han Chinese, heterogeneity consists among Han Chinese. Even though all Han Chinese are considered as one ethnic group in contemporary China, local

Table A.XV: Evidence from CGSS: Other Values

	(1) Premarital sex	(2) Same sex	(3) Science is good	(4) Generalized Trust	(5) Abortion_1	(6) Abortion_2
Mean of Dep. Var.	1.884	1.319	2.091	3.483	2.612	2.489
Cotton textiles (1300-1840)	-0.0782	0.0246	0.116	-0.00776	0.0632	-0.0362
	(0.0740)	(0.0429)	(0.101)	(0.0617)	(0.107)	(0.0977)
Contemporary controls	Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes				
Socioeconomic Macroregion FE	Yes	Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes				
Adjusted R^2	0.0552	0.0218	0.0248	0.0193	0.0280	0.0316
Observations	6436	6412	1938	6465	1996	2030

Standard errors in parentheses
$^{+}$ $p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table reports the correlations between the cotton revolution and other values in CGSS 2010. The unit of observation is a survey respondent in CGSS 2010 (Chinese General Social Surveys). Surveys questions are: "Is it right to have premarital sex?"; "Is it homosexual sex right?"; "Overall, science has benefited us"; "Most people can be trusted". Abortion_1 and Abortion_2 are two different questions about attitudes towards abortion: "Do you think abortio is right or wrong? What if the family is poor?" "Do you think abortion is right or wrong? What if the fetus has birth defects?". Responses range from 1 to 5 (always right - absolutely right). Contemporary controls are the same as in column 3 of Table I. Standard errors are clustered at the county level. Standard errors in parentheses $+p < 0.15$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

languages among Han Chinese often vary. In anthropology, shared language is usually an important indicator for ethnic identity, which implies the local language spoken in a specific county could provide important information about the ancestral traits of the local population. By adding language fixed effects, I am able to identify variation in cotton textile production within populations speaking the same language. Controlling for socioeconomic macroregions accounts for deep-rooted differences across populations as well, but common language provides a potentially finer measure of population-level differences. Estimates from column 11 suggests that my results survive the inclusion of this more demanding control for population-level differences, with a decrease of one fifth in my coefficient estimate.

In practice, this exercise also provides an alternative way to control for ancestral plough use. As normally, ancestral plough use is identified at the ethnic group level (Alesina, Giuliano, and Nunn, 2013), by only identifying variation within populations speaking the same language—a proxy for ethnicity—I effectively control for ancestral plough use. And at the same time, it take care of other important differences at the language group level as well.

E.9 The Impact of State Socialism

Having established that the effects of the cotton revolution do not go away even under a strict socialist regime, I turn to an analysis of how state socialism interacted with the cotton revolution. The Chinese Government has been promoting gender-equitable laws, policies and institutions from the onset of state socialism (Johnson, 2009). A cohort analysis in Table A.XVI suggests that the cotton revolution has less impact on cohorts exposed to state socialism than on older cohorts, which is consistent with the view that state socialism weakened cultural norms. I first interact my treatment with all age groups and find the interaction terms are positive for older cohorts (column 1). In column 2, I compare individuals who were at least 14 by 1949 (born before 1935) and those who were younger. I find a greater effect of the cotton revolution on individuals who were under 14 by 1949.[67] In column 3, I compare individuals born before and after 1949. The interaction term remains positive but is no longer significant. This suggests that the impact of the cotton revolution is more or less uniform for the individuals subject to state socialism in their formative years.

F Additional Historical Background

F.1 The Long-Distance Trade of Cotton Textiles

The introduction of new weaving and spinning technologies dramatically increased productivity of cotton textile production in Ming China. In particular, the new technologies enabled cotton textiles to be produced at a large-scale and for the market. Households switched for producing clothing for their own extended markets and began to produce for the market. Parallel to proto-industrialization in Europe (Ogilvie and Cerman, 1996) and the beginning of industrialization in early America (Rivard, 2002), there was an expansion of domestic industries producing goods for non-local markets.

The spinning and weaving of cotton faced different climatic constraints from the cultivation of cotton. Whereas cotton cultivation called for a relatively dry climate with minimal rain during the growing season, cotton spinning and weaving called for a more humid climate. As a result, places with different climates quickly began to specialize in spinning, weaving or the cultivation of cotton. Long-distance transportation of both cotton and cotton textiles emerged in response to differential endowments and resulting specialization across regions. A portion of the long-distance transportation of cotton textiles was conducted by the state as part of the in-kind tax system.[68]

In the late Ming period, market exchange of cotton textiles became more prevalent as a market economy developed further with the "single whip" reform. A booming money economy

[67] Teenage years are usually considered the most impressionable stage of the life. The results are robust to small shifts near the cutoff point of age 14.

[68] R. Huang (1964) estimates that in the early 17th century, at least one million bolts of cotton cloth were transported through the Grand Canal as tax payments to the Ming Government. One bolt of cotton cloth is 33.33 meters long. One million bolts of cotton cloth were worth half a million *taels* at the time. For much of the Ming Dynasty, cotton textiles accounted for a large portion of taxes in kind, second only to grain.

Table A.XVI: Wife Heading the Household: A Cohort Analysis

Dependent variable: wife	(1)	(2)	(3)
Mean of Dep. Var.	0.0589	0.0589	0.0589
Cotton textiles (1300-1840) × born before 1935		0.256**	
		(0.117)	
Cotton textiles (1300-1840) × born before 1949			0.115
			(0.123)
Cotton textiles (1300-1840) × 20 to 24	0.130		
	(0.571)		
Cotton textiles (1300-1840) × 25 to 29	0.205		
	(0.570)		
Cotton textiles (1300-1840) × 30 to 34	0.170		
	(0.582)		
Cotton textiles (1300-1840) × 35 to 39	0.175		
	(0.573)		
Cotton textiles (1300-1840) × 40 to 44	0.155		
	(0.583)		
Cotton textiles (1300-1840) × 45 to 49	0.118		
	(0.592)		
Cotton textiles (1300-1840) × 50 to 54	0.261		
	(0.588)		
Cotton textiles (1300-1840) × 55 to 59	0.427		
	(0.571)		
Cotton textiles (1300-1840) × 60 to 64	0.378		
	(0.579)		
Cotton textiles (1300-1840) × 65 to 69	0.540		
	(0.566)		
Cotton textiles (1300-1840) × 70 to 74	0.683		
	(0.576)		
Cotton textiles (1300-1840) × 75 to 79	0.474		
	(0.593)		
Cotton textiles (1300-1840) × 80+	0.769		
Cotton textiles (1300-1840)	Yes	Yes	Yes
Born before 1935	No	Yes	No
Born before 1949	No	No	Yes
Controls	Yes	Yes	Yes
Socioeconomic macroregion FE	Yes	Yes	Yes
Province FE	Yes	Yes	Yes
# cluster	88	88	88
Pseudo R^2	0.067	0.067	0.067
Observations	701263	701263	701263

Notes: The table reports the impact of cotton textiles (1300-1840) on the probability of wife heading the household. The unit of observation is a individual in the 1990 Census. The sample is restricted to individuals who are the head of the household, married and Han Chinese. All estimates are based on Logit regressions. Controls include baselineline controls, age group and family size. The omitted category in column 1 is age 15-19. Robust standard errors are clustered at the prefecture level. Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

promoted domestic trade and expanded the market for cotton textiles.[69] The production of cotton textiles became increasingly commercialized and specialized. In describing patterns of regional specialization, van 298]Glahn16 notes:

> "Since Jiangnan could not produce sufficient cotton to meet the rising demand for cloth, merchants imported raw cotton from the Central Plain and Guangdong. Merchant capital regularly intervened at each step in the manufacturing process. Many rural spinners and weavers, the vast majority of whom were women, became full-time cottage handicraft workers earning piece-rate wages. Brokers based in market towns delivered ginned cotton to spinners and yarn to weavers on credit, purchasing the finished product at a discounted price."

By the time of the Opium War (1840–1842), the size of the cotton textile trade was second only to that of the grain trade. To illustrate the relative size of the cotton textile trade, I show the breakdown of trading goods just before 1840 in Table A.XVII.

Table A.XVII: Domestic Long-Distance Trade in 1840

Categories	Quantity	Value	
		Silver (10,000 taels)	Percent (%)
Grain	24,500,000,000 *jin*	16,333.30	42.14
Cotton	2,555,000 *dan*	1,277.50	3.3
Cotton textiles	31,451,770,000 bolts	9,455.30	24.39
Raw silk	71,000 *dan*	1,202.30	3.1
Silk textiles	49,000 *dan*	1,455.00	3.75
Tea	26,050,000 *dan*	3,186.10	8.22
Salt	3,220,000,000 *jin*	5,820.90	15.1
Total		38,762.40	100

Notes: The table is taken from B. Li (2010). The original estimates are made by Wu (1983). The figures exclude goods exchanged on local markets.

The increased earnings and status of women in cotton textile producing regions are measured *relative* to women in non-producing China reasons. Women in the rest of China

[69] The Single Whip Law was initiated in the early 16th century, and was promoted to the entire empire in 1580 by Zhang Juzheng (Flynn and Giráldez, 1995). The reform replaced per capita taxes and in-kind taxes in most regions, which led to the further growth of a money economy and a great expansion of commerce. In theory, we should expect men to switch to the lucrative activity—cotton textile production—after the reform. But historical records suggest that it was still relatively uncommon for men to produce textiles even after 1580.

did not directly benefit from the cotton textile revolution. They benefited as consumers as they were able to purchase higher quality, light-weight textiles, from the market; but their incomes did not increase. Moreover, as producers of local textiles women in non-cotton textile producing regions may have lost incomes and may have seen their status within the household diminish. It is possible that the treatment effect reflects the difference in women's status between places which benefited from cotton textiles production and those that did not.

F.2 The Decentralized Production and Ownership of Cotton Textiles

The production of cotton textiles in premodern China was highly decentralized. The basic units of production were textile-producing households. Compared with silk, benefits of centralized production were far less substantial for cotton textiles, as the economy of scale was quite limited given the level of technology, and the quality and consistency of cotton textiles were not highly valued by the majority of consumers at the time. Even after the mid-19th century, when domestic yarn was driven out of market by foreign yarn, weaving conducted by individual weavers remained competitive.[70] The practice of weaving at home was not uncommon for the pre-industrial period and remained fairly common decades into the more industrialized period. During the years from 1790 to 1830, when yarn was produced by water-powered machinery, tens of thousands of New Englanders labored in their homes to weave yarn into cloth. In 1820, an estimated two-thirds of cloth used in America was still made in families (Rivard, 2002).

Textile-producing households were essentially small businesses in rural China. This distinguish them from home weavers in 18th century England, or in early 19th century New England. Home weavers in China were also different from urban craftsmen in medieval and early modern Europe, who were often guilded.[71]

F.3 Macroeconomic Conditions

As noted, the Ming period saw substantial Smithian growth—as the population recover, domestic trade expanded, and market exchange grew. The growth of the textile industry was an important part of this development (Bin Wong, 1997; Pomeranz, 2000). Urbanization ensured that demand for cotton textiles from city dwellers increased. Interregional specialization increased. According to Richard van Glahn (2016, p. 298): "in many respects the major development in the late Ming period was the rise of rural handicraft industries, above all cotton manufacture". These developments were further cemented in the Qing period which

[70] Fairbank (1978, pp.15–28) documents that in the 19th century, people in rural China continued to use hand-crafted cloth due to its lower price and reduced susceptibility to wear and tear. Foreign merchants and consular officials in late 19th century China complained about the difficulty of penetrating the Chinese market, especially in the interior provinces.

[71] See Epstein et al. (1998), Wallis (2008), Ogilvie (2011), and Ogilvie (2014) for European guilds.

saw "the maturation of the market economy" (Glahn, 2016, p. 295).

China remained Malthusian during the period. This in the long-run, increased productivity was translated into faster population growth rather than a sustained increase in per capita income. Theories of economic growth suggest that per capita income growth in a Malthusian setting dependent on the elasticity of the income-mortality schedule and the income-fertility schedule (Ashraf and Galor, 2011; Voigtländer and Voth, 2013b). Fertility was high in Ming and Qing China but not unconstrained; though marriage was early and close to universal, spacing and infanticide meant that martial fertility was well below maximum (J. Lee, C. Campbell, and Feng, 2002). In this setting improved production technology for cotton textiles in conjunction with a thriving market economy could led to increased incomes in short to medium rum but in the long-run incomes will return to their Malthusian equilibrium levels due to population growth (Galor, 2011).

This macroeconomic conditions helped to ensure that the productivity shock associated with the introduction on spinning and weaving technologies had a lasting impact on society. During the period under study, the Chinese economy expanded in terms of both population and total income, but it did not experience sustained increases in per capita income. Its failure to do so is a central theme of the Great Divergence debate. Conditions favored the growth of a commercial economy, particularly in the Yangtze Delta but not industrialization. In the context, of such an economy the increase in productivity associated with the cotton textile revolution would not be expected to permanently raise incomes in the long-run. Rather we would expect the improvement in cotton textiles technology and the rise of a commercial market for cotton textile products to increase incomes in the short-to-medium run and then to have a lasting impact on the ratio between male and female wages.

F.4 A Comparison to the Cotton Textile Proto-Industry in England

Cotton textiles (1300-1840) in China bore many similarities with the proto-industry in other advanced premodern economies such as 18h century England. The following key differences, however, deserve emphasis. (a.) Chinese households typically owned the machines rather than renting them. Households occasionally owned more than one machine and hired help, but they did so on a very limited scale(Fairbank, 1978). (b.) Few concurrent technology shocks occurred during the relevant time frame (1300-1840). The cotton revolution took place in an agrarian economy, and the economy remained largely agrarian for the next six~~th~~ centuries. (c.) A relatively small number of regions had the geo-climatic conditions suitable for spinning and weaving, and especially, for weaving. (d.) Though the goods market was dense and highly sophisticated in both countries, the labor market was far from being a free labor market. Emperors in the Ming and Qing periods instituted strict laws on labor mobility. The clan system continued to keep individuals tied to their extended families (as discussed in Greif and Tabellini, 2010; Greif and Tabellini, 2015). This constrained the reallocation of labor to areas suitable for cotton textile production. (e.) A higher percentage of Chinese families owned land than British families working under the putting-out system in the 18th century. Despite periodic increases in land concentration ratio as part of the dynastic cycle, China had no equivalent of the movement of enclosure that took place in England between 1600 and 1850. The majority of Chinese families were small landowners. Male labor was absorbed by grain production, for which women did not have the comparable physical strength. With land ownership, men often had to do field work to pay in-kind taxes or else the revenue of land would be forgone. Together (b.), (c.) and (d.) ensured that prices of cotton textiles stayed reasonably high—cotton textile prices hovered at a level that generated enough income for a skilled textile worker to support a family of four, whereas (a.) and (e.) led women to reaping most of the benefits from this revolution.

F.5 A Comparison to the Black Death

Historians have argued that the Black Death led to greater female participation in the labor force in late medieval Europe. Specifically, the Black Death induce a shift from arable to pastoral agriculture in northwestern Europe. Whereas men had a distinct comparative advantage in arable farming; this was not the case in pastoral agriculture (Voigtländer and Voth, 2013b). As a consequence of this shift and overall labor scarcity, new labor market opportunities opened up for unmarried women (De Moor and Van Zanden, 2010). The difference between this episode and the cotton revolution in China is that these were generally comparatively low-paying jobs. Women worked as milkmaids and domestic servants; they did not have the opportunity to earn higher incomes than men. The labor market opportunities that opened up in northwestern Europe after the Black Death were for young women. Women worked for a couple of years before marriage—this likely gave them greater bargaining power when it came to the choice of mate, but such advantages would not last into marriage. A simple bargaining model would suggest that women's bargaining position within marriage is unaffected by the amount of incomes they earn before marriage.

In contrast, the cotton revolution raised female earning power for women across their entire life-cycle.

F.6 Confucianism and status of women

Traditional Chinese society was shaped in important ways by Confucian values. A set of political and moral doctrines based on the teachings of Confucius became an important basis for the Chinese state since the Han Dynasty (206 BC–220 AD). By the late imperial period, the Chinese state had standardized family practices across regions, classes and dialect groups, with far fewer time and space variation in inheritance practices, marriage rates, naming practices and patrilocality (P. Ebrey, 1990; Paul S Ropp, 1994). Throughout the period where the shock ("cotton revolution") was in place (1300-1840), the state adhered to unified political and legal institutions based on Confucianism.

Confucianism had a twofold impact on attitudes toward women. On the one hand, the Confucian tradition strongly disfavored women. Confucianism lays a particular emphasis on continuing the family line, and only male offspring can fulfill this purpose. Daughters are seen as a liability, or *pei qian huo* in local languages.[72] The term was consistent with economic reality prior to the emergence of the textile industry: daughters could not work outside home due to concern for women's "purity" and therefore had to rely on family resources to survive.[73] And unlike a son, a daughter would not be able to support her own parents once she became married because a married woman had to move into the home of her husband's family and became an official family member of that family. As a result of the high cost of dowries, having too many daughters could cause a household serious financial distress (Harrell, 1995; Watson and P. B. Ebrey, 1991). For these reasons, parents wanted to control the number of daughters they had to raise.[74] On the other hand, mothers and grandmothers had important and respected places in their families, and older women were often very powerful within their families.

In addition, Confucianism celebrated the virtue of hard work (Yu, 1985; Yu, 1992). It assigned high moral worth to individuals who worked hard to provide for their families, including hard working women. This attitude provided women with an avenue whereby they could earn the respect due to them for their contribution to the household. Regardless of social clas, performing productive manual labor was seen as a virtue for all women (Mann, 1997).

F.7 Neo-Confucianism and Widow Suicide

In contrast to the Europe Marriage Pattern (De Moor and Van Zanden, 2010; Voigtländer and Voth, 2013a), premodern China featured universal and early marriage. Unmarried and married women alike had few opportunities to engage in public life. However, widows were

[72]It is generally believed that a family would suffer economically from the birth of a daughter. In the play *Qujiang Chi* from the early Yuan period, the heroine refers to herself as *pei qian huo*, which literally means a money-losing proposition. The term is still used in Mainland China, Singapore, Malaysia, Taiwan, Macau and Hong Kong today. In 2007, the Yahoo dictionary in Taiwan was discovered to have the English-language translation of the Chinese term *pei qian huo* as a. "a money-losing proposition" and b. "a girl; a daughter" (http://news.tvbs.com.tw/entry/305992).

[73]Chow (1991) regards non-western women's "purity" or "chastity" as both sexual and nationalistic.

[74]Historian James Z. Lee and sociologist Cameron D. Campbell (2007) document excess female mortality during infancy and childhood. They find that girls between ages one and five had a 20 percent higher mortality rate than boys of the same age.

granted some autonomy in making economic decisions for herself and for the household (Afeng, 2002). Prior to the cotton revolution, women typically lacked the means to support themselves after their husband's death. Before the 11th century, remarriage was quite common, and then things took another turn. Influenced by Song-Ming Neo-Confucianism, which was first developed in the Song Dynasty (960–1279), inheritance laws became more unfriendly to women, creating barriers for a woman to inherit wealth from her deceased husband. Song-Ming Neo-Confucianism also stigmatized remarriage. Premodern China was not unique in terms of the circumstances widows had to face. Widows in developing countries today often find themselves in similar circumstances: upon widowhood, women not only lose the main breadwinner of the household, but also have restricted access to economic resources due to property ownership laws and employment norms. Many studies document the role of widowhood in excess mortality of unmarried adult women (Anderson and Ray, 2015; Miguel, 2005; Oppong, 2006; Sossou, 2002).

Before 1300, among all "virtuous" women, half of the women were "chaste windows" who provided for her in-laws and children for a number of decades, the other half were "heroic widows" who committed suicide upon their husband's death to demonstrate their exemplary character (Dong, 1979). After 1300, cotton textiles began to financially empower women. The percentage of women who chose chaste widowhood over suicide likely increased. I hypothesize that cotton textiles tilted women's decision towards chaste widowhood from suicide, as availability of financial means was key to widow survival.[75] All else equal, women with no financial means would be at a higher risk to commit suicide.

Appendix References

Acemoglu, Daron, Camilo Garca-Jimeno, and James A. Robinson (2015). "State Capacity and Economic Development: A Network Approach". In: *American Economic Review* 105.8, pp. 2364–2409.

Afeng (2002). "Huizhou wenshu suo jian mingqing shidai funv de diwei yu quanli(Status of Women in Ming and Qing China from Huizhou Archives)". PhD thesis.

Alesina, Alberto, Paola Giuliano, and Nathan Nunn (2013). "On the Origins of Gender Roles: Women and the Plough". In: *The Quarterly Journal of Economics* 128.2, pp. 469–530.

Almond, Douglas, Hongbin Li, and Shuang Zhang (Forthcoming). "Land reform and sex selection in China".

Altonji, Joseph G, Todd E Elder, and Christopher R Taber (2005). "Selection on Observed and Unobserved Variables: Assessing the Effectiveness of Catholic Schools". In: *Journal of Political Economy* 113.1, pp. 151–184.

[75]To be awarded "chase widow" status, a long wait is required. According to Qing regulations, to be eligible to the title of " chase widow", a woman either had to remain widowed since before the age of 30 years old to the age of 50 years old, or had been widowed for ten years or more but died before reaching 50 (Mann, 1987). The long time frame required to be eligible to the "chase widow" status heightened the importance of having financial resources at one's disposal. Here I do not try to argue that having financial means was the single key factor in widows' decision making; I acknowledge that many factors could be at play (Theiss, 2005; Paul Stanley Ropp, Zamperini, and Zurndorfer, 2001).

Anderson, Siwan and Debraj Ray (2015). *Missing Unmarried Women*. Tech. rep. National Bureau of Economic Research.

Anukriti, S, Sonia Bhalotra, and Hiu Tam (2015). "Missing Girls: Ultrasound Access and Excess Female Mortality". In:

Ashraf, Quamrul and Oded Galor (Aug. 2011). "Dynamics and Stagnation in the Malthusian Epoch". In: *American Economic Review* 101.5, pp. 2003–41.

Bai, Ying and James Kai-sing Kung (2014). "Diffusing knowledge while spreading God's message: Protestantism and economic prosperity in China, 1840–1920". In: *Journal of the European Economic Association*.

Balazs, Etienne (1960). "The birth of capitalism in China". In: *Journal of the Economic and Social History of the Orient* 3.2, pp. 196–216.

Bao, weimin (2001). *Songdai difang caizhengshiyanjiu (A study of local financial administration in Song China, 960-1279)*. Renmin University Press.

Bertocchi, Graziella and Monica Bozzano (2015). "Women, medieval commerce, and the education gender gap". In: *Journal of Comparative Economics*.

Bin Wong, R (1997). *China Transformed : Historical Change and the Limits of European Experience*. Ithaca, NY: Cornell University Press.

Cameron, A Colin, Jonah B Gelbach, and Douglas L Miller (2008). "Bootstrap-based improvements for inference with clustered errors". In: *The Review of Economics and Statistics* 90.3, pp. 414–427.

Carranza, Eliana (2014). "Soil endowments, female labor force participation, and the demographic deficit of women in India". In: *American Economic Journal: Applied Economics* 6.4, pp. 197–225.

Chang, Kwang-chih (1963). *The archaeology of ancient China*. New Haven: Yale University Press.

Chen, Yuyu, Hongbin Li, and Lingsheng Meng (2013). "Prenatal Sex Selection and Missing Girls in China: Evidence from the Diffusion of Diagnostic Ultrasound". In: *Journal of Human Resources* 48.1, pp. 36–70.

CHGIS, Harvard Yenching Insitute (2007). "CHGIS". In:

Chow, Rey (1991). *Woman and Chinese modernity: The politics of reading between West and East*. U of Minnesota Press.

Chu, Junhong (2001). "Prenatal sex determination and sex-selective abortion in rural central China". In: *Population and Development Review* 27.2, pp. 259–281.

Das Gupta, Monica and PN Mari Bhat (1997). "Fertility decline and increased manifestation of sex bias in India". In: *Population studies* 51.3, pp. 307–315.

De Moor, Tine and Jan Luiten Van Zanden (2010). "Girl power: the European marriage pattern and labour markets in the North Sea region in the late medieval and early modern period". In: *The Economic History Review* 63.1, pp. 1–33.

Deng, yibing (1999). "The Trade of Cotton and Cotton Textiles in early Qing". In: *Shi Xue Yue Kan (History Monthly)* 3, pp. 41–45.

Dong, Jiazun (1979). "A Statistical Analysis of Virtuous Women by Dynasty". In: *Zhongguo funv shilunji (A collection of essays on women in Chinese history)*.

Ebrey, Patricia (1990). "Women, marriage, and the family in Chinese history". In: *Heritage of China*, pp. 197–223.

Epstein, Stephan R et al. (1998). "Craft guilds, apprenticeship, and technological change in preindustrial Europe". In: *Journal of Economic History* 58, pp. 684–713.

Fairbank, John King (1978). *The Cambridge History of China: Late Ching, 1800-1911, pt. 2*. Cambridge University Press.

Flynn, Dennis O and Arturo Giráldez (1995). "Born with a" silver spoon": The origin of world trade in 1571". In: *Journal of World History*, pp. 201–221.

Fun, I-chun (1993). "Long-distance trade and market integration in the Ming-Ch'ing period, 1400-1850". PhD thesis. Stanford University.

Galor, Oded (2011). *Unified Growth Theory*. Princeton, New Jersey: Princeton University Press.

Glahn, Richard van (2016). *The Economic History of China From Antiquity to the Nineteenth Century*. Cambridge: Cambridge University Press.

Greif, Avner and Guido Tabellini (2010). "Cultural and institutional bifurcation: China and Europe compared". In: *The American economic review*, pp. 135–140.
— (2015). *The Clan and the City: Sustaining Cooperation in China and Europe*. Working Paper 445. IGIER (Innocenzo Gasparini Institute for Economic Research).
Hansen, Casper Worm, Peter Sandholt Jensen, and Christian Volmar Skovsgaard (2015). "Modern gender roles and agricultural history: the Neolithic inheritance". In: *Journal of Economic Growth*, pp. 1–40.
Harrell, Stevan (1995). *Chinese historical microdemography*. Vol. 20. Univ of California Press.
Howarth, Glennys and Oliver Leaman (2003). *Encyclopedia of Death and Dying*. Routledge.
Hu, Luojia and Analıa Schlosser (2015). "Prenatal Sex Selection and Girls' Well-Being: Evidence from India". In: *The Economic Journal* 125.587, pp. 1227–1261.
Huang, Ray (1964). *The Grand Canal During the Ming Dynasty: 1368-1644*. University Microfilms.
Iqbal, Mansoor et al. (2012). "Textile Environmental Conditioning: Effect of Relative Humidity Variation on the Tensile Properties of Different Fabrics". In: *Journal of Analytical Sciences, Methods and Instrumentation* 2.02, p. 92.
Jia, Ruixue (2014). "The legacies of forced freedom: China's treaty ports". In: *Review of Economics and Statistics* 96.4, pp. 596–608.
Johnson, Kay Ann (2009). *Women, the family, and peasant revolution in China*. University of Chicago Press.
Lee, James Z and Cameron D Campbell (2007). *Fate and Fortune in Rural China: Social Organization and Population Behavior in Liaoning 1774-1873*. Vol. 31. Cambridge University Press.
Lee, James, Cameron Campbell, and Wang Feng (2002). "Positive Check or Chinese Checks?" In: *The Journal of Asian Studies* 61.2, pp. 591–607.
Li, Bozhong (2010). "China's national market in early nineteenth century: scale and spatial structure". In: *Zhejiang xuekan* 4, p. 001.
Li, Bozhong and Po-Chung Li (1998). *Agricultural development in Jiangnan, 1620-1850*. Macmillan.
Lin, Ming-Jen, Jin-Tan Liu, and Nancy Qian (2014). "More missing women, fewer dying girls: the impact of sex-selective abortion on sex at birth and relative female mortality in Taiwan". In: *Journal of the European Economic Association* 12.4, pp. 899–926.
Liu, William Guanglin (2015). *The Chinese Market Economy, 1000–1500*. SUNY Press.
Mann, Susan (1987). "Widows in the Kinship, Class, and Community Structures of Qing Dynasty China". In: *Journal of Asian Studies* 46.1, pp. 37–56.
— (1997). *Precious records: Women in China's long eighteenth century*. Stanford University Press.
Miguel, Edward (2005). "Poverty and Witch Killing". In: *Review of Economic Studies* 72.4, pp. 1153–1172.
Nachtergaele, Freddy et al. (2008). "Harmonized world soil database". In: *Food and Agriculture Organization of the United Nations*.
Ogilvie, Sheilagh (2011). *Institutions and European Trade: Merchant Guilds, 1000-1800*. Cambridge: Cambridge University Press.
— (2014). "The economics of guilds". In: *The Journal of Economic Perspectives* 28.4, pp. 169–192.
Ogilvie, Sheilagh and Markus Cerman (1996). *European Proto-Industrialization: An Introductory Handbook*. Cambridge University Press.
Oppong, Christine (2006). "Familial roles and social transformations older men and women in sub-Saharan Africa". In: *Research on Aging* 28.6, pp. 654–668.
Oster, Emily (2014). "Unobservable selection and coefficient stability: Theory and evidence". In: *University of Chicago Booth School of Business Working Paper*.
Perkins, Dwight Heald et al. (1969). *Agricultural Development in China, 1368-1968*. Chicago: Aldine Publishing Company.
Pomeranz, Kenneth (2000). *The Great Divergence: China, Europe, and the making of the modern world economy*. Princeton University Press.
Qu, tongzu (2003). "Local Government in Qing". PhD thesis. Beijing: Law Press.
Rivard, Paul E (2002). *A new order of things: How the textile industry transformed New England*. UPNE.
Ropp, Paul S (1994). "Women in late imperial China: a review of recent english-language scholarship [1]". In: *Women's History Review* 3.3, pp. 347–383.

Ropp, Paul Stanley, Paola Zamperini, and Harriet Thelma Zurndorfer (2001). *Passionate women: Female suicide in late imperial China*. Brill.

Skinner, G William (1980). *Marketing systems and regional economies: their structure and development.* Chinese Academy of Social Sciences.

Skinner, G.W., Mark Henderson, and Merrick Lex Berman (2013). "Socioeconomic Macroregions of China". In: *Harvard Dataverse, V1.*

Song, Xu (1957). *Edited Administrative Statutes of the Song Dynasty (Song huiyao jigao).*

Sossou, Marie–Antoinette (2002). "Widowhood practices in West Africa: the silent victims". In: *International Journal of Social Welfare* 11.3, pp. 201–209.

Stamper, Eugene and Richard L Koral (1979). *Handbook of Air Conditioning, Heating, and Ventilating.* Industrial Press Inc.

Stauffer, Milton Theobald et al. (1922). "Christian occupation of China". In:

Theiss, Janet M (2005). *Disgraceful matters: The politics of chastity in eighteenth-century China*. Univ of California Press.

Voigtländer, Nico and Hans-Joachim Voth (2013a). "How the West" Invented" Fertility Restriction". In: *American Economic Review* 103.6, pp. 2227–64.

— (2013b). "The Three Horsemen of Riches: Plague, War, and Urbanization in early modern Europe". In: *Review of Economic Studies* 80, pp. 774–811.

Wallis, Patrick (2008). "Apprenticeship and training in premodern England". In: *Journal of Economic History* 68.03, pp. 832–861.

Wang, Zengyu (2006). "Silk, Linen and Cotton in Ancient China". In: *Wen Shi.*

Watson, Rubie Sharon and Patricia Buckley Ebrey (1991). *Marriage and inequality in Chinese society.* Vol. 12. Univ of California Press.

Wu, Chenming (1983). "National market in early Qing". In: *Historical Studies (Lishi yanjiu)* 1, pp. 28–30.

Yang, Zhengtai, Bian Huang, and chunyu Cheng (2006). *Courier stations in the Ming Dynasty (Mingdai yizhan kao).* Shanghai Ancient Books Publishing House.

Yu, Ying-shih (1985). "Confucian thought and economic development: early modern Chinese religious ethics and the spirit of the merchant class". In: *The Chinese Intellectual* 2, pp. 3–55.

— (1992). "Zhongguo jinshi zongjiao lunliyu shangren jingsheng (Religious Principles and Merchants' Consciousness in Modern China)". In: *Taipei: Jinglian.*